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Assessing the Impact of Benchmarking Antecedents on Quality Improvement and its Financial Consequences

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ABSTRACT: The objective of this study is to assess whether firms involved in quality benchmarking projects achieve greater actual quality improvements if they have in place the benchmarking antecedents identified by Elnathan et al. (1996). To show the financial impact of these results, we further assess the effect of quality improvement on profitability, both through relative cost improvement and through other means. To this end, we collected data from 457 manufacturing business units with quality-benchmarking projects and analyzed the variable relationships using structural equation modeling. The results indicate a strong positive relationship between benchmarking antecedents and quality improvement and a significant impact of quality improvement on relative costs improvement, which in turn is significantly associated with profitability. However, the direct relationship between benchmarking antecedents and relative costs improvement or profitability is not significant, nor is the direct relationship between quality improvement and profitability. These relations are further analyzed within the context of quality and cost systems. Specifically, a comparison between the TQM/Non-ABC group and the Non-TQM/Non-ABC group shows that the TQM/Non-ABC group outperforms the Non-TQM/Non-ABC group and that the Non-TQM/ABC group outperforms the Non-TQM/Non-ABC group. Results show differences between groups, indicating the importance of cost and quality systems in improving manufacturing business unit performance. The implications, limitations, and directions for future research are discussed.

Keywords: *benchmarking antecedents; quality improvement; relative costs; improvement; profitability.*

INTRODUCTION

A competitive business environment has dictated major shifts in corporate strategies, organizational cultures, and organizational designs (Elnathan et al. 1996). The overall focus of management is on what actions a company must take in order to remain competitive and perhaps gain competitive advantage. To this end, Elnathan et al. (1996) integrate the literature from various disciplines and propose a research framework in which benchmarking antecedents (i.e., preliminary internal competitive analysis, preliminary external competitive analysis, degree of organizational commitment, and prior benchmarking) set up the necessary preconditions for success. Hence, *the first objective of this study is to assess whether the success of benchmarking in improving quality depends on the presence* *of these antecedents*. This study focuses on quality improvement because, according to prior studies (e.g., Markland et al. 1995), U.S. and European manufacturing executives still rank quality as the most important competitive priority.

Deming (1986) suggests that "improved business processes will result in both lower costs and higher profitability, thus implying that a company should emphasize both quality and costs improvements" (Gitlow et al. 1990). This idea of both cost reductions and revenue expansion is supported by many quality theorists and practitioners (Hiam 1993; U.S. GAO 1991). Hence, *the second objective of this study is to examine the empirical relationships among quality improvement, relative costs improvement, and profitability*. Specifically, we investigate the direct impact of quality improvement on both relative costs improvement and business unit profitability and the effect of relative costs improvement on profitability.

Prior studies (e.g., Galbraith 1973; Tushman and Nadler 1978; Govindarajan 1986) suggest that a firm's performance may be contingent upon the nature of the alignment between its organizational design and strategy. Given that design and strategy result from management's adaptive choices, it is important to ensure that they are congruent with one another, especially when this congruency affects performance (Thompson 1967). Accordingly, *the third objective of this study is to investigate the related propositions that the relation between benchmarking antecedents, quality improvement, costs improvement, and profitability is a function of the "fit" or "match" between a firm's quality and/or cost management strategies*. This investigation is carried out by (1) partitioning the sample into four subsamples (TQM/ABC [total quality management/activity-based costing]subsample, TQM-only subsample, ABC-only subsample, Non-TQM/Non-ABC subsample), (2) analyzing each subsample, and (3) comparing the model path coefficients of (a) Non-ABC/TQM and Non-ABC/Non-TQM, subsamples and (b) ABC/Non-TQM and Non-ABC/Non-TQM subsamples.

Using data from 457 manufacturing business units, we find a strong positive relationship between benchmarking antecedents and quality improvement. The impact of quality improvement on relative costs improvement is also significant, as is the relation between relative costs improvement and profitability. However, the direct relationship between quality improvement and profitability (i.e., the relation not mediated by relative cost improvement) is not significant. Further analyses indicate that both quality improvement and relative costs improvement perfectly mediate the relation between benchmarking antecedents and profitability, and relative costs improvement perfectly mediates the relationship between quality improvement and profitability. In other terms, benchmarking antecedents impact relative costs improvement through quality improvement and impact profitability through quality improvement and relative costs improvement. These relations are also further analyzed within the context of cost and quality strategies indicating that the relations among the variables of the model vary according to the type of systems used. More specifically, a comparison between model path coefficients of the TQM/Non-ABC group and the Non-TQM/Non-ABC group shows that the TQM/Non-ABC group outperforms the Non-TQM/Non-ABC group. Similarly, the Non-TQM/ABC group outperforms the Non-TQM/Non-ABC group.

The paper is organized as follows: First, the literature review is discussed and hypotheses are developed; second, the research methods are explained; then, after the empirical results are reported, a discussion is presented.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The primary objective of this study is to address the following research questions: (1) Is there a direct association between benchmarking antecedents and quality improvement?

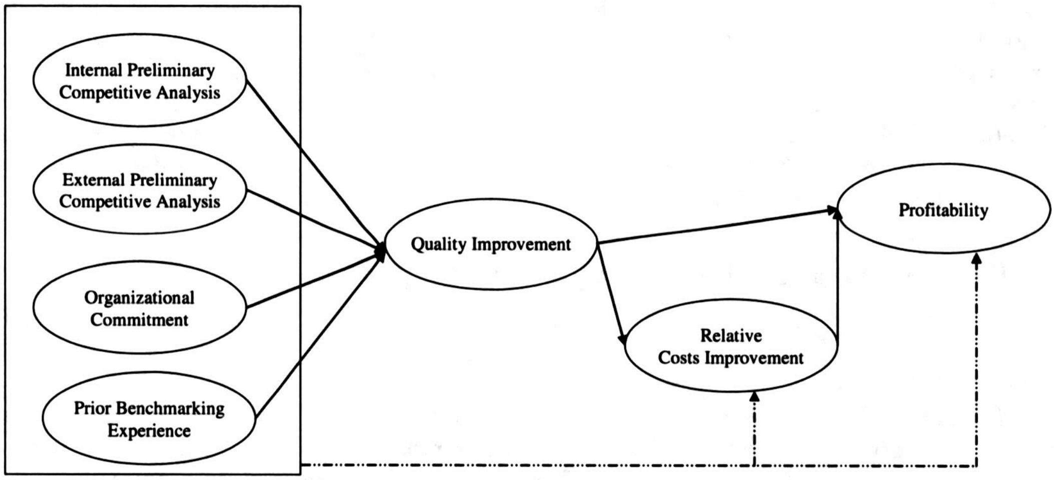
(2) Is there an indirect effect of quality improvement on manufacturing plants' profitability through relative costs improvement? and (3) Are the relationships among the variables contingent upon business unit cost (ABC) and quality (TQM) management systems?

Following Elnathan et al. (1996), the four types of benchmarking antecedents utilized in this study are (1) internal preliminary competitive analysis, (2) external preliminary competitive analysis, (3) organizational commitment, and (4) prior benchmarking. We incorporate these questions in the form of a conceptual model, shown in Figure 1, that integrates the hypotheses developed below.

Preliminary Competitive Analysis

Planning is essential to the accomplishment of most objectives and is certainly important for successful implementation of quality benchmarking. This form of planning can be referred to as preliminary competitive analysis, which suggests that a firm will initially evaluate its own strengths and weaknesses in order to make good initial choices related to benchmarking partners, the scope of the project, and the types of information to be collected. Several types of preliminary competitive analysis were identified by Elnathan et al. (1996) including internally based analyses that focus on best practices within the organization, on continuous improvement targets, and/or on targets or goals established by the firm. It is also likely that management's intuition regarding the firm's competitive position will play a substantial role in initial analyses as well (Elnathan et al. 1996). Externally based analyses also can be valuable; they can be based on published industry comparisons and on rankings by organizations, publications, and participants in the value chain, including suppliers and customers (Elnathan et al. 1996). Any of these forms of preliminary competitive analyses can contribute to a better-focused and efficient quality benchmarking effort leading to greater efficiency in the firm and increased success of the firm. Based on this conjecture, it is expected that manufacturing plants that engage in preliminary competitive analyses will experience better quality improvement; thus, we predict that:

FIGURE 1
Structural Path Coefficients of the Overall Model



H1: There is a positive association between internal preliminary competitive analysis and quality improvement.

H2: There is a positive association between external preliminary competitive analysis and quality improvement.

Organizational Commitment

There is substantial consensus that successful implementation of any innovation within organizations is heavily influenced by the commitment of members of the organization to the planned changes (Shields and Young 1989; Ginzberg 1981; Jarvenpaa and Ives 1991). The success of quality benchmarking is an important management innovation and thus should benefit from strong commitment from all members of the organization (Elnathan et al. 1996). Importantly, strong senior management commitment can result in more project funding, incentives that result in enhanced employee attention to any quality benchmarking project, and greater participation by internal and external benchmarking partners (Elnathan et al. 1996). Organizational commitment can be divided into four separate elements: senior management support, long-term commitment, an empowering organizational culture, and clear objectives (Elnathan et al. 1996). An empowering culture may involve lower-level employees in decision making and allow them to make autonomous actions which will enhance their contribution to the success of the quality benchmarking project (cf. Birnberg et al. 1990). Additionally, with a clear set of objectives, benchmarking teams and their members will have an excellent understanding of the mission of the organization and customer expectations before planning and implementing quality benchmarking (Bean and Gros 1992, 37). These arguments suggest the following hypothesis:

H3: There is a positive association between organizational commitment and quality improvement.

Prior Benchmarking

Organizations that have prior benchmarking experience bring substantial expertise into any new benchmarking experience. For example, Elnathan et al. (1996) suggest that these experienced firms may more efficiently and quickly implement any new quality benchmarking project because they have trained personnel and experienced coordinators that can reduce the time and effort required to achieve a successful benchmarking project. A capable coordinator and experienced employees are likely to encounter fewer problems and, if any unanticipated issues do arise, are likely to be able to resolve them more quickly (Elnathan et al. 1996). These advantages of prior benchmarking experience should create relatively greater success, therefore we predict the following:

H4: There is a positive association between prior benchmarking and quality improvement.

Quality Improvement

The relationship between cost and quality has received considerable attention. Prior studies have consistently argued that better quality practices can reduce cost (e.g., Juran 1988; Roth and Morse 1983; Crosby 1979). The cost reduction can come directly from increased output of defect-free products and lower expenditure on scrap and rework (Ittner

1994; Kaynak 2003), or indirectly through fewer disruptions in operations due to out-of-conformance purchases and production, elimination of buffer inventories held to compensate for poor quality, improved machine utilization, and reductions in quality-related schedule changes, congestion, and downtime (Ittner 1994). Fine (1983) found that costs declined more rapidly for plants that produced high-quality products than for plants that produced low-quality ones. Thus, costs should decline even more rapidly with the experience of producing high-quality products (Fine 1986). Therefore, this study suggests that that quality improvement will reduce costs. Unless competitors' quality typically changes at identical rates, larger improvements in a firm's quality relative to past performance are likely to represent larger improvements *relative* to competitors' costs as well. Hence, we hypothesize that:

> **H5:** There is a positive association between quality improvement and relative costs improvement.

Relative Costs Improvement

Relative costs improvement will translate into increased profitability only if product-market pressures do not force prices down as costs decrease (e.g., Balakrishnan et al. 1996). Prior literature strongly endorses the view that improved manufacturing performance will translate into higher profits (Garvin 1988; Hayes et al. 1988). Roth and Borthick (1989), for example, support the view that manufacturing performance, i.e., product cost, is an important key to improved business performance. Low cost is linked to competitive strategy because having a low-cost position yields the firm above-average returns relative to competitors by achieving lower relative direct costs (Phillips et al. 1983; Porter 1980). These contentions are captured in the following hypothesis:

> **H6:** There is a positive association between relative costs improvement and profitability improvement.

Quality improvement can also affect profitability through means other than cost improvement (George and Weimerskirch 1994; NIST 1998). For example, quality gauges the capability of the firm to design and produce products that would fulfill customer expectations (Hall et al. 1991; Doll and Vonderembse 1991) which, in turn, would result in more satisfied customers with greater loyalty and increased sales (Ahire and Dreyfus 2000; Choi and Eboch 1998; Handfield et al. 1998). Prior studies support the positive direct link between quality improvement and profitability. For example, Tatikonda and Montoya-Weiss (2001) found that product quality does, in fact, translate into financial performance. Also, Buzzell and Gale (1989) found that product quality is a significant, and the most consistent, predictor of both market share and overall firm profitability. Accordingly, we propose that:

> **H7:** There is a positive direct association between quality improvement and profitability improvement (not through relative costs).

Contingency Factors

The specification of the theoretical framework (see Figure 1) consists of a set of hypotheses suggesting structural relationships among variables in the study. Although the hypothesized model relationships are supported in literature, we should not ignore the possibility that the relationships could be contingent upon some organizational characteristics. Below, we identify cost (ABC) and quality (TQM) strategies as relevant contingency factors and discuss their potential impact on the model relationships.

With detailed information about value-added and non-value-added activities, ABC is expected to enhance quality improvement initiatives by identifying the activities caused by poor quality and the drivers of these problems (Armitage and Russell 1993; Carolfi 1996). Volume-based costing fails to provide timely information that is needed for quality control. Similarly, TQM is an organization-wide problem-solving methodology that focuses on systematically and continuously improving the quality of products (U.S. DOC/NIST 1994). Hence, although we hypothesized in H1 through H4 that benchmarking initiatives are significantly associated with quality improvement, we also propose that the association between benchmarking initiatives and quality improvement will be stronger for manufacturing plants that have adopted ABC or TQM than those Non-ABC/Non-TQM plants.

With ABC information, managers can reduce costs by designing products and processes that consume fewer activity resources, thereby increasing the efficiency of existing activities and eliminating activities that do not add value to customers. Traditional volume-based costing systems typically provide only volume-related cost drivers (Dearman and Shields 2001; Swenson 1995) that do not provide a true picture of product costs. Without an accurate picture of product costs, it is extremely difficult to evaluate whether a product is contributing to the profitability of the firm (Gupta and Galloway 2003). Also, as suggested in prior studies (Cooper et al. 1992; Ittner 1999; Ittner et al. 2002), by highlighting the costs of quality-related non-value-added activities, ABC systems can help justify investments in quality improvement activities that might otherwise be considered uneconomic and improve the allocation of resources to the highest-valued improvement projects.

TQM advocates suggest that, rather than increasing costs, improving quality should actually reduce costs (York and Miree 2004) and improve long-term profitability (Hendricks and Singhal 1997, 1999; Easton and Jarrell 1998). In contrast, under the traditional manufacturing environments, manufacturing initiatives provide only aggregated financial information relatively infrequently, operational control based on variances from budgeted standards, and reward systems tied primarily to profitability (Kaplan 1983; Johnson and Kaplan 1987; Johnson 1992; Banker et al. 1993; Wruck and Jensen 1994). Hence, we propose that, although the impact of quality improvement is hypothesized to be significantly associated with relative costs improvement (H5) and profitability improvement (H7), the association will be stronger for manufacturing plants with ABC or TQM than for Non-ABC/Non-TQM plants. We also propose that the association between relative costs improvement and profitability (H6) will be stronger for manufacturing plants with ABC or TQM than for Non-ABC/Non-TQM manufacturing plants.

In Figure 2, four regions of strategies are suggested. For simplicity, we dichotomize strategies as either the presence or the absence of ABC (TQM). (Further refinement could identify the levels of intensity of these strategies and associate this intensity with performance, as suggested by Lawless et al. [1989]).

RESEARCH METHODS

Sample

A survey questionnaire[1] was used to complement previous research by collecting data from a broad cross section of manufacturing plants that are profit centers. To establish the

[1] See the Appendix for an abbreviated copy of the research questionnaire with variables used to analyze the data.

FIGURE 2
Cost Systems

Quality Systems		ABC	Non-ABC
	TQM	TQM/ABC	TQM/Non-ABC
	Non-TQM	Non-TQM/ABC	Non-TQM/Non-ABC

size of the survey population, we took two steps. In the first, using various sources, we identified manufacturing firms that have mentioned "benchmarking." The primary sources used include the trade association reports, *The Wall Street Journal*, *IndustryWeek's* series on manufacturing excellence, various industrial engineering journals, and periodical indices. Additional sources include the National Automated Accounting Research System (NAARS) database to identify any firms that mentioned benchmarking in their annual report or form 10-K, the Malcolm Baldrige National Quality Award winners, and *FORTUNE Magazine's* "Top 20 Best-Managed Companies." This initial search identified a total of 137 firms. In the second step, manufacturing plants were randomly selected from the 137 firms obtained from the initial search (step one) using Dun and Bradstreet. This produced a listing of 955 manufacturing firms for the initial mailing.

Four weeks after the first mailing of the questionnaire, a postcard reminder was sent to the nonrespondents. This was followed by a second survey that was mailed to the remaining nonrespondents. This process resulted in 471 responses of which 457 were usable,[2] giving a 49.32 percent response rate.[3]

Measurement Instruments

In this study we explore the relationship between benchmarking antecedents and quality improvement, the impact of quality improvement on relative costs improvement, the effect of relative costs improvement on business unit profitability improvement, and the direct impact of quality improvement on profitability improvement. Figure 1 presents the basic theoretical model, which uses the benchmarking antecedents as exogenous constructs and quality improvement, relative costs improvement, and profitability improvement as the endogenous constructs. We carry out additional tests to investigate the model relationships within the context of cost (ABC) and quality (TQM) strategies. The analysis is based on the data obtained from a cross section of manufacturing plants. The constructs are developed on the basis of items proposed in prior studies. The constructs and their indicators are discussed below in detail.

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[2] We retained only plants that are profit centers.
[3] To evaluate response/nonresponse bias of the sample, a t-test for differences in the mean responses between late respondents and early respondents was carried out. There were no statistically significant differences in the mean responses on any of the variables we are testing.

Exogenous Constructs

The benchmarking antecedents constitute the latent exogenous constructs. Following Elnathan et al. (1996), benchmarking antecedents are measured with 13 items. Three variables are associated with internal preliminary competitive analysis (assessment of performance in relation to target/goals, philosophy of continuous improvement, and management intuition). Three variables capture external preliminary competitive analysis (industry ranking, industry comparisons, and customer/stakeholder feedback). Four variables capture organizational commitment (senior management support, clear set of objectives, long-term commitment, and empowering organizational culture). Finally, three variables capture prior benchmarking (extent of benchmarking experience, experienced coordinator, and training). Respondents were asked to indicate their perceptions of the degree to which the variables were used on a seven-point Likert-scale (1 = extremely low, 7 = extremely high).

Endogenous Variables

Quality improvement. Borrowing from the quality literature (e.g., see Crosby 1979, 1996), this study focuses on the nonconformance aspect of quality, i.e., internal failure. The performance of finished products in final tests and the proportion of defective units of production are widely used indicators of conformance quality at the end of production processes (Crosby 1979, 1996; Reeves and Bednar 1994; Jayaram et al. 1997). Hence, "quality improvement" was measured using two steps. First, respondents were asked to indicate the (1) scrap rate in parts per million, (2) rework rate in parts per million, and (3) defect rate of the finished product in parts per million, all for the years 2000 and 2001. Second, we used the following formula to calculate quality improvement:

$$\text{Percent change in } QI_{\mathrm{i}} = \frac{QI_{i2000} - QI_{i2001}}{QI_{i2000}} \times 100, \tag{1}$$

where:

QI = quality improvement;
i = number of units scrapped, reworked, or defective per million.

Relative costs improvement. This variable represents a source of competitive advantage for a product. Consistent with the literature, the commercial performance of a product can be measured by perceived measures such as the degree to which the product's objectives (e.g., cost) have been achieved (e.g., Moenaert et al. 1994), which are relative to competition and expectation within the industry (Deshpande et al. 1993). Following Gatignon and Xuereb (1997), we use one indicator to measure relative costs improvement. Respondents were asked to indicate the relative costs improvement[4] of manufacturing/operations costs compared to their main competitors over the past three years on a seven-point Likert-scale (1 = our costs are much lower, 7 = our costs are much higher).

Profitability improvement. Profitability improvement was the final outcome variable. A number of views exist on how profitability can be measured. For the purpose of this study, we use return on assets (*ROA*) as a measure of profitability that addresses asset utilization and contribution to revenue (Connolly 2000). Following prior studies (e.g., Atkinson et al. 2001; Kinney and Wempe 2002), respondents were asked to provide net

[4] Reverse coded.

income before corporate expenses, sales for the years 2000 and 2001, and total net operating assets (net working capital + long-term operating assets) data for the years 1999, 2000, and 2001. We then used this information to compute profitability improvement as follows:

$$\text{Profitability Improvement} = \frac{ROA_{2001} - ROA_{2000}}{ROA_{2000.}} \times 100. \quad (2)$$

Contingency Factors

The contingency factors concern the cost and quality strategies used at the plant. Following Krumwiede (1998), to help respondents differentiate ABC systems from other costing techniques, respondents were first asked to classify their costing system in one of three categories: individual plant-wide overhead rates, departmental or multiple plant-wide rates, and ABC (see Appendix). Although respondents selected from among three responses, for statistical testing, this response was converted to a dichotomous measure. If individual plant-wide or departmental or multiple plant-wide rates are used, this measure was coded Non-ABC, otherwise the measure was coded as ABC.

The second contingency factor was quality system. Following Slocum (1996), respondents were asked to classify their quality system in two categories, traditional quality control, or total quality management, as illustrated in the Appendix. For statistical testing, this response was converted to Non-TQM for traditional quality control system and TQM for TQM adopters.[5]

RESULTS

In this section we first present the descriptive statistics. Next, the structural equation models for the hypotheses and research question are assessed through the measurement model and the structural model analyses. The measurement model considers the adequacy of the various measures used for theoretical constructs employed in the study, while the structural equation model specifies the relationships between the various constructs. The strength of structural equation modeling is that multiple indicators are used to represent each unobserved latent construct and that it provides an efficient technique for estimating interrelated dependence relationships, such as those proposed in this study. Finally, the results of hypotheses and research question testing are presented.

Descriptive Statistics

Data for the study were obtained from 457 companies. Table 1, Panel A indicates that respondents' job titles included 35 accounting managers, 42 directors of manufacturing, 33 directors of operations, 41 manufacturing managers, 36 operations managers, 57 plant managers, 46 production engineers, 63 production managers, 49 quality engineers, and 55 quality managers.

Table 1, Panel B provides the profile of the responding companies and shows they constitute a broad spectrum of manufacturers as defined by the 2-digit SIC codes. The classifications by the primary 2-digit SIC code place the respondents as follows: 59 were from chemicals and allied products, 71 from electronics and electrical equipment, 42 from fabricated metal products, 41 from food and kindred products, 54 from industrial, commercial machinery and computers, 53 from instruments and related products, 40 from paper and allied products, 53 from rubber and plastics, and 44 from transportation equipment.

[5] TQM implementation of at least three years has been used as an adequate time frame to evaluate outcomes of TQM campaigns (Dawson and Patrickson 1991, Ahire 1996).

TABLE 1
Descriptive Statistics

Panel A: Job Title of Respondents

Job Title Used by Respondents	Number of Respondents	Percentage
Accounting Manager	35	7.65
Director of Manufacturing	42	9.19
Director of Operations	33	7.22
Manufacturing Manager	41	8.97
Operations Manager	36	7.88
Plant Manager	57	12.47
Production Engineer	46	10.07
Production Manager	63	13.79
Quality engineer	49	10.72
Quality Manager	55	12.04
Total	457	100 %

Panel B: Industry Classification

Industry	SIC	Number of Respondents	Percentage
Chemicals and allied products	28	59	12.91
Electronic, electrical equipment	36	71	15.54
Fabricated metal products	34	42	9.19
Food and kindred products	20	41	8.97
Industrial, commercial machinery, computers	35	54	11.81
Instruments and related products	38	53	11.60
Paper and allied products	26	40	8.75
Rubber and plastics	30	53	11.60
Transportation equipment	37	44	9.63
Total		457	100%

Panel C: Other Characteristics of Respondents

	Minimum	Maximum	Mean	Standard Deviation
Length at present position (years)	4	16	11.34	5.32
Length in management (years)	7	23	19.72	8.63
Number of employees	113	647	437	234

Additional information on respondents' characteristics is provided in Table 1, Panel C. The responses to the question regarding number of years with the business unit had a mean of 11.34 years in their current position, with a range of 4 to 16 years. To the number-of-years-in-management question, responses indicated a mean of 19.72 years. It appears from their positions that the respondents are well qualified to provide the information required. The results also show that the average number of employees was 437.

Analysis of Measurement Model

Confirmatory Factor Analysis (CFA) was used to assess the measurement model. A measurement model describes the nature of the relationship between a number of latent variables, and the manifest indicator variables that measure those latent variables (Li et al. 2002). The measurement model was tested using LISREL 8.30 with the maximum likelihood estimation method. The completely standardized coefficients and t-values for the measurement model are shown in Table 2. They are all statistically significant at $p < .001$ (i.e., t-values superior to the 1.96 threshold) and have strong loadings on their respective factors.

Many researchers note the need to present multiple fit criteria to rule out measuring biases inherent in the various measures (Hair et al. 1987); thus, several are presented in Table 2. The ratio of χ^2 (chi-squared) to the number of degrees of freedom (χ^2/df) has generally been used to assess model fit. The rule of thumb is that χ^2/df be less than 3.00 (Wheaton et al. 1977), while the goodness-of-fit index (GFI), comparative fit index (CFI), and normed fit index (NFI) should be greater than 0.90 (Bentler and Bonnet 1980), and the residual mean square approximation (RMSEA) should be less than 0.10 (Kline 1998; Steiger 1990). The resulting measurement model (Table 2) has an acceptable model-to-data fit (χ^2/df = 1.652, GFI = 0.92, CFI = 0.93, NFI = 0.91, and RMSEA = 0.087).[6]

In addition to overall measurement model fit, we assessed content validity, reliability, convergent validity, and discriminant validity. The literature review established the basis of content validity of the survey. Convergent validity was assessed by examining the magnitude and sign of the factor loadings of the observed variables onto their respective latent variables. Convergent validity was supported with all t-values greater than 2.0 (Pedhazur and Schmelkin 1991). Convergent validity is also reflected by comparative fit index (CFI) and normed fit index (NFI) values of 0.90 or above (Ahire et al. 1996). The most widely accepted method for testing reliability in the management literature is using Cronbach's coefficient alpha and the minimum generally accepted alpha level is .70 (Nunnally 1967; Flynn et al. 1990). As shown on the diagonal in Table 3, all constructs produce an alpha level above this threshold, and the average variance extracted estimates are greater than 0.50, thus providing further evidence of reliability (Bagozzi and Yi 1989). Discriminant validity was assessed by comparing the average variance extracted with the squared correlation between constructs (Fornell and Larcker 1981). In all cases the average variance extracted is greater than the squared correlation. Table 3 provides reliability measures, average variance extracted, and correlations among the constructs and square correlations. Overall, there is support for the models to allow proceeding with an evaluation of the structural model and hypotheses testing.

Before testing the specified hypotheses, we first confirmed the overall model by calculating χ^2 difference tests to identify any statistically significant paths that are not in the original conceptual model. This procedure has been recommended by Bollen (1989) and others (e.g., Hayduk 1987; Joreskog and Sorbom 1993; Medsker et al. 1994). We test the appropriateness of the research model (nested model) by comparing it to the full model which includes the direct effects.

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[6] To ensure that specification error is not biasing the results, we rerun the factor analysis to allow the errors (i.e., δ_n) of the measures to covary. In other words, we release the zero-correlation constraint for the relevant off-diagonal elements in the Θ_σ matrix. According to Hughes et al. (1986), one would expect that if an unobservable error biases the data, a common error variance would be generated between items actually measured. The absence of a significant improvement in overall model fit when these constraints are released would demonstrate the absence of such a bias. We find no significant difference between the fit of the new and original factor analysis models at a confidence level of α = .05. Thus, the proposition that omitted variables are generating biases at the overall model level is rejected at α = .05.

TABLE 2
Analysis of Measurement Model

	Standardized Loadings	t-Value
Internal Preliminary Competitive Analysis		
Assessment of performance in relation to target/goals	0.71	—*
Philosophy of continuous improvement	0.92	20.53
Management intuition	0.88	19.32
External Preliminary Competitive Analysis		
Industry ranking	0.89	—
Industry comparisons	0.88	15.67
Customer/stakeholder feedback	0.87	15.61
Organizational Commitment		
Senior management support	0.79	—
Clear objectives	0.88	16.26
Long-term commitment	0.89	16.47
Empowering organizational culture	0.92	17.13
Prior Benchmarking		
Prior benchmarking experience	0.89	—
Experienced coordinator	0.89	17.03
Training	0.79	15.61
Quality Improvement		
Scrap rate in parts per million	0.91	—
Rework rate in parts per million	0.86	15.73
Defect rates of finished products in parts per million	0.88	16.07
Relative Costs Improvement		
Manufacturing/operations	1.00	—
Profitability Improvement		
Percent change in *ROA*	1.00	—

*Indicates a parameter is fixed at 1.0 in the original solution.
χ^2/df = the ratio of χ^2 (chi-squared) to the number of degrees of freedom.
Fit indices: $\chi^2/df = 1.652$, GFI = 0.92, CFI = 0.93, NFI = 0.91, RMSEA = .087.

Results in Table 4 indicate that none of the χ^2 difference tests is significant at the .05 level, suggesting none of the fit indices of the alternative models show an improvement over the proposed theoretical model, thereby reinforcing the finding that the theoretical model is the best-fitting model. There are no significant paths between the variables that are not originally identified that would further explain the relations among the variables. Hence, additional paths in a fully saturated model are not included because the proposed model provides a better fit relative to the hypothesized fully mediated model. These results also indicate that benchmarking antecedents do not have direct significant impacts on both relative costs improvement and profitability, and that quality improvement does not have a direct significant effect on profitability.

Analysis of Structural Model

The structural model fit (Table 5) appeared to be reasonable (e.g., $\chi^2/df = 4.65$, GFI = 0.96, CFI = 0.92, NFI = 0.90, and RMSEA = .080). The standardized parameter estimates (see Table 5, Panel A, and Figure 3) indicate that the association between benchmarking antecedents and quality improvement are positive and significant (path coefficient = 0.28, t = 7.30 for internal preliminary competitive analysis; path coefficient = 0.30, t

TABLE 3
Correlation, Square Correlation, Reliability, and Discriminant Analysis

	1	2	3	4	5	6	7
(1) Internal Preliminary Competitive Analysis	0.89[a], 0.76[b]						
(2) External Preliminary Competitive Analysis	0.00[c], 0.00[d]	0.79, 0.71					
(3) Organizational Commitment	0.04, 0.00	0.06, 0.00	0.82, 0.77				
(4) Prior Benchmarking	0.07, 0.00	0.10, 0.01	0.05, 0.00	0.81, 0.74			
(5) Quality Improvement	0.27*, 0.07	0.29*, 0.08	0.34*, 0.11	0.14*, 0.02	0.86, 0.79		
(6) Relative Costs Improvement	0.05, 0.00	0.03, 0.00	0.02, 0.00	−.07, 0.00	0.44*, 0.19	NA	
(7) Profitability Improvement	0.00, 0.00	0.00, 0.00	−0.04, 0.00	−.08, 0.00	0.08, 0.00	0.39*, 0.15	NA

[a] Reliabilities are on the diagonal.
[b] Average variance extracted are on the diagonal.
[c] Correlation [*significant at the 0.01 level (2-tailed)]
[d] Square correlation.
For discriminant validity, average variance extracted (diagonal elements denoted b) should be larger than the square correlations (off-diagonal elements denoted d) (Fornell and Larcker 1981).

TABLE 4
Analyses of Nonhypothesized Paths

Models	χ^2	$\Delta\chi^2$	p-value
Theoretical Model	146.18	—	—
Model 1—Internal preliminary competitive analysis → Relative costs improvement	145.09	1.09	n.s.*
Model 2—External preliminary competitive analysis → Relative costs improvement	144.99	1.19	n.s.
Model 3—Organizational commitment → Relative costs improvement	145.08	1.10	n.s.
Model 4—Prior benchmarking → Relative costs improvement	145.14	1.04	n.s.
Model 5—Internal preliminary competitive analysis → Profitability	144.89	1.30	n.s.
Model 6—External preliminary competitive analysis → Profitability	144.92	1.26	n.s.
Model 7—Organizational commitment → Profitability	144.95	1.23	n.s.
Model 8—Prior benchmarking → Profitability	145.44	0.74	n.s.

* nonsignificant

= 7.57 for external preliminary competitive analysis; path coefficient = 0.37, t = 9.39 for organizational commitment; path coefficient = 0.07, t = 1.97 for prior benchmarking). Thus H1, H2, H3, and H4 are supported. Furthermore, the standardized parameter estimate between quality improvement and relative costs improvement is positive and significant (path coefficient = 0.44, t = 10.46). Relative costs improvement, in turn, is found to have a positive significant impact on profitability improvement (path coefficient = 0.11, t = 2.08) are positive and significant. However, the impact of quality improvement on profitability improvement is not significant (path coefficient = 0.03, t = 0.66). Thus, H5 and H6 are supported, while H7 is rejected. (See Table 5, Panel B for model hypotheses summary.) The nonsignificant direct effect of quality improvement on profitability improvement suggests that quality impacts profitability through relative costs improvement. This is consistent with Rust et al. (2002), who hold that profitability improvement associated with quality efforts will come primarily through cost reduction.

Contingency Factors

Before investigating the research question (i.e., whether the model relationships are contingent upon cost [ABC] and quality [TQM] strategies), two evaluations must occur: it is necessary to evaluate the model fit to the subgroup samples, then evaluate the invariance of the path model across subgroups (Marsh 1987; Bollen 1989). For the subgroups measurement model analysis, the research question stated above is intended to evaluate the model relationships for four specific subgroups corresponding to the following four combinations of the ABC and TQM contingency factors: ABC/TQM, ABC/Non-TQM, Non-ABC/TQM, and Non-ABC/Non-TQM. Following the recommendations of Doll et al. (1998), we first examine the adequacy of the baseline measurement model for each of the subgroups as follows. The measurement model is executed and the ratio chi-squared/degree of freedom and the GFI, CFI, NFI, and RMSEA values are used to assess the model fit for each subgroup.

The fit statistics in Table 6 reveal that the proposed model fits the data of each subgroup reasonably well. First, the ratio chi-squared statistic/degree of freedom for each subgroup results in a ratio less than 2.0, indicating good fit (Wheaton et al. 1977). Second, the measures of relative and absolute fit indices exceed .90, and the RMSEA for each subgroup

TABLE 5
Structural Model Path Coefficients

Panel A: Summary of Effects in the Overall Structural Model

	Standardized Path Coefficient	t-Value
Quality improvement		
Effect of internal preliminary competitive analysis	0.28**	7.30
Effect of external preliminary competitive analysis	0.30**	7.57
Effect of organizational commitment	0.37**	9.39
Effect of prior benchmarking	0.07*	1.97
Relative costs improvement		
Effect of quality improvement	0.44**	10.46
Profitability Improvement		
Effect of quality improvement	0.03	0.66
Effect of relative costs improvement	0.11*	2.08

Panel B: Summary of Results

Model	Hypotheses	Results
H1:	There is a positive association between internal preliminary competitive analysis and quality improvement	Supported
H2:	There is a positive association between external preliminary competitive analysis and quality improvement	Supported
H3:	There is a positive association between organizational commitment and quality improvement	Supported
H4:	There is a positive association between prior benchmarking and quality improvement	Supported
H5:	There is a positive association between quality improvement and relative costs improvement	Supported
H6:	There is a positive association between relative costs improvement and profitability improvement	Supported
H7:	There is a positive direct association between quality improvement and profitability improvement	Not supported

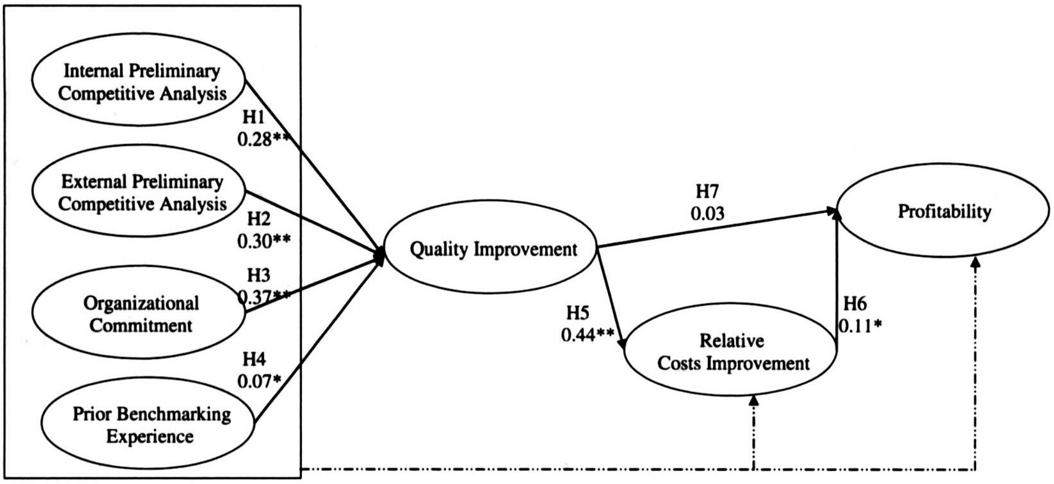
* = $p < .05$, ** = $p < .001$.
χ^2/df = the ratio of χ^2 (chi-squared) to the number of degrees of freedom.
Fit indices: $\chi^2/df = 4.65$, GFI = 0.96, CFI = 0.92, NFI = 0.90, and RMSEA = .080.

is less than .10. These results demonstrate the overall adequacy of the baseline measurement model for the subgroups. Therefore, these results enhance our confidence in the generalizability of the measurement model for plants of different cost/quality structures.

The results for the subgroup construct model lead the way for further analyses of the structural path model. Hence, a LISREL analysis was performed on each subgroup sample (ABC/TQM, ABC/Non-TQM, Non-ABC/TQM, and Non-ABC/Non-TQM). The within-group completely standardized coefficient estimates were reviewed for each subgroup of the corresponding contingency model. The within-group completely standardized path coefficient estimates can be used to compare the relative magnitudes of various direct effects within each subgroup. Results of the subgroup structural model analysis show the standardized path coefficient estimates for each subgroup (see Table 7).

As in the measurement model, the estimates for each subgroup were obtained in standard error of the means by standardizing the latent variables within a subgroup to unit

FIGURE 3
Structural Path Coefficients of the Overall Model



** $p < .001$
* $p < .05$

TABLE 6
Subgroup Model Fit Analyses

	χ^2/df	GFI	CFI	NFI	RMSEA
ABC/TQM	0.94	0.91	0.97	0.94	0.00
ABC/Non-TQM	1.23	0.97	0.96	0.95	0.08
Non-ABC/TQM	1.47	0.91	0.95	0.92	0.00
Non-ABC/Non-TQM	1.98	0.93	0.99	0.90	0.01

variance for each subgroup. The results show that, in all four groups, the impact of quality improvement on profitability improvement (not mediated by cost improvement) is not significant. Results also indicate that, except for the Non-ABC/Non-TQM subgroup, all path coefficients are significant in the other subgroups. The only significant path coefficient in the Non-ABC/Non-TQM subgroup is the impact of organizational commitment on quality improvement.

In summary, the results show that, for the three subgroups, ABC/TQM, ABC/Non-TQM, and Non-ABC/TQM, the relative magnitudes of effects for various paths of the structural model relationships vary slightly with each contingency factor. However, for the Non-ABC/Non-TQM subgroup, except for the significant positive impact of internal preliminary competitive analysis on quality improvement, the remaining path coefficients are not significant. The results indicate that firms with favorable benchmarking antecedents do not experience greater benefits relative to firms with less favorable benchmarking without the information advantage of ABC or the control benefits that often accompany TQM (i.e., the coefficients are insignificant for the Non-ABC/Non-TQM group).

TABLE 7
Summary of Effects in the Subgroups Structural Model

	ABC/ TQM	ABC/ Non-TQM	Non-ABC/ TQM	Non-ABC/ Non-TQM
Quality improvement				
Effect of internal preliminary competitive analysis	0.30**	0.41**	0.43*	0.19
Effect of external preliminary competitive analysis	0.13**	0.43*	0.12**	0.02
Effect of organizational commitment	0.29*	0.17**	0.29**	0.26***
Effect of prior benchmarking	0.14**	0.65*	0.17*	0.12
Relative product cost improvement				
Effect of quality improvement	0.47*	0.27**	0.32**	0.11
Profitability improvement				
Quality improvement	0.14	0.09	0.17	0.01
Effect of relative product cost improvement	0.39**	0.13**	0.32**	0.14

* p < .001
** p < .05
*** p < .10

Next, we assess the differential effect on the pattern of linkages according to the level of TQM control by comparing the Non-ABC/TQM group to the Non-ABC/Non-TQM group. The chi-squared of a baseline model with 234 degrees of freedom (chi-squared = 423.69) was compared against the chi-squared for a model (Table 8) that specified invariance for the endogenous and exogenous matrices with 263 degrees of freedom (chi-squared = 463.58). The difference of 39.89 in chi-squared for 29 degrees of freedom was not statistically significant ($p > 0.10$). The loadings appeared to be the same for Non-ABC/TQM and Non-ABC/Non-TQM. Next, factorial invariance for loadings and error terms was specified. The chi-squared was 502.32 with 312 degrees of freedom. The difference in chi-squared was 38.74 with 49 degrees of freedom and a $p > 0.10$. There is evidence that the error terms are equivalent across the two groups. In the last test, invariance of loadings, error terms, and structural coefficients (i.e., β and γ) was specified. The chi-squared for the latter model was 542.09 with 325 degrees of freedom. The difference in chi-squared was 39.77 with 13 degrees of freedom. The difference was statistically significant ($p < 0.10$) and thus differences in path coefficients were detected. A search procedure followed to identify which path coefficients were different for the two groups.

This procedure involves the testing of two models at a time: Model 3 and one in which a given path coefficient is specified as invariant (Table 8). Thus, the difference in degrees of freedom was one. Chi-squared differences are used as a test statistic with threshold of 2.71 ($p < .10$), 3.84 ($p < .05$), and 6.63 ($p < .001$) for rejecting the specific path invariance. The β coefficients that describe the relationship between internal preliminary competitive analysis and quality improvement (chi-squared difference = 5.71), the relationship between external preliminary competitive analysis and quality improvement (chi-squared difference = 4.83), the relationship between organizational commitment and quality improvement (chi-squared difference = 2.96), and prior benchmarking and quality improvement (chi-squared difference = 4.87) are all significantly different. Hence, the impacts of the endogenous variables are stronger predictors of quality improvement in a Non-ABC/TQM environment

TABLE 8
Invariance Tests between Non-ABC/TQM and Non-ABC/Non-TQM

	χ^2	df	χ^2/df	Nested Models	$\Delta\chi^2$	Δdf	Significance Level
(1) Base model	423.69	234	1.81	—	—	—	—
(2) Equal loadings	463.58	263	1.76	2-1	39.89	29	$p > 0.10$
(3) Equal loadings, measurement error	502.32	312	1.61	3-2	38.74	49	$p > 0.10$
(4) Equal loadings, measurement error, structural coefficients	542.09	325	1.67	4-3	39.77	13	$p < 0.10$
(5a) Internal preliminary competitive analysis → Quality improvement	519.03	313	1.66	3-5a	5.71	1	$p < 0.01$
(5b) External preliminary competitive analysis → Quality improvement	507.19	313	1.62	3-5b	4.83	1	$p < 0.05$
(5c) Organizational commitment → Quality improvement	505.28	313	1.61	3-5c	2.96	1	$p < 0.10$
(5d) Prior benchmarking → Quality improvement	507.19	313	1.62	3-5d	4.87	1	$p < 0.05$
(5e) Quality improvement → Relative cost improvement	509.95	313	1.63	3-5e	7.63	1	$p < 0.01$
(5f) Quality improvement → Profitability	503.41	313	1.61	3-5g	1.09	1	$p > 0.10$
(5g) Relative cost improvement → Profitability	509.06	313	1.63	3-5f	6.74	1	$p < 0.01$

than in a Non-ABC/Non-TQM environment. Also, quality improvement is more conducive for relative costs improvement in a Non-ABC/TQM than a Non-ABC/Non-TQM environment (chi-squared difference = 7.63). The effect of relative costs improvement on profitability improvement is also sample specific, i.e., this effect is more pronounced in a Non-ABC/TQM environment than in a Non-ABC/Non-TQM environment (chi-squared difference = 6.74). However, the impact of quality improvement on profitability improvement is not sample specific as the chi-squared difference is not significant (chi-squared difference = 1.09).

We also assess the differential effect on the pattern of linkages according to the level of ABC information by the ABC/Non-TQM group to the Non-ABC/Non-TQM group. The chi-squared of a baseline model with 234 degrees of freedom (chi-squared = 385.31) was compared against the chi-squared for a model (Table 9) that specified invariance for the endogenous and exogenous matrices with 263 degrees of freedom (chi-squared = 423.43). The difference of 38.12 in chi-squared for 29 degrees of freedom was not statistically significant ($p > 0.10$). The loadings appear to be the same for the ABC/Non-TQM and Non-ABC/Non-TQM groups. Next, factorial invariance for loadings and error terms was specified. The chi-squared was 477.36 with 312 degrees of freedom. The difference in chi-squared was 53.93 with 49 degrees of freedom and a $p > 0.10$. There is also evidence that the error terms are equivalent across the two groups. In the last test, invariance of loadings, error terms, and structural coefficients (i.e., β and γ) was specified. The chi-squared for the latter model was 529.75 with 325 degrees of freedom. The difference in chi-squared was 52.39 with 13 degrees of freedom. The difference was statistically significant ($p < 0.01$) and thus differences in path coefficients were detected. A search procedure followed to identify which path coefficients were different for the ABC/Non-TQM and Non-ABC/Non-TQM groups.

This also involves the testing of two models at a time: Model 3 and one in which a given path coefficient is specified as invariant (Table 9). Thus, the difference in degrees of freedom was one. The β coefficients that describe the relationship between internal preliminary competitive analysis and quality improvement, the relationship between external preliminary competitive analysis and quality improvement, the relationship between organizational commitment and quality improvement, and prior benchmarking and quality improvement (chi-squared differences are 6.86, 5.22, 3.91, and 4.61, respectively) are all significantly different. Hence the impacts of the endogenous variables are stronger predictors of quality improvement in an ABC/Non-TQM environment than in a Non-ABC/Non-TQM environment. Also, the impact of quality improvement on relative costs improvement is more pronounced in an ABC/Non-TQM than a Non-ABC/Non-TQM environment (chi-squared difference = 8.65). The effect of relative costs improvement on profitability improvement is also sample specific, i.e., this effect is more pronounced in an ABC/Non-TQM environment than in a Non-ABC/Non-TQM environment (chi-squared difference = 3.96). However, the impact of quality improvement on profitability improvement is not sample specific as the chi-squared difference is not significant (chi-squared difference = 1.63).

DISCUSSION

Using structural equation modeling, this study uses data at the strategic business unit level and links benchmarking antecedents (internal preliminary competitive analysis, external preliminary competitive analysis, organizational commitment, and prior benchmarking) to quality improvement in plants that use quality benchmarking. It further investigates the relation between quality improvement and relative costs improvement, the relation between

TABLE 9
Invariance Tests between ABC/Non-TQM and Non-ABC/Non-TQM

	χ^2	df	χ^2/df	Nested Models	$\Delta\chi^2$	Δdf	Significance Level
(1) Base model	385.31	234	1.65	—	—	—	—
(2) Equal loadings	423.43	263	1.61	2-1	38.12	29	$p > 0.10$
(3) Equal loadings, measurement error	477.36	312	1.53	3-2	53.93	49	$p > 0.10$
(4) Equal loadings, measurement error, structural coefficients	529.75	325	1.63	4-3	52.39	13	$p < 0.01$
(5a) Internal preliminary competitive analysis → Quality improvement	484.22	313	1.55	3-5a	6.86	1	$p < 0.01$
(5b) External preliminary competitive analysis → Quality improvement	482.58	313	1.54	3-5b	5.22	1	$p < 0.05$
(5c) Organizational commitment → Quality improvement	481.27	313	1.54	3-5c	3.91	1	$p < 0.05$
(5d) Prior benchmarking → Quality improvement	481.97	313	1.54	3-5d	4.61	1	$p < 0.05$
(5e) Quality improvement → Relative cost improvement	486.01	313	1.55	3-5e	8.65	1	$p < 0.01$
(5f) Quality improvement → Profitability	478.99	313	1.53	3-5f	1.63	1	$p > 0.10$
(5g) Relative cost improvement → Profitability	481.32	313	1.54	3-5g	3.96	1	$p < 0.05$

relative costs and profitability improvement, and the impact of quality improvement and profitability improvement. Further analyses assess these relationships within the context of cost and quality systems.

The results show that the measurement model is adequate for the entire sample as well as for the four subgroups. The hypothesized paths show that benchmarking antecedents have a positive impact on quality improvement and that quality improvement affects relative costs improvement, which, in turn, has a significant impact on business unit profitability improvement. However, the impact of quality improvement on profitability improvement *not* mediated by cost improvement is not significant. Also, none of the non-hypothesized paths are significant, indicating that both quality improvement and relative costs improvement mediate the relation between benchmarking antecedents and profitability improvement, and that relative costs improvement mediates the relation between quality improvement and profitability improvement.

The significant impact of quality improvement on profitability improvement through relative costs improvement is in line with the "cost emphasis" in prior literature which suggests that quality efforts that reduce costs transfer their savings to the bottom line. Our findings support advocates of programs that emphasize increasing efficiency and productivity by eliminating defects and unnecessary effort. These advocates hold that profitability improvements associated with quality efforts will come primarily through cost reduction (Bohan and Horney 1991; Campanella 1990; Carr 1991; Gryna 1988; Rust et al. 2002).

We also test for measurement model invariance as well as structural model invariance as the contingency factors of cost and quality strategies. Results show that these contingency factors affect the strength of the model relationships. An examination of differences in path coefficients between the ABC/Non-TQM group and the Non-ABC/Non-ABC group and between the Non-ABC/TQM group and the Non-ABC/Non-TQM group shows significant differences in model relationships. These results suggest that manufacturing plants that have adopted ABC or TQM experienced higher benefits compared to those with Non-ABC/Non-TQM as the model relationships are higher for ABC or TQM plants than for Non-ABC/Non-TQM plants. This indicates that the antecedents to successful benchmarking identified by Elnathan et al. (1996) are significantly more effective in supporting quality improvement and cost improvement in the presence of ABC or TQM than in their absence.

This study has limitations. For example, it is desirable to have multiple respondents providing data as opposed to a single respondent in order to improve data quality and avoid common-response bias. However, collecting data from several sources significantly increases the cost of data collection. Consistent with prior research (Ernst and Teichert 1998; Lynn and Akgun 1998), we have used the most knowledgeable (or key) respondent to provide data to maximize the likelihood of highly reliable data; we have used perceptual measures for both exogenous and endogenous variables and those were provided by the same individual. Another limitation is that this study used only cost and quality strategies as contingency factors. Future studies may incorporate additional contingency factors such as product complexity, size, and industry. Identifying contingency factors that may affect these relationships could provide both the academic and practitioner communities with potentially compelling answers to the best strategic fits.

Despite the limitations, this study is of particular interest to manufacturing units as it provides strong evidence to suggest that benchmarking antecedents lead to improved quality that is translated into improved costs and, in turn, improved profitability. Our findings also show the importance of the contingency factors within the context of model relationships. Finally, these findings have wide applicability because the study spans all of the manufacturing sectors (SIC 20 through 38).

APPENDIX

Part I. Degree of Benchmarking Antecedents Measures (Elnathan 1996):

Please indicate the degree to which each of the following is present for your plant benchmarking initiative in relation to quality improvement, using a seven-point scale where 1 = Extremely Low and 7 = Extremely High.

	Extremely low						Extremely high
(1) Assessment of performance in relation to target/goals	1	2	3	4	5	6	7
(2) Philosophy of continuous improvement	1	2	3	4	5	6	7
(3) Management intuition	1	2	3	4	5	6	7
(4) Industry ranking	1	2	3	4	5	6	7
(5) Industry comparisons	1	2	3	4	5	6	7
(6) Customer/stakeholder feedback	1	2	3	4	5	6	7
(7) Senior management support	1	2	3	4	5	6	7
(8) Clear set of objectives	1	2	3	4	5	6	7
(9) Long-term commitment	1	2	3	4	5	6	7
(10) Empowering organizational culture	1	2	3	4	5	6	7
(11) Extent of prior benchmarking experience	1	2	3	4	5	6	7
(12) Experienced coordinator	1	2	3	4	5	6	7
(13) Training	1	2	3	4	5	6	7

Quality Improvement (Crosby 1979, 1996)

	Year 2000	Year 2001
Scrap rate in parts per million	____	____
Rework rate in parts per million	____	____
Defect rates of finished products in parts per million	____	____

Relative Costs Improvement* (Gatignon and Xuereb 1997)

	Our costs are much lower						Our costs are much higher
Manufacturing/operations	1	2	3	4	5	6	7

* = reverse coded

Profitability Improvement (Kinney and Wempe 2002; Atkinson et al. 2001)

	Year 1999	Year 2000	Year 2001
Net income before corporate expenses	____	____	____
Total sales	____	____	____
Net operating assets (net working capital + long-term operating assets)	____	____	____

Cost Strategy (Krumwiede 1998)

For each of the following three types of costing techniques, indicate whether your business unit uses it.

A. *Individual plant-wide overhead rate*: allocates all indirect manufacturing costs via a single overhead cost rate (e.g., 200 percent of direct labor, etc.).

B. *Departmental or multiple plant-wide overhead rates*: allocates all indirect manufacturing costs using either different rates by department or multiple plant-wide rates (e.g., or 66.2 percent).
For purposes of this study, plants A and B are presumed to be a nonadopter of ABC.

C. *Activity- or Process-Based Costing Method ("ABC"):* assigns indirect costs to individual activity or process (rather than departmental) costs pools, then traces costs to users activities (e.g., products, customers, etc.) based on more than one cost driver.
For purposes of this study, plant C is presumed to be an adopter of ABC.

Question:
Which plant (A, B or C) represents your company? Please tick against A, B or C below.
A ___________
B ___________
C ___________

Quality Control System (Slocum 1996)

A. *Traditional quality control*: (1) screen for quality, (2) quality is the responsibility of the quality control department, (3) some mistakes are inevitable, (4) quality means inspection, (5) scrap and reworking are the major costs of poor quality, (6) quality is tactical issue.
B. *Total quality management*: (1) plan for quality, (2) quality is everybody's responsibility, (3) strive for zero defects, (4) quality means conformance to requirements that meet or exceed customers' expectations, (5) scrap and rework are only a small part of the costs of nonconformance, (6) quality is a strategic issue.

Question: Which quality system (A or B) represents your company? Please tick against A or B below.
A ___________
B ___________

If your answer is B, please indicate how long you have implemented TQM ___________

Part II. Please answer the following:

(1) What is your business two-digit SIC code? ___________
(2) What is the number of employees at your plant? ___________
(3) How long have you been working at this plant? ___________

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