



Successful ISO 9000 implementation in Taiwan

How can we achieve it, and what does it mean?

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Abstract

Purpose – This study aims to examine empirically how business in Taiwan has successfully implemented and benefited from ISO 9000.

Design/methodology/approach – Of 1,668 survey questionnaires mailed to companies with ISO 9000 certification, a total of 441 usable responses were used in the survey. Using the structural equation model, this study is grounded in a theoretical framework that links five key variables: top management support, quality planning, employee involvement, continuous improvement and firm performance.

Findings – The empirical results indicate that there is a positive relation between ISO 9000 and business performance. Keys to success include four constructs, namely top management support, quality planning, employee involvement and continuous improvement. These constructs are a series of chain, rather than parallel components.

Originality/value – This study constructs a conceptual framework that links the following key variables: top management support, quality planning, employee involvement, continuous improvement and firm performance. This study not only assesses the impact of these practices on firm performance, but also clarifies the process through which ISO 9000 implementation effects performance. Moreover, it provides an empirical framework for testing the well-known PDCA cycle. The results should provide valuable information for dealing with similar managerial issues.

Keywords ISO 9000 series, Senior management, Quality management, Employee involvement, Continuous improvement, Taiwan

Paper type Research paper

Introduction

ISO 9000 has been established for most of the past two decades, albeit in different revisions. The conformation and application of standardized quality system models

Data analyzed in this paper were collected by the research project “An Empirical Study on Motivation for Experience with ISO 9000 and ISO 14000 Certification in Taiwan” sponsored by the National Science Council (NSC 90-2416-H006-019-SSS). This research project was carried out by the National Cheng Kung University Department of Statistics and directed by Dr Jeh-Nan Pan. The Center for Survey Research of Academia Sinica is responsible for the data distribution. The authors appreciate assistance in providing data from the institutes and individuals aforementioned. The views expressed herein are the authors’ own.



(ISO 9000) in business is considered one of the most important recent phenomena in quality management development and globalization (Dick, 2000). According to the latest statistics released by the ISO (2006), up to the end of December 2005, 161 countries accounted for 776,608 certifications. Such an impressive number does indeed make ISO 9000 a universal and significant phenomenon.

While the nature and scope of ISO 9000 is well understood, several issues remain unaddressed. First, optimistic (Arauz and Suzuki, 2004; Huarng *et al.*, 1999; Yahya and Goh, 2001; Casadesús and Karapetrovic, 2005) as well as pessimistic (Corrigan, 1994; Stephens, 1994; Lima *et al.*, 2000) views are held about ISO 9000 certification. While many businesses have benefited, many others have failed to achieve quality and competitive benefits through ISO 9000 implementation, which means that not all of companies are able to take advantage from the certification. For this reason, it is important to take a closer look at the issues surrounding the implementation of ISO 9000 and construct a conceptual framework for its successful implementation.

Second, among all of the empirical studies, many examine the impact of implementation process on ISO 9000 performance (Arauz and Suzuki, 2004; Gotzamani and Tsiotras, 2002; Huarng *et al.*, 1999; Terziovski *et al.*, 2003; Joubert, 1998; Meegan and Taylor, 1997; Vloeberghs and Bellens, 1996), but very few (Naveh and Marcus, 2005; Briscoe *et al.*, 2005) are grounded in a particular framework. Sousa and Voss (2002), nevertheless, suggest models for quality awards and quality standards (e.g., ISO 9000) that require adherence to a particular framework. Moreover, Conti (2004) advocates that it is essential that business customers and their suppliers be on the same wavelength in terms of quality standards all over the world, as it is important to share the same conceptual framework on how to manage and assure quality. For the globalization of ISO 9000, it is urgent that a conceptual framework of its successful implementation be constructed for thousands of companies worldwide.

Third, the Deming cycle, also known as the plan-do-check-act (PDCA) cycle, was developed to link the production of a product with consumer needs and to focus the resources of all departments in an organization. The PDCA cycle is, essentially, used as a guide for the continuous improvement of quality, which is an ongoing process (Senge, 1992). The ISO 9000 philosophy emphasizes top management support, quality planning, employee involvement and continuous improvement, and this, in fact, closely resembles Deming's PDCA cycle. Important here, however, as Dow *et al.* (1999) argued, is that a fundamental weakness in the literature on quality management is the underlying assumption that quality management practices are interdependent, although this has never been empirically tested. Although the widely-accepted PDCA cycle should be evidence enough, an empirical testing of the framework is required.

Fourth, little research has examined the effects of top management support, quality planning, employee involvement and continuous improvement in ISO 9000 implementation. Oakland (2005) contends that:

Quality professionals must be in the vanguard of helping organizations increase competitiveness, but they will be listened to only if they communicate what they offer in clear terms that managers and employees can identify with. Improving performance through good planning, better processes and full involvement of the people should be the focus for quality professionals in the 21st Century.

Najmi and Kehoe (2000) claim that the ISO 9000 series provide an important initial step towards quality development and that the significant factors are top management commitment, clear developmental planning, employee involvement and continuous improvement. Thus, it is necessary to consider what effects these variables have on ISO 9000 implementation.

Few studies investigate both the impact of ISO 9000 practices on firm performance and the relationships among these practices. This is the first paper to explore these issues by using the structural equation model. This model constructs an integrated theoretical framework that links five key variables: top management support, quality planning, employee involvement, continuous improvement and firm performance. This study also develops a conceptual framework model for ISO 9000 practices by not only assessing the impact of these practices on firm performance, but also clarifying the process through which ISO 9000 implementation effects performance. Moreover, it examines whether these ISO 9000 practices have parallel influences on firm performance, as previous research indicates, or whether they actually interconnect, like links in a chain. This research provides insight into the important issues reported in the aforementioned research. In addition to supplying ISO 9000 practitioners with relevant practical information, the findings in this study may facilitate the creation of implementation guidelines to help organizations progress more successfully towards ISO 9000 certification. Furthermore, the results of this study may provide managers with the information they need to determine the degree to which they should embrace or reject ISO 9000 certification.

The rest of this paper is organized as follows. The next section introduces the research model and related hypotheses based on the literature review. The following section then describes the research methodology, including the sample and data collection procedures, operationalized measures of the variables and the tests of reliability and validity. The next section presents the results from testing the structural model. Next, the penultimate section discusses the contributions that this research makes to the extant literature and the implications of the results for researchers and practitioners. The paper concludes with suggestions for further research.

Conceptual framework and research hypotheses

The ISO 9000 series provides the basis for demonstrating a company's compliance with a quality system since it has established the documentation and procedural standards that must be met (Anderson *et al.*, 1999). This study reviews the literature and then suggests four constructs, namely top management support, quality planning, employee involvement and continuous improvement, to incorporate the ongoing operations associated with continuous organizational efforts by ISO implementers. The consideration of these four constructs allows us to examine and test the relationships among them and to assess the direct and indirect impact of each of them on ISO 9000 performance. Figure 1 presents the theoretical framework used in this investigation. The individual parts of the model are discussed below, and then the hypotheses of this study are presented.

Top management support

Top management support refers to the commitment, involvement and resources that top management devote to their work. The resources and internal cooperation

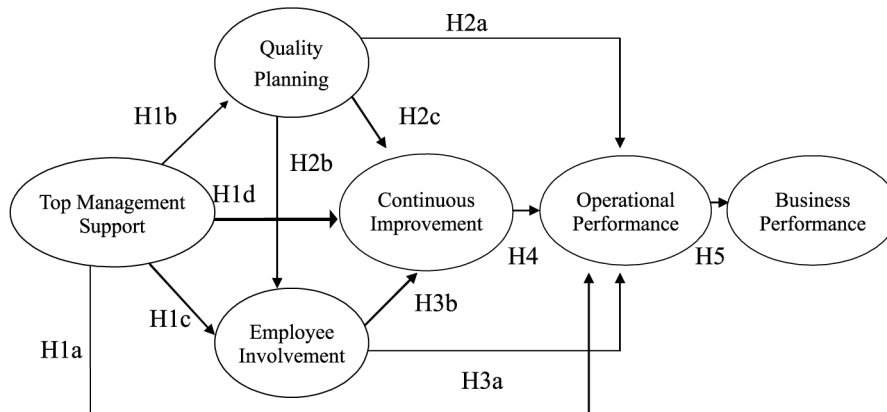


Figure 1.
Conceptual model

required generally come when top management provides appropriate leadership (Goetsch and Davis, 1995; Carlsson and Carlsson, 1996). Sandholm (2005) contends that worthwhile results can only be achieved when top management has a clear and explicit commitment, and Juran and Gryna(2001) agree that active leadership by top management goes hand in glove with successfully achieving quality superiority.

Rayner and Porter (1991) and Lamprecht (1991) put forth the view that commitment to ISO 9000 begins with top management who perceive ISO 9000 as something beyond just a matter of producing goods. Effective and successful ISO 9000 implementation, in their view, is dependent on the attitude of the chief executive. Vloeberghs and Bellens (1996) also argued that strong senior management commitment had a positive effect on ISO 9000 implementation. Thus, the findings in the literature lead us to the following hypothesis:

H1a. Top management support is positively related to operational performance.

Anecdotal evidence has it that top management support is integral to encouraging the practices and behaviors that lead to quality performance throughout an organization. It is expected to have an impact on all of the dimensions of the framework (Flynn *et al.*, 1995) and, thus, might even be considered the cornerstone.

Quality is viewed as ultimately and inescapably the responsibility of top management. ISO 9000 standards require that top management ensure that the planning of the quality management system is performed in such a way that it meets the quality objectives and requirements (Hoyle, 2001). Top management commitment and involvement must first be assured for the planning of ISO 9000 implementation (Sarkar, 1998). Because top management creates the organizational systems that determine how products and services are designed and produced, the quality-improvement process must begin with management's own commitment to total quality (Hackman and Wageman, 1995). And, once a strategic plan is in place, organizational leaders need to determine the goals, performance measures and targets to fully execute that plan. Worth pointing out, no matter what the type of business, the plan for its development should, as its mission, ensure that there is full commitment

and that top management will provide its dedicated support. Only in this way, can the objectives be achieved (Hopen, 2004). This then takes us to the following hypothesis:

H1b. Top management support is positively related to quality planning.

The role of dedicated, effective leaders provide quality management of processes by integrating staff members' efforts, enhancing communication and the breaking down all obstacles and fears that would impede employees from being fully involved in the change (Ishikawa, 1985; Deming, 2000; Oakland, 2000). That is, leaders must personally be involved in communicating their company's goals and plans and in motivating and rewarding their employees. Top management must be seen by the other employees to be totally committed and involved. This commitment requires top management support and implies participation, funding for resources and recognition of accomplishments. According to Argyris (1998, p. 99):

Commitment is about generating human energy and activating the human mind. Without it, the implementation of any new initiative or idea would be seriously compromised.

It is essential for top management to model all of the quality behavior that they want employees to mimic. Bit-by-bit, leadership from top management downwards can eventually lead to changes in the attitudes of staff members. Employees' work effectiveness is deemed a direct function of the quality of the systems that managers create (Goetsch and Davis, 1995). Just as important, both vision and quality policies need to be effectively communicated by management to every staff member in the organization. Furthermore, management must make certain that the said vision and quality policies can be applied to every job function in the organization and that each staff member understands what that means in his/her position. It is the duty of fully-committed managers to transmit this, and this will determine how successfully personnel adapt to these changes (Sandholm, 2005). As Wilms *et al.* (1994) put it, whatever management does, in whatever direction they push, and however hard they push dictates where the company eventually goes. Thus, the following hypothesis is postulated:

H1c. Top management support is positively related to employee involvement.

The Malcolm Baldrige National Quality Award (MBNQA) and the European Quality Award (EQA) recognize the crucial role of top management leadership in creating goals, values and systems that guide the pursuit of continuous performance improvement (NIST, 2006; EFQM, 2006). To implement ISO 9000 systems as effectively as possible, managers have to be knowledgeable about how to identify the best practices for ISO implementation after receiving certification, determine organizational weaknesses and focus on making maximal efforts toward continuous improvement. Juran (1993) emphasized that management has a duty to instill a philosophy of continuous improvement and provide the necessary supporting organizational practices. This may help ISO-certified firms to determine the areas in which they need to be engaged in the process of continuous improvement (Chang and Lo, 2005). Top management must always provide evidence of its commitment and ensure the quality system includes a commitment to continual improvement (Huarng *et al.*, 1999). Hua *et al.* (2000) examine the critical factors of ISO 9000 that require continuous improvement. Through both a mail survey and personal interviews, Hua

et al. determine that top management support is critical to continuous improvement. Thus, the following hypothesis is put forth:

H1d. Top management support is positively related to continuous improvement.

Quality planning

Quality management theorists have proposed that, to improve business performance, formal quality planning processes are required to produce explicit quality plans containing detailed quality objectives and clearly identified means of achieving them (Feigenbaum, 1983; Dumke de Medeiros, 2000; Juran and Gryna, 2001). In quality planning, provisions to measure, monitor and analyze processes, determine their sequence and interactions, identify criteria and methods to ensure effective operations and control and document a quality management system must be put in place. Apart from that, there need to be provisions for the resources and information necessary to support the operations and the monitoring of these processes. To sum up, quality planning prepares an organization to meet quality goals.

Improving quality is a long-term competitive strategy (Barclay, 1993; Deming, 2000; Juran, 1986; Lascelles and Dale, 1988; Peters, 1988; Tillery and Rutledge, 1991), and as such, it is necessary to concentrate on a thorough plan as to how the business has to be developed with a focus on quality. A quality plan including all quality related activities has to be developed, and these be effective integrated so that they can only result in optimal competitiveness and excellent business performance (Sandholm, 2005). A study by the American Quality Foundation & Ernst and Young (1992) in four developed countries, the USA, Canada, Germany and Japan, found that strategic quality planning had significant effects on organizational performance. Thus, the following hypothesis is posited:

H2a. Quality planning is positively related to operational performance.

In the ideal situation, employees in an organization are eager to help meet its mission. They have good intentions, and they work hard. But by any measure, organizations must develop formal systems to encourage, track and reward employee involvement. Otherwise, the extent and quality of participation might very well decline, and this would result in a very dissatisfied work force (Chevalier, 1991; Griffin, 1988).

Two types of plans need to be made – plans for individuals and plans for work groups, or teams. Within each, specific prioritized projects and activities are defined and laid out so that the organization's overall plan can be followed in proper sequence. Individual work efforts must be planned so that collectively they both facilitate individual employee's full involvement and complement work team efforts and thus help them achieve their plans. And, in so doing, organizational strategies and goals can be successfully accomplished (Hopen, 2004). Wilson and Collier (2000) test the theory and causal performance linkages implied by the MBNQA and find that the path from quality planning to human resource management is statistically significant. Thus, the following hypothesis is proposed:

H2b. Quality planning is positively related to employee involvement.

ISO 9000 standards require that the organization plan the monitoring, measurement, analysis and improvement processes necessary to continually improve the

effectiveness of the quality management system. It also necessitates that the organization conduct internal audits at planned intervals to determine whether the quality management system conforms to the planned arrangements (Hoyle, 2001).

In a broad sense, the combination of systems for quality planning and continuous improvement creates checks and balances for the organization. Quality planning can only come to fruition through continuous improvement. The path from quality planning to continuous improvement was supported by both Anderson *et al.* (1995) and Rungtusanatham *et al.* (1998). In this regard, continuous improvement means analyzing current performance and taking action. Without taking action as dictated by quality planning, improvement is unlikely. Thus, it is hypothesized that:

H2c. Quality planning is positively related to continuous improvement.

Employee involvement

As the primary producer of output for customers, the workforce is, of course, an important player, and their cooperation and personal commitment to ISO 9000 systems are essential (Koo *et al.*, 1998; Mahadevappa and Kotreshwar, 2004). Each and every employee in a firm must be fully committed to ISO 9000 implementation. The collective, integrated and coordinated efforts of all fully involved staff members make for a world-class organization (Ishikawa, 1985). If employees are not involved in the development of the system, there is no question: they will not comply with the procedures and goals defined in the system (Vloeberghs and Bellens, 1996). Hence, it is hypothesized that:

H3a. Employee involvement is positively related to operational performance.

According to Senge (1992) "Continuous improvement is a natural by-product of people's commitment and empowerment". The ISO 9000 series provides the platform for a company to demonstrate its compliance with a quality system by establishing the documentation and procedural standards that must be met (Anderson *et al.*, 1999). Beyond any doubt, employees in an organization must follow the procedures laid out in the plans (Douglas *et al.*, 1999). Only through involvement can employees internalize the need to continually improve and devote their efforts to fix deficiencies, and thereby achieve the goals of quality improvement. Empirical results also support the assertion that employee involvement is directly related to continuous improvement (Flynn *et al.*, 1995; Ho *et al.*, 1999). This is not surprising because efficient measurement, availability and use of quality data require continuous awareness of quality-related issues among employees who play a significant role in quality decisions. Generally speaking, only when these decisions are based on accurate quality data, can they contribute to improvement (Ho *et al.*, 1999). Thus, we propose the following hypothesis:

H3b. Employee involvement is positively related to continuous improvement.

Continuous improvement

ISO 9000 standards also require that the organization continually improve the effectiveness of the quality management system through the use of the firm's policy on quality, quality objectives, audit results, the analysis of data, corrective and preventive actions and management review (Hoyle, 2001). Chin *et al.* (2000) stated that continuous improvement of the ISO 9000 quality management system is essential to monitor and improve the system.

Indeed, certification is just the beginning of the ISO 9000 process, what cannot be ignored is that the firm must continue with its internal audits, management review and corrective actions (Hockman and Grenville, 1994). Based on a survey of ISO certified companies in India, Acharya and Ray (2000) found that the most important focus is on continuous improvement after implementation. Several studies (Huarng *et al.*, 1999; Arauz and Suzuki, 2004) reported that the opportunity for ISO 9000 certified companies to gain organizational benefits was influenced by the effectiveness of continuous improvement in ongoing operations. Thus, we hypothesize the following:

H4. Continuous improvement is positively related to operational performance.

Relationships between operational performance and business performance

A firm's profits clearly depend on its costs and sales. First, improving product quality by reducing waste and improving efficiency increases a firm's return on assets, which in turn increases its profitability (Handfield *et al.*, 1998). Second, improvements in quality increase customer satisfaction, and this then leads to increased market share and profit growth (Craig and Douglas, 1982; Jacobson and Aaker, 1987; Phillips *et al.*, 1983). According to Huarng *et al.* (1999), the direct benefit from ISO 9000 certification lies in systemization which, it is expected, results in better product quality, which in turn improves sales. Devos *et al.* (1996) reported that ISO 9000 certified companies are perceived to have better profits, return on investment, sales per employee and asset turnover. Naser *et al.* (2004) found an association between ISO 9000 registration and business performance of companies. Tari and Molina (2002) and Heras *et al.* (2002) showed that firms implemented ISO 9000 achieve significant improvement in business results. Consequently, this study hypothesizes the following:

H5. Operational performance is positively related to business performance.

Research methodology

This empirical study started by establishing the sample and data collection procedures and the operationalized measures of the variables. Aside from this, reliability and validity tests were conducted to confirm the internal consistency and distinctions of the measurements in this study.

Sample and data collection procedures

A list of 1,668 companies with ISO 9000 certification in Taiwan was obtained from the Bureau of Standards, Metrology and Inspection of the Ministry of Economic Affairs of the ROC. A survey questionnaire was mailed to the 1,668 companies, and of these, a total of 441 usable completed surveys were obtained, yielding a 26.44 percent response rate. Table I summarizes the distribution of the response rates for two sectors,

Industry subdivision	Percent of companies	
	Population	Sample
Manufacturing	92.2	92.8
Non-manufacturing	7.8	7.2

Table I.
Breakdown of samples by
industry type

manufacturing and non-manufacturing, which is comparable to Taiwan's industry structure.

Operationalized measures of the variables

The instrument followed standard scale development procedures, which started with a review of the extant academic literature and then conducted a series of interviews with various organizations. Those interview items incorporated comments from practitioners who participated in executive education sessions in ISO 9000.

Based on the ISO 9000 literature (Vloeberghs and Bellens, 1996; Joubert, 1998; Anderson *et al.*, 1999; Huarng *et al.*, 1999; McAdam and Mckeown, 1999) and field interviews, the portion of the survey instrument pertaining to this investigation measured a total of 17 question statements, which can be classified into two categories: ISO 9000 implementation and firm performance.

ISO 9000 implementation category. The ISO 9000 implementation category includes four constructs, top management support, quality planning, employee involvement and continuous improvement. They were measured from one, three, one and three items, respectively. The respondents were asked to indicate their perceived depth of ISO 9000 implementation practices.

Firm performance. Quality studies (Flynn *et al.*, 1995) have identified two dimensions of firm performance that are affected by quality: operational and business. This study uses seven items to measure the operational performance of ISO 9000 practices. The respondents were asked to indicate their perceived benefits of ISO 9000 certification. Business performance is defined as the achievement of financial and market share objectives. Based on the literature, this study considers two variables for a more complete assessment of business success and achievement: market share growth and business performance growth. The respondents were asked to indicate their perceptions of market share growth and profit growth after ISO 9000 certification.

We measured all of the above question items on a five-point Likert scale, where a "one-point" score means that the respondent strongly disagrees with the question statement and a "five-point" score means that the respondent strongly agrees with the question statements. This can be treated as interval data. Table II lists the specific items.

Analysis of reliability and validity

In order to avoid possible interactions between the measurement and the structural model, the analysis followed a two-step procedure based on Gerbing and Anderson (1988). The first step employed a confirmatory factor analysis to develop a measurement model that achieved an acceptable fit to the data. The second step tested the theoretical model (or structural model) using path analysis to determine fitness.

This section examines the quality level of the measurement scales we used. The reliability and three components of construct validity, i.e. unidimensionality, convergent validity and discriminant validity were assessed.

Reliability provides a measure of the internal consistency and homogeneity of the items comprising the scale (Churchill, 1979). Table II provides the results of the reliability assessment of the scales using Cronbach's α . For Cronbach's α , a value above 0.70 is generally considered acceptable for existing scales. All scales in this study exhibit good reliability.

Sample items	Mean	Standard deviation	Cronbach's α	Factor loading	t-value
<i>Top management support</i>	4.07	0.82	0.85 ^a		
<i>Quality planning</i>			0.77		
Identification of quality aspects	4.15	0.70		0.80	^b
Defining standard procedures	4.29	0.69		0.75	14.22
Documentation	4.28	0.65		0.76	11.33
<i>Employee involvement</i>	3.71	0.86	0.85 ^a		
<i>Continuous improvement</i>			0.84		
Periodic auditing	4.24	0.72		0.70	^b
Following standard procedures	4.18	0.73		0.84	16.06
Corrective action	4.10	0.75		0.89	16.16
<i>Operational performance</i>			0.89		
Increased productivity	3.26	0.88		0.84	^b
Cost reductions	2.95	0.96		0.75	6.56
Improved internal procedures	3.91	0.72		0.70	10.44
Improved employees' morale	3.34	0.84		0.79	10.55
Improved on time delivery	3.40	0.88		0.74	10.14
Improved perceived quality	3.86	0.75		0.81	11.82
Improved customer satisfaction	3.81	0.78		0.80	11.84
<i>Business performance</i>			0.86		
Increased market share	3.13	1.00			^b
Increased profitability	3.08	0.93		0.94	9.18

Notes: ^a For single item construct, the study assume that the reliability is 0.85; ^b Item fixed for scaling purposes

Table II.
Measurement model
statistics

To establish the unidimensionality of the measurement scale, a confirmatory factor analysis was carried out from which the model theoretically deduced from each scale was estimated. Evidence of the unidimensionality of each construct included appropriate items with a loading of at least 0.50 on their respective hypothesized components and with a loading not exceeding 0.30 on other components in the factor analysis (Steenkamp and van Trijp, 1991). The factor loadings associated with this model are listed in Table II, and all factor loadings are high and statistically significant, indicating unidimensionality.

Convergent validity is exhibited when a set of alternative measures accurately represents the construct of interest (Churchill, 1979). A test of the factor loading of each item was used to assess convergent validity. For convergent validity, items are expected to have standardized loadings greater than 0.70, which implies that the indicators share more variance with their respective latent variable than with error variance. Table II shows that the convergent validity for all scales was above the minimum threshold.

Discriminant validity indicates that each variable really does represent a different concept. One way of testing discriminant validity is to bring two concepts together and to study the dimensionality of the new concept. The two concepts are considered to be different if the hypothesis that together they form a single concept can be rejected. Discriminant validity can be assessed using a series of "pairwise tests" (Bagozzi and Phillips, 1982) of all competencies. The pairwise analysis tests determine whether a

confirmatory factor analysis model representing two competencies with two factors fits the data significantly better than a single-factor model. A statistically significant difference between the chi-squared values for the two models (degree of freedom = 1) allows us to confirm the existence of discriminant validity. Table III lists the values of the chi-square differences calculated for all possible construct pairs. All chi-square differences are significant ($p < 0.01$). Therefore, although the six constructs are interrelated (based on the correlation values), it is reasonable to claim that they are concepts that differ from one another. Thus, the existence of discriminant validity is affirmed.

Before the structural equation model (SEM) was evaluated, the validity of the measurement models was tested (Jöreskog and Sörbom, 1993). That is, the resulting scales in the exploratory factor analysis were evaluated and refined via a confirmatory factor analysis before the full latent variable model was tested (Gerbing and Anderson, 1988). Table IV lists the goodness-of-fit statistics associated with this model. Overall, the fit indices show an adequate fit to the data.

In sum, the measurement model is clean, and there is sound evidence of reliability, unidimensionality, convergent validity and discriminant validity, thus facilitating the structural model evaluation.

Chi-square differences matrix	Top management support (1)	Quality planning (2)	Employee involvement (3)	Continuous improvement (4)	Operational performance (5)	Business performance (6)
(1)	–					
(2)	121.81	–				
(3)	0.62 ^a	95.21	–			
(4)	98.05	113.72	93.67	–		
(5)	118.68	126.60	114.66	135.12	–	
(6)	107.18	116.45	100.34	124.74	120.32	–

Table III.
Chi-square differences matrix

Notes: All chi-squared difference tests are significant at p -value < 0.01 . (Critical value of chi-square for 1 degree of freedom at p -value = 0.01 is 6.63); ^a these two constructs are single item, and their correlation coefficients are shown

Goodness-of-fit statistics	Measurement model	Structure model	Recommended values for fit	Sources
Chi-square	305.92	311.27		
Degrees of freedom	120	124		
Chi-square/degrees of freedom	2.55	2.51	> 3.00	Hair <i>et al.</i> (1995)
RMSEA ^a	0.06	0.06	> 0.08	Jöreskog and Sörbom (1993)
Comparative Fit Index (CFI)	0.98	0.98	< 0.90	Jöreskog and Sörbom (1993)
Goodness of Fit Index (GFI)	0.93	0.93	< 0.90	Byrne (1998)

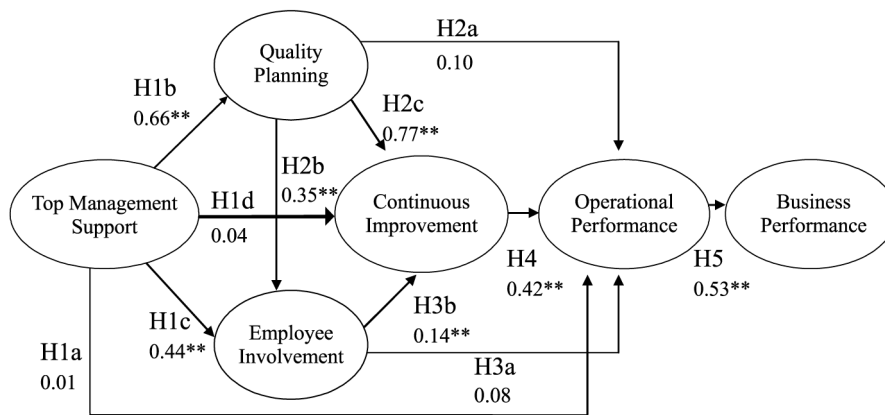
Table IV.
Goodness of fit statistics

Note: ^a Root Mean Square Error of Approximation

Results

Based on the validated scales, the research propositions were tested using a structural equation model (SEM) to represent the causal relationships specified by our hypotheses. The estimated standardized parameters for the SEM are listed in Figure 2 along with the levels of significance. Overall, the chi-square value for the structural model is 311.27 (df = 124), and the χ^2/df ratio for the structural model in this study is 2.51 (311.27/124), which is indicative of an acceptable fit in this sample. The model fit also used CFI (0.98), GFI (0.93), AGFI (0.90) and RMSEA (0.059). The results presented here indicate that an adequate fit of the data was achieved for the structural equation model. The goodness of fit statistics are listed in Table IV.

With regard to the tests of the individual research propositions, these parameters are reported in Table V.



Note: ** significant at the 0.05 level

Figure 2.
Parameter estimates for
conceptual model

Path	From	To	Standardized coefficient	t-value	Significant
H1a	Top management support	Operational performance	0.01	0.01	No
H1b	Top management support	Quality planning	0.66	10.62	Yes
H1c	Top management support	Employee involvement	0.44	7.45	Yes
H1d	Top management support	Continuous improvement	0.04	0.67	No
H2a	Quality planning	Operational performance	0.10	0.58	No
H2b	Quality planning	Employee involvement	0.35	5.12	Yes
H2c	Quality planning	Continuous improvement	0.77	8.16	Yes
H3a	Employee involvement	Operational performance	0.08	1.10	No
H3b	Employee involvement	Continuous improvement	0.14	2.46	Yes
H4	Continuous improvement	Operational performance	0.42	2.48	Yes
H5	Operational performance	Business performance	0.53	7.95	Yes

Table V.
LISREL structure model

Discussion and implications

The primary purposes of this study were to investigate the relationships among top management support, quality planning, employee involvement and continuous improvement and to identify the direct and indirect effects on ISO 9000 performance. The results and their implications are discussed in this section.

Discussion of results

Our empirical ISO 9000 model indicates that the ISO 9000 constructs can be classified into four constructs and that each construct has a unique role in the system. First, top management clearly has a significant role to fill in a successful ISO 9000 implementation. Companies with greater top management support are more likely to have thorough quality planning that facilitates successful ISO implementation (*H1b*, standardized coefficient = 0.66). Top management support also empowers employee involvement in ISO implementation (*H1c*, standardized coefficient = 0.44). Further, top management support indirectly affects continuous improvement (*H1d*) and operational performance (*H1a*) through the mediating effects of quality planning and employee involvement. The results consistently emphasize the significant role of top management support in ISO 9000 implementation, and this has previously been supported in a number of studies (Rayner and Porter, 1991; Lamprecht, 1991; Vloeberghs and Bellens, 1996). Theoretical quality models, such as the MBNQA and EQA models, indicate that top management support drives the system that brings results (NIST, 2006; EFQM, 2006). Too often, however, a serious commitment on the part of top management to ISO 9000 is weak or even lacking (Hind, 1996). Several respondents, among Hind's sample companies, complained about management's lack of support and its resistance to change when ISO 9000 practices were being implemented. Problems like these make it difficult to cultivate and benefit from ISO 9000's potential. ISO implementation requires top management support which implies participation, funding for resources and recognition of accomplishments.

Second, good underlying quality planning is a solid foundation for ISO implementation in that it helps strengthen employee involvement (*H2b*, standardized coefficient = 0.35) and provides clear guidelines for continuous improvement (*H2c*, standardized coefficient = 0.77). Equally important, quality planning also indirectly affects operational performance (*H2a*) through the mediate effects of continuous improvement (*H4*). Senge (1992) pointed out that firms in the USA and Japan often practice the PDCA cycle in quite different ways. He explained that many American managers have failed to generate a significant improvement because they often jump from plan to action. The inherent weakness here is that it is not always well understood that quality planning cannot be immediate. On the contrary, it takes considerable time and money. In short, sufficient time must be allocated to analyzing and doing the necessary quality planning. It is the duty of managers to devote adequate time to quality planning to customize the ISO program to fit their firm's needs and to help all staff members realize that ISO implementation will help their firm achieve its organizational objectives.

Third, it is clearly apparent from the results that employee involvement is essential, because it internalizes the need for continuous improvement (*H3b*, standardized coefficient = 0.14) and indirectly affects operational performance (*H3a*). Bhuiyan and Alam (2005a, b) concluded that the lack of management support, inadequate perception

of quality on the part of most employees, and employee resistance to change were the main obstacles in establishing an ISO 9000 quality management system. Moreover, Martínez *et al.* (2000) showed that the involvement of both top management and employees simplifies the implementation process. Employees naturally care about the quality of their work, which they will take every effort to improve. But, improvement only happens if they are provided with the proper tools and recognition, and management listen to their ideas. Employee involvement is one approach to improving quality and productivity, it is a means to better meet the organization's goals for quality and productivity at all levels of an organization (Besterfield *et al.*, 2002). Managers need to make employees understand the importance of ISO 9000 certification, model all of the quality behavior that they want employees to emulate, exemplify the ISO 9000 message, remove their employees' fear of change, and in this way, will facilitate employees' voluntary implementation of ISO 9000.

Fourth, it also emerges from our results that improved performance depends most on continuous improvement in ISO implementation, and this must become part of the routine-part of the organization. The standardized coefficient of 0.42 (*H4*) indicates that the more efforts that are made toward continuous improvement, the greater are the rewards that are reaped. Reporting on their quantitative analysis of 221 firms and 18 qualitative case studies of ISO 9000 certified companies in the UK manufacturing sector, Najmi and Kehoe (2001) claim that, as expected, benefits were continuously improved in companies that had attempted, at least to a moderate degree, a post-ISO 9000 quality development strategy. Those companies that had stopped short of pursuing ISO 9000 certification were significantly lagging in the performance dimensions of quality and time as well as in financial aspects. The major criticism about ISO 9000 standards (Burr, 1990; Bodinson, 1991; Struebing, 1996; Brown *et al.*, 1998; Najmi and Kehoe, 2000) is that they do not provide a complete and dynamic system to achieve business excellence. To overcome this shortcoming, as Ho (1995) explained, "the ISO 9000 series should be regarded as the beginning of a continuous improvement rather than the end". What is truly important here is for management to develop a vision that can win the hearts of the people, thereby energizing them to strive for continuous improvement at all levels and in all functions of the organization.

Worth noting too is that the results here substantiate that operational performance is directly related to business performance (*H5*, standardized coefficient = 0.53). This confirms that making efforts in ISO 9000 implementation increases business performance. The confirmed positive effect of ISO 9000 implementation on business performance should be most encouraging for managers.

In light of all the evidence, it is reasonable to conclude that a comprehensive ISO 9000 model is supported by four key constructs, as summarized and depicted in Figure 2, namely top management support, quality planning, employee involvement and continuous improvement. These constructs create a series of chain (i.e. top management support → quality planning → employee involvement → continuous improvement → operational performance → business performance chain), which has a direct impact on business performance. It must be noted that these are not independent, parallel components. There should be no question that practitioners and researchers alike are not free to simply pick and choose a few constructs to implement. The force behind the companies that get results with ISO 9000 is that their leadership

carefully and diligently implements all of the links in the chain and that they do reviews throughout the life of the systems.

Implications for researchers and practitioners

Several important implications in terms of both theory and research and practice emerge from the results of this study. To compare and contrast their key findings in this study with findings from other leading authors around the world, Figure 3 was displayed to show a summarization of seven studies and provide the following details for each one: the performance model, the methodology and sample, ISO 9000 practices and the main findings. In the following points, we draw on the information summarized in Figure 3 to illustrate the similarities and dissimilarities across different

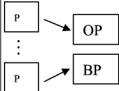
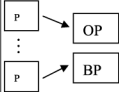
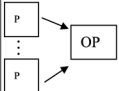
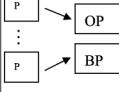
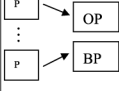
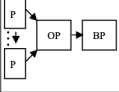
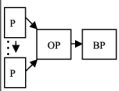
Study	Performance model	Methodology & Sample	Practices	Main findings
Arauz and Suzuki (2004)		Survey study, Regression, Japan, n = 294	Organizational structure, implementation team, auditing, quality activity, employees involvement and information system	The findings suggested that the integration of the influential issues within the organizational system allows the organization effectively to improve performance through ISO 9000.
Huang <i>et al.</i> (1999)		Survey study, Regression, Taiwan, n = 370	Communication, employee involvement, top management support and training, internal audit, quality activities experience, information system and organizational culture	The results indicated that adopting ISO 9000 brings registered Taiwanese enterprises significant performances. Employee involvement, information system and quality activities experience increase operational performance; internal audit and organizational culture increase business performance.
Mahadevappa and Kotreshwar (2004)		Survey study, Correlation analysis, India, n = 56	Product design, process management, supplier quality management, training, employee involvement, quality data, quality department and top management support	Besides quality data and top management support, all other factors have significant relationships with the levels of scrap/defect. All eight factors indicated a decrease in the levels of customer complaints.
Naveh and Marcus (2004)		Survey study, Regression, North America, n = 1,150	Assimilation and going beyond	The study found that the extent to which ISO 9000 is associated with performance improvement depends on the level of its assimilation, and the degree to which an organization goes beyond the minimal requirements of the standard.
Terziovski and Power (2007)		Survey study, Regression, Australia, n = 400	Motivation, quality culture and management responsibility	Motivation for ISO 9000 certification was found to be significantly associated with benefits derived from certification. The results show that ISO 9000 certification can deliver significant business benefits if it is implemented as part of a continuous improvement strategy.
Naveh and Marcus (2005)		Survey study, HLM, North America, n = 1,150	Installation and usage	The use of ISO 9000 is positively related to business performance since operating performance is positively related to business performance. Installation and usage are positively related to operating performance.
The study		Survey study, SEM, Taiwan, n = 441	Top management support, quality planning, employee involvement and continuous improvement	The empirical results indicated that there is a positive relation between ISO 9000 and business performance. Keys to success include four constructs, namely top management support, quality planning, employee involvement and continuous improvement. These constructs are a series of chain, rather than parallel components.

Figure 3. Summary of the empirical evidence on the relationship between ISO 9000 practice and performance

Note: P: practices; OP: operational performance; BP: business performance; HLM: hierarchical linear models

empirical studies on the relationships between ISO 9000 practices and performance from other countries.

First, the overall results have confirmed that top management support, quality planning, employee involvement and continuous improvement are critical practices for ISO 9000 implementation. Besides this, this study develops a conceptual framework model for ISO 9000 that assesses not only the impact of ISO 9000 practices on firm performance, but also the relationship among ISO 9000 practices. The model integrates top management support, quality planning, employee involvement, continuous improvement and performance, and clarifies the process through which ISO 9000 implementation produces performance. This research makes new contributions to ISO 9000 studies, in that we have constructed a relatively comprehensive model that includes the majority of relevant process variables discussed in the literature. Although the ISO 9000 standard itself is homogeneous, how a company implements it will achieve different levels of performance (Casadesùs *et al.*, 2001; Naveh and Marcus, 2005). The findings provide needed implementation guidelines to practitioners for effective ISO 9000 implementation and gives possible reasons to explain some cases of ISO 9000 implementation where the perceived benefits fell short of expectations.

Second, the present study used a structural model to confirm the powerful effects of the PDCA cycle. The model reveals that implementing ISO 9000 is a series of links in a chain (i.e. top management support → quality planning → employee involvement → continuous improvement → operational performance → business performance), rather than parallel components. The PDCA cycle can be applied to the business process in all organizations, regardless if they are seeking ISO 9000 certification. The results show that if practitioners want their company to make progress, they have to follow a similar process as the PDCA to lead them toward a creative process (Box, 1997). Neither practitioners nor researchers can simply pick and choose a few constructs to implement. The results should provide valuable information for dealing with similar managerial issues.

Third, the results corroborate previous research, which demonstrates that ISO 9000 standards implementation has improved operational and business performance. The confirmed positive effect of ISO 9000 implementation on business performance should be encouraging for managers. This is likely to be the major determinant of the degree to which managers will embrace or reject ISO 9000 certification in the twenty-first century (Terziovski *et al.*, 2003). Using data from 1998 to 2002, Casadesùs and Karapetrovic (2005) found that although there has been a significant decrease in the perception of ISO 9000 implementation benefits, majority companies still believe that ISO 9000 is useful since ISO 9000 implementation and maintenance costs have substantially decreased (Bhuiyan and Alam, 2005a, b). Thus, the empirically validated positive relation between ISO 9000 and business performance, for example that which is documented in this study, can be very useful for leaders who take the initiative to make improvements in the quality of their products or services, to enhance and to obtain the resources needed for ISO 9000 implementation.

Fourth, the conceptual framework encompasses measures of both efficiency (items such as productivity, cost and time delivery) and effectiveness (items such as internal procedures, employee morale, perceived quality, customer satisfaction and market share growth). This framework confirms both the efficiency and effectiveness of ISO 9000 implementation, and also provides an answer to the dilemma between the two.

Operation management may prefer the high efficiency method of producing more output, rather than ensuring super quality in production, as their productivity bonus may be based on high efficiency. However, Besterfield *et al.* (2002) argue that quality and productivity are not mutually exclusive. Improvements in quality can lead directly to increased productivity and other benefits. Deming (1982) found that improved quality results in a 5.6 percent improvement in productivity, capacity and profit. In this study, Table II shows that the means for the items "Improved perceived quality" and "Increased productivity" are 3.26 and 3.86, respectively. Both are above the midpoint value of three (undecided) on the five-point scale. The correlation coefficient of the two items is 0.635, which is statistically significant because it indicates that ISO 9000 implementation has a positive effect on both quality and productivity. These results indicate that top managers may constantly look for ways to do things right (more efficiency) and, in the meantime, keep asking questions about the impact on quality, customer service and employee morale when making any decisions (more effectiveness). That is, top managers should not only stay focused on the short-term profit or market share, but also the potential long-term impact of all their decisions.

Fuentes *et al.* (2000) conclude that most of the companies aim for certification because they want to improve their image and not their processes. It is also apparent that the lack of a strategic focus causes companies to face obstacles in ISO 9000 implementation. The structural model proposed and tested in this study may serve as a flow chart for practitioners who attempt effective ISO 9000 implementation. Companies should first secure complete top management backing for ISO 9000 implementation. It is far better to forgo immediate implementation in favor of adequate preparation. Top management should motivate management to perform thorough and compelling quality planning. Top management support and complete quality planning empower employees to adhere to ISO 9000 standards. Thus, the three constructs lay the foundation for ISO 9000. Further, an organization must continue with its internal audits, management review and corrective actions. All in all, a firm cannot simply select some of the ISO 9000 practices discussed above and expect to realize full operational and business benefits from implementing partial ISO 9000. With the right support, planning, employee involvement and continuous improvement, any firm can look forward to a cost and time efficient ISO 9000 implementation for maximum profitability and return on investment.

Limitations and avenues for further research

A few limitations of this study must be mentioned. These limitations also point to worthwhile avenues for further research.

First, the potential country-specific properties of the data could very well affect the generalizability of the results. While this sample is valuable, caution must be taken in generalizing the results of ISO 9000 implementation in Taiwan to other countries.

Second, this study focuses on top management support, quality planning, employee involvement and continuous improvement as successful factors in ISO 9000 implementation. Future conceptual development and empirical research might consider other factors, such as company size, information technology, corporate governance, human resources or existent quality system, as some of these may affect ISO 9000 performance.

Third, this work investigates overall ISO 9000 certificated businesses. However, much empirical research has suggested that the relationship between quality management practices and organization is contingent on the operating environment and industry. Researchers should be encouraged to further examine the model in various industrial settings.

Fourth, our study uses perceptual measures of the magnitude of operational and business performance. To make more precise predictions as to how ISO 9000 affects business performance, additional research could develop objective measures of these constructs.

In the past two decades, companies have invested lots of money in implementing ISO 9000 standards. Without a careful understanding of how such a quality system influences individual and organizational decision making and performance, it is likely that these investments will not be optimally leveraged. This situation presents many rich research opportunities for developing generalizations about what factors impact ISO 9000 performance and how. We hope that the work presented here can play a part in helping to affect both the theory and practice of ISO 9000 implementation.

References

- Acharya, U.H. and Ray, S. (2000), "ISO 9000 certification in Indian industries: a survey", *Total Quality Management*, Vol. 11 No. 3, pp. 261-6.
- American Quality Foundation & Ernst and Young (1992), *International Quality Study: The Definitive Study of the Best International Quality Management Practices*, American Quality Foundation & Ernst and Young, Cleveland, OH.
- Anderson, S.W., Daly, J.D. and Johnson, M.F. (1999), "Why firms seek ISO 9000 certification: regulatory compliance competitive advantage?", *Production and Operations Management*, Vol. 8 No. 1, pp. 28-43.
- Anderson, J., Rungtusanatham, M., Schroeder, R. and Devaraj, S. (1995), "A path analytic model of a theory of quality management underlying the Deming management method: preliminary empirical findings", *Decision Sciences*, Vol. 26, September/October, pp. 637-58.
- Arauz, R. and Suzuki, H. (2004), "ISO 9000 performance in Japanese industries", *Total Quality Management and Business Excellence*, Vol. 15 No. 1, pp. 3-33.
- Argyris, C. (1998), "Empowerment: the emperor's new clothes", *Harvard Business Review*, Vol. 76 No. 3, pp. 98-105.
- Bagozzi, R.P. and Phillips, L.W. (1982), "Representing and testing organizational theories: a holistic construal", *Administrative Science Quarterly*, Vol. 17 No. 1, pp. 459-89.
- Barclay, C.A. (1993), "Quality strategy and TQM policies: empirical evidence", *Management International Review*, Vol. 33 No. 2, pp. 87-98.
- Besterfield, D.H., Besterfield-Michna, C., Besterfield, G.H. and Besterfield-Sacre, M. (2002), *Total Quality Management*, Prentice-Hall, Englewood Cliffs, NJ.
- Bhuiyan, N. and Alam, N. (2005a), "An investigation into issues related to the latest version of ISO 9000", *Total Quality Management and Business Excellence*, Vol. 16 No. 2, pp. 199-213.
- Bhuiyan, N. and Alam, N. (2005b), "A case study of a quality system implementation in a small manufacturing firm", *International Journal of Productivity and Performance Management*, Vol. 54 No. 3, pp. 172-86.
- Bodinson, G.W. (1991), "Warning: ignoring ISO standards may be harmful to your company's future", *Industrial Management*, Vol. 33 No. 2, pp. 11-12.

- Box, G. (1997), "Scientific method: the generation of knowledge and quality", *Quality Progress*, Vol. 30 No. 1, pp. 47-50.
- Briscoe, J.A., Fawcett, S.E. and Todd, R.H. (2005), "The implementation and impact of ISO 9000 among small manufacturing enterprises", *Journal of Small Business Management*, Vol. 43 No. 3, pp. 309-30.
- Brown, A., Wiel, T. and Loughton, K. (1998), "Smaller enterprises' experience with ISO 9000", *International Journal of Quality & Reliability Management*, Vol. 15 No. 3, pp. 273-85.
- Burr, J.T. (1990), "The future necessity", *Quality Progress*, Vol. 23 No. 6, pp. 19-23.
- Byrne, B.M. (1998), *Structural Equation Modeling with LISREL, PRELIS, and SIMPLIS: Basis Concepts, Application, and Programming*, Lawrence Erlbaum, Mahwah, NJ.
- Carlsson, M. and Carlsson, D. (1996), "Experiences of implementing ISO 9000 in Swedish industry", *International Journal of Quality & Reliability Management*, Vol. 13 No. 7, pp. 36-47.
- Casadesús, M. and Karapetrovic, S. (2005), "Has ISO 9000 lost some of its lustre? A longitudinal impact study", *International Journal of Operations & Production Management*, Vol. 25 No. 6, pp. 580-96.
- Casadesús, M., Giménez, G. and Heras, I. (2001), "Benefits of ISO 9000 implementation in Spanish industry", *European Business Review*, Vol. 13 No. 6, pp. 327-36.
- Chang, D.S. and Lo, L.K. (2005), "Measuring the relative efficiency of a firm's ability to achieve organizational benefits after ISO certification", *Total Quality Management and Business Excellence*, Vol. 16 No. 1, pp. 57-69.
- Chevalier, F. (1991), "From quality circles to total quality", *International Journal of Quality & Reliability Management*, Vol. 8 No. 4, pp. 9-24.
- Chin, K.S., Poon, G.K.K. and Pun, K.F. (2000), "The critical maintenance issues of the ISO 9000 system: Hong Kong manufacturing industries' perspective", *Work Study*, Vol. 49 No. 3, pp. 89-96.
- Churchill, G. (1979), "A paradigm for developing better measures of marketing constructs", *Journal of Marketing Research*, Vol. 16 No. 1, pp. 64-73.
- Conti, T. (2004), "From infancy to maturity: rethinking the role of ISO 9000 standards", *ASQ World Conference on Quality and Improvement Proceedings*, Vol. 58, pp. 1-7.
- Corrigan, J. (1994), "Is ISO 9000 the path to TQM?", *Quality Progress*, Vol. 27 No. 5, pp. 33-6.
- Craig, C.S. and Douglas, S.P. (1982), "Strategic factors associated with market and financial performance", *Quarterly Review of Economics and Business*, Vol. 22 No. 2, pp. 101-12.
- Deming, W.E. (1982), *Quality Productivity and Competitive Position*, Center for Advanced Engineering Studies, Massachusetts Institute of Technology, Cambridge, MA.
- Deming, W.E. (2000), *Out of Crisis*, Center for Advanced Engineering, MIT, Cambridge, MA.
- Devos, J.F., Guerrero-Cusumano, J.L. and Selen, W.J. (1996), "ISO 9000 in the low countries: reaching for new heights?", *Business Process Re-engineering and Management Journal*, Vol. 2 No. 1, pp. 26-47.
- Dick, G.P.M. (2000), "ISO 9000 certification benefits, reality or myth?", *The TQM Magazine*, Vol. 12 No. 6, pp. 365-71.
- Douglas, A., Kirk, D., Brennan, C. and Tone, K. (1999), "Maximizing the benefits of implementation", *Total Quality Management*, Vol. 10 No. 4, pp. 507-13.
- Dow, D., Samson, D. and Ford, S. (1999), "Exploding the myth: do all quality management practices contribute to superior quality performance?", *Production and Operations Management*, Vol. 8 No. 1, pp. 1-27.

- Dumke de Medeiros, D. (2000), "Preparing an enterprise for ISO 9000 certification", *Work Study*, Vol. 49 No. 5, pp. 194-7.
- EFQM (2006), *Introducing Excellence*, The European Foundation for Quality Management, Brussels, available at: www.efqm.org/uploads/introducing_english.pdf
- Feigenbaum, A.V. (1983), *Total Quality Control*, McGraw-Hill, New York, NY.
- Flynn, B.B., Schroeder, R.G. and Sakakibara, S. (1995), "The impact of quality management practices on performance and competitive advantage", *Decision Sciences*, Vol. 26 No. 5, pp. 659-91.
- Fuentes, C.M., Benavent, F.B., Moreno, M.A.E., Cruz, T.G. and Pardo del Val, M. (2000), "Analysis of the implementation of ISO 9000 quality assurance systems", *Work Study*, Vol. 49 No. 6, pp. 229-41.
- Gerbing, D.W. and Anderson, J.C. (1988), "An updated paradigm for scale development incorporating unidimensionality and its assessment", *Journal of Marketing Research*, Vol. 25 No. 2, pp. 186-92.
- Goetsch, D.L. and Davis, S. (1995), *Implementing Total Quality*, Prentice-Hall, Englewood Cliffs, NJ.
- Gotzamani, K.D. and Tsiotras, G.D. (2002), "The true motives behind ISO 9000 certification: their effect on the overall certification benefits and long term contribution towards TQM", *The International Journal of Quality & Reliability Management*, Vol. 19 No. 2, pp. 151-69.
- Griffin, R. (1988), "Consequences of quality circles in an industrial setting: a longitudinal assessment", *Academy of Management Journal*, Vol. 31 No. 2, pp. 338-58.
- Hackman, J.R. and Wageman, R. (1995), "Total quality management: empirical, conceptual, and practical issues", *Administrative Science Quarterly*, Vol. 40 No. 2, pp. 309-42.
- Hair, J.F., Anderson, R.E., Tatham, R.L. and Black, W.C. (1995), *Multivariate Data Analysis*, Prentice-Hall, Englewood Cliffs, NJ.
- Handfield, R., Ghosh, S. and Fawcett, S. (1998), "Quality-driven change and its effects on financial performance", *Quality Management Journal*, Vol. 5 No. 3, pp. 13-30.
- Heras, I., Casadesus, M. and Dick, G.P.M. (2002), "ISO 9000 certification and the bottom line: a comparative study of the profitability of Basque region firms", *Managerial Auditing Journal*, Vol. 17 Nos 1/2, pp. 72-8.
- Hind, M. (1996), "Are the cultures required to attain ISO 9000 and total quality management mutually exclusive?", *Training for Quality*, Vol. 4 No. 2, pp. 25-9.
- Ho, D.C.K., Duffy, V.G. and Shih, H.M. (1999), "An empirical analysis of effective TQM implementation in the Hong Kong electronics manufacturing industry", *Human Factors and Ergonomics in Manufacturing*, Vol. 9 No. 1, pp. 1-25.
- Ho, S.K.M. (1995), "Is the ISO 9000 series for total quality management?", *International Journal of Physical Distribution & Logistics Management*, Vol. 25 No. 1, pp. 51-66.
- Hockman, K.K. and Grenville, R.J.S. (1994), "Road map to ISO 9000 registration", *Quality Progress*, Vol. 27 No. 5, pp. 39-42.
- Hopen, D. (2004), "Consequences and changing behaviors", *The Journal for Quality and Participation*, Vol. 27 No. 1, pp. 15-23.
- Hoyle, D. (2001), *ISO 9000 Quality Systems Handbook*, 4th ed., Butterworth-Heinemann, Oxford.
- Hua, H., Chin, K.S., Sun, H. and Xu, Y. (2000), "An empirical study on quality management practices in Shanghai manufacturing industries", *Total Quality Management*, Vol. 11 No. 8, pp. 1111-22.

- Huarng, F., Horng, C. and Chen, C. (1999), "A study of ISO 9000 process, motivation and performance", *Total Quality Management*, Vol. 10 No. 7, pp. 1009-25.
- Ishikawa, K. (1985), *What Is Total Quality Control? The Japanese Way*, Prentice-Hall, Englewood Cliffs, NJ.
- ISO (2006), *ISO's Membership Rises to 150 Countries*, International Organisation for Standardisation, Geneva, available at: www.iso.org/iso/en/commcentre/pressreleases/2006/Ref1021.html
- Jacobson, R. and Aaker, D.A. (1987), "The strategic role of product quality", *Journal of Marketing*, Vol. 51 No. 4, pp. 31-44.
- Jöreskog, K.G. and Sörbom, D. (1993), *LISREL 8: Structural Equation Modeling with the SIMPLIS Command Language*, Scientific Software International, Chicago, IL.
- Joubert, B. (1998), "ISO 9000: international quality standards", *Production and Inventory Management Journal*, Second Quarter, pp. 60-5.
- Juran, J.M. (1986), "Quality trilogy", *Quality Progress*, Vol. 19 No. 8, pp. 14-24.
- Juran, J.M. (1993), "Made in USA: a renaissance in quality", *Harvard Business Review*, Vol. 71 No. 4, pp. 42-50.
- Juran, J.M. and Gryna, F.M. (2001), *Quality Planning and Analysis: from Product Development through US*, McGraw-Hill, Boston, MA.
- Koo, H., Koo, F. and Tao, F.K.C. (1998), "Analysing employee attitudes towards ISO certification", *Managing Service Quality*, Vol. 8 No. 5, pp. 312-21.
- Lamprecht, J.L. (1991), "ISO 9000 implementation strategies", *Quality*, Vol. 30 No. 11, pp. 14-17.
- Lascelles, D.M. and Dale, B.G. (1988), "A review of the issues involved in quality improvement", *International Journal of Quality & Reliability Management*, Vol. 5 No. 5, pp. 76-94.
- Lima, M., Resende, M. and Hasenclever, L. (2000), "Quality certification and performance of Brazilian firms: an empirical study", *International Journal of Production Economics*, Vol. 66 No. 2, pp. 143-7.
- McAdam, R. and Mckeown, M. (1999), "Life after ISO 9000: an analysis of the impact of ISO 9000 and total quality management on small business in Northern Ireland", *Total Quality Management*, Vol. 10 No. 2, pp. 229-41.
- Mahadevappa, B. and Kotreshwar, G. (2004), "Quality management practices in Indian ISO 9000 certified companies: an empirical evaluation", *Total Quality Management and Business Excellence*, Vol. 15 No. 3, pp. 295-305.
- Martínez, C., Balbastre, F., Escribá, M.A., González, T. and Pardo del Val, M. (2000), "Analysis of the implementation of ISO 9000 quality assurance systems", *Work Study*, Vol. 49 No. 6, pp. 229-41.
- Meegan, S.T. and Taylor, W.A. (1997), "Factors influencing a successful transition from ISO 9000 to TQM: the influence of understanding and motivation", *International Journal of Quality & Reliability Management*, Vol. 14 No. 2, pp. 100-17.
- Najmi, M. and Kehoe, D.F. (2000), "An integrated framework for post-ISO 9000 quality development", *The International Journal of Quality & Reliability Management*, Vol. 17 No. 3, pp. 226-58.
- Najmi, M. and Kehoe, D.F. (2001), "The role of performance measurement systems in promoting quality development beyond ISO 9000", *International Journal of Operations & Production Management*, Vol. 21 No. 1, pp. 159-72.

- Naser, K., Karbhari, Y. and Mokhtar, M.Z. (2004), "Impact of ISO 9000 registration on company performance: evidence from Malaysia", *Managerial Auditing Journal*, Vol. 19 No. 4, pp. 509-16.
- Naveh, E. and Marcus, A. (2005), "Achieving competitive advantage through implementing a replicable management standard: installing and using ISO 9000", *Journal of Operations Management*, Vol. 24 No. 1, pp. 1-26.
- NIST (2006), *Malcolm Baldrige National Quality Award Criteria*, US Department of Commerce, National Institute of Standards and Technology, Gaithersburg, MD, available at: www.quality.nist.gov/PDF_files/2006_Business_Criteria.pdf
- Oakland, J. (2000), *TQM Text with Cases*, 2nd ed., Butterworth-Heinemann, Oxford.
- Oakland, J. (2005), "From quality to excellence in the 21st century", *Total Quality Management and Business Excellence*, Vol. 16 Nos 8-9, pp. 1053-60.
- Peters, T. (1988), "Facing up to the need for a management revolution", *California Management Review*, Vol. 30 No. 2, pp. 8-38.
- Phillips, L.W., Chang, D.R. and Buzzell, R.D. (1983), "Product quality, cost position, and business performance: a test of some key hypotheses", *Journal of Marketing*, Vol. 47 No. 2, pp. 26-43.
- Rayner, P. and Porter, L. (1991), "ISO 9000 – the experience of small and medium sized businesses", *International Journal of Quality & Reliability Management*, Vol. 8 No. 6, pp. 16-28.
- Rungtusanatham, M., Forza, C., Filippini, R. and Anderson, J. (1998), "A replication study of a theory of quality management underlying the Deming management method: insights from an Italian context", *Journal of Operations Management*, Vol. 17 No. 1, pp. 77-95.
- Sandholm, L. (2005), "Strategic plan for sustainable excellence", *Total Quality Management and Business Excellence*, Vol. 16 Nos 8-9, pp. 1061-8.
- Sarkar, A. (1998), "Implementation of ISO 9000 in a textile mill", *Total Quality Management*, Vol. 9 No. 1, pp. 123-31.
- Senge, P. (1992), "Building learning organizations", *The Journal for Quality and Participation*, Vol. 15 No. 2, pp. 30-8.
- Sousa, R. and Voss, C.A. (2002), "Quality management re-visited: a reflective review and agenda for future research", *Journal of Operations Management*, Vol. 20 No. 1, pp. 91-109.
- Steenkamp, J.-B.E.M. and van Trijp, H.C.M. (1991), "The use of LISREL in validating marketing constructs", *International Journal of Research in Marketing*, Vol. 8 No. 4, pp. 283-99.
- Stephens, K.S. (1994), "ISO 9000 and total quality", *Quality Management Journal*, Fall, pp. 57-71.
- Struebing, L. (1996), "ISO 9000 changes in progress", *Quality Progress*, Vol. 29 No. 10, pp. 23-8.
- Tari, J.J. and Molina, J.F. (2002), "Quality management results in ISO 9000 certified Spanish firms", *The TQM Magazine*, Vol. 14 No. 4, pp. 232-9.
- Terziovski, M., Power, D. and Sohal, A.S. (2003), "The longitudinal effects of the ISO 9000 certification process on business performance", *European Journal of Operational Research*, Vol. 146 No. 3, pp. 580-95.
- Tillery, K.R. and Rutledge, A.L. (1991), "Quality-strategy and quality-management connections", *International Journal of Quality & Reliability Management*, Vol. 8 No. 1, pp. 71-7.
- Vloeberghs, D. and Bellens, J. (1996), "Implementing the ISO 9000 standards in Belgium", *Quality Progress*, Vol. 29 No. 6, pp. 43-8.
- Wilms, W.W., Hardcastle, A.J. and Zell, D.M. (1994), "Cultural transformation at NUMMI", *Sloan Management Review*, Vol. 36 No. 1, pp. 99-113.

Wilson, D.D. and Collier, D.A. (2000), "An empirical investigation of the Malcolm Baldrige National Quality Award causal model", *Decision Sciences*, Vol. 31 No. 2, pp. 361-90.

Yahya, S. and Goh, W. (2001), "The implementation of an ISO 9000 quality system", *International Journal of Quality & Reliability Management*, Vol. 18 No. 9, pp. 941-66.

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