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EXCELLENCE AWARDS AS A FUNDAMENTAL FOR HIGH-TECH INDUSTRIES IMPLEMENTING TOTAL QUALITY MANAGEMENT

This study employs the Taiwan National Quality Award framework to investigate the measurement criteria of total quality management (TQM) and analyze its influence on firm competitiveness in high-tech industry. We adopt the modified Delphi method to identify the factors affecting the TQM implementation and then conduct the analytic hierarchy process to prioritize the important indicators. The results indicate that the Quality Award excellence model is a well-designed measurement dimension for developing TQM. The attention and proactive involvement of top management and focusing on a customer-oriented strategy are the key success factors for high-tech firms. This study provides a discussion on the theoretical and practical implications of the findings.

Keywords: *Taiwan National Quality Award, total quality management, modified Delphi method, AHP.*

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НАГОРОДИ ЗА ЯКІСТЬ ЯК ОСНОВА КОМПЛЕКСНОГО УПРАВЛІННЯ ЯКІСТЮ У ВИСОКОТЕХНОЛОГІЧНИХ ГАЛУЗЯХ

У статті досліджено тайванську систему нагород за якість у рамках вимірювання критеріїв комплексного управління якістю (КУЯ) та проаналізовано його вплив на конкурентоспроможність фірми для галузі високотехнологічної промисловості. Для виявлення факторів, що впливають на реалізацію КУЯ, застосовано модифікований метод Дельфі, а потім проведено аналіз ієрархій для встановлення пріоритетності показників. Результати показали, що модель, яка використовує показники нагород за якість, надійно визначає розміри впровадження КУЯ. Ключовими факторами успіху для високотехнологічних фірм є активна участь вищого керівництва і клієнтоорієнтована стратегія розвитку. Описано теоретичні та практичні способи застосування отриманих даних.

Ключові слова: *Тайванська національна нагорода за якість, комплексне управління якістю, модифікований метод Дельфі, метод аналізу ієрархій.*
Рис. 2. Табл. 4. Літ. 35.

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НАГРАДЫ ЗА КАЧЕСТВО КАК ОСНОВА КОМПЛЕКСНОГО УПРАВЛЕНИЯ КАЧЕСТВОМ В ВЫСОКОТЕХНОЛОГИЧНЫХ ОТРАСЛЯХ

В статье исследована тайваньская система наград за качество в рамках измерения критериев комплексного управления качеством (КУК) и проанализировано его влияние на конкурентоспособность фирмы для отрасли высокотехнологичной промышленности. Для выявления факторов, влияющих на реализацию КУК, применен модифицированный метод Дельфи, а затем проведен анализ иерархий для установления приоритетности показателей. Результаты показали, что модель, использующая показатели наград за качество, надежно определяет размеры внедрения КУК. Ключевыми факторами успеха для высокотехнологичных фирм являются активное участие высшего руководства и клиентоориентированная стратегия развития. Описаны теоретические и практические способы применения полученных данных.

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Ключевые слова: *Тайваньская национальная награда за качество, комплексное управление качеством, модифицированный метод Дельфи, метод анализа иерархий.*

1. Introduction.

Because of the globalization of trade and economic reform, quality-differentiated market competition has become an increasingly popular trend. Since 1980 numerous countries have advocated the concept of business excellence management, which is generally considered an effective method for pursuing quality excellence (Yang, 2009). Currently, more than 80 countries have developed their own national quality award systems with reference to the business excellence of European Foundation for Quality Management and Malcolm Baldrige National Quality Award (BEPASS, 2011).

Taiwan government implemented the Taiwan National Quality Award (TNQA) to help enterprises face the accelerated integration of the current global economic environment and enhance their international competitive edge. Established in 1990, the TNQA is now in its twenty-first year. To rapidly react to recent changing economic conditions and the evolution of technological quality trends, TNQA began to promote business excellence model in 2008. The main structure and process of the TNQA is based on both the US the Malcolm Baldrige National Quality Award (MBNQA) as well as the European Foundation for Quality Management (EFQM).

Taiwan's high-tech industry has a great reputation with high product quality and innovation performance (Hung et al., 2011). The 2011 report on world competiveness by a famous global investigation publication (IMD, 2011) ranks Taiwan's high-tech exports among the world's top five. High-tech Taiwanese firms that adopt total quality management (TQM) have played an important role in the economic transition and development. Therefore, this study investigates the high-tech industry path towards TQM with the analytic hierarchy process (AHP) methodology.

The following sections are organized as follows: Section 2 presents the literature review and uses the principle TNQA to verify key measurement indicators for complete quality management; Section 3 adopts the modified Delphi method and AHP to examine the factors for evaluating TQM in the high-tech industry; Section 4 illustrates the results of applying the Modified Delphi and AHP and management implications; and lastly, Section 5 demonstrates our discussion and conclusion.

2. Literature Review.

2.1. Total Quality Management (TQM). Extended from Deming's management philosophy (Deming, 1986), quality management contains 3 viewpoints of major innovations: (1) quality needs to be created; (2) quality improvement must be continuous; and (3) enterprises should set up inter-departmental working groups to jointly solve quality issues. TQM is a way to improve an organization's core competencies and maximize market share in enterprise management (J-K Chen and I-S Chen, 2009). Yoo (2003) considered TQM as a system with both input and output processes. Therefore, the principal managerial efficiency criteria of maximum outputs with minimum inputs should be applied to TQM. By collecting opinions from Spanish firms, Bou-Llusar et al.(2009) concluded that many organizations use MBNQA and EFQM as a guide to TQM implementation. Previous study shows that, due to industrial special characteristics and particular business targets, different firms might adopt industrial TQM measurement indicators (Hung et al., 2011; J-K Chen and I-S Chen, 2009; Wang and Li, 2010).

2.2. TNQA Business Excellence. The Taiwan National Quality Award (TNQA), promoted by the Ministry of Economic Affairs, aims to measure indicators specified by business excellence under the guide of the National Quality Awards (NQA). Fig. 1 illustrates the business excellence structure of TNQA (Li, 2007). The famous MBNQA proposes 7 key indicators: customer and market, leadership, strategy and plan, measurement analysis and knowledge management, process management and industry focusing capacity. The definition of EFQM includes process, leadership, policy and strategy, staff, partnership and resource, customer, social perception, and key performance result. Many empirical studies conclude that these measurement dimensions can help enterprises become excellent (Bou-Llusar et al., 2009; Prybutok et al., 2008). Yang (2009) included Six Sigma and a balanced scorecard to provide an integrated business excellence framework. Li and Chen (2007) addressed the standard of the TNQA that provided an excellence self-assessment guide, and indicated the direction that the enterprise must improve in each systematic perspective. It is therefore important to survey innovative factors with high quality in both product and market for high-tech firms in Taiwan. This study synthesizes the Quality Award by implementing TQM activities, and proposes TNQA as a measurable basis for the key metrics of TQM in high-tech industry.

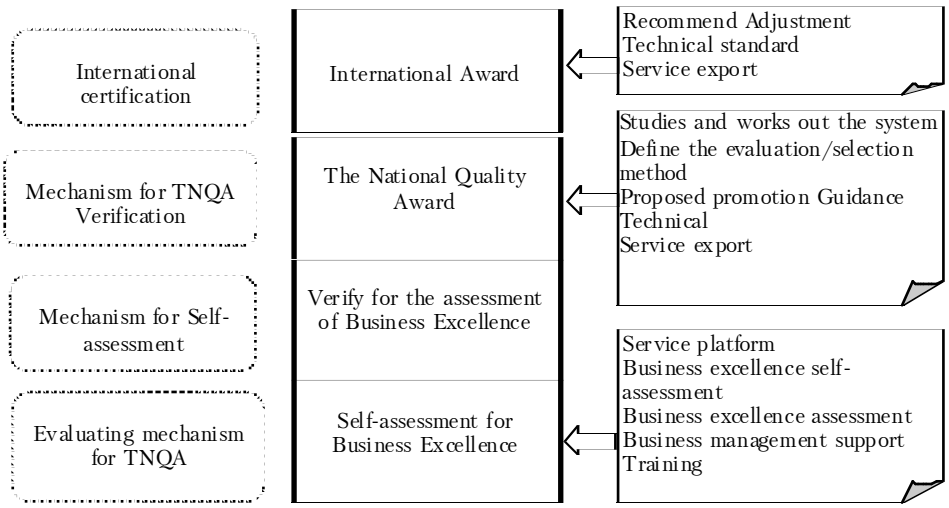


Figure 1. **Structure of TNQA business excellence**

2.3. Preliminary Measuring Indicator. The measuring model in this study is based on the TNQA Business Excellence System (BEPASS, 2011), and defines 8 measuring indicators: (1) leadership and management concepts; (2) strategic management; (3) research, development, and innovation; (4) customer and market development; (5) human resources and knowledge management; (6) information strategy, application, and management; (7) process management; and (8) performance. The eighth indicator performance represents the results of enterprises after implementing the first 7 dimensions, and is therefore not included in the initial measure. This study uses the first 7 assessment dimensions of TQNA with their 33 detail items as basic criteria, then

further synthesizes previous research in the field of TQM and business excellence (Bou-Llusar et al., 2009; J-K Chen and I-S Chen, 2009; Tseng and Lin, 2008; Keng et al., 2007; Samat et al., 2006). We performed interviews with TQM experts (Table 1). Those in the category of high-tech firms include 5 chief officers of business and planning units, 4 from major members of TNQA, 7 senior managers in production and quality management, and 4 professors whose research interests include TQM. These professors possess deep empirical knowledge relevant to this survey.

Table 1. **The breakdown of the surveyed experts**

The classification of expertise	No. of experts	Background
Major members of TNQA	4	TNQA's committee members who lead the plan and related guideline development for activity of the business excellent model in Taiwan. They possess rich background of business excellent concept and well familiar to TQM.
Senior Manager or Leader of production and quality management unit	7	Senior managers of production and quality units in high-tech industry. They're working for well-known global enterprises.
Chief officer or senior manager of business and planning unit	5	Chief officers of high-tech firms responsible for firms' business management, planning and KPI achievement.
Professional or Business consultant in TQM field	4	Professors or experts familiar with TQM theory, with profound empirical experience in this field.

Based on this expert feedback, we designed 48 preliminary measuring factors for implementing TQM in the high-tech industry. We explain the preliminary measurement items as followings:

1. Leadership and management concepts: This study adopts the view of organization managers in quality control management when conducting the research survey. Six measurement items were used to measure the system.

2. Strategy management: This aspect specifies the development of enterprise management strategy and execution. 6 factors were used to measure the system.

3. Research, development, and innovation: This dimension describes the view of innovation and creation of product and market in the high-tech industry environment. This study proposed 4 measurement items in this category.

4. Customer and market development: Based on the industrial characteristics of the high-tech industry, and with respect to customer orientation and market strategy, this category includes 10 measurement factors.

5. Human resource and knowledge management: this study reinforces the importance of employee retention and benefits in high-tech industries, 10 measurement items were used to measure the system.

6. Information utilization and management: This measurement item describes the point of complementing management with information technology from the business perspective. Therefore, this category includes 6 information-related measurement items.

7. Process management: This explains the view of company's executive practice. This study proposes 6 factors in this category.

In total, this study proposes 48 preliminary measurement factors for the empirical research in the following sections.

3. Research Methodology.

3.1. Description of Architecture Planning. This study adopts the modified Delphi method and AHP as our main research methodologies. Professionals with practical experience and academic backgrounds assisted us to create a systematic measurement items to ensure that the high-tech industry achieves TQM. According to these professional opinions, we summarize the most important factors within each dimension. Since the AHP and Delphi method are both group decision-making methodologies, we selected experts with the appropriate experience who provided feedback using a circular response method until all points raised by the experts diminished to a minimum (Delbecq et al., 1975). The modified Delphi used in this study is based on the original Delphi method, and is widely used in empirical research for assessment (Murry and Hammons, 1995). AHP is a decision-making method invented by Thomas Saaty (1977a; 1980b) in 1971 and is designed to help decision-makers build different levels of structure for complex problems using a systematic structured method (Aguilar-Lasserre et al., 2009; Chin et al., 2002; Kalpande et al., 2010; Lee et al., 2008; Nakatsu and Iacovou, 2009; Phillips-Wren et al., 2009; Wang and Li, 2010; Yoo, 2003). The literature review was conducted to reveal appropriate measurement factors for the two-stage modified Delphi process. This study also uses the AHP method to analyze the measurement items' weight.

3.2. Background of Experts Participating in the Study. The Modified Delphi and AHP both require qualified experts with a deep understanding of the TQM issues. All the experts in this study had been actively involved in a number of TNQA activities and TQM projects in high-tech firms as managers, senior consultants, or principal investigators.

3.3. Survey and Steps of Research. Two rounds of the survey were conducted according to the modified Delphi method. The AHP method was then used to discuss the relative weight of important measuring factors. The experts completed 3 rounds of the survey. The following points explain this process:

(1). First and second modified Delphi survey.

The first and second modified Delphi survey summarized the responses of the 2 rounds survey and the results of the statistical analysis. These results show that there are 52 measuring items under 7 dimensions for TQM implementation. The statistical analysis of these results shows that all standard deviation (SD) were less than 1 and the mean (M) was greater than 3.75. This result indicates that the experts and professional reached consensus during the first and second surveys.

(2). The results of first and second modified Delphi surveys.

Table 2 presents the results of the first and second surveys of the modified Delphi. The results show that the measurement items' SD tended to decrease. The average number of most of the measuring items showed that the result of the second round of surveys was higher than that in the first round. This shows that the experts tended toward unanimous opinions and attitudes regarding the importance of these measurement items. In summary, this preliminary research verifies that the measurement items based on 7 dimensions established by TQNA can serve as TQM measurement dimensions in the high-tech industry. These dimensions used to be proposed by previous studies as shown on Table 3. These results further indicate that the 52 measuring items under all 7 dimensions can be used to implement TQM in the high-tech industry.

Table 2. **The results of the first and second surveys of modified Delphi**

Measure items	First survey			Second survey		
	Mode	Mean	SD	Mode	Mean	SD
A - Leadership and management concepts						
A1. Top management's quality management concept	5	4.55	0.51	5	4.85	0.37
A2. Establishing quality systems	5	4.20	0.83	5	4.50	0.61
A3. Shaping the quality culture	5	4.55	0.69	5	4.75	0.44
A4. Vision and mission building	5	4.65	0.59	5	4.85	0.37
A5. The promotion quality concept	4	4.25	0.55	4	4.35	0.49
A6. Identifying the measurement method for quality management	5	4.35	0.75	5	4.60	0.50
B - Strategy Management						
B1. The strategic objectives management	5	4.60	0.50	5	4.85	0.37
B2. The implementation of strategic planning	5	4.45	0.60	5	4.55	0.60
B3. The strategic development process	4	4.30	0.66	4	4.25	0.44
B4. The strategy implementation process	4	4.25	0.64	4	4.25	0.55
B5. Strategy review system	5	4.60	0.50	5	4.75	0.44
B6. Business strategy and resources integration	5	4.35	0.75	5	4.70	0.47
C - Research, Development and Innovation						
C1. Establishing units responsible for research and innovation	5	4.60	0.68	5	4.65	0.59
C2. Product development fulfill market-oriented	5	4.45	0.69	5	4.60	0.60
C3. Encouraging employees to the proposal	4	4.15	0.67	4	4.25	0.55
C4. Changing the business model in response to environmental changes.	4	4.40	0.60	4	4.44	0.50
C5. Customer focus' innovation				5	4.55	0.60
C6. Integrated Customer satisfaction and outcome of product research				4	4.25	0.55
D - Customer and Marketing						
D1. Customers integrated marketing strategies	5	4.50	0.61	5	4.70	0.47
D2. Market-oriented development strategy	4	4.25	0.64	4	4.35	0.49
D3. Rapid customer response	5	4.70	0.57	5	4.85	0.37
D4. Attention to staff education and training	4	4.25	0.44	4	4.25	0.44
D5. Implementing customer satisfaction surveys	4	4.05	0.76	4	4.20	0.52
D6. Customer Business management	4	4.10	0.79	4	4.15	0.37
D7. Customer relationship management	4	3.90	0.85	4	4.25	0.44
D8. Customer-oriented product design	4	3.90	0.64	4	4.00	0.46
D9. Employee participation in customer relationships	4	3.80	0.70	4	4.05	0.39
D10. Standardization of Customer Relationships	4	3.80	0.83	4	4.15	0.37
E - Human resource and knowledge management						
E1. Human resource planning	4	4.2	0.64	4	4.25	0.44
E2. Manpower inventory on a regular basis	4	4.20	0.62	4	4.20	0.41
E3. Staff training program	4	4.20	0.62	4	4.15	0.49
E4. Smooth promotion paths	5	4.55	0.51	5	4.75	0.44
E5. Employee career planning	4	3.75	0.85	4	3.95	0.60
E6. Employee welfare	5	4.55	0.60	5	4.70	0.47
E7. Employee relationship management	4	3.75	0.79	4	3.95	0.60
E8. Human resource development	4	4.15	0.49	4	4.20	0.41
E9. Human resources	4	4.10	0.64	4	4.15	0.49
E10. Staff knowledge management.	4	4.00	0.92	4	4.20	0.52
F - Information utilization and management						
F1. IT strategic planning	4	4.15	0.88	4	4.25	0.64
F2. Focusing on information quality	4	4.00	0.86	4	4.20	0.41
F3. Information system upgrades and improvements	4	4.05	0.76	4	4.15	0.49
F4. Information system fulfill operational managements	4	4.20	0.83	4	4.45	0.51
F5. The used extent for information system	4	4.10	0.64	4	4.25	0.55
F6. Competitive information management system	4	4.30	0.66	4	4.44	0.50

Continuation of Table 2

G - Process Management						
G1. The design of a clear operational procedures	5	4.40	0.68	5	4.55	0.60
G2. Appropriate quality control mechanisms	5	4.50	0.61	5	4.75	0.44
G3. Written specification of work	5	4.30	0.73	5	4.55	0.60
G4. Adopting the spirit of continuous improvement	4	4.30	0.66	4	4.44	0.60
G5. Valuing customer feedback	4	4.25	0.72	4	4.44	0.50
G6. Respecting data management	4	4.35	0.59	4	4.25	0.55
G7. Qualification for supplier management				4	4.35	0.59
G8. Conducting the total quality management system				5	4.60	0.50

Table 3. **Previous studies that conform to the dimensions of the TNQA excellence award**

Indicator main aspect	Studies
Leadership and management concepts	Chin et al. (2002), Coyle-Shapiro et al. (2003), Hung et al. (2011), J-K Chen and I-S Chen (2009), Ooi et al. (2007), Prybutok et al. (2008), Sila (2006), Wanger and Schaltegger (2004)
Strategy management	Chin et al. (2002), Hoang et al. (2006), Sila (2006)
Research, development and innovation	Han et al. (2007), Hung et al. (2011)
Customer and marketing	Bayazit and Karpak (2006), Hung et al. (2011), Ooi et al. (2007), Prybutok et al. (2008), Samat et al. (2006), Sila (2006)
Human resource and knowledge management	Bayazit and Karpak (2006), Chin et al. (2002), Coyle-Shapiro et al. (2003), Ooi et al. (2007), Sila (2006), Samat et al. (2006)
Information utilization and management	Chin et al. (2002), Samat et al. (2006), Sila (2006)
Process management	Sila (2006), Coyle-Shapiro et al. (2003), Chin, et. al. (2002)

(3). AHP

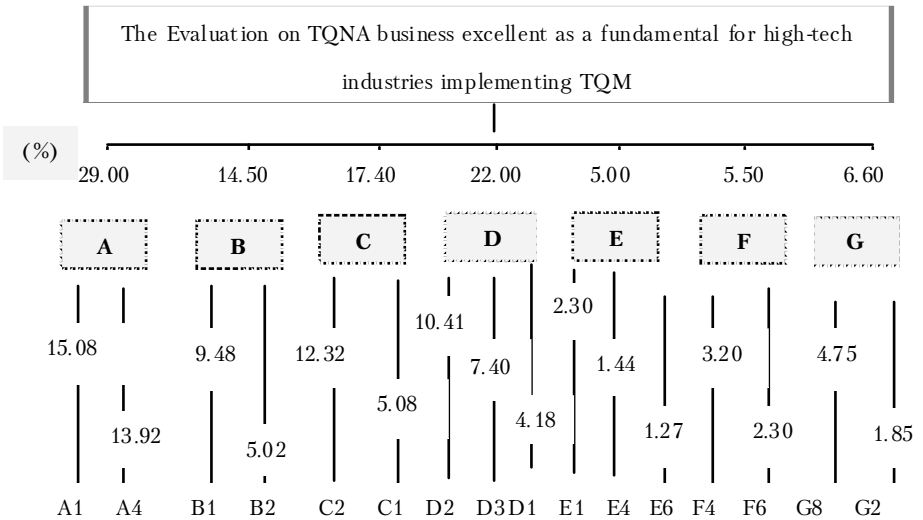
The third survey in this study was extracted from the higher means of previous result of the modified Delphi survey, according to expert's feedback in each dimension and the top 30% high measure of means. 16 important measurement items were compiled based on the 7 main dimensions. The AHP hierarchical structure was constructed using the framework of the TQM's major dimensions and the results of the most important measurement items. The next AHP procedure requires making a pairwise comparison, and the fundamental scale for pairwise comparisons is divided into 5 categories. Figure 2 shows the framework for weighting important measurement items. This study further organizes the relative weight of the whole measurement. Table 4 presents the weights of all the measurements in the sequence. The following section discusses the statistical results for both surveys of the modified Delphi and the AHP method.

Table 4. **Result for the weights of all measurements in the sequence**

Rank	Important measure indicators	Weight, %
1	A1	15.08
2	A4	13.92
3	C2	12.32
4	D2	10.41
5	B1	9.48
6	D3	7.40
7	C1	5.08
8	B2	5.02
9	G8	4.75
10	D1	4.18

Continuation of Table 4

11	F4	3.20
12	F6	2.30
12	E1	2.30
14	G2	1.85
15	E4	1.44
16	E6	1.27



A: Leadership and management concepts, B: Strategy Management
C: Research, Development and Innovation, D: Customer and Marketing
E: Human resource and knowledge management
F: Information utilization and management, G: Process management

Figure 2. **Framework for weighting important measurement items**

4. Empirical results of the survey.

The results of this study indicate that "A-Leadership and management concepts" (29%) had the highest weight, followed by "D-Customer and marketing" (22%). Thus, when pushing a TQM project for high-tech firms, enterprise leaders should install the concept of excellence at all levels of the enterprise and integrate every single resource to ensure the success. The influence of customers and marketing is second rate. The purpose of emphasizing quality management at an enterprise is to strengthen its competitiveness. One of the most important ways to promote enterprise development and operational performance is to attach importance to customer and market development and recognize the operational value represented in the real requirements of clients. The results of this study prove that when TQM action is guided, experts agree with the viewpoint that the customer and marketing is the most crucial success factors (J-K Chen and I-S Chen, 2009; Hung et al., 2011; Prybutok et al., 2008).

This study shows that "F-Information utilization and management" (5.5%) and "E-Human resource and knowledge management" (5%) have the lowest weights. Thus, when experts apply the TQM system to high-tech industries, these two perspectives have relatively little influence on enterprise business and quality management. That the weight of item "E" is low seems to contradict the viewpoint that the

sustained business of an enterprise is founded on people. The item "F" also has a low weight. This has great relevance to the high-tech information service development because it implies that information technology with service seems to have little influence on the high-tech industry. This also implies that investment/supporting of information technology resource and information utilization/management are low priorities for firms.

By adopting the AHP method, this study shows that the most influential measurement factors are "A1-Top management's quality management concept" (15.08%), "A4-Vision and mission building" (13.92%), "C2-Product development fulfill market-oriented" (12.32%), "D2-Market-oriented development strategy"(10.41%), and "B1-The strategic objectives management" (9.48%). These 5 measuring items account for relatively large weight (61.21%).This means that the experts have strong mutual recognition of the key factors. The measurement items with the lowest weights include "E6-Employee welfare", "E4-Smooth promotion paths", "G2-Appropriate quality control mechanisms", "E1-Human resource planning" and "F6-Competitive information management system". These measurement items belong to the administrative work related to various units. These measurement items are relatively unimportant to high-tech firms wanting to develop TQM. Previous empirical studies demonstrate that staff participation and teamwork are one of the key success factors in implementing TQM (Bayazit and Karpak, 2006; Chin et al., 2002; J-K Chen and I-S Chen, 2009; Samat et al., 2006; Ooi et al., 2007). The results of this study illustrate that high-tech firms often neglect their personnel. This in turn may negatively affect continuous growth. Therefore, high-tech firms should address the importance of providing employee benefits and fostering personnel, and increase their focus on integrating and balancing between each department in the firm.

5. Conclusion and Suggestions.

The aim of this study is to establish the dimensions and measuring items of TQM under the TNQA excellence model and discuss its importance in high-tech organizations. By synthesizing the empirical results of the literature review, this study proposes the country promoted quality award in Taiwan to evaluate the TQM project. We also summarizes our empirical findings and expert suggestions to setup TNQA criteria for the firms willing to implement TQM in the high-tech industry. This study extracts 16 important measurement items that have a high degree of consensus by experts, and uses the AHP method to determine their relative weights and analyze their weight order. The most influential factors are "Top management's quality management concept", "Vision and mission building", "Product development fulfill market-oriented", "Market-oriented development strategy", and "The strategic objectives management". These items are essential measurement criteria when implementing TQM in high-tech firms. We therefore recommend that high-tech industry focuses on the interaction and integration of different departments. Enterprises should focus particularly on personnel and knowledge management to reduce staff turnover rates and establish sustainable operations. Moreover, we suggest that enterprises integrate business developments with information technology to increase business synergy.

Due to its substantial industrial research and development capabilities (IMD 2011), Taiwan's high-tech industry has a good reputation and a substantial global market share. The results of this study can be used by managers to determine their

TQM status and develop action plans. Furthermore, high-tech firm can make appropriate decisions on specific areas for improvement to further enhance TQM.

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