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# Business Performance and Enterprise Resource Planning

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# BUSINESS PERFORMANCE AND ENTERPRISE RESOURCE PLANNING

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## ABSTRACT

*Business performance is affected by the quality management practices of the organization. Holistic programs, including the national quality award programs, six-sigma initiatives, and enterprise resource planning (ERP) applications may characterize the highest level of quality initiatives. Arguably, the most popular quality initiative is the ISO 9000 program. The effect of different levels of quality initiatives on business performance was studied in a stratified sample of 280 firms in the Canadian provinces of Ontario and Quebec. The effect of using these quality initiatives in combination with ISO 9000 was also studied. Finally, the relationship between a firm's use of enterprise resource applications and performance excellence was examined. The study revealed that, regarding quality initiatives, ISO 9000 certification was deemed positively beneficial only when combined with quality initiatives of the highest level. Further, there is a moderately significant relationship between ERP applications and performance excellence.*

## 1. INTRODUCTION

The evolution towards total (holistic) quality management is congruent with the change in business vision over the past few decades—from a focus on production to a more integrated focus on operations (Miller and Arnold 1998), of which quality management has become a significant component (Hayes 1998). Yet, quality problems still abound (Evans and Lindsay 2002). The implementation of quality management initiatives is one of the several strategic plans that firms adopt to combat competitive pressures. The debate about quality initiatives centres on the supposed potential benefits of adopting a quality initiative.

Quality issues have generated a tremendous amount of interest in many sectors of the economy and continue to affect senior management agendas in nearly all organizations. Garten (2000) suggests that although quality has slipped from the front pages, corporate America is deluding itself into thinking that quality is less a problem than it was. Notwithstanding this, and also Foster's (1998) cautionary note regarding complacency, high performing firms continuously improve their organizational capabilities and outrun their competition by increasing value to their stakeholders — customers, employees, and shareholders (Blazey 1997).

Two common practices at improving the organization are the ISO 9000 certification program and/or the adoption of some program loosely grouped under the total quality management (TQM) umbrella. As one response to the need to add value, there have been over 343,600 certificates in the ISO 9000 awarded worldwide (ISO 9000 survey-9). In fact according to the most recent statistics available (ISO 2001), there has been a steady growth in the number of certificates awarded since 1993.

Empirical studies have shown mixed results of the benefits that have accrued to ISO certified firms. For example, Anderson, Daly and Johnson (1995) and Carlsson, (1996) concluded ISO had positive benefits, while Terziovski (1997) concluded that it did not. Similarly, there are a number of

empirically based attempts to provide a framework for TQM measurement, which are not conclusive regarding measured performance benefits. These include Saraph et al (1989); Benson et al (1991); Dean and Bowen (1994); Flynn et al (1994); Ahire (1995); Black and Porter (1996); and Easton and Jarrell (1998). TQM can be seen as the most comprehensive practice. There are, however, more limited practices that need be taken into account. In Figure 1 the relation between four categories of quality practices is presented.

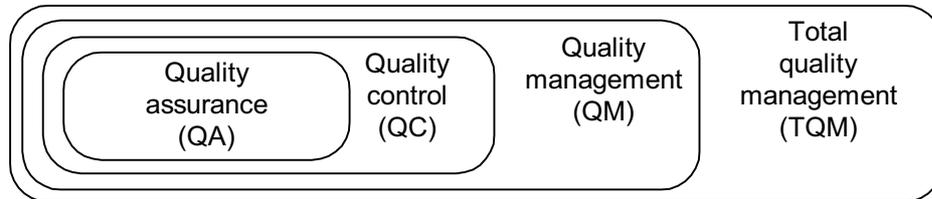


Figure 1 Quality Management Evolution

Total quality management is a revolutionary approach and integrative management philosophy for effective management that may take several years to implement (Hendricks and Singhal 2001). TQM practices involve the entire firm and are major strategic designs in pursuit of overall excellence. This paper attempts to advance the framework for measurement of quality practices by proposing that a classification of quality initiatives might include enterprise resource planning (ERP) as part of the high-level category (holistic level) of quality initiatives. These high-level practices include business process reengineering, six-sigma efforts, enterprise technologies, and an effort to comply with integrated criteria of the different national quality award programs. In the following Table 1, examples of various quality practices are located within these four categories. Further, this paper empirically (1) examines ERP usage and (2) measures the relationship between ERP and business performance.

Table 1 Quality Practices in Evolution

QA	QC	QM	TQM
<ul style="list-style-type: none"> <li>• Scientific management</li> <li>• Quality tools and techniques</li> <li>• ISO 9000 (1987 &amp; 1994)</li> </ul>	<ul style="list-style-type: none"> <li>• Statistical process control</li> <li>• Control charts</li> <li>• Process capability</li> <li>• Design for quality</li> </ul>	<ul style="list-style-type: none"> <li>• Human behaviour movement</li> <li>• Quality circles</li> <li>• Kaizen,</li> <li>• Continuous improvement</li> <li>• Just-in-time (JIT)</li> </ul>	<ul style="list-style-type: none"> <li>• Business process reengineering</li> <li>• Six sigma</li> <li>• Integrated technology (ERP)</li> <li>• Balanced scorecard</li> <li>• National quality awards</li> <li>• ISO 9000:2000</li> </ul>

## 2. ENTERPRISE RESOURCE PLANNING

The attempt to totally eliminate process variation has recently influenced the development of process management technologies that, in maintaining an integrated view of the effects of business decisions, are identifying opportunities to eliminate waste through the decision process based on integrated and shared awareness. The result expected would be an improved decision process, fewer errors, improved communication, better inventory control, improved customer satisfaction and consequently improved performance.

Through the advances in information technology, a number of enterprise software packages have hit the business market; products that help enhance decision making for optimal performance and competitive advantage, e.g., SAP, Baan, PeopleSoft, and Oracle (Jeffery and Morrison 2000; Brady,

Monk et al. 2001). These are examples of software proposed as fully integrated families of business management-applications that:

- Improve business decisions and coordination through increased knowledge,
- Extend supply chain support beyond the boundaries of an organization, and
- Provide operational flexibility that businesses require in order to be leaders in their marketplace.

These and similar technologies provide the organization with a knowledge-foundation and cooperative thinking that facilitates the decision process. Not only does the right hand know what the left hand is thinking, but also, both act in concert. Consequently, all parts of the system focus on achieving the same result (Lingle and Nygreen 2001).

### **3. THE EFFECT OF QUALITY INITIATIVES**

Not all quality initiatives succeed. Some quality initiatives have failed because top managers have tried to implement quality with a less than comprehensive approach, piecing together various elements from past quality eras into a patchwork of quality process. According to Dean and Bowen (1994:393), “there is little theory available to explain the differences between successful and unsuccessful efforts.” Consequently, even though a few years have passed, research that examines the benefits of quality initiatives continues to be appropriate.

The debate about quality initiatives, particularly ISO, centres on the potential benefits that have been endorsed in the literature and by the many consultants and registrar firms. The literature suggests that as global business takes shape, the study of benefits of quality approaches needs to be examined anew (Kim and Chang 1995). Further, the literature suggests that in a different culture or economic system, the results of quality initiatives may be different (Puay, Tan et al. 1998). Thus, it may be appropriate to study how performance is affected by quality initiatives in a particular culture. Hence, this study in the central region of Canada.

Previous studies do not go far enough to explore the link between ISO certification and other quality initiatives in firms. DeFoe of the Juran Institute claims that although the ISO standards are very good, they are too narrowly defined for the needs of most manufacturers today (Bergstrom 1996). Furthermore, he states that the guidelines and standards set out by the national quality award programs are closer to what suppliers and manufacturers require as they attempt to create a competitive advantage.

Hence, is as much as the quality management literature in not conclusive regarding measurement of organizational performance, particularly multi-factor performance, as a consequence of quality initiatives, and similarly because there is a dearth of studies regarding combined-quality-initiative effect on performance, it is opportune to test the relationship between performance and the fourth level (holistic approaches) of quality initiatives leading to the following hypothesis:

**Hypothesis 1:** There is a significant relationship between business performance excellence and ISO certification used in combination with high-level quality initiatives.

There is a shortage of research on the degree of use of enterprise software. It may be important for academe and practioners alike to realize to what extent ERP is practiced. The ultimate use of ERP is in fully integrated across the firm application. This begs the question about the effect on business performance. Hence, the following hypothesis is studied:

**Hypothesis 2:** There is a significant relationship between business performance excellence and the use of enterprise resource planning applications.

## 4. METHODOLOGY

### 4.1 Population and sample

This research surveyed a stratified sample of firms from both manufacturing and service industries in two provinces of central Canada - Quebec and Ontario. Firm size, as defined by the number of employees and grouped by industrial sector, served as the basis of stratification. Furthermore, the stratified sample included firms that are publicly traded as well as those that are private firms. Two publicly available databases were used to produce the sample of firms to be contacted (CRIQ 1999; Scott's 1999). From the total population of 9493 firms, 5883 were in Ontario (62%) and 3610 in Quebec (38%). A proportionate-population, allowing for a minimum of 7 firms in any one category, for each type of firm in each province was established and 825 firms were randomly selected as a stratified population. The firms were sent letters describing the research, inviting their participation, and a professional polling firm contacted 641 of these firms (Laframboise 2002). Useable responses were collected from 280 firms, 119 from Quebec, and 161 from Ontario, representing a response rate of over 43%.

### 4.2 Model

Business performance excellence was modelled as a multidimensional second-order latent construct (i.e., unobservable variable) where each dimension is conceptualized as a first-order factor reflected by 24 observable items (Laframboise 2002). The first-order factors include product quality, process quality, customer focus, employee role, stakeholder dissatisfaction, supplier status, and financial performance. Graphical representation of the model is given in Figure 2.

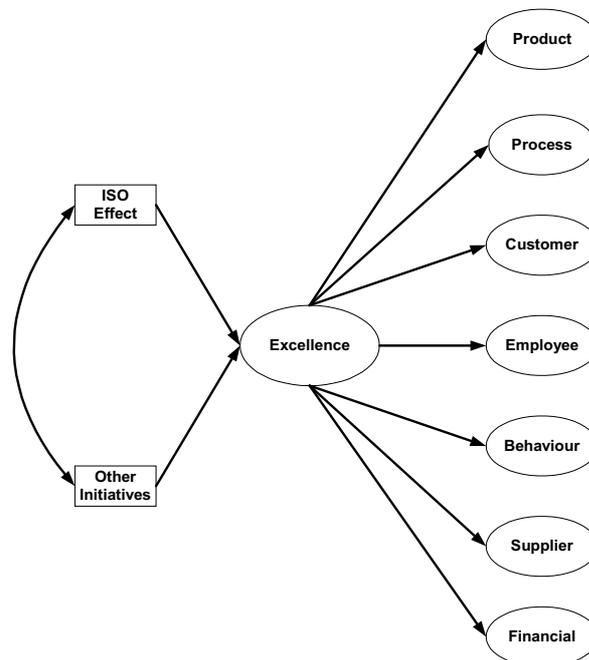


Figure 2 Quality Initiative Effect of Business Performance Excellence

The research instrument, asked participants to identify which quality initiatives on a list of practices their firm had implemented, whether the firm had been certified ISO 9000 and whether the firm had self-audited against the criteria of a national quality award program. For the purpose of simplifying the test, the quality practices were divided into three categories, based on the degree of comprehensiveness. Respondents were placed in one category only (highest appropriate level).

Comprehensiveness includes degree of difficulty for implementation; time and expense for implementation; or a pervasiveness cultural change required, i.e., new quality philosophy. Admittedly, this is a subjective classification established in order to experiment with various treatments of the quality effect on performance. The three classifications are shown in Table 2 below, (the values in brackets represent the percentage of respondents in the sample that indicated the firm practiced this initiative.)

**Table 2 Three Levels of Quality Practices**

Level 1	Level 2	Level 3
Benchmarking (52.1%) Quality circles (28.9%) Quality assurance (61.8%) Industry standards (37.9%)	Kaizen (30.7%) Just-in-time-JIT (42.1%) ISO 14000 (5.7%)	Six-Sigma Program (11.1%) Total Quality Management (36.4%) National Quality Award program (3.9%)
70 of 280 respondents	71 of 280 respondents	115 of 280 respondents

To measure the effect on performance for a specific quality initiative effect (allowing for ISO interaction), the data from Table 2 was entered into the cross-tabulation Table 3 below (the quality level numbers correspond to those presented in Figure 1.).

**Table 3 Three Levels of Quality and ISO Cross Tabulation**

Level of Quality Initiatives	ISO yes	ISO no	Total
0 (no quality level)	3	21	24
I	33	37	70
II	33	38	71
III	61	54	115
Total	130	150	280

In order to test the effect of the independent variables (quality initiatives or ISO certification) on performance excellence, an aggregate dependent (response) variable was created for performance excellence. This aggregate variable is the average of the 24 observed variables (OBSERVED PERFORMANCE) in the seven factors above in Figure 2. The different sets of independent variables are measured against the performance excellence variable using univariate analysis of variance.

Furthermore, in order to test the effect of ERP application, the research instrument required participants to describe the firm's use of the technology. The question, "To what extent does your firm use enterprise integration software, e.g., SAP, BAAN, PeopleSoft, Oracle?" allowed a response on a 5-point scale, ranging from (1) don't know to (5) large-scale use of ERP technology. The results from these two tests are revealed below.

## 5. ANALYSIS

Using GLM univariate analysis of variance, the results for this scenario are as follows. As shown in Table 4, and with  $\alpha < 0.10$  as a reference, there is a slightly significant effect of ISO on the main response variable (performance excellence (p value = .080). Although the 3 levels of quality initiatives treated together is not significant (p value = .466), when the Levels of Quality interact with the existence of ISO certification the result is highly significant (p value = .002).

**Table 4 Three Level Quality and ISO Interaction**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5.54	7	.79	2.27	.029
Intercept	3076.70	1	3076.70	8819.79	.000
ISO	1.07	1	1.07	3.08	<b>.080</b>
Levels of Quality	.89	3	.30	.85	.466
Interaction	5.26	3	1.75	5.02	<b>.002</b>
Error	94.89	272	.35		
Total	7459.31	280			
Corrected Total	100.42	279			

In order to discriminate which level or levels are determinant of this highly significant interaction, GLM univariate analysis of variance was used, resulting in the following:



Figure 3 Level-Three Quality & ISO Effect on Performance

In the graph depicted in Figure 3, the perceived performance for “no quality programs” (except possibly for ISO) and the perceived performance for levels 1 and 2 quality programs decline when considered along with “No ISO presence” as compared to “ISO presence”. This is reflected as well in Table 5. The mean value for the response variable for Level 0 declines from 5.16 to 4.57 when ISO certification is present. For Level I, the mean value declines slightly from 5.17 to 5.01 and for Level II the mean value declines from 5.25 to 4.95. This suggests that with ISO and no other quality initiative, or ISO in combination with lower levels of quality initiatives (I & II), the effect on performance excellence in this model is negative. Such a situation supports the conclusion of Terziovski (1997).

On the other hand, the graph line for Level III quality initiatives rises and, as presented in Figure 3 and Table 5, the mean value rises from 5.00 to 5.30. In the light of the p value of .002 for this interaction (Table 4), it is clear that the interaction between ISO certification and Level III quality initiatives is highly significant regarding performance excellence. This positive effect supports the position of Anderson, Daly and Johnson (1995) and Carlsson, (1996).

**Table 5 Three Level Quality & ISO Descriptive Statistics**

Levels of Quality		Mean	Std. Deviation	N
No ISO	No Quality Program	5.16	.797	21
	Level I Quality Program	5.17	.443	39
	Level II Quality Program	5.25	.559	39
	Level III Quality Program	5.00	.637	54
	Total	5.13	.601	153
ISO	No Quality Program	4.57	.604	3
	Level I Quality Program	5.01	.556	31
	Level II Quality Program	4.95	.540	32
	Level III Quality Program	5.30	.610	61
	Total	5.12	.601	127
Total	No Quality Program	5.08	.789	24
	Level I Quality Program	5.09	.499	70
	Level II Quality Program	5.11	.566	71
	Level III Quality Program	5.16	.637	115
	Total	5.13	.600	280

The most significant effect on performance excellence, in this scenario, is the combination of ISO certification and any of the quality practices of the highest level, i.e., six sigma programs, auditing against the criteria of the national quality programs or practicing total quality management. Hypothesis 1 states that there is a significant relationship between business performance excellence and ISO certification used in combination with high-level quality initiatives. As was shown in the graph above, as well in Table 5, this hypothesis is highly significantly supported ( $p$  value = .002). It may be concluded that managers may be 95% confident that the combination of ISO certification and a Level III quality initiative will provide the highest value for performance excellence, with a mean value for the response variable of between 5.15 and 5.45.

Regarding use of ERP, of the 280 respondents, 71 do not know if the firm uses an ERP. However, the balance of the respondents (271) is able to comment on usage. The majority of the firms responding (125) do not use ERP. The others use ERP to varying degrees, low use (22), medium (22) or high (40). See figure 4.

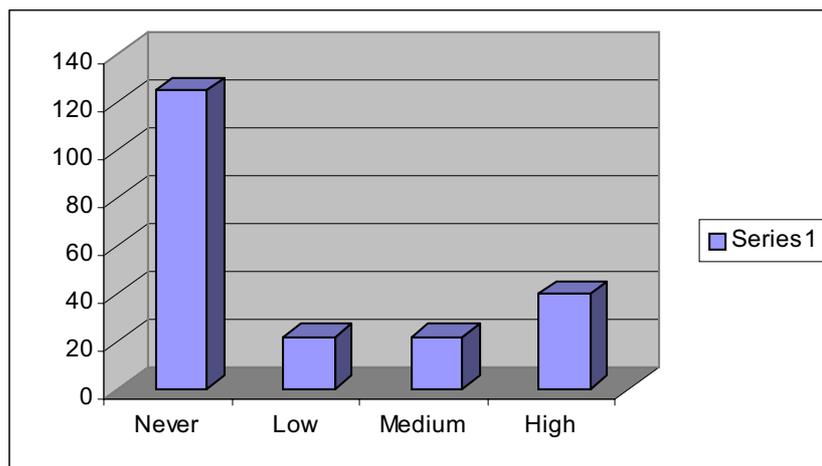


Figure 4 Extent of ERP Usage

Using GLM univariate analysis of variance, the results for the second scenario indicate that using the aggregated dependent variable above – OBSERVED PERFORMANCE and the ERP question as the independent variable, the result show a slightly significant relationship (0.060).

Consequently, both hypotheses were supported. There is a significant relationship between business performance excellence and ISO certification used in combination with high-level quality initiatives ( $p < .01$ ). There is a significant relationship ( $p < 0.10$ ) between business performance excellence and the use of enterprise resource planning applications.

Table 6 Tests of Between-Subjects Effects Dependent Variable: Observed Performance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2.603	3	.868	2.507	.060
Intercept	3415.617	1	3415.617	9867.535	.000
<b>ERP Usage (Ind. Var.)</b>	<b>2.603</b>	<b>3</b>	<b>.868</b>	<b>2.507</b>	<b>.060</b>
Error	70.960	205	.346		
Total	5523.432	209			
Corrected Total	73.563	208			

## 6. RESULTS

In this study of 280 firms in Ontario and Quebec, the existence of an ISO 9000 certification alone has only mild significance ( $p$  value  $< .10$ ) when related to performance excellence. This conforms to the position of several contributors, including Rayner and Porter (1991) and Williams (1997). Furthermore, for firms having a combination of ISO and another program, there is no significant enhancement in perceived performance excellence for two of the three categories. This partially would support the work of Terziowski, Samson and Dow (1997) who claim that ISO has no significant positive effect on performance. The only situation where there is a highly significant enhancement of perceived performance is the combination of ISO 9000 and the level-three category composed of holistic quality programs. Furthermore, in as much as enterprise resource planning applications are integrated tools that improve quality, the third level may be considered as including ERP.

The results of ERP relationship to business performance (hypothesis 2) parallel the results of the high-level quality initiatives with ISO relationship to business performance (hypothesis 1). This, in addition to the similar holistic characteristics of improved benefits from ERP and total quality management practice, support the theoretical proposition that ERP may be considered as a high-level quality initiative.

Earlier ISO 9000 was categorized as a quality assurance tool. Recently (November 2000) the ISO 9000:2000, a major departure from the earlier versions (Reid 2001; West 2001), came into force. Indeed, the ISO 9000 standard has undergone its own reengineering, so much so that it may be more appropriate to locate this approach to quality as belonging to the outer ring in Figure 1. The major changes in the new ISO standard permit the program to be regarded more as a total quality management tool (Tonk 2000) than as a tool for assurance of a quality system. Furthermore, the major change regarding improvement involves a requirement that senior management strongly support the initiative. This commitment, including appropriate resources, for continuous improvement and review is what may indeed bring ISO closer to the national awards programs and the holistic TQM philosophy. The result just may be corporate excellence.

## 7. DISCUSSION

We empirically examined the use of ERP in the area of information systems (IS) in two ways (1) the extent of use of ERP and (2) the relationship between ERP and business performance excellence. The next step is to study the role of enterprise applications in the networked B2B environments. It may be relevant to study the influence of the larger partners over the not-as-large partners in a networked value chain. For example, it may be interesting to discover the influential effect on respective

performances where the larger partner has adopted enterprise applications and arrangements are required for the participation of smaller partners who have not adopted enterprise systems. Additionally, there may be agents who negotiate between the partners in the value chain. These agents in principle are customers of customers and thus we are faced with examining the use and influence of C2C agents in supply-chain relationships.

Another interesting area of concern may be an examination of quality assurance across the value chain in the networked environment. This would suggest that the various organizations in the chain might have different philosophies regarding quality management and through the use of enterprise systems for example variance of product quality may be an issue.

In the area of operations management, the benefit of the previous version of ISO was once more examined empirically showing a slightly significant relationship to performance excellence, and particularly a highly significant relationship to performance when linked to integrated quality practices, including TQM, six-sigma, national awards, and possibly ERP. This latter suggestion about the possible ERP role as a high-level quality practice might be re-examined. Additionally, the role of the new version of ISO 9000 as a high-level quality practice needs to be examined.

## REFERENCES

- Ahire, S. L., R. Landeros, et al. (1995). "Total Quality Management: A Literature Review and Agenda for Future Research." Production and Operations Management 4(3): 288-306.
- Anderson, S. W., J. D. Daly, et al. (1995). The value of management control systems: Evidence on the market reaction to ISO 9000 quality assurance certification, University of Michigan. Working Paper 9501-16.
- Benson, P. G., J. V. Saraph, et al. (1991). "The Effects of Organizational Context on QM: An Empirical Investigation." Management Sciences 37(9): 1107-1124.
- Bergstrom, R. Y. (1996). "Looking for a break in the quality drive? Don't." Automotive Production 108(6): 26-.
- Black, S. A. and L. J. Porter (1996). "Identification of the critical factors of TQM." Decision Sciences 27(1): 1-21.
- Blazey, M. (1997). "Achieving Performance Excellence." Quality Progress 30(6): 61-64.
- Brady, J., E. Monk, et al. (2001). Concepts in Enterprise Resource Planning, Thompson Learning.
- Carlsson, M. and D. Carlsson (1996). "Experiences of implementing ISO 9000 in Swedish industry." International Journal of Quality and Reliability Management 13(7): 36-47.
- CRIQ (1999). Répertoire des produits disponibles au Québec - version CD-ROM. Québec, Centre de Recherche Industrielle du Québec.
- Dean, J., James W. and D. E. Bowen (1994). "Management theory and total quality: Improving research and practice through theory development." Academy of Management Review 19: 392-418.
- Easton, G. S. and S. L. Jarrell (1998). "The effects of total quality management on corporate performance: an empirical investigation." Journal of Business 71(2): 253-307.
- Evans, J. R. and W. M. Lindsay (2002). The Management and Control of Quality. Cincinnati, South-Western (Thomson Learning).
- Flynn, B. B., R. G. Schroeder, et al. (1994). "A framework for quality management research and an associated instrument." Journal of Operations Management 11: 339-366.
- Foster Jr., S. T. (1998). "The ups and downs of customer-driven quality: How to use strategic quality planning to anticipate needs." Quality Progress 31(10): 67-72.
- Garten, J. (2000). The War for Better Quality is Far From Won. Business Week.
- Hayes, R. (1998). "Developing POM faculties for the 21st century." Production and Operations Management 7(2): 99-105.
- Hendricks, K. and V. Singhal (2001). "The Long-Run Stock Price Performance of Firms with Effective YQM Programs." Management Science 47(3): 359-368.
- ISO, I. O. f. S. (2001). The ISO Survey of ISO 9000 and ISO 14000 Certificates -

Ninth cycle - 1999. Geneva.

Jeffery, B. and J. Morrison (2000). ERP, One Letter at a Time. CIO Magazine, CIO Communications, INC. 2001.

Kim, Y. K. and D. R. Chang (1995). "Global Quality Management: A research focus." Decision Sciences 26(5): 561-568.

Laframboise, K. (2002). An Empirical Study of the Relationship between Quality Practices and Business Performance Excellence in Central Canada. Department of Decision Sciences and M.I.S. Montreal, John Molson School of Business - Concordia University.

Lingle, J. and N. Nygreen (2001). "Use a Balanced Scorecard to Implement Strategy." Quality Management Forum 27(3).

Miller, J. and P. Arnold (1998). "POM teaching and research in the 21st century." Production and Operations Management 7(2): 99-105.

Puay, S. H., K. C. Tan, et al. (1998). "A comparative study of nine national quality awards." The TQM Magazine 10(1): 30-39.

Rayner, P. and L. J. Porter (1991). "BS5750 / ISO 9000 - The Experience of Small and Medium-sized Firms." International Journal of Quality & Reliability Management 8(6): 16-28.

Reid, R. D. (2001). "From Deming to ISO 9000:2000." Quality Progress 34(6): 66-70.

Saraph, J. V., P. G. Benson, et al. (1989). "An instrument for measuring the critical factors of quality management." Decision Sciences 20(4): 810-829.

Scott's (1999). Scott's Directories, Southam Inc.

Terziovski, M., D. Samson, et al. (1997). "The business value of quality management systems certification: Evidence from Australia and New Zealand." Journal of Operations Management 15: 1-18.

Tonk, H. S. (2000). "Integrating ISO 9001:2000 and the Baldrige Criteria." Quality Progress 33(8): 51-55.

West, J. E. J. (2001). "Implementing ISO 9000:2000." Quality Progress 34(5): 65-70.

Williams, N. (1997). "ISO 9000 as a route to TQM in small to medium-sized enterprises: snake or ladder?" The TQM Magazine 9(1): 8-13.