QFD Model for Quality Performance Self-assessment*

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Abstract

How to measure Quality Performance (QP) or excellence performance in organizations is very important for improving the quality of an organization's products and services. This paper takes Quality Function Deployment (QFD) as a useful tool to identify the key characteristics of quality performance and measure the influence factors on quality performance. Most national quality awards provide a framework of the criteria to show the essential elements of an organization's quality performance and get the Quality Performance Score (QPS) by self-assessment using the criteria. By means of these criteria, especially, the criteria of China Quality Award (CQA), a measurable indicator system for quality performance is set up. A four-phase QFD model of assessment for quality performance is developed. This QFD model not only presents the most important efforts for the deployment of the measurable indicators of quality performance, but also takes great advantage of evaluating the quality performance and obtaining the quality performance score. The measurable indicator hierarchy of quality performance is formed and its implementation method for assessment quality performance is described in this paper.

Key Words: Quality Performance, Quality Performance Score, Self-assessment, QFD Model

1. Introduction

Improving the quality of an organization's products and services is fundamental to business success. Managers in world-class companies realize that customer wants and desires are changing, that customers' expectations must be clearly understood, and that their firm must conform to customer wishes. Many countries have established national quality awards to recognize deserving companies who had excelled in quality management practices. There are a number of internationally recognized models, such as the Deming Prize in Japan (Lascelles

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and Peacock, 1996), the Malcolm Baldrige National Quality Award (MBNQA) in the USA (MBNQA, 2003) and the European Quality Award (EQA) in European (EFQM, 2002). China Quality Award (CQA) was re-founded in 2001 (CQA, 2003). These national quality award programs promote quality awareness, recognize quality achievements of companies, and provide a platform for sharing successful quality management initiatives. Most national quality awards use a framework of criteria that seeks to assess an organization's quality related performance that is known as Quality Performance (QP) or Excellence Performance.

Since the mid-1990s the topic of quality awards and self-assessment has received considerable attention from researchers and is well defined in the literature (Conti, 1997; Hakes, 1998; Porter *et al.*, 1998). Western companies adopt the business excellence models in national quality awards to self-assess business performance (Wisner and Eakins, 1994; Brereton, 1996; Brown, 1997). A self-assessment process for new product introduction is adapted and applied by organizations to evaluate their performance against best practice, and improve conformance through rigorous application (Tennant and Roberts, 2003). By means of the criteria of national quality awards, some self-assessment practices are carried out to obtain comprehensive performance ratings to gauge the production and service quality performance (Ritchie and Dale, 2000; Parkan, 2002).

However, the majority of the academic literature has concentrated on the models and comparison of their criteria, and the relationship between award winners and business results (Bohoris, 1995; Ojanena, Piippob, and Tuominen, 2002). Although there are some successful self-assessment practices using the business excellence models as above, the criteria used in these national awards only provide a comprehensive performance assessment of various areas in an organization. Companies could regularly use the framework to benchmark their current quality performance and identify areas of improvement. The criteria do not look for specific measurements for quality performance but rely on a prescriptive perspective during assessment.

Quality Function Deployment (QFD) is a very useful tool for translating customer voice into product development in quality engineering (Akao, 1997). The primary functions of QFD have been expanded from product development (Crow, 2000), quality management (Hassan *et al.*, 2000; Ho *et al.*, 2001) to wider fields such as product design (Nibbelke *et al.*, 2001; Reich, 2000), and costing (Chan and Wu, 2002), especially, decision-making (Xie, Tan, and Goh, 2003). QFD has been widely applied to the major aspects of decision-making, included performance measurement (Jagdev *et al.*, 1997; Kochhar and Eguia, 1998; Kutucuoglu *et al.*, 2001), evaluating company's current status (Kumar and Midha, 2001). In fact, QFD is a methodology for measuring and analyzing evaluation indicators by their relationship matrix. We have introduced QFD into the customer satisfaction measurement problem, and developed a new QFD model for evaluation of customer satisfaction index (Liu and Xu, 2003).

How to measure quality performance is very important during assessment. This paper pres-

ents a development methodology that uses the assessment criteria of a national quality award as the basis for creating a self-assessment QFD model to measure quality performance. In this study, the CQA framework has been used. The criteria used by CQA are quite similar to those used by the Baldrige Award framework. Because all criteria language has been converted to question format, it is not easy to measure and evaluate the essential elements in each of the criteria. Quality Function Deployment is taken as a useful tool to identify the key characteristics of company performance and evaluate quality performance. A measurement indicator system for quality performance according to the criterion of CQA is set up. A multi-phase QFD model for evaluation of quality performance is developed. This model presents the evaluation indicator hierarchy and its measurement method for the quality performance. The emphasis will be on the method in which the indicators should be derived, an appropriate scoring mechanism to be used, and the validation process that may be used. QFD is taken as an evaluation tool for measurement quality performance based on different national quality award criteria could be developed based on the generalized development methodology described in this paper.

2. Criteria for Assessment QP

There are various dimensions of enterprise performance measurement (PM), such as financial versus non-financial and qualitative versus quantitative. Traditionally, many organizations rely largely on financial measures and process outcomes using self-referenced objective data from internal sources (Daily and Dalton, 1992). According to these financial measures, they encourage managers to minimize any variance from the standard rather than seeking continual improvement, and they fail to provide information on what customers want and how competitors are performing (Neely, 1999). Several ideas reflect what one might mean by Quality Performance, including perfection, consistency, elimination of waste, speed of delivery, compliance with policies and procedures, providing a good, reliable product, doing it right the first time, delighting or pleasing customers, total customer service and satisfation (Evans and Lindsay, 1999; Tamimi and Sebastianelli, 1996).

There are several financial and non-financial factors related to Quality Performance (Kee-Hung Lai, 2003). Individually, the factors might be categorized as latent variables or constructs for which, several observable variables may be measured, i.e., variables that serve as indicators of the constructs. Accordingly, it may be possible to test the structure of each of the latent constructs of the latent constructs of quality performance. Kevin points out that there are six specific constructs that indicate the quality performance of an organization, including product quality effectiveness, operational process efficiency, customer focus, emphasis on employee, supplier role, and financial performance (Kevin Laframboise, 2002). In other

words, these are latent constructs, which measure or define Quality Performance. The selection of these constructs is based on the criteria and measures of "business results" found generally in the different national quality awards programs and specifically in the Malcolm Baldrige National Quality Award of the United States. It is also hypothesized the correlations among these six factors can be further examined by a common construct that may be called Bossiness Performance Excellence. That is, analysis of the data may reveal that performance excellence is a latent variable that is listed by several factors.

In this context, it is essential for organizations to monitor their performance on a regular basis that relied on the major national quality awards, especially, on the China Quality Award. For better understanding of the assessment criteria of quality performance, it seems reasonable to have a brief description of the selected frameworks of the major national quality awards. The salient features of the three national quality awards, i.e. Malcolm Baldrige National Quality Award, the European Quality Award and the China Quality Award will be presented here. Similarities and differences of these three models will also be discussed. It is to be noted that the China Quality Award has been used as the basis for the development of the self-assessment tool reported here.

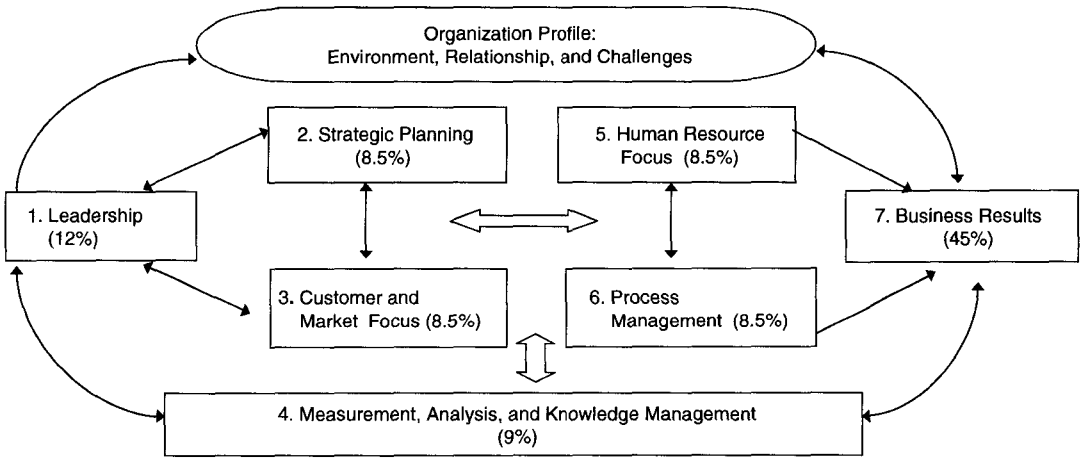


Figure 1. Baldrige Criteria for Performance Excellence Framework

The Baldrige Criteria for quality performance or performance excellence provide organizations with an integrated, systems perspective, results-oriented framework for implementing and assessing processes for managing all operations. The core values and concepts of the criteria are embodied in the performance excellence framework, which consists of seven categories: leadership, strategic planning, customer and market focus, measurement, analysis, and knowledge management, human resource focus, process management, and business results. Figure 1 shows the framework connecting and integrating the categories with their relative

weights (MBNQA, 2003).

The European Quality Award criteria are based on the European Foundation for Quality Management's (EFQM) model for business excellence, that is, the Business Excellence Model (BEM), as shown as Figure 2. Since its launch in 1991, the Business Excellence Model has become increasingly well established amongst European organizations as a diagnostic tool, and many countries in Europe have based their national quality awards on the BEM framework and criteria (Porter *et al.*, 1998). BEM is based on the concept that customer satisfaction, people (employee) satisfaction and impact on society are achieved through leadership driving policy and strategy, people management, resources and processes, leading ultimately to excellence in business results.

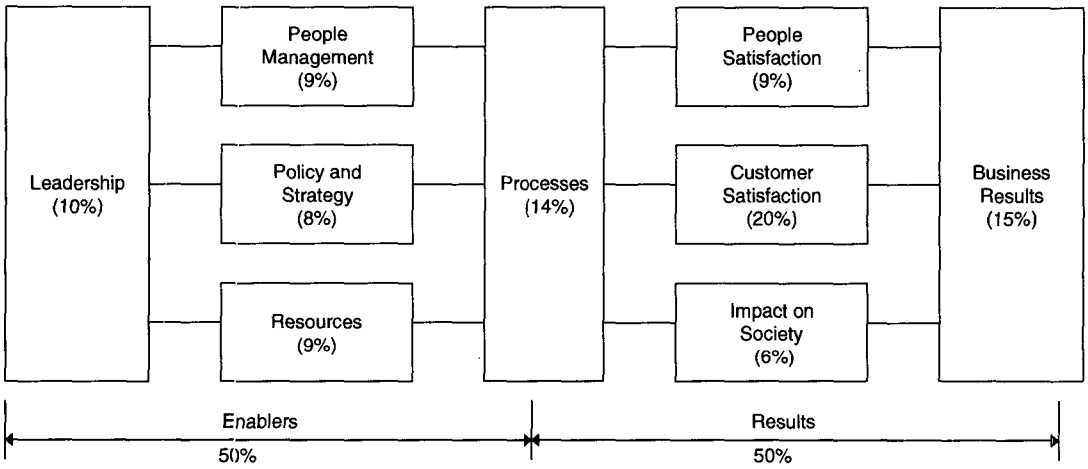


Figure 2. Business Excellence Model in EQA

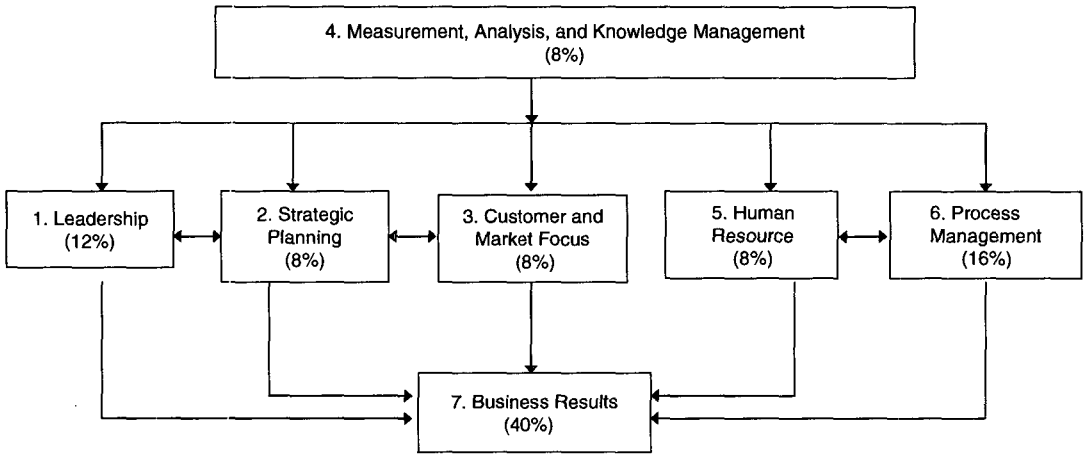


Figure 3. Performance Excellence Framework in CQA

China Quality Award was re-founded in 2001. The original criteria of CQA consist of five categories: leadership and strategic, resource management, process management, information management and business results. The criteria of CQA were revised in 2003 according to the criteria for performance excellence of the Malcolm Baldrige National Quality Award. As a symbol of world-class business excellence, the CQA encourages organizations to strengthen their management system to improve their competitiveness. There are seven categories in the CQA criteria. Figure 3 shows relationships among the seven categories in the criteria. It is to be noted that the CQA criteria are very similar to 2003 criteria for performance excellence of the Malcolm Baldrige National Quality Award.

Examining of the above three frameworks, it reveals strong similarities between the MBNQA and CQA frameworks. In both of the criteria, there are similar six assessment areas in the business results: customer-focused results, product and service results, financial and market results, human resource results, organizational effectiveness results, including key internal operational performance measures and governance and social responsibility results. They focus on the key areas of organizational performance given above. There are, however, differences in weighs, "assessment items" and the "areas to address" in these two frameworks. The EQM appears to be somewhat different both in the structure and the criteria for assessment. However, a close examination reveals that there are more similarities than differences between these models. These awards have similar criteria measuring leadership, information analysis, process management, strategic planning, human resource management, partnerships, public responsibility, quality results, operations results, and customer satisfaction. In most of these awards, companies are assessed on their approaches, the depth of deployment in their approaches, and performance results associated with operations, quality, and customer satisfaction (EFQM, 1999; NIST, 1999). Assessors make a conscious effort to link approaches to results, and examples are in the areas of human resource and customer satisfaction.

3. QFD Model for Measurement QP

A reliable and valid self-assessment tool for quality performance should satisfy two cardinal conditions. First, it should measure what it is supposed to measure, in this case measuring all dimensions of business that are deemed to have impact on overall organization's quality performance and construct a measurement attribute system or indicator system. Second, it must be able to measure them correctly, in this case providing an effective measurement method and its implementation process. In this paper, a self-assessment indicator system is developed using the China Quality Criteria as the framework, and a multi-phase QFD model for measuring QP is created, which present the evaluation indicator hierarchy

and its measurement method for the quality performance. The QFD model measured quality performance can ensure that its scoring mechanism follows closely the actual national quality award requirements that would satisfy the above two conditions.

As the above mentioned, a multi-phase QFD model is used successfully for measuring the customer satisfaction index (Liu and Xu, 2003). In fact, this QFD model can be taken as a self-assessment tool for quality performance based on the criteria of CQA. A house of quality in the multi-phase QFD measurement model plays a very important role in two aspects. First, it can analyze a wide variety of factors impacting on quality performance and translate them into measurable indicators in different levels, in this case quantifying the relationship between the upper level indicators (ULT) and its lower level indicators (LLI) by their relationship matrix and the correlativity among the factors by their correlation matrix. Second, it can set up a self-assessment matrix by the questionnaires for the lower level indicators and obtain the weights of the lower level, in this case calculating the quality performance scores of the upper level indicators. Figure 4 shows both of the functions in a QFD model for self-assessment.

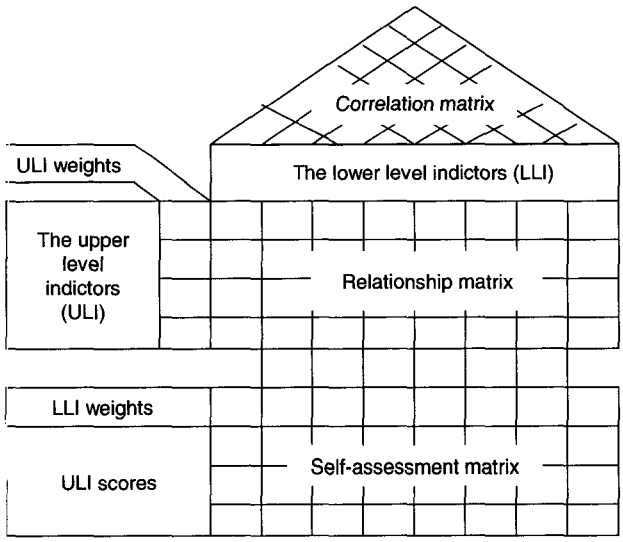


Figure 4. A QFD Model for Self-assessment

4. Self-assessment Indicator System for QP

Most national quality awards use a framework of criteria that assesses an organization's quality performance. Although these frameworks have similar categories, such as, leadership, process management, strategic planning, human resource, and business results, in actual appli-

cations, companies are assessed on their approaches to show their performance results associated with operations, quality, and customer satisfaction. Thus, different companies in different countries may use different approaches and the performance results that are assessed would mostly be linked to the stated approaches. In order to facilitate wider use of the award criteria, a self-assessment QFD model based on the criteria of China Quality Award could be developed for measuring the essential elements in each of the criteria.

As discussed earlier, CQA criteria has seven categories: leadership, strategic planning, customer and market focus, measurement, analysis, and knowledge management, human resource focus, process management, and business results. Each of these categories contains several items that have to be assessed. There are 19 items according to the categories, for example, there are customer-focused results, product and service results, financial and market results, human resource results, organizational effectiveness results, governance and social responsibility results seven items in business results categories. The items under each criterion are meant to address various aspects of the organization. There are 32 areas under each the items. The method of assessment used in CQA is to score how well an organization is performing in these areas.

The first step of the assessment method for quality performance based on the CQA criteria is to analyze the essential elements in each of the criteria and then to translate them into measurable indicators in different levels, further, to form a measurable indicator hierarchy of the overall quality performance (OQP) and assess how quality performance an organization is. By means of the above QFD model, a measurement indicator system for China Quality Award will be set up. In order to obtain the final score of overall quality performance, that is, Quality Performance Score (QPS), a four-phase QFD assessment model should be introduced, as shown as Figure 5.

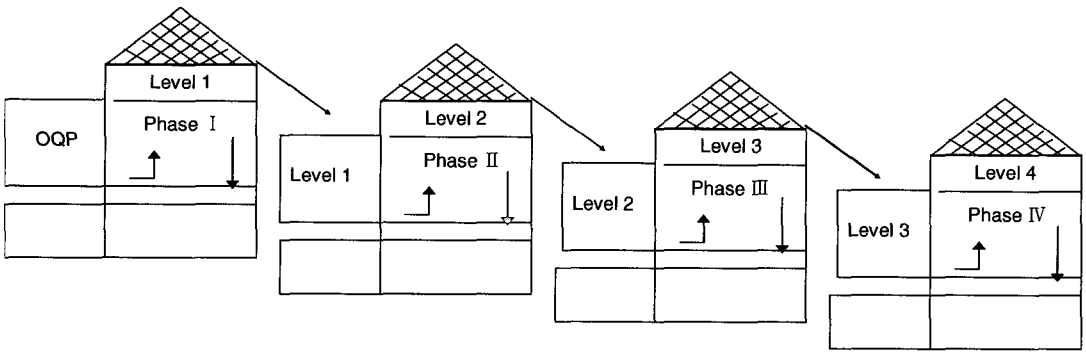


Figure 5. A Four-phase QFD Assessment Model for QP

In the first phase, there is only one indicator that is overall quality performance on the left wall in the first house of quality, and the critical factors impacting on OQP can be

known as the first level measurement indicators, that is, there are seven indicators: leadership, strategic planning, customer and market, information analysis, human resource, process management, and business results corresponding to the seven categories of China Quality Award Criteria, which are hung on the ceiling of the house. OQP is regarded as the upper level indicator of the first level indicators, and their relationship matrix is in the cells of the house.

In the second phase, seven measurement indicators in the first level place on the left wall in the second house of quality, as shown as Figure 5. According to the CQA, the criteria items under the categories should be taken as the second level indicators. There are 19 indicators on the ceiling of the second house of quality, such as, customer and market knowledge, customer relationships and satisfaction as two of the second level indicators corresponding to customer and market focus that is one of the first level indicators.

The third level measurement indicators are taken as the 32 criteria areas to address under each of the items in CQA, for example, corresponding to the second level indicators customer relationships and satisfaction, there are two indicators: customer relationship building and customer satisfaction determination. The third level indicators are put on the ceiling of the third house of quality. Because the 32 areas to address in CQA are design in quest format, it is difficult to measure them and obtain their scores.

In the fourth phase, we develop an approach based on the questionnaire to measure the requirements and results needed in each area to address through a set of subsections. These subsections can be taken as the fourth level indicators. For instance, according to the requirements of customer satisfaction determination in the criteria of CQA, we design a questionnaire to measure these requirements, seen as Figure 6. The four factors: overall customer satisfaction index, meeting customer need number, industry customer satisfaction index and the relationship CS between new product development are selected as the fourth level indicators under the customer satisfaction determination. The relationship between the third level indicators and the fourth level indicators are put into the rooms or relationship matrix in the fourth house of quality, as shown as Figure 5.

As the above discussion, by means of a four-phase QFD assessment model and the criteria of China Quality Award, the overall quality performance can be deployed into the first level indicators, and then the first level indicators can be deployed to the second level indicators, until to the fourth level indicators, in which each deployment uses a relationship matrix represented the relationship ratings between the upper level and the lower level indicators. A measurable indicator hierarchy or assessment system is made up of the indicators from all levels, which can be shown clearly in Figure 5. One of significant characteristics of the multi-phase QFD model is that it can display intuitively the procedure of identifying, analyzing and deploying the upper level indicators to the lower indicators from the first phase to last phase, while the lower indicators in this phase will become the upper

level indicators in the next phase, and then forming an indicator hierarchy for assessing QP. Another advantage of this model is that we can utilize it to assess the QP, which will be discussed in details in the next section.

Table 1. The requirement of customer satisfaction determination and its questionnaire

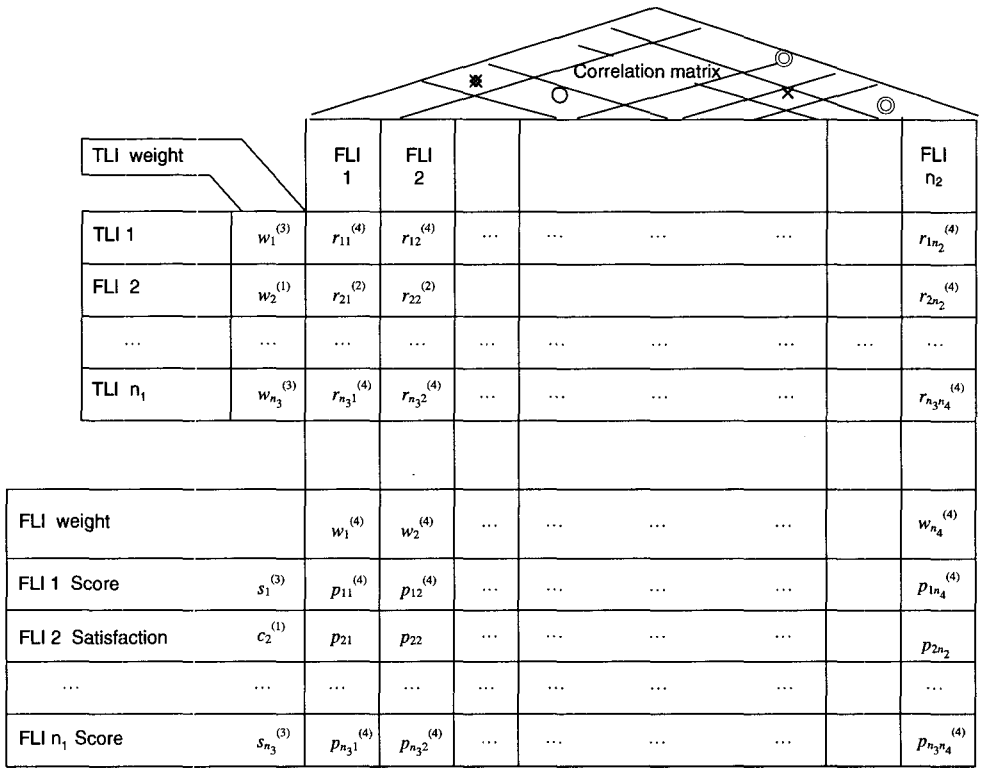
Customer Satisfaction Determination	Questionnaire
(1) How do you determine customer satisfaction and dissatisfaction?	The degree of overall customer satisfaction? ☐ ☐ ☐ ☐ ☐
(2) How do you follow up with customer regarding on products, services, and transaction quality to receive prompt and actionable feedback?	The number of the meeting the customers? ☐ ☐ ☐ ☐ ☐
(3) How do you obtain and use information on your customers' satisfaction relative to customers' satisfaction with your competitors and/or industry benchmarks?	The degree of customer satisfaction in the industry? ☐ ☐ ☐ ☐ ☐
(4) How do you keep your approaches for determining satisfaction current with business needs and directions?	The relationship between CS and new product development? ☐ ☐ ☐ ☐ ☐

5. Self-assessment Implementation for QP

By means of the upper part of the houses of quality, a measurable indicator hierarchy of QP is set up in the order from the first phase to the fourth phase in Figure 5. After forming a measurable indicator system, the key problem of assessing the quality performance is to explore the implementing assessment method based on the four-phase QFD model. A multi-phase QFD model not only presents the most important efforts for the deployment of the measurable indicators of QP, but also takes great advantage of evaluating of the quality performance and obtaining the quality performance score. From the above discussion, the forming of the quality performance indicators is in the order from the first phase to last phase. On the contrary, when the measurable values of quality performance are traced back from the last level indicators to the overall quality performance, the quality performance score will be obtained.

Based on the four-phase QFD model, overall quality performance is deployed to the first level indicators, and subsequently to the fourth level indicators that are selected by the questionnaires, as shown as Table 1. In these questionnaires, assessors can judge easily and give their scores for each subsection, represented as $s_i^{(4)}$ (i=1,2,...,n_4). These scores of the fourth level indicators consist of the self-assessment matrix, denoted by ($p_{ij}^{(4)}$), which is put into the lower part of the four-phase house in Figure 6. The cells in the middle of the house describe the relationship matrix ($r_{ij}^{(4)}$), where $r_{ij}^{(4)}$ (i=1,2,...,n_3; j=1,2,...,n_4) is denoted the

relationship rating, or the degree of correlation, between the i^{th} indicator in the third level and the j^{th} indicator in the fourth level. The partition wall between the left wall and cells displays the weights or the degrees of importance, $w_i^{(3)}$ (i=1,2,...,n_3), of the third level indicators, where n_3=32. The weights of the fourth level indicators, $w_i^{(4)}$ (j=1,2,...,n_2) are placed on the floor. The cells of basement are full of the components of self-assessment matrix ($p_{ij}^{(4)}$), and the scores, $s_i^{(3)}$ (i=1,2,...,n_4), of the third level indicators are put on the left wall of the basement.



Note: TLI: The third level indicator, FLI: The fourth level indicator
◎: Significant positive correlation, ○: Positive correlation,
×: Negative correlation, ※: Significant negative correlation

Figure 6. The House of Quality in the Four-phase

5.1 Assigning the Relationship Ratings

The choice of a relationship rating scheme is critical in implementing a suitable method of QFD model. The relationship matrix used in the house of quality has a strong and direct

impact on the quality performance measurement. In this paper, the relationship ratings between the upper level and the lower level indicators for quality performance are measured on a 5-point scale (1-5 scale). It is however necessary to select a team of 5-7 assessors organized an evaluation group. Depending the impact of the upper level indicators on the lower level indicators, assessors assign the 5-point scale. The relationship ratings of the k level to the k-1 level indicators, shown in Table 2, which form the corresponding relationship matrix $(r_{ij}^{(k)})$ (k=1, 2, 3, 4).

Table 2. The relationship ratings

1	2	3	4	5
No relation between the k level and k-1 level indicators	Possible relation between the k level and k-1 level indicators	Weak relation between the k level and k-1 level indicators	Moderate relation between the k level and k-1 level indicators	Strongish relation between the k level and k-1 level indicators

5.2 Determining the Judgment Matrix

For the last level indicators in Figure 6, assessors can easily give their scores, $s_j^{(4)}$(j=1, 2,...,n_4). The k level indicators corresponding to the k-1 level indicators can be prioritized according to the relationship ratings, $r_{ij}^{(k)}$ (k=1,2,3,4), and then the self-assessment matrix of quality performance in k level, $(p_{ij}{}^{(k)})$, is obtained by $s_j^{(k)}$ (j=1,2,...,n_4), that is:

$$p_{ij}^{(k)} = \begin{cases} p_{i_o j}^{(k)} = s_j^{(k)} & when \ r^{(k)}{}_{i_o j} = \max\{r_{ij}^{k-1}\} \\ 0 & Otherwise \end{cases} \quad j = 1, ..., n_2 \tag{1}$$

5.3 Computing the Weights of Indicators

The importance weights of indicators play a significant role in measuring the quality performance. According to the scoring mechanism of CQA, each category and item has its different score. Thus, the weights of the indicators in the first level and the second level can be easily obtained by use of these scores. The weights of seven indicators in the first level can be taken as the weight of the seven categories in the framework of CQA, shown as in Figure 3. The weights of the second level indicators can be represented as the ratio of the second level indictor scores to the first level indicator scores, such as, the score of the customer and market focus in the first level is 80, 40 is both of the scores of the customer relationship building and customer satisfaction determination in the second level, and then the weights of the two second level indicators are 0.5. Similarly, the other second level indicator scores can be easily got.

The weights of the third level and the fourth level indicators can be calculated by the weights of their upper level indicators and their relationship matrix. $w_i^{(k-1)}$ (i=1,2,...,n_{k-1}; k=3,4) denotes the weights of the (k-1)th level indicators, and $r_{ij}^{(k)}$ (i=1,2,...,n_{k-1}; j=1,2,...,n_k; k=3,4) describes the relationship ratings of the kth level indicators to the (k-1)th level indicators. In order to obtain the weights, $w_j^{(k)}$ (j=1,2,...,n_k), of the kth level indicators, we should use the weights $w_i^{(k-1)}$ with the relation ratings $r_{ij}^{(k)}$ (k=3,4). For each indicator in the kth level, the weight $w_j^{(k)}$ is obtained through the normalization of $w_j^{(k)'}$, which are computed as follows:

$$w_j^{(k)'} = \sum_{i=1}^{n_{k-1}} r_{ij}^{(k)} w_i^{(k-1)} \qquad j = 1,2,...,n_k \tag{2}$$

$$w_j^{(k)} = \frac{1}{\sum_{j=1}^{n_k} w_j^{(k)'}} w_j^{(k)'} \qquad j = 1,2,...,n_k; k = 3,4 \tag{3}$$

Figure 6 shows the calculated results of $w_j^{(4)}$ $j = 1,2,...,n_4$ in the fourth house of quality.

5.4 Scoring the Quality Performance

The procedure of getting the quality performance score keeps in order from the last level to the overall quality performance in the four-phase QFD model. First, the quality performance scores of the last level indicators are obtained by a set of questionnaires from the assessors' judgment values, and then quality performance scores for next level indicator are established. Finally, the overall quality performance score or QPS is calculated.

In the four-phase QFD model, for each indicator in the fourth level, its satisfaction can be obtained directly from assessors' judgments by questionnaires, which constitute the judgment matrix of customer satisfaction, ($p_{ij}^{(4)}$). According to the above discussion, the weights $w_j^{(k)}$(k=1,2,3,4), of the k level indicators can be calculated. The quality performance scores, $s_i^{(k-1)}$ (i=1,2,...,n_{k-1}), of the k-1 level indicators are computed using the product of each row of the self-assessment matrix in the k level and their corresponding weights, that is,

$$s_j^{(k-1)} = \sum_{j=1}^{n_k} p_{ij}^{(k)} w_j^{(k)} \quad (i = 1,2,...,n_{k-1}; k = 1,2,3) \tag{3}$$

When k=0, the quality performance score, QPS, is obtained by $s_i^{(0)}$.

6. Conclusions

A fourth-phase QFD model as a useful self-assessment tool for measuring quality performance in organizations has been presented in this paper. This methodology advocates the use of China Quality Award Criteria requirements as the basis for developing a questionnaires-based self-assessment tool. The proposed QFD model and its methodology will hopefully provide guidance for anyone who wanted to develop self-assessment tools for measuring quality performance in organizations.

This study made an importance effort in three areas namely (1) to integrate the framework of QFD into the measurement of quality performance based on the national quality award criteria, and (2) to develop a new multi-phase assessment QFD model and (3) to provide the implementing method for measuring quality performance. The benefit of the proposed QFD model and methodology is that it is not only a portable tool used in organizations' internal assessment for quality performance, but also it can be extended to external evaluation for quality performance as long as the weights of the first level and the second level aren't taken as their scores of CQA. A multi-phase measurement QFD model is a very useful tool for identifying and forming the measurable indicator hierarchy by a set of relationship matrices that overall quality performance is deployed to the first level indicators, and sequentially to the last level indicators. This is found to be one of the critical aspects of the evaluation problem in any quality performance process.

References

1. Akao, Y.(1997), "QFD: Past, Present, and Future," Proceedings of the International Symposium on QFD'97, Linkoping.
2. Bohoris, G. A.(1995), "A Comparative Assessment of Some Major Quality Awards," *International Journal of Quality & Reliability Management*, Vol. 12, No. 9. pp. 30-43.
3. Brereton, M.(1996), "Introducing Self-assessment - One of the Keys to Business Excellence," *Management Services*, Vol. 40, No. 2, pp. 22-26.
4. Brown, M. G.(1997), "Measuring up against the 1997. Baldrige Criteria," *The Journal for Quality and Participation*, Vol. 20, No. 4, pp. 22-28.
5. Chan, L. K. and Wu, M. L.(2002), "Quality Function Deployment: A Literature Review," *European Journal of Operational Research*, Vol. 143, pp. 463-497.
6. CQA.(2003), "The China Quality Award," http://www.caq.org.cn.
7. Crow, K.(2000), "Performing QFD Step by Step," DRM Associates, Palos Verdes, CA.
8. Conti, T.(1997), "Organizational Self-Assessment," Chapman and Hall, London.
9. Daily, C. M. and Dalton, D. R.(1992), "The Relationship between Governance Structure

and Corporate Performance in Entrepreneurial Firms," *Journal of Business Venturing*, Vol. 7, No. 5, pp. 375-386.

10. EFQM.(2002), The European Quality Award.
11. EFQM.(1999), "The European Quality Award Application Handbook," Foundation for Quality Management.
12. European Foundation for Quality Management.(1998), "Self-Assessment Guidelines for Companies," EFQM, Brussels.
13. Evans, J. R. and Lindsay, W. M.(1999), "The Management and Control of Quality," Cincinnati, South-Western (Thomson Learning).
14. Ho, D. C. K., Duffy, V. G., and Shih, H. M.(2001), "Total Quality Management: an Empirical Test for Mediation Effect," *International Journal of Production Research*, Vol. 39, No. 3, pp. 529-548.
15. Hassan, A., Baksh, M. S. N., and Shaharoun, A. M.(2000), "Issues in Quality Engineering Research," *International Journal of Quality and Reliability Management*, Vol. 17, No. 8, pp. 858-875.
16. Hakes, C.(1998), "The Self-Assessment Handbook for Measuring a Corporate Excellence," Chapman and Hall, London.
17. Jagdev, O., Bradley, P., and Molloy, O.(1997), "A QFD Based Performance Measurement," *Computers in Industry*, Vol. 33, pp. 357-366.
18. Kee-Hung Lai.(2003), "Market Orientation in Quality-oriented Organizations and Its Impact on Their Performance," *International Journal of Production Economics*, Vol. 84, pp. 17-34.
19. Kevin Laframboise.(2002), "An Empirical Study of the Relationship between Quality Practice and Business Performance Excellence in Central Canada," Quebec, Canada.
20. Kutucuoglu, K. Y., Hamali, J., Irani, Z., and Sharp, J. M.(2001), "A Framework for Managing Maintenance Using Performance Measurement Systems," *International Journal of Operations and Production Management*, Vol. 21, No. 1-2, pp. 173-195.
21. Kumar, R. and Midha, P. S.(2001), "A QFD Based Methodology for Evaluating a Company's PDM Requirements for Collaborative Product Development," *Industrial Management and Data Systems*, Vol. 101, No. 3, pp. 126-131.
22. Kochhar, A. K. and Eguia, F. J.(1998), "A Quality Function Deployment Approach to Performance Measurement and Benchmarking in Manufacturing Control Systems," *Proceedings of the 9th IFAC Symposium*, Vol. 2, pp. 815-820.
23. Liu, Y. and Xu, J.(2003), "Customer Satisfaction Measurement Model Based on QFD," *The Asian Journal on Quality*, Vol. 4, No. 2, pp. 101-122.
24. Lee, P. M. and Quazi, H. A.(2001), "A Methodology for Developing a Self-assessment Tool to Measure Quality Performance in Organizations," *International Journal of Quality & Reliability Management*, Vol. 18, No. 2, pp. 118-141.

25. Lascelles, D. M. and Peacock, R.(1996), "Self-assessment for Business Excellence," McGraw Hill, Berkshire.
26. MBNQA.(2003), "Criteria for Excellence Performance," The Malcolm Baldrige National Quality Award Program, Available: http://www.quality.nist.gov.
27. Nibbelke, R., Ferro, D., and Hoogeboom, P.(2001), "Design and Evaluation with the Human in Mind," *Air and Space Europe*, Vol. 3 No. 3-4, pp. 218-220.
28. NIST.(1999), "Overview of the Criteria for Performance Excellence," National Institute for Science and Technology, Washington, DC, Available: http://www.quality.nist.gov.
29. Neely, A. D.(1999), "The Performance Measurement Revolution: Why Now and What Next," *International Journal of Operations & Production Management*, Vol. 19 No. 2, pp. 205-228.
30. Ojanena, V., Piippob, P., and Tuominen, M.(2002), "Applying Quality Award Criteria in R&D Project Assessment," *Int. J. Production Economics*, Vol. 80, pp. 119-128.
31. Parkan, C.(2002), "Measuring the Operational Performance of a Public Transit Company," *International Journal of Operational & Production Management*, Vol. 22, No. 6, pp. 693-720.
32. Porter, L., Oakland, J., and Gadd, K.(1998), "Unlocking Business Performance with Self- assessment," *Management Accounting*, Vol. 76, No. 8, pp. 35-7.
33. Ritchie, L. and Dale, B. G.(2000), "Self-assessment Using the Business Excellence Model: A Study of Practice and Process," *Int. J. Production Economics*, Vol. 66, pp. 241-254.
34. Reich, Y.(2000), "Improving the Rationale Capture Capability of QFD," *Engineering with Computers*, Vol. 16, No. 3-4, pp. 236-252.
35. Tennant, C. and Roberts, P.(2003), "The Creation and Application of a Self-assessment Process for New Product Introduction," *International Journal of Project Management*, Vol. 21, pp. 77-87.
36. Tamimi, N. and Sebastianelli, R.(1996), "How Firms Define and Measure Quality," *Production and Inventory Management Journal*, Vol. 37, No. 3, pp. 34-39.
37. Wisner, J. D. and Eakins, S. G.(1994), "A Performance Assessment of the US Baldrige Quality Award Winners," *International Journal of Quality & Reliability Management*, Vol. 11, No. 2, pp. 8-25.
38. Xie, M. Tan, K. C., and Goh, T. N.(2003), "Advanced QFD Applications," ASQ Quality Press, Milwaukee, WI, USA.