

A Structure Equation Model of Total Quality Management and Innovation Capability Affecting Organization Performance

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Key words: Total quality management, innovation capability, organizational performance, structure equation model

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Abstract: This study examines the relationship between Total Quality Management (TQM) and innovation capability affecting organizational performance. The empirical data were obtained from a survey of 437 automobile and autoparts industries and 462 electrical and electronic industries. Structural equation model is used to analyze structural between measured variable and latent constructs. The findings suggest that TQM and innovation capability have positive influence on organizational performance. The analysis of structural equation model and TQM, innovation capability and organizational performance gave consistent result with empirical information. The results from this research show that TQM have positive effects to the innovation capabilities and organizational performance. The result was shown that the criteria related with people management and supplier quality management have a stronger correlation with the performance. According organization should give the necessary quality-related training and rewarded for superior quality improvement. The leader should maintain close communication with suppliers about quality considerations and design changes.

INTRODUCTION

Nowadays most organizations are trying to improve their product and service through various strategies to create competitive advantage market in the business such as Total Quality Management (TQM), green manufacturing and world class manufacturing (Goetsch and Davis, 2014; Dean and Bowen, 1994). TQM is an integrated management philosophy aimed at improving effectiveness of business to customer demands (Prajogo and Sohal, 2003). The automobile sector and electronic industry are two of the prime job creators in Thailand. They are involved in one or various ways in the business and covering around 12.2 and 7.8% of Thailand manufacturing Gross Domestic Product (GDP),

respectively. It is also noticed that Thailand is the 13th-largest automobile manufacturer in the world and become the first largest automotive market in Southeast Asia by 2016. However, Thailand automobile and electronic industry have started to realize the importance of quality management due to competitive, regulatory and face three problems affecting the growth in the future: Middle income trap, inequality trap and imbalance trap. Innovation has become a key issue at various levels for firms, institutions and governments. It's importance has motivated researchers to identify its various driving forces (Becheikh *et al.*, 2006). Innovation is a broad and multi-dimensional concept that refers to all scientific, technological, organizational and commercial activities which lead to the implementation of new technology or

improved products or services. The link between innovation and organizational performance is well established in the previous research. There is an evidence in the academic literature indicating a positive relationship between innovation and organizational performance in the manufacturing industry (Ahire *et al.*, 1996). The need for quality and innovation in organizations became vital for their business excellence and to compete through strengthen their competitive advantage (Juneja *et al.*, 2011; Karani and Bichanga, 2012). This has driven and motivated many researchers to conduct studies in the relationship between TQM practices and innovation. The existing literature has provided fresh views and various approaches from different prospectiveness into TQM practice-innovation relationship.

Although, number of studies exist in literature to measure the impacts of TQM practices on expected performance outcomes but very small number of empirical researches have been carried out to know the impacts of key practices of TQM for implementing the improvement and new creating innovation towards sustainability on expected organizational performance outcomes. Therefore, this research is aimed to study the causal factors of total quality management and innovation capability effecting organizational performance. And to analyze the causal relationship structure and confirmatory factor analysis of TQM and innovation capability effecting organizational performance. The study was carried out on companies with ISO9001 or IAIF16949 certificates. The surveys were given to the quality managers working in 899 automobile and electronic companies in Thailand. The data from the survey were then analyzed using structure equation model software package. The next section describes the literature and hypothesis. This is followed by the finding and discussion. This study finishes with the conclusions.

Literature review

Development of hypothesis: This research hypothesis are proposed based on the literature review presented as follows:

The relationship between TQM and organizational performance: A review of the literature of this relationship between the TQM and the organizational performance found that there are supportive and consistent research work related to the relationship between TQM and organizational performance. The results of most scholars have confirmed that the factors of TQM are positively related to organizational performance. (Zehir and Sadikoglu, 2012; Sadikoglu and Zehir, 2010; Prajogo and Hong, 2008; Kaynak, 2003; Prajogo and Sohal, 2003; Brah *et al.*, 2002). On the other hand, the results of some research didn't find a correlation analysis between determining multiple factors together (Prajogo and Sohal, 2006a, b; Agus, 2005). All the previous works have measurement of all indicators at the

different time (Zehir and Sadikoglu, 2012; Prajogo and Sohal, 2006a, b; Agus, 2005). Therefore, this research aims to study based on Sirisan and Pianthong (2017) the relationship of TQM and the organizational performance that is intended to measure from three indicators; business results, product quality and innovation performance. Then have the measurement of all indicators at the same time.

Although, most the relationship between TQM and organizational performance. Found that support positive with this relationship. But have some study of this relationship found that the results negatively (Agus, 2005). From the literature review in this relationship hadn't found any research used three indicators; business results, product quality and innovation performance to the measurement in an empirical at the same time. In addition, we also found that some research studies the relationship between TQM and organizational performance in product quality and business results directly and have studied the relationship between TQM and innovation performance directly (Agus, 2005; Prajogo and Ahmed, 2006; Prajogo and Sohal, 2006a, b). Therefore, from all the studies mentioned above. Thus, we developed a hypothesis as follows:

H₁: the critical success factors of TQM have positive direct and indirect influence on organizational performance

The relationship between TQM and innovation capability: The previous literature of the relationship between TQM and Innovation capability found that in this relationship there wasn't extensive research. All which is considered by the TQM determines innovation capability indirect of this study only (Schroeder *et al.*, 1989; Nohria and Gulati, 1996; Samson and Terziovski, 1999). Most the results of this relationship showed that positive to support and confirm. In the manufacturing industry have the study of this relationship isn't very extensive. And mostly focus on studying the roles that are expected to arise from this relationship to enhance the overall efficiency of the organization and the ability to create new innovations and mostly have an indirect measure of this relationship (Yusr, 2016; Perdomo *et al.*, 2006). Therefore, from the literature review in this relationship considers this as a guideline and an important part of studying on the relationship between total quality management and innovative capabilities that effect to the organizational performance of this research. All the direct and indirect relationship are estimated in a single analysis. Type of innovation capability in this study based on Sirisan and Pianthong (2017), three types of innovation capability; process innovation capability, product innovation capability and administrative innovation capability. Hence, from all the studies mentioned above, thus, we developed a hypothesis of the relationship between TQM and innovation capability as follows:

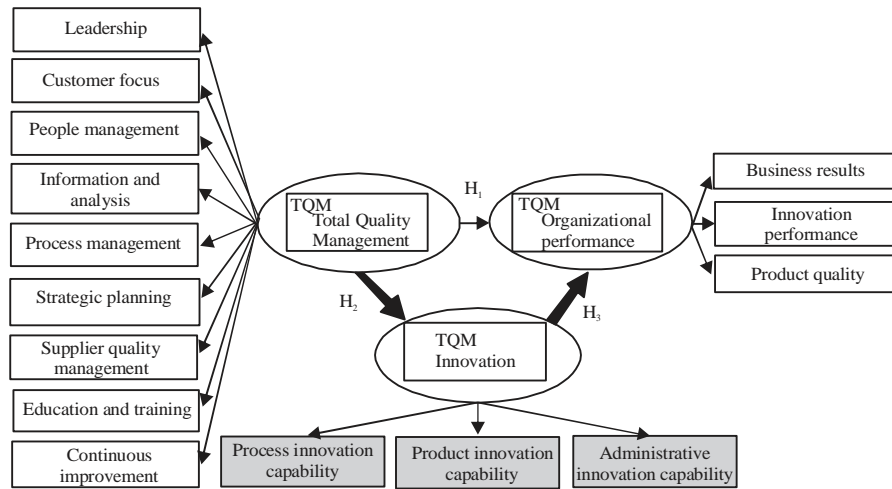


Fig. 1: Research framework

H₂: the critical success factors of TQM have positive direct influence with innovation capability

The relationship between innovation capability and organizational performance: The literature review of the relationship between innovation capability and organizational performance for use in the manufacturing industry has found that innovation capabilities are positively correlated with organizational performance (Das *et al.*, 2008; Feng *et al.*, 2006; Prajogo and Sohal, 2003). However, there isn't evidence of extensive empirical study on the relationship of innovation capability in three types; process innovation capability, product innovation capability and administrative innovation capability to the organizational performance by measuring of business results, product quality. The structural relationship between construct is estimated with a single calculation using SEM approach. From past research, even though most findings of the relationship between innovation capability and organizational performance support innovation capabilities, there is a positive correlation with the firm performance (Rajapathirana and Hui, 2018; Karabulut, 2015; Muhamad *et al.*, 2014; Alam *et al.*, 2013; Jimenez-Jimenez and Sanz-Valle, 2011).

However, found that some of the results were negative or unable to find a statistically significant relationship and the factors between the ability of innovation in the form of observable variables as well have a good positive relationship with statistically significant significance (Gunday *et al.*, 2011). Therefore, in the study of this relationship, the results were both positive and negative which could not significantly correlate between such variables. It may indicate that there is a possibility that there are other factors that cause interrelationship but may be more complex because at nowadays, innovation is an important part of the

organization's survival long-term and innovative capabilities can be considered as a good intermediary that can help to promote the relationship between management to be effective (Prajogo and Sohal, 2006a, b). However, if the organization or business has the ability to innovation, good management with the ability to innovate, effective processes will result in the organization having the ability to innovate products that can develop products that respond to the needs of consumers faster and create competitive advantage in the market for the organization (Camison and Villar-Lopez, 2014; Ul Hassan *et al.*, 2012; Gunday *et al.*, 2011; Hult *et al.*, 2004; Calantone *et al.*, 2002). As well as able to maintain the ability to compete in the market continuously (Yusr, 2016). Thus, we developed hypothesis as follows:

H₃: the innovation capability has positive direct influence relationship with the organizational performance

Research framework: This research framework based on the study of Sirisan and Pianthong (2017) is developed to simultaneously examine the relationship between the important factors of TQM and innovation capability effecting organizational performance. The framework is presented in Fig. 1.

MATERIALS AND METHODS

A survey instrument was used to gather data to test the relationships shown in the research model. The study was carried out in Thailand. A company test of the survey was carried out in order to assess the content validity and internal consistency of the instrument. The instrument was pre-tested with TQM managers of total 150 firms.

The selected sample included 899 firms which had implemented a TQM system. This sample was made

up of 437 automobile and auto parts industries and 462 electrical and electronic industries with ISO9001 or IATF16949 certificates. The respondents of the survey were the CEOs or top executives of the sample selected. Finally, valid responses from 899 organizations were obtained. Most of them had a broad experience with TQM system implementation (90.5% revealed >8 years of TQM experience) and 94.8% large-size enterprises (under 200 employees).

RESULTS AND DISCUSSION

This study present the results in this study which consists of four major parts. The latent in this research is show in 5.1, while the general information of the questionnaire is in 5.2. The reliability and validity of data are in 5.3 and finally, the hypothesis testing in 5.4 as follow:

The latent in this research: The instrument developed in this study consists of three major parts based on Sarisan and Pianthong (2017), the first part comprises nine critical success factors of TQM: leadership, customer focus; people management, information and analysis, process management, strategic planning, supplier quality management, education and training and continuous improvement. The second part comprises three types of innovation capability: product innovation capability, process innovation capability and administrative innovation capability. And the third part comprises three measuring different indicators of organizational performance: business results, innovation performance and product quality.

The general information of the questionnaire: The instrument used is a seven-point Likert scale, representing a range of attitudes from strongly disagree to strongly agree. Empirical data were obtained through a random survey data collected from 437 automobile and industries and auto parts industries and 462 electrical and electronic industries. The study found that most respondents were male has 89.8%, aged between 21-30 years, 48.7 %. Most of whom were head of department, 69.1% and education level were the bachelor's degree level, 83.5%. Most of the representative sample consisted of 48.6% of the automobile and auto parts and 51.4% of electrical appliances and electronics. Most of the organizations were international organizations, 94.4% had the head office in Asia, 83.9% of certificate of quality management in ISO9001, 100%, IATF16949 standard, 50.7% use the entire quality management system (TQM), 18.7% by using quality management 8 years up to 90.5%. These organizations have certified the quality management of ISO9001, 100%, the IATF16949 standard, 50.7% and use the Total Quality Management system (TQM), 18.7%, most use the quality management system from 8 years or more.

Table 1: KMO and Bartlett's test

| Bartlett's test of sphericity | Values |
|---|----------|
| Kaiser-Meyer-Olkin measure of sampling adequacy | 0.871 |
| Approx. χ^2 | 3056.382 |
| df | 36 |
| Sig. | 0.000 |

Reliability and validity of data: Data were first analyzed to ensure instrument quality by convergent and discriminant validity. Applying SPSS, the Confirmatory Factory Analysis (CFA) was conducted to measure the underlying dimension associated with 36 items of nine TQM factors. The constructs validity was measured using Bartlett's test of Sphericity and Kaiser-Mayer-Olkin (KMO) measure of the sampling adequacy of individual variables. KMO overall should be 0.6 or over to per-form factor analysis (Hair *et al.*, 2010). According to the results of Bartlett's test of Sphericity and KMO revealed that both are significant and suitable for the factor analysis (Table 1).

The value of Bartlett's test of sphericity indicate sufficient correlation between the variables, it shows 3056.382 and significant ($p > 0.000$). The factor loading of all items of each scale exceeds 0.5 (Hair *et al.*, 2010). All the factors loaded above 0.6 (Table 3), thus, these values constitute of evidence of convergent validity. This data analysis demonstrates that measurements possessed an acceptable convergent validity. The composite reliability of the measurements must reach 0.6 or above (Fornell and Larcker, 1981). The results indicated that all the latent variables reached (0.73-0.911) the standard or above.

Then reliability coefficient was also tested by using Cronbach alpha (α) in order to measure the reliability for the set of five constructs. According to the Cronbach alpha test, the total scales of reliability varies from 737- 0.835 (Table 2) which exceed the threshold point of 0.7 introduced by Nunnally (1978). The value of 0.7 or greater is indicated that good scale of reliability (O'Leary-Kelly and Vokurka, 1998). The Cronbach alpha of fifteen factors ranges 0.737-0.835 which indicated that they all are reliable.

Moreover, convergent and discriminant validities were measured using the average variance extracted. According to the Bagozzi *et al.* (1988), the basis test's criterion on each value of average variance extracted should be 0.5. All of the average variance extracted for measurements range 0.602-0.691, exceeds the threshold of 0.5 (Bagozzi *et al.*, 1988) which indicate that study had adequate levels of convergent and discriminant validity.

Hypothesis testing: The SEM model was employed to examine the relationship between constructs developed by this study. Hence, SEM analysis was performed by AMOS 22 Version and analyses simultaneously goodness-of-fit indices. For the whole model statistical results shows that Chi-square (χ^2)/df = 3.151,

Table 2: Factors loading and reliability analysis

| Scale | Items | 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 | | |
| Organization performance | Business results | 0.907 | 0.797 | 0.691 | 0.731 |
| | Innovation performance | 0.890 | 0.760 | | |
| | Product quality | 0.900 | 0.828 | | |

Table 3: Model fit

| Goodness of fit indices | Constructs | Results |
|---|------------|---------|
| $\chi^2/\text{degree of freedom}$ | 3.151 | Pass |
| CFI (Comparative Fit Index) | 0.984 | Pass |
| GFI (Goodness Fit Index) | 0.980 | Pass |
| AGFI (Adjusted Goodness of Fit Index) | 0.945 | Pass |
| RMSEA (Root Mean Square Error of Approximation) | 0.049 | Pass |
| SRMR (Root Mean Square Residual) | 0.018 | Pass |

Table 4: Standard estimation of the main model

| Path | DE | IE | TE |
|-------|------|------|------|
| 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: Organizational performance; DE: Direct Effect; IE: Indirect Effect; TE: Total Effects

CFI = 0.984, GFI = 0.980, AGFI = 0.945, RMSEA = 0.049, SRMR = 0.018 (Table 3). Hu and Bentler (1999) mentioned that RMSEA, CFI and GFI are necessary to value for the model fit. According to the study, we hypothesized three paths including three hypotheses.

Using the SEM investigated that impact of TQM, innovation capability and organizational performance. Results exhibits all the paths are significant ($p < 0.01$). A SEM Model divulges the TQM is directly, Indirectly and positively affects the organizational performance. In addition, the TQM is directly and positively affecting the innovation capability. The entire paths were significant at $p < 0.01$. The nine factors of TQM are directly and indirectly effects to the three indicators of organizational performance in the automobile and auto parts industries and electrical and electronic industries, the statistical findings revealed that TQM have positive effects to the innovation capabilities and organizational performance. TQM also have indirect influence on organizational performance. Therefore, this hypothesis H_1 and H_2 accepted at 0.01 statistically significance. The correlation coefficients among TQM and organizational performance are 0.46, 0.78 and 0.26 ($p < 0.01$). In addition, this study was finding the innovation capability has positive direct influence on organizational performance at 0.01 statistically significance. The correlation coefficients is 0.44 ($p < 0.01$). Hence, H_3 hypothesis is accepted (Table 4).

The findings of the research supported to claim that total quality management in automobile and auto parts industry and electrical and electronic industry in Thailand have positive effects and strong impact to organizational

performance. TQM also have indirect influence on organizational performance which corresponds to Leavengood (2010); Feng *et al.* (2006) and Prajogo and Sohal (2006a) found that acceptance and implementation of quality TQM factors will lead the organization to improve the efficiency of the organization. Important factors such as customer focus factors based on TQM principles will enable the organization to know the real needs of customers. Enabling the management of the organization to bring the needs of this real client to consider together with the comparison with competitors to determine the strategy and vision of the organization. Leading to the implementation of the strategic plan of every department within the organization to enable the organization to create a competitive advantage with other companies. Thus, hypothesis H_1 is supported. Especially, total quality management has a strong and significant impact on the business results, product quality and innovation performance. It also found additional observations that the factors of TQM in the implementation of the organization and the focus on human resources could not find a direct relationship with the performance of innovation. On the other hand, found that both factors can be positively related to each other when measured indirectly with the ability to innovate as a passing aid. This study supported to claim that total quality management and in automobile and auto parts industry and electrical and electronic industry in Thailand have positive effects and strong impact to innovation capability. From the results of this study, therefore, prioritizing the importance of factors is consistent with empirical data which means that the quality management elements throughout the organization are important

elements for organizational development resulting in innovative capabilities of efficient organization. In accordance with Yusr (2016), Perdomo *et al.* (2006), Prajogo and Sohal (2006a, b) and Kim *et al.* (2012) said that the factors of TQM are positively correlated with ability innovative way with this relationship being implemented or used in different industries. Moreover, quality management throughout the organization can also help the organization to increase the way to create creativity for employees until they can create new innovations into the market leading to continued business expansion. When considering each aspect according to the priority of the observed variables of quality management throughout the organization that affect the innovation ability. Thus, hypothesis H₂ is supported.

Another important result of this study is innovation capabilities activities has positive direct influence and significant impact on organizational performance. In accordance with Camison and Villar-Lopez (2014), this confirms that all three innovative capabilities are highly correlated with the organization performance in business results. In addition, it is consistent with Muhamad *et al.* (2014), Alam *et al.* (2013), Jimenez-Jimenez and Sanz-Valle (2011), concluded that organizations with effective management innovation capabilities will able to support the development of capabilities in process innovation and product innovation capabilities to be able to lead the organization to have superior performance than competitors. As well as being able to help improve the production level to make the organization respond to the needs of the market faster and help develop the production process to be effective in order to create a sustainable competitive advantage. Also, in accordance with the study of Manual (2005) and Gunday *et al.* (2011), concluded that if an organization or business has innovative capabilities, good management, ability, innovation, effective processes will result in the organization has innovative product capabilities that can develop products in a short time or respond to new products that are the needs of consumers and competitors. As a result, the organization can successfully overcome and create competitive advantage in the market. Including also in accordance with the research study of Rajapathirana and Hui (2018), Karabulut (2015), Camison and Villar-Lopez (2014), Muhamad *et al.* (2014), Alam *et al.* (2013), Rosli and Sidek (2013), Gunday *et al.* (2011), Jimenez-Jimenez and Sanz-Valle (2011) and Martinez-Costa *et al.* (2008) which conducted research on the influence of the components of innovation ability on the performance of the organization and concluded that the components of innovation ability are intermediate variables and indirectly affect the performance of the organization. Thus, hypothesis H₃ is supported.

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: to study the causal factors of total quality management and innovation capability effecting organizational performance, to study the relationship between the important factors of TQM and innovation capability, 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 437 automotive and auto parts industries in Thailand and 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 study found that most respondents were male has 89.8%, aged between 21-30 years, 48.7 %. Most of whom were head of department, 69.1% and education level were the bachelor's degree level, 83.5%. Most of the representative sample consisted of 48.6% of the automobile and auto parts and 51.4% of electrical appliances and electronics. Most of the organizations were international organizations, 94.4% had the head office in Asia, 83.9% of Certificate of quality management in ISO9001, 100%, IATF16949 standard, 50.7% use the entire quality management system (TQM), 18.7% by using quality management 8 years up to 90.5%. These organizations have certified the quality management of ISO9001, 100%, the IATF16949 standard, 50.7 % and use the Total Quality Management system (TQM), 18.7%, most use the quality management system from 8 years or more.

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 result was shown that the criteria related with people management and supplier quality management have a stronger correlation with the performance. 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 ($p < 0.01$).

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