Evaluating Importance Level of Factors to Quality Management System Implementation with Analytic Hierarchy Process and Mean Test

David Han-Min Wang, and Quang Linh Huynh

***Abstract*—** The implementation of quality management system is predicted by organizational characteristics and environmental uncertainty. The predicting variables affect the implementation of quality management system at different levels. Nevertheless, these affecting levels have not been assessed and compared amongst the predicting variables. This paper uses the analytic hierarchy process to evaluate and rank the importance levels the predicting variables play in leading to the implementation of quality management system in business. Then for the robustness of the findings from the analytic hierarchy process, this paper also employs mean-test procedures to re-assesses the importance levels. The findings are robust across the two methods. Organizational characteristics are more important than environmental uncertainty in explaining the implementation of quality management system. Of the six elements of organizational characteristics and the six elements of environmental uncertainty, decentralization is the most important, whereas technology is the least important. This paper has some implications on how management managers should implement quality management system facing different types of organizational characteristics and environmental uncertainty.

***Keywords*—** Quality management system, Analytic hierarchy process, Organizational characteristics, Environmental uncertainty

I. Introduction

QUALITY management system is a formal management system that is considered as the organizational structure, procedures, processes and resources that organizations employ to implement quality management. Organizations apply quality management systems, on the one hand, to obtain a high degree of differentiation and customer satisfaction, and also enhance brand image, and on the other hand, to diminish costs by preventing errors, reducing waste-time and improving organizations' processes [7]. The implementation of quality management system is costly to organizations; however it allows the organizations to enjoy many positive benefits for business. Hence, organizations attempt to implement quality management system in order to gain competitive advantages and then achieve successes for business. A number of previous studies have investigated the effect of factors on the successful implementation of quality management systems ([7], [12], [21], [25], [27], [28]).

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Nonetheless, only few studies have made investigation on factors that determine the implementation of quality management systems. To the best of our knowledge, only a research by Bello-Pintado and Merino-Díaz-de-Cerio [4] has examined determinants of the use of quality management systems. In addition, no research has ranked the importance level that factors make in leading managers to implementing quality management systems. Similarly to management systems such as management accounting system in previous studies ([1], [6], [10], [11], [24]) that management accounting system is predicted by organizational and environmental factors, we suggest that quality management system is also determined by organizational and environmental factors (known as organizational characteristics and environmental uncertainty). This paper investigates the impact of organizational characteristics and environmental uncertainty on the implementation of quality management system in business. Particularly, it assesses and compares the importance degree to which the variables of organizational characteristics and environmental uncertainty contribute to the adoption of quality management system in business.

In order to rank the importance which the variables contribute to the likelihood of implementing quality management system in business, this paper is the first to use the analytic hierarchy process to make pair-wise comparisons between all the judgments with each other. Furthermore, to check the robustness of the findings from the analytic hierarchy process, the mean test is the first time employed to evaluate the importance levels of variables in contributing to the implementation of quality management system. The empirical findings indicate that, of the twelve elements which affect the decisions managers make to implement quality management system in their organizations, the decentralized structure of organization is the most important determinants of the implementation of quality management system, while technology is the weakest variable in explaining the implementation of quality management system.

The findings provide management researchers with an insight into the importance level of elements leading to the implementation of quality management system which, in turn, improve organizational performance. The research also help organizations' managers by providing them with better understanding of the priority degrees of the factors affecting the implementation of quality management system. Hence they make better decisions on implementing quality management system, especially when their organizations face the different types of environmental uncertainty as well as organizational characteristics.

The rest of the paper will continue as follows. A literature review discusses the arguments to support the important role that elements play in implementing quality management system in the next part. Subsequently, the research methodology offers the guidance for collecting and analyzing the data, followed by the empirical findings. Some conclusions are presented in the final part.

II. Literature Review

The implementation of quality management system is regarded to be determined by organizational characteristics as well as by environmental uncertainty. Literature in the effect of organizational characteristics as well as environmental uncertainty on the implementation of quality management system will be reviewed in the next sections.

2.1 Organizational Characteristics (ORC)

Papa [19] refers to internal factors or organizational characteristics as a variable composed of organizational structure and organizational culture. Organizational structure is regarded as the way that a company organizes people and jobs in order to meet its goals, while organizational culture is considered as the types of workplace relationships as well as the ways of doing jobs within an organization. Chen and Huang [5] refer to organizational structure as decentralization (versus centralization), mutual adjustment (versus formalization) and integration. They also imply that organizational culture is made up of trust, communication and coordination. In this research, 'organizational characteristics' is defined as a variable related to both organizational structure and organizational culture. It is made up of six dimensions: (1) decentralization- ORC1, (2) mutual adjustment- ORC2, (3) integration- ORC3, (4) trust- ORC4, (5) communication- ORC5 and (6) coordination- ORC6. They make different levels of contribution to 'organizational characteristics'.

'Organizational characteristics' including organizational culture and organizational structure is suggested in previous studies to influence the implementation level of management systems in business. Chenhall and Morris [6] reveal that organizational structure imposes effect on the design of management accounting system. It is discovered that organizational structure and social interaction considered as organizational culture are positively related to the application of knowledge management [5]. The arguments by Yap et al. [26] indicate that when knowledge management is considered to implement in business, organizational culture and structure should always be taken into account. In addition, prior studies ([2], [13]) suggest that organizational culture is a critical success factor of the implementation of knowledge management. These discussions imply that "Organizational characteristics" determines the implementation of management systems. Hence it also affects the implementation of quality management system. Furthermore, Mellahi and Eyuboglu [15] offer suggestion that organizational culture and organizational structure are critical factors for the implementation of quality management system, while Warwood and Roberts [25] argue that organizational culture and organizational structure play an important role in the implementation of quality management system. A study by Gimenez-Espin et al. [9] finds empirical evidence that organizational culture should fit best with a quality management system in order to achieve improved business performance. The above mentioned discussions lead us to suppose that 'organizational characteristics' is an important variable in determining the implementation of quality management system in business.

2.2 Environmental Uncertainty (ENU)

Environmental uncertainty is a situation in which managers have difficulty in predicting their business environment. They undergo environmental uncertainty, since they have a little information to accurately predict business conditions [18]. Duncan [8] refers to environmental uncertainty as an important contextual variable to business. He mentions environmental uncertainty as a variable connected with customers, suppliers, competitors, social-political issues, governmental policies and technologies. A study by Miles et al. [16] defines environmental uncertainty as managers' predictability of business conditions. The predictability is considered as the ability of an organization to estimate the situations of business environment in the future by Steers [23] and Jusoh [11]. Miller [17] in his study of "Industry and Country Effects on Managers' Perceptions of Environmental Uncertainties" classifies environmental uncertainty into six areas: (1) governmental policies- ENU1, (2) economy- ENU2, (3) resources and services used by the company- ENU3, (4) product market and demand- ENU4, (5) competition- ENU5 and (6) technology- ENU6. This definition is employed for this paper.

Governmental policies, economy, resources and services used by the company, product market and demand, competition, and technology are important dimensions making up "environmental uncertainty". Their roles in contributing to forming "environmental uncertainty" are at different extents. While environmental uncertainty is constituted by the above dimensions, it is suggested to affect the extent to which a company adopts management systems such as quality management system. When the uncertainty of business environment becomes higher, managers need more formal procedures to cope with it [20]. In addition, a study by Chenhall and Morris [6] reveals that the design of management accounting system is significantly associated with environmental uncertainty facing managers. Additionally, the relationship between environmental uncertainty and the utilization of information systems is reported by Masrek [14]. Environmental uncertainty is also suggested by Ashill and Jobber [3] and by Ibadin and Imoisili [10] to affect the use of marketing information system as well as the design of management accounting system. Like other management systems, quality management system is also a control tool utilized by a company to gain competitive advantages, so achieve business performance. Furthermore, Bello-Pintado and Merino-Díaz-de-Cerio [4] report evidence that firms facing high uncertainty of business environment are more likely to implement quality management system. These arguments allow us to suggest that environmental uncertainty plays an important role in the implementation of quality management system in business.

2.3 Research Hierarchy Model

Having discussed the relationships derived from the reviewed literature, we come to the research hierarchy model in Figure 1. The research methodology employed to guide the data collection and the data analysis will be discussed in the next part.

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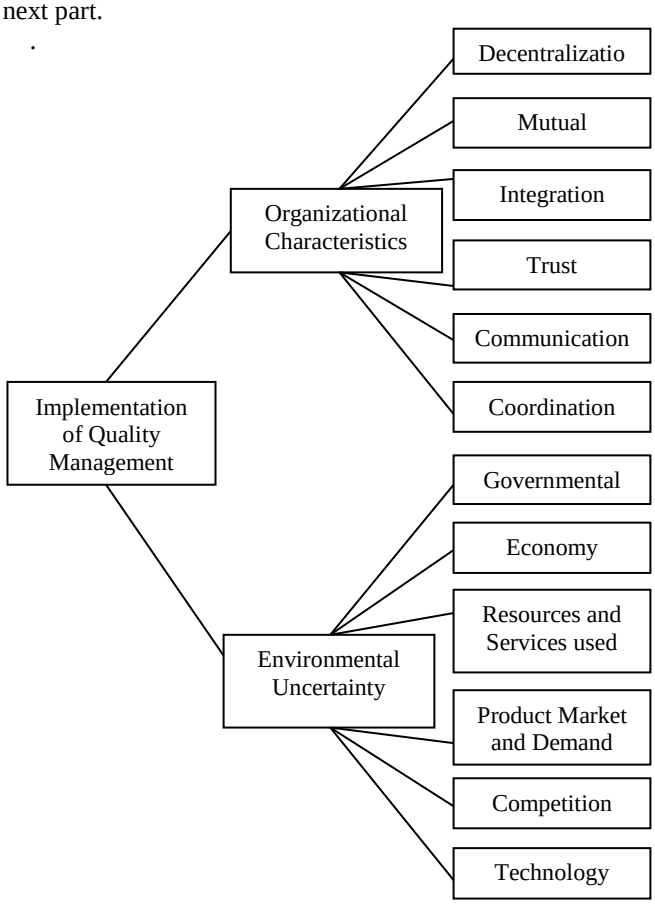

Fig. 1 Research Hierarchy Model

III. Research Methodology

3.1 Questionnaires

This paper applies two different types of questionnaires for the two methods: (1) Analytic Hierarchy Process and (2) Mean Test. They will be discussed below.

(1.1) Analytic Hierarchy Process

Analytic hierarchy process is a tool used for multi-criteria judgment as well as for analyzing the decision-making process, suggested by Saaty [22]. Analytic hierarchy process has the subjective judgment of each judgment-maker as input and the quantified weight of each option as output. Analytic hierarchy process is considered as a compensatory method that decomposes a complex judgment problem into a hierarchy. Pair-wise comparisons between all choices with each other are employed to obtain the weights and scores.

The judgment scale used for pair-wise comparisons is exhibited in Table I. If attribute A is as equally important in explaining their factor as attribute B, it is rated at 1. If attribute A is absolutely more important in explaining their factor than attribute B, it is rated at 5. If B is absolutely less important in explaining their factor than A, it is valued at 1/5. It is similar for "more important- 3" or "intermediate values- 2 and 4". There are three steps to conduct analytic hierarchy process.

TABLE I
THE SAATY RATING SCALE OF RELATIVE IMPORTANCE OF FACTORS

Intensity of Importance	Definition	Explanation
1	Equally important	Two factors contribute equally to the objective.
3	More important	Experience and judgment favor one over the other.
5	Absolutely more important	The evidence favoring one over the other is of the highest possible validity.
2, 4	Intermediate values	When compromise is needed

(i). Stratifying the framework of decision-making

A decision problem is decomposed into its components. Organizing all the constituents in a hierarchy offers an overall view of the complicated relationships and allows decision-makers to evaluate whether components in each level have the same magnitude in order that they can be precisely compared. A constituent in a given level functions as an attribute for comparison. A hierarchy in this paper consists of two levels: (1) is composed of '*organizational characteristics'* and '*environmental uncertainty'* (2 factors); (2) includes decentralization, mutual adjustment, integration, trust, communication, and coordination (6 elements) on '*organizational characteristics'*, and governmental policies, economy, resources and services used by the company, product market and demand, competition, and technology (6 elements) on *'environmental uncertainty'*, as in Figure 1.

(ii). Pair-wise comparison of options on each criterion

For each pair of components, decision-makers are asked to assess how important component A is compared to component B. Each of these judgments is assigned a number on a scale (from 1 to 5) as above discussed. At level 1, 'organizational characteristics' and 'environmental uncertainty' are compared with each other. At level 2, six elements, namely, decentralization, mutual adjustment, integration, trust, communication, and coordination are compared with one another. So are the other six elements (governmental policies, economy, resources and services used by the company, product market and demand, competition, and technology). Then the matrices of the judgments are produced. These matrices lead to determining the weights of the components within each level, called the local weights.

(iii). Obtaining the relative weights or importance of components

The relative weights or importance of components are calculated from the matrices of the judgments. In order to test the consistence of judgments, a consistency ratio (CR) is computed to measure how consistent the judgments are. CR is a ratio of consistency index (CI) to random index (RI_n), where RI_n is obtained from Table II [22] according to the values of n, while CI is equal to $(\lambda_{max}\text{-}n)/(n\text{-}1)$. λ_{max} is the maximum

eigenvalue, whereas 'n' is the number of components needed to be compared. CI and CR should be less than 0.1, the preferred value stipulated by Saaty [22].

Finally, after obtaining the local weights at each level of the hierarchy, the global weights are calculated as follows.

$w_i = \sum_{i=1}^{n} (a_{ik} b_k)$ Where: w_i is the global weight of the i^{th} component

a_{ik} is the local weight of the i^{th} component to the k^{th} factor

b_k is the local weight of the k^{th} factor

TABLE II
RANDOM INDEX

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI_n	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

(1.2) Mean Test

Another method applied to rank the importance of components in making up or predicting their factors is 'Mean Test'. 'Mean Test' is to test how important component A is comparative to component B. For each component, respondents are asked to rank the importance of the twelve components in leading to the implementation of quality management system in business with a five point scale (from 1.not important at all, 2.a little important, 3.fairly important, 4.important, to 5.very important). For each pair of components, 'Mean Test' is utilized to test which one is more important than the next one. The six components of organizational characteristics- namely decentralization, mutual adjustment, integration, trust, communication, and coordination and the six elements of environmental uncertainty- namely governmental policies, economy, resources and services used by the company, product market and demand, competition, and technology are compared with the next one in mean. Finally, the whole twelve components are ranked for their importance. Mean test is a tool to test for the difference between two means. The test procedure consists of three main steps as follows.

(i). State the hypotheses

A null hypothesis is "$\mu_1 - \mu_2 \leq 0$" and while the alternative hypothesis is "$\mu_1 - \mu_2 > 0$". This is a one-tailed Test. μ_1 is the mean of one population and μ_2 is the mean of another population.

(ii). Analyze sample data

The sample data is employed to calculate for the standard error, degrees of freedom, test statistic, and the P-value related to the test statistic.

- Standard error: $SE = \text{sqrt}[(s_1^2/n_1) + (s_2^2/n_2)]$
  Where s_1 is the standard deviation of sample 1, s_2 is the standard deviation of sample 2, n_1 is the size of sample 1, and n_2 is the size of sample 2.
- Degrees of freedom: $DF = (s_1^2/n_1 + s_2^2/n_2)^2 / \{[(s_1^2 / n_1)^2 / (n_1 - 1)] + [(s_2^2 / n_2)^2 / (n_2 - 1)]\}$
- Test statistic: $t = (x_1 - x_2)/SE$
  Where x_1 is the mean of sample 1, x_2 is the mean of sample 2, and SE is the standard error.
- P-value is the probability of observing a sample statistic as extreme as the test statistic.

(iii). Interpret results

If the P-value is less than the significance level (often 0.01, 0.05, or 0.10), then the null hypothesis is rejected and the alternative hypothesis is statistically significant; otherwise the null hypothesis cannot be rejected.

3.2 Respondents and Sample

The objects for this paper are companies in Vietnam. The sample comprises 169 companies that are granted with the certificates of quality management system by QMS Certification Services and 238 companies by VinaCert Certification Body. This paper utilizes the data set for two purposes: one for analytic hierarchy process and the other for mean test. Of the 407 targeted companies, 203 are used for analytic hierarchy process and the other 204 for mean test. The initial solicitations were carried out to obtain responses from key informants with experience in quality management system. For each of these firms, we contacted a quality management system manager or a manager involved in quality management system to complete a questionnaire by email. Of the 407 questionnaires that were emailed, 214 were returned, in which 56 questionnaires did not provide enough information as required. Finally, 158 useful replies with sufficiently required information are obtained for our research. Of them, 60 are suitable for analytic hierarchy process, and the 98 others are appropriate for mean test.

IV. EMPIRICAL FINDINGS

4.1 Analytic Hierarchy Process

With the sample of 60 observations, taking an average for each element and using the Saaty procedure, we obtain element weights of each level as shown in Tables III, IV and V.

Table III shows that organizational characteristics are three time more important in explaining the implementation of quality management system than environmental uncertainty (0.75 compared to 0.25). Based on Table III, we calculate CI and CR which are 0.00 far less than 0.1, the acceptable level suggested by Saaty [22]). The consistency test of the weights is paaed; so these weights can be used for our research model.

Tables IV and 5 indicate the importance levels that elements play in constituting organizational characteristics as well as environmental uncertainty. CIs for organizational characteristics and environmental uncertainty are both 0.09, whereas CRs are both 0.07. They are all smaller than 0.l, which pass the limit level stipulated by Saaty [22]. The

consistency tests are satisfied. As a consequence, the weights are suitable for our research model.

TABLE III
LOCAL WEIGHTS OF LEVEL 1 (FOR IMPLEMENTATION OF QUALITY MANAGEMENT SYSTEM)

	ORC	ENU	The 2^{th} root of product of values	Weights	New Vector	New Vector/Weight
ORC	1.00	3.00	1.73	0.75	1.50	2.00
ENU	0.33	1.00	0.58	0.25	0.50	2.00
Total			2.31	1.00		4.00

Where:
Weight: w_j = the 2^{th} root of product of value$_j$/ the total of the 2^{th} root of product of values
New vector: $[v_{1j}] = [a_{jj}] \times [b_{1j}]$
$[a_{jj}]$ is the matrix of the 2 components with 2 columns and 2 rows
$[b_{1j}]$ is the matrix of the weights with 1 column and 2 rows

λ_{max} = Sum(New Vector/ Weight)/2 = 4.00/2 = 2.00
CI = (λ_{max}-n)/ (n-1) = (2.00 – 2) x (2-1) = 0.00, so CR = 0.00

TABLE IV
LOCAL WEIGHTS OF LEVEL 2 (FOR ORGANIZATIONAL CHARACTERISTICS)

	ORC1	ORC2	ORC3	ORC4	ORC5	ORC6	The 6^{th} root of product of values	Weights	New Vector	New Vector/ Weight
ORC1	1.00	1.10	2.00	2.02	3.48	3.28	1.92	0.28	1.70	6.01
ORC2	0.91	1.00	2.03	2.08	3.00	3.15	1.82	0.27	1.61	6.03
ORC3	0.50	0.49	1.00	1.12	2.03	2.00	1.02	0.15	0.90	6.02
ORC4	0.50	0.48	0.90	1.00	1.98	1.88	0.96	0.14	0.85	6.02
ORC5	0.29	0.33	0.50	0.50	1.00	1.12	0.55	0.08	0.48	6.02
ORC6	0.30	0.32	0.50	0.53	0.89	1.00	0.53	0.08	0.47	6.02
Total							6.81	1.00		36.12

Where: Weight: w_j = the 6^{th} root of product of value$_j$/ the total of the 6^{th} root of product of values
New vector: $[v_{1j}] = [a_{jj}] \times [b_{1j}]$
$[a_{jj}]$ is the matrix of the 6 components with 6 columns and 6 rows
$[b_{1j}]$ is the matrix of the weights with 1 column and 6 rows

λ_{max} = Sum(New Vector/ Weight)/6 = 36.11/6 = 6.02 NCI = (λ_{max}-n)/ (n-1) = (6.02 – 6) x (6 -1) = 0.09
With 'n'=6, based on Table 1, RI_n is 1.24; hence, CR = CI/ RI_n = 0.09/1.24 = 0.07

TABLE V
LOCAL WEIGHTS OF LEVEL 2 (FOR ENVIRONMENTAL UNCERTAINTY)

	ENU1	ENU2	ENU3	ENU4	ENU5	ENU6	The 6^{th} root of product of values	Weights	New Vector	New Vector/ Weight
ENU1	1.00	2.02	1.97	2.97	3.02	4.82	2.36	0.34	2.04	6.03
ENU2	0.50	1.00	1.12	2.02	2.07	3.07	1.39	0.20	1.20	6.02
ENU3	0.51	0.90	1.00	2.00	1.88	3.02	1.32	0.19	1.14	6.01
ENU4	0.34	0.50	0.50	1.00	1.13	2.05	0.76	0.11	0.66	6.02
ENU5	0.33	0.48	0.50	0.88	1.00	2.02	0.72	0.10	0.62	6.02
ENU6	0.21	0.33	0.33	0.49	0.50	1.00	0.42	0.06	0.36	6.02
Total							6.96	1.00		36.12

Where:
Weight: w_j = the 6^{th} root of product of value$_j$/ the total of the 6^{th} root of product of values
New vector: $[v_{1j}] = [a_{jj}] \times [b_{1j}]$
$[a_{jj}]$ is the matrix of the 6 components with 6 columns and 6 rows
$[b_{1j}]$ is the matrix of the weights with 1 column and 6 rows

λ_{max} = Sum(New Vector/ Weight)/6 = 36.11/6 = 6.02 CI = (λ_{max}-n)/ (n-1) = (6.02 – 6) x (6 -1) = 0.09
With 'n'=6, based on Table 1, RI_n is 1.24; hence, CR = CI/ RI_n = 0.09/1.24 = 0.07

Local and global weight calculation is presented in Table VI. This table indicates the local rank of the two factors "organizational characteristics" and "environmental uncertainty", in which organizational characteristics is ranked the first and environmental uncertainty is ranked the second. Table VI also demonstrates the local rank and overall rank of the components of "organizational characteristics" and "environmental uncertainty". Within "organizational characteristics", decentralization- ORC1 and mutual adjustment- ORC2 are ranked the first and the second, integration- ORC3 stands at the third position, then trust- ORC4 and communication- ORC5 take the fourth and fifth positions and finally coordination- ORC6 is the last; while within "environmental uncertainty", governmental policies- ENU1 takes the first position, economy- ENU2 is the second, resources and services used by the company- ENU3 is ranked the third, then product market and demand- ENU4 takes the fourth, finally competition- ENU5 is ranked the fifth and technology- ENU6 takes the last position. The overall rank indicates the relative importance of the twelve components of "organizational characteristics" and "environmental uncertainty". For the whole twelve components, decentralization- ORC1, mutual adjustment- ORC2, integration- ORC3 and trust- ORC4 are ranked the first, second, third and fourth, respectively; then governmental policies- ENU1 takes the fifth position, communication- ORC5 and coordination- ORC6 are the sixth and seventh; finally economy- ENU2, resources and services used by the company- ENU3, product market and demand- ENU4, competition- ENU5 and technology- ENU6 ranked the eighth, ninth, tenth, eleventh and twelfth, respectively.

TABLE VI
LOCAL & GLOBAL WEIGHTS AND RANKS OF LEVELS 1 AND 2

Factors	Local Weights	Local Rank	Components	Local Weights	Local Rank	Global Weights	Overall Rank
Organizational Characteristics	0.75	1	ORC1	0.283	1	0.212	1
			ORC2	0.267	2	0.200	2
			ORC3	0.150	3	0.113	3
			ORC4	0.141	4	0.106	4
			ORC5	0.080	5	0.060	6
			ORC6	0.078	6	0.059	7
Environmental Uncertainty	0.25	2	ENU1	0.339	1	0.085	5
			ENU2	0.199	2	0.050	8
			ENU3	0.189	3	0.047	9
			ENU4	0.109	4	0.027	10
			ENU5	0.104	5	0.026	11
			ENU6	0.060	6	0.015	12

4.2 Mean Test

Applying the above mentioned mean-test procedures to analyze the sample of 98 observations, we obtain mean importance, standard errors, degrees of freedom, t-statistics and P_{value}, as displayed in Table VII and then we rank the importance of components as in Table VIII.

TABLE VII
PAIRED COMPARISONS OF MEAN IMPORTANCE: MEAN-TEST STATISTICS

Compared Pair	Paired Means	SE	DF	t	P_{value}	Result
ORC1- ORC2	4.47-4.11	0.112	14958	3.18	0.0008	Significant
ORC2- ORC3	4.11-3.81	0.132	10910	2.32	0.0110	Significant
ORC3- ORC4	3.81-3.43	0.141	09741	2.68	0.0040	Significant
ORC4-ENU1	3.43-3.13	0.129	11295	2.30	0.0121	Significant
ENU1- ORC5	3.13-2.88	0.111	15568	2.29	0.0120	Significant
ORC5- ORC6	2.88-2.63	0.116	14195	2.12	0.0150	Significant
ORC6- ENU2	2.63-2.38	0.109	15035	2.33	0.0090	Significant
ENU2- ENU3	2.38-2.14	0.101	18564	2.32	0.0110	Significant
ENU3- ENU4	2.14-1.90	0.103	18048	2.38	0.0080	Significant
ENU4- ENU5	1.90-1.65	0.091	22866	2.68	0.0030	Significant
ENU5- ENU6	1.65-1.35	0.082	28522	3.72	0.0005	Significant

Pairs of components that have adjacent mean values are compared with each other. The mean-test procedures are to test whether a component with the larger mean importance has a statistically significant bigger mean than the one with the smaller mean importance. The eleven pairs of components are compared. They are decentralization- ORC1 versus mutual adjustment- ORC2, mutual adjustment- ORC2 versus integration- ORC3, integration- ORC3 versus trust- ORC4, trust- ORC4 versus governmental policies- ENU1, governmental policies- ENU1 versus communication- ORC5, communication- ORC5 versus coordination- ORC6, coordination- ORC6 versus economy- ENU2, economy- ENU2 versus resources and services used by the company- ENU3, resources and services used by the company- ENU3 versus product market and demand- ENU4, product market and demand- ENU4 versus competition- ENU5, competition- ENU5 versus technology- ENU6. Table VII reveals that all the compared pairs achieve statistical significance at levels less than 0.05. As a result, the importance of elements is significantly ranked as in Table VIII, which indicates that decentralization- ORC1, mutual adjustment- ORC2, integration- ORC3 and trust- ORC4, governmental policies- ENU1, communication- ORC5 and coordination- ORC6 are ranked the first, second, third, fourth, fifth, sixth and seventh,

respectively; on the other hand economy- ENU2, resources and services used by the company- ENU3, product market and demand- ENU4, competition- ENU5 and technology- ENU6 take the eighth, ninth, tenth, eleventh and twelfth positions, respectively.

TABLE VIII
RANKING OF IMPORTANCE OF ELEMENTS

Elements	ORC1	ORC2	ORC3	ORC4	EUN1	ORC5	ORC6	EUN2	EUN3	EUN4	EUN5	EUN6
Mean	4.47	4.11	3.81	3.43	3.13	2.88	2.63	2.38	2.14	1.90	1.65	1.35
Ranking	1	2	3	4	5	6	7	8	9	10	11	12

The findings from the mean-test method are consistent with those from the previous procedure- Analytic Hierarchy Process. Organizational characteristics of decentralization play the most important role in managers' decision to adopt quality management system in business. Mutual adjustment and integration are ranked as the second and third importance. Higher trust between employees is the fourth important element in leading managers to implementing quality management system. Governmental policy is one of the most important elements that urge managers to choose quality management system. This element takes the fifth important position, which is more important than communication and coordination of organizational characteristics that take the sixth and the seventh. In contrast, economy, and resources and services used by the company are less important elements which are the eighth and ninth, while product market and demand, competition, and technology are the least important. Product market and demand, and competition are ranked as the third, second least important, whereas technology plays the least important role in leading managers to the implementation of quality management system.

V. CONCLUSION

Factors impacting on the successful implementation of quality management system have been explored in previous studies. Nonetheless, only few studies have investigated the influence of organizational characteristics and environmental uncertainty on the implementation of quality management system. Furthermore, the importance level of elements in determining the implementation of quality management system has not been examined. This paper applies the analytic hierarchy process to make pair-wise comparisons between all the judgments with each other in order to rank the importance that the variables contribute to the likelihood of implementing quality management system in business. To further check the robustness of the findings from the analytic hierarchy process, this paper utilizes the mean test re-evaluate the importance orders of variables in contributing to the adoption of quality management system.

Our empirical findings reveal that organizational characteristics are more important in determining the implementation of quality management system than environmental uncertainty. The findings also imply that organizations with the decentralized structure are most likely to implement quality management system. Organizational characteristics of mutual adjustment and integration are ranked as the second and third importance in urging managers to implement quality management system in their organizations. Next, trust between employees plays the fourth important role to the implementation of quality management system. Organizational characteristics of communication and coordination are the sixth and seventh important elements, while governmental policy takes the fifth important position. On the other hand, product market and demand, and competition are ranked as the third, second least important and technology plays the least important role. Finally, economy, and resources and services used by the company are the fifth and fourth least important elements in leading organizations to the implementing quality management system.

This paper offers management researchers with an insight into the importance level of elements in determining the implementation of quality management system. It is also useful to organizations' managers by helping them better understand the priority levels of the factors leading to the implementation of quality management system. Therefore, they make better decisions on implementing quality management system which, in turn, improves organizational performance, especially when organizations of different characteristics face different type of environmental uncertainty.

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