International Journal of Business and Management

Vol. 5, No. 1

January 2010

www.ccsenet.org/ijbm

Confirmatory Factor Analysis of TQM Practices in Malaysia and Thailand Automotive Industries

Norhayati Zakuan (Corresponding author)

Dept. of Manufacturing & Industrial Engineering, Faculty of Mechanical Engineering

Universiti Tun Hussein Onn Malaysia (UTHM)

Parit Raja, Batu Pahat, Johor, Malaysia

Tel: 006-07-6526-835 E-mail: hayatiz@uthm.edu.my

Shari Mohd Yusof, Muhamad Zameri Mat Saman and Awaluddin Mohd Shaharoun

Dept. of Manufacturing & Industrial Engineering, Faculty of Mechanical Engineering

Universiti Teknologi Malaysia (UTM)

Skudai, Johor, Malaysia

The research is financed by Universiti Tun Hussien Onn Malaysia and MOSTI Science Fund, VOT 79120.

Abstract

Automotive companies must implement and maintain a high degree of Total Quality Management (TQM) practices due to competitive automotive market and customer pressure. In the operations management research field, TQM has been considered as infrastructural strategy. It has become one of the most recognized models for operational excellence besides Lean Operation, Supply Chain Management, and Technology Management. The authors have reviewed updated literature on TQM research and one question that arrised was in re-validating the TQM constructs. Eight constructs were consolidated from literature. Can these eight constructs validly represent TQM as a whole? This paper presents findings of Confirmatory Factor Analysis (CFA) on TQM practices in Malaysia and Thailand automotive industry. Data were obtained from 161 and 150 automotive companies and related suppliers in Malaysia and Thailand with 25% and 21% response rate respectively. The results indicate that from the eight TQM constructs, only seven TQM constructs are acceptable for further analysis. The paper with a proposed future direction ends of this research.

Keywords: Automotive Industry, TQM constructs, Confirmatory Factor Analysis, Structural Equation Modeling, Malaysia and Thailand

1. Introduction

In a competitive market, the demand for quality is emerging as the single most critical factor for companies to survive in the ever expanding global market place. Quality is vital in determining the economic success of manufacturing companies (Garvin 1988; Curkovic, *et al*., 2000). World class manufacturing companies gain competitive edge and greater market share through extraordinary levels of performance by providing a quality product with a competitive price as required by demanding customers.

The concept of Total Quality Management (TQM) has been developed as a result of intense global competition. Organizations with international trade and global competition have paid considerable attention to TQM philosophies, procedures, tools and techniques. According to Juran, international competition requires higher levels of quality by organizations (Blackiston, 1996).

However, the implementation of quality management has not occurred at the same pace in different regions of the world. While early implementation started in Japan, US, Europe, and followed by the developing countries. To compete in the global market, these countries need to implement quality management practices, tools, and techniques within all sections of their industries. Despite the number of publications and quantity of research on TQM, little empirical work has been carried out in developing countries, particularly in the ASEAN region. This research contributes to understand some of the differences that could exist in this part of the world with regard to quality management implementation.

In Malaysia automotive industry itself, there are a few studies that have been conducted on the implementation of quality practices. Noviyarsi (2005) had developed a framework for quality engineering implementation which can assist

the automotive companies to meet their customer satisfaction. Deros *et al*. (2004) had suggested a framework for benchmarking implementation for automotive manufacturing SMEs. Meanwhile, Sohail *et al*. (2003) had compared the TQM practices and organizational performances of companies with and without ISO 9000. They pointed out there are significant differences in performances between certified and non-certified companies. However, all of them focus within Malaysian context, and till date no research has been conducted in quality practices and implementation especially on comparative study among ASEAN country dedicated to automotive industries.

Since the realization of ASEAN Free Trade Area (AFTA) in 2005, it shows the impact on Malaysia's car manufacturer sales. Prior to AFTA, most of Malaysian automotive market is protected by the government with instruments such as tariffs, refunds schemes and investment control in order to compete with their overseas competitors. Actually, AFTA, for automotive industries, in a positive perspective would drive the regional manufacturing integration and cost competitiveness among ASEAN countries rather being a threat to them. Based on analysis for the world vehicles market for the year 2000 and projected 2010 by The Malaysian Automotive Association report (2006), ASEAN is the fifth largest market in the world and Malaysia is far behind when compared to Thailand by the year 2010.

Given the importance of automotive industries to the Malaysian economy, the author decided to evaluate the relationship between TQM and organizational performance. To survive in a competitive market place, quality practices implementation is one of the key issues that can help align organization's to stay competitive. Besides that, based on current situation, comparative study among ASEAN, especially Thailand, is gives a good opportunity that could provide an overall perspective and understanding of the main differences and similarities for TQM practices and the impact of ISO/TS16949 certification. Those strength that exist within the Malaysian automotive practices can be maintained, while those lacking in practices from Thailand counterparts could probably absorbed and copied by Malaysian automotive industry players.

2. Literature Review

The importance of quality management in business organizations has increased significantly over the past 20 years. TQM from an international perspective require studying different countries and aims at understand TQM in a global context. The concept of international serves as the motivation for developing a global TQM standard for evaluating TQM practices within countries (Rao *et al*, 1999). The practice of TQM also affects from the national level to the international level which helps organizations to compete internationally and gain a competitive edge in the global market.

2.1 Quality in International Context

Currently, developed and developing countries are in different stages of the quality movement especially in automotive industries. In this industry, most quality practices research has focused on developed countries since the early 1990's such as United States and Japan (Benson *et al.,* 1991; Ebrahimpour and Johnson, 1992; Flynn, 1992; Rogers, 1993). Studies on the implementation of quality practices in developed countries are found to be very common and thus most quality practices nowadays is based on the experienced of developed countries such as Toyota, GM and Ford (Dale, 2003; Womack *et al*., 1990). Benito and Dale (2001) had reported some empirical observation of the way in which Spanish auto components industry is implementing supplier quality practices. They pointed out that suppliers which are more advanced in the use of quality practices are achieving better operational performance in terms of quality, reliability, cost, flexibility and design. Johnson and Khan (2003) had conducted a study into the use of failure mode and effect analysis (FMEA) in the automotive industries in the UK. He had established how the effectiveness of FMEA could be determined. A recent study by Iwaarden *et al*. (2006) in a European automotive manufacturer showed that the application of a management control model in the field of quality management practices is found to be useful in explaining what changes are necessary to maintain high quality levels.

Quality practices research has been extended beyond developed countries to other countries around the world such as China and India (Rao *et al*., 1999). In China, Lee (2004) conducted a study to investigate the status of quality practices and its perception among Chinese small manufacturing companies. He pointed out that by adopting certain quality management practices, it can help Chinese small manufacturers to achieve competitive advantages in both domestic and international markets. Lin *et al*. (2004) showed that Taiwanese and American firms can benchmark the efficient practices of Japanese firms in order to be the best-in-class. The study found that the efficiency of quality management practices for Japanese-owned firms is the highest, even though almost all of their employees are Taiwanese; also, American-owned firms' efficiency is higher than that of Taiwanese-owned firms.

Some studies have compared quality practices between developed and developing countries. Yoo *et al*. (2006) discusses the differences in implementation quality practices in manufacturing companies among four countries which are Korea, USA, Mexico and Taiwan. They noted that transferring quality practices from a home country to another country or in another way are required to achieve overall business objective and to consider similarities and differences in the context globalization. Meanwhile, Raghunathan *et al*. (1997) surveyed 228 USA, 78 China and 168 Indian manufacturing

including automotive industries. They found that it is important to consider quality practices between developed and developing countries to understand the status and there may be opportunities for developing countries to learn from the successes and failures of the quality practices of developed countries. They also suggested, whether commonalities and differences found, both developed and developing countries need to use uniform instruments and method analysis for future studies.

Aziz *et al*. (2000) surveyed 540 Malaysian and 180 UK companies emphasising on manufacturing small and medium enterprises (SMEs). From the survey results, they found there is a reliance on inspection and relatively low use of more sophisticated statistical methods for quality improvement for both countries. They also stated that the types of quality practices used by the UK and Malaysian SMEs are related to the types of quality practices promoted by their own governments. Parast *et al*. (2006) conducted a comparative analysis of quality management practices between USA and Mexico manufacturing companies, using the Malcolm Baldrige National Quality Award (MBNQA) criteria as a framework. The results show there are differences between the critical success factors of quality management practices within USA and Mexico. In both countries, social responsibilities and supplier quality were significant in explaining variability of quality results. More similarities in both countries were found in the effect of quality management practices on customer focus and satisfaction.

Schniederjans *et al*. (2006) conducted a study on quality management practices in manufacturing companies between three countries which are India, Mexico and USA. A reason for selecting the USA and Mexico for comparison can be suggested by the movement of USA firms to Mexico under the North American Free Trade Agreement (NAFTA). Another, reason for selecting the USA and India for comparison is the outsourcing phenomenon that is a result of Indian firms being the greatest beneficiary of USA firms that outsource to India (Lee *et al.*, 2003). Schniederjans *et al.* (2006) stated that cross comparison study may be helpful in understanding the similarities and differences in quality management practices in various countries.

The international comparative studies on quality practices implementation can provide an insight into quality practices in global scale. Sila and Ebrahimpour (2002) had investigated comparative study on quality practices survey based research between 1989 and 2000. Table 1 shows the results of countries investigated and the number of corresponding article.

<Insert Table 1 here>

In relation to that, some of the past related researches on comparative study in quality practices implementation between countries from the year 2000 to 2007 have been summarized in Table 2.

<Insert Table 2 here>

2.2 TQM Constructs

Numerous studies have examined what constitutes quality management, what the common barriers to quality management implementation are, and what factors are critical for the success of quality management (Saraph *et al.*, 1989, Flynn *et al*., 1994, Ahire *et al.,* 1996, Rao *et al*., 1999, Yusof and Aspinwall, 2000 and Sila, 2007). Although these studies have provided different results such as critical factors, they have identified a common set of practices considered essential to the success of a quality management implementation.

TQM constructs have been reviewed extensively here. To generate distinct generic construct, a list of constructs proposed in a large set of articles was analyzed. Table 3 presents, for each generic construct, a list of similar practices proposed by other authors. Each construct was then analyzed whether it was different or similar to the constructs previously analyzed. This process resulted with a proposed set of eight constructs which are: quality leadership, customer focus and satisfaction, quality information and analysis, human resource development, strategic planning management, quality results, and quality assurance.

The above eight constructs were derived from the comparison of quality management practices across different studies as shown in Table 4 and also by combining the constructs in the Malcolm Baldrige National Quality Award Criteria, TS 16949, and the ISO 9000 certification requirements. Furthermore, those constructs also,

i. Constitute practices that represent the hard and soft aspects of quality management.

ii. Cover the most prestigious quality award criteria that are widely accepted by quality management scholars and practitioners.

iii. Have been considered as critical practices in quality management (Sila and Ebrahimpour, 2002).

iv. Correspond to the Malaysian Prime Minister Quality Award (PMQA) and Thailand Quality Award (TQA) criteria. It is believed that there are suitable for testing in the Malaysian and Thailand automotive industry context.

<Insert Table 3 here>

<Insert Table 4 here>

3. Research Methodology and Data Collection

Mail survey was conducted to collect data in this study. Mail surveys are used because they are relatively simple way to collect quantitative data. The survey packet consisted of a large (9" x 12") mailing envelope that included the instrument and cover letter stapled together, as well as a post-paid self addressed envelope. The survey packet was mailed in various batches to the target sample. The target population of this study will be from the automotive industries in Malaysia and Thailand. In this study automotive industries can be defined as a car manufacturer and their tier 1 and tier 2 suppliers.

The second mailing was done to non-respondents about one month after the first mailing. In order to minimize survey costs, a decision was made to send a complete survey packet with reminder letter to every alternate non-respondent on the mailing list. The other non-respondents were sent a post card that was post-paid. It requested the recipient to complete the questionnaire and return it, if the original survey was lost, and the recipient would be willing to complete a survey, a new survey package will be sent.

Even after second mailing was done, the response rate was still low of around 10% especially in Thailand. To increase the response rate telephone calls and follow-up fax transmission were made persuading them to fill up the questionnaires. In Thailand, due to most of the companies representative preferred to converse in Thai language, the follow-up process was carried out with the help of researchers from Thammasat University. A well-designed training program was provided to the researchers before they conducted the survey. This was helpful to increase the response rate and get the respondents answer the questionnaire.

The data was collected between July 2008 and December 2008. In the case of Malaysia, the questionnaire was distributed to a total of 650 companies and 161 completed forms received giving a response rate of 25%. Meanwhile, for Thailand, the questionnaire was distributed to a total of 700 companies with 150 returning the forms, thus giving a response rate of 21%.

3.1 Treatment for missing data

Since the structural equation modeling (SEM) software was used to analyze part of the data, missing data became an issue. SEM requires that "complete data are required for the probability density and adjustment must be made to data sets that are incomplete" (Brown, 1994). Thus, a method for handling missing data was required. A question in a given survey dataset may be missing a value for different reasons. Reasons include:

i. Omission during entering data from original questionnaire

ii. Accidental lack of response by the respondent

In this study, it would appear that both reasons come to play. A different procedure was used to adjust to the missing data for each situation. The first step was to eliminate input errors on the part of the data entry. The hardcopy of each questionnaire that presented missing value was examined and the data entry error was input. There were five cases in Malaysia dataset and only one case in Thailand dataset.

The second step was to face the issue of respondent non-response. In this study, if less than 5% of the data is missing, the missing data will be filled in with the mean (Tabachnick and Fidell, 1996). Otherwise, if more than 5% of the data is missing, the information will be dropped from the study. For Malaysian respondents, there were 10 cases the missing data filled in with the mean and four cases was dropped from the dataset since more than 5% of the data is missing. Meanwhile, none of the cases was found in Thailand dataset. Table 5 shows the summary of the final dataset.

<Insert Table 5 here>

4. Results and Discussions

The next stage involves testing the measurement model, where TQM constructs are tested based on two steps:

(1) Single factor

(2) First order confirmatory - multiple factor

Chinna (2009) suggested testing a measurement model that underlying a full structural model first. If the fit of the measurement model is found acceptable, then one should proceed to test the structural model. The confirmatory factor model is conducted to assess construct validity by using the maximum likelihood method. The confirmatory factor analysis (CFA) technique is based on the comparison of variance-covariance matrix obtained from the sample to the one obtained from the model.

4.1 Confirmatory Factor Analysis for TQM Constructs – Single Factor

Consequently, a CFA is conducted for each factor of TQM constructs and the results are presented as follows:

i) Quality leadership (QL)

QL is presented by seven items and based on results of the CFA (see Figure 1), QL constructs indicate an excellent fit with χ^2 statistic of 35.158 (degrees of freedom = 12, $p < 0.001$), with the χ^2/df ratio having a value of 2.930 that is less than 3.0. Joreskog and Sorbom (1993) suggested that it should be between 0 and 3 with smaller values indicating better fit. The goodness fit index (GFI) was 0.970, adjusted goodness of fit index (AGFI) was 0.930, comparative fit index (CFI) was 0.972, and Tucker-Lewis coefficient (TLI) was 0.950. These scores are very close to 1.0 where a value of 1.0 indicates perfect fit (Bentler, 1992; Bentler and Bonett, 1987). The next set of fit statistics focus on the root mean square error of approximation (RMSEA) which is 0.079. Browne and Cudeck (1993) proposed that values less than 0.08 indicates good fit, and values high than 0.08 represent reasonable errors of approximation in the population.

<Insert Figure 1 here>

With regard to factor loadings, the standardized coefficient estimates are between 0.56 and 0.85. All these are considered good which is above the acceptable level of 0.3 (<0.30 shows convergent validity not satisfactory) with p-value < 0.001. R-squared value (0.38, 0.43, 0.34, 0.73, 0.31, 0.34, and 0.56) indicates the percentage of variation in each indicator (QL6, QL7, QL5, QL2, QL4, QL3, and QL1), that is explained by the factor QL. From this result, it is noted that QL2 presents the best indicator for this construct which is 0.85 followed by QL1 with the value of 0.75, and lowest indicator is QL4. The first two highest values represent the "responsibility of the top management" as the best indicator for QL. Therefore, these seven items can measure the construct "Quality leadership".

ii) Customer focus satisfaction (CFS)

The results of the CFA indicate an excellent fit, with χ^2/df value of less than 3, GFI, AGFI, CFI and TLI more than 0.9 as very good and RMSEA value less than 0.08. The R-squared values for each indicator (0.35, 0.30, 0.30, 0.57 and 0.69) of this construct are graphically displayed in Figure 2.

<Insert Figure 2 here>

Based on factor loadings as shown in Figure 2, the standardized coefficient estimates (0.830, 0.757, 0.550, 0.547, and 0.593) are above the acceptable level (0.3) with p-value less than 0.001. It might be noted that "Resolved customer complaint" (CF6) is the best indicator for this construct with standardized estimate 0.830. The construct CFS may be designed using the above five observed variables.

iii) Quality information and analysis (QIA)

The results of CFA shows χ^2/df value of 2.675 with other indices (GFI, AGFI, CFI and TLI) indicating excellent fit which is more than 0.9 with RMSEA less than 0.08. Based on R-squared value, QIA6 indicates the highest percentage of variation that is explained by the factor QIA (0.71) and the remaining R-square value for each indicator (0.34, 0.33, 0.54 and 0.71) of this constructs are graphically presented in Figure 3.

<Insert Figure 3 here>

With regard to the factor loadings, the standardized coefficient estimate for the first indicator (QIA1) is 0.571 which is somewhat lower than the remaining standardized loadings (0.581, 0.734, and 0.843). It can be said that "used of quality data by workers" (QIA6) is perceived to have the strongest impact on this factor with regression weight of 0.843. Based on the CFA results, the QIA construct can be designed using these four items of measurement.

iv) Human resources development (HRD)

The results of the CFA show that χ^2/df value 1.595 has good fit with other indices GFI (0.995), AGFI (0.974, CFI (0.997) and TLI (0.992) more than 0.9 indicating excellent fit. Root mean square error approximation (RMSEA) is less than 0.08 indicates a good fit. The highest variation percentage, R-square value is 0.69 (HRD3) and the lowest variation percentage is 0.44 (HRD7) as presented in Figure 4.

<Insert Figure 4 here>

On the factor loading, the standardized coefficient estimate are acceptable with HRD3 (0.829) giving the highest value. Based on this loading, it should be noted that "training" is the best indicator to measure human resource development construct. The factor loading value (0.829, 0.779, 0.692 and, 0.664) is more than 0.3. Thus, the construct of HRD can be designed using the four observed variables.

v) Strategic planning management (SPM)

The results of the single factor CFA show that the χ^2 is rather high (6.892) but the χ^2/df value is less than 3 showing a good fit with GFI (0.991), AGFI (0.956), CFI (0.992) and TLI (0.974) shows excellent fit. Based on R-square value, SPM 3 (0.26) gave the lowest variation percentage that explained by this construct. The remaining R-square values are 0.48, 0.52, 0.50, and 0.53 as displayed in Figure 5.

<Insert Figure 5 here>

On the factor loading, the standardized coefficient estimate shows convergent validity is met with values of 0.727, 0.512, 0.724 and 0.692 respectively. The highest value is SPM1 (0.727), indicating that "strategic plan" is the best indicator for strategic planning management construct. With the CFA results, these five items may measure the construct of strategic planning management.

vi) Supplier quality management (SQM)

The results of the CFA indicate an excellent fit, χ^2/df = 1.354 with GFI equals to 0.993, AGFI of 0.974, CFI of 0.997, and TLI of 0.994. The RMSEA also shows a good fit with a value less than 0.08. The highest percentage variation explained by construct SQM is SQM7 (0.60). The remaining R-squared values are 0.45, 0.40, 0.47 and 0.54 as presented in Figure 6.

<Insert Figure 6 here>

Regarding the factor loading, all values (0.775, 0.734, 0.684, 0.633, and 0.669) are more than 0.3 that shows convergent validity. The highest value is question 7 (0.775) and it shows that the indicator "relationship with supplier lead to continuous improvement" have the strongest impact on this construct. Thus, the construct SQM may be designed using the five indicators.

vii) Quality results (QR)

The results of the CFA show that χ^2/df value 1.339 has good fit with other indices GFI (0.995), AGFI (0.975), CFI (0.997) and TLI (0.990) which is more than 0.9 shows excellent fit. Root mean square error approximation (RMSEA) is less than 0.08 indicates a good fit. The highest variation percentage, R-squared value is 0.65 (QR1) and the lowest variation percentage is 0.19 (QR4) as presented in Figure 7.

<Insert Figure 7 here>

Based on the factor loadings, the standardized coefficient estimates (0.674, 0.809, 0.440, 0.375 and 0.592) are above the acceptable level (0.3) with a p-value less than 0.001. It can be seen that "rework levels" (QR2) is the best indicator for this construct with standardized coefficient estimate 0.809 while "warranty costs" is the lowest indicator with standardized coefficient estimate 0.375 to this construct. Therefore, the construct QR can be designed using the above five observed variables.

viii) Quality assurance (QA)

The result of the CFA indicated an excellent fit, χ^2/df = 2.271 with GFI= 0.992, AGFI= 0.958, CFI= 0.987, and TLI= 0.956. RMSEA also show a good fit with value less than 0.08. The highest percentage variation explained by construct QA is QA3 (0.63). The remaining R-square values are 0.27, 0.25, 0.21 and 0.31 as presented in Figure 8.

<Insert Figure 8 here>

As to the factor loading, the standardized coefficient estimate are acceptable with QA3 (0.792) giving the highest value. Based on this loading, it should be noted that "productivity" is the best indicator to measure this QA construct. The value of the factor loading (0.560, 0.505, 0.521, 0.792, and 0.462) is more than 0.3. Thus, the construct of QA may be designed using the five observed variables.

4.2 First Order Confirmatory Analysis of TQM Constructs – Multiple Factor

This stage of analysis is called First Order Confirmatory with Multiple Factor. It involves testing the measurement model. TQM constructs are tested using the first order confirmatory factor model to assess construct validity using the maximum likelihood method with multiple factor. The results consistently supported the factor structure for TQM constructs with eight factors.

4.2.1 TQM Constructs with Eight Factors

The model tested shows that TQM is a eight constructs structure which composed of quality leadership (QL), supplier quality management (SQM), quality information and analysis (QIA), customer focus satisfaction (CFS), quality results (QR), quality assurance (QA), human resource development (HRD), and strategic planning management (SPM). The model is tested for the combined data from Malaysia and Thailand respondents (n=307).

The first order confirmatory test with multiple factors result showed an adequate fit as shown in Figure 9. The χ^2 statistic was 1336.128 (degrees of freedom = 712, $p < 0.001$), with the χ^2/df ratio having a value of 1.877 that is less than 2.0 indicating a good fit. However, the Goodness Fit Index (GFI) was 0.820 and Adjusted Goodness of Fit (AGFI) was 0.793. The comparative fit index (CFI) was 0.899, Tucker-Lewis coefficient (TLI) was 0.882. These scores are less than 0.9 which is not satisfactory. The next set of fit statistics focus on the root mean square error of approximation (RMSEA) which is 0.056 which is less than 0.08 indicating good fit.

<Insert Figure 9 here>

Regarding the factor loading, the standardized coefficients estimate is somewhat low but above the acceptable level (> 0.3). However, there is one canonical correlation (r_c) value of more than 1.0 which is between quality results (QR) factor and quality assurance (QA) factor that showed multicollinearity is high (1.04). This means that the items under the factor (QR) and (QA) are duplicating between each other. This result also showed that discriminant validity is not met (China, 2009).

Given this situation, it is suggested to remove one of the factor or consolidate both factors. Based on literature review, both factors are important for TQM implementation. Thus, the authors decided to consolidate these two factors and rename as "quality results and assurance (QRA)". Before proceeding with seven TQM constructs, reliability test was performed once again to confirm whether the consolidated factors (QRA) are reliable. The Cronbach's alpha result is 0.856 which is more than 0.7. Thus, it implies that the new factor (QRA) for TQM is statistically reliable. All the items have reliability coefficients (alpha value) less than 0.856 and more than 0.7, they are statistically reliable and no items should be dropped for further analysis (see Table 6).

<Insert Table 6 here>

The modified TQM model with seven factors result showed an adequate fit as shown in Figure 10. The χ^2 statistic was 1068.914 (degrees of freedom = 707, $p < 0.001$), with the χ^2/df ratio having a value of 1.512 that is less than 2.0 indicating a good fit. The Goodness Fit Index (GFI) was 0.850 and Adjusted Goodness of Fit (AGFI) was 0.826 meaning moderate fit. The comparative fit index (CFI) was 0.941, Tucker-Lewis coefficient (TLI) was 0.935. These scores are more than 0.9 which is an excellent fit. The RMSEA value is 0.041 which is less than 0.08 and thus indicating good fit. All canonical correlation (r_c) show values less than 1.0, implying that the discriminant validity has been tested and acceptable.

On the factor loading, the standardized coefficient estimates are between 0.517 and 0.811 are good since they are above the acceptable level of 0.3 with p-value < 0.001. Therefore, it is suggested that these seven constructs be used to measure the TQM implementation and the results of CFA showed that the new TQM constructs exhibit both convergent and discriminant validity.

<Insert Figure 10 here>

5. Conclusion and Future Research

In this study, the original model of TQM constructs proposed by literature was not proved to be valid. The main problem was that it is not a eight-factor model but only a seven factor model. That is, 'quality results' and 'quality assurance' are identical. Therefore, the authors have modified the model by consolidating these two factors and renamed it as 'quality results and assurances (QRA)'. The results of seven-factors showed that the measurement model for TQM constructs had a good fit and the model is valid and reliable for Malaysia and Thailand automotive industries. In conclusion, it can be described that TQM is a latent exogenous variable, which is represented by seven observed endogenous variables namely, 'quality leadership', 'customer focus satisfaction', 'quality information and analysis', 'human resource development', 'strategic planning management', 'supplier quality management' and 'quality results and assurance'. The next step in this study is to propose a structural model of the relationship between TQM practices and organizational performance using structural equation modeling (SEM).

References

Ahire, S. L., and Dreyfus, P. (2000). The impact of design management and process management on quality: an empirical investigation. *Journal of Operations Management,* 18, 549-575.

Ahire, S. L., Golhar, D. Y., Waller, M. A. (1996). Development and validation of TQM implementation constructs. *Decision Science,* 27(1), 23-56.

Ahmad, S., and Schroeder, R. G. (2002). The importance of recruitment and selection process for sustainability of total quality management. *International Journal of Quality & Reliability Management,* 19(5), 540-550.

Aziz, Z. A., Chan, J. F. L., and Metcalfe, A. V. (2000). Quality Practices in The Manufacturing Industry in the UK and Malaysia. *Journal of Total Quality Management*, 11(8), 1053-1064.

Benito, J. G., and Dale, B. (2001). Supplier quality and reliability assurance practices in the Spanish auto components industry: A study of implementation issues. *European Journal of Purchasing & Supply Management,* 7, 187-196.

Benson, P. G., J. V. Saraph, R. G., and Schroeder. (1991). The effects of organizational context on quality management: An empirical investigation. *Management Science,* 17, 1107-1124.

Bentler, P. M. (1992). On the fit of models to covariances and methodology to the Bulletin. *Psychological Bulletin,* 112, 400-404.

Bentler, P. M., and Bonett, D. G. (1987). This week's citation classic. *Current contents, Social and Behavioral Sciences,* 19, 16.

Blackiston, G. H. (1996). A barometer of trends in quality management. *National Productivity Review,* 16, 15-23.

Brown, R. L. (1994). Efficacy of the indirect approach for estimating structural equation models with missing data: A comparison of five methods. *Structural Equation Modeling,* 1(4), 287-316.

Browne, M. W., and Cudeck, R. (1993). Alternative ways of assessing model fit. In K.A. Bollen and J.S. Long (Eds.). Testing structural equation models. Newbury Park, CA: Sage. 445-455.

Chinna, K. (2009). *Structural Equation Modeling Using AMOS*. Lecture Note for SPSS User' Group. Kuala Lumpur: Malaysia.

Curkovic, S., S. Melnyk, R. Calantone., and R. Handfield. (2000). Validating the Malcolm Baldrige national quality award framework through structural equation modeling. *International Journal of Production Research,* 38(4), 765-791.

Dale, B.G. (2003). *Managing Quality*, 4th., Blackwell Publishers: Oxford.

Ebrahimpour, M., and J. L. Johnson. (1992). Quality, vendor evaluation and organizational performance: A comparison of U.S. and Japanese firms. *Journal of Business Research,* 25, 129-142.

Feng, J., Prajogo. D. I, Tan, K. C., and Sohal, A. S. (2006). The impact of TQM practices on performance: A comparative study between Australian and Singaporean organizations. *European Journal of Innovation Management*, 9(3), 269-278.

Flynn, B. B. (1992). Managing for quality in the U.S. and in Japan. *Interfaces,* 22(5), 69-80.

Flynn, B. B., Schroeder, R. G., and Sakakibara, S. (1994). A framework for quality management research and an associated measurement instrument. *Journal of Operations Management,* 11, 339-366.

Garvin, D. A. (1988). *Managing Quality: The Strategic and Competitive Edge*. New York: The Free Press.

Hermann, A., Huber, F., Algesheime, R., and Tomczak, T. (2006). An empirical study of quality function deployment on company performance. *International Journal of Quality & Reliability Management,* 23(4), 345-366.

Iwaarden, J. V., Wiele, T. V. D., and Williams, R. (2006). A Management Control Perspective of Quality Management: An Example in the Automotive Sector. *International Journal of Quality & Reliability Management,* 23(1), 102-112.

Jabnoun, N. (2005). Organizational structure for customer-oriented TQM: an empirical investigation. *The TQM Magazine,* 17(3), 226-236.

Johnson, K. G., and Khan, M. K. (2003). A study into the use of the process failure mode and effects analysis (PFMEA) in the automotive industry in the UK. *Journal of Materials Processing Technology,* 139(1-3), 348-356.

Joreskog. K. G., and Sorbom, D. (1993). *LISREL 8: Structural equation modeling with the SIMPLIS command language*. Chicago: Scientific Software International

Khoo, H. H., and Tan, K. C. (2003). Managing for quality in the USA and Japan: Differences between the MBNQA, DP and JQA. *TQM Magazine,* 15, 14-25.

Lee, C.Y. (2004). TQM in small manufacturers: an exploratory study in China. *International Journal of Quality & Reliability Management,* 21(2), 175-197.

Lee, S. M., Rho, B. H., and Lee, S. G. (2003). Impact of MBNQA criteria on organizational quality performance. *International Journal of Production Research*, 41(9), 2003-2020.

Lin, C., Madu, C. N., Kuei, C. H., and Lu, M. H. (2004). The Relative Efficiency of Quality Management Practices – A Comparison Study on American, Japanese and Taiwanese Owned Firms in Taiwan. *International Journal of Quality and Reliability Management,* 21(5), 231-244.

Noronha, C. (2003). National culture and total quality management: empirical assessment of a theoretical model. *The TQM Magazine,* 5(5), 351-355.

Parast, M. M., Adams, S. G., Jones, E. C., Rao, S. S., and Raghu-Nathan, T.S. (2006). Comparing Quality Management Practices between the United States and Mexico. *Quality Management Journal,* 13(4), 36-49.

Raghunathan, T. S., Rao, S. S., and Solis, L. E. (1997). A comparative study of quality practices: USA, China and India. *Industrial Management & Data Systems,* 97(5), 192-200.

Rao, S. S., L. E. Solis, and Raghu-Nathan. (1999). A framework for international quality management research: Development and validation of a measurement. *Total Quality Management,* 10(7), 1047-1075.

Rogers, R. E. (1993). Managing for quality: Current differences between Japanese and American approaches. *National Productivity Review,* 12, 503-517.

Rothenberg, S., Schenck, B., and Maxwell, J. (2005). Lessons from benchmarking environmental performance at automobile assembly plants. *Benchmarking: An International Journal*, 12(1), 5-15.

Saraph, J. V., Benson, P. G., and Schroeder, R.G. (1989). An instrument for measuring the critical factors of quality management. *Decision Science,* 20, 810-829.

Schniederjans, M. J., Parast, M. M., Nabavi, M., Rao, S. S., and Raghunathan, T.S. (2006). Comparative analysis of Malcolm Baldrige National Quality Award criteria: An empirical study of India, Mexico, and the United States. *Quality Management Journal*, 13(4), 7-21.

Sila, I. (2007). Examining the effects of contextual factors on TQM and performance through the lens of organizational theories: An empirical study. *Journal of Operations Management,* 25, 83-109.

Sila, I., and Ebrahimpour, M. (2002). An investigation of the total quality management survey based research published between 1989 and 2000: A literature review. *International Journal of Quality & Reliability Management,* 19(7), 902-970.

Tabachnick, B., and Fidell, L. (1988). *Using multivariate Statistics*. New York, HarpereCollins.

Tari, J. J., Molina, J. F. and Castejon, J. L. (2007). The relationship between quality management practices and their effects on quality outcomes. *European Journal of Operational Research*, 183(2), 483-501.

Womack, J.P., Jones, D. and Roos, D. (1990). *The Machine that Changed the World,* Macmillan, New York, NY.

Yoo, D. K., Rao, S. S., and Hong, P. (2006). A Comparative Study on Cultural Differences and Quality Practices: Korea, USA, Mexico and Taiwan. *International Journal of Quality & Reliability Management,* 23(6), 607-624.

Yusof, S. M., and Aspinwall, E. (2000). Critical success factors for total quality management implementation in small and medium enterprises, *Total Quality Management,* 10(4,5), 803-809.

Zakuan, N., and Yusof, S.M. (2007). A comparative study of quality practices and implementation for Malaysian automotive manufacturer: A review, in *Proceeding of the 2nd International Engineering Convention (INTEC2007),* 10th-14th March 2007 Jeddah, Saudi Arabia, 51-58.

Table 1. Countries investigated and the number of corresponding articles (Sila and Ebrahimpour, 2003)

Country	**No**	**Country**	**No**
Australia, New Zealand	7	Germany, UK	1
USA, Canada	4	Spain, Nertherland, UK	1
USA, UK, Middle East, Singapore/ Malaysia	1	Asia/South Pacific, Europe, North America	1
India, China, Mexico	3	China, Norway	1
Australia, Europe	3	Argentina, Brazil, Chile, Mexico	1
USA, Japan	3	Twelve countries – Russia, USA etc.	1
USA, Canada, Germany, Japan	2	Eastern and Western Companies	1
USA, Mexico	2	Nordic countries and East Asia	1
Japan, UK	2	Japan, Korea	1
USA, Spain, Europe	1	USA, UK, Japan	1
USA, Spain	1	USA, Taiwan	1
USA, Costa Rica	1	USA, Luxembourg	1
USA, India, China, Mexico	2	USA, Mexico, Australia	1
USA, Germany, Denmark, Canada	1	USA, Japan, Korea, EU, Mexico	1
USA, India, China, Mexico, Taiwan	1	Australia, Japan	1
An international survey of 45 major corporations	1	Australia, Singapore	1
USA, Germany, Japan	1	Australia, New Zealand, UK	1
USA, Germany, UK	1	Australia, UK	1
USA, UK, Canada	1	Brazil, UK	1
USA, Korea, New Zealand	1	Denmark, East Germany, West Germany, Finland, France, UK, Ireland, Italy, Netherlands, Norway, Sweden, Switzerland, Spain, Turkey	1
USA, Canada, Western Europe, Japan, the Pacific Basin, Mexico, Latin America, Southeast Asia, Eastern Europe	1	East (Japan, Korea and Taiwan) and West (Denmark, Finland, Sweden and Australia)	1

Table 2. Research on comparative study in quality practices implementation between countries from the year 2000 to 2007 (Zakuan and Yusof, 2007)

Year	Author	Focus area	Sector	Countries
2000	Aziz *et al.*	Quality practices	Manufacturing	UK, Malaysia
2002	Ahmad and Schroeder	TQM	Automotive	US, Germany, Italy, Japan
2003	Noronha	TQM	Manufacturing	China, Hong Kong, Taiwan
2003	Khoo and Tan .	TQM	Manufacturing	US, Japan
2005	Jabnoun	TQM	Manufacturing	Saudi Arabia, Australia, Canada
2005	Rothenberg *et al.*	Benchmarking	Automotive	US, Japan, Europe
2006	Schniederjans *et al.*	MBNQA	Manufacturing	India, Mexico, US
2006	Iwaarden *et al.*	Quality practices	Automotive	European
2006	Yoo *et. al.*	Quality practices	Manufacturing	Korea, USA, Mexico, Taiwan
2006	Parast *et al.*	Quality practices	Manufacturing	USA, Mexico
2006	Hermann *et al.*	Quality tools	Automotive	Germany, France, England, Italy
2006	Feng *et al.*	TQM	Manufacturing	Australia, Singapore
2007	Tari *et al.*	TQM	Manufacturing	Spain, US, Korea

Table 3. Constructs proposed by literature

Constructs	Related constructs
Quality leadership (QL)	The role of top management leadership (Saraph *et al*., 1989), top management support (Flynn *et al.,* 1994), top management commitment (Ahire *et al.,* 1996), management leadership (Yusof and Aspinwall, 2000), leadership (Sila, 2007)
Customer focus and satisfaction (CFS)	The role of quality department (Saraph *et al*., 1989), customer involvement (Flynn *et al.,* 1994), customer focus (Ahire *et al.,* 1996), customer orientation (Rao *et al.,* 1999)
Quality information and analysis (QIA)	Quality data and reporting (Saraph *et al.,* 1989), quality information (Flynn *et al.,* 1994), quality information and availability (Ahire *et al.,* 1996), information and analysis (Sila, 2007).
Human resource development (HRD)	Workforce management (Flynn *et al.,* 1994), employee training (Ahire *et al*., 1996), support for human resource development (Sila, 2007), human resource management (Parast *et al.,* 2006).
Strategic planning management (SPM)	Process design management (Saraph *et al.,* 1989), process management (Flynn *et al.,* 1994), design quality management (Ahire *et al.,* 1996), strategic planning process of quality management (Parast *et al.,* 2006).
Supplier quality management (SQM)	Supplier involvement (Flynn *et al*., 1994), supplier quality management (Ahire *et al.,* 1996), supplier quality (Rao *et al.,* 1999, Parast *et al.,* 2006), supplier quality assurance (Yusof and Aspinwall, 2000), supplier management (Sila, 2007).
Quality results (QR)	Product quality (Ahire *et al.,* 1996), internal quality results (Rao *et al.,* 1999), quality results (Parast *et al.,* 2006), organizational effectiveness (Sila, 2007).
Quality assurance (QA)	Supplier quality assurance (Yusof and Aspinwall, 2000), quality assurance of products and service (Rao *et al.,* 1999).

Table 4. Comparison of quality management constructs across different studies

No.	Saraph *et al*., 1989	Flynn *et al*., 1994	Ahire *et al*., 1996	Rao *et al*., 1999	Yusof and Aspinwall, 2000	Parast *et al*., 2006	Sila, 2007	Proposed constructs
1	The role of top management leadership	Top management support	Top management commitment	Top management commitment Quality citizenship	Management leadership	Quality leadership	Leadership	Quality leadership
2	The role of the quality department	Customer involvement	Customer focus	Customer orientation	-	Customer focus and satisfaction	Customer focus	Customer focus and satisfaction
3	Quality data and reporting	Quality information	Internal quality information usage Benchmarking	Quality information availability	Measurement and feedback	Quality information and analysis	Information and analysis	Quality information and analysis
4	Training	Workforce management	Employee training	Employee training	Education and training Human resource development	Support for human resource development	Human resource management	Human resource development
5	Employee relations	-	Employee empowerment Employee involvement	Employee involvement	Resources	-	-	-
6	Product/service design Process management	Product design Process management	Design quality management Statistical process control usage	Product/process design	System and process Improvement tools and techniques	Strategic planning process of quality management	Process management	Strategic planning management
7	Supplier quality management	Supplier involvement	Supplier quality management	Supplier quality	Supplier quality assurance	Supplier quality	Supplier management	Supplier quality management
8	-	-	Product quality	Internal quality results	-	Quality results	Organizational effectiveness	Quality results
9	-	-	-	-	-	Quality assurance of products and services	-	Quality assurance
10	-	-	Supplier performance	External quality results	Continuous improvement process	-	Financial and market results	-

Table 5. Summary of final dataset

	Malaysia (cases)	Thailand (cases)	Remark
Received	161	150	
Data entry error	5	1	Edit and accept
Less than 5% missing	10	0	Fill in with mean and accept
More than 5% missing	4	0	Drop
Total	157	150	

Table 6. Results of internal consistency analysis for QRA items

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
QR5	37.86	19.513	.536	.326	.842
QR3	38.01	19.752	.517	.356	.844
QR4	37.95	19.867	.493	.350	.846
QR1	37.56	19.391	.681	.503	.832
QR2	37.79	18.499	.615	.450	.835
QA7	37.95	20.161	.465	.240	.848
QA4	37.89	19.422	.546	.367	.842
QA3	38.04	19.100	.611	.399	.836
QA1	37.50	19.806	.579	.366	.839
QA2	37.77	19.259	.558	.404	.841

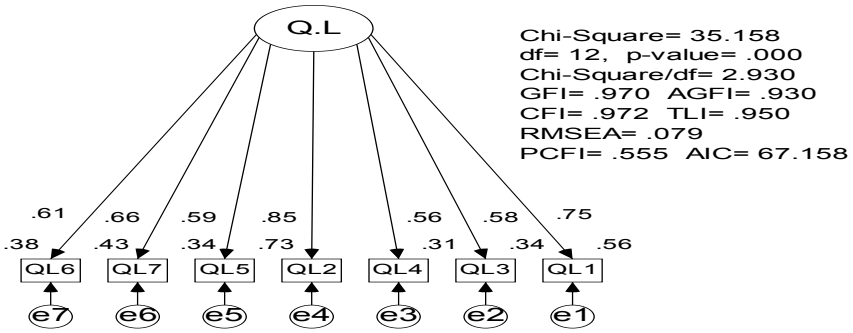

Figure 1. QL- Statistic results and factor loading

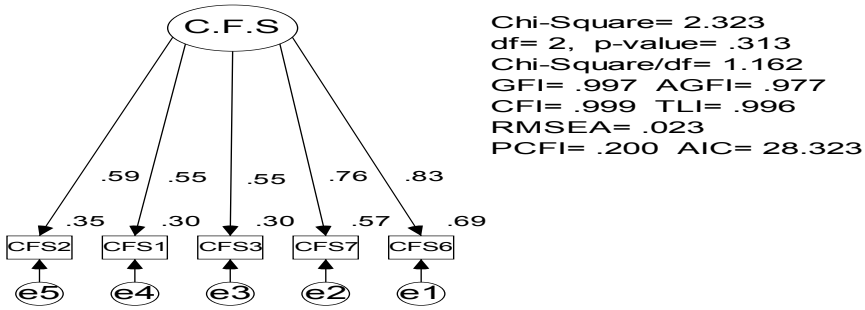

Figure 2. CFS- Statistic results and factor loading

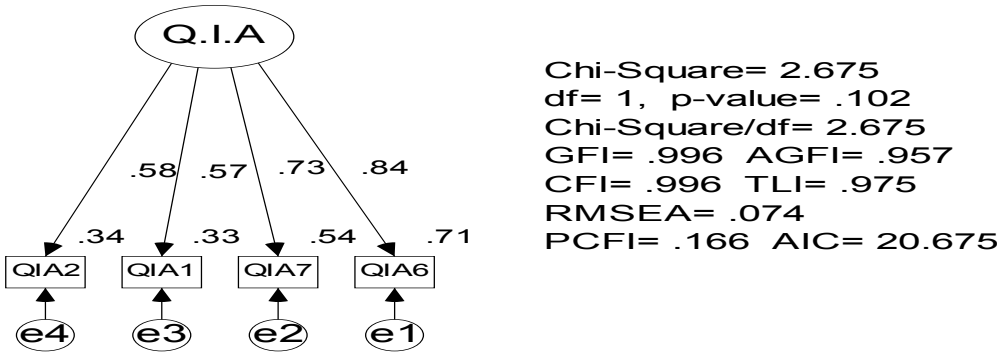

Figure 3. QIA- Statistic results and factor loading

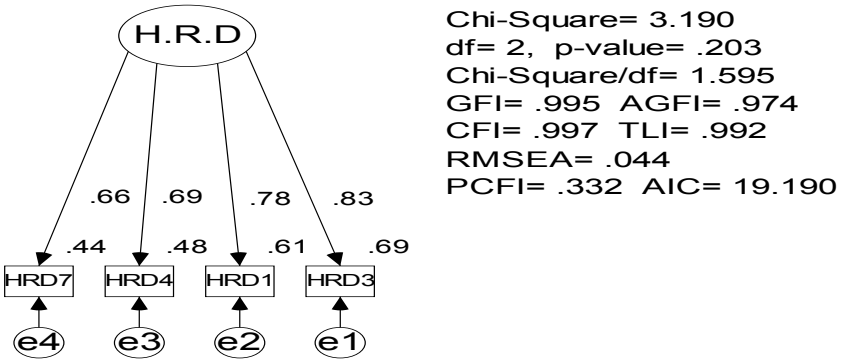

Figure 4. HRD- Statistic results and factor loading

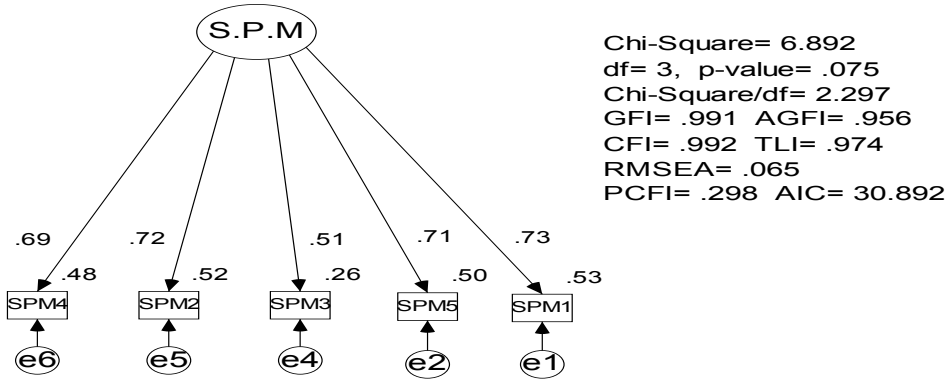

Figure 5. SPM- Statistic results and factor loading

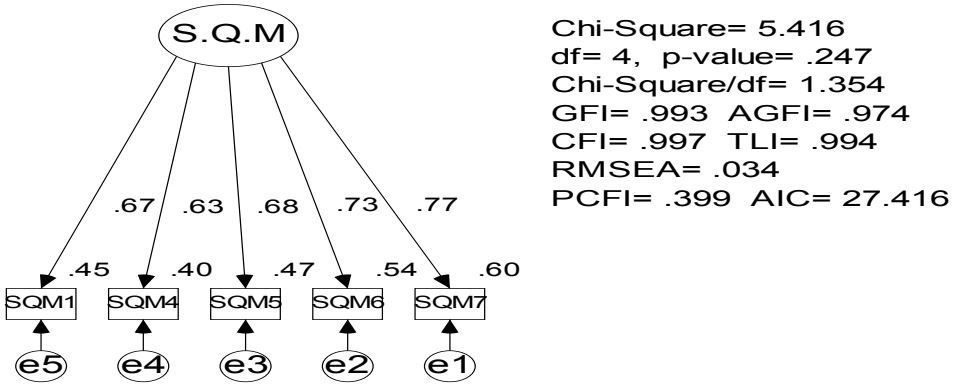

Figure 6. SQM- Statistic results and factor loading

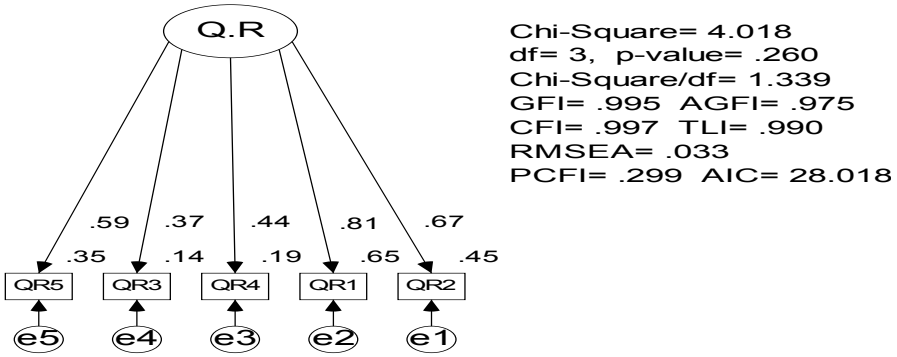

Figure 7. QR- Statistic results and factor loading

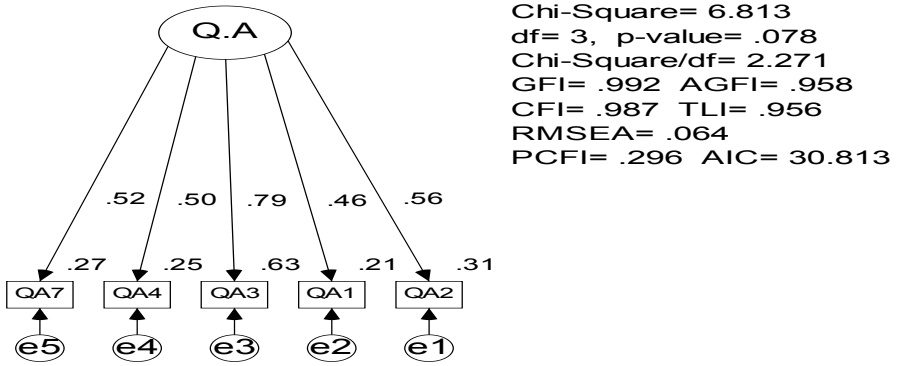

Figure 8. QA- Statistic results and factor loading

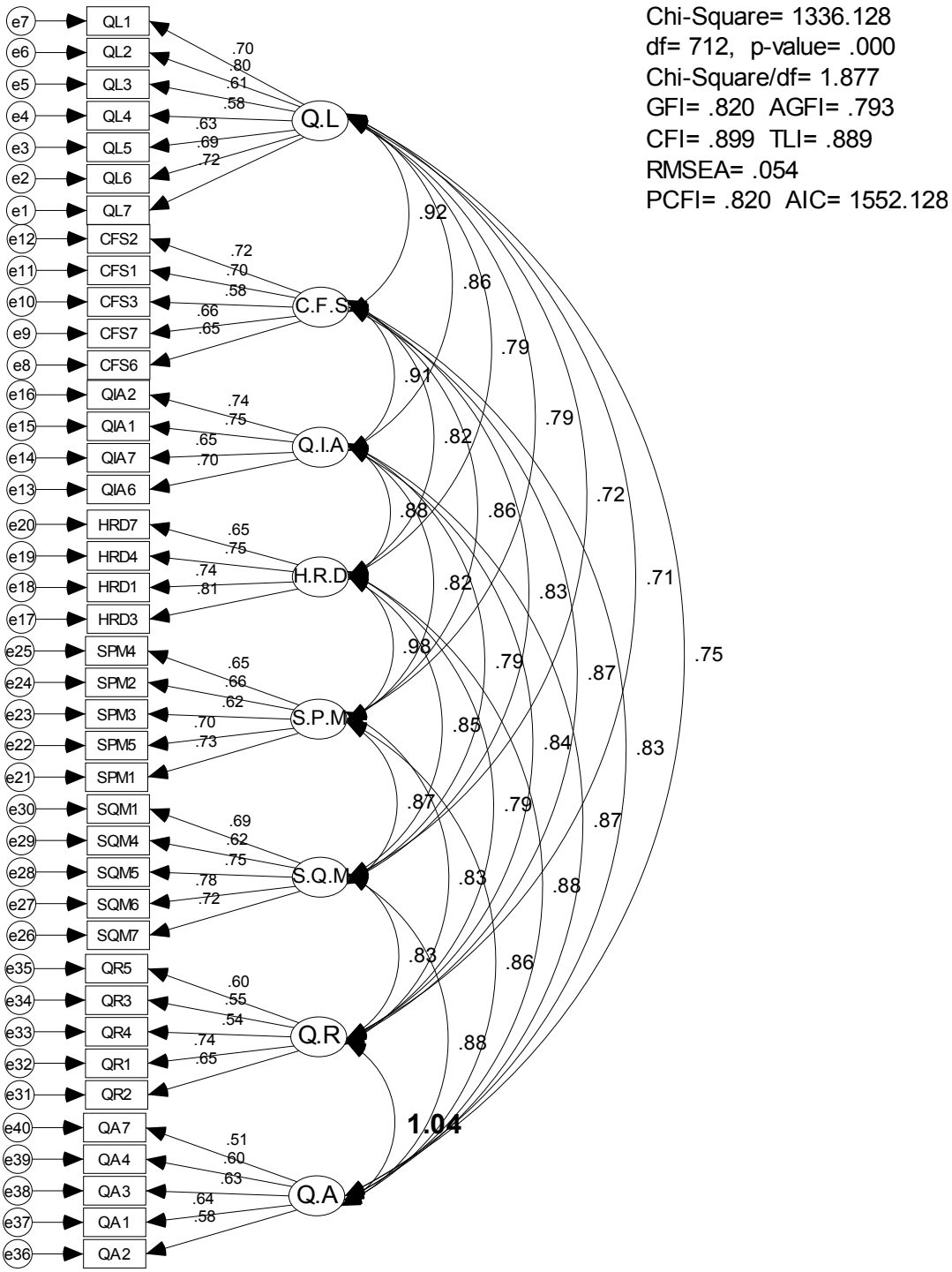

Figure 9. The output path diagram for eight factors TQM model

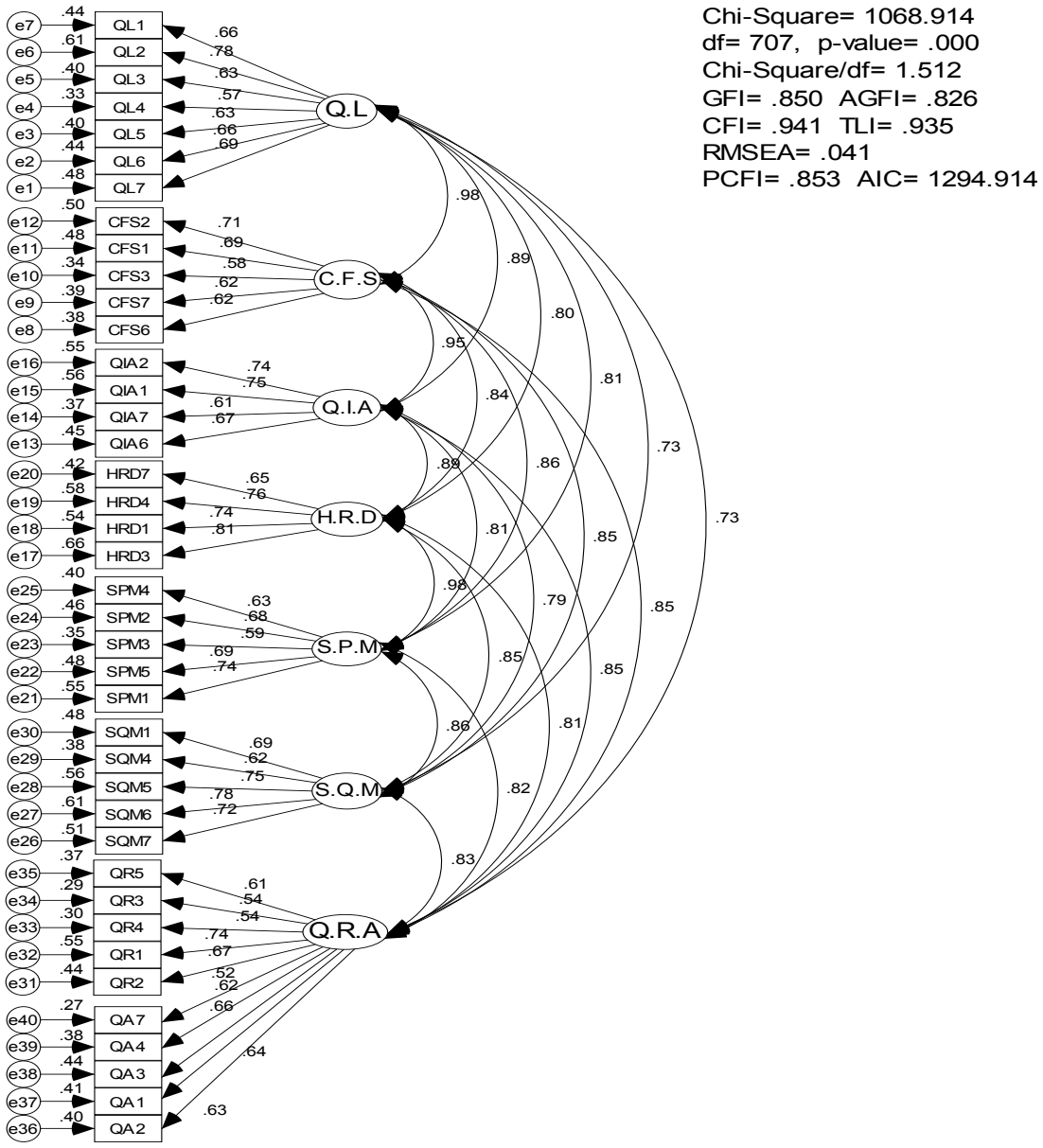

Figure 10. Modified TQM model: The output path diagram with seven factors