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Quality dimensions, capabilities and business strategy: an empirical study in high-tech industry

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ABSTRACT *Excellence in quality helps firms gain customer loyalty and achieve competitive edge. Previous studies have suggested the need to develop quality capabilities to improve business performance. However, quality is multi-dimensional, and the development of each dimension requires different sets of resources. It is important for a firm to develop quality capabilities with a focus on a particular set of quality dimensions to support its strategic needs. This study hypothesizes that the relative contribution of the different quality dimensions to business performance is contingent on a given business strategy. We have identified the theoretical relationship between quality capabilities (expressed as a set of dimensions) and business strategy. Using the data collected from 113 high-tech manufacturing firms in Taiwan, we have analyzed and prescribed the matching of seven quality dimensions with three business strategies. Statistical results indicate that the business performance of quality management is strategy dependent. The congruencies between business strategy, quality dimensions and capabilities are important to a firm's performance in new product introduction, net profit and sales.*

Introduction

The success of Japanese manufacturing in the 1980s changed the focus of manufacturing from a traditional low cost mindset to one of quality. While customers were demanding better quality with lower prices, Japanese manufacturing demonstrated to US industry how these two competitive dimensions could be accomplished simultaneously. Meanwhile, quality gurus, such as Crosby, Feigenbaum, Deming, Juran and many others, introduced the concept of total quality management and continuous improvement, which helped firms to re-establish their quality systems. Several other academic studies have also indicated the effect of quality on business performance. Sousa & Voss (2002) and Yusof & Aspinwall (2000) provide a comprehensive literature review of the effects of quality management on business performance.

It is important that firms develop high quality products and service to gain a competitive edge in marketplace. Nevertheless, any quality programme implemented to achieve a competitive edge requires careful planning. That is, quality management has to be an integral part

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of the business strategy in order to improve business performance (Flynn *et al.*, 1995; Samson & Sohal, 1990). Garvin (1984, 1987) suggests that quality is multi-dimensional and appears in eight different forms, including performance, features, reliability, conformance, serviceability, aesthetics, durability and perceived quality. Forker *et al.* (1996) studied the contribution of various quality dimensions to sales and profit without connecting them with business strategy. Some of these quality dimensions are trade-offs with each other, and each dimension may require different resources to develop. For example, high quality performance requires superior product design and a strong engineering function; outstanding reliability requires good product and process design to ensure superior fits and minimal piece-to-piece variations; and excellent serviceability requires responsive and capable field support personnel. Firms must not attempt to excel in all dimensions but to assess what customers want and then to select specific dimensions to develop necessary quality capabilities to enhance their competitive edge. Since not all quality dimensions are required, nor can they be accomplished simultaneously, due to resource or technical limitations, those selected dimensions must be able to establish quality capabilities compatible with business strategy and market niche. Specifically, any efforts firms make to develop the chosen quality dimensions, and thus quality capabilities, must be consistent with their business strategies.

This research investigates the current practice of developing quality capabilities aligned with business strategy and verifies empirically the positive impact of this matching on business performance. The research premise is that quality capability is developed along various dimensions, and its contribution to business performance is contingent upon its alignment with business strategy. Making any quality efforts without considering business strategy would lead to a waste of valuable resources without improving business performance.

Here, we first review and summarize the theoretical relationship between various quality dimensions and business strategy, then we investigate the research design, including hypothesis and statistical methods. Finally, statistical results and managerial implications are presented.

Business strategies and quality capabilities

An integrated business strategy framework

While there have been many business strategy frameworks suggested by previous studies, this study applies a typological framework developed by Chang *et al.* (2002). This framework considers both the dimensions of competitive advantages and timing of entry into the marketplace. Based on this framework, all firms could be classified into one of three business strategy categories: *Pre-emptive/First Mover*, *Low Cost/Follower* and *Differentiation/Follower*.

The Pre-emptive/First Mover tends to enter the new market or adopt the new technology the earliest of these categories in order to achieve its competitive advantage. One semiconductor manufacturer we visited took on the average of three or four months less lead time when introducing new products, while its adoption of advanced manufacturing technology (e.g. surface mount technology (SMT)) was normally ahead of its competitors by one to two years. As a first mover, this firm has the advantage of proto-typicality, reputation, high consumer brand switching cost, high market share and high profit margin. Meanwhile, the pre-emptive or first mover also has to endure the higher risk and innovation costs—costs that are not required by the other two strategies.

The Low Cost/Follower is a firm that has late entry into the market or has late adoption of new technology. It usually focuses on tight cost control in order to achieve low cost production. Finally, the Differentiated/Follower is a firm that closely watches and implements

the development of new products and technologies. Firms using this strategy usually achieve competitive advantage through redesigning existing products or implementing different sales and distribution activities. The next section offers a more detailed discussion of these three business strategies in relation to various dimensions of manufacturing flexibility.

Relationship between quality capabilities and business strategies

We define quality capabilities as a firm's relative performance on various quality dimensions, as suggested by Garvin (1984, 1987). Sousa & Voss (2002) also suggested the use of those dimensions as the framework to study quality management. Among the eight dimensions, 'durability' is excluded in this study since this particular dimension is not considered to be critical by the high-tech industry in Taiwan. Figure 1 defines the remaining seven quality dimensions and summarizes their theoretical relationship with business strategies.

Previous research has barely discussed relationships between various quality dimensions/capabilities and business strategies. Utterback & Abernathy (1975) developed a process and product innovation model that defines the fundamental relationship between the Pre-emptive/First Mover and quality capabilities. The model suggests that, in light of product life cycles, firms that emphasize new product introduction must gain their competitive advantages through the achievement of excellence in product performance. Sweeney (1991) also advocated the need for Pre-emptive/First Mover firms to develop the quality capability of high performance. In addition to high performance capability, some researchers also believe the 'pioneer' strategy works best when customers make purchasing decisions based on corporate image and brand names (Fitzsimmons *et al.*, 1991; Schnaars, 1986). Overall, the Pre-emptive/First Mover strategy is compatible with the dimensions of 'high performance' and 'perceived quality'.

If firms follow the business strategy of Low Cost/Follower, they should make efforts to reduce product defects and increase reliability, thereby reducing production cost (Garvin, 1984; Gitlow & Hertz, 1983). Low Cost/Follower firms enter the market at the product maturity stage and usually face strong competition with the pressure for large volume and lost-cost production. Improved quality conformance and reliability could lead to reduced cost (Sousa & Voss, 2002). It is therefore important for firms with this business strategy to possess the quality capabilities of 'reliability' and 'conformance'.

Finally, firms with the business strategy of Differentiated/Follower usually introduce products with unique features in order to differentiate themselves from others (Varadaraj an, 1986). They also achieve a differential advantage through prompt after-sales service (Buaron, 1981) or by changing the looks, feel and taste of products (Garvin, 1984; Krajewski & Ritzman, 2001). Since product appearance is a subjective preference, firms could target particular groups of customers with similar tastes (Garvin, 1984; Fitzsimmons *et al.*, 1991). One notebook computers manufacturer that we visited has the Differentiated/Follower strategy. Its new products are often introduced to the market approximately two months later than major competitors (IBM and HP). However, all of its new products are able to include unique features (e.g. low weight, large LCD screen, etc) and an attractive appearance that customers could not find from other notebook computers firms. This firm also excels in its service quality through by a guarantee of next day repair service. Generally, the Differentiated/Follower business strategy aims at improving and developing the quality dimensions of 'aesthetics', 'unique features' and 'serviceability'.

In summary, the literature on the relationship between business strategy and quality dimensions and capabilities is sparse, but it clearly raises the possibility of the performance of quality dimensions being strategy dependent. We have identified and gathered the above studies to construct the preliminary view of the relationsht between quality capabilities

Figure 1. *Quality dimensions, quality capabilities and business strategy.*

(expressed as various dimensions) and business strategy shown in Fig. 1. However, no empirical studies have specifically and thoroughly verified such relationships, or the impact of such compatibility on business performance.

Research design

Basic model and hypothesis

Figure 2 displays the basic research model of this study. Based on the literature, we hypothesize that the degree of fit between quality capabilities (defined by a combination of different quality dimensions) and business strategy affects the performance of a firm, including the rate of successful new product introduction, net profit and sales growth rate. In this study, four hypotheses are tested:

Figure 2. Fitting quality capabilities with business strategy.

H₁: Among all the firms surveyed, their business strategies can be clustered into three categories: Pre-emptive/First Mover, Differentiated/Follower, and Low Cost/Follower.

This hypothesis was already tested by Chang *et al.* (2002). We will verify this business strategy framework using different samples. The next three hypotheses propose that the contribution of quality capabilities to business performance is contingent on their alignment with business strategy types. If the quality dimensions developed are inconsistent with business strategy, business performance cannot be improved. The measure of business performance includes both financial (net profit) and non-financial (growth and successful new product introduction) performance (Walker & Ruekert, 1987).

H₂: For those firms following a Pre-emptive/First Mover business strategy, the quality capabilities of high performance and perceived quality have positive effects on business performance.

H₃: For those firms following a Differentiated/Follower business strategy, the quality capabilities of unique quality features, aesthetics and serviceability have positive effects on business performance.

H₄: For those firms following a Low Cost/Follower business strategy, the quality capabilities of reliability and conformance have positive effects on business performance.

Survey

A survey was used to collect data pertaining to the research hypotheses. A field test of the survey instrument was conducted by meeting with manufacturing executives, vice presidents or presidents from four companies. A copy of the questionnaire is included in the Appendix. The questionnaire includes four sections: Business Strategy, Quality Capabilities, Business Performance and Basic Data. The 'Business Strategy' section asked for subjective evaluations pertaining to the relative emphasis on various action programmes and the timely introduction of new products and new technology. For instance, the respondents were asked to indicate the importance of product innovation to the accomplishment of their business strategy, using a seven-point scale with endpoints 'Least Important (1)' and 'Extremely Important (7)'. The data collected in the section were later used to identify the business strategy type.

The 'Quality Capabilities' section collected data pertaining to a firm's relative competitive edge in the seven dimensions of quality. Respondents were asked to provide a seven-point rating of the firm's performance relative to its major competitors. The 'Business Performance'

section evaluated a firm's sales performance, finance and adaptability as suggested by Walker & Ruekert (1987). Financial performance was measured in terms of net profit. Adaptability indicated the ability of a firm to achieve long-term success, measured by the rate of successful new product introduction. Similar to the Vickery *et al.*; (1993) study each measure was assessed in three ways:

- (1) the firm's performance relative to its major competitors;
- (2) the firm's performance relative to its historic performance and/or company goals; and
- (3) the actual values.

Finally, the 'Basic Data' section gathered information on the profiles of the firms.

A total of 282 questionnaires were mailed to top executives (Vice President, General Managers or Plant Managers) in selected SBUs in high tech manufacturing firms from the telecommunications, personal computers, semiconductor and consumer electronics industries in Taiwan. These four industries represent well developed high tech manufacturing in Taiwan. They have similar market structure and they are subject to similar environmental uncertainty. Most firms are original equipment manufacturers (OEMs) for large computer companies in the United States or Europe. The homogeneity of the nature of their operations environment reduces the possibility of contamination from multiple industry studies and increases researcher control variance in the external environment (Swamidass & Newell, 1987). In order to improve the response rate, we contacted target plants by phone and by letter to generate interest and obtain approval. As a result, 127 questionnaires were returned, a response rate of 48%. Of the returned questionnaires, 113 were valid samples for statistical analysis. Based on gross sales in Taiwanese Dollars, 59% of the samples were small- to-medium sized firms with gross sales of less than US\$15 million (500 million Taiwanese Dollars). Table 1 provides a summary of the descriptive statistics of these 113 samples.

Table 1. *Industry composition and size of sample respondents*

	Type of industry	% of respondents	Products
Industry breakdown	1. Telecommunication	13.3	Wireless phone, fax, satellite receiving equipment, wireless communication equipment, display pager, digital phone, digital electronic auto, branch exchange, and GPS.
	2. Computer	42.8	Desk computers, notebook computers, industrial computers, monitors, printers, modems, computer main boards, scanners, DVDs, LAN cards, and mouse.
	3. Semiconductor	18.9	Integrated circuits, integrated circuits packages, wafers, Linear ICs, Hybrid ICs, DRAMs, phototransistors and lead frame for semiconductors
	4. Consumer electronics	25.0	Mini-CD-ROMs, disc players, optical disk drivers, LCD TVs, Television cameras, digital TVs, electronic dictionaries.
	Total	100	
No. of Employees	1. 100–300	34.7	
	2. 301–600	22.3	
	3. 601–900	14.0	
	4. 901–1200	9.1	
	5. 1201–1500	8.3	
	6. 1501 and above	11.6	
	Total	100	

Statistical methods

There were two stages of statistical analysis. In the first stage, we used cluster analysis to assign all firms into three business strategy groups. Factor analysis was then applied to provide an insight as to which dimensions of business strategy were captured by Chang *et al.*'s (2002) framework.

The second statistical technique used was multiple regression. The basic model tested the relationships between quality capabilities, business strategies and business performance measures as suggested in Fig. 2. For every business strategy a regression model was developed to test the effect of manufacturing capabilities on sales growth, net profit and the successful rate of new product introduction.

Statistical results

Analysis of business strategy framework

This section discusses the statistical results pertaining to hypothesis H₁ in order to test the validity of Chang *et al.*'s (2002) business strategy framework. Factor analysis with varimax rotation was applied to see how the 13 business strategy variables would converge. The Bartlett test of sphericity was performed to assess the overall significance of the correlations among the strategy variables. Table 2 presents the results of the varimax factor analysis. Three constructs are clearly defined with high loading. All eigenvalues from the three factors were greater than 1.0. All standardized factor loadings were 0.50 or above with the majority falling above 0.70; thus, the loadings can be considered large (Bollen & Lennox, 1991). The reliability of each construct was measured with Cronbach's α . The coefficient alpha values for the three factors are 0.935, 0.957 and 0.896, respectively. In general, all three dimensions are very clear, showing a significant relationship between those dimensions and the factor loading.

With these three business strategy factors, we then performed cluster analysis using the SAS Fastclus procedure. This is a non-hierarchical procedure well suited for large data sets. As in Miller & Roth's (1994) study, we also used the variations of the *k*-means method in the partitioning process. Table 3 summarizes the Scheffe pair-wise comparison tests of mean (centroid) differences. The number of clusters was determined based on Lehmann's (1979) suggestion—the number of clusters to be between $n/30$ and $n/60$. The three-cluster model was selected because it gave the best R^2 and pseudo-F statistic. The three groups are described in terms of their respective group mean scores and their relative importance in their business strategy. The interpretations of the three groupings are predicated based on (a) the significance of difference in the cluster means of the business strategy factors at the 0.05 level or less, and (b) the relative importance of a business strategy factor within a cluster. In general, the three groupings can be designated as Pre-emptive/First Mover (G₁), Differentiation/Follower strategy (G₂) and Low Cost/Follower strategy (G₃). Overall, the results verify Chang *et al.*'s (2002) business strategy framework and support our first research hypothesis H₁.

Analysis of fitting quality capabilities with business strategies

This section reports the alignment between quality capabilities and three different business strategies.

Table 2. *Varimax factor analysis*

Variables	Factor Loading			Cumulative percent of variance	Cronabach's α -value	Factor (eigenvalue)
	F1	F2	F3			
C5	0.863					
C6	0.833					
C3	0.819					
C1	0.786					
C2	0.747			33.14%	0.935	Product Differentiation (2.26723)
C11		0.829				
C9		0.804				
C10		0.743				
C7		0.725				
C4		0.673				
C8		0.665		63.48%	0.957	Low Cost (1.73518)
C12			0.820			
C13			0.847	78.58%	0.896	Timing ...* (1.46293)

*Timing of new production introduction and new technology adoption

C1: frequency of product innovation

C2: high priced market

C3: identification of company brand names

C4: offering products competing with price

C5: offering of high quality products

C6: image of superior products

C7: use of low cost component parts

C8: use of common component parts

C9: increase in worker productivity

C10: efficiency of sales and distribution channels

C11: searching for low cost production methods

C12: timing of new technology adoption

C13: timing of new product introduction

(1) *Quality capabilities and Pre-emptive/First Mover strategy*

Treating the seven dimensions of quality capabilities as independent variables, we tested the statistical relationship between quality capabilities and three performance measures: the rate of successful new product introduction, net profit and sales growth. Table 4 summarizes the results of the regression analysis. Note that only significant relationships are included in Table 4.

First, the results show that the Pre-emptive/First Mover achieves higher business performance through superior customer perception and brand image. High quality performance improves the rate of success of new product introduction and sales growth but not net profit. The insignificant net profit effect suggests the need for further investigation. We made a few field trips to interview plant managers to understand this finding. A possible explanation is offered in the next section. Unique quality features also contribute to net profit and sales growth, which is understandable even though such effects are not specifically mentioned in the literature. Overall, the findings confirm the second hypothesis H_2 . ANOVA shows the p -values for the three models as 0.0085, 0.0199 and 0.0012 separately.

(2) *Quality capabilities and Differentiated/Follower strategy*

In most cases, the Differentiated/Follower strategy is able to achieve the higher successful rate of new product introduction, net profit, and sales growth through the offering of unique

Table 3. *Scheffe's test: business strategy by groups*

Business strategy factors	Business strategy group		
	Group 1 (G1) Differentiated/Follower strategy	Group 2 (G2) Low cost/Follower strategy	Group 3 (G3) Pre-emptive/First Mover strategy
Product Differentiation (F1)	High ¹ 0.59956 ² (0.60006) ³ (G2) ⁴	Low −0.81027 (1.14369) (G1, G3)	Medium 0.20575 (0.51903) (G1)
Low cost (F2)	Low −0.67412 (0.61732) (G2)	High 0.95232 (0.82909) (G1, G3)	Medium −0.27492 (0.70058) (G2)
Timing of new product/ technology (F3)	Late ⁵ 0.70243 (0.69225) (G3)	Medium 0.40969 (0.51430) (G3)	Early −1.19341 (0.45073) (G1, G2)
Number of Firms	39	38	36

1. The importance of this business strategy factor to each group.
2. Represents cluster mean scores.
3. The standard error of the estimate of the mean score.
4. Represents the group number from which this group was significantly different at the 0.05 level.
5. The timing of new production/technology introduction.

product features and serviceability. One exception is the effect of serviceability on net profit, discussed in the next section. Moreover, the 'aesthetics' dimension does not have a significant impact on net profit or sales growth. The insignificant effects may be due to the fact that firms being sampled in this study included many component manufacturers. The look and appearance of components are not as critical to winning customer orders. The impact of the 'aesthetics' dimension may likely be contingent on the types of products and industry. In summary, the findings confirm the third hypothesis H_3 with the exception of the effects of aesthetics. ANOVA shows the p -values for the three models to be 0.0001, 0.0002 and 0.0005.

(3) *Quality capabilities and Cost/Follower strategy*

The statistical results support H_4 with the exception of the insignificant impact the conformance dimension (measured as the rate of defects) has on successful new product introduction. Again, a possible explanation is offered in the next section. Additionally, we found that the Low Cost/Follower business strategy may hurt itself by developing the dimension of 'unique quality features'. Namely, firms that emphasize low cost could reduce profit by investing on the 'unique features' capability. ANOVA shows the p -values for the three models to be 0.0391, 0.0001 and 0.0015.

Discussion

Statistical results indicate that compatibility of quality capabilities and business strategy is necessary for a firm to achieve better performance. Firms should invest resources and time to develop quality capabilities that fit into their business strategies. Without such alignment,

Table 4. Regression analysis: quality capabilities and business performance

Business strategy	Quality capability	Successful new product introduction	Net profit rate	Sales growth
Pre-emptive/ first mover	Q ₁ : High performance	+*		+*
		0.1045 (0.002)		2.8411 (0.0457)
	Q ₂ : Unique quality features		+*	+*
			1.8416 (0.0189)	3.5716 (0.0194)
	Q ₇ : Perceived quality	+*	+**	+*
		0.4725 (0.0439)	1.1951 (0.0011)	2.7279 (0.0119)
	ANOVA <i>p</i> -value	0.0085**	0.0199**	0.0012**
		Reject H ₀	Reject H ₀	Reject H ₀
	R ²	0.418	0.520	0.599
Differentiated/ follower	Q ₂ : Unique quality features	+*	+*	+*
		0.0488 (0.047)	1.1893 (0.0048)	2.3437 (0.046)
	Q ₅ : Aesthetics	+*		
		1.1683 (0.049)		
	Q ₅ : Serviceability	+*		+*
		0.0473 (0.046)		2.7268 (0.018)
	ANOVA <i>p</i> -value	0.0001*	0.0002**	0.0005**
		Reject H ₀	Reject H ₀	Reject H ₀
	R ²	0.366	0.425	0.689
Low cost/ follower	Q ₂ : Unique quality features		—*	
			−1.9386 (0.0122)	
	Q ₃ : High Reliability	+*	+**	+*
		0.0840 (0.0199)	1.1687 (0.0387)	3.1740 (0.0363)
	Q ₄ : Conformance		+*	+**
			1.0050 (0.0495)	3.8146 (0.0073)
	ANOVA <i>p</i> -value	0.039*	0.000*	0.001**
		Fail to reject H ₃	Reject H ₀	Reject H ₀
	R ²	0.109	0.338	0.499

Notes: 1. '+': positive effect; '—': negative effect.

2. The first number is the coefficient of the regression and the second number is the *p* value.

3. ***p* < 0.05; **p* < 0.10.

4. This table only includes those flexibility dimensions that are significantly related to business performance.

not only can firms fail to achieve competitive edge, in some situations they could even decrease business performance.

There are some findings that are either unexpected or never discussed in previous studies. First, firms with Pre-emptive/First Mover strategy should be aware of the effect on their profit in the short term when developing high performance quality. Most R&D projects of new product development in high-tech industries involve huge expenditures over several years. It is likely that the huge amount of R&D investment cannot be fully recovered in the short term, which explains the insignificant effect of high performance on net profit in the short run. Interestingly, dealing with the slow investment return of developing high conformance products, some firms collaborated with government-supported R&D institutes such as the Industrial Technology Research Institute (ITRI) and/or universities in new product design, pilot test and process design. We found that those companies were able to improve net profit with high quality performance through such collaboration effort.

Developing the 'serviceability' dimension by firms with the Differentiated/Follower strategy does not lead to higher profits as expected. Consumers in Taiwan generally do not

have the concept of paying for after-sale. They tend to perceive service as part of the purchase and are not willing to pay for service charges. As a result, the revenue received from after-sales service is not enough to support the cost of providing such service. Another factor that contributes to the insignificant effect of serviceability on net profit is the fact that serviceability has become an 'order qualifier' for most high-tech OEMs in Taiwan. With increasingly severe competition from nearby countries such as China, Korea and Singapore, it is common practice that business agreements with major US and European customers include attractive after-sale service. Offering such service agreements can gain more customer orders and sales at the expense of net profit. During our field trips to several firms, we identified one company that had developed its serviceability with the aid of the Internet. This firm was able to use the Internet to trace customer needs and direct customers to perform part of the maintenance, online and efficiently. The Internet also sped up the after-sales service quicker but without using extensive resources.

The statistical results indicate that the 'conformance' dimension failed to improve new product introduction. In this study, conformance is measured as a low defect rate, which is regarded as 'internal quality performance', since it mainly deals with the results of internal quality inspection (Forker *et al.*, 1996; Sousa & Voss, 2002). Previous studies have indicated that internal quality conformance does not have a direct impact on business performance, which may explain the insignificant effect of conformance on new production introduction.

Conclusions

Past research in quality management often treats quality as a unidimensional construct. Very few studies have investigated the concept from a strategic perspective (Sousa & Voss, 2002). The research premise of this study is that quality is multi-dimensional, and the contributions of the different quality dimensions to business performance are contingent on business strategies. Developing quality capabilities based on a given business strategy will provide firms with competitive advantages and better business performance. In general, the statistical results indicate that the compatibility of quality dimensions, capabilities and business strategy is necessary for a firm to achieve better business performance in new product introduction, net profit and sales.

The findings of this study have important management implications. Many researchers have observed the nature of trade-offs among various quality dimensions. Given limited resources, firms must set clear priorities in investing and developing a set of quality dimensions that match their business strategy. On the other hand, it is also necessary for firms to review existing quality capabilities during the process of developing business strategy. Note we are not suggesting that firms ignore those quality dimensions not compatible with the existing business strategies. Instead, those 'incompatible' quality amount dimensions may need to be treated as 'order qualifiers', which also require a minimal amount of attention from management (Hill, 2000). The findings are also consistent with Juran's concept of 'optimal quality' (Juran, 1988). Namely, for every business strategy (e.g. Pre-emptive/First Mover), there is an optimum level for those 'incompatible' quality dimensions (e.g. conformance and reliability) above which those dimensions become order qualifiers and cease to be directly beneficial to business performance.

A stream of research has suggested that the performance of quality management is situational (Karmarkar & Pitbladdo 1997; Reed *et al.* 1996; Sousa & Voss, 2001, 2002). Those researchers argue that the impact of quality on business performance is contingent on certain market factors such as market structure and industry. However, we have not found any in-depth analysis of the effectiveness of quality using any sort of market factors in the

strategic level. This study definitely contributes to the area by verifying the contingent performance of the quality dimensions from the aspect of business strategy.

Finally, the data used in this study were collected from high-tech industry such as semiconductor, telecommunications, and consumer electronics in Taiwan. Taiwan is an interesting setting for this study because of its active role in the worldwide high tech market. For example, Taiwanese computer manufacturers supply more than 50% of the world's notebook PCs. However, it is not known how the selection of industries and geographical areas would affect our findings. Since the nature of product life cycle, competitive environment and industry structure are different from industries to industries or from countries to countries, future study should investigate the applicability of our findings with other industries and geographical areas. On the other hand, Hamlin (1999) observed similar business behaviours from the OEMs in many Asian countries. Generally, high tech contract manufacturers in Asian countries face similar demand, supply, technology and competition uncertainties. Therefore, we believe that the results of this study provide valuable insights to managers in other Asian countries (e.g. China, South Korea and Malaysia) as well.

Another limitation of this study is related to the measures of quality dimension. The use of single item indicators for the quality dimension measure could limit the generalizability of the statistical results, although there is no one right way to combine multiple indicators underlying a multidimensional concept (Flynn *et al.*, 1995; Noble 1995). On the other hand, there are researchers who advocate the use of single item indicators for better efficiency in social science studies (e.g. see Drolet & Morrison, 2001). Regardless of those potential shortcomings, this study confirms the contingency of the performance of quality management and the necessary development of quality capabilities aligned with business strategy.

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Appendix: Survey items and scales

I. Business strategy

Over the past three years, please indicate the importance of each of the following items in accomplishing Your business strategy?

	Least Important					Extremely Important	
	1	2	3	4	5	6	7
Var 1: frequency of product innovation	1	2	3	4	5	6	7
Var 2: high pricing market segment	1	2	3	4	5	6	7
Var 3: offering of high quality products	1	2	3	4	5	6	7
Var 4: offering of low price products	1	2	3	4	5	6	7
Var 5: offering of high quality products	1	2	3	4	5	6	7
Var 6: image of superior products	1	2	3	4	5	6	7
Var 7: use of low cost component parts	1	2	3	4	5	6	7
Var 8: use of common component parts	1	2	3	4	5	6	7
Var 9: increase of worker productivity	1	2	3	4	5	6	7
Var 10: efficiency of sales/distribution channels	1	2	3	4	5	6	7
Var 11: implementation of low cost production	1	2	3	4	5	6	7

Compared with the company's major competitors, how early does it adopt the new production technology and introduce new products to the market?

	Early				Late		
Var 12: The timing of adopting new production technology	1	2	3	4	5	6	7
Var 13: The timing of introducing new products to the market	1	2	3	4	5	6	7

II. *Quality dimensions/capabilities*

Over the past three years, please indicate how does each of the following quality dimensions/capabilities compare with Your competitors?

	Far worse than competitors				Far better than competitors		
Var 1: High quality performance (e.g. CPU speed)	1	2	3	4	5	6	7
Var 2: Unique product features	1	2	3	4	5	6	7
Var 3: High reliability and low frequency of breakdown	1	2	3	4	5	6	7
Var 4: Low defect rate	1	2	3	4	5	6	7
Var 5: Speedy after-sales maintenance and service	1	2	3	4	5	6	7
Var 6: Appealing product appearance	1	2	3	4	5	6	7
Var 7: Good corporate image and high product quality reputation	1	2	3	4	5	6	7

III. *Business performance*

Over the past three years, please indicate how each of the following performance measures compare with your projected performance?

	Very Satisfied				Very Dissatisfied		
Var 1: Average net profit	1	2	3	4	5	6	7
Var 2: Average sales growth rate	1	2	3	4	5	6	7
Var 3: Number of new product introductions	1	2	3	4	5	6	7
Var 4: Successful new product introductions	1	2	3	4	5	6	7

Compared with the company's major competitors, please indicate how each of the following performance measures compare with your competitors?

	Very Weak				Very Strong		
Var 5: Average net profit	1	2	3	4	5	6	7
Var 6: Average sales growth rate	1	2	3	4	5	6	7
Var 7: Number of new product introductions	1	2	3	4	5	6	7
Var 8: Successful new product introductions	1	2	3	4	5	6	7

Please complete the following information.

Var 9: Over the last three years, the net profit rate:

Var 10: Over the last three years, the sales growth rate:

Var 11: Over the last three years, the number of new product introductions:

Var 12: Over the last three years, the number of successful new product introductions:

IV. Company background information

Questions in this section include: industry, number of employees, sales, percentages of make-to-order and make-to-stock, percentage of export sales, break down of material and labor cost, and total assets.