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AN EMPIRICAL STUDY OF THE RELATIONSHIP BETWEEN QUALITY PRACTICES AND BUSINESS PERFORMANCE EXCELLENCE IN CENTRAL CANADA

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A Thesis in the Joint Doctoral Program

Presented in partial fulfillment of the requirements for the degree Doctorate in Administration at the John Molson School of Business, Concordia University Montreal, Quebec, Canada

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ABSTRACT

AN EMPIRICAL STUDY OF THE RELATIONSHIP BETWEEN QUALITY PRACTICES AND BUSINESS PERFORMANCE EXCELLENCE IN CENTRAL CANADA

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Overall excellence of business performance can be defined and measured through various factors. In an attempt to operationalise measurement of performance excellence, a stratified sample of 280 firms in the Canadian provinces of Ontario and Quebec is studied. Using the structural equation modeling methodology, this study empirically demonstrates that business performance may be measured by 24 variables grouped into seven correlated factors labelled as financial performance, product quality effectiveness, process quality, the role of customer, of employee, of supplier, and stakeholder behaviour. It is also shown that these 7 factors can be grouped further, to form a higher order factor, which may be labelled as business performance excellence.

In order to identify variables that can affect performance excellence, two sets of variables are considered. First, the effect of different levels of quality initiatives on business performance is studied. Among the several quality initiatives investigated are the national quality award programs, the six-sigma program, and ISO 9000 certification program. Moreover, the effect of using these quality initiatives in combination is studied. Second,

the relationship between firm characteristics and performance excellence is evaluated.

The study reveals that, regarding quality initiatives, only ISO 9000 certification combined with initiatives of the highest level such as a national quality awards program assessment has a highly significant affect on perceived performance excellence. Also, the assessment reveals that a firm's location, industry sector, organization size, or whether the firm is private or publicly listed are not significant factors for perceived overall performance excellence.

The upshot of this research is a holistic scorecard for the measurement of business performance excellence. Furthermore, this work offers continuing positive support for the future of total quality management.

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I. Introduction

> "What I have in mind is the movement toward Total Quality Management. I think that today there is a full consensus that this is the thing to do. It's not an overnight fashion; it's something serious and very much needed. But look how difficult it is to introduce it into companies. The results come so painfully slow, and in many companies this movement has already stagnated into, let's face it, simply lip service" (Goldratt 1992) [1]

During the last three decades Canadian firms have implemented various quality management practices. Because the practices were applied primarily to the manufacturing sector, most of the focus has been based on the product quality and a concern for waste reduction and the prevention of defects. Traditionally, assuring quality has occurred via a process of final inspection as opposed to systematic error prevention and quality was applied at the operational level.

However, within the infrastructure of successful firms, quality practices have evolved to also include a need for (i) top management commitment to quality, (ii) higher employee involvement, (iii) quality suppliers, and (iv) a focus on continuous quality improvement throughout the organization — all embraced within a perspective of increased customer focus and satisfaction (Ahire, Landeros et al. 1995). More specifically, the latter focus has become the primary goal in the evolution of the quality movement.

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[1] Alex in conversation with Jonah

This evolution towards quality management is congruent with the change in business vision over the past 25 years—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). This thesis highlights examples of how both the prescriptive and conceptual literature on one hand and the empirical and practitioner literature on the other have explored quality criteria and concerns in a search for competitive advantage.

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, which have been endorsed in the literature and by many consulting firms. Many business firms have experienced a significant change in their operations because international competition has affected their markets. Consequently, it is necessary that quality management initiatives be examined anew when markets and operations become global (Kim and Chang 1995).

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. Yet, 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 the beginning in 1993. The tables below show the last nine-year growth pattern (see Table 1) and the countries with the greatest number of certificates (see Table 2). While the first column in Table 2 indicates the countries with between 1000 and 5000 certificates, the ISO 900 survey reveals that there are approximately 132 countries with fewer than 1000 certificates.

Table 1 Total number of ISO Certifications Worldwide

World Results	'93-01	'93-09	'94-06	'95-03	'95-12	'96-12	'97-12	98-12	'99-12
Total	27,816	46,571	70,384	95,117	127,349	162,701	223,299	271,847	343,643
Growth		18,755	23,793	24,753	32,232	35,352	60,698	48,548	71,796
Countries	48	60	75	88	96	113	126	141	150

Table 2 Milestones for Number of ISO Certificates Awarded per Country (1999)

1 000	5 000	10 000	15 000	20 000	30 000	60 000
Argentina	Brazil	Canada	China	Australia	Germany	UK
Greece	India	Japan	France	Italy	USA	
Mexico		Korea				
Poland						
Portugal						
UAE						

While this impressive growth of ISO 9000 certification implies that awareness exists for the need for quality planning and management, there exists nevertheless a deficiency in ISO research regarding quality improvement and economic gains (Puay, Tan et al. 1998). Although anecdotal reports indicate that there have been benefits that have accrued to ISO certified firms, with the exception of empirical studies such as Anderson, Daly and Johnson (1995), there is little empirical testing that ISO is beneficial, particularly in Canada. Furthermore, studies in the UK and Australia regarding ISO implementation have shown mixed results (Carlsson and Carlsson 1996; Terziovski, Samson et al. 1997).

Similarly, and surprising as it may seem, there are only a small number of empirically based attempts to provide a framework for TQM measurement (Ahire, Landeros et al. 1995). These include Saraph et al (1989); Benson et al (1991); Dean and Bowen (1994); Flynn et al (1994); Black and Porter (1996); and Easton and Jarrell (1998). Additionally, there is a dearth of empirical studies that examine business performance as a consequence of quality initiatives.

Ahire, Landeros, and Golhar (1995) indicate that quality management research has been unbalanced, tilted heavily toward concept development and prescriptive writing. They opine that quality efforts need to be assessed in an ongoing manner, and that the elements of critical measures of performance should be identified and operationalised.

Accordingly, this thesis presents an instrument to gauge business performance. The instrument may be used to measure the success of instituting such quality management programs, whether in service or in manufacturing industries. The need to measure quality initiative implementation is of paramount importance. Quality whether in product or

process will not improve unless organizations measure performance (Reichheld and Sasser 1990).

Most studies of organizational performance are done either on the manufacturing sector or on the services sector, but not both. That is, the definition and measurement of performance in manufacturing industries may be quite different from the definition and measurement of performance in service industries. Although early measures of performance were applied to the manufacturing sector; nevertheless, for service activities several indicators are possible (Boyett and Conn 1988; Edgett and Snow 1996), e.g., measuring performance, by tracking indicators of customer satisfaction or product performance, among others.

Performance measurements for office or service personnel create certain problems not present in manufacturing. Several reasons may be raised: e.g., for some, there is a less-obvious tangible or countable product, there may be resistance to measurement by such personnel, there may be fear of untoward results, and finally, the true nature of the function as a dynamic activity may be unclear. The results from such studies may not be useful for between-sector comparison if the methodology is not carefully implemented to handle this. This study is an attempt to provide such a cross sectors comparison using a carefully configured methodology.

In addition to sector influence, there might also be an issue with firm size. As Hendricks and Singhal (1997) point out, a quality award might be issued to a business unit of a large firm wherein financial performance measures is based on the entire firm and not the particular unit. Perhaps smaller firms would be affected differently. In this study, since

data will be collected from firms of varying size, analysis may reveal differences in how performance is defined and measured along with differences regarding the relationship between size and quality practices that organizations implement.

Furthermore, this research might determine the degree of difference in perceived benefits for ISO certified firms that also have another quality management system in place compared to firms that did not already have a quality program.

Consequently, in order to prepare a backdrop for an empirical study, in the next section, a connection to existing theory is made. A review of some of the literature is undertaken, including literature that is (i) relevant to the evaluation of quality management; (ii) relevant to organizational performance measurement; and, (iii) relevant to various quality practices. Subsequently, this thesis will connect the theory of performance to several hypotheses within a framework of empirical research, will describe the methodology used to carry out the research, and will describe the issues that analysis uncovered. Finally concluding remarks will expose both the strengths and contributions of the proposed research.

Thus, chapter 2 contains the literature review of the theoretical origins of quality assurance, quality control, quality management as well as quality management measurement. Chapter 3 presents the research objectives, the background for measuring selected constructs of performance and some background on the effect of implementing quality initiatives. Chapter 4 describes the design of this research, chapter 5 the methodology, and chapter 6 contains the results of the research and an analysis of these results. The analysis includes the results of structural equation modeling and the

influence that various quality initiatives have on the model. Chapter 7 contains some discussion and chapter 8 the conclusion to this thesis. The references are found in chapter 9 and the different appendices are in chapter 10.

First then, consider the literature.

II. Literature Review of Quality Management Theory

This section identifies the literature that forms the basis for the theoretical framework of the study. The review begins with the theoretical origins of the quality trail, followed by a review of the literature that reports on studies on quality and measured outcomes, be they on quality itself or on performance.

A. Theoretical Origins

It may be argued that conscientious individuals, throughout history have endlessly pursued the quest for better quality. For example, consider the master painters, or those who would produce magnificent sculptures, and the musicians from the Middle Ages on. Consider the builders of the ancient and robust castles and churches, or the craftsmen (trained through a period of apprenticeship) of the eighteenth and nineteenth centuries. Prior to the industrial revolution, quality was in the hands of the individual.

The industrial revolution brought change to the notion of practiced quality. Assembly-line procedures separated the quality of the output from the worker. Pride of craftsmanship was no longer the pursuit. In 1886, Robert Towns stated, "The matter of shop management is of equal importance with that of engineering", and so began an interest of the management movement (Dilworth 2000). Consequently, for the past century of business management, particularly in the manufacturing sector, a renewed quest for quality output has steadily evolved to the current comprehensive level of quality management.

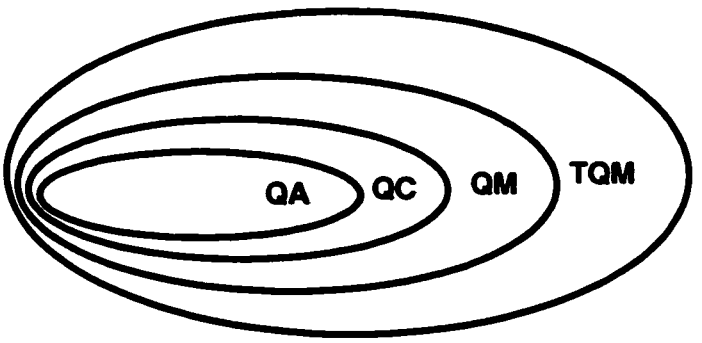
Today, that generators of services or goods should attempt to produce a defect-free

product is a given. Quality is no longer the "order-winner" that it once was, but simply a minimum expectancy—the "order-qualifier" in Hill's (1994) terminology. Consequently, many quality practices have come to the fore.

Included among the many quality initiatives are popular and well-known practices such as statistical process control (SPC), continuous quality improvement (CQI), benchmarking, Kaizen, just-in-time (JIT) practices, ISO 9000 certification, and total quality management (TQM). Additionally, during the past decade, several countries (e.g., Canada, USA, Australia) or groups of nations (e.g., Europe) have begun to offer quality awards to recognize the best-performing firms in terms of quality practices. The objectives of these awards are business excellence and competitive advantage. An examination of these practices is essential and serves as a backdrop for intensive study.

Using a Venn diagram, see Figure 1, to graphically represent the quality evolution (revolution), this section of the thesis classifies the different quality practices into four categories. These four categories are (i) Quality Assurance (QA); (ii) Quality Control (QC); (iii) Quality Management (QM), and, (iv) Total Quality Management (TQM).

Figure 1 Quality Management Evolution



Total quality management in its full essence (the full explosion to the largest circle in the above diagram) is by its own definition an unattainable goal. However, the path to a never-ending quest for business excellence is strewn with quality efforts. Firms would certainly not attempt each and every one of these practices; nor has anyone established that there exists an ideal pattern or sequence that must be followed when firms adopt particular practices. More than likely, organizations strategically adopt quality practices that they estimate would be necessary for their own business and situation. Adoption of practices may sometimes occur separately in isolation, but more often than not, probably occur somewhat concurrently. The various approaches will be briefly explained below, according to the categories in the diagram above (see Figure 1).

1. Defining Quality

There is no one definition of "quality" because the notion has evolved and over time consultants, academics and practioners have explained it from their own perspective. Several ideas reflect what one might mean by quality, including perfection, consistency, elimination of waste, speed of delivery, compliance with policies and procedures, providing a good, reliable product, doing it right the first time, delighting or pleasing customers, total customer service and satisfaction (Evans and Lindsay 1999; Tamimi and Sebastianelli 1996). Comprehensive reviews of the concept and definition of quality have been provided by Garvin (1984), Smith (1993), Reeves and Bednar (1994) and Seawright and Young (1996).

2. Quality Assurance

Quality assurance is the primary notion of quality going back through the history of

production through all the ages. It is the quality mindset that suggests that society be provided with a product, whether a good or a service, that is of appropriate quality. There have been several steps along this path towards improving the output of production. Included are early practices that formed what is known as scientific management growing into management science; tools and techniques to clarify or present different elements of an exercise for greater and improved output; and recent attempts for standardization. First, examine the origins of management science.

a) Scientific Management

Following the industrial revolution, the scientific methods of Frederick W. Taylor (Baker 1911; Taylor 1911) were the first to attempt to maximize the efficiency of the worker in the atmosphere of mass production. Taylor's approach would "shift the management of industry from the old military basis to an educational and cooperative basis. Scientifically regarded, there is no employment that is not skilled, no employment to which brains will not add a vast amount of improvement" (Baker 1911).

Although recognized as the Father of Scientific Management, Taylor had important company in the pioneering efforts for this field. Frank and Lillian Gilbreth also developed a "best way" to perform activities. Their principles of motion study made a significant contribution. Likewise, the Gantt chart for work scheduling and appreciating work progress against an established plan as developed by Henry Gantt was an important contribution.

Subsequently, the field of scientific management was advanced first during the 1920s and 30s through the work on econometrics of Nobel Prize winners Ian Tinbergen and Ragnar

Frisch. Their contributions "expanded the theoretical and empirical applications of statistics in business and economics, increasing the relevancy of statistical techniques to management science" (Zahedi 1998).

A by-product of wars is the advancement of scientific methods as a consequence of attempts of a winning strategy. Another period of advancement in the foundations of quality occurred during World War II. Quantitative techniques were advanced through the contributions of Leonid Kantorovich (linear programming) and George Dantzig and Russell Ackoff (optimization models). Their contributions lead to greater role for statistics in decision-making and operations research or management science (Zahedi 1998).

Next, consider the contribution of tools and techniques.

b) Quality Tools and Techniques

There exist a number of techniques or tools that are commonly associated with quality practices (Evans and Lindsay 1999). These techniques include

1. Deming's Plan-Do-Study-Act cycle: This technique is a continuing (and never-ending) circle of design and feedback for improved redesign. Theoretically perfection becomes the ultimate potential output for customer satisfaction.
2. Brainstorming: This method of idea generation has many positive aspects including a greater number of potential ideas for improvement decisions, greater sense of collaboration and acceptance by participants to name only two.
3. Affinity diagram: This tool helps users to associate any number of ideas into coherent

thought patterns for better understanding and decision.

4. Pareto chart: This technique allows root causes of problems to be prioritized in terms of relative influence, thus allowing the more serious solutions for improvement to be tackled first.

5. Interrelationship digraphs: This tool allows users to comprehend and visualize the relationship that one aspect of a solution has on another. Accordingly, solutions may not be attempted without realizing consequences.

6. Tree diagram: This tool, like the affinity chart groups ideas into logical groups. The difference lies in the fact the groups are structured to different levels.

7. Matrix diagram: This technique allows for two-way visualization of the components of an issue.

8. Quality Function Deployment (QFD): This tool is used to suggest optimal strategies for action having cross-referenced customer wishes-with the firm's ability to meet these wishes within an evaluation of the strategic advantages through opponent and market evaluation.

9. Cause-and-effect diagram (Fishbone): This frequently used tool depicts the major root-causes behind a particular output (usually, but not limited to, a problem). It allows the users to visualize what causes need to be considered to affect or modify the output.

10. Simulation: This tool is used to find optimal solutions for processes that are long, expensive or dangerous.

Utilization of these techniques or tools provides the organization with a greater awareness of their operations and needs. This increase in knowledge facilitates better decision-making and improves quality output. Next, consider the recent focus on standardization.

c) International Organization for Standards: ISO 9000

Among the many quality initiatives, the ISO 9000 certification program has increasingly become very popular. The ISO 9000 program is today probably the most widely used and internationally accepted quality management tool (Carlsson and Carlsson 1996; Withers and Ebrahimpour 1996; Askey and Malcolm 1997). The ISO 9000 series of standards was developed by the International Organization for Standardization in order to help companies define what a quality system should do (Russel 1993). Elmuti (1996) offers that ISO 9000 is one way for any kind of firm of any size to custom fit itself to gain advantage over competitors.

The purpose of ISO standards is typically to obtain consistent levels of performance, to leverage a competitive advantage in the market place (Parrish 1995), and, to provide a means of contributing to global quality system conformity (Withers and Ebrahimpour 1996). Tummala and Tang (1996) argue that the standards are minimum requirements for an effective quality system to ensure that the product or service consistently meets customer requirements, the foundation stone according to Porter & Tanner (1996). Accordingly, it is essential to appraise the viability of these issues.

The need that suppliers meet certain standards has been an element of quality assurance for some time. It is safe to assume that most business contracts in the past had some conditions that the client considered essential. However, "formal standards" systems

came about particularly through defence contracts with suppliers, e.g., the US Department of Defence's MIL-Q-9858A Quality Program Requirements issued in 1959 (Uzumeri 1997). The automotive industry, too, had its supplier certification programs, e.g., the Ford Motor Company introduced the Q1 Preferred Quality Award in 1981 (Uzumeri 1997).

The list of specific-industry based standards is long, but suffice it to say that the International Organization for Standardization finally, in 1987, published what has become the most popular and comprehensive standards certification program. A company can achieve a great deal if there is real commitment to ISO 9000 and what it can do.

By purchasing from registered companies, customers will be assured that the processes producing the products meet strict international quality requirements. Companies seeking registration will be compelled to get control of their quality systems and improve them (Huyink and Westover 1993). However a cautionary note is raised in Jackson (1996) with the indication that going into ISO 9000 purely because your customer tells you to can prove very costly. ISO certification is not simply a quality mark to satisfy customers. It represents cultural change in the prevailing system of management. Prevailing management practices draw from outdated quality systems based largely on inspection whereas ISO 9000 defines a system resting on a consistent quality control process (Elmuti 1996).

The standards provide improvement opportunities through reviewing past performance. Porter and Tanner (1996) also suggest that the main steps in applying the ISO standard are similar to Deming's plan-do-study-act cycle. The steps are: (i) justify and write down

what is done, (ii) do what is written, (iii) record and analyze what was done through system audits and reviews, and, (iv) revise what will be done through corrective and preventive action. Admittedly, the last point was not a structured part of the process with the 1994 version, but is structured into the 2000 version of ISO. This cyclical improvement process is the basis not only of ISO, but TQM or a program of continuous quality improvement (CQI) as well.

However, ISO does not stand alone as a "standards" tool. Other tools exist and the existence of such other tools may cause business firms to question the relative merits of each. Quality assurance provides the basis (a confidence level) for a somewhat defect-free product; an objective whereby the appropriate quality characteristics of a product are identified and the means of controlling for these characteristics are established. Several control techniques have been used, initially in manufacturing but increasingly in services as well. These control techniques make up the substance of the second circle of the Venn diagram.

3. Quality Control

There are different practices that might be included under the label "quality control". Among these are statistical-quality-control in general, and specific examples of SQC, i.e., control-charts, process-capability, cost-of-quality and Taguchi-methods. Each is examined below.

a) Statistical Quality Control

Statistical-quality-control is the quality approach that Shewhart, Dodge, Edwards, and

others, including Deming, recognized as they developed techniques to improve quality (Evans and Lindsay 1996). Among the techniques is the analysis of data based on acceptance sampling, for instance, the use of statistics, "to assure the recipient that all is well, e.g., the product is fit for use; the process is behaving normally; the procedures are being followed or to provide the recipient with an early warning when all is not well" (Juran and Gryna 1980).

In his landmark text, Juran (1979) reveals that a scientific approach to problem solving can be applied such that, in a step by step fashion, a problem is (i) acknowledged, (ii) specifically determined, and, (iii) diagnosed (which includes hypothesizing possible causes and testing these until a solution is found). Then remedies are determined and implemented. In organizations, improvement can be achieved through such a systematic approach to a problem. For example, one such problem may be variation. Variation is an expected occurrence in every process but occasionally variation becomes a problem, either because the range is too wide or because a special cause allows the situation to be considered out of control. Hence, use of a technique such as SQC helps identify where solutions may be found to a problem such as process variation.

That quality is related to manufacturing has existed in for decades. However, through the contributions of many, (Armistead 1990; Heskett 1990; Gummesson 1991; Waldman, Motahari et al. 1993; Collier 1994; Kettinger and Lee 1994; Roth and Jackson 1995; Harvey 1998), quality, today, is definitely considered to be likewise related to the service industry. Accordingly, service functions should also be controlled using SQC. For example Gardner (1994) describes how SQC might be used in banking services.

To facilitate statistical quality control (SQC), several charting tools have been suggested, including: Pareto analysis, Ishikawa or fish-bone diagrams, flow charts, run charts, histograms, correlation charts, and control charts (Juran 1979; Bohn 1984; Farnum 1994; Kenett 1994; Wheeler 1994). The latter charts are considered next, in greater detail.

b) Control Charts

For several decades, contracting business partners in manufacturing have required that the supplying firm demonstrate to the customer that the manufacturing process is in control. Specifically this refers to an examination of variability in the process such that variance within accepted limits is noted as being in control and acceptable (process capability being an associated issue is discussed later) and variance beyond the limits (or according to an unacceptable pattern) is noted as being out of control.

In an attempt to control variation, the need is to continuously improve the system through statistical process control (SPC). Solving problems in production may be detected using SPC (Shewhart 1939). This technique advanced by Juran and Deming, among others, grew out of the quality assurance notion.

By maintaining control, the variation in a system will be held in check and problems may be prevented, problems like defect or unscheduled system shutdown, or missed delivery time because a vital piece of equipment fails, and the like. For example, the ISO 9000 standard mandates that equipment be maintained so it is reliable when needed. By so doing, a firm is attempting to assure that variability is maintained at a minimal level. Thus, maintaining control of variation is seen as part of quality of the manufacturing process.

The use of control charts dates to the 1920s when Walter Shewhart and his disciples, particularly W. Edwards Deming and Joseph Juran, created control charts within a framework of overall statistical process control (SPC). Shewhart himself had been influenced by Sir Ronald Fisher who, in the early 1900s, contributed to modern statistics by his work in test statistics and discriminant analysis (Zahedi 1998).

The use of control charts, formally known as statistical process control (SPC), is a very common measure for improving the quality of a product/process. The use of SPC allows for the identification of special causes of variation and subsequently the corrective action that appropriately reduces the variation. The result is that the mean and the variance of a process become stable over time, and thus, quality is considered improved.

Control charts are the single most important tool of quality management. Notwithstanding its usefulness and popularity, Deming warned that to overly react to variance in a process could be as disastrous as not reacting in cases where the process was out of control. Evans (1999: 649) also indicates that although SPC is "quite effective for companies in the early stages of quality efforts" it is "ineffective for quality levels approaching six-sigma." Once the process is in control, it is then possible to examine process capability.

c) Process Capability

"Process capability or performance needs to be matched with the product and process requirements and consumer expectations. This process capability needs to be determined, and monitored statistically, over time", (Reid 2001:67).

Process capability is an index determined by dividing the difference between the

upper and lower tolerance levels for a process by six times the standard deviation of the process, i.e., $C_p=(UTL-LTL)/6\sigma$. The tolerance levels are determined by firm's self claimed ability to meet specifications or through a contract with the customer. Ability to meet specifications might be more stringent by establishing ability at the upper level of specification (upper specification minus process mean divided by three standard deviations, i.e., $C_{pu}=(UTL-\mu)/3\sigma$) or at the lower level of specification (process mean minus lower specification divided by three standard deviations, i.e., $C_{pl}=(\mu-LTL)/3\sigma$).

Although firms may strive to maintain quality control of their processes to demonstrate a quality output, it is far more important in the eyes of the customer that the process is capable of producing according to specification. Specifications are normally contractual, either as a specific agreement between supplier and customer in a formal contract that specifies acceptable limits for variation or by tacit agreement between the parties that arises from the public pronouncement of the supplier (promotion, advertising, etc.).

Accordingly firms may gain competitive advantage by being able to openly state that they have a very high measure of capability. This would be given as a C_{pk} value, the commonly used minimum value measure of capability which reflects the worst-case scenario, i.e., C_{pk}=minimum (C_{pu},C_{pl}).

When a firm is aware of its process capability it is better able to predict its ability to meet specifications, predict what resources are required for production, and predict where improvement, given the right resources, may be made.

By focusing on capability, that is, through a reduction of variability, firms are able to improve the quality of their product. Most companies are functioning at minimum or

below minimum capabilities, i.e., 2-3 sigma levels (Velocci Jr. 1998). As an example, AlliedSignal Aerospace President and CEO Joseph Leonard suggests most of the aerospace industry is functioning at this level (Velocci Jr. 1998).

Sprouting from such dire levels of performance, the notion of six-sigma quality emerged. This approach will be examined later under the umbrella of programs of excellence. Next, however, is the role that examining quality costs plays in improving quality.

d) Cost of Quality

"Traditional accounting does not identify the high costs of ineffectiveness and inefficiency" (Harris 1998). To get a handle on this it is necessary to realize the cost of quality. The cost of quality has two components, the cost of implementing "good quality" and the costs incurred by the presence of "bad quality". The good quality costs are those that include prevention and appraisal; while the bad quality costs are those that include internal and external failure. Evans (1999) and Garvin (1986) divide these costs categories into several business processes (see Table 3).

It is interesting to note that although Evans (1999) has "appraisal costs" as a good quality grouping, he introduces a nuance of conflict. He, like Deming (1986), would coincidentally suggest that inspection should be minimized. Others, for example DeFoe (2001), would prefer to classify appraisal costs as a cost of "poor quality".

Table 3 Quality Costs

Prevention Costs	Appraisal Costs	Internal Failure Costs	External Failure Costs
Quality planning costs New product review Quality control costs Information Systems Costs Training and general management costs Documentation & reporting costs	Test & inspection costs Instrument maintenance costs Process measurement & control costs Evaluation of storage costs	Scrap & rework costs Costs of corrective action Downgrading costs & yield losses Process failure costs Downtime Disposition costs	Costs due to customer complaints & returns Product recall costs & warranty claims Product liability costs Allowances for downgraded products

Feigenbaum (2001: 27) contends, "Quantifying the cost of quality, including failure costs, is the key to profitability and sales growth." He, along with several others (Crosby 1979; Garvin 1986; Harris 1998) suggests that the cost of quality failures (three quarters of which are external failures) can run as high as 15-20% of a firm's sales revenue.

At all times, but particularly in times of severe competition or economic downturn, maintaining control over the costs of quality, strategically investing in "good quality" areas and subsequently benefiting from a reduction in "bad quality" consequences becomes an interesting option. It is necessary to appreciate the value to understanding the cost of quality. Feigenbaum (2001: 27) also offers, "Quality cost means the cost of delivering complete customer satisfaction through accounting for quality in a way that links quality and business improvement."

e) Design for Quality

Genichi Tagucci does not accept the notion of "zero defects" as suggested by Crosby because he suggests that quality should be designed into a manufactured product as opposed to attempting to produce the product without defect. He argues that as long as a product is poorly designed it will have quality problems regardless of worker attempts to

produce without error (Heinzlmeir 1991). The mathematical procedure known as the Taguchi Loss Function suggests that loss increases quadratically as variation moves away from the targeted value (Taguchi and Clausing 1983). Thus, quality-perfect designed procedures would diminish the need for testing for defect.

Wilkins Jr., (2000) indicates that robust engineering was developed by Taguchi as a way to rapidly optimize the performance of processes and products while reducing costs in research and development and in advanced engineering areas. The concept requires engineers to concentrate on design function. He also suggests that if engineers identify the ideal function for a particular design, they must then focus on what consumers want.

Robust design can also be facilitated using the "House of Quality". The "House of Quality", also known as "Quality Function Deployment" (QFD), is a structured method for strategically deciding on the components of a product after having matched customer desires with the firm's ability to meet these desires, strategically keeping in mind the strengths of the competition. "A basic element in the implementation of a quality function deployment (QFD) project is combining customers' preferences to create an optimum product design" (Lowe and Ridgway 2000).

4. Quality Management

The designation "Quality Management" is not the same as the designation "Total Quality Management". This thesis suggests a nuance of difference exists because of the word "Total". This nuance will be explained later.

In the present section, the third circle of the Venn diagram (see Figure 1), suggests that the label "Quality Management" contains specific practices. These include the human

behaviour influence, the use of quality circles, the continuous improvement approach, the use of benchmarking, the Just-in-Time approach, and, the zero-defect mentality. Consider first the human behaviour influence.

a) Human Behaviour Movement

This movement initiated with several experiments at the Hawthorne (Chicago) Works of the Western Electric Company from 1924-1933. In the words of Homans (1941: 241), "perhaps no single research study has had a greater impact on management theory and practice."

The experiments included a study of lighting and its relationship to productivity. The results were ambiguous but productivity increased. The analysis indicated that increased productivity was a result of increased attention the workers received from top management. "The attention fostered group pride and was reinforced by supervisors' favourable treatment" (Zahedi 1998: 448."). The mental attitude of the employee is directly related to improved output (Homans 1941). This analysis is based on a number of variables that explain why the productivity of the participants in the study was higher than those employees not in the study (Homans 1941):

1. The girls had fun. They were allowed to converse on the job. Birthdays were recognized.
2. They felt less anxiety because there was an absence of supervisory control.
3. They socialized more with each other outside work hours and, accordingly, social development of the group became a factor.

4. The group developed leadership and common purpose.

As a consequence of this movement, the role of the employee as an important ingredient in the quality movement is linked to this behavioural management thrust. Today, in increasing frequency, business recognizes the importance of this asset.

Next, the role of employees in quality circles is examined.

b) Quality circles

Harvard's Richard Walton, claiming that employee involvement should be the heart of a national competitive strategy, states, "To have world-class quality and costs and the ability to assimilate new technology, we must have the world's best ability to develop human capabilities" (Hoerr 1989). Quality circles provide this opportunity.

Quality circles are defined as small groups of usually eight to ten employees, generally from the same work area and who, as willing participants, regularly meet (usually once a week during work hours) to identify, analyze, and solve problems related to their work area (Griffin 1988). The quality circle not only involves employees in their jobs but it also threatens their old ways of working, giving to management at the same time, a powerful tool to improve productivity but at the possible cost of undermining a manager's control (Hoerr 1989).

The quality circle initiative is an outgrowth of union demands of the 1970's for worker participation in problem solving. Ironically, according to Hoerr (1989), the movement has evolved to also threaten the existence of unions since workers now have gained a voice in shop operations, taking away some managerial duties at the same time.

One problem with quality circles is the honeymoon effect. Griffin (1988) empirically demonstrates that benefits from quality circles last for about two years after which the effect declines. Thus, Griffin suggests that quality circles might be considered as an organic short-term strategy for enhancing organizational effectiveness. Nevertheless, the use of quality circles enables a firm to think "continuous improvement."

c) Continuous Improvement, Kaizen, JIT

Continuous improvement (also known as continuous quality improvement – CQI) is a quality approach that has become fairly popular over the past decade or so. The concept of CQI is built on the premise, that since work output is the result of interrelated steps and activities, (that) in order to reduce the variability and improve the reliability of the process of work, it is necessary to offer continuous attention to each of the interrelated steps (Tenner and DeToro 1992).

Perhaps it would be more accurate to describe CQI as a quality philosophy. This nuance in terminology is suggested because, although a firm might decide to begin a continuous improvement effort, the need to continuously improve is an underlying principle of the quality movement. Firms have adopted this approach for improving the entire organization or for improving part of it (e.g., a department or specific business unit).

The Japanese word "Kaizen" literally translate as "continuous improvement". Kaizen is an improvement philosophy that seeks to change any aspect of the business in small, gradual, and frequent improvements over the long haul. Cheser (1994) suggests that Kaizen offers a means by which workers can find better ways to do their jobs.

According to Imai (1986), a number of tools and techniques fall under the

umbrella of Kaizen which he claims work together well for the Japanese because they are process-oriented as opposed to the United States concentration on results. He contends that Kaizen is accordingly a foundation for all activities, a primary process for the ongoing improvement of the lives of all individuals. At the heart of Kaizen is the desire to eliminate waste through a detailed study of workers' motion (Imai 1986).

One technique that complements the CQI approach is what is known as "Just-in-time" (JIT). The JIT approach is operationalized by the use of KANBAN or pull method of production. The point of JIT is that the matterial required for the next step in a production process is available and defect free when it is required. In other words, JIT leads to a reduction in waste. Evans and Lindsay (1999) indicate that JIT is fundamental to Kaizen and continuous improvement.

d) Benchmarking

Benchmarking is a process whereby a firm postures itself against another firm with the intention to benefit from the comparison. It is generally aimed outside the walls of the organization, at the marketplace and the competition (Altany 1990). Evans and Lindsay (1999) define it as the search for best practices in any company, in any industry, anywhere in the world. According to Pulat (1994) benchmarking is a reengineering/continuous improvement technique that was only recently brought into the limelight mainly by the Baldrige Award. It aims to find and adapt best practices to improve processes for better, faster, cheaper products and services which lead to overall organizational improvement (Edgett and Snow 1996; Cavanagh and Williams 1997).

As such, benchmarking efforts should be tied to the firm's strategic goals and objectives.

Among the five benefits of benchmarking suggested by Camp (1989), these two are related directly to quality initiatives: (i) benchmarking is beneficial for establishing goals based on a concerted view of external conditions, and (ii) benchmarking increases awareness of the best practices in the industry. Finally, Guimaraes (1994) demonstrates that benchmarking is necessary for growth and survival in a competitive environment and is an important part of continuous improvement.

e) Zero-defect initiatives

For Crosby (1979), quality is achieved by not having to re-do things that weren't done right the first time. Crosby's performance standard is "zero-defects" which translates as no variation from specification (Heinzlmeir 1991). Waste reduction that is embedded as a goal into quality practices such as the ISO series can ultimately lead to the achievement of zero-defect levels.

The push for zero-defect may be viewed as the ultimate end when controlling for variation. There are various approaches that might be considered as practices to identify and totally eliminate waste in addition to those mentioned earlier, i.e., Kaizen or the ISO certification series of standards.

Other quality initiatives that help organizations approach waste elimination and zero-defect operations are business process reengineering (BPR), a six-sigma program, and integrated-management process tools. These process improvement practices can lead to dramatic improvement results, seeking stretch goals or performance breakthroughs. As such, they involve a holistic approach to improving quality and are the matter of the next section.

5. Total Quality Management

As stated earlier, this thesis distinguishes QM from TQM. The early practices of the quality management movement were initiatives that were designed to focus on product quality or to change (improve) the processes continuously but gradually. The initiatives include all those discussed above, in quality assurance (QA) and quality control (QC), as well as the examples in the QM sections. The fourth circle in the Venn diagram (see Figure 1) however covers a broader scope in quality initiatives.

Total quality management is a revolutionary approach and integrative management philosophy for effective management (Ahire, Landeros et al. 1995). The TQM practices are holistic, integrated initiatives and it may take three to five years to implement an effective TQM program (Hendricks and Singhal 2001). These TQM practices involve the entire firm and are major strategic designs in pursuit of overall excellence. They include business process reengineering, six-sigma efforts, and an effort to comply with integrated criteria of the different national quality award programs. Consider first the reengineering of the process of doing business.

a) Business Process Reengineering

A business can be improved gradually (i.e., CQI / Kaizen) or it can be improved dramatically by reengineering the business process. The difference between the two approaches is the status or degree of the need for change. CQI can be accomplished gradually over a period of time, in ways that may be economical and non-threatening. It may be, however, that the old procedures are being cemented over along with certain inefficiencies. This is Hammer's (1990) "paving the cow-path analogy". On the other

hand, it may be the survival of the firm or fierce competition that is driving the need for rapid and drastic change. In order for this to come about, several enablers are required. Since BPR calls for broad reorganization, such change would require an integrated examination of the firm's processes, establishing dramatic change to one or many processes. One would expect that dramatic changes in one process would carry over into related processes. Thus, BPR should be viewed as holistic change for business improvement.

In a case study, it was shown that the combined effect of a set of enablers into an integrated model permitted a national police force to drastically restructure its operations (Laframboise 1995). From this study of three firms (i.e., a national police firm, an aeronautics firm, and a clothing manufacturer), it was suggested that because of the various enablers, several benefits might occur to the firms as a result of the BPR effort. The study demonstrated that information technology is the primary enabler of a BPR effort (the independent variable in the model), and four complementary enablers (moderating variables) are required: (i) strategy, (ii) a human resource complement, (iii) leadership issues (Waldman, Lituchy et al. 1998), and, (iv) organizational issues. The study confirms that several benefits accrue from process reengineering. A firm could expect (i) increased customer satisfaction, (ii) better quality products and services, (iii) lower costs, (iv) shorter lead times to get the product (good or service) to market, (v) increased market share, (vi) new product development, (vii) improved employee satisfaction, and (viii) improved efficiency.

Several firms have successfully reengineered their operations (Davenport 1993), thus making BPR an important process-based technique for improving the quality path of the

firms. BPR might also serve as method to allow firms to adopt a six-sigma approach to their process.

b) Six-sigma

Six-sigma is both a statistical tool and a philosophy of quality. A six-sigma approach can be used as a comparative instrument to measure the quality of a product across processes or industries (Evans and Lindsay 1999). It allows products or services to be compared on a common basis (Fontenot, Behara et al. 1994). This common metric allows firms to measure process capability and improvement efforts therein. It may be used to measure production processes, internal or external customer satisfaction, or to benchmark against best-in-class performance of competitors. It may be considered both a quality approach as well as a quality performance measure. Among the many companies that have adopted a six-sigma process, the Motorola Company is the most known.

Regarding the name, the Greek letter "σ", is used in statistics as a name for variation, an indication of how much any business process deviates from its production target. At Motorola and other firms that have adopted this quality approach, six-sigma denotes a defect rate, expressed in the number of defects per opportunity for defect, (i.e., 3.4 defects per million opportunities). It is a universal methodology that encompasses all operations whether manufacturing or non-manufacturing, for both products and services (Buetow 1996).

In the six-sigma program, a higher number of sigma denotes a more stringent result. Thus, as sigma increases, reliability improves, the need for inspection diminishes, work in progress declines, costs go down, cycle time goes up, and customer satisfaction goes

up. Harry (1998) states further, that there is a direct correlation between the number of defects, wasted operating costs, and customer satisfaction. As an example of improving satisfaction, at Motorola, there is the attempt to actively seek and listen to the customer's voice in order to best define defect (Buetow 1996). Several firms are adopting this six-sigma mentality in order to perfect their production of goods or services. Moreover, knowing where the problems lie can also significantly help to perfect a process. New, integrated-management tools, the subject of the next section, are facilitating this.

c) Integrated decision tools- improvement enabling tools

The attempt to totally eliminate process variation has recently influenced the development of integrated process management technologies. That is, firms are identifying opportunities to eliminate waste by maintaining an integrated view of their different processes. The result would be an improved decision process and consequently improved performance. Among these developments are such practices as the balanced scorecard (Kaplan and Norton 1992) and the use of technology software that identify a collective view of the effect of change or improvement in process.

(i) Integrated Software

Recently, through the advances in information technology and sophisticated software, a number of products have hit the business market that are meant to help enhance decision making for optimal performance and competitive advantage. The significant difference from previous technologies is that these recent technologies are considered comprehensive, integrative managerial support systems, which are today possible

because of advances in hardware technology.

Examples of such enterprise software packages include SAP, Baan, PeopleSoft, Cognos, and Oracle. These packages are proposed as fully integrated families of business management-software. That is, they are purported to be management tools that (i) improve business decisions and coordination through increased knowledge, (ii) extend supply chain support beyond the boundaries of an organization, and (iii) provide operational flexibility that businesses require in order to be leaders in their marketplace.

(ii) Balanced Scorecard

Integrated tools help provide what Kaplan and Norton (1992) support with their contribution about a balanced scorecard which they claim answers managers' need for a balanced presentation of both financial and operational measures. The scorecard calls for measures that are selected against different far-reaching criteria to help align an organization and monitor progress in strategy implementation (Lingle and Nygreen 2001).

That is, Kaplan and Norton's scorecard technology "complements the financial measures with operational measures on customer satisfaction, internal processes, and the organization's innovation and improvement activities" (Kaplan and Norton 1992:71). According to these authors, the scorecard helps guard against sub-optimization by allowing managers to see whether improvements in one area are achieved at the expense of another area by making a query of the information system if an unexpected signal pops up for an area.

These technologies, either as integrated software or as scorecard approaches, 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. All parts of the system focus on achieving the same result (Lingle and Nygreen 2001).

In summary, these approaches are designed to have the greatest impact on customer satisfaction, i.e., reducing cycle time, improving quality, employee skills and productivity. As stated by Kaplan and Norton (1992), "a well designed financial control system can actually enhance rather than inhibit an organization's total quality management program." The next section examines the most comprehensive quality approaches available to organizations.

d) Business Excellence Measurement Models

Business excellence measurement models include, for example, the Canada Awards for Excellence (CAE), the Baldrige Award in the U.S., the Deming Prize in Japan, the European Quality Award, the UK Quality Award, the Mexican Quality Award, and other national or international quality awards, or regional awards like "Qualimètre" in Quebec. In addition to various national awards, there are other forms of recognition that include international certification programs and industry recognition awards.

Although the ISO program has grown to be the most common standard internationally, the recognition programs like the national quality awards are a different and more thorough form of standardization, one that includes specific reference to customer concerns (Uzumeri 1997). The suggestion is that the criteria of the awards serve as a

quality standard that award winners demonstrate as being fundamental to their operations.

The value added of the different quality award systems is that they recognize TQM firms, promote TQM awareness, create a spirit of competition, and motivate and challenge firms to benchmark themselves against the award winners (Hendricks and Singhal 2001). The criteria of the programs challenge the different functions of the organization, essentially having the effect of integrating the functions towards a total quality culture.

Integration is basic to the notion of inter-functionality in firms. Inter-functionality requires that the various functions or departments of a firm collaborate their efforts in reaching business decisions. Collier (1994) suggests, for example, that the point of contact with the service delivery process includes simultaneous execution of marketing, operations, and human resource management tasks, with each functional area being an equal player in delivering service. He argues that a comprehensive approach (i.e., the seven Ps— product, price, place, promotion, physical evidence, process design, and participants) can be viewed as an opportunity to build quality, gain competitive advantage, and define business strategy. Increasingly, firms are seeking to gain competitive advantage to gain or maintain market share.

According to Caravatta (1997), over one million copies of the Malcolm Baldrige National Quality Award (MBNQA) criteria are in circulation, most for self-assessment purposes, responding, for example, to approximately 175,000-180,000 requests each year (Griffin and Hauser 1993; Ettore 1996). Business excellence and competitive advantage are the objectives of the different national awards systems that originate in several countries. The national quality awards programs represent an important alternative resource for quality

system management. They play an important role in promoting and rewarding quality and business excellence (Puay, Tan et al. 1998).

The trendsetter in this regard and the base reference for the other awards is the MBNQA in the U.S. First awarded in 1987, the Baldrige framework is the most accepted domain for total quality management (TQM) currently available (Black and Porter 1996). Influenced by the Baldrige program, other national and regional awards were developed subsequently, generally since 1990. For example, the original Canadian Award of Business Excellence, now CAE, was designed around the same time as the Baldrige, and according to the National Quality Institute's website (www.nqi.ca) has been recognizing excellence since 1983.

Porter and Tanner (1996) contend that many organizations are using these award criteria not necessarily just to compete for the award but also to carry out self-assessments in an attempt to measure their improvement progress and potential. Perhaps this is the real benefit of such awards, (i.e.,) the continued use for strategic improvement (Fisher 1994). According to Fisher (1994), in preparing for an award, a firm is attempting to dress up an organization but in doing a self-assessment, a firm is attempting to dress down the organization, getting at its core. Perhaps this is what makes the use of the quality award criteria so popular, i.e., really getting to know the basic truths underlying all parts of the firm's operations.

e) ISO 9000:2000

Earlier in this section of the literature review, the role of ISO 9000 as a quality assurance tool was explored. In November 2000, the new and improved ISO 9000 program came

into force. The change from the early versions of ISO 9000 (1987, 1994) is not cosmetic or a gradual improving of the standards. 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 last circle of the Venn diagram described earlier. The 2000 version is a significant departure from the earlier versions (Reid 2001; West 2001).

The major changes in the ISO 9001:2000 standard permit the program to be regarded more as a total quality management tool than as a tool for assurance of a quality system. Tonk (2000) offers that a sound quality program can be implemented by an organization using ISO 9001:2000, the Baldrige Award and its criteria, and total quality management only if it actually makes the effort to use these elements and their associated tools to create, maintain, and continuously improve real quality. He furthers argues, that ISO 9001:2000's set of quality management systems and the Baldrige criteria have attempted to create a grand unification by which all quality requirements and functional demands of all given organizations would be subsumed. Included among the changes to the new standard are the structure of the standard, a focus on process, and an emphasis on sustaining improvement. The provisions to the standard are structured in such a way as to more closely resemble how firms are managed and how processes are operationalised. This change might eliminate the "shadow" quality system, which, as West (2001) suggests, was typical of firms to have a parallel system to the actual operations.

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.

f) Quality Practice Implementation

Some firms have adopted more than one quality practice, either sequentially or in tandem. Questions might be raised as to an appropriate sequence to selecting an approach. Carlsson and Carlsson (1996) indicate that participants in their study dispute whether ISO is a first step towards Total Quality Management (TQM). This is an important issue as it may be an indication of the degree of ambition for quality as well as an acceptance of ISO as a tool for organizational development. Others argue that ISO is an appropriate initial step to TQM (Ho 1994), the beginning of a continuous improvement process.

Arguably, the ideal focus for quality might be for an organization to measure itself against the quality criteria of the national awards for excellence (Perry 1995). Some might inquire as to whether these programs are equivalent or better "standards" than the ISO 9000 series. The answer to this question may be that a firm can't hope to meet the expectations of any of the recognition programs if it isn't already implementing the ISO 9000 certification standards in the company.

These ISO standards provide the foundation on which a firm can build its quality management and quality assurance systems so that it may ultimately achieve a high level of success. Moreover, the ISO 9000 series is the only system accepted globally. Ultimately, the question then becomes, can firms reach business excellence that is identified with any of the awards programs using ISO 9000 as the initial step?

This completes a brief review of some of the pertinent contributions to the different

types of quality programs, approaches or techniques that companies attempt. It might be remarked that the literature fails to identify a strategic plan for implementing these different initiatives. As indicated earlier, there is no ideal sequence of practices since firms implement according to their strategic analysis of their needs.

Several benefits are expected following the implementation of quality programs. In the next section, a review of the literature highlights several studies that purport to measure quality management and its implementation. Some of the past empirical research in this area is also highlighted.

B. Quality Management Measurement and Methods

1. Measuring Quality

An early, and often cited, quality management study was over a decade ago by Saraph, Benson and Schroeder (1989). They proposed eight criteria for measuring quality management: (i) the role of management leadership and quality policy; (ii) the role of the quality department; (iii) training; (iv) product/service design; (v) supplier quality management; (vi) process management; (vii) quality data reporting; and, (viii) employee relations. It is significant to note that seven of their criteria are similar to criteria in the categories of the national quality award programs. These authors were not alone in measuring quality components.

During the 1980s, the focus of empirical studies was similarly based on the establishment of quality principles or criteria (Ebrahimpour 1985; Garvin 1986; Roth, Meyer et al. 1989; Roth and Miller 1992). Saraph, Benson and Schroeder (1989) concluded that their

instrument was a valid measure of quality management in manufacturing or service industries. The authors nevertheless encourage not only replication of the study but also studies that involve more items and larger, more broadly based, samples.

In a different study, the strength of the Deming influence on quality management was empirically tested and put forward by Anderson, Rungtusanatham, Schroeder, and Devaraj (1995). Using Delphi techniques on several experts on Deming, the authors identified seven constructs that capture the essence of the Deming approach. Basing themselves on Whetten (1989), they conclude that this Delphi treatment constitutes theory development. Thus, the following seven constructs can be compared to the lists from the other major contributors (i) visionary leadership, (ii) internal and external cooperation, (iii) learning, (iv) process management, (v) continuous improvement, (vi) employee fulfillment, and, (vii) customer satisfaction.

In their treatment of the seven constructs, Anderson et al. propose a causal path essentially clarifying whether the construct is a cause or an effect. In this instance, their model reflects the cause/effect path described by Saco (1997) and others (Best 1997; Brennen 1997; Chang 1997; DuPont 1997; Hertz 1997; Sagnol 1997; Williamson 1997). Similar to Heskett et al. (1994), Anderson et al. (1995) conclude that customer satisfaction is effected by process outcomes (continuous improvement and employee fulfillment).

They contend that these result from process management according to a system of organization (internal and external cooperation and learning) that is driven by leaders with vision. Using a path model, they demonstrate that the constructs need to fit a pattern

that requires integration of constructs. It should be noted, however, that their study has been criticized for falling short on generalizability of results because their work suffers from a lack of systematic scale development, content validity and empirical validation (Ahire, Golhar et al. 1996).

Whereas Saraph, Benson and Schroeder (1989) based the constructs of their integrated model on the positions of the quality gurus, for example: Ishikawa (1976); Crosby (1979); Juran (1979); Garvin (1983); Deming (1986), Flynn, Schroeder and Sakakibara (1995) based the constructs of their integrated model on both practitioner and empirical literature.

However, Ahire, Golhar and Waller (1996), in order to derive the constructs of their integrated model, used both the prescriptive and conceptual literature on the one hand and the empirical and practitioner literature on the other; and, like Flynn, Schroeder and Sakakibara (1995), have focused on the manufacturing sector. The unit of measure for their study was a group of 371 plant managers for a single industry, providing internal consistency. However, that there was one respondent per firm may be considered a weakness in the methodology, as this would constitute of a bias factor.

The Ahire, Golhar and Waller (1996), integrated model contained several constructs similar to the other studies e.g., Flynn, Schroeder and Sakakibara (1995) and Saraph, Benson and Schroeder (1989), but they added performance albeit with only two constructs, i.e., product quality and supplier performance. They also include constructs not found in either of the two aforementioned studies, i.e., benchmarking and employee empowerment.

In another important study, Black & Porter (1996) took a different avenue to examine quality management. Unlike the previous empirical studies, their study focused on the Malcolm Baldrige National Quality Award (MBNQA) criteria and attempted to establish an empirically validated assessment of its constructs. Black & Porter purported to present a method to improve self-assessment frameworks of the national quality awards, thereby, more effectively informing organizations in the development of total quality. To do this, they extracted a series of items from the Baldrige and the literature with which they constructed their survey instrument. Furthermore, Black and Porter, in reviewing the literature, identified seven items, which they indicate did not make up part of the Baldrige Award. Hence, they added these variables to the final list, which contained 39 items.

2. Performance of Quality Practice

Of interest, Garvin (1986) is one of a few who also looked at performance being a result of quality practices. Another performance work is the study by Roth and Miller (1992) whose contribution focuses on economic performance (profitability and return on assets-ROA). They demonstrate this as a consequence of managerial success in certain capabilities (quality, flexibility, delivery and cost). However, it is necessary to jump to the 1990s to find other studies regarding integrated quality measurement models of any significance.

Flynn, Schroeder and Sakakibara (1995) produced a frequently cited paper, which demonstrates the relationship of specific quality management practices to quality performance at the plant level. These authors propose that quality management is an integrated, inter-functional means of achieving and sustaining competitive advantage.

They have grouped management practices into core quality management practices that lead to improved quality performance. They also group some practices into infrastructure practices that in turn support the core management practices. Thus, for these authors, the core management practices are (i) process flow management, (ii) product design process, and, (iii) statistical control/feedback. The quality management infra-structural practices include, (i) customer relationship, (ii) supplier relationship, (iii) work attitudes, (iv) workforce management, and, (v) top management support. The performance outcomes include (i) perceived quality market-outcomes, (ii) percent of items that pass final inspection without requiring rework, and, (iii) competitive advantage.

In the Flynn, Schroeder and Sakakibara (1995) model, top management commitment was an exogenous variable while all others were endogenous. Furthermore, the "percent passed final inspection" variable was an objective measure while all other variables were operationalised using the mean on a five-point perception scale. The results, using path analysis, produced a refined model for the multifaceted construct that is competitive advantage. The results also suggest that different dimensions of performance function in different strategic ways, i.e. conformance-related quality has slipped into being an order-qualifier (Hill 1994), while quality features and aesthetics are order-winners.

3. Benefits of ISO Certification

Companies registered to an ISO 9000 standard must have a defined and documented quality system that will be evaluated by a disinterested third party. Periodic surveillance audits will continue while the registration is in force. The third step of the ISO process to "analyze what was done through system audits" requires both internal and external

audits. Internal quality audits are a fundamental part of the application of the ISO quality management system and such audits help to drive the quality improvement process.

Porter and Tanner (1996) offer that an audit (external) is an unbiased fact-finding exercise that provides effective management information and, accordingly, substantially improves the quality of decisions. Additionally, Warling (1997) proposes that the effectiveness and efficiency of audits can be greatly enhanced by having a large number of employees participating to some degree in the internal auditing process.

These audits must be documented as well and, additionally, reviewed with the personnel having responsibility in the areas audited, including any required corrective action to alleviate nonconformity. Since ISO is designed to ensure the adequacy of a given quality system, audits ensure adherence (Corrigan 1994). Such quality audits, in the form of self-assessment, whether carried out for certification programs or for recognition programs (e.g., national award) can be primary actions that might ultimately lead to business excellence.

However, it is necessary to point out that support for ISO 9000 is not unanimous. ISO 9000 (versions 1987 & 1994) has been criticized as a certification that has no direct connection to a product or service. The criticism contends that while the program forces companies to document what they do, they do not necessarily change what they do. In fact, the business value of certification has varied from unprecedented successes to an increasing workload and the "cost of doing business" (Terziovski, Samson et al. 1997).

Further criticisms maintain that ISO 9000 is not aimed at improving customer satisfaction; it only creates a system to ensure that the processes perform in a uniform and

consistent fashion (Russel 1993). According to the European Commission's Directorate General III for Industry, certification may not be a help to infuse quality into organizations and consequently, the focus should not be on the legal necessity of obtaining certification but on the use of ISO simply as a tool (Stratton 1994).

Some companies say that the ISO 9000 quality standard does not provide the expected benefits and is not worth the cost. From their study, Terziovski, Samson, and Dow (1997) conclude that ISO certification is not shown to have a significantly positive effect on organizational performance in the presence or absence of a TQM environment. They indicate that ISO 9000 is not only a poor predictor of organizational performance; it is also a poor predictor of quality.

While the above issues may be debatable, one cannot avoid looking at the rush to obtain ISO certification, for, it is viewed as a symbol of quality by many organizations. Indeed, certification appears for other organizations to have had a positive influence on internal routines and procedures, providing external benefits for improved customer relations, and establishing competitive ability.

Carlsson and Carlsson (1996) contend, for example, that introducing ISO creates of a need for information and communication thus creating a change in cultural behaviour within the firm. Furthermore, the Rao, Ragu-Nathan, and Solis study (1997) found that companies that are registered have better quality management practices and enjoy better quality results than companies that are planning to get registered or companies that are not interested in registration. The study also found that those planning to get registered do not have any better quality practices than those who have no intention of pursuing

registration.

Indeed, Terziovski, Samson, and Dow (1997) believe that ISO 9000 certification can contribute to organizational performance if a climate of change is created. Effectively implemented, it may act as a foundation on which to build a quality organization. Furthermore, they conclude that the strength of the relationship between ISO 9000 certification and organizational performance is not contingent on the presence of a strong or weak TQM environment.

However, the entire process of registration can be quite expensive for some firms, both in terms of cost and time implications. This, combined with the threat of not being successful either in being granted certification or of perceiving benefit, requires that firms be cautious when approaching this program. As Withers and Ebrahimpour (1996: 10) state, "Considering the cost of registration ($10,000 to $250,000 per company) and the high first-time failure rate of American firms (more than 70%), comprehensive empirical evidence of the implications of registration is sorely needed."

Registration to an ISO 9000 standard will improve the performance of the firm (Rayner and Porter 1991; Williams 1997). Accordingly, the benefits arising from certification go beyond simply having access to the international market. The purported improved performance can be measured using established criteria for performance offered in the literature. They include operational benefits and the ability to use documented procedures to train employees (Jackson 1996). Thus, the main benefits of ISO certification in terms of performance measures could be (i) improved product quality (whether a good or a service), (ii) improved operational results, (iii) improved employee satisfaction, (iv)

improved customer and market relations, and (v) improved financial performance. However, these are a dearth of studies measuring these outcomes.

ISO certification helps to ensure that the firm attempts to ensure efficient and effective processes. Efficiency, in operations management literature, is seen as requiring a minimum of lead-time to manufacture a good or provide a service. It also requires an elimination of waste, a reduction of complaints, or elimination of redundant steps in the process of manufacturing or service provision. Efficiency of operations thus would produce the good or service at a minimum cost. ISO certification therefore, may accordingly be a program that allows an organization to benefit by continuously striving for greater efficiency (Carlsson and Carlsson 1996). Similarly, the process of becoming certified, including the regular follow-up audits, forces organizations to become more efficient. Likewise, regular objective audits by outside quality professionals are very helpful in terms of improving efficiency and cost control (Russel 1993; Gopalakrishnan and Reddy 1996).

Effectiveness of a firm's operations allows it to produce quality products that satisfy customers thus maintaining or improving market share and profitability. A product with a higher conformance level has a much better chance of gaining market share than a product with a lower conformance level (Hendricks and Singhal 1996). While this is supported in operations management and quality management literature, it is also suggested as a benefit of ISO certification literature. One of the most critical benefits is access to markets (Gopalakrishnan and Reddy 1996). ISO 9000 certification gives organizations access to vital markets where registration is a requirement and where major

firms require it as a prerequisite to continued business relation (Simpson 1994).

Any organization with a quality system that meets ISO standards has all or most of the characteristics that constitute significant benefits. These include improved productivity, reduced costs, thorough documentation of all processes, reduced waste, better informed and competent management decisions-making, total quality awareness by all employees, an emphasis on problem prevention rather than detection, increased sensitivity to customers needs, and, upgraded systems to produce quality products and services (Gopalakrishnan and Reddy 1996).

ISO is about corporate-wide quality systems. A quality system is designed to ensure the continued repeatability of a set of product characteristics, whether goods or services, that have implicitly been agreed to by customer and supplier (Corrigan 1994). Thus, there needs to be consistent and efficient processes and procedures to effectively provide the quality product. Systematic and effective internal auditing can assure this performance and a test for measuring performance is required, as the above discussion suggests. Finally, ISO may provide competitive advantage.

As more and more organizations in all sectors of the economy move to ISO certification, it becomes a necessity for all firms to obtain certification in order to remain competitive. This is known as the price of doing business, the order-qualifier suggested by Hill (1994), Collier (1994) and Skinner (1996). Major companies, when looking at different suppliers will most certainly favour those that are certified to an ISO 9000 standard. For small and mid-size companies, ISO 9000 creates a level playing field and gives them the ability to export (Russel 1993). Also, Russel suggests that having the certificate tends to reduce the

number of customer and supplier audits.

In summary, it might be accepted that the external benefits from ISO certification include a quality product whether in the form of a good or a service. Both employees and clients will be more satisfied as a result of implementing ISO. The firm should likewise enjoy greater profitability whether in market share or return on investment. Such factors contribute to organizational effectiveness and are beneficial to the various stakeholders.

This concludes a brief examination of the literature regarding empirical research in quality initiatives. Next, before describing the research methods and results, this thesis examines the theoretical basis for variables that will be measured specifically in this research.

III. Performance Variables and Research Hypotheses

A. Research Objectives

This research project endeavours to respond to three series of questions. First, based on the literature, can we develop an integrated measure of what constitutes business excellence? In other words, to what extent should Canadian firms measure business performance using indicators that operationalise the various latent variables that identify excellence? Is there a set of reliable and valid measures for each of these performance constructs?

Second, is there a significant difference in the measures of business excellence for firms that are accredited with the international standards certification program (ISO) and firms that are not ISO certified? This question implies the need to investigate if indeed, after a period of time, the initial promises made by proponents of the ISO program, such as improved quality, increased market advantage, and secured customer response, have been met in Canadian firms. Additionally, is there a significant difference in perceived benefits for firms that have ISO certification and which also have a complementary quality management system, particularly a total quality management approach (TQM) in place when compared to firms that have only ISO certification?

Finally, what other variables affect business excellence? At the outset, however, consider the theory behind what could be the variables of performance measurement. The first of these three objectives is examined next.

B. Business Performance Measurement

This section examines the notion of organizational performance and the measurement of performance within different organizational areas. To measure business performance organizations have traditionally relied almost exclusively on financial measures, but today, managers want a balanced presentation of both financial and operational measures (Kaplan and Norton 1992). Product quality, efficiency of the process, customer satisfaction, employee relations, supplier quality, and financial performance are six frequently mentioned constructs that theorists for the past decade have indicated should be associated with quality management or improvement. Consequently, it might be appropriate to examine these as criteria of quality improvement and the corresponding impact on organizational performance. To begin however, consider the construct of performance itself.

1. Performance

As highlighted in a previous section, the literature includes studies that empirically examine performance benefits as a result of implementing TQM (Saraph, Benson et al. 1989; Black and Porter 1996). Furthermore, there are studies that examine the impact of quality management practices on non-financial measures of performance (Benson, Saraph et al. 1991; Flynn, Schroeder et al. 1995). The suggestion is that if decision-makers focus on quality management, improvements will occur in overall business performance, which ultimately results in improved financial performance. For example, a US government study by the General Accounting Office (GAO) links improved performance with quality efforts using past winners of the MBNQA (Black and Porter 1996; Hendricks and

Singhal 1997).

The GAO study indicates that these winning organizations achieved improved employee relations, better quality products, lower costs, greater customer satisfaction, improved operating results as indicated by improved market share, sales per employee, return on sales, return on assets which translates as improved profitability. Although criticism has been raised regarding the limited sample used in the research, Garvin (1991) offers that such limitations only go to show how difficult it is to test hypotheses regarding awards.

The organizations in the study all demonstrated customer focus, management leadership in quality values, employee involvement, an open corporate culture, fact-based decision-making, and partnerships with suppliers, thus, supporting in Black and Power's (1996) view, the relevance of implementing TQM as defined by the MBNQA. Indeed, by extension, this support suggests that similar awards with similar criteria would also be appropriate to implement and measure TQM in the respective country.

Hendricks and Singhal (1997) cite a few other studies that add results to performance constructs. For example, an automotive study (Fitzerald and Erdmann 1992) reports on profit increase as a result of continuous improvement efforts. In an IBM study (1993), high-scoring Baldrige-self-audit business units outperformed the other units in customer satisfaction, employee morale, market share, revenue and profitability. Of greater significance, Hendricks and Singhal (1997) also report on a study (a working copy that was subsequently published) by Easton and Jarrell (1998) that demonstrated improved financial performance, which, like their own study, is measured against a benchmark. In their study, Hendricks and Singhal measure performance over a time period surrounding

the date of winning the MBNQA. Two other studies mentioned by Hendricks and Singhal (1997) make reference to improved stock prices and a decrease in systematic risk of a firm after winning the quality award (Heller 1994; Hendricks and Singhal 1996), but they indicate a limitation in that these studies only capture a part of implementing a TQM process.

Overall, the literature suggests several financial and non-financial factors of business performance. Individually, the factors might be categorized as latent variables or constructs for which, several observable variables may be measured, i.e., variables that serve as indicators of the construct. Accordingly, it may be possible to test the structure of each of the latent constructs of performance. In the following sections, this possibility will be explored.

2. Specific Performance Constructs

In this research, the six specific constructs that indicate the performance of an organization include (i) product quality effectiveness, (ii) operational process efficiency, (iii) customer focus, (iv) emphasis on employee, (v) supplier role, and (vi) financial performance. In other words, these are latent constructs, which measure or define performance. The selection of these constructs is based on the criteria and measures of "business results" found generally in the different national quality awards programs and specifically in the Malcolm Baldrige National Quality Award of the United States. Blazey (1997a) (1997b) points out that results fall into 5 main categories: 1) customer satisfaction, 2) financial and market performance, 3) human resource effectiveness, 4) supplier and partner performance, and. 5) organizational specific performance (product

quality and operational performance). The last criterion was split for this research.

The identification of organizational performance measures was also the foundation in the seminal work of Kaplan and Norton (Kaplan and Norton 1992). In their work on the "Balanced Scorecard" , they suggest that firms track four measurements:

1) Financial measures that might include return on investment (ROI), profitability, revenue growth, economic value added, and shareholder value.

2) Internal measures that might include quality performance, productivity, cycle time, and cost control.

3) Customer measures that might include satisfaction measure and customer loyalty through repeat business

4) Innovation and learning measures that might include employee satisfaction, new product innovation, and employee training.

The constructs in this research are in some ways similar to the "Balanced Scorecard" notions and in effect expand them. Like the "Balanced Scorecard", these constructs may be accepted as targets for receiving feedback for organizational learning. Furthermore, there is need to consider the barometer upon which the feedback is based. Blazey (1997b:17) indicates,

> "The high performance organization collects, manages, and analyzes data and information to drive excellence and improve its overall performance. Using data and information as strategic weapons, effective leaders compare their organization constantly to competitors, similar service providers, and world-class organizations."

Accordingly, in this research, the basis of comparison is the firm's perception to it's performance vis-à-vis the industry, i.e., its competitors. Since these constructs are operationalised by indicators that are frequently mentioned in the literature we will assess the reliability and validity of these constructs by means of confirmatory factor analysis. Furthermore, it may be possible to group the factors as a single expression of performance. In the following, we will consider each construct in turn and to test their proposed structure, we present a hypothesis for each construct.

a) Product Quality Effectiveness

Customers can set quality requirements and state these as standards in a contract with the supplier. This has been, for example, particularly true for defence contracts and for the automotive industry. On the other hand, a firm itself may set its quality standards in as much as it properly interprets or envisions customer requirements. The point is, however, that it must be the customer, not the server, who defines quality. Consequently, an audit process, whether the firm does the audit internally, or the customer or a third party performs an external the audit, may verify if standards are met. Essentially, the determination that the quality of the product exists rests with the consumer who is the ultimate judge of quality. Accordingly, meeting standards and customer needs is a key responsibility of any firm.

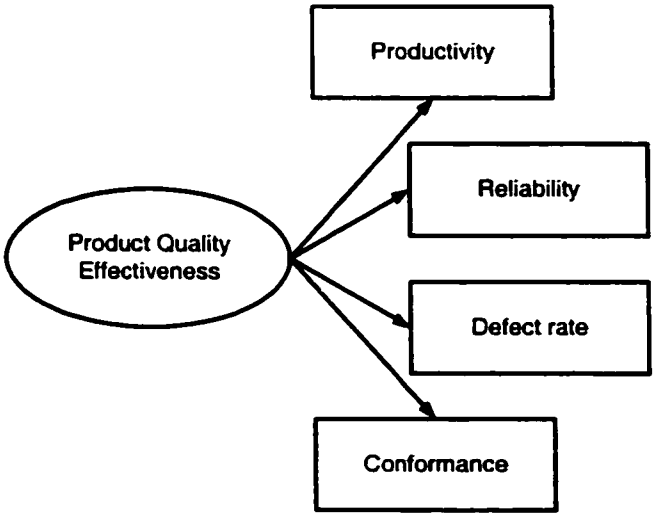
A system of standards establishes a desired quality level of a product, and standards may help improve process as well (Uzumeri 1997). The ISO 9000 certification program is a primary example of such standardization. Firms whether manufacturing or service can establish their standards and then using ISO 9000 attempt to compete even on the global

stage (Marash and Marquardt 1994). As a consequence of using formally established standards, a firm is in the position to identify the status of its operations or its production results, i.e., to measure whether the established standards are indeed met. Performance measurement involving data such as defect rates, error rates, rework cost, and scrap cost are measures of quality performance (Saraph, Benson et al. 1989). To measure service/product quality, measures might also include the level of the reliability (Evans and Lindsay 1999). A reliability measure respects the "fitness-for-use" definition of quality (Juran and Gryna 1980).

This construct may be assessed by testing the following hypothesis, which is presented graphically in Figure 2.

H1: That "product quality effectiveness" of a firm may be operationalised through measures of productivity, reliability, defect, and standards process capability.

Figure 2 Product Quality Effectiveness



b) Process Efficiency

Operational process efficiency may be defined by various measures; for example the level of, or the frequency of, "on-time" response; or the frequency that schedules are met. Firms could also measure the level of the cycle time or elapsed time to perform an activity; or, the level of availability of, or waiting time to start an activity.

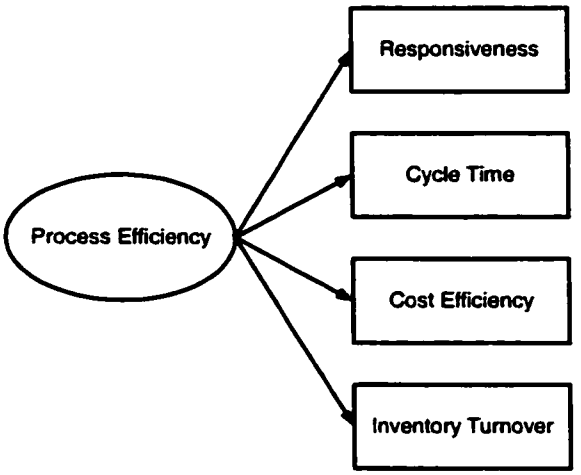
Because of customer dialogue at the point of product delivery, managing supply and demand in services differs from managing these in manufacturing. In manufacturing, rhythms imposed by customers can be buffered from those preferred by managers.

Recently, organizations have chosen to implement concurrent engineering as an attempt to rectify this deficiency, and improve their processes. Concurrent engineering is meant to shorten the cycle time for a new product by using cross-functional teams composed of those who design, those who engineer, those who produce, those who sell and those who serve the customer.

Improved process leads to cost reduction and this too can be measured. Inventory turnover could also be measures of operations improvement. Finally, as a firm becomes more efficient and knowledgeable, it should be narrowing the gap between the actual costs of doing business compared to the planned costs. This too should be measured. This construct may be assessed by testing the following hypothesis, which is presented graphically in Figure 3.

H2: That "process efficiency" of a firm may be operationalised through measures of responsiveness, cycle-time, cost efficiency, and inventory turnover.

Figure 3 Process Efficiency



c) Customer Focus

The focus on customer has become ingrained as part and parcel of the quality movement. As Porter and Tanner (1996:59) indicate, "Customer-driven quality is a strategic concept whose measures of successful implementation include customer retention and increase in market share." The satisfaction of the customer affords the potential of loyalty, which in turn helps assure organizational survival as a minimum (Dean and Bowen 1994), and possibly organizational prosperity as a potential luxury. How assets are managed and customers are served is affected by organizational culture. To affect the best use of assets, a properly established strategy is essential, one that indicates that the moment of interaction with a customer is a moment of truth (Carlson 1987) that influences loyalty. Whatever transpires during the moment of truth can make or break a long-term customer relationship.

A quality-minded culture requires that the primary aim of everyone in the organization

must be to fully understand, meet and strive to exceed the needs of customers. Managing for improved quality begins with an understanding of customers' expectations. This means that service quality in a pure service firm, or in the service component of a manufacturer of goods, is the difference between what the service provided and what the customer expected. This was the issue of much research in the 1980s (Parasuraman, Zeithaml et al. 1988).

However, the firm needs to truly identify who its real customers are and those that will assure the firm's survival are to be taken care of primarily. As a consequence to such identification, the firm will be in a position to accordingly measure what is needed to satisfy, provided it has learned to listen. Berry and Parasuraman (1997) offer that the quality of listening impacts on the quality of service. On this note, the firm would be able to deploy several tools to hear the voice of the customer.

Among these, we might find for example, the use of surveys, suggestion boxes, focus groups, (Berry and Parasuraman 1997) or the tool such as quality function deployment (QFD) (Hauser and Clausing 1988), a tool, which identifies, structures, and prioritizes customer needs (Griffin and Hauser 1993). When a firm's operations are driven by the voice of the customer, it is not limited by the edicts of top management or the opinions or desires of design engineers (Evans and Lindsay 1996).

Part of the process of focusing on the customer requires consequently the documentation of customer performance expectations often via some form of standardization. The use of cross-functional teams is a method to improve the process of efficiently devising standardization. For organizations that include client and supplier on the cross-functional

team, the voice of the customer is even more direct. Involving customers in this way also helps build customer loyalty.

Organizations typically account for fixed assets as indicators of net worth but fail to account for creativity and innovative capacities of their members or for customer loyalty and faithfulness (Kelada 1996). Recently, however, both manufacturing and services similarly are increasingly focusing on customer loyalty. Whether it's cashiers going out of their way to help customers or salespeople being compensated for customer maintenance, or truckers procuring replacement trucks to assure delivery, all are attempting to guarantee service to make for loyal customers.

Customer and employee loyalties are at the heart of all service breakthroughs and are the cornerstone of a successful service. Heskett (1990) goes on to state that customer loyalty influences employee and supplier loyalty and produces profit, which, in turn, leads to shareholder loyalty. He suggests that to develop this loyalty, breakthrough service leaders will determine the value of a customer, keeping in mind that retaining customers costs twenty percent that of attracting new ones. It is thus incumbent upon the organization to understand the client and in essence manage accordingly.

Heskett (1990) offers further that service leaders will attempt to understand customer needs first, by emphasizing psycho-graphics (a profile of the way people think, feel, behave) as well as the traditional demographics (age, location, education, wealth, income); and secondly, by watching migration patterns and customer evaluation processes. Likewise, Reichheld and Sasser (1990) argue that customer defections cost the organization dearly and, accordingly, by studying why customers defect, i.e., defection

management, the organization can earn what it needs to prevent defection and encourage customer relationships to the level of being a loyal customer.

Their logic is based on the assumption that customer loyalty is an important determinant of profit (Reichheld and Sasser 1990; Heskett, Jones et al. 1994). Heskett (1990) suggests that it is possible to develop better customers by measuring expectations and managing expectations. It is necessary to wow customers on the first encounter by managing the service bookends with outstanding service they will never forget. For example, this might include guarantees to the customer.

Customer loyalty can be facilitated by the use of service guarantees (Hart 1988; Hart, Schlesinger et al. 1992). A service guarantee can serve as an important vehicle for both communicating and delivering on a service promise. Guarantees in the hands of breakthrough service companies provide a tangible, organizing device for achieving total customer satisfaction, the highest form of service quality (Heskett 1990). The service guarantee can be thought of as a tool both to obtain information about quality and to force an organization to "hold its (collective) feet on the fire" regarding service quality.

Not only should service providers never take the customer for granted, (even in situations of a monopoly) but that providers must also strive to make the customer 100% satisfied during and after every service encounter (Jones and Sasser 1995). In this light, Bitner and Hubbert (1994) studied three customer related constructs i.e., (i) service encounter satisfaction, (ii) overall satisfaction, and (iii) perceived service quality. After quantitative and qualitative analysis, they found that the three are distinctly important to consumers, are highly correlated and that the first was most distinguishable in customer relationships.

An additional issue to these points, is raised by Bolten and Drew (1994) who, as a result of their study of three firms, caution that when measuring service features during an examination of customer satisfaction and perceived quality, the researcher must be aware of mediating cognitive variables. These variables include (i) perceived control, i.e., the extent to which the customer has control of the process; (ii) perceived personalization, i.e., the extent to which the customer is made to feel like a "somebody"; (iii) disconfirmation, i.e., the extent to which service perceptions do not concur with expectations of service; and (iv) service attributions, i.e., the situational and unique aspects of each encounter.

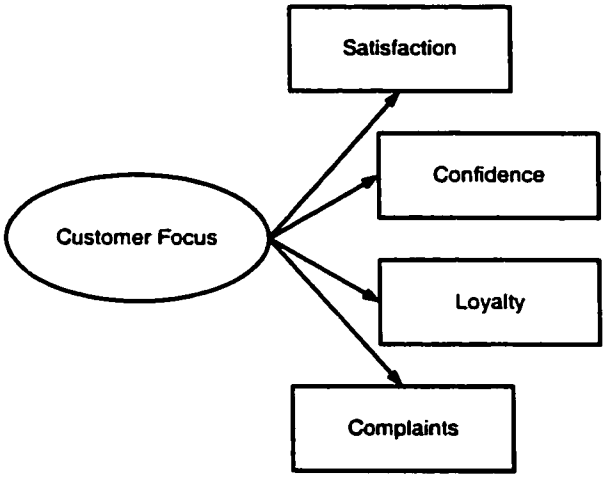
Accordingly, customer retention and loyalty must be carefully and regularly analyzed. This requires systemic service follow-up investigations, including a form of exit interview with defectors. Firms generally don't have a clue as to why they lose customers and don't seem to worry about such losses (Reichheld 1996). Yet recruiting new customers is an expensive procedure, far more than the cost of retaining customers, without even considering that the longer a customer remains loyal the more the customer seeks the services offered, i.e., the more the customer is increasingly a profit source. Just like Jones and Sasser (1995), Reichheld (1996) warns that firms can misinterpret satisfaction surveys suggesting that they can easily misread them or be misguided in their analysis of the results. Griffen and Hauser (1993) also warn against misreading customer satisfaction measures. Instead, firms should focus on the failures, i.e., why customers defect, why results have diminished, why there isn't 100% satisfaction. Through such undertakings, Reichheld (1996) claims that the firm will learn what it is that their customers value in the services offered which in turn may be the offering that leads to

customer loyalty.

In summary then, a customer focus involves (i) identification of the customer, (ii) establishing what are the customer's requirements, which include durability, reliability and speed of service, (iii) managing customers relations accordingly, and, (iv) measuring customer satisfaction. This construct may be assessed by testing the following hypothesis, which is presented graphically in Figure 4.

H3: That an organisation's focus on the external customer may be operationalised via measures of satisfaction, confidence, loyalty, and complaints.

Figure 4 Customer Focus



d) Employee Status

At the centre of quality initiatives lies the human aspect—employees. No quality activity can be carried out effectively if the people involved are not willing and able to be involved (Kelada 1996). They must see the quality initiatives as contributing to their

benefit as well as to the benefit of the organization. Kelada (1996) suggests that the human factor is what makes or breaks these attempts. Accordingly, the success of a company is dependent on the skills and motivation as well as the degree of participation and empowerment of its workforce. The time and money spent on training to affect these must be seen as an investment (Porter and Tanner 1996). The acceptance of employees' vital importance to the quality performance of the firm has evolved gradually over the past century.

As described in Sower et al (1995), the work of Taylor (1912), and Gilbreth (1922), fathers of scientific management, gave rise to functionalism and hierarchical forms of organizations. Sower (1997) further indicates that Weber advocated "bureaucracy" as a highly efficient model based on hierarchy and formal authority. On the other hand, Bounds (1994) offers that two views of the organization exist, i.e., rational and cultural. The rational view of organizations requires that the manger endeavour to achieve the organization's purpose by focusing on goals, formal roles, technologies and combinations of these elements. A cultural view of organizations goes in the opposite direction. In 1908, Gantt (like his cohort Taylor) was a precursor of the cultural view by positing that the individual worker trained in the correct work ethic would benefit himself, his superior, and the firm. He suggested that attitude towards work would allow greater performance than knowledge or skill.

It is impressive that some of Gantt and Taylor's suggestions are still making the rounds among today's theoreticians. Consider these examples: Similar to what is often heard these days, they suggested that there is a need to train the worker. They claimed that workers can suggest better ways of doing their task, thus foretelling current suggestions

that empowered workers can contribute to process improvement. They suggested that experts could write up standards for workers to follow, reflecting the ISO 9000 system that is so currently popular.

Nevertheless, Gantt's and Taylor's concern was the individual worker and there are those today who caution that the important concern must be the system, e.g., Deming's (1982) insistence that quality is achieved by improvement of the process, notwithstanding his emphasis of the employee status and contribution. Davenport, Jarvenpaa and Beers (1996) indicate that in the past, the focus was on managing knowledge workers rather than knowledge work.

They propose a process approach to allow an end-to-end view of how best to structure, sequence, and measure work activities to reach targeted outcomes. They caution that firms must better manage the precious assets of knowledge and the people who create and possess it. How a firm manages its human resources will affect its competitiveness.

In this regard, and relating to service encounters, Bitner, Booms and Mohr (1994), demonstrate with their study that front-line employees are a critical source of information about customers. They show that employees often modify their behaviour from moment to moment on the basis of feedback they receive while serving customers.

Furthermore, they posit that these employees have a better understanding of customer needs and problems than do other (non-frontline) employees of the firm. Firms that rely on employees to provide the feedback from customers are at the same time providing a sense of value and ultimately satisfaction to the employee. Employee satisfaction has been found to drive productivity, to increase employee loyalty, and to link positively to

customer satisfaction (Heskett, Jones et al. 1994).

Accordingly, involving employees through training and flexibility of experience to understand the customer, and subsequently deal with the customer appropriately, provides the firm with an advantage. Involving the employee, for example through the quality circles (a quality practice that was examined earlier) has proved beneficial. In their study, Marks, Hackett, Mirvis and Grady (1986) found that quality circle participation led to improvements in productivity and absenteeism rates.

It almost appears ironic, that as firms improve their competence and competitiveness and when all firms have access to the same flexible technology, they can at least in theory, all perform equally well on quality, time, and cost. In this situation, Corbett and Wassenhove (1994) suggest, the only difference between firms is the people working for them and how the knowledge these people create is managed to enhance learning. Thus, human resources management now becomes the critical competence.

In their study, Ebrahimpour and Withers (1992) argue that the success of Japanese style manufacturers is due to employee involvement. They demonstrate that in Japanese firms or Japanese-based firms in North America, there is a significantly higher level of employee involvement and there is significantly higher use of statistical quality control tools. It seems essential for firms to train the employees in the use of quality tools and involve the employees in decisions affecting the quality of the production.

Furthermore, it becomes incumbent upon the organization to respect the individual and encourage its people to develop their full potential. If the individual is to use creativity and make positive contributions, he must be in the position to continuously improve, to

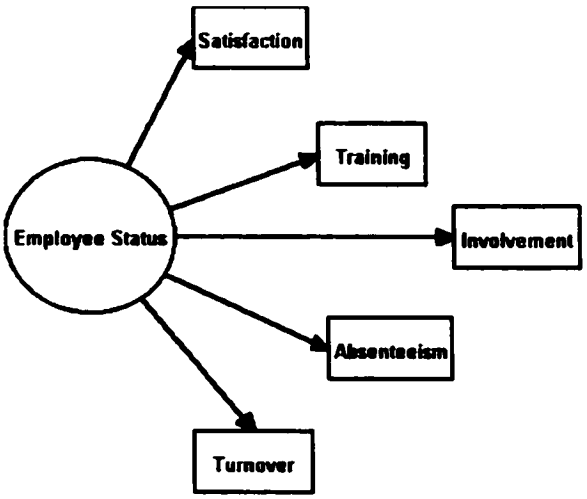
be in a learning mode. The organization's collective commitment to learning comes from the individual commitment to learning (Senge 1995).

Thus, in summary, the development and deployment of a human resource plan is a requirement for meeting the goals of the organization, and achieving excellence through people. The plan involves the organization's efforts to foster and support an environment that encourages people to reach their full potential through participation in the feedback and improvement process of the firm. Endeavouring to increase the satisfaction level of the employees will reap many benefits to the organization. Firms must see that the learning employee and the learning organization are related issues. Not only will trained employees be more productive, satisfied and loyal but also the customers as a consequence will be more satisfied.

This construct may be assessed by testing the following hypothesis, which is presented graphically in Figure 5.

> H4: That a firm's emphasis on employee status may be operationalised via measures of employee satisfaction, the extent of training, the degree of involvement, the level of employee absenteeism, and, the level of employee turnover.

Figure 5 Employee Status



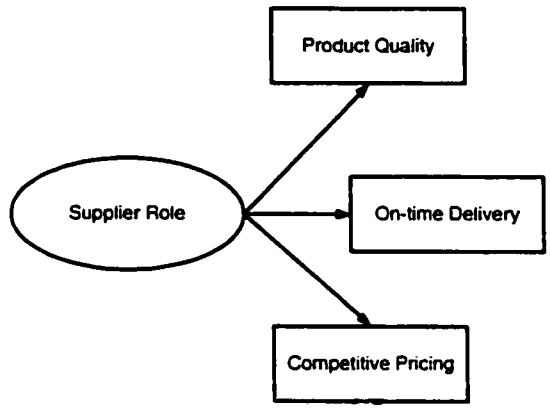
e) Supplier Role

Supplier involvement embraces several issues. Alliances with other organizations have apparently become critical to meeting a firm's strategic objectives. The just-in-time concept (JIT) and the global competition for resources are two reasons that Dowlatshahi (1998) raises for the importance of integrating suppliers in the decision process of an organization. For example, ISO certified firms are expected to have their suppliers seek certification. Bates (1997) posits that this is a mandate of coercion along the supply chain. Likewise, as firms proceed in a quality management process, part of the continuous improvement effort is the establishment of long-term relationships with suppliers as contracting partners, a form of imposition (Deming 1986; Bates 1997). Several researchers (Saraph, Benson et al. 1989; Dean and Bowen 1994; Flynn, Schroeder et al. 1994; Ahire, Golhar et al. 1996) have developed and tested constructs to measure factors such as supplier quality management and design quality management.

This construct may be assessed by testing the following hypothesis, which is presented graphically in Figure 6.

H5: That the construct "supplier role" may be operationalised by performance measures including product quality of the supplier, the timeliness of delivery, the competitive nature of the price charged by the supplier.

Figure 6 Supplier Role



f) Financial Performance

Research has shown strong positive relationship between quality improvement incentives and financial performance (Wisner and Eakins 1994). Likewise, Hendricks & Singhal (1996) show that firms that focus on improving the quality of their products and processes (conformance and/or performance quality) tend to increase revenues and reduce costs thereby positively impacting net expected future cash flows.

In addition, following a quality award, the stock market reaction regarding the winning firms is positive and these firms tend to improve their market value (GAO 1991; Hendricks and Singhal 1996). Also, a stock investment study, the third conducted by the

National Institute of Standards and Technology (NIST) of the USA, reiterates the fact that quality pays. The publicly traded Malcolm Baldrige National Quality Award (MBNQA) winners outperformed the S&P 500 by approximately 3 to 1 (NIST 1997).

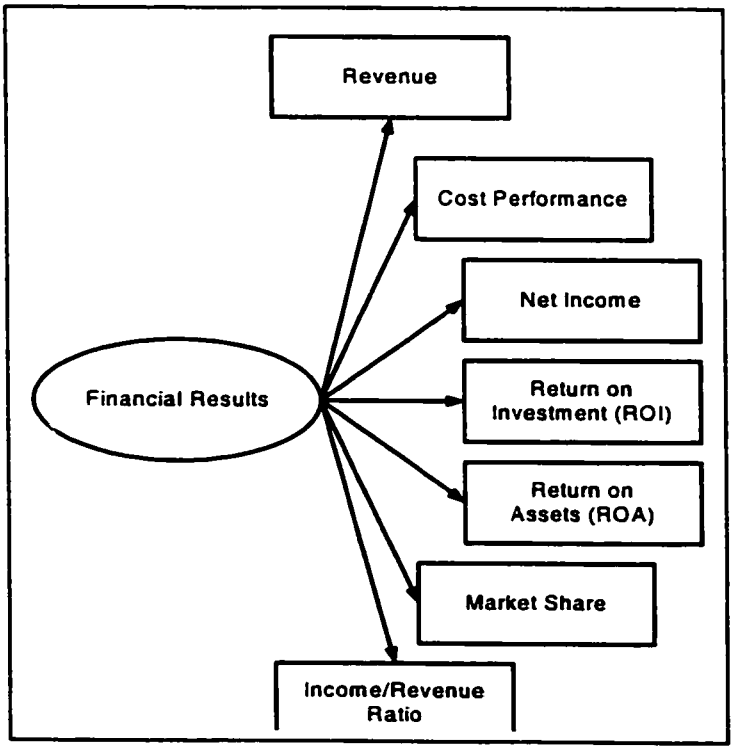
In a later study, Hendricks and Singhal (1997) demonstrate that quality award winning organizations outperform a control sample on operating income-based measures. These measures are improvement over a 10-year period of 107% of operating income, which is 48% greater than the control sample. In their recent study, Hendricks and Singhal (2001) advance their previous work by demonstrating the effect on stock price performance over a long term. They demonstrate that there is no significant difference during the implementation phase of a TQM program (3-5 years) but that during the post implementation phase (five years), TQM firms significantly outperform matched control firms.

Additionally, in their research, they show that the change in ratio of operating income to (i) assets, (ii) sales, and (iii) number of employees is 20% higher than the control sample. Furthermore, they found (i) strong evidence that that the test sample outperformed the control sample on sales growth, and (ii) weak evidence of more success at cost control. This construct may be assessed by testing the following hypothesis, which is presented graphically in Figure 7.

H6: That the construct financial results may be operationalised by obtaining measures that include the level of sales, the level of revenue production, the level of cost performance, the level of profit performance, the level of return on investment and the level of return on assets as well as market share.

As a cautionary note, performance results are sometimes difficult to pinpoint specifically. Press releases about a firm's activities, presentations by senior managers to meetings and conferences both within and outside the firm, sharing with industry colleagues, participating in industry studies, or organizing special days for employees are public demonstrations of such a promotion of quality pursuits. In a study of stock market reaction to winning a quality award, Hendricks and Singhal (1996) indicate that the actual winning of an award would not be a surprise to the stock market for these types of reasons. Accordingly, any significant quality initiative effort by a firm that becomes known publicly may indeed have an effect on performance. It may not be possible to control for this.

Figure 7 Financial Performance



In summary, six factors are proposed as constructs (latent variables) of business performance where these constructs are measured by the 27 observed variables depicted above.

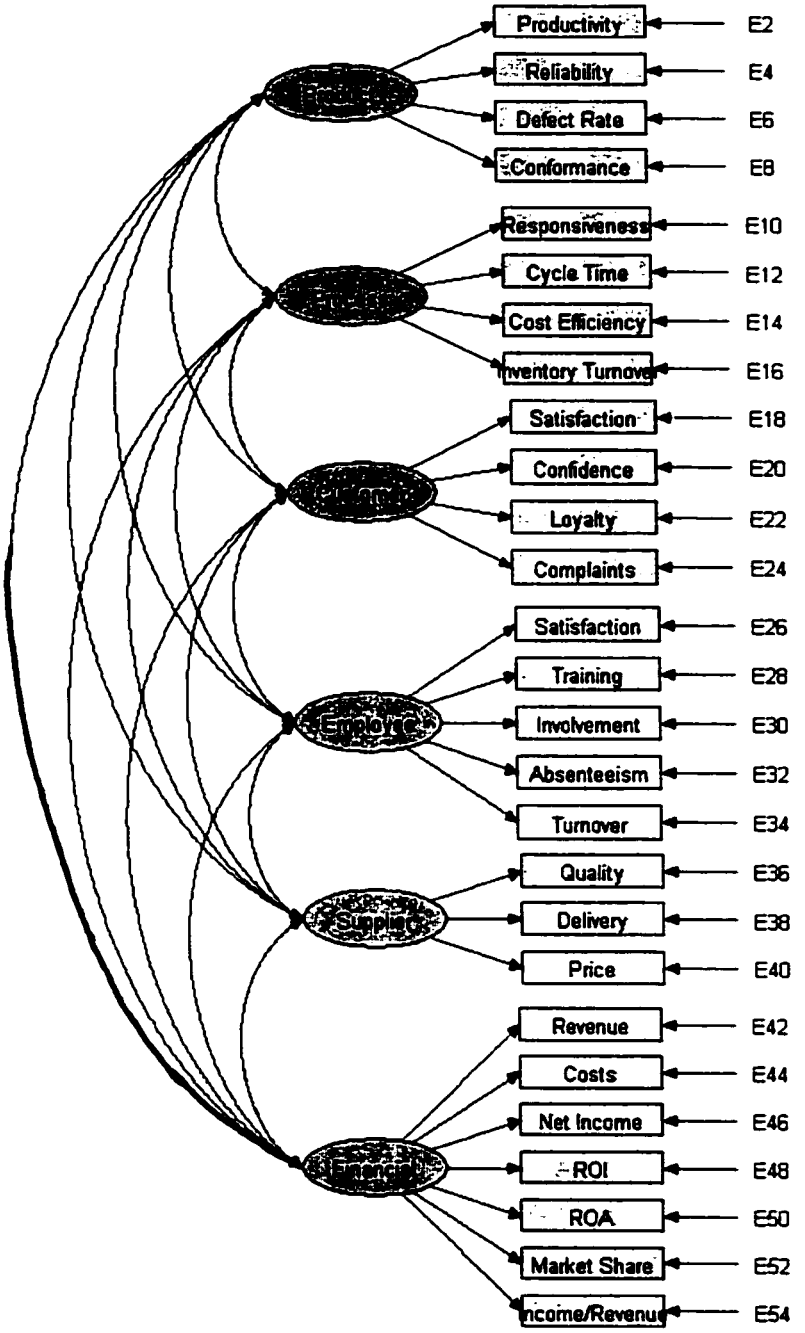
g) Correlation Model

The next objective is to test the above six factors simultaneously by fitting a correlated factor model to the data as depicted in Figure 8. In the graphical presentation, the curved two-headed arrows linking all possible pairs of factors suggest that the factors are inter-correlated. The single headed arrows leading from the constructs to the items represent the proposed regressions of item scores on each factor and the source-less single headed arrows represent random measurement error.

Therefore, it is hypothesized that the above six factors are significantly correlated.

H7a: That the 27 measured variables may be grouped into six correlated factors, namely (i) product quality effectiveness, (ii) process efficiency, (iii) customer focus, (iv) employee status, (v) supplier role, and (vi) financial performance.

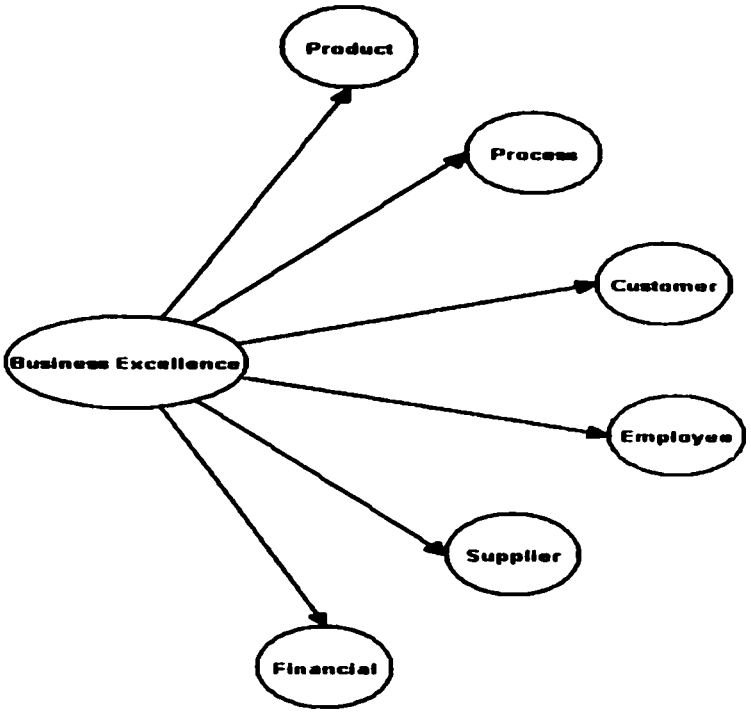
Figure 8 Correlation Model – A Six-Factor model



It is also hypothesized that the correlations among these six factors can be further explained by a common construct (a second-order factor) that may be called Business

Performance Excellence. That is, analysis of the data may reveal that performance excellence is a latent variable that is operationalised by six factors. As described above, these factors are determined by various commonly accepted indicators or observed, explanatory variables. Hypothesis 7b is graphically depicted in Figure 9.

Figure 9 Business Performance Excellence - 2nd Order Factor Model



H7b: That business performance excellence may be operationalised as a second order factor model which may be considered as a holistic measure of performance of six factors: (i) product quality effectiveness, (ii) operational efficiency, (iii) customer focus, (iv) employee status, (v) supplier role, and (vi) financial performance.

The next objective of the research is to consider the impact that quality initiatives have on business excellence.

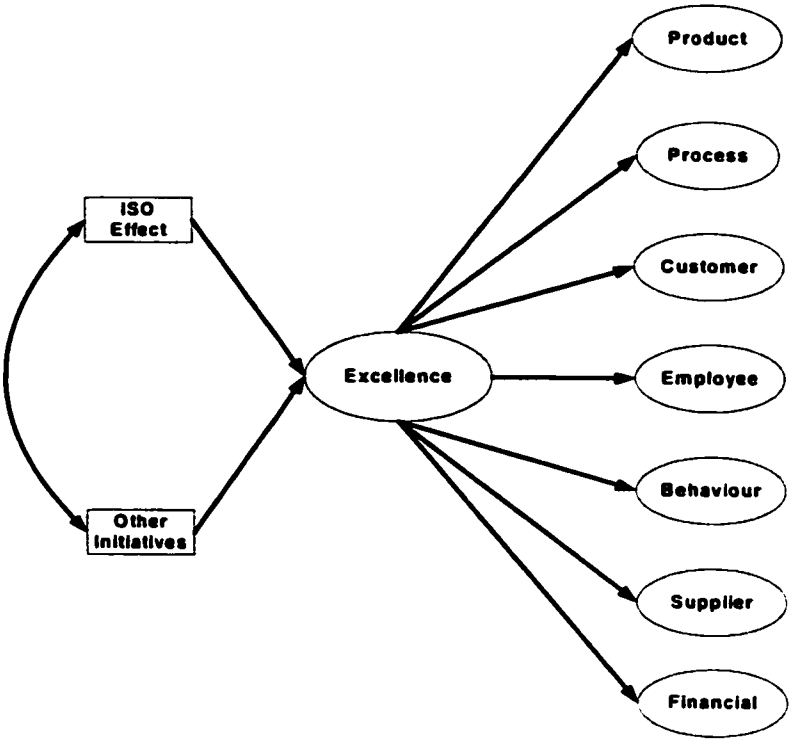
C. The Effect of Quality Initiatives

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, 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. A survey by Quality Systems Update and Dun & Bradstreet Information Services rated ISO 9000 to be a success (Sissell 1996). Of the 1,880 respondents, 95% reported internal benefits, 85% were able to show external savings, 83% reported higher perceived quality, and 70% cited higher competitive advantage as a result of obtaining the certification. The literature also 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. The following model (Figure 10) suggests there may be a direct causal relationship between quality initiatives and performance.

Figure 10 Quality Initiatives and Organisational Performance



These hypotheses arise.

H8a: That Canadian firms that have been awarded ISO 9000 certification will demonstrate greater business performance than firms that are not ISO 9000 certified.

H8b: That firms that have instituted quality initiatives, but which have not obtained ISO certification, will demonstrate business performance as good as firms with a quality program as well as being ISO certified.

H8c: That firms that have instituted both ISO certification and other quality initiatives will demonstrate business performance greater than firms that are ISO 9000 certified only.

Previous studies do not go far enough to explore the link between ISO certification and

other quality initiatives in firms. Joe 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, DeFoe 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.

H8d: That the measured benefits for business performance show greatest positive improvement when ISO certification is used in combination with business excellence practices of national quality award programs or other high-level quality initiatives

Next, in relation to business performance excellence, the interactive effect of various characteristics of a firm and ISO 9000 is considered. The following hypotheses are offered:

H9a: That regarding business performance excellence, there is no perceived advantage for large firms over small or medium sized firms.

H9b: That regarding business performance excellence, there is no perceived advantage for either manufacturing firms or distribution firms, or service firms.

H9c: That regarding business performance excellence, there is no perceived advantage whether the firm is located in Quebec or Ontario.

H9d: That regarding business performance excellence, there is no perceived advantage whether the firm is privately or publicly owned.

What follows is a description of the design of a test of these hypotheses.

IV. Research design

In this section, the details of the research design will be explained. First, the different stages of the study will be highlighted. Then the identification and selection of the participants in the sample of the research will be presented. Next, the research procedures and the specifications of the instrument will be explained.

A. Three Research Stages

This research was carried out in three stages, namely, (i) focus group, (ii) pre-test, and, (iii) survey. These three stages will now be described.

1. Focus group - Stage 1

Stage one involved the laying of the groundwork for this study and, as well, a potential survey instrument was developed. A literature review and some case studies helped lay the foundation of the study. Both industry and academic leaders have pointed out that it is important for the business community and academia to work together and learn from each other when exploring quality issues (Ahire, Landeros et al. 1995).

While exploring the literature on quality management and on business-performance (as reviewed above), a case study was concurrently conducted. This involved a half-day interview with a representative from each of three (AlliedSignal, Rival, and Westburne Inc.) firms. See Appendix A-1 Case Study Participants for Stage One). Five senior managers from a fourth firm (Siemens) subsequently participated in a series of one-on-one interviews.

These interviews, both the focus group and the field interviews, were recorded, transcribed by a third party, and analyzed, (Miles and Huberman 1994; Yin 1994). During this exercise, a sample questionnaire was discussed as to its contents and use (see Appendix A, 1-2 Phase 1 ISO Survey). It is interesting to note that this original design instrument was entirely focused on ISO 9000 and questions were worded accordingly.

Subsequent to these interviews, the instrument was redesigned to allow the same focus but the questions were reworded to make them more generic to various quality approaches and allow the effect of the ISO 9000 approach to emerge from the analysis. Consequently, the wording and organisation of the instrument was reworked and pre-tested with the participation of a fifth firm (Canadian Marconi).

Six senior executives from this firm accepted to discuss quality issues and the survey instrument from their perspective. Once more the interviews were recorded. Appendix A lists the titles of these fourteen (14) participants. Their names have been withheld as they were promised anonymity and that the specific details of their interviews would be treated discretely and confidentially.

Thus, the first stage of the study served the dual role of in-depth data procurement from field study as well as helping to provide content validation of the research instrument that was used in subsequent stages.

2. Pre-test – Stage 2

Stage two involved a pre-test for the survey instrument using a convenience sample of quality-minded individuals who were participants at an international conference on

"Quality in Organizations"[2]. This pre-test was used to increase the validity of the instrument including the wording and formatting. According to Madu (1998) questionnaires, should (i) be designed to be able to address the important issues, (ii) use a Likert-type scale to reduce ambiguity, and, (iii) be tested before full-blown administration by knowledgeable candidates. These guidelines were considered "de rigueur" for this research.

Ten individuals who had agreed to participate were sent a working-copy of the potential survey instrument requesting them, as representatives of their firms, to respond to the questions and to comment on the format, thoroughness, and clarity of the questions (Madu 1998). Seven of these individuals responded and their comments and answers helped to refine the survey instrument (see Appendix B– Pre-Test Participants for Stage 2). Such a refinement is essential to address the issue of content validity. Analysis of the data from this convenience sample helped clarify what would be required for the third stage.

3. Survey Instrument - Stage 3

During the third stage, an extended survey was conducted, using the questionnaire instrument that was refined through the previous two stages of the research. The refined survey instrument used various question formats, one of which includes seven-point

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[2] "Quality in Organisations" was a three-party presentation at the 1st North American Congress on Quality in Organizations (Montreal, September 28- October 1, 1998). The parties for this joint presentation were representatives of two of the firms who were part of the field study from stage one and this researcher acting as lead presenter and coordinator.

Likert type questions that elicit the respondent's perception of firm performance in comparison to the industry level of performance. Use of Likert scales is quite common. For example, Roth and Miller (1992), use it as a self-anchoring seven-point scale relative to the firm's primary competitors in the same industry. Davis and Cozenza (1993) offer that Likert measurement represents an ordinal level of measurement if narrowly defined.

In this research, the survey attempts to draw out participant observations or perceptions of both financial and non-financial performance. The range of the Likert scale is from "worst in the industry" (1) to "best in the industry" (7). Zero was used for non-applicable response. Table 4 below displays the range of responses.

Table 4 Likert Scale (Performance Questions)

*For these questions, **circle** the number between 1 and 7 on the scale, which corresponds to the level of performance for your firm. **Circle 0 if your firm doesn't measure this item.***

0	1	2	3	4	5	6	7
	Worst in industry	*Weak*	*Less than average*	*Average*	*Better than average*	*Very good*	*Best in industry*

Along with a series of questions related to firm performance, the questionnaire (see Appendix C) also requested respondents to indicate the frequency with which these performances items are measured. By way of example, below is the first question showing both the "performance" and the "frequency" response range. At the start of this research project, questions relating to the "frequency" of measuring for performance were not part of the research plan. Only the questions regarding the measurement of performance were intended. The suggestion to include "frequency" was a result of the

stage-one focus group.

Subsequent to stage one, the instrument was redesigned in such a way that the same questions that were used as the items for "performance measurement" were also used to determine frequency of measurement. The participant was requested to indicate how frequently the firm measured each item, using a four-item Likert scale, where

A = not measured

B = measured rarely

C = measured sometime

D = measured often.

This example (Q6 in Table 5) shows the two different responses (performance and frequency) that participants would choose from. All 27 questions are listed in Table 6.

Table 5Sample Format - 27 items

		Frequency of measure				Perceived Performance						
		Not	Rare	Some	Often	Worst	Weak	Below	Average	Above	Good	Best
Q6.	The level of productivity for your firm is	A	B	C	D	1	2	3	4	5	6	7

As can be examined in Appendix C, subsequent to these 27 questions, there were, in addition, a number of questions related to quality practices of the firm as well as

questions related to the characteristics of a firm.

B. Indicators of Six Constructs

As stated earlier, this research suggests there are six first-order factors that describe difference aspects of business performance. It was hypothesized that 27 indicators can measure these six constructs. What follows is a breakdown of the indicators for each construct.

Hypothesis 1 (Figure 2 above) states that the factor "product quality effectiveness" may be measured using four items. These items are Q6, Q7, Q8, and Q9 (see Table 6).

Hypothesis 2 (Figure 3 above) states that the factor "operational efficiency" may be measured using four items. These items are Q10, Q11, Q12, and Q13 (see Table 6).

Hypothesis 3 (Figure 4 above) states that the factor "customer focus" may be measured using four items. These items are Q14, Q15, Q16, and Q17 (see Table 6).

Hypothesis 4 (Figure 5 above) states that the factor "employee status" may be measured using five items. These items are Q18, Q19, Q20, Q21 and Q22 (see Table 6).

Hypothesis 5 (Figure 6 above) states that the factor "supplier role" may be measured using three items. These items are Q23, Q24, and Q25 (see Table 6).

Hypothesis 6 (Figure 7 above) states that the factor "financial results" may be measured seven items. These items are Q26, Q27, Q28, Q29, Q30, Q31, and Q32 (see Table 6).

Table 6 Survey Instrument Questions regarding Performance and Frequency

Hypothsis #	Construct	Quest #	Question
1	Product	Q6.	The level of productivity for your firm is
1	Product	Q7.	The reliability of your product (service) is
1	Product	Q8.	The defect rate (or error per opportunity rate) for your
1	Product	Q9.	Your firm's conformance to standards or specifications for
2	Process	Q10.	The on-time delivery for your product (service) is
2	Process	Q11.	The cycle time for the production of your product (service) is
2	Process	Q12.	Your firm's success in reducing production costs is
2	Process	Q13.	Inventory turnover for your product is Roll-over for your service is
3	Customer	Q14.	Customer satisfaction with your product (service) is
3	Customer	Q15.	Customer confidence in your product (service) is
3	Customer	Q16.	Customer loyalty (repeat business) for your product (service)
3	Customer	Q17.	The rate of customer complaints for your product (service) is
4	Employee	Q18.	Employee satisfaction with your firm is
4	Employee	Q19	Effectiveness of the training of your people is
4	Employee	Q20.	The acceptance rate for employee suggestions is
4	Employee	Q21.	Employee absenteeism in your firm is
4	Employee	Q22.	Employee turnover in your firm is
5	Supplier	Q23.	Product (service) quality of your suppliers is
5	Supplier	Q24.	The on-time delivery from your suppliers is
5	Supplier	Q25.	The competitive level of prices from your suppliers is
6	Financial	Q26.	Revenue/sales of your firm is
6	Financial	Q27.	Cost performance of your firm is
6	Financial	Q28.	Net income of your firm is
6	Financial	Q29.	Return on investment of your firm is
6	Financial	Q30.	Return on assets of your firm is
6	Financial	Q31.	Market share for your product (service) is
6	Financial	Q32.	The "operating income/revenue" ratio of your firm is

In summary, the above questions would serve as the focal point of a research instrument.

C. Structural Equation Modeling

Structural equation modeling (SEM) is a statistical modeling technique that enables one to assess validity of definitions of latent constructs by examining the relations among the measurable variables or the indicators (Mueller 1995). Each group of questions in the above hypotheses forms a relationship that explains a specific factor or construct. The

selection of the questions is guided by the theory found in the literature. The questions serve as the observed variables that define the factors or the latent (unobserved) variables. Bollen (1989) indicates that since all latent variables correspond to concepts, they are hypothetical variables and are representations of concepts in measurement models. Thus, the factors are operationalised by assessing the responses to the questions.

The following measurement model expresses the relationship between the indicators (items) and the constructs (factors) in the form:

Data = Model + Residual

The structural equation for these models above would be $\mathbf{V} = \Lambda\mathbf{F} + \mathbf{E}$ where, **V** represents the observed indicators ; Λ represents the coefficient of the loading of factors on the indicators; **F** represents the latent factors and **E** represents the error term associated with indicators.

This is equivalent to a typical structural equation in LISREL notation (Jöreskog and Sörbom 1988),

$$x_i = \lambda_{il}\xi_l + \ldots \lambda_{ij}\xi_j + \delta_i$$

where j, in this particular instance is equal to 6. In this equation, x_i is the observed indicator (any item or variable *i*); λ_{ij} (lambda) is the coefficient of the expected effect of the latent variable or the standardized loading of factor *j* on indicator *i*; ξ_j (xi) is the latent variable (factor *j*); and, δ_i (delta) is the error term associated with indicator *i*. The error terms are typically uncorrelated among themselves and with the factor (Bollen 1989).

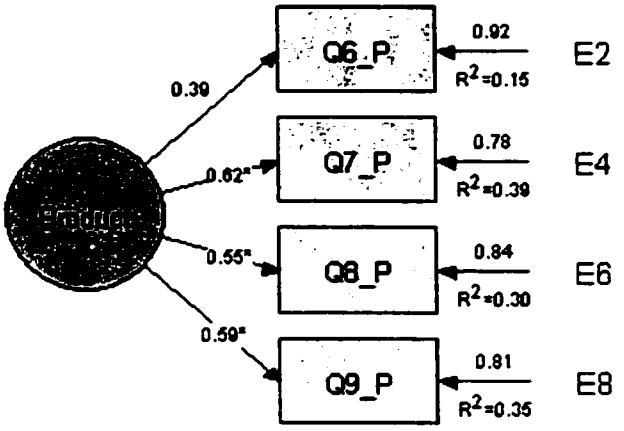
The procedure is to estimate the measurement models and to evaluate their correspondence to the data of the responses. This may be established using confirmatory factor analysis (CFA) (Mueller 1995).

CFA is a statistical test of the relationship that exists between the observed variables and any underlying factors (Byrne 1994). Barki and Hartwick (2001) indicate that CFA enables the internal consistency reliability of each construct to be assessed. They further offer that good model fit and significant correlations between the dimensions (the first-order factor constructs in this work) provide evidence of convergent validity. They also share the Bagozzi and Philips (1982) view that correlations between constructs that are significantly less than 1.0 provide evidence of discriminant validity. Accordingly, in this study, CFA is used to measure the strength of the fit of the indicators as definitions of the constructs of the six hypotheses

Portraying the model as in figure 9 above and the figures below makes it easy to conceptualize how the various components relate to one another. In the models, the six factors (the constructs) are represented within ellipses and the observed measurements (their indicators) within boxes. The single headed arrows leading from the ellipses to the rectangles "represent the proposed regressions of item scores on each factor in accord with beliefs about which variables are valid measurements of the factor in question. For clarification of this graphical symbolism, an example is found below. The sourceless single-headed arrows represent random measurement error and this has some bearing on the reliability of the fit of the observed variables" (Byrne 1994: 13). Asterisks are placed on the arrows for model parameters that are freely estimated and a value of 1.0 for those parameters that are fixed. This combination allows for statistical identification (i.e. a

unique set of parameters consistent with the data, allowing the data to be 'just-identified or one-to-one correspondence') (Byrne 1994). The labels in Figure 11 (for example, Q6_P) correspond to the questionnaire in Appendix C as well as the labels in the correlation model above.

Figure 11Sample Format for Single Construct (Factor)



In this example, the regression values of 0.39, 0.62, 0.55, 0.59 are the loadings of the factor "product quality effectiveness" on the four indicators (Q6=productivity, Q7=reliability, Q8=defect rate, and Q9=conformance). The value 0.92 represents the loading of the error measurement of Q6 or productivity. Similarly, the remaining error loadings are 0.78 on Q7, 0.84 on Q8, and 0.81 on Q9.

The maximum likelihood (ML) estimation method is the most commonly used methods in CFA. The estimation method requires that the data be normally distributed. Where there exists a departure from normality it is necessary that the data be fitted using appropriate fitting or estimation functions (Lawley and Maxwell 1971). Given such situations, Chou and Bentler (1995) recommend the use of other estimation methods, for

example, elliptical re-weighted least square (ERLS) estimation. These estimation methods will usually produce different goodness of fit measures.

Multiple indices for verifying the overall goodness of fit are suggested (Hu and Bentler 1995). These include the Robust Chi-Square, Santora-Bentler Scaled Chi-Square (which should be non-significant), the Robust CFI (>0.90), and the Average Absolute Standardized Residual (AASR < 0.05) (Barki and Hartwick 2001). These criteria serve as the basis for determining the strength of the fit of the models presented in this research.

In testing the above hypotheses, it is expected that the goodness of fit index (CFI) be high (>0.90), for the first six hypotheses (first order factor models), because the hypotheses are simple models of three to seven indicators for the single construct.

However, depending on the results of this model assessment, re-specifications may be necessary. Accordingly, respecification continues until some optimal model is achieved. Nevertheless, models obtained from re-specifications must be theoretically sound and not just provide a high CFI.

As well, CFA provides an estimate of the strength of the relationship among the six constructs in the correlation model (see Figure 8) and in a higher order factor model in which the latent constructs define a performance construct (see Figure 9). Thus, in summary, business performance excellence is modeled as a multidimensional second-order latent construct where each dimension is conceptualized as a first-order latent construct reflected by observable indicators. Subsequent modeling can determine how this performance excellence construct is affected by quality initiatives or the organizational characteristics of location, industry type, size and ownership.

V. Methodology Stratified Sample

The third stage of 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. This stratification, summarized in Appendix F Stratified Sample Foundation, is explained below.

Manufacturing strata included firms between 50-99 employees (classified as small); between 100-249 employees (classified as medium) and greater than 250 (classified as large). Service industry strata used both distribution-wholesaler firms and pure service firms. Distribution-wholesaler strata included firms between 50-99 employees (small), between 100-150 employees (medium) and greater than 150 (large). Pure service industry strata included firms between 20-49 employees (small), between 50-99 employees (medium) and greater than 100 (large). The decisions for this strata-size grouping were based on the expert recommendation of, and discussions with, a reputable research-marketing firm that was contracted to gather the data.

It was decided to engage the services of a research-marketing firm for the purpose of data collection using telephone polling. The major advantage to appointing a research-marketing firm to do the polling is the opportunity for a high participant response-rate. With traditional mail surveys, the researcher is at the mercy of respondents, (i) who are not seized with the urgency of the request, (ii) who may procrastinate, or (iii) who simply refuse to participate. For non-respondents, it is necessary to wait for an appropriate time-

delay to renew efforts to solicit cooperation.

On the other hand, telephone polling tends to be incessant. Respondents tend to cooperate from the set-go. The response rate in traditional mail surveys may be low (Labrecque 1978; Schaeffer, Mendenhall et al. 1996) 5% - 20% of the sample (Fowler 1993). Long and complex surveys might have response rates in the single digits. Using telephone polling allows for a much higher response rate.

Accordingly, 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. For the Quebec sample of firms, the database produced by the "Centre de Recherche Industrielle du Québec" (CRIQ 1999); was used while for Ontario, the database prepared by Scott's Directories (Scott's 1999) was used.

As a first step, in June 1999, the two databases were consulted to establish the total number of manufacturers, wholesalers, and service firms that existed in each the two provinces, i.e., the overall population of firms according to the above strata. This consultation revealed that as of this date and according to the existing databases, a population total of 9493 firms existed in these categories (as defined above) in the two provinces. For Ontario the total number of firms was 5883, (62%) while in Quebec the total was 3610 (38%). See Table 7.

Table 7 The Population of Firms for the Study

Size of population

	Quebec (CRIQ)			Ontario (Scott's)			
Size	**Manufacture**	**Distributor**	**Service**	**Manufacture**	**Distributor**	**Service**	**TOTAL**
Small	50-99	50-99	20-49	50-99	50-99	20-49	
	1485	230	346	1854	586	476	
Medium	100-249	100-149	50-99	100-249	100-149	50-99	
	773	89	122	1408	200	206	
Large	250 & more	150 & more	100 & more	250 & more	150 & more	100 & more	
	329	90	146	694	229	230	
TOTAL	2587	409	614	3956	1015	912	
Grand Total			**3610**			**5883**	**9493**
% of Total			**38%**			**62%**	

As a first intention, participation for an equal number of firms (e.g., 20) in each category, in each province was contemplated. To obtain a representative sample of each category of the strata would have required a total respondent sample of at least 360 firms. However, due to limited available financial resources, a sample of approximately 275 firms was considered to be the maximum possible.

Furthermore, establishing relative representation according to strata within this maximum would have provided over-representation of certain types of firms and under-representation for others. This would have created a systematic bias. Consequently, a second plan was developed whereby a sample proportionate to the type of firm in each province was established. Because some categories were still under-represented for a

valid response rate, the larger values in the stratified database were reduced (without real effect to validity and representation) to allow some smaller values to be increased. For example, for Ontario, the 54 medium and 41 small manufacturers were reduced in order to consider 41 and 39 manufacturers respectively. It was not felt that such a reduction would hurt relative representation. The net effect of this shift of some numbers was to allow for a minimum of seven firms in anyone category, a number that was deemed sufficient for the purposes of this study. Thus, the number of required responses was established. See Table 8.

Table 8 Number of Firms in the Sample

	Sample						
	Quebec (CRIQ)			Ontario (Scott's)			
Size	**Manufacture**	**Distributor**	**Service**	**Manufacture**	**Distributor**	**Service**	**TOTAL**
Small	50-99	50-99	20-49	50-99	50-99	20-49	
	41	7	10	45	17	14	
Medium	100-249	100-149	50-99	100-249	100-149	50-99	
	22	7	7	39	7	7	
Large	250 & more	150 & more	100 & more	250 & more	150 & more	100 & more	
	11	7	7	20	7	7	
TOTAL	74	21	24	104	31	28	
Grand Total			**119**			**163**	**282**
% of Total			**42%**			**58%**	

Accordingly, the firms are randomly selected within the stratified population. This stratified sample represents a cross section of business as follows:

1- Manufacturing, wholesaler/distributor, and service firms

2- Both private and publicly traded firms

3- Large, medium, and small firms

4- Firms from two provinces of Central Canada

A. Sample Selection

This breakdown having been established, both the CRIQ and the Scott's databases were consulted to establish a random population from which the sample of 275 respondents would come. Using the random number function of the software package (Microsoft Excel, for each category of table 8, a sample of firms, three times larger than the required number of responses, was randomly selected. A factor of three was determined after consultation with the research-marketing firm that was chosen to conduct the survey. In other words, to secure a large enough sample, a randomly generated list of firms three times greater than the number of required responses was provided. Subsequently, the names of contact people in the organizations were identified from the database and were submitted to the research firm.

The participants to this survey were executives or senior managers, particularly in operations or in quality management, from firms in the two provinces. Although, not all firms were eventually contacted because quotas had been reached, each of the first block of 825 firms was mailed an introductory letter of invitation that explained the purpose of the research and asked for their cooperation (Refer to Appendix D1 for the English letter, and D2 for the French letter). The covering letter was printed on Concordia University

letterhead, and included the logos of supporting or sponsoring institutions.

The four supporting institutions had reviewed the research proposal, including the contents of the questionnaire, and accepted to be mentioned as providing such support and gave permission for their logos to be used. The English version of the covering letter, which was used for the Ontario sample population, utilized the logo of the National Quality Institute. The French version, which was used for the Quebec sample population, utilized the logo of the Movement Québecois de la Qualité. The fact that these latter two institutions are recognized proponents of quality practices, and that they accepted the questionnaires, is further attestation for the content validity of the questionnaires (Madu 1998). Finally, both covering letters used the logo of the research-marketing firm that did the polling, Guilbault and Associates. The use of the logos of supporting institutions was used in order to stress the significance of the study as well as to facilitate a higher response rate (Labrecque 1978).

B. Research Instruments

All communications with respect to the survey were carried out in French or in English depending on the participant's choice of language. Accordingly, professional translation and bilingual telephone researchers were required. The questionnaire that resulted from the refinements of stages 1 and 2 was translated into French and copies in both English (see Appendix C1) and French (see Appendix C2) were printed for distribution to the participating firms. A written protocol (see Appendix E1-English or E2-French) was also prepared which explained the purpose of the research, along with an appropriate ethical treatment guarantee. In other words, participants were guaranteed confidential treatment,

no participant would be harmed in any way, and reporting of results would be handled anonymously.

C. Data Collection

The research-marketing firm subsequently telephoned the firms following the prescribed order as determined by the randomly generated numbers. Firms that agreed to participate were faxed the summary protocol, (see Appendix E). For this study, with such a long and complex survey, the response rate was 51% for Quebec and 42% for Ontario. This was achieved through a determined effort using telephone calls and follow-up fax transmission of the survey instrument to elicit participation in this study. This high response rate is an important attribute of the project.

Data was collected between June and August of 1999. The polling firm contacted 248 Quebec firms and 393 Ontario firms (see Appendix G1 for Quebec, G2 for Ontario). Accordingly, the firm collected the responses for 282 firms (119 from Quebec for a 51% rate and 163 from Ontario for a 42.3% rate of response. The data was submitted in SPSS format.

1. Missing Data

The following paragraphs will consider the issue of missing data. Since the structural equation modeling software application "EQS" (Bentler and Wu 1998) was used to analyse part of the data, missing data became an issue. EQS requires that "complete data are required for the probability density and adjustments must be made to data sets that are incomplete" (Brown 1994:288). Thus, a method for handling missing data was required.

A cell in a given survey dataset may be missing a value for different reasons. Reasons include (i) omission by the person entering data from the original source, (ii) accidental lack of response by the respondent, or (iii) deliberate non-response by the participant. In the current survey, it would appear that all three come into play. A different procedure was used to adjust to the missing data for each situation.

The first step was to eliminate input errors on the part of the data entry clerks. The hardcopy of each record (firm data) that presented a missing value was examined and the data-entry error was input. There were only four such instances.

The second step was to face the issue of participant non-response. There were two possibilities, i.e., either, fill the void in an acceptable, statistically-sound, method; or drop the variable or record (firm) from consideration if the rate of missing value was high thus making valid analysis questionable.

None of the 27 variables presented a high, unacceptable, number of missing-values. However, a decision was made to eliminate two records from the dataset. These were firms for which the respondent failed to provide a high number of responses. Since the missing values represented 8 of 27 possible responses (29.6%) for these, it was felt to include them would create a bias as their whole answer set may possibly be prejudiced by only portraying their good side. Hence two records were not considered in the final dataset, a small Ontario manufacturing firm (osm 7) and a small Ontario service firm (oss 14), leaving 280 records or firms. Table 9 indicates that considering all 282 respondents there were 110 missing values in the dataset, but with 2 firms excluded there were only 94 missing values out of 7560 possible responses (i.e., 94 out of 27*280 or 1.05%

missing data). For Quebec 0.75% of the relevant dataset had missing values. For Ontario 1.38% of the relevant dataset had missing values after 2 cases were dropped.

Table 9 Missing Values

Missing Values in Two Scenarios

# Variables	Records	# Missing	% Missing
27	282	110	1.22%
27	280	94	1.05%

2. Data Imputation

For the remaining dataset (27 variables within 280 records) with missing data, it was necessary to adopt a method of determining a value. There are several methods explored in Brown (1994), namely, (i) listwise deletion, (ii) pairwise deletion, (iii) mean imputation, (iv) hot-deck imputation, and, (v) similar response pattern imputation.

For the purpose of this research, hot deck imputation was chosen. This method was adopted because it is simple to apply (unlike similar response pattern), would not lose or eliminate some information (like listwise deletion), and would not cause a problem in the data being positive definite or using a small sample (like pairwise deletion). Further, hot-deck imputation increases the variance rather than reducing it (like mean imputation) (Brown 1994).

In this method, the variable containing an empty cell was matched against the variable with the highest correlation to it within the same case. The value of the response of this highly correlated variable was imputed as the value for the missing cell. If the highest

correlated variable also contained a missing value in the cell, then the next highest correlation variable was selected. This method was used to fill in all missing values.

With a full dataset thus assured for the performance variables of the questionnaire, the analysis of the data is the focus of the next section.

VI. Results and Analysis

A. Respondent Characteristics

1. Individual demographics

The respondents to the survey were requested to provide their job title or function in the firm. The majority of the respondents, quite expectedly, were involved in quality related functions (52.8%). See Table 10 below. Among those with "quality" in their titles were Director, Manager, Coordinator, Senior Auditor, or Supervisor of Quality. The remainder of the respondents was evenly divided into two categories, Operations Management (24.5%) and Other (22.7%). In "Operations Management", the functional areas included logistics, sales, production, technical services, marketing, and purchasing and the respondents' titles included Vice-President, Director, Manager, or Chief Engineer.

In the "Other" group, respondents' titles included President, Owner, CEO, Vice-President, Director General, Plant Manager, National or Regional Manager, or Director. The respondents filled generic management functions such as executive, project, plant, or general management, human resources management, finance, or controller.

Table 10 Job Functions of Respondents

Job Function		
Quality related	149	52.8%
Production related	69	24.5%
Other	64	22.7%

It should be observed that, indeed, the participants accepted this study with due diligence because response was provided by senior individuals. Such participation lends support to the authenticity of the response and the relative importance that quality plays in these firms. Next, we examine various characteristics of a firm.

2. Public vs. Private Firms

Previously, the stratified sample of the respondents was explained (refer to Appendix F). The four criteria for stratification were business sector (manufacturing, distribution, and service), firm size, location, and that the population included both private and public firms. While the first three criteria were met through the sample, the fourth criterion was met by circumstance of the respondent.

In this regard, the percentage of private ownership firm respondents was 70.6% with the balance (29.4%) representing firms with public ownership. Table 11 breaks this down per province. As can be noticed, the result was similar in the two provinces.

Table 11 Distribution of Firms by Ownership

Firm Ownership			
	Quebec	Ontario	Total
Private Firms	85	114	199
	71.4%	69.9%	70.6%
Public Firms	34	49	83
	28.6%	30.1%	29.4%

Next, an analysis of the core questions in the survey will be performed.

B. Statistical Analysis

This section describes the results of the analysis of the survey. First, descriptive statistics for the 27 variables will be presented. Then, a confirmatory factor analysis model will be used to test hypotheses 1 through 6 above. Subsequently, the results of fitting a model with six correlated factors, and also a second order factor model will be presented. Finally, the effects of a set of variables on performance excellence will be examined.

1. Descriptive Statistics for Performance Measurement

The first statistical procedure was to examine the descriptive statistics. Because respondents were asked to evaluate their perception of firm performance, it was expected that the mean of the responses would be above the mid-point of the 7-point scale. As an example, Table 12 shows the first performance question on the survey (Q6) and the range of responses for the Likert scale question on perceived performance.

Table 12 Response Range - Perceived Performance

		Frequency of measure				Perceived Performance						
		Not	Rare	Some	Often	Worst	Weak	Below	Average	Above	Good	Best
Q6.	The level of productivity for your firm is	A	B	C	D	1	2	3	4	5	6	7

The mean response for this example was $\overline{X} = 5.207$ with a standard deviation S= 1.002.

For the 27 variables, the overall mean for the 280 respondents was 5.14 with a standard deviation of 1.16. Regarding the mean of each individual variable the range was 4.63 – 5.71. Generally, and as expected, the respondents saw their firms as performing above average. This could be due to self-reporting bias. However, if every firm perceives itself as higher than industry performance, this should not affect the magnitude of the correlation of the factors and the formation of the underlying constructs.

In order to examine the normality of distribution for the variables, the measures of skewness and kurtosis were used (Tabachnick and Fidell 1988). For the 280 cases of 27 variables, the standard error for skewness was 0.145 and the standard error for kurtosis was 0.290. These values are quite acceptably small.

It should be noted that only two variables, i.e., the first 2 questions regarding customer focus (Q14 & Q15), had a kurtosis greater than 0.702 but these too are acceptable. See Table 13.

Table 13 Large Kurtosis

Hypothesis	Question #	Item	Mean	Std Dev	Skewness	Kurtosis
3	Q14	Customer satisfaction is	5.550	0.945	-0.966	1.283
3	Q15	Customer confidence is	5.614	0.901	-1.057	2.273

The descriptive statistics for all 27 variables are contained in appendix H-1. There is minimal skewness and kurtosis and the data distribution appears close to normality (see appendix H-8). As mentioned earlier, given this slight non-normality, it is appropriate to use maximum likelihood (ML) estimation and elliptical re-weighted least squares

(ERLS).

2. Confirmatory Factor Analysis

Consequently, a CFA is conducted for each factor and the EQS output for hypotheses 1 through 7 is presented next.

a) Results for H1: – Product Quality Effectiveness

Regarding hypothesis 1 – product quality effectiveness – the research instrument included four items, as depicted in Table 14.

Table 14 Initial Items for Product Quality Effectiveness Construct

	Circle the number (1-7) regarding your firm's performance compared with your industry	Frequency of measure				Perceived Performance						
		Not	Rare	Some	Often	Worst	Weak	Below	Average	Above	Good	Best
Q6.	The level of productivity for your firm is	A	B	C	D	1	2	3	4	5	6	7
Q7.	The reliability of your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q8.	The defect rate (or error per opportunity rate) for your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q9.	Your firm's conformance to standards or specifications for your product (service) is	A	B	C	D	1	2	3	4	5	6	7

As mentioned, the respondents indicated their perceptions of performance using the 7-point Likert scale. The results of the CFA (see selected output in Table 15) indicate an excellent fit, CFI = 0.99. Also, the P-value for the chi-squared statistics of 0.214 is good.

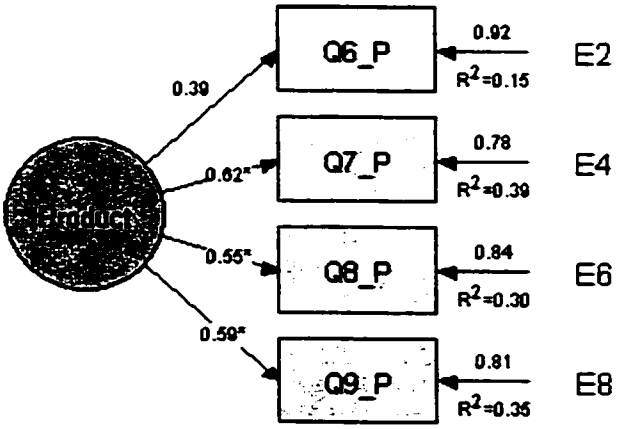
The average standardized residual of 0.015 is very good. These suggest a very close fit.

Table 15 Product Quality Effectiveness

Items and Test Statistics	Results
Chi square	3.086
Degrees of Freedom	2
Probability for Chi square statistics	0.21376
Normalized Chi Squared	3.101
Absolute average standardized residual (AASR)	0.0152
Maximum Standardized residual	0.05
Normed Fit Index	0.974
Non-Normed Fit Index	0.971
Comparative Fit Index	0.990

Regarding the factor loadings, the standardized coefficient for the first indicator is 0.392, which is somewhat lower than the remaining standardized loadings (0.62, 0.55, 0.59). The standardized factor-loading coefficients, the coefficients of the error term and the R-squared value (0.15, 0.39, 0.39, 0.35) for each indicator of this "Product Factor" are presented below (see Figure 12). From this figure we note that the best indicator for this factor is Q7_P (Reliability) followed by Q9_P "Conformance".

Figure 12 Product Quality: Factor Loading and the R^2 values



Although, this construct may be defined with these four indicators, there is an apparent inconsistency. The indicator "Productivity", Q6, with low standardized loading (0.39) and low R-squared value (0.15) would appear to set this indicator apart from the remaining items. This latter point notwithstanding, we conclude that Hypothesis 1 is not rejected. Therefore, these four items may measure the construct "Product quality effectiveness".

b) Results for H2: – Process Efficiency

Regarding hypothesis 2 – process efficiency – the survey instrument contained 4 items as depicted in Table 16.

Table 16 Initial Items of Process Efficiency Construct

Q10.	The on-time delivery for your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q11.	The cycle time for the production of your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q12.	Your firm's success in reducing production costs is	A	B	C	D	1	2	3	4	5	6	7
Q13.	Inventory turnover for your product is Roll-over for your service is	A	B	C	D	1	2	3	4	5	6	7

The results of the CFA indicated an excellent fit, CFI = 0.987. (See Table 17) Although the P-value for the chi square statistics of 0.125 is not satisfactory, the average standardized residual of 0.0157 is very good, as is the maximized standard residual of

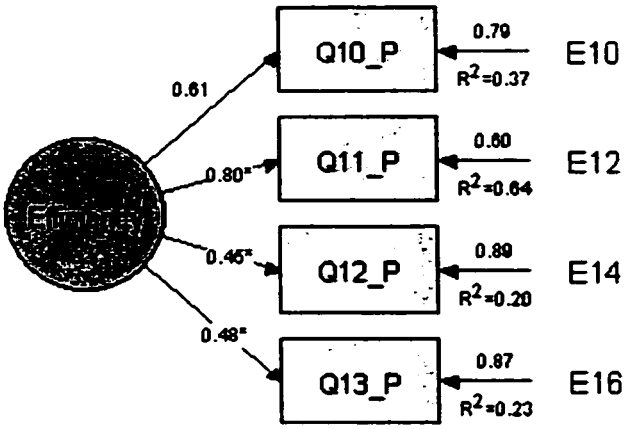
0.076. These indices combined suggest a close fit for this model.

Regarding the factor loadings, the standardized coefficients are somewhat low but above the acceptable level (.30). The standardized factor-loading coefficients (0.61, 0.80, 0.45, 0.48), the coefficients of the error term and the R-squared value for each indicator (0.37, 0.64, 0.20, 0.23) of this construct are graphically displayed in "Process Efficiency" below (see Figure 13). It might be noted that "cycle time" (Q11) is perceived to have the strongest impact on this factor with a regression coefficient loading of 0.80.

Table 17 Process Efficiency

Items and Test Statistics	Results
Chi square	4.162
Degrees of Freedom	2
Probability for Chi square statistics	0.1248
Normalized Chi Squared	4.173
Average standardized residual	0.0157
Largest Standardized residual	0.076
Normed Fit Index	0.976
Non-Normed Fit Index	0.961
Comparative Fit Index	0.987

Figure 13 Process Efficiency: Factor Loading and the R^2 values



Accordingly, Hypothesis 2 is not rejected. The construct "Process Efficiency" may be designed using these four items of measurement.

c) Results for H3: – Customer Focus

Regarding hypothesis 3 – customer focus – the questionnaire contained 4 items as depicted in Table 18.

Table 18 Initial Items for Customer Focus Construct

Q14.	Customer satisfaction with your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q15.	Customer confidence in your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q16.	Customer loyalty (repeat business) for your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q17.	The rate of customer complaints for your product (service) is	A	B	C	D	1	2	3	4	5	6	7

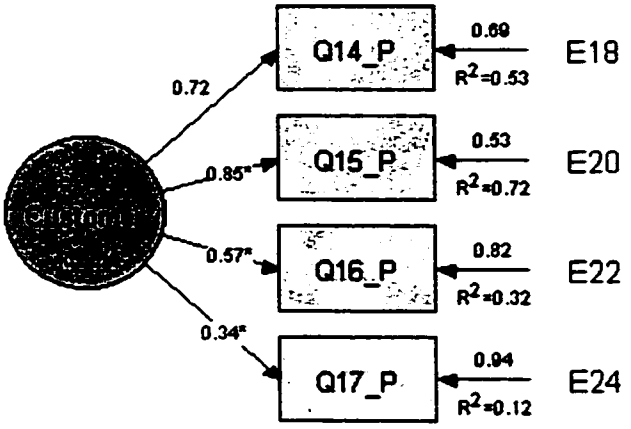
The results of the CFA show that the Chi square value of 9.675 (df=2) is rather high and the P-value of the chi-square statistics (.0079) is not satisfactory (see Table 19). However, the CFI = 0.969 is very good, and the average standardized residual of 0.0214 is good. These latter indices suggest a close fit.

Table 19 Customer Focus

Items and Test Statistics	Results
Chi square	9.675
Degrees of Freedom	2
Probability for Chi square statistics	0.0079
Normalized Chi Squared	9.259
Average standardized residual	0.0214
Largest Standardized residual	0.081
Normed Fit Index	0.962
Non-Normed Fit Index	0.906
Comparative Fit Index	0.969

The factor-standardized coefficients (0.72, 0.85, 0.57, 0.34), the coefficients of the error term and the R-squared value for each indicator (0.53, 0.72, 0.32, 0.12) of this construct are graphically displayed below (see Figure 14). Based on these standardized loadings, it should be noted that "customer confidence" (Q15) is the most important indicator of a customer focus.

Figure 14 Customer Factor: Factor Loading and the R^2 values



The output indicates that Q17 "Complaints" has a relatively weak standardized loading coefficient (0.34), a low R-squared value (0.12) and the largest standardized residual (.094). These results indicate that this particular item does not have much in common with the remaining items. Nevertheless, Hypothesis 3 is not rejected. The construct "Customer Focus" may be designed using the above four observed variables.

d) Results for H4: – Employee Status

Regarding hypothesis 4 – employee status – the research instrument included these five observable indicators, as depicted in Table 20.

Table 20 Initial Items of Employee Status Construct

Q18.	Employee satisfaction with your firm is	A	B	C	D	1	2	3	4	5	6	7
Q19	Effectiveness of the training of your people is	A	B	C	D	1	2	3	4	5	6	7
Q20.	The acceptance rate for employee suggestions is	A	B	C	D	1	2	3	4	5	6	7
Q21.	Employee absenteeism in your firm is	A	B	C	D	1	2	3	4	5	6	7
Q22.	Employee turnover in your firm is	A	B	C	D	1	2	3	4	5	6	7

The results of the CFA (see Table 21) show that although the average standardized residual is acceptable (.045) for this construct, the fit (CFI = 0.833) is below the acceptable minimum (0.90). Additionally, the p-value for chi square statistics is 0.001, which is not acceptable.

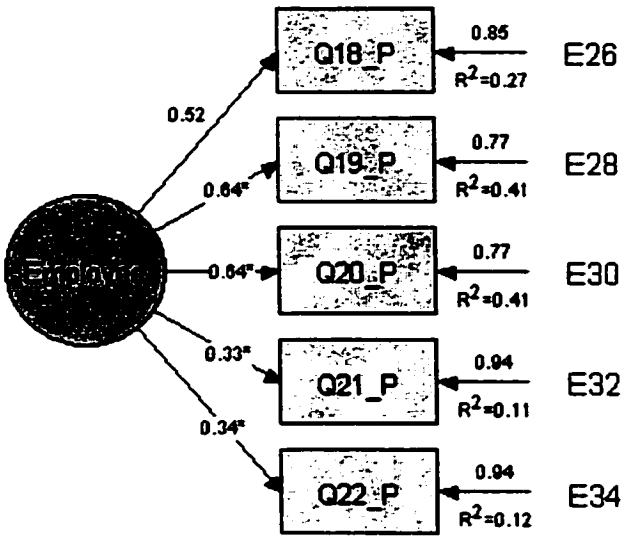
Table 21 Employee Status

Items and Test Statistics	Results
Chi square	32.353
Degrees of Freedom	5
Probability for Chi square statistics	.001
Average standardized residual	.0451
Largest Standardized residual	.231
Normed Fit Index	0.814
Non-Normed Fit Index	0.667
Comparative Fit Index	0.833

The factor-loading coefficients (0.52, 0.64, 0.64, 0.33 and 0.34), the coefficients of the error term and the R-squared value (0.27, 0.41, 0.41, 0.11, 0.12) for each indicator of this construct are graphically portrayed below (see Figure 15).

The standardized factor loadings for the first three indicators (0.521, 0.640 and 0.641) are satisfactory. However the standardized loading coefficients of the fourth item "Absenteeism" (Q21 = .332) and fifth item "Turnover" (Q22 = .341) are low, as are the R-squared values (0.11, 0.12). Further the largest standardized residual is Q22= .231. Apparently, these two variables do not have much in common with the remaining items.

Figure 15 Employee Role: Factor Loading and the R^2 values



These results indicate that these two observed indicators are apart from the first three indicators (Q18, Q19, and Q20). Thus, Hypothesis 4 was not supported as originally stated. By not including items Q21 and Q22, the factor is re-specified as a 3-item factor. Following a CFA of the re-specified factor, the standardized loadings are .460, .676, & .688 and R-squared values are .211, .457, and .474 respectively. This re-specified model does not reject the hypothesis because a CFI is not calculated for a 3-item model with zero degrees of freedom. The construct "Employee Role" may be designed using the first three observed variables above: Satisfaction (Q18) - Training (Q19) - Involvement (Q20).

e) Results for H5: – Supplier Role

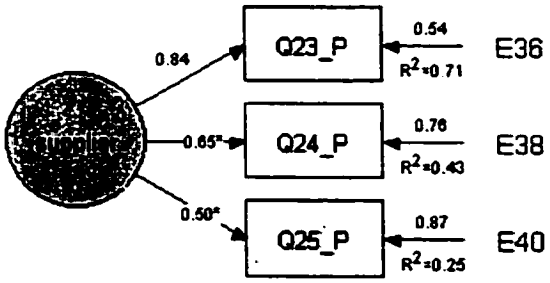
Regarding hypothesis 5 – supplier role – the three items of the questionnaire are depicted in Table 22.

Table 22 Initial Items for the Supplier Role Construct

Q23.	Product (service) quality of your suppliers is	A	B	C	D	1	2	3	4	5	6	7
Q24.	The on-time delivery from your suppliers is	A	B	C	D	1	2	3	4	5	6	7
Q25.	The competitive level of prices from your suppliers is	A	B	C	D	1	2	3	4	5	6	7

The results of the CFA for a 3-item construct are not calculated. However, the standardized factor-loading coefficients (0.84, 0.65, 0.50), the coefficients of the error term and the R-squared value (0.71, 0.43, 0.25) for each indicator of this construct are graphically displayed below (see Figure 16). The large standardized loading coefficient for supplier quality (Q23) stands slightly apart from the standardized loading of the two other indicators.

Figure 16 Supplier Role: Factor Loading and the R^2 values



The results are deemed acceptable and the Hypothesis 5 is not rejected. The construct "Supplier" may be designed using the three observed variables above: Quality (Q23) - Delivery (Q24) - Price (Q25).

f) Results for H6: – Financial Performance

Regarding hypothesis 6 – financial performance – the survey instrument contained the questions as depicted in Table 23.

Table 23 Initial Items for the Financial Performance Construct

Q26.	Revenue/sales of your firm is	A	B	C	D	1	2	3	4	5	6	7
Q27.	Cost performance of your firm is	A	B	C	D	1	2	3	4	5	6	7
Q28.	Net income of your firm is	A	B	C	D	1	2	3	4	5	6	7
Q29.	Return on investment of your firm is	A	B	C	D	1	2	3	4	5	6	7
Q30.	Return on assets of your firm is	A	B	C	D	1	2	3	4	5	6	7
Q31.	Market share for your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q32.	The "operating income/revenue" ratio of your firm is	A	B	C	D	1	2	3	4	5	6	7

The results of the CFA (see Table 24) show that the fit, CFI = 0.891, is below the 0.90 minimum. Furthermore, the p-value for chi square statistics is 0.001, which is not acceptable. Thus, even though the AASR is good at .0414, the other indices indicate an unacceptable fit.

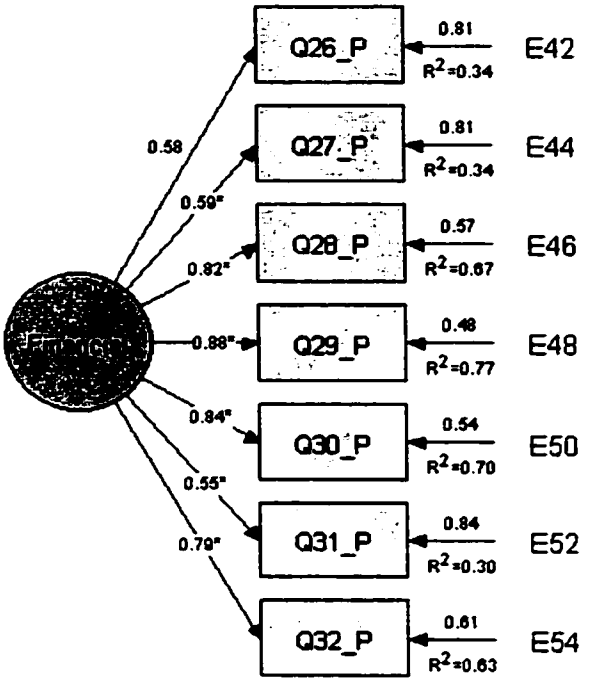
The standardized factor-loading coefficients, the coefficients of the error term and the R-squared value for each indicator of this construct are displayed graphically below (see Figure 17)

Table 24 Financial Performance

Items and Test Statistics	Results
Chi square	132.127
Degrees of Freedom	14
Probability for Chi square statistics	0.001
Average standardized residual	.0414
Largest Standardized residual	.249
Normed Fit Index	0.881
Non-Normed Fit Index	0.837
Comparative Fit Index	0.891

Regarding the factor loadings, the standardized coefficients of four indicators Q28 = .819, Q29 = .878, Q30 = .839, and Q32 = .792 are high. However, the standardized loading coefficients for Q26 = .583, Q27 = .587, and Q31 = .546, are relatively lower as are the R-squared values (.34, .34, and .30 respectively). This suggests that three of the items do not share a commonality with the first four. Furthermore, the standardized residuals for Q26 and Q27 are high.

Figure 17 Financial Factor: Factor Loading and the R^2 values



Re-specifying the model by eliminating some indicators might improve the fit. The questions Q26 and Q27 are re-examined and after due reflection, are considered to be faulty. First, Q26 "Revenue/sales of your firm is" seems to be ambiguous. The financial performance factor in phase 2 of the research contained eight items. Just prior to launching the questionnaire, two items were grouped as a single question. *Revenue of your firm* and *Sales of your firm* were grouped to be "Revenue / sales of your firm. However, in hindsight and because of the weak results, ambiguity appears to be a problem since revenue and sales are very different concepts. The question containing an "or" with 2 different concepts can generate invalid and unreliable data.

Similarly, Q27 "Cost performance of your firm is" may be seen as an ambiguous question. The original intention of the item was to get a sense of a firm's ability to control

costs. In the light of the weak and inconclusive results, it appears that the question may have been ambiguous for the respondents (particularly since a question in the Process factor also spoke about costs, (i.e., your firm's success in reducing production costs is).

Consequently, both of these questions were eliminated from the items for this factor. Hence the original Hypothesis 6 that a financial construct be operationalised by 7 items is rejected. Instead a five-item factor is not rejected.

The fit of the five item financial first-order construct would be quite acceptable based on the results in Table 25.

Table 25 Financial Performance – Five Items

Items and Test Statistics	Results
Chi square	35.4
Degrees of Freedom	5
Probability for Chi square statistics	0.001
Average standardized residual	.0217
Largest Standardized residual	.086
Normed Fit Index	0.957
Non-Normed Fit Index	0.925
Comparative Fit Index	0.963

In summary, the CFA output showed that some of the hypotheses are supported. Hypotheses 1, 2, 3, & 5, with CFI fit indices greater than 0.90 and acceptable AASR values, are among this group. However, hypotheses 4, and 6, with CFIs less than 0.90 are not supported as originally proposed and some re-specification was required. See appendix H-2 for a summary of the results of the CFA for the six hypotheses.

3. Subsequent Modeling

With the above six individual factor models satisfactorily specified, additional models, which build on these models, are tested. First, a correlated factor model is tested. Based on the result of this, a second-order factor model is subsequently tested. Finally, the effects of different independent variables on the second order factor are studied. Each of these three tests is explained below beginning with a correlated model.

a) Six-Factor Correlated Model

In this model, the six factors specified separately in the previous section were tested together as a six-factor correlated model. Since two variables of the original 27 in the questionnaire were removed earlier (Q26 & Q27), the number of observed variables in this correlated model was twenty-five. The following provides a summary of the results. The average absolute standardized residual value was 0.0461, which may be considered as satisfactory. However, using maximum likelihood estimation (ML) method, the comparative fit index was unacceptable, 0.886. Thus, an attempt was made to re-specify the model. The EQS program offers several alternatives to improve the fit. One alternative is to simply not consider a variable and remove it from the model. Another alternative is to relocate the variable as an indicator of a different construct. Although structural modeling may present the basic statistical opportunity for doing any of these, it is necessary to consider the logic of the structure and perform such steps only if they are in keeping with the substantive understanding of the problem (Chin and Todd 1995).

(i) A seventh factor - Stakeholder Behaviour

Examination of the output of the 6-factor correlated model reveals that Q17, Q21, and Q22 have small loadings (.404, .343 and .361 respectively) and low R-squared values (respectively .163, .117, .130). In the previous single factor models, analysis of the customer factor and the employee factor (hypotheses 3 and 4 above) also identified these variables (Q17, Q21, Q22) as not having much in common with the remaining variables.

Given this situation, it is suggested that the three indicators be removed from the two original constructs and be considered as forming the basis of a new construct. The difference might be that the indicators of these customer and employee constructs measured either attitude or behaviour. By grouping these three behavioural measures (see Table) a new construct can be suggested that accordingly might be referred to as "stakeholder behaviour". In the literature, customers and employees referred to as stakeholders and the three questions reflect a common logic, i.e., a reaction on the part of customers or employees. This factor might also be labelled "Stakeholder Dissatisfaction".

Table 26 Items for a Stakeholder Behaviour Construct

Q17.	The rate of customer complaints for your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q21.	Employee absenteeism in your firm is	A	B	C	D	1	2	3	4	5	6	7
Q22.	Employee turnover in your firm is	A	B	C	D	1	2	3	4	5	6	7

The correlated model, now composed of 7 factors is run. The EQS output reveals that the CFI has improved 0.1 (from 0.886 to 0.896) as a result of the creation of the 7th factor. This is still unacceptable but the factor loadings in the correlated factor model for the

above three questions have improved (Q17=0.552, Q21=0.551, and Q22=0.489). However, given the still poor fit for the 7-factor model, further re-specification is required.

(ii) Removal of one variable

In the EQS output for the above 6-factor correlated model, Q8 (see Table 27) has a relatively low loading coefficient (0.411), a high error value (0.912) and a low R-squared value (0.169). Furthermore, Q8 has a large standardized residual (0.215) in this model.

Table 27 Item Excluded from Model

Q8.	The defect rate (or error per opportunity rate) for your product (service) is	A	B	C	D	1	2	3	4	5	6	7

Given these results, the question itself was re-examined. Given the Likert-scale choice of "worst (1) to best (7)" in the industry, it might be suggested that the respondents may have been faced with a dilemma on how to respond. With this question, the respondent might have found it easier to have the choice "highest to lowest" in the industry. Given this possible ambiguity and the low loading coefficient and the large residual, the question was removed from the model.

b) Seven-Factor Correlated Model

The model is now specified as a 7-factor model defined by 24 variables. The re-specified model was run. A test for multivariate normality is the Mardia measure of multivariate kurtosis. Normality would be rejected if the variables were too light or too heavy-tailed

compared to distribution expected with normal theory (Bentler 1995). In this seven-factor correlated model and the second-order factor model, the Mardia-based kappa = 0.1603 and mean scaled univariate kurtosis = -0.0137. This is acceptable and indicates close to normal distribution (see Appendix H-8). If multi-normality is not a reasonable description of the distribution, then maximum likelihood may not yield appropriate statistical statements and standard errors and chi-square tests may be incorrect (Bentler 1995). In such a case, the different fit indices and the average absolute standardized residual (AASR) become better guides as to the adequacy of the model.

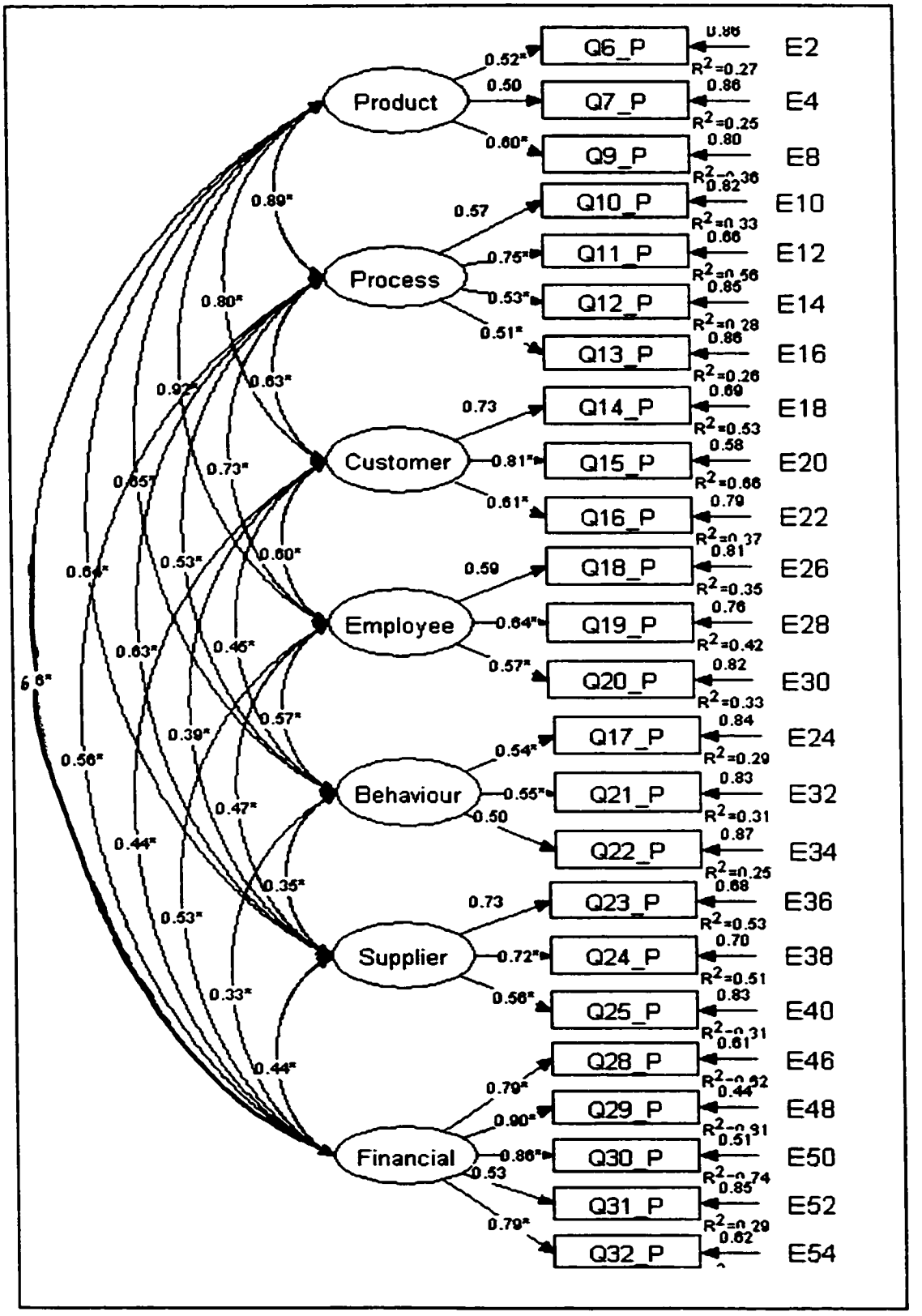
Using maximum likelihood estimation, the model achieved a very good overall fit. The chi-square test was significant, (Chi-square = 369.85, df = 209, p = < .001). Although not desirable, such a significant p-value can occur due to a slight violation of normality assumption or large samples (Jöreskog and Sörbom 1988; Barki and Hartwick 2001). However, both the ML-CFI and AASR indices exceed recommended threshold levels (CFI = .920 and AASR = .0429.) Factor loadings were also good ranging from .497 to .925. Using ERLS and Robust estimation, the above results are even more impressive. As depicted in Table 28, the CFI is 0.975. This model is statistically and logically sound. Hence, the hypothesis that business performance may be defined as a multi-factor correlated model is supported.

Table 28 Output Seven Factor Correlated Model

Items and Test Statistics	Results using ML	Results using ERLS
Chi square	369.85	310.9
Degrees of Freedom	209	209
Probability for Chi square statistics	< 0.001	< 0.001
Average standardized residual	.0429	.0429
Largest Standardized residual	.192	.191
Normed Fit Index	.836	.932
Non-Normed Fit Index	.903	.971
Comparative Fit Index	.920	.976
Robust Comparative Fit Index	.931	.975

A graphical representation of the Seven-Factor Correlated Model, with the correlations, the regression coefficients, the error terms, and the R-squared values, is presented in Figure 18 below.

Figure 18 Seven-Factor Correlated Model



As suggested above, the construct labelled "Behaviour" might also be labelled "Stakeholder Dissatisfaction" because the indicators that measure this factor are indicators of customer or employee negative reactions. The correlations among the factors are listed in Table 29 below. All values are significant and represent a convergent validity for the factors in the model. Some interesting observations may be made from the results of this model.

The highest correlation (.923) exists between product quality effectiveness and the role of employees. This is strong support for the importance of training employees, accepting their suggestions and assuring their satisfaction. The result of such a focus may well be more effective quality production. Similar observations are often seen in the literature (Marks, Hackett et al. 1986; Johnston, Fitzgerald et al. 2001).

The correlation between an efficient process (F2) and product quality effectiveness (F1) is very high (.894). This is an indication of strong relationship between quality initiatives that improve cycle time, that reduce production costs, that respect service delivery specifications, that minimize inventory, on the one hand, and improved productivity, product capability and reliability on the other hand. This linkage is the basis of the ISO program and this high correlation supports the theory behind ISO (Uzumeri 1997).

There is a very strong relationship (.796) between customer (F3) and the product quality effectiveness (F1). This underlines the belief that to be considered as having an effective quality production, a firm should practice

initiatives that are based on customer satisfaction, that attempt to build customer confidence and that assure customer loyalty. This would support the focus on designing for customer satisfaction through the QFD process (see Griffen & Hauser (1993).

- There is a strong relationship (.729) between a concern for employees (F2) and the process efficiency of the firm. This suggests that by working towards higher employee satisfaction, proving them training and involving them in the operation (suggestion acceptance) will translate into greater process efficiency which in turn translates into greater product quality effectiveness. This is reflected in Bell and Becker's article in Quality Progress (Bell and Becker 2001).

- The correlation between the employee construct and the customer construct is .603 which would mildly support the position of Schlesinger and Zornilsky (1991)

The correlations between product quality effectiveness (F1) and the other factors (see the F1 column in table 29 below) are relatively high. This underscores the importance of product quality effectiveness. Placing the correlation values in a descending order may also be an agenda for organizational strategy.

F4 - Employee role (.923)

F2 – Process efficiency (.894)

F3 – Customer focus (.795)

F7 – Financial performance (.659)

F5 – Stakeholder behaviour (.646)

F6 – Supplier role (.645)

Examining the lower values, some of the correlations for supplier role (F6) might be seen as a discouragingly low (.388, .470 and .354) for proponents of supply chain management because the link between supplier and the other factors that make up organizational performance is not as strong as the other factors in this model. Conversely, such a weak relationship in the model may be accepted as a challenge for future emphasis.

Table 29 Correlation Values - Seven Factor Correlated Model

Integrated Model Correlations among Seven Factors						
	F1	F2	F3	F4	F5	F6
F2	.894*					
F3	.795*	.628*				
F4	.923*	.729*	.603*			
F5	.646*	.527*	.454*	.568*		
F6	.645*	.631*	.388*	.470*	.354*	
F7	.659*	.558*	.437*	.525*	.328*	.436*

c) Second-Order Factor Model

Subsequent to the successful fit of the correlated seven-factor model, a second-order

factor model is tested. It is hypothesized that the first-order factors might together define a higher-order latent construct "performance excellence". A graphical representation for this model appears below (see Figure 19.) For this model, the regression weights for the two constructs "product" and "process" are constrained to be equal. This constraint is required to make the model identified (Byrne, 1994).

The EQS output for this higher-order model likewise shows a very good overall fit. Both robust maximum likelihood (ML) and elliptical re-weighted least squares (ERLS) estimation methods are used. Similar to the correlated seven-factor model above, the chi-square test is significant, (ML Chi-square = 459.63 or ERLS Chi-square 399.008, df = 246, p = .000). However, both the CFI and AASR indices exceed their respective recommended threshold levels (Robust ML CFI = 0.915 and Robust ERLS CFI = 0.968 and AASR = .0454. Factor loadings for the performance excellence construct are high, ranging from .602 to .955.

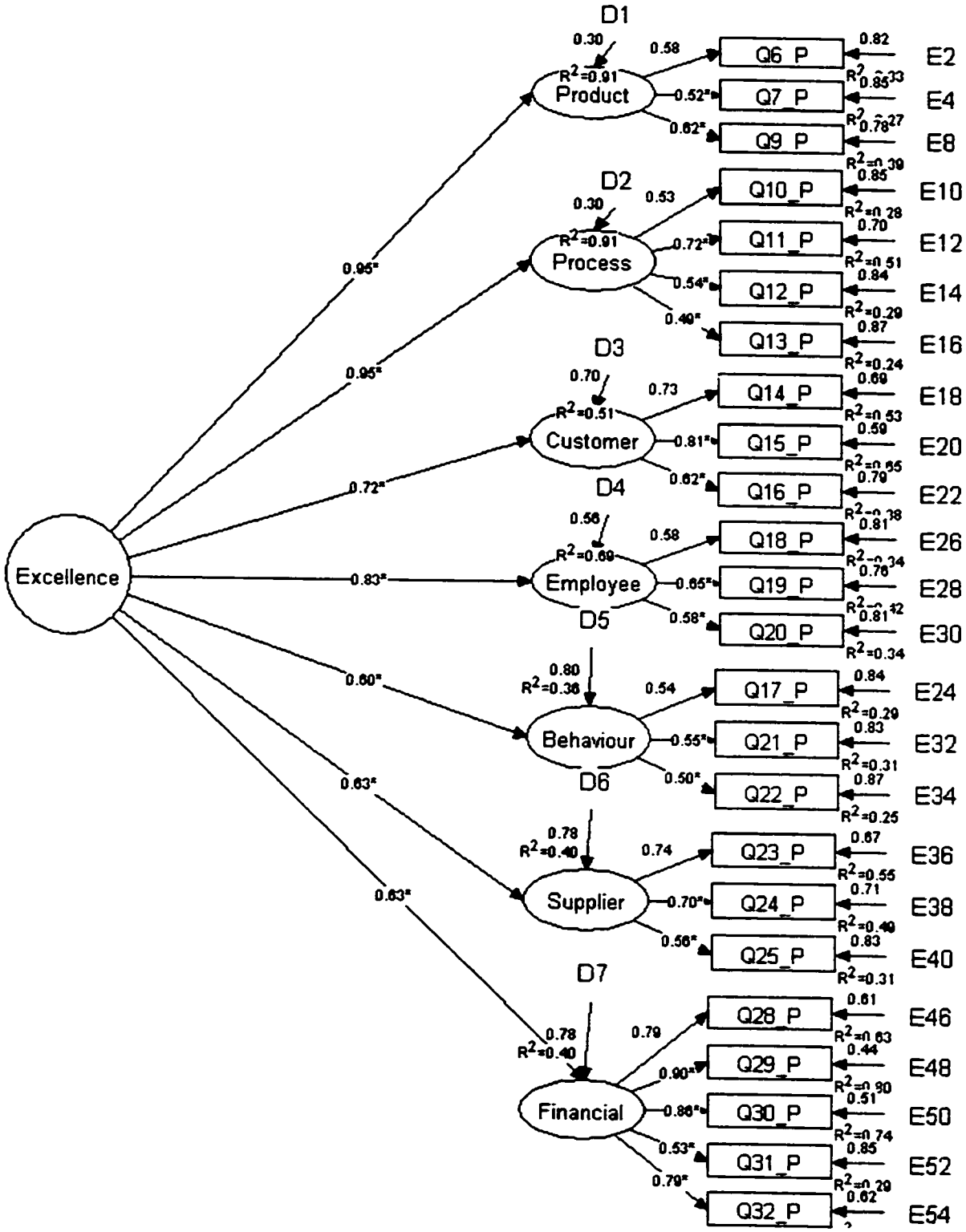
Furthermore, the t-statistics for all 24 coefficients of regression are significant. The EQS output is presented in Appendix H-2

Once again, some interesting observations might be made, for example:

> In relation to business performance excellence, product quality effectiveness and organizational process efficiency have the largest loadings followed by emphasis on the role of employees and a focus on customer.
>
> It might be noted that in comparison to the correlated model above, the loadings for F2 and F4 are in a reverse position. In other words, in the second-order factor model, process efficiency has a larger loading on the

business performance excellence factor than did the employee status factor. Nevertheless, in this research sample, an emphasis on the role of employees is a stronger indicator of performance excellence than are four of the remaining factors (customer, supplier, behaviour-dissatisfaction, finance).

Figure 19 Second-Order Factor Model



It might also be noticed that financial performance, relationships with suppliers and stakeholder behaviour have approximately equal regression coefficients on performance excellence, i.e., their respective influence is approximately equal.

This model underscores the need for firms to obtain performance metrics in addition to ubiquitous financial metrics in defining business performance excellence.

The next section describes the influence of various independent variables on the performance excellence model.

4. Three Scenarios Relative to Performance Excellence

Two scenarios are presented to test the influence of different independent variables on performance excellence. These scenarios are:

1. The effect of ISO 9000 certification on performance excellence
2. The effect of quality management programs on performance excellence
3. In addition, the relationship between firm characteristics and performance excellence is studied.

In order to test the effect of these independent (qualitative) variables on performance excellence, first, a measure of performance excellence was created by averaging the 24 observed variables used in the above seven-factor correlated model. Then, the effect of a number of factors on this measure of performance excellence was assessed by means of analysis of variance.

a) The ISO Effect

To test the effect of the ISO 9000:1994 certification program on performance excellence model, three groups are considered. The first group involves firms that had not been ISO certified but which applied other quality initiatives or programs. There were 132 such cases (47.1% of the sample.) The second group only used ISO 9000, i.e., they applied no other quality initiative but ISO. In the sample of 280 firms, there were only 3 such firms (1.1% of the sample). The third group includes firms that indicated they had neither ISO certification nor had they adopted any other quality program.[3] In this group there were 21 firms (7.5%) of the 280-firm sample. Table 30 provides a cross-tabulation of the data.

Table 30 ISO Distribution in Sample

	ISO certification	No ISO certification	Total
Other quality programs	124	132	256
No other quality programs	3	21	24
Total	127	153	280

[4] Question 38 provided a list from which respondents indicated the programs they adopted. These included Benchmarking, Quality Circles, Just in Time (JIT), Kaizen / Continuous Quality Improvement, Six Sigma, Industry Standards Compliance Programs, ISO 14000, Quality Assurance system, Total Quality Management Approach, Other _____). Q44 asked whether or not they obtained ISO certification. Q45 asked whether or not they had self-audited against or won a national or regional quality award. These questions are part of the survey instrument (see appendix C1.)

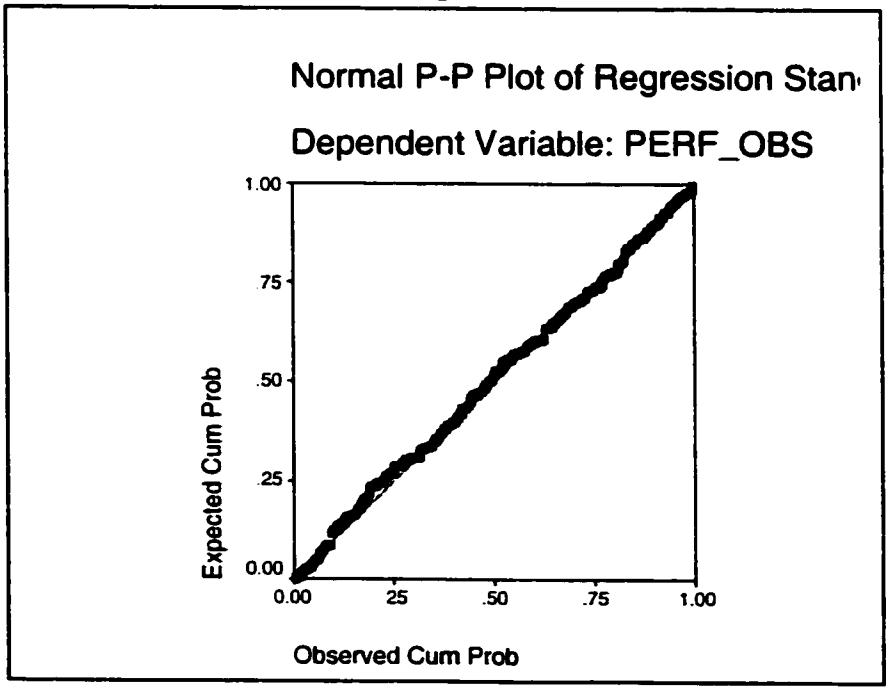
Using GLM univariate analysis of variance of the SPSS program, the results, as shown in Table 31 below, indicate that neither ISO, nor ISO in the presence of other quality programs, affects performance excellence.

Table 31 ISO & Quality Program Effect on Performance Excellence

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.96	3	.32	.89	.448
Intercept	1007.52	1	1007.52	2795.75	.000
ISO	.84	1	.84	2.34	.127
Quality Initiatives	.72	1	.78	1.99	.160
Interaction	.90	1	.90	2.50	.115
Error	99.46	276	.36		
Total	7459.31	280			
Corrected Total	100.42	279			

The standardized residual for the dependent variable was plotted and, as demonstrated in Figure 20, no strong departure from the normally distributed is observed.

Figure 20 Normal P-P Plot of Regression Standardized Residual



The next section describes the second scenario where the effect of various specific quality initiatives on performance excellence is measured.

b) The Quality Initiatives Effect

As stated earlier, question 38 on the research instrument, asked participants to identify which quality initiatives, on a list of practices, their firm had implemented. These items are listed in the footnote above. Furthermore, participants were asked to indicate in question 44 whether the firm had been certified ISO 9000 and in question 45, whether the firm had self-audited against the criteria of a national quality award program, e.g., Baldrige (U.S.), Canada, Qualimètre in Quebec, etc.[4]

The intention of this section is to test the effect of these quality practices as well as the effect of ISO in combination with these other practices, on the response variable. For the purpose of simplifying the test, the practices listed in question 38 were divided into three categories, based on the degree of comprehensiveness. Comprehensiveness includes

---

[5] The notion of "self-audit" was used because relatively few firms actually apply for their national award but several do request or are made aware of the criteria Hendricks and Singhal Hendricks, K. B. and V. R. Singhal (1997). "Does implementing an effective TQM program actually improve operating performance? Empirical evidence from firms that have won Quality Awards." Management Science 43(9): 1258-1274.. Since there is a quantum leap in process excellence between knowing the criteria and successfully abiding by the criteria, it is quite a task for firms to arrive at the point of being able to compete. The number of firms here is quite limited It is suggested here that simply to begin the practice of abiding by the criteria and self-auditing against them could accordingly be deemed a worthy quality practice, a first step towards excellence.

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 32 below, (the values in brackets represent the percentage of respondents in the sample that indicated the firm practiced this initiative.)

Table 32 Three Levels of Quality Practices

Level 1	Level 2	Level 3
Benchmarking (52.1% of the respondents) 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

Respondents were placed in only one category, i.e., the highest level according to their response. In this grouping there are 256 respondents. The remaining respondents to the sample either had no quality initiative of any kind (21 cases) or were only certified ISO (3 cases). Here are a few examples of how the respondents were classified:
If a firm indicated that it had adopted a quality assurance program and that it did benchmarking, the firm was classed as level 1 since either activity was in Level 1.
If a firm used quality circles (Level 1 activity) and indicated it started a TQM program (Level 3 activity), it was placed in level 3 since this was the higher level of the two activities.

In order to test the specific quality initiative effect (with ISO interaction), the data arising from Table 32 is entered into the cross-tabulation Table 33 below.

Table 33 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

Using GLM univariate analysis of variance, the results for this scenario are as follows. As shown in Table 34, with $\alpha < 0.10$ as a reference, there is a slightly significant main effect of ISO on the response variable, performance excellence (p value = .080). But, the main effect of "levels of quality initiatives" is not significant. That is, Quality initiatives alone, do not influence performance excellence (p value = .466). However, the interaction between this factor and the ISO is highly significant (p value = .002).

Table 34 Three Level Quality and ISO Interaction

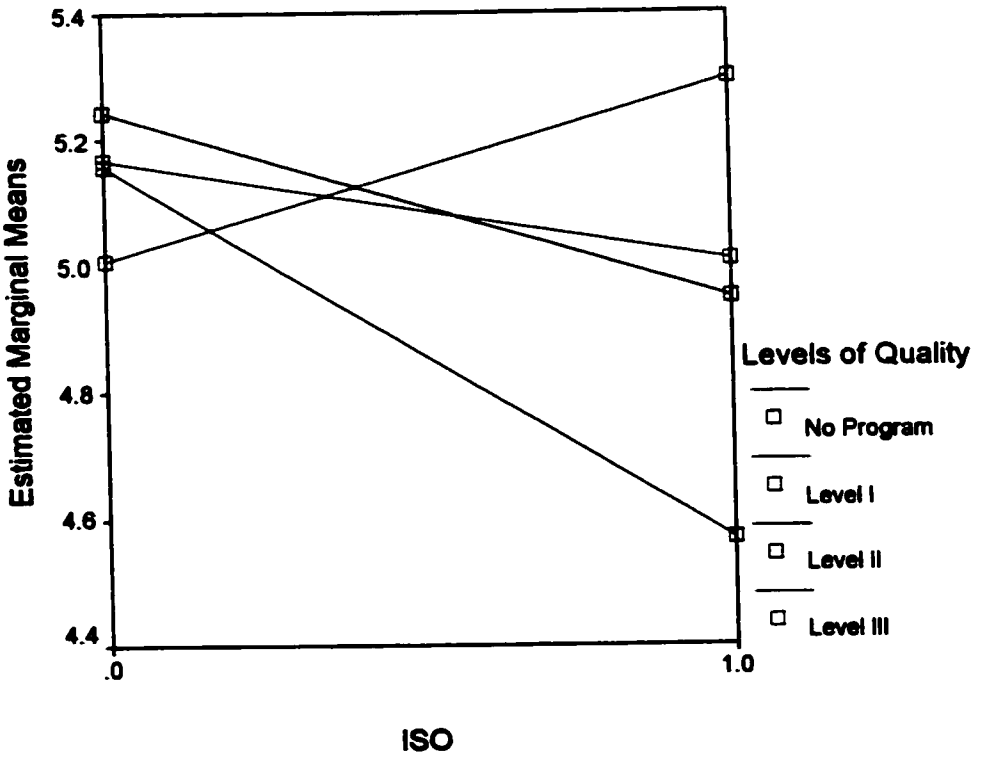
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5.54	7	.79	2.27	.029
Intercept	3076.70	1	3076.70	8819.79	.000
ISO	1.07	1	1.07	3.08	.080
Levels of Quality	.89	3	.30	.85	.466
Interaction	5.26	3	1.75	5.02	.002
Error	94.89	272	.35		
Total	7459.31	280			
Corrected Total	100.42	279			

This significant interaction effect between levels of quality and ISO can be observed in Table 35 and Figure 21. In order to discriminate which level or levels are determinant of

Table 24 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

Figure 20 Level Three Quality & ISO Effect on Performance



We note from the above graph (Figure 21) that, the lines corresponding to no quality program (level 0), and also for levels 1 and 2 decline. The mean value of the response variable for Level 0 quality declines from 5.16 when ISO is not present to 4.57 when ISO certification is present. Similarly, 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 is reflected as well in Table 35.

At first, it seems that, at level zero, one and two quality, performance of ISO-certified firms is less than that of none-certified firms. However, by performing Scheffé method of multiple comparisons on the mean of these groups, we note that, at α = .05, these differences in the performance are not statistically significant. That is, at these three levels of quality (0, 1 and 2) firms with ISO and without ISO are performing similarly. However, the line for Level III quality is upward. The mean value of performance excellence rises from 5.00, for firms without ISO, to 5.30 for firms with ISO. A Scheffé method of multiple comparisons on the mean of these two groups was performed and the result was significant at α = 05. Therefore, it seems that the significance of the interaction between ISO certification and quality level is only caused by the combination of ISO and Level III quality.

In summary, as reported in Table 34 above, ISO has slightly significant main effect (p value = .08) and the interaction between Levels of Quality and ISO is highly significant. As was shown in the graph (Figure 21) and Table 35, the combination of ISO and Level III significantly increases performance excellence.

It must be noted that the assumption of homogeneity of variance is valid since the Levene

test is not significant. See Table 36 below.

Table 36 Levene's Test of Equality of Error Variances

F	df1	df2	Sig.
.920	7	272	.492

Using the 7 individual constructs in the common-factor model as the response variable, similarly, a set of two-way ANOVA was conducted and the following results were obtained.

- Regarding the finance construct, both ISO (p value .052) and the interaction of ISO and the Levels of Quality (p value = .079) have a moderately significant effect. Furthermore, the mean values of the response variable does not vary significantly for different combinations of ISO with Level I and Level II quality. However, at level III the mean value of the finance construct shows a small increase, (from $\bar{x} = 4.87$ to $\bar{x} = 5.08$).

- Regarding the employee role construct, the interaction of ISO and Levels of Quality has a highly significant effect on this construct (p value = .004). Furthermore, the mean values of the response variable do not vary significantly at different combinations of ISO and Level I, or ISO and Level II. However at level III the mean value of the construct shows a significant increase when ISO is present, (from $\bar{x} = 4.54$ to $\bar{x} = 4.95$).

- Regarding the customer focus construct, the interaction of ISO and Levels of Quality (p value = .001) has a highly significant effect on the construct.

Furthermore, the mean values of the response variable do not vary significantly at different combinations of ISO and level of quality. However, for firm with ISO, at level III the mean value of the response variable "customer focus" increased (from $\bar{x} = 5.39$ to $\bar{x} = 5.70$).

- Regarding the process efficiency construct, both ISO (p value .029) and the interaction of ISO and Levels of Quality (p value = .004) have a highly significant effect on the process factor. Furthermore, this interaction effect is due to the combination of ISO and level III. (The mean value of the response variable significantly increases from $\bar{x} = 5.09$, when ISO is not present, to $\bar{x} = 5.29$ when ISO is present).

- Regarding the product quality construct, the interaction of ISO and Levels of Quality (p value = .022) has a highly significant effect on the factor. Furthermore, although the mean values of the response variable for different combinations of ISO and quality initiatives are not significantly different, at level III the mean value significantly increases from $\bar{x} = 5.37$, when ISO is not present to $\bar{x} = 5.57$ when ISO is present.

These effects indicate that ISO and particularly the combination of ISO and Level III quality initiatives have a significant effect on the overall construct of business performance excellence. In addition except for shareholder behaviour and supplier role, the other 5 constructs obtained in the common-factor model are also significantly affected similarly. This should be a strong motivation for managerial pursuit of such practice.

Consequently, regarding the hypotheses of this research that relate to quality initiatives,

we may conclude the followings:

- Hypothesis 8a states that the presence of ISO certification would positively affect performance excellence. The data provide no evidence to support the above hypothesis. This may be due to different situations, including (a) the motivation for ISO itself, or (b) the motivation for ISO especially where firms have undergone no other or only minor quality programs.

- Hypothesis 8b states that firms that have instituted quality initiatives, but which have not obtained ISO certification, will demonstrate business performance as good as firms with a quality program as well as being ISO certified. This hypothesis is supported. While, the mean for firms with ISO and a quality program is 5.133, the mean for firms without ISO and a quality program in the sample is 5.125, which is not significantly different. These results for these two hypotheses would not be encouraging for firms contemplating embarking upon ISO certification. ISO certification is not sufficient in its own right to move a firm to business excellence. However, the next 2 sets of results will counter balance this.

- Hypothesis 8c states that firms that have instituted both ISO certification and other quality initiatives will demonstrate business performance greater than firms that are ISO 9000 certified only. This hypothesis is partly supported only because of the Level III quality initiatives. Regarding Level I and Level II initiatives, as is demonstrated above, given the mean values for the response variable, there was not enough evidence to support this hypothesis.. This gives important focus on the

next hypothesis.

- 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 have a significant positive effect on performance excellence. Hypothesis 8d states that the measured benefits for business performance show greatest positive improvement when ISO certification is used in combination with business excellence practices of national quality award programs or other high-level quality initiatives. As was shown above (see Figure 21 and Table 35), this hypothesis is fully supported (p value = .002). It may be concluded that managers may be confident that the combination of ISO certification and a Level III quality initiative will provide the highest value for performance excellence.

Next the third scenario is presented.

c) The Effect of Firms Characteristics

This next section describes the relationship of various characteristics, as established in the stratification of the population, with the overall measure "performance excellence". As indicated earlier, the sample was drawn from three different industry types (manufacturing, distribution, service), from firms of three different sizes determined by the number of employees (small, medium, large), and from two different locations (Ontario and Quebec). See appendix F, part of which is reproduced in Table 37.

Table 37 Sample Strata

	Sample						
	Quebec			Ontario			
Size	Manufacture	Distributor	Service	Manufacture	Distributor	Service	TOTAL
Small	41	7	10	41	17	13	129
Medium	22	7	7	40	7	7	90
Large	11	7	7	22	7	7	61
TOTAL	74	21	24	103	31	27	
Grand Total			119			161	280
% of Total			42%			58%	

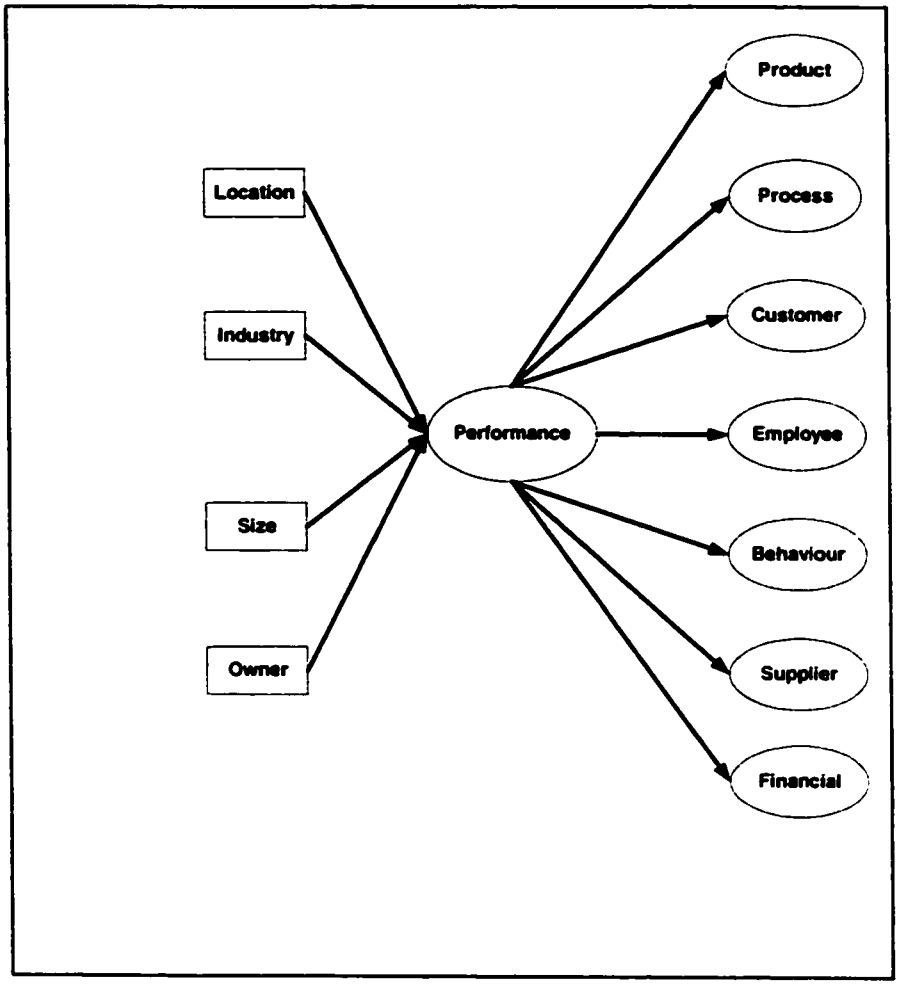
A break down of this sample is given in Table 38 below.

Table 38 Sample by Location, Type, and Size

		N
LOCATION	Ontario	161
	Quebec	119
INDUSTRY	Manufacturing	177
	Distribution	52
	Service	51
SIZE	Small	129
	Medium	90
	Large	61

To help visualize a model of the effects, a graphical depiction is presented in Figure 22.

Figure 22 Strata Population Effect



Once more, a GLM univariate analysis of variance is conducted. The results are presented here. Again, the assumption of homogeneity of variance is met since the Levene test is not significant. See Table 39 below.

Table 39 Levene's Test of Equality of Error Variances

F	df1	df2	Sig.
.788	17	262	.707

In this scenario, none of the qualitative variables tested on the response variable were significant. See table 40.

Table 40 Strata and Performance Excellence Relationship

Tests of Between-Subjects Effects
Dependent Variable: PERF_OBS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	10.574	34	.311	.848	.711
Intercept	3041.439	1	3041.439	8293.295	.000
OWNER	.153	1	.153	.419	.518
LOCATION	.133	1	.133	.362	.548
INDUSTRY	1.568	2	.784	2.137	.120
SIZE	.822	2	.411	1.120	.328
OWNER * LOCATION	4.635E-02	1	4.635E-02	.126	.723
OWNER * INDUSTRY	.962	2	.481	1.312	.271
LOCATION * INDUSTRY	3.438E-02	2	1.719E-02	.047	.954
OWNER * LOCATION * INDUSTRY	9.917E-02	2	4.959E-02	.135	.874
OWNER * SIZE	1.103	2	.551	1.504	.224
LOCATION * SIZE	.218	2	.109	.297	.743
OWNER * LOCATION * SIZE	.697	2	.348	.950	.388
INDUSTRY * SIZE	.841	4	.210	.573	.682
OWNER * INDUSTRY * SIZE	.145	4	3.621E-02	.099	.983
LOCATION * INDUSTRY * SIZE	1.332	4	.333	.908	.460
OWNER * LOCATION * INDUSTRY * SIZE	.851	3	.284	.773	.510
Error	89.850	245	.367		
Total	7459.310	280			
Corrected Total	100.424	279			

a R Squared = .105 (Adjusted R Squared = -.019)

In post analysis, the relationship between these qualitative variables and the individual constructs of the common-factor model is studied. Some relationships are suggested:

- Industry has a slightly significant relationship with the "process efficiency" factor (p value = .096)
- The interaction between industry and size has a moderately significant relationship with the stakeholder behaviour factor (p value = .055)

- Size has a slightly significant relationship with the finance factor (p value = .078)

Considering the fact the p-value for these tests are more than .05 and that the hypotheses are not "a-priori" established, these results might simply be due to chance.

Consequently, the 4 hypotheses regarding this scenario are supported:

9a	That regarding business performance excellence, there is no perceived advantage for large firms or small firms or medium sized firms
9b	That regarding business performance excellence, there is no perceived advantage for either manufacturing firms or distribution firms, or service firms
9c	That regarding business performance excellence, there is no perceived advantage whether the firm is located in Quebec or Ontario
9d	That regarding business performance excellence, there is no perceived advantage whether the firm is privately or publicly owned

C. Frequency of measurement -Distribution

The survey questions dealing with performance are also used to evaluate the frequency with which the firm measures these particular items. This series uses a four-point scale. As an example, this is the first question in Table 41.

Table 41 Response Range for Frequency of Measurement

		Frequency of measure				Perceived Performance						
		Not	Rare	Some	Often	Worst	Weak	Below	Average	Above	Good	Best
Q6.	The level of productivity for your firm is	A	B	C	D	1	2	3	4	5	6	7

Regarding the four-point scale A=not measured, B=rarely measured, C=sometimes measured, and D=often measured a descriptive analysis produces output similar to the following for each of the 27 variables, see Table 42.

In the survey instrument, respondents were requested to use the A-B-C-D scale to indicate the frequency of measuring each item. The choice of A-B-C-D was to consciously distinguish these "frequency" from the "performance" questions. However, in coding the responses in SPSS, A=1, B=2, C=3, and D=4. Hence Table 42 and Appendix H-5, indicate the groups as 1-2-3-4 rather than A-B-C-D.

Table 42 Sample SPSS Descriptive Statistics for Frequency of Measurement

Q6_F

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.0	11	3.9	3.9	3.9
	2.0	13	4.6	4.6	8.6
	3.0	38	13.6	13.6	22.1
	4.0	218	77.9	77.9	100.0
	Total	280	100.0	100.0	

A summary table for the 27-item output was prepared. See Table 43 below.

The results show that the following distribution

9.6% of the respondents answered "A" (not measured),

6.1% answered "B" (measured rarely),

18.8% responded, "C" (sometimes measured),

65.5%) answered "D" (often measured).

This result provides strong support for the notion that, indeed, firms do measure numerous items to get a sense of how their operations are proceeding. Furthermore, traditional tracking of effective and efficient operations (e.g., items Q6-Q10 particularly) and financial performance (items Q26-Q32) is demonstrated by the high results in the category "D- measure often" for these factors.

To underscore the scope of these results, "A" responses are aggregated with the "B" responses and categorized as "not measured" and "C" responses are aggregated with the "D" responses and categorized as "measured". This permits two groups for comparison.

Using the combined frequency of measure scores (not-measured & measured) and grouping them per factor, we can observe a cross tabulation of the frequency by factor from the most often measured factor (financial performance) to the least often measured factor (employee status). The following Table 43 highlights this ranking. See Appendix H-5 Frequency of Measurement Descriptive Statistics.

Table 43 Grouped Frequency of Measurement

Factor	Not Measured	Measured
Financial Performance	7.9%	92.1%
Product Quality Effectiveness	9.6%	90.4%
Supplier Role	13.0%	87.0%
Process Efficiency	15.2%	84.8%
Stakeholder Behaviour	18.6%	81.4%
Customer Focus	20.1%	79.9%
Employee Emphasis	38.2%	61.8%

The results indicate:

As might be expected, over 90% of respondents sometimes or often measure two factors, i.e., product quality effectiveness or financial performance.

Alternatively, items Q11-Q25 (measurement regarding a customer focus, employee impact, and supplier role) may be considered more recent additions to the measurement practices of firms, i.e., these measures are less frequently carried out. The more even distribution of responses across the 4-point scale would support this. See Table 44 below.

Table 44 contains the mean value for each question when the choices A-D (above) are scored 0-4 respectively. The large means for the 27 questions confirms that firms do frequently measure the items of this study.

It is important to observe the items relating to a focus on employee (Q18-Q22). The items in this factor are the least frequently measured.

For example, Q18 Employee satisfaction with your firm is not measured or seldom measured by 40% of firms. Employee suggestions (Q20) are not accepted or seldom accepted by 43% of the firms. This may be an indication that a focus on employees within the large picture of contributing factors of firm performance has some way to go.

Table 44 Distribution of Frequency of Measure

Question #	Factor	Mean	Std Dev	A - frequency	B - frequency	C - frequency	D - frequency
6 F	Product	3.654	0.746	11	13	38	218
7 F		3.629	0.779	14	10	42	214
8 F		3.514	0.880	18	19	43	200
9 F		3.686	0.780	14	8	30	228
10 F	Process	3.721	0.694	10	9	30	231
11 F		3.232	1.101	40	24	47	169
12 F		3.332	0.977	28	18	67	167
13 F		3.464	0.965	27	14	41	198
14 F	Customer	3.457	0.854	16	19	66	179
15 F		3.071	1.152	53	17	67	143
16 F		3.182	1.139	48	16	53	163
17 F	Behaviour	3.450	0.907	19	23	51	187
18 F	Employee	2.621	1.126	68	46	90	76
19 F		2.893	1.131	54	33	82	111
20 F		2.600	1.220	83	37	69	91
21 F	Behavior	3.457	0.915	20	22	48	190
22 F		3.096	1.098	42	30	67	141
23 F	Supplier	3.443	0.918	23	14	59	184
24 F		3.407	0.965	26	18	52	184
25 F		3.532	0.816	15	13	60	192
26 F	Financial	3.911	0.373	2	2	15	261
27 F		3.775	0.589	6	6	33	235
28 F		3.882	0.355	1	0	30	249
29 F		3.686	0.646	7	7	53	213
30 F		3.475	0.859	19	11	68	182
31 F		3.121	1.113	45	23	65	147
32 F		3.550	0.837	19	6	57	198
Average		3.402	0.886	27.0	17.0	52.7	183.4
Percent				9.6%	6.1%	18.8%	65.5%

D. Frequency of measurement - ANOVA results

Using the seven factors of the second-order model as dependent variables (DV), and frequency of measuring the 27 items of the factors as independent variables (IV), a set of ANOVA tests was conducted. The p -values for all these tests are reported in the table in Appendix H-6. The seven dependent variables were performance scores for the seven factors obtained by summing the observed value of the items belonging to a construct. For example, for the first factor, three variables (6P+7P+9P) were summed to create a score for "Product Quality-Effectiveness".

From Table 45 we note that frequency of measuring product, (question 6F) has a significant effect on the first construct "Product Quality Effectiveness". In this example, the summed score "Product" is the Dependent variable and question 6F is the independent variable.

Table 45 ANOVA: The effect of question 6F on Product Quality-Effectiveness

ANOVA

PRODUCT

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7.646	3	2.549	5.042	.002
Within Groups	139.504	276	.505		
Total	147.150	279			

The result (p value .002) would suggest that how frequently a firm measures productivity (Q6) seems to effect this factor, "product quality effectiveness", and by extension, "performance excellence." This is expected. The items that make up a factor should have a significant p-value, e.g., 6F, 7F & 9F are supposed to significantly effect the construct

"product". Referring to Appendix H-4 and to Table 46, we notice that this is true for several factors, i.e., Product (6f, 7F, 9F); Process (10F, 11F, 12F, 13F); Customer (14F, 15F, 16F); Employee (18F, 19F, 20F) and Supplier (23F, 24F, 25F). But this is not always true in this study.

With the "Stakeholder Behaviour" factor and the "Financial" factor, some items are not highly significant. The following (Table 46) provides a summary of the results.

Table 46 Significance of Measurement Frequency by Items in Each Construct

Factor	Highly sig. (<0.01)	Moderately sig. (<0.05)	Lightly sig.(<0.10)	Not sig. (>0.10
1 Product	Q6, Q7, Q9	-	-	-
2 Process	Q10, Q11, Q12, Q13	-	-	-
3 Customer	Q14, Q15, Q16	-	-	-
4 Employee	Q18, Q19, Q20	-	-	-
5 Behaviour	Q22	-	Q21	Q17
6 Supplier	Q23, Q24, Q25	-	-	-
7 Financial	Q 29, Q30, Q31	Q32	-	Q28

Generally, the variables associated with the items of the factors display a highly significant effect on performance. The first column of the table shows this. However, referring to the annex and the summary in Table 47, a number of additional interesting observations can be made.

Table 47 Seven-factor ANOVA - Summary

Factor	Total # sig.	High sig. (<0.01) within own factor	High sig. (<0.01) from other factors	Moderately sig. (<0.05)	Low sig. (<0.10)
Product	16	3	7	5	1
Process	18	4	10	4	0
Customer	17	3	12	0	2
Employee	17	3	9	3	2
Behaviour	9	1	1	3	4
Supplier	12	3	1	5	3
Financial	15	3	5	6	1

The fourth column in Table 47 (High sig. from other factors) shows the number of questions (variables) that have a highly significant ($p< 0.01$) effect in a different factor. For example, regarding the "process efficiency" factor, all 4 indicators of this factor are significant for the factor "process", but interestingly, 10 of the 20 questions of the other factors also have a significant effect on the "process efficiency" factor. This raises several interesting observations regarding items effecting other factors, some of which are highlighted below.

The three questions (Q14, Q15, Q16) that measure the frequency of measurement for the factor "customer focus" likewise play a highly significant role in the performance of the three other factors of a firm's performance, i.e., product quality, process efficiency, and employee role. In

other words, how frequently a firm measures customer satisfaction, confidence, and loyalty are significant for the performance of four of the factors of performance. Similarly, how frequently a firm measures its productivity (Q6) the reliability of its product (Q7) or its ability to meet standards (Q9) not only have a significant effect on product quality (the directly related factor) but these items also have a very significant effect on both the process efficiency factor and the employee role factor of performance.

Regarding the employee status factor, several frequency of measurement questions from other performance factors play a significant role in this factor. Specifically, how often a firm measures the reliability of its product, its conformance to standards, its on-time delivery, its production cycle-time, its customer satisfaction, customer confidence and customer loyalty or measure its market share, (all) are highly significant to the employee status factor.

Question 28 considers the frequency that a firm measures net income. It seems that the performance of those firms that measure net income less frequently is not different from those firms that measure net income more frequently.

This concludes the analysis of the data. Next is the discussion.

VII. Discussion

The business operations literature is replete with suggestions for managers to consider. They are encouraged to monitor many items, with particular focus on financial measures, on customer satisfaction, on productivity and so on. While one might easily find a hundred or more items to measure, for the busy business office, only a restricted number of issues can be monitored and measured. Practicality forces the issue.

It becomes necessary to create a succinct and marketable package of measurement. What must be monitored needs to be succinct because the time and effort required for evaluating or measuring progress in any one area has to be reasonable. It must also be a marketable effort because those who evaluate (as well as those evaluated) and those for whom the evaluations are done must also see the exercise as reasonable and of benefit. This form of inspection must be intelligently deployed because it is not practical to measure all characteristics (Reid 2001). This study proposes a succinct and marketable package of measurement.

A. Scorecards

Certainly, those involved in setting up what is the holistic criteria for business excellence (exemplified by the national quality awards programs) have a variety of examples of items to describe what constitutes excellence. Similar to the work of Black and Porter (1996), this empirical study, based on firms within this geographic area, attempts to confine and define a succinct combination of items that would be examples of metrics of the common constructs contained in the various awards programs. This is a contribution

to the theory performance measurement and to the field of quality management metrics. As has been shown, it is possible to specify certain observable items that collectively describe a construct of business performance.

At the outset of this research, it was proposed that six constructs, essentially reflecting the awards programs, can be defined and measured using observable items. The results from a structural equation modeling of the variables measured in this study demonstrate that a seventh factor emerges. This seventh factor advances the theory of performance evaluation.

Typically, firms are encouraged to focus on customer satisfaction and on employee satisfaction. This study, by suggesting a seventh factor identified as "stakeholder behaviour", is creating a two-pronged view of the typical customer and employee focus, i.e., attitude and behaviour or dissatisfaction. It might be suggested that firms be sensitive to what it is they do to create positive stakeholder attitude and then, as a separate issue that they be concerned with measures of the reaction by the stakeholders. In other words, not only should firms measure positive items such as customer and employee satisfaction or loyalty but also should measure indicators that indicate negative reaction such as measures of dissatisfaction and turnover. Suggesting that "negative measures" be added to the scorecard appears to be contribution to this measurement tool.

Additionally, notwithstanding that some re-specification is necessary to statistically support the constructs, seven factors for firm performance were defined. Similar to Kaplan and Norton (1992), the items that define these factors can serve as a scorecard, for managers. This unique combination of items as a measuring device is a further

contribution to the theory of performance measurement. The benefit of having a scorecard allows managers to make comparisons over time, which in-turn, is an opportunity for improvement. You can't improve what you don't measure (Deming 1986).

Examining individual factors in isolation is one thing, but examining the factors as a collective whole provides a holistic view. The statistically sound seven-factor correlated model and the second-order factor model provide business leaders with an integrated model that can be used as a scorecard for mapping progress. This contribution reflects the conclusions of several, including Saco (1997) and Best (1997). Of possible greater importance is the fact that a strategic business decision to observe several measures within a related frame might encourage business leaders to contemplate possible auditing against the more holistic criteria of the national award programs.

B. Quality Practice Effect on Performance Model

After the confirmation of a structural equation model that operationalised business performance excellence, the next objective was to test how the model is affected by the existence of quality practices in the firm. As was pointed out earlier in the analysis section, two of the four hypotheses were not supported.

In other words, in this study of 280 firms in Ontario and Quebec, the existence of an ISO 9000 certification alone does not play a significant role (p value < .050) on performance excellence. This conforms to the position of several others, including Rayner and Porter (1991) and Williams (1997). Furthermore, for firms having a combination of ISO and another program, there is no perceived evidence of significant enhancement in

performance excellence for two of the three categories of quality initiatives. This partially would support the work of Terziovski, 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 a total quality management program or a six sigma program or if the firm has performed a self-assessment against the criteria of a national quality award program. This last scenario was the only case where the results were highly significant.

It had been hypothesized that the more complex category of practices (Level III) would have made a difference in performance without the need for an ISO combination. This does not arise from this study. Perhaps, this deception is caused by the small sample of firms that report that they are instituting a six sigma program (31 firms – 11% of the sample) or who indicate that they audit against a national award program (11 firms – 4% of the sample), see Appendix H-7.

Nevertheless, according to this sample and this structural model, ISO in combination with the more complex quality practices is the only instance of a significant enhancement of perceived performance. This must be taken as a guiding light for management in the future. This conclusion is an important contribution of this research.

Now that ISO 9000:2000 has been thrust upon the quality scene, this should prove to be a most important opportunity for improved performance. Since the new ISO program incorporates the characteristics of a TQM program, particularly continuous improvement, it would classify as a Level III category in this study. Thus, the suggestion is that firms

wishing to significantly improve performance to the level of business excellence should be undertaking the new ISO 9000 certification program in conjunction with a continuous effort to reduce errors to the 6σ level. Furthermore, these firms might coincidently self-assessing against the criteria of the national awards quality program. Better still, would see firms actually applying to be considered for the award. In addition, keeping track of progress using a scorecard, possibly based on the models of this research might prove beneficial.

C. Firm Characteristics and Perceived Performance

In the planning stages of this research, the establishment of the sample was given much thought. A stratified sample scheme was used to reflect the population of firms in the two provinces. An equal number of firms in each category for each firm (regardless of industry type or size) would have created a bias, either favouring Quebec with its fewer number of firms or favouring large sized firms or favouring service firms. Instead, as seen in Appendix F, proportionate numbers were derived to assure validity of response. The size of the stratified sample for this research contributes to the validity of the work. So, too, the high response rate, helped by the use of telephone polling is support for the reliability of the results.

This study did not find any significant difference in perceived performance when certain firm characteristics were considered. The characteristics included location, industry, size, and ownership. It is not surprising that the location of the firm (Ontario or Quebec) does not significantly influence performance excellence. The number of firms with ISO certification (Ontario 45.3% vs. Quebec 47.1%), and the breakdown into three categories

of quality initiatives is quite evenly distributed in the 2 provinces as shown in Table 48. This increases the validity of the results.

Table 48 Firms per Quality Levels by Province

Province	Level 1	Level 2	Level 3
Quebec	29%	25%	37%
Ontario	22%	25%	43%

Unlike the work of Ahire (1996) whose study involved only small manufacturing firms, or of Flynn, Schroeder and Sakakibara (1995) who studied only manufacturing firms, this study examines manufacturing, distribution and service firms, each of varying sizes. Whether the industry of the firm was a manufacturing, distribution, or service, there is no significant difference in perceived performance due to the existence of quality initiatives. This was expected and this result may help respond to concerns regarding industry type. Traditionally, quality initiatives have been perceived as easier to apply in manufacturing and harder to measure in services. Perhaps an important contribution of this performance excellence model might be that it provides a tool for other researchers to compare these industry types.

One might imagine that large firms have an advantage in that they could more easily afford having a relatively large quality management department presumably leading to greater performance. That there is no significant difference in perceived performance in relation to size could be seen as a plus. This would support the thrust that argues that

quality is everyone's job and not the work of one department, and that any quality initiative relies heavily on senior management passion. Any firm, regardless of size, that is guided by a management passion for quality will perform well.

Additionally, ownership, whether private or public, does not make for a significant difference with regards to perceived performance. Again, this along with the above (size and industry type) would support the idea that quality practices are spread across all businesses and this can be construed as a positive.

Finally, the frequency with which a firm measures various indicators of performance (e.g., the 24 indicators opined in this study) appears to play a significant role in firm performance. The performance of those firms measuring would appear to be different from firms that do not measure.

VIII. Conclusion

A review of the literature has highlighted how comprehensive the quality philosophy has become. It might be appreciated that this philosophy has evolved both because of the anecdotal contributions of many as well as the scientific contributions of a few. Because evolution of the philosophy has occurred and because the examples of practices have proliferated, it is indeed opportune to again examine the situation scientifically. It is timely to examine the benefits in terms of organizational performance vis-à-vis different approaches.

A. Contribution of the research

This empirical study has painted a picture of the quality management practices in two Canadian provinces at the turn of the century. This work has proposed and defined a definition of organizational performance beginning with individual constructs within a framework of common factor models and proceeding to integrate these constructs into a second-order factor model.

This model might subsequently serve as a point of departure for identifying a unique succinct and statistically sound set of items to measure the criteria of the national awards programs. As such, the models in this work are only one possible integrated and succinct picture.

The results of this research might be of interest to the academic community as a re-examination of the various areas of quality management, especially performance in the light of more global awareness of quality and spreading interest and acceptance of awards

programs and the new ISO 9000:2000 program.

Such a study might also be useful for the quality practitioner by providing a more complete idea of where to look for benefits of quality initiatives as well as providing a tool for measuring the benefits. Interested quality practioners might include business executives, consultants for quality initiatives, ISO registrars and ISO-leadership committees, and, as well, the directors of the Quebec Society for Quality and Canada's National Quality Institute. Accordingly, the results of applying the models might facilitate business-performance enhancement as a result of ISO certification or TQM implementation.

This research offers an alternative to, or an expression of, the Balance Scorecard notions put forward by Kaplan and Norton (1992). It offers a suggestion to link items generally found on a Scorecard with the awards programs by suggesting the criteria constructs of the awards might serve as the headings of the Scorecard.

B. Future study

The more comprehensively defined model of the constructs of organizational performance as offered by this research and the measure of the effects on performance excellence through monitoring these constructs should continue to pique research interest. One might expect that future research needs to be done on how scorecard models such as these will evolve and of what the benefits are to organizations. The objective of having a succinct measurement model of business performance excellence with the most important combination of observable items should be the subject of ongoing research. For example, it would be interesting to examine relationships between pairs of constructs in

this research. That is to say, is there a cause and effect relationship say, between the measure of employee satisfaction and employee turnover, or between customer satisfaction and customer loyalty?

Another issue for future study might be to modify the indicators, adding some or re-locating some relative to the factor. For example, in this study, "productivity" was measured as an indicator of the factor "product quality effectiveness". One could argue that it might better be measured as an indicator of "process efficiency". Although the fit of the proposed model was good, perhaps the model would have a better fit with this latter modification.

In addition, ISO 9000:2000 is a template that should be enhanced with other elements to drive efficiency and effectiveness (Reid 2001). As was demonstrated in this project, the effect of the combination of ISO 9000:1994 with the national quality award programs had a significant effect on perceived performance. The new ISO 9000:2000 should afford businesses a new start to sustainability, growth and excellence. Firms that attempt this combination of practices (ISO and awards) should indeed be monitored, possibly through in-depth qualitative case study research.

Within this framework one might wonder to what extent the new ISO, in isolation, will be as strong a driver for excellence as the awards programs are proving to be. Will the new ISO have a significant effect on a holistic model of integrated constructs?

This research has brought out that there is a non-frequent use of quality tools (see appendix H-7) and the cost-of-quality components of the literature. Presuming that firms increase their awareness of the benefits of using such tools, future research may monitor

the effects on performance with their application.

It would certainly be interesting to extend this model to the not-for-profit area. Future research using such a scorecard model as proposed in this research and as well self-assessment against the national quality awards in government management, in education or health care management might prove worthwhile (Evans and Lindsay 2002).

Finally, organizations have to constantly examine performance to find out where they can do better, now and in the future (Lepore and Cohen 1999). Reid (2001) offers that organizations are either growing or dying daily and that to grow they must be managed well and committed to improving faster than the competition. Ultimately survival is the issue.

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X. Appendices

The pages that follow contain several appendices that support different areas of this thesis. For clarity, each appendix begins on a new page.

Appendix A: Focus Group & Case Study – Stage 1

1. Participants

Position	Firm
Representatives from three firms participated as focus group members in a half-day discussion of the issues of quality management and programs as implemented in their firms. Following round table discussions, the participants discussed a potential questionnaire that might bring out how firms measure performance of different processes within a firm.	
Director Quality Assurance (Plant level)	Allied Signal (St. Laurent plant)
Corporate Director of Quality Safety & Customer Service	The Rival Company Clinton, Missouri
Directeur du service a la clientele	Westburne Quebec, Inc.
The group below (from Siemens) were interviewed as part of a case study	
Director Corporate Quality Management	Siemens Electric Limited
Vice President	Siemens Electric Limited Electromechanical Components
Manager, MIS & organization	Siemens Electric Limited
General Manager & Controller	Siemens Electric Limited Electronics Division
The group below (from Marconi) were interviewed as part of a 2nd case study	
Quality Director	Canadian Marconi
Manager Quality Assurance	Canadian Marconi
Manager Information Technology	Canadian Marconi
VP Human Resources	Canadian Marconi
VP Communications	Canadian Marconi
VP Operations	Canadian Marconi
VP & CFO	Canadian Marconi

This is the original instrument that was subsequently totally revised as a consequence of phase 1. It is inserted here for information and to underscore the shift in direction.

2. Phase 1 ISO Survey

SECTION A: INITIATION OF A QUALITY MANAGEMENT SYSTEM

In this section, check the box (one or more than one) that best answers the question.

V	Item	Response
	What was (or were) the original key reason(s) that lead your firm to seek certification in the ISO 9000 series? (choose one or several)	
	pressure from existing customers	
	desire to do business in new markets	
	improve the quality of our product (goods or services)	
	improve our efficiency (reduce waste, delivery time)	
	improve our process and procedures	
	initiate a quality system	
	develop a tool for improving operations	
	increase profitability	
	get a banner on the wall	
	other _____	
	Does your firm require your suppliers to be ISO 9000 certified?	
	No	
	Yes	
	Do your customers require that your firm be ISO 9000 certified?	
	None	
	Some	
	Most	
	All	
	What quality improvement tool did your firm use prior to ISO 9000 certification?	
	None	
	TQM	
	Other _____	
	What quality improvement tool has your firm instituted (or maintained) subsequent to the ISO 9000 certification?	
	None	
	TQM	
	Other _____	
	Was the decision to seek ISO certification the catalyst to creating a quality management position in the firm?	
	No	
	Yes	

SECTION B: OUTCOMES FROM ISO 9000 CERTIFICATION

For these questions, circle the number between 1 and 7 on the scale to the right that corresponds to the degree to which you agree with the statement.

1	*2*	*3*	*4*	*5*	*6*	*7*
Strongly disagree	*moderately disagree*	*mildly disagree*	*neither agree nor disagree*	*mildly agree*	*moderately agree*	*strongly agree*

In our firm, the ISO programme is part of a strategic plan for a total quality management system.	1 2 3 4 5 6 7
Without ISO certification, our firm would not have been able to bid for certain jobs.	1 2 3 4 5 6 7
ISO certification has allowed our firm to compete globally.	1 2 3 4 5 6 7
The ISO programme at our firm is for the long-term.	1 2 3 4 5 6 7
ISO certification causes the leaders of our firm to review strategy.	1 2 3 4 5 6 7
ISO certification has forced our firm to develop a quality system	1 2 3 4 5 6 7
As a result of ISO certification, our firm is increasingly sensitive towards societal and "well being" issues (e.g., health, safety and environmental issues).	1 2 3 4 5 6 7
ISO certification has created in our firm a continuous learning environment that fosters innovation.	1 2 3 4 5 6 7
Because of ISO certification, our senior management fosters a dedication to quality principles at all levels.	1 2 3 4 5 6 7
Because of ISO certification, our firm shares our knowledge of improvement with other organisations.	1 2 3 4 5 6 7
Because of ISO certification, our senior management shares a responsibility for improvement throughout the organisation.	1 2 3 4 5 6 7
ISO certification has facilitated our procedure for determining the current needs of our customers.	1 2 3 4 5 6 7
ISO certification has facilitated our procedure for determining the future needs of our customers.	1 2 3 4 5 6 7
ISO certification has facilitated our procedure for converting customer needs into product or service requirements.	1 2 3 4 5 6 7
ISO certification has enabled our firm to focus on customer satisfaction.	1 2 3 4 5 6 7
ISO certification has made it easier for our customers to complain about our product, whether goods or services.	1 2 3 4 5 6 7
ISO certification has helped our firm respond to customer complaints.	1 2 3 4 5 6 7
ISO certification has given our firm an advantage with buyers.	1 2 3 4 5 6 7
A focus on ISO conformance prevents our firm from addressing customer-driven quality.	1 2 3 4 5 6 7
ISO certification has allowed our firm to develop greater trust with our customers.	1 2 3 4 5 6 7
Our firm's other quality management system (either prior to ISO or subsequent to ISO certification) has been successful.	1 2 3 4 5 6 7
Because of ISO, the employees of our firm are encouraged to suggest innovative solutions to address improvement goals.	1 2 3 4 5 6 7
Because of ISO, our firm is better ready to identify key elements that will lead to improvement of our operations.	1 2 3 4 5 6 7
Because of ISO, our firm is better able to communicate our improvement plan.	1 2 3 4 5 6 7
External audits (ISO registrar) are important to the successful maintenance of our quality system.	1 2 3 4 5 6 7
Internal audits (self-audits) are important to the successful maintenance of our quality system.	1 2 3 4 5 6 7
Internal audits provide our firm with awareness of issues that lie beyond the quality assurance of ISO 9000.	1 2 3 4 5 6 7
Our firm is ripe to evaluate itself (self-audit) against a national quality award as a method of instituting a quality system.	1 2 3 4 5 6 7

ISO certification has enabled our firm to improve our human resource planning.	1 2 3 4 5 6 7
ISO certification has enabled our firm to improve our procedures for recruiting and selecting personnel.	1 2 3 4 5 6 7
ISO certification has enabled our firm to minimise the effects of any restructuring or reorganization.	1 2 3 4 5 6 7
ISO certification has encouraged employees to share information regarding customer needs and expectancies.	1 2 3 4 5 6 7
ISO certification has provided our employees an awareness of where innovation for improvement may be possible.	1 2 3 4 5 6 7
ISO certification has enabled employees to identify where improvements can be made that respond to health and safety issues.	1 2 3 4 5 6 7
Employees were involved in ISO during the certification process.	1 2 3 4 5 6 7
Employees were fully committed to ISO during its implementation.	1 2 3 4 5 6 7
Top management was fully committed to ISO leading up to certification.	1 2 3 4 5 6 7
ISO certification has allowed our firm to identify areas of our quality system that require increased training and development.	1 2 3 4 5 6 7
ISO certification has enabled our firm to better identify the contributions of the employees.	1 2 3 4 5 6 7
The documenting of all our processes has improved the satisfaction level of the employees.	1 2 3 4 5 6 7
ISO cannot stand alone as a quality initiative and must form part of an overall quality improvement system.	1 2 3 4 5 6 7
ISO certification has allowed our firm to have consistent uniformity in our goods or services.	1 2 3 4 5 6 7
ISO certification caused our firm to document what we do, not necessarily to change what we do.	1 2 3 4 5 6 7
Our ISO programme attempts to make our processes uniform and consistent.	1 2 3 4 5 6 7
Our firm emphasizes ISO conformance far more than it emphasizes continuous improvement.	1 2 3 4 5 6 7
The costs associated with ISO certification have been paid back through increased benefits.	1 2 3 4 5 6 7
ISO certification has guided our firm's to co-operative working relationships with our suppliers.	1 2 3 4 5 6 7
ISO certification has permitted our firm to share information with our suppliers to help them improve.	1 2 3 4 5 6 7
ISO certification has permitted our firm to involve our suppliers in the development of new products, whether goods or services.	1 2 3 4 5 6 7

In this section, circle the number between 1 and 7 on the scale to the right that corresponds to the degree to which the issue in the statement increases or decreases due to ISO certification.

1	*2*	*3*	*4*	*5*	*6*	*7*
Strongly disagree	*moderately disagree*	*mildly disagree*	*neither disagree nor agree*	*mildly agree*	*moderately agree*	*strongly agree*

V	Item	Response
	Top management commitment to ISO has decreased/increased since certification.	1 2 3 4 5 6 7
	ISO certification has decreased/increased our firm's market share.	1 2 3 4 5 6 7

ISO certification has allowed our firm to decrease/increase the prices for our product (goods or service).	1 2 3 4 5 6 7
ISO certification has caused our firm to decrease/increase a focus on the needs of our customers.	1 2 3 4 5 6 7
Certification has decreased/increased customer demand for our product.	1 2 3 4 5 6 7
ISO certification has allowed our firm to decrease/increase our customer base.	1 2 3 4 5 6 7
The number of customer complaints has decreased/increased since certification.	1 2 3 4 5 6 7
The number of customer audits has decreased/increased since certification.	1 2 3 4 5 6 7
The average duration of customer audits has decreased/increased since certification.	1 2 3 4 5 6 7
Employee commitment to ISO has decreased/increased since certification.	1 2 3 4 5 6 7
The level of job satisfaction of our middle managers has decreased/increased since certification	1 2 3 4 5 6 7
The level of job satisfaction of our non-managerial employees has decreased/increased since certification	1 2 3 4 5 6 7
ISO certification has decreased/increased the number of conflicts over the interpretation of procedures.	1 2 3 4 5 6 7
ISO certification has decreased/increased our quality training needs.	1 2 3 4 5 6 7
ISO certification has led to a decrease/increase in the amount of quality awareness training is given to all employees.	1 2 3 4 5 6 7
Documentation of current processes has led to the creation of designs for new processes.	1 2 3 4 5 6 7
The amount of internal inspection has decreased/increased since certification.	1 2 3 4 5 6 7
The number of employees involved in quality initiatives has decreased/increased since certification?	1 2 3 4 5 6 7
The amount of waste (scrap/rework) has decreased/increased since certification.	1 2 3 4 5 6 7
Production costs have decreased/increased since certification.	1 2 3 4 5 6 7
Warranty costs have decreased/increased since certification.	1 2 3 4 5 6 7
ISO certification has allowed our firm to decrease/increase costs of our product.	1 2 3 4 5 6 7
ISO certification has meant a decrease/increase in the overall quality-performance in our firm.	1 2 3 4 5 6 7
ISO certification has meant a decrease/increase in the quality of our product (goods or service).	1 2 3 4 5 6 7
ISO certification has decreased/increased the number of procedures in our organisation.	1 2 3 4 5 6 7
ISO certification has meant decreased/increased delivery precision.	1 2 3 4 5 6 7
ISO certification has decreased/increased the quality of the products, whether goods or services, of our suppliers.	1 2 3 4 5 6 7

In this section, circle the number between 1 and 7 on the scale to the right that corresponds to the degree to which the issue in the statement is weakened or enhanced due to ISO certification.

1	*2*	*3*	*4*	*5*	*6*	*7*
greatly weakened	*moderately weakened*	*slightly weakened*	*neither weakened nor enhanced*	*slightly enhanced*	*moderately enhanced*	*greatly enhanced*

V	Item	Response	Fac
	ISO certification has allowed our firm to weaken/enhance the relationships with customers	1 2 3 4 5 6 7	
	ISO certification has allowed our firm to weaken/enhance customer loyalty.	1 2 3 4 5 6 7	
	ISO certification has weakened/enhanced our firm's ability to identify key issues that impact the firm.	1 2 3 4 5 6 7	
	ISO certification has to weakened/enhanced company morale.	1 2 3 4 5 6 7	
	The documentation procedure of ISO certification has weakened/enhanced quality awareness among employees.	1 2 3 4 5 6 7	
	ISO certification has weakened/enhanced internal communications.	1 2 3 4 5 6 7	
	ISO certification has weakened/enhanced employee empowerment.	1 2 3 4 5 6 7	
	ISO certification has weakened/enhanced our firm's ability to benefit from learning about the performance of outside organisations.	1 2 3 4 5 6 7	
	ISO certification has weakened/enhanced operational efficiency in our firm.	1 2 3 4 5 6 7	
	ISO certification has allowed our firm to weaken/enhance the 'on-time-delivery' of our goods or services.	1 2 3 4 5 6 7	
	The documentation procedure of ISO certification has weakened/enhanced process improvements.	1 2 3 4 5 6 7	
	ISO certification has weakened/enhanced our firm's ability to select capable suppliers.	1 2 3 4 5 6 7	
	ISO certification has weakened/enhanced our firm's working relationships with suppliers to encourage innovation that would improve the quality of our product, whether goods or service.	1 2 3 4 5 6 7	
	ISO certification has weakened/enhanced the relationship between our firm and our suppliers that focuses on continuous improvement.	1 2 3 4 5 6 7	

SECTION C: GENERAL COMPANY and RESPONDANT INFORMATION

In this section, check the box that best answers the question asked.

V	Item	Response
	In which category is your firm?	
	Manufacturing	
	Product _____	
	Service	
	Institutional (school, hospital, municipality)	
	Other (please specify) _____	
	The scope of your firm is	
	regional	
	national	
	multinational	
	What are the annual sales of the firm?	
	less than $ 5 million	
	between 5 to 10 million	
	between 10 to 25 million	
	between 26 to 50 million	
	between 51 to 100 million	
	more than $100 million	
	How many full-time employees are there in your organisation?	
	less than 50	
	between 50 to 100	
	between 101 to 500	
	between 501 to 2000	
	more than 2000	

How many full-time employees are there at your site?

less than 50
between 50 to 100
between 101 to 500
between 501 to 2000
more than 2000

Is your site unionized?

No
Yes

When was your site certified in the ISO 9000 series? _____

How many ISO 9000 series certificates does your firm possess?

one
between 2 to 5
between 6 to 25
between 26 to 100
more than 100

Is your firm considering auditing according to the standards of a national or international quality award (e.g., Canada Awards of Excellence, or Baldrige Awards, or European Awards)?

No
Yes
Possibly
Has already begun such audits

What is your function within the firm? (choose most appropriate)

ISO programme manager
Quality management
Operations management
Financial management
Marketing management
Union Representative
Other _____

Who is accountable for ISO certification?

ISO programme manager
Quality systems manager
Other _____

Including internal costs such as employee time (at fully loaded rate) for writing documents, attending training, etc., what is the cost per employee for implementing ISO?

Don't know or can't estimate, or
In the following range
less than $100
between $100 to $300
between $301 to $500
between $501 to $700
between $701 to $900
between $901 to $1100
more than $1100

If you are able to quantify the monetary benefit of having ISO 9000 certification, what is the annual benefit per employee?

Don't know or can't estimate, or
In the following range
less than $100
between $100 to $300
between $301 to $500
between $501 to $700
between $701 to $900
between $901 to $1100
more than $1100

Appendix B: Pre-Test - Stage 2

1. Participants

Position	Firm
V.P. Quality Management	Imperial Tobacco Limited
Director, Quality Management	Difco
Directeur, Services aux clients Affaire	Bell Canada
V.P. Développement & Services techniques	Natrel
Président	ISONORM
Coordonateur, qualité	Kruger Inc.
Chef de l'assurance qualité	La compagnie minière Québec Cartier
Quality Manager	Fritz Starber Inc.
Lead Auditor	QMI
Quality Assurance & Methods Engineer	GEBO Convetors, Consultants & Systems Inc

Appendix C: Survey instruments - Phase 3

On the next series of pages, the research instrument is presented in both languages. The format represents that used by the polling firm.

Identification: _____

1. English Language Survey

SURVEY ON QUALITY PRACTICE IN THE FIRM

Hello,

My name is _____ from the firm Guilbault and Associates. I'm calling with regards to the invitation your firm recently received to participate in a joint Concordia University-National Quality Institute research project about firm performance and quality initiatives.

Would you please take a few minutes to answer a few questions?

If no: Is there a more appropriate time we might contact you.

If still no: Thank you.

If yes: To begin, we have some questions for background information

Background

1. What is your name? _____ *(ask only if different from intended respondent)*

2. What is your title with the firm? _____

3. What is your area of responsibility within the firm? *(ask only if responsibility is not clear in title)*

   ❑1 Quality management

   ❑2 Operations management

   ❑3 Other (please indicate) _____

4. What is the industrial sector of the firm?

   ❑1 Manufacturing ❑2 Retail/Distribution ❑3 Service

5. What is principal activity (product/service) of the firm

   _____

Section A

For the following questions, I will provide statements that could describe possible facets of organisational management. For each of these statements, using the current year as a point of reference, please identify ***the frequency*** *with which your firm measures the particular indicator. Your choices include rarely, sometimes, or often measured.*

In addition, for each of these statements, please indicate ***your perception*** *of the performance of the firm compared to your industry. Please provide a number in the 1-7 range, where 1 equals among the worst in your industry, 4 equals average performance within your industry, and, 7 equals among the best in your industry.*

N.B. If your firm produces several goods (services), when responding to the questions below, please consider the average performance of all products (services).

		Not	Rare	Some	Often	Worst	Weak	Below	Average	Above	Good	Best
Q6.	The level of productivity for your firm is	A	B	C	D	1	2	3	4	5	6	7
Q7.	The reliability of your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q8.	The defect rate (or error per opportunity rate) for your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q9.	Your firm's conformance to standards or specifications for your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q10.	The on-time delivery for your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q11.	The cycle time for the production of your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q12.	Your firm's success in reducing production costs is	A	B	C	D	1	2	3	4	5	6	7

Q13.	Inventory turnover for your product is Roll-over for your service is	A	B	C	D	1	2	3	4	5	6	7
Q14.	Customer satisfaction with your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q15.	Customer confidence in your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q16.	Customer loyalty (repeat business) for your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q17.	The rate of customer complaints for your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q18.	Employee satisfaction with your firm is	A	B	C	D	1	2	3	4	5	6	7
Q19	Effectiveness of the training of your people is	A	B	C	D	1	2	3	4	5	6	7
Q20.	The acceptance rate for employee suggestions is	A	B	C	D	1	2	3	4	5	6	7
Q21.	Employee absenteeism in your firm is	A	B	C	D	1	2	3	4	5	6	7
Q22.	Employee turnover in your firm is	A	B	C	D	1	2	3	4	5	6	7
Q23.	Product (service) quality of your suppliers is	A	B	C	D	1	2	3	4	5	6	7
Q24.	The on-time delivery from your suppliers is	A	B	C	D	1	2	3	4	5	6	7
Q25.	The competitive level of prices from your suppliers is	A	B	C	D	1	2	3	4	5	6	7
Q26.	Revenue/sales of your firm is	A	B	C	D	1	2	3	4	5	6	7
Q27.	Cost performance of your firm is	A	B	C	D	1	2	3	4	5	6	7
Q28.	Net income of your firm is	A	B	C	D	1	2	3	4	5	6	7
Q29.	Return on investment of your firm is	A	B	C	D	1	2	3	4	5	6	7
Q30.	Return on assets of your firm is	A	B	C	D	1	2	3	4	5	6	7
Q31.	Market share for your product (service) is	A	B	C	D	1	2	3	4	5	6	7
Q32.	The "operating income/revenue" ratio of your firm is	A	B	C	D	1	2	3	4	5	6	7
Q33.	Other performance measure not listed above _____	A	B	C	D	1	2	3	4	5	6	7

SECTION B - TOOLS

In this section, I will list a number of management tools or techniques. Please indicate how frequently your firm uses the tool, specifically, rarely sometimes, or often.

Please circle the number (0-4) to indicate.	**utilisation**				
	Do not know	Not used	Rarely used	Sometimes	Often used
34. How often does your firm use these <u>quality management</u> tools?					
I. Tools to understand a situation (flowcharts, run charts, control charts - SPC)	0	1	2	3	4
II. Tools to find facts (check sheets)	0	1	2	3	4
III. Tools to identify problems (Pareto charts, histograms)	0	1	2	3	4
IV. Tools to generate ideas (brainstorming, cause & effect diagrams)	0	1	2	3	4
V. Tools to develop solutions (scatter diagrams)	0	1	2	3	4
35. How often does your firm use these <u>policy deployment and planning</u> tools?					
I. Affinity Diagrams	0	1	2	3	4
II. Interrelationship Digraph	0	1	2	3	4
III. Tree Diagrams	0	1	2	3	4
IV. Matrix Diagrams	0	1	2	3	4
V. Matrix Data Analysis	0	1	2	3	4
VI. Process Decision Program Charts	0	1	2	3	4
VII. Arrow Diagrams	0	1	2	3	4

36. **How often does your firm use these process design tools?**

I.	Statistical Experimentation (DOE)	0	1	2	3	4
II.	Taguchi Loss Function	0	1	2	3	4
III.	Quality Function deployment (QFD)	0	1	2	3	4
IV.	Fail-Safing (Poka Yoke)	0	1	2	3	4

37. **How often does your firm use these process analysis tools?**

I.	Enterprise Resource Planning (e.g., SAP, Oracle, Baan, PeopleSoft)	0	1	2	3	4
II.	Balanced Scorecard	0	1	2	3	4
III.	Activity Based Costing (ABC)	0	1	2	3	4
IV.	Failure Mode and Effect Analysis (FMEA) for reliability	0	1	2	3	4
V.	Fault Tree Analysis (FTA) for reliability	0	1	2	3	4
VI.	Other _____	0	1	2	3	4

SECTION C

In this section, I will be asking questions regarding quality initiatives in your firm.

38. Which quality improvement programs or techniques has your firm used? (Please, check off ✔box)

Please indicate the year that the firm initiated use of this device.

❑1	Benchmarking	Year: _____
❑2	Quality Circles	Year: _____
❑3	Just in Time (JIT)	Year: _____
❑4	Kaizen / Continuous Quality Improvement	Year: _____
❑5	Six Sigma	Year: _____
❑6	Industry Standards Compliance Programs	Year: _____
❑6	ISO 14000	Year: _____
❑8	Quality Assurance system	Year: _____
❑9	Total Quality Management Approach	Year: _____
❑10	Other _____	Year: _____

39. **Please explain the effect of the more important programs or tools on your quality system.**

40. If the firm **ceased** its use of any of the above programs or tools, please explain when (year) and why.

(when? _____) & why? _____

(when? _____) & why? _____

(when? _____) & why? _____

41. Does your firm measure the following indicators of the cost of quality

a) Prevention Costs *(quality planning costs, process control, data information costs, training)* ❑1 yes ❑2 no

b) Appraisal Costs *(test & inspection costs, instrument maintenance costs, process measurement costs)* ❑1 yes ❑2 no

c) Internal Failure Costs *(scrap & rework costs, costs of corrective action, process failure costs, downgrading costs)* ❑1 yes ❑2 no

d) External Failure Costs *(costs for customer complaints, returns, product recall, warranty costs, liability costs)* ❑1 yes ❑2 no

42. Which well-being programs does your firm maintain at your site?

Spontaneous response

Specifically, does your firm provide:			Year first used
a) recreational activities for employees	❑1 yes	❑2 no	____
b) day-care services for employees	❑1 yes	❑2 no	____
c) alternate work arrangements (ex. flextime, job rotation)	❑1 yes	❑2 no	____
d) counselling services for personal problems	❑1 yes	❑2 no	____

43. a) Does your firm have a human resources development (training) program?

❑1 Yes

❑2 No (Go to Q44)

b) What percent (%) of total salaries is devoted to training? ___%

c) What is the number of days/employee is allocated to training? ___days

44. a) Is your site ISO 9000 certified?

❑1 Yes Year of first certification _____

❑2 No (Go to Q45)

b) Which one? ❑1 9001

❑2 9002

❑3 9003

c) How many ISO 9000 series certificates does your firm possess? _____

d) Please explain the role that ISO serves within your firm's quality system.

---

45. Does your firm perform self-audits (practice) using the standards of any quality recognition program (ex. Canada Awards of Excellence, Malcolm Baldrige National Quality Awards, European Quality Awards?

❑1 Yes Which one? _____ Year first used: _____

❑2 No

**** Please explain the benefit of self-audits on your quality system**

46. Is your firm considering the possibility of pursuing such a national or international quality award (e.g., Canada Awards of Excellence, Baldrige Awards, European Awards, Mexican Award)?

❑1 Yes Which one? _____

When? _____

❑2 No

❑3 Do not know

47. Other than the above quality practices, please indicate event(s) that may have had significant positive effect on organisational performance (for example; significant leadership change, significant change in financial situation, major technological adjustment):

_____

_____

48. Please indicate whether your responses to this questionnaire are for the firm as a whole or the site (plant).

Firm ❑1 Site ❑2

49. a) About how many employees are there in the whole firm? _____

(Full time = 1, Partial time = ½)

b) About how many employees are there at your site? _____

ıll time = 1, Partial time = ½)

50. Is your firm publicly traded?

Yes ❑1 Which stock market? _____

No ❑2

51. The target market for your firm's product (service) is

Régional ❑1 National ❑2 Multinational ❑3
(includes province)

52. What is the **approximate** (CA$) financial performance of the firm for each of the following years?

(N.B. If your firm is international in scope, please respond for the Canadian performance.)

	1995	1996	1997	1998	Forecast 1999
a) Total sales/revenues	_____	_____	_____	_____	_____
b) Operating income	_____	_____	_____	_____	_____
c) Operating costs	_____	_____	_____	_____	_____
d) Total Assets	_____	_____	_____	_____	_____
e) Ratio: Operating Income	_____	_____	_____	_____	_____
Revenue	_____	_____	_____	_____	_____
f) Market share (%):	_____	_____	_____	_____	_____
g) Total # employees					

53. What is your email address ?

_____

54. What is your firm's Website address?

_____

55. How frequently are you surveyed about your quality system or performance?

_____

Thank you for participating in this research

Identification : _____

2. French Language Survey

ÉTUDE SUR LES PRATIQUES DE QUALITÉ DANS LES ENTREPRISES

Bonjour,

Mon nom est _____ de Guilbault et Associés. Je vous appelle à propos de la lettre que nous vous avons fait parvenir afin de participer à un projet de recherche mené conjointement entre l'Université Concordia et le Mouvement québécois de la qualité, concernant la performance des firmes ainsi que les initiatives reliées à la qualité.

Serait-il possible pour vous de prendre quelques minutes de votre temps pour répondre à quelques questions ?

Si non : Est-ce qu'il y a un moment plus approprié que nous pouvons vous rejoindre ?

Si toujours non : Merci

Si oui : Nous allons commencer avec des questions de background

Background

1. Quel est votre nom ? _____ *(si pas déjà connu)*
2. Quelle est votre fonction ? _____
3. Quel est votre domaine de responsabilité dans votre entreprise ? *(si pas déjà clair dans son titre)*

   ❑1 Gestions de la qualité

   ❑2 Gestions des opérations

   ❑3 Autre (s.v.p. indiquez laquelle) _____

4. Quel est le secteur industriel de votre entreprise ?

   ❑1 Manufacturier ❑2 Distributeur ❑3 Service

5. Quelle est l'activité principale de votre entreprise ?

Produit (Service)_____

Section A

Pour les prochaines questions, je vais vous présenter des indicateurs de gestion d'une entreprise. Pour chacun de ces indicateurs, pourriez-vous nous indiquer la fréquence avec laquelle votre entreprise mesure ces indicateurs. Est-ce que vous évaluer ces indicateurs « *rarement* », « *occasionnellement* » *ou* « *assez souvent* ».

De plus, pour chacun de ces indicateurs, pourriez-vous nous indiquer votre perception de la performance de votre entreprise face à votre industrie en utilisant l'année courante comme année de référence. Votre perception doit se faire sur une échelle 1 à 7, ou 1 est « parmi les plus faibles de l'industrie », 4 est « dans la moyenne de l'industrie » et 7 est « parmi les plus fortes de l'industrie ».

N.B. Si votre entreprise produit plusieurs biens ou services, considérez la performance en étant la moyenne des performances de tous ces produits, s.v.p.

		FRÉQUENCE				PERFORMANCE						
		Pas mesuré	Rarement	à l'occasion	Souvent	Plus faible	Faible	Moins que	Moyenne	Meilleure	Bonne	Plus Forte
6.	Le niveau de la productivité de vos opérations est	A	B	C	D	1	2	3	4	5	6	7
7.	La fiabilité de vos produits (services) est	A	B	C	D	1	2	3	4	5	6	7
8.	Le taux de défauts (ou taux d'erreurs par opportunité) de vos produits (services) est	A	B	C	D	1	2	3	4	5	6	7
9.	La conformité aux standards ou spécifications de vos produits (services) est	A	B	C	D	1	2	3	4	5	6	7

10.	Le respect des délais de livraison (juste à temps) de vos produits (services) est	A	B	C	D	1	2	3	4	5	6	7
11.	Le cycle de production de vos produits (services) est	A	B	C	D	1	2	3	4	5	6	7
12.	Les succès de votre entreprise à réduire les coûts de production de vos produits (services) sont	A	B	C	D	1	2	3	4	5	6	7
13.	Le roulement de l'inventaire (turnover) de vos produits (services) est	A	B	C	D	1	2	3	4	5	6	7
14.	La satisfaction du client envers vos produits (services) est	A	B	C	D	1	2	3	4	5	6	7
15.	La confiance du client dans vos produits (services) est	A	B	C	D	1	2	3	4	5	6	7
16.	La fidélité (achats répétés) du client pour vos produits (services) est	A	B	C	D	1	2	3	4	5	6	7
17.	Le taux de plaintes envers vos produits (services) est	A	B	C	D	1	2	3	4	5	6	7
18.	La satisfaction des employés vis-à-vis votre entreprise est	A	B	C	D	1	2	3	4	5	6	7
19	L'efficacité de la formation de vos employés est	A	B	C	D	1	2	3	4	5	6	7
20.	Le taux d'acceptation des suggestions de vos employés est	A	B	C	D	1	2	3	4	5	6	7
21.	Le taux d'absentéisme des employés dans votre entreprise est	A	B	C	D	1	2	3	4	5	6	7
22.	Le roulement (turnover) de vos employés est	A	B	C	D	1	2	3	4	5	6	7
23.	La qualité du produit (service) de vos fournisseurs est	A	B	C	D	1	2	3	4	5	6	7
24.	Le respect des délais de livraison (juste à temps) de vos fournisseurs est	A	B	C	D	1	2	3	4	5	6	7
25.	Le niveau concurrentiel des prix de vos fournisseurs est	A	B	C	D	1	2	3	4	5	6	7
26.	Le revenu (volume des ventes) de votre entreprise est	A	B	C	D	1	2	3	4	5	6	7

27.	Les dépenses d'opérations de votre entreprise sont	A	B	C	D	1	2	3	4	5	6	7
28.	Le bénéfice net de votre entreprise est	A	B	C	D	1	2	3	4	5	6	7
29.	La retour sur le capital de votre entreprise est	A	B	C	D	1	2	3	4	5	6	7
30.	La retour sur les actifs de votre entreprise est	A	B	C	D	1	2	3	4	5	6	7
31.	La part de marché de vos produits (services) est	A	B	C	D	1	2	3	4	5	6	7
32.	L'indice d'efficacité (bénéfices d'opérations/revenu) de votre entreprise est	A	B	C	D	1	2	3	4	5	6	7
33.	Autre mesure de performance non indiquée ci-dessus (mentionnez laquelle) _____	A	B	C	D	1	2	3	4	5	6	7

SECTION B – LES OUTILS

Dans cette section, je vais énumérer quelques outils ou techniques de gestion. SVP, indiquer la fréquence, (rarement, des fois, souvent) avec laquelle votre entreprise utilise l'outil indiqué. Est-ce rarement, quelques fois ou souvent utilisé ?

Encerclez un nombre entre 0 et 4	**utilisation**				
	ne sais pas	pas utilisé	rarement	quelques fois	souvent

34. À quelle fréquence votre entreprise utilise-t-elle ces outils de la gestion des processus ?

I. Les outiis pour comprendre une situation (diagramme de processus, run charts, cartes de contrôle-SPC)	0	1	2	3	4
II. Les outils pour relever les données d'une situation (feuilles de relèves)	0	1	2	3	4
III. Les outils pour identifier les problèmes (analyse de Pareto, histogramme)	0	1	2	3	4

IV. Les outils pour générer des idées (brainstorming, diagramme de cause-effet)	0	1	2	3	4
V. Les outils pour développer des solutions -diagramme de corrélation	0	1	2	3	4

35. **À quelle fréquence votre entreprise utilise-t-elle ces outils de <u>planification et le déploiement</u> de la politique de l'entreprise ?**

I. Diagramme des affinités	0	1	2	3	4
II. Diagramme des relations	0	1	2	3	4
III. Diagramme en arbre	0	1	2	3	4
IV. Diagramme matriciel	0	1	2	3	4
V. Analyse en composantes principales (analyse matricielle)	0	1	2	3	4
VI. Diagramme des alternatives	0	1	2	3	4
VII. Diagramme fléché	0	1	2	3	4

36. **À quelle fréquence votre entreprise utilise-t-elle ces outils de <u>design des processus</u> ?**

I. Statistical Experimentation (DOE)	0	1	2	3	4
II. Taguchi Loss Function	0	1	2	3	4
III. Quality Function Deployment (QFD)	0	1	2	3	4
IV. Fail-Safing (Poka Yoke)	0	1	2	3	4

37. **À quelle fréquence votre entreprise utilise-t-elle ces outils de <u>l'analyse des processus</u> ?**

I. Enterprise Resource Planning -ERP (e.g., SAP, Oracle, Baan, PeopleSoft, Cognos, etc.)	0	1	2	3	4
II. Tableau de bord (Balanced Scorecard)	0	1	2	3	4
III. Évaluations des coûts de chaque activité (Activity Based Costing)	0	1	2	3	4
IV. Failure Mode and Effect Analysis (FMEA) for reliability	0	1	2	3	4
V. Fault Tree Analysis (FTA) for reliability	0	1	2	3	4
VI. Other _____	0	1	2	3	4

SECTION C

Dans cette section, nous posons des questions à propos des initiatives de qualité dans votre entreprise.

38. Quels sont les programmes ou techniques d'amélioration de la qualité dont votre firme s'est servie ?

SVP, indiquez l'année à laquelle votre entreprise s'est initialement servie de cette pratique.

❑1	Étalonnage concurrentiel (benchmarking)	Année : _____
❑2	Cercles de qualité	Année : _____
❑3	Juste à temps (JIT)	Année : _____
❑4	Kaizen/Amélioration continue	Année : _____
❑5	Six Sigma	Année : _____
❑6	Programme de conformité aux standards de l'industrie	Année : _____
❑6	ISO 14000	Année : _____
❑8	Système d'assurance de la qualité	Année : _____
❑9	L'approche de gestion intégrale de la qualité	Année : _____
❑10	Autre _____	Année : _____

39. SVP, expliquez le rôle que ces programmes ou outils jouent à l'intérieur de votre système de qualité.

_____

40. Si votre entreprise a cessé l'utilisation d'un de ces programmes ou outils, veuillez expliquer quand (année) et pourquoi.

(quand ? _____) & pourquoi ? _____

(quand ? _____) & pourquoi ? _____

(quand ? _____) & pourquoi ? _____

41. Est-ce que votre firme mesure les indices suivants du coût de la qualité ?

a. coûts de la prévention *(coûts de planification de la qualité, contrôle, formation, coûts de l'information)* ❑1 oui ❑2 non

b. coûts d'évaluation *(coûts de l'inspection, vérifications, maintenance des outils, coûts de mesurage des processus)* ❑1 oui ❑2 non

c. coûts de défaillance interne *(coûts de correction, reprises, gaspillage, temps mort des machinerie)* ❑1 oui ❑2 non

d. coûts de défaillance externe *(coûts reliés aux plaintes des clients, retours, rappels, garanties, poursuite légale)* ❑1 oui ❑2 non

42. Quels sont les programmes de bien-être des employés que votre entreprise offre sur place ?

Réponses spontanées

Spécifiquement, est-ce que votre entreprise offre : L'année

a) Des activités récréatives pour les employées ? ❑1 oui ❑2 non ____

b) Des services de garderie pour les employées ? ❑1 oui ❑2 non ____

c) Flexibilité dans les heures de travail, rotations des postes ? ❑1 oui ❑2 non ____

d) Programme d'aide aux employés ? ❑1 oui ❑2 non ____

43. a) Est-ce que votre entreprise a un programme de formation des employés ?

❑1 Oui

❑2 Non (Go to Q44)

b) Quel pourcentage (%) des salaires est consacré au développement ? ____ %

c) Combien de jours par employé sont alloués au développement ? ___ jours

44. a) Est-ce que votre site est certifié ISO 9000 ?

❑1 Oui L'année certification _____

❑2 Non (Go to Q45)

b) Laquelle ? ❑1 9001

❑2 9002

❑3 9003

c) Combien de certificats ISO 9000 votre entreprise possède ? _____

d) Expliquez le rôle que ISO a eu dans votre entreprise en ce qui concerne votre système de qualité ?

---

45. Est-ce que votre entreprise **auto-évalue** (pratique) sa performance selon les standards de qualité d'un programme de prix national (e.g. : Qualimètre, le Prix d'excellence du Canada, le prix Malcolm Baldrige National Quality Award, le prix de qualité Européen, le prix de qualité Mexique, etc.) ?

❑1 Oui Lequel ? _____La date initiale de cette auto-évaluation : _____

❑2 Non

**** SVP, expliquez le rôle que joue l'auto-évaluation sur votre système de qualité.**

---

46. Est-ce que votre entreprise considère la possibilité de postuler à un prix national ? (ex. : Qualimètre, le Prix d'excellence du Canada, le prix Malcolm Baldrige, le prix de qualité Européen, le prix de qualité Mexique, etc.) ?

❑1 Oui Lequel ? _____ Quand ? _____

❑2 Non

❑3 Je ne sais pas

47. En plus des pratiques de qualité mentionnées ci-dessus, veuillez indiquer les éléments qui ont pu avoir eu un effet significatif et positif sur votre performance organisationnelle (exemples un changement majeur de leadership, changement significatif dans la situation financière, un changement majeur de technologie soit dans l'industrie, soit à l'entreprise)

48. SVP, indiquez si vos réponses à ce questionnaire s'appliquent à votre entreprise en général ou seulement à ce site

Entreprise en général ❑1 Site ❑2

49. a) Approximativement, combien y a-t-il d'employés dans toute l'entreprise ? _____

(Temps plein = 1, temps partiel = ½)

b) Approximativement, combien y a-t-il d'employés à votre site ? _____

(temps plein = 1, temps partiel = ½)

50. Est-ce que votre entreprise est cotée à la bourse ?

Oui ❑1 Quelle bourse ? _____

Non ❑2

51. Le marché visé pour vos produits (services) est :

Régional ❑1 National ❑2 Multinational ❑3

(inclus la province)

52. Quelle est la performance financière **($ CA)** approximative pour chacune des années suivantes ? **(N.B. Si votre entreprise à une perspective internationale, s.v.p. répondez selon la performance canadienne.)**

	1995	1996	1997	1998	prévision
a) Ventes totales/revenus	_____	_____	_____	_____	_____
b) Bénéfices nets des opérations	_____	_____	_____	_____	_____
c) Dépenses d'opérations	_____	_____	_____	_____	_____
d) Actifs totaux	_____	_____	_____	_____	_____
e) Indice : Bénéfices des opérations / Revenu	_____	_____	_____	_____	_____
f) Part de marché (%)	_____	_____	_____	_____	_____
g) Nombre d'employés	_____	_____	_____	_____	_____

53. Quelle est votre adresse de courrier électronique ? _____

54. Quelle est l'adresse "Site Web" de l'entreprise ? _____

55. Avec quelle fréquence votre entreprise est demandée de participer dans les sondages sur la qualité et la performance ? _____

Merci pour votre participation

Appendix D: Initial Contact Letters

The next 2 pages of this appendix contain the letters that were addressed to the firms that were invited to participate. These firms were the first 700 firms, in order, on the list generated through random selection using the CRIQ and Scott databases.

Letters sent to Quebec firms were in French and contained the logos of Concordia University, the Movement québecois de la qualité, and Guilbault et Associés

Letters sent to Ontario firms were in English and contained logos of Concordia University, the National Quality Institute and Guilbault et Associés.

1. English Invitation to participate

Montreal, June, 1999

Sir, Madam

RE: RESEARCH IN QUALITY MANAGEMENT PRACTICES AND BUSINESS PERFORMANCE

This is an invitation for your firm to participate in an important research project. The study investigates the various types of measures that firms use to gauge business performance. The influence of strategic quality initiatives on performance will be evaluated. The ultimate objective is to clarify the definition of business excellence that is shared by academics and business leaders as well as to provide a guideline for achieving business excellence.

It is significant to note that this research is developed and controlled by researchers from Concordia University and the project has the support of the National Quality Institute of Canada.

You are being invited to participate in this study as a representative firm from a cross-section of companies that are likely to have both influenced, and been influenced by, quality initiatives. As a senior business leader, your experience and awareness is deemed essential for a proper appreciation of issues in quality management and firm performance.

We wish to assure you that this research will protect and respect you as participant.

Your name as participant (individual or firm) will remain confidential to the primary researcher.

Your participation will be treated anonymously (individual or firm) in any report of the results of the research. In no way will you or your firm be prejudiced by the information you provide.

The data gathered will be treated confidentially in any publication. Only aggregate results of the entire study will be published.

The research project will be guided by the following procedure:

Our representative research firm will contact you by telephone in the next weeks to ascertain your participation and conduct a short telephone interview, either then or at an appointed hour of your convenience and availability.

Results of this study will be made available to the participants via email as well as through publications. Participants will receive, via email, notification that a publication is available.

The members of the research team are indeed indebted to participants who have agreed to be involved in this project. On behalf of the research team, thank you for your co-operation.

2. French Invitation to participate

Montréal, juin, 1999

Monsieur, Madame

Sujet: La performance organisationnelle et la gestion de la qualité

Ceci est une invitation, comme leader en affaires, à participer à un important projet de recherche. Cette étude évalue les différents indices que les organisations utilisent afin de mesurer la performance. L'influence des divers programmes stratégiques de gestion de qualité fera aussi partie de l'étude. L'objectif ultime est de contribuer à une définition de l'excellence en affaires partagée conjointement entre la communauté académique ainsi que la communauté affaires.

Il est important de souligner que cette étude est développée et contrôlée par des chercheurs de l'Université Concordia et que le projet a reçu le support du Mouvement québécois de la qualité.

Vous êtes invité à participer à ce projet en tant que leader d'une firme sélectionnée à partir d'un échantillon de firmes qui ont passablement influencé, et été influencées par des approches de qualité. Comme leader senior, votre expérience et entourage d'influence vous rend apte à offrir une forte appréciation des points saillants de la gestion de la qualité et de la performance d'une entreprise.

Nous voulons vous assurer, en tant que participant, que ce projet de recherche protégera et respectera votre identité. Plus précisément:

Votre nom comme participant (individu ou la firme) sera gardé confidentiel par le chercheur primaire.

Votre participation (individu ou la firme) sera traitée anonymement dans tous les rapports des résultats de la recherche. D'aucune manière votre firme ne sera lésée.

Les données recueillies seront traitées confidentiellement dans toute publication. Seuls les résultats agrégés de l'étude seront publiés.

Ce projet sera guidé selon la procédure suivante :

Notre mandataire, la firme de recherche Guilbault et Associés, vous contactera par téléphone, dans les semaines à venir, pour une courte entrevue téléphonique immédiate ou à une heure que vous désignerez plus propice.

Les résultats de cette étude seront expédiés, en résumé, par courrier électronique aux participants et également par le biais des publications. Les participants seront avisés, par courrier électronique, qu'une publication est disponible.

Les membres de l'équipe de recherche sont très reconnaissants envers les participants qui acceptent de s'impliquer dans ce projet. Au nom des membres de l'équipe de recherche, merci de votre coopération.

Kevin Laframboise,. Candidat au Ph.D

Université Concordia

Appendix E: Protocols

1. Summary Protocol Form for Research Human Subjects

Names of Research Associate: Kevin Laframboise, Ph.D. Candidate -Concordia University

Title of Research Project: An empirical study of the relationship between quality practices and business excellence.

Granting Agency: CASA General Research Grants

Sample of Persons to be studied: A survey questionnaire will be forwarded to each of three senior managers of approximately 250 firms in Quebec and Ontario.

Method of Recruitment of Participants: Participants for this study will be randomly selected from the Industry Canada database and approached with the help of the National Quality Institute and the Quebec Society for Quality, who would lend their name to the research. The contact person for each firm will be the senior person responsible for Quality. This contact person will be contacted by mail and telephone during the Spring of 1999. Each firm will be asked to provide a list of potentially collaborating individuals, representing different levels/departments of the firm.

Treatment of Participants in the course of the research: The names of the individuals and the firms participating will remain confidential. The survey questionnaire will be forwarded to each of the individuals from the participating firms with a postage-paid return envelope provided. Although the participation of respondents will remain confidential, a control list of firms and individuals will be maintained so that non-respondents might be contacted anew to encourage their participation.

Indicate briefly how the research plan deals with the following ethical concerns:

Informed consent: As part of the questionnaire, respondents will be requested to sign a consent form. This form will explain the protocol: i.e., the purpose of the research, respect for confidentiality of participation, promise of a summary of the results, any indication of possible journal publication of the study, the time required to complete the questionnaire.

Deception: The participants will be assured in the protocol letter that there will be no attempt at deception including deliberate presentation of false information, suppression of material information, any misleading information, or selected disclosure.

Freedom to discontinue: The protocol will advise participants that they are free and for any reason to discontinue participation at any time during the course of the research.

Risks to Subjects' Physical and Psychological Welfare: The participants will be advised that there is no risk, neither for the firm nor for the individuals, as a result of their participation in this research.

Post-Research Explanation and/or Debriefing: The summary of results of this research as well as a copy of any publication will be forwarded to the participating firms. The protocol letter will indicate this. Furthermore, a long-range relationship with the firm will be sought.

Confidentiality of Results: Reports of all individual firms will remain confidential and only aggregated results will be published.

Protecting and/or Addressing Participant "At Risk" Situations: Confidentiality being assured, there is no, "at risk" situation.

Other Ethical Concerns: There do not appear to be any other ethical concerns at this point in time.

Expected Benefits to be Derived from this Research: This research would provide a significant addition to the field of management operations were it to empirically demonstrate the degree to which quality initiatives have, after a passage of time, indeed contributed to business excellence. Furthermore, the ultimate benefits of ISO or other quality practices on two fronts can be

appraised through empirical testing. The first is organizational external effectiveness in the form of improved quality of product (goods or service) performance, increased customer satisfaction and market share, and improved supplier relationships. The second is that quality practices may provide internal benefits to the firm in the form of a quality system, increased efficiency of operations, improved financial performance and increased employee morale.

The target-audience for the eventual publication of the results of this study includes the academic community as well as business leaders involved in quality issues. The business community includes business leaders, consultants and registrars for quality initiatives, ISO committees, the directors of the Quebec Society for Quality and the National Quality Institute. We envision obtaining a wide range of research results that will be of interest for presentations at conferences. In addition, results will be submitted for publication to academic journals. The study will also culminate in feedback reports to the participants.

It is anticipated that the study will not only indicate the current state of quality initiatives and/or ISO 9000 program benefits in Central Canada, but it will provide a vision for the future that might encourage a transition towards a quality management system based performance excellence within the criteria of the national quality awards.

Name of Project Director: *Jamshid Etezadi, Ph.D.*

Signature of Project Director: _____ *Department: Decision Sciences and MIS*

*Date:*_____ _____. *candidate*

2. Research Participant Protocol Consent Form for Stage 1

Objective:

This protocol pertains to a research project that intends to investigate the extent to which performance of the firm is measured pursuant to the firm's quality initiatives. The ultimate objective is to contribute to the vision of business excellence that is shared by corporate leaders whether local or national.

This particular part of the project has been designed by, and will serve as an important component of a doctoral thesis of Kevin Laframboise. The overall project is a long-term study on this topic being steered by Mohan Gopalakrishnan, Ph.D., Jamshid Etezadi, Ph.D., Jean Harvey, Ph.D., Harjeet Bharbra, Ph.D., and Kevin Laframboise Ph.D. candidate at Concordia.

Participation:

The individual participants invited to contribute to this study represent a cross-section of company stakeholders who are likely to have both affected, and been affected by, the quality initiative. As senior officers or managers, their experience and sphere of influence is deemed essential to a proper appreciation of issues of quality.

The firm was selected on the basis of its demonstrated record for a quality product, whether goods or service and its willingness to be a partner in a long-range relationship regarding quality improvement efforts.

Conditions:

This research protocol protects the participant and the researcher.

The name of any respondent will remain confidential to the researchers.

The anonymity of the participant (individual) in any report of the results of the research is guaranteed. In no way will the participant be prejudiced by the information he or she provides.

The data gathered will be treated confidentially in any publication.

The results of this research should provide the basis for articles in business publications and academic journals or for professional conferences.

Participation on the part of the interviewee is entirely voluntary and the interviewee may withdraw participation at any time prior to analysis of the data.

Procedure:

The research will be guided by the following procedure:

Completion of the survey questionnaire should take less than one hour.

The respondent should return the duly completed questionnaire in the self addressed envelope included with the mailing.

Results of this study will be made available.

Questions:

The questions of the interviews would be something along these lines:

Your firm has implemented quality initiatives in the past. What was (were) this (these) initiative(s)? When was the initiative implemented?

Could you list what you would consider the key elements to the success of any quality initiative? Did your firm demonstrate these elements? If there was more than one quality initiative, is it possible to identify any specific relationships of element to initiative?

Could you elaborate how you would define or what you include as comprising each of the key elements of the quality initiative?

Could you elaborate on the results of these elements, (i.e., how effective each of these has been in the firm as well as what measurement tools were used)? If there was more than one quality initiative, is it possible to identify any specific results that are particular to the initiative?

Could you elaborate specifically on the financial performance of the firm as a direct result of the quality initiative(s)?

Participant:

Name: _____ Title: _____

Firm: _____

Phone: _____ Fax: _____ E-mail: _____

Signed: _____ Date: _____

Appreciation:

The members of the research team are indeed indebted to the participants who have agreed to get involved in this project. Such contributions serve not only to help the individual review personal views on the issues, but also help advance the science and reality of business administration. On behalf of the research team, thank you for your consideration.

Kevin Laframboise, Ph.D. Candidate, Concordia University

Appendix F: Stratified Sample Foundation

Size of population

	Quebec (CRIQ)			Ontario (Scott's)			
Size	**Manufacture**	**Distributor**	**Service**	**Manufacture**	**Distributor**	**Service**	**TOTAL**
Small	50-99	50-99	20-49	50-99	50-99	20-49	
	1485	230	346	1854	586	476	
Medium	100-249	100-149	50-99	100-249	100-149	50-99	
	773	89	122	1408	200	206	
Large	250 & more	150 & more	100 & more	250 & more	150 & more	100 & more	
	329	90	146	694	229	230	
TOTAL	2587	409	614	3956	1015	912	
Grand Total			**3610**			**5883**	**9493**
% of Total			**38%**			**62%**	

Sample

	Quebec (CRIQ)			Ontario (Scott's)			
Size	**Manufacture**	**Distributor**	**Service**	**Manufacture**	**Distributor**	**Service**	**TOTAL**
Small	50-99	50-99	20-49	50-99	50-99	20-49	
	41	7	10	45	17	14	
Medium	100-249	100-149	50-99	100-249	100-149	50-99	
	22	7	7	39	7	7	
Large	250 & more	150 & more	100 & more	250 & more	150 & more	100 & more	
	11	7	7	20	7	7	
TOTAL	74	21	24	104	31	28	
Grand Total			**119**			**163**	**282**
% of Total			**42%**			**58%**	

Appendix G: Calculations of Response Rate

The next two pages G1 for Quebec firms and G2 for Ontario firms are the calculations done by the polling firm to determine the respective response rate.

1- Some firms on the list no longer had a place of business at the listed address. There were 12 "hors service" in Quebec and 8 in Ontario.

2- Two Quebec firms were incorrectly classified on the list.

3- After repeated attempts to get in contact with an appropriate executive, some firms were given up as potential respondents, 48 in Quebec, 90 in Ontario.

4- With contact made, some firms refuse to participate 67 in Quebec, 132 in Ontario.

5- The number of firms that agreed to participate was 119 in Quebec, 163 in Ontario.

6- The 2 firms incorrectly classified affected the eligibility rate for Quebec as 98.9%

7- The rate of response is determined by dividing the eligibility factor by the total number for points 3-4-5 above, proving a response rate of 51% for Quebec, and 42.3% for Ontario

1. Quebec Response

Calcul du taux de réponse

Projet: Concordia (Québec)

Non valides		
Hors service (10)	12	
Résidence(08/09/18)	0	
		12
Hors échantillon		
reject		
Langue (12-13)	0	
Incapacité (11)	0	
Hors Quotas	2	
Non éligible - autres (14)	0	**2**
Dans l'échantillon sans éligibilité		
Pas de réponse/occupé (06/07)	48	
Refus avant éligibilité (04)		**48**
Dans l'échantillon (non complétés)		
Absence prolongée (18)	0	
Incomplet (02)	0	
Rendez-vous (03)	0	
Refus après éligibilité (05)	67	**67**
Complétés (01)	119	**119**
Taux d'éligilibité:		**98.9%**
Taux de réponse:		**51.0%**

2. Ontario Response

Calcul du taux de réponse

Projet: Concordia (Ontario)

Non valides		
Hors service (10)	8	
Résidence (08/09/18)	0	8
Hors échantillon		
Langue (12-13)	0	
Incapacité (11)	0	
duplicata	0	
Non éligible - autres (14)	0	0
Dans l'échantillon sans éligibilité		
Pas de réponse/occupé (06/07)	90	
Refus avant éligibilité (04)	0	90
Dans l'échantillon (non complétés)		
Absence prolongée (18)	0	
Incomplet (02)	0	
Rendez-vous (03)	0	
Refus après éligibilité (05)	132	132
Complétés (01)	163	163

Taux d'éligilibité: **100.0%**

Taux de réponse: **42.3%**

Appendix H: Results

This appendix contains various results.

The first part of this appendix contains the output from various important "runs" from the EQS execution. For clarity, each run begins a new page.

Subsequent inclusions are

H-1. Descriptive Statistics for "Performance Measurement"

H-2. The second-order factor model (EQS representative output)

H-3. Covariance Matrix

H-4. The ANOVA Table: "frequency of measurement" each item vs. 7 factors

H-5. The descriptive statistics of the "Frequency of Measurement Items"

H-6. Frequency of the Quality Practices

H-7. Frequency of the use of tools

H-8. Distribution of Performance Indicators

1. Descriptive Statistics for Performance Measurement

Hypothesis	Question#	Indicator variable	Mean	StdDev
1	Q6	The level of productivity for your firm is	5.207	1.002
1	Q7	The reliability of your product (service) is	5.668	1.002
1	Q8	defect rate (or error per opportunity rate) is	5.204	1.160
1	Q9	conformance to standards or specifications	5.689	0.998
2	Q10	The on-time delivery for your product (service)	5.436	1.137
2	Q11	The cycle time for the production	5.171	1.123
2	Q12	success in reducing production costs is	4.929	1.156
2	Q13	Inventory turnover for your product is	4.957	1.206
3	Q14	Customer satisfaction is	5.550	0.945
3	Q15	Customer confidence is	5.614	0.901
3	Q16	Customer loyalty is	5.707	1.027
3	Q17	The rate of customer complaints is	5.064	1.282
4	Q18	Employee satisfaction with your firm is	4.800	1.147
4	Q19	Effectiveness of the training of your people is	4.704	1.111
4	Q20	The acceptance for employee suggestions is	4.621	1.273
4	Q21	Employee absenteeism in your firm is	4.846	1.273
4	Q22	Employee turnover in your firm is	5.057	1.436
5	Q23	Product (service) quality of your suppliers is	5.225	0.982
5	Q24	The on-time delivery from your suppliers is	5.029	1.001
5	Q25	Competitive prices from your suppliers is	5.189	1.000
6	Q26	Revenue/sales of your firm is	5.364	1.076
6	Q27	Cost performance of your firm is	5.089	1.059
6	Q28	Net income of your firm is	5.043	1.145
6	Q29	Return on investment of your firm is	4.879	1.185
6	Q30	Return on assets of your firm is	4.843	1.190
6	Q31	Market share for your product (service) is	4.875	1.254
6	Q32	The "operating income/revenue" ratio is	4.914	1.044
		Mean scores	5.136	1.115
		max score	5.707	1.436
		min score	4.621	0.901

2. Second-Order Factor Model - EQS output

What follows are parts of the EQS output for the second-order factor model, selected as representative of the numerous confirmatory factor analysis modeling done for this research.

```
************************************************************************
EQS, A STRUCTURAL EQUATION PROGRAM                    MULTIVARIATE
SOFTWARE, INC.
COPYRIGHT BY P.M. BENTLER                VERSION 5.7b (C) 1985 - 1998.
 PROGRAM CONTROL INFORMATION
   1 /TITLE
   2 Model created by EQS 5.7b -- EXCEL24G.EDS
   3 /SPECIFICATIONS
   4  DATA='C:\EQS\THESIS\MATRIX2.ESS';
   5  VARIABLES= 54; CASES=  280;
   6  METHODS=ML,ERLS,ROBUST;
   7  MATRIX=RAW;
   8 /LABELS
   9 V1=Q6_F; V2=Q6_P; V3=Q7_F; V4=Q7_P; V5=Q8_F;
  10 V6=Q8_P; V7=Q9_F; V8=Q9_P; V9=Q10_F; V10=Q10_P;
  11 V11=Q11_F; V12=Q11_P; V13=Q12_F; V14=Q12_P; V15=Q13_F;
  12 V16=Q13_P; V17=Q14_F; V18=Q14_P; V19=Q15_F; V20=Q15_P;
  13 V21=Q16_F; V22=Q16_P; V23=Q17_F; V24=Q17_P; V25=Q18_F;
  14 V26=Q18_P; V27=Q19_F; V28=Q19_P; V29=Q20_F; V30=Q20_P;
  15 V31=Q21_F; V32=Q21_P; V33=Q22_F; V34=Q22_P; V35=Q23_F;
  16 V36=Q23_P; V37=Q24_F; V38=Q24_P; V39=Q25_F; V40=Q25_P;
  17 V41=Q26_F; V42=Q26_P; V43=Q27_F; V44=Q27_P; V45=Q28_F;
  18 V46=Q28_P; V47=Q29_F; V48=Q29_P; V49=Q30_F; V50=Q30_P;
  19 V51=Q31_F; V52=Q31_P; V53=Q32_F; V54=Q32_P;
  20 /EQUATIONS
  21 V2 =  + 1F1  + 1E2;
  22 V4 =  + *F1  + 1E4;
  23 V8 =  + *F1  + 1E8;
  24 V10 =  + 1F2  + 1E10;
  25 V12 =  + *F2  + 1E12;
  26 V14 =  + *F2  + 1E14;
  27 V16 =  + *F2  + 1E16;
  28 V18 =  + 1F3  + 1E18;
  29 V20 =  + *F3  + 1E20;
  30 V22 =  + *F3  + 1E22;
  31 V24 =  + 1F5  + 1E24;
  32 V26 =  + 1F4  + 1E26;
  33 V28 =  + *F4  + 1E28;
  34 V30 =  + *F4  + 1E30;
  35 V32 =  + *F5  + 1E32;
  36 V34 =  + *F5  + 1E34;
```

```
37  V36 =  + 1F6  + 1E36;
38  V38 =  + *F6  + 1E38;
39  V40 =  + *F6  + 1E40;
40  V46 =  + 1F7  + 1E46;
41  V48 =  + *F7  + 1E48;
42  V50 =  + *F7  + 1E50;
43  V52 =  + *F7  + 1E52;
44  V54 =  + *F7  + 1E54;
45  F1 =  + *F8  + 1D1;
46  F2 =  + *F8  + 1D2;
47  F3 =  + *F8  + 1D3;
48  F4 =  + *F8  + 1D4;
49  F5 =  + *F8  + 1D5;
50  F6 =  + *F8  + 1D6;
51  F7 =  + *F8  + 1D7;
52  /VARIANCES
53  F8 = 1.00;
54  E2 = *;
55  E4 = *;
56  E8 = *;
57  E10 = *;
58  E12 = *;
59  E14 = *;
60  E16 = *;
61  E18 = *;
62  E20 = *;
63  E22 = *;
64  E24 = *;
65  E26 = *;
66  E28 = *;
67  E30 = *;
68  E32 = *;
69  E34 = *;
70  E36 = *;
71  E38 = *;
72  E40 = *;
73  E46 = *;
74  E48 = *;
75  E50 = *;
76  E52 = *;
77  E54 = *;
78  D1 = *;
79  D2 = *;
80  D3 = *;
81  D4 = *;
82  D5 = *;
```

```
 83 D6 = *;
 84 D7 = *;
 85 /COVARIANCES
 86 /CONSTRAINTS
 87 (D1,D1)=(D2,D2);
 88 /OUTPUT
 89  parameters;
 90  standard errors;
 91  listing;
 92  data='EQSOUT&.ETS';
 93 /END
```

OUTPUT

PARAMETER ESTIMATES APPEAR IN ORDER,
NO SPECIAL PROBLEMS WERE ENCOUNTERED DURING OPTIMIZATION.
ALL EQUALITY CONSTRAINTS WERE CORRECTLY IMPOSED
AVERAGE ABSOLUTE STANDARDIZED RESIDUALS = 0.0453
AVERAGE OFF-DIAGONAL ABSOLUTE STANDARDIZED RESIDUALS = 0.0491

ITERATIVELY REWEIGHTED GENERALIZED LEAST SQUARES SOLUTION (ELLIPTICAL DISTRIBUTION THEORY) LINEARIZED ESTIMATION

GOODNESS OF FIT SUMMARY
INDEPENDENCE MODEL CHI-SQUARE = 5379.163 ON 276 DEGREES OF FREEDOM
INDEPENDENCE AIC = 4827.16329 INDEPENDENCE CAIC = 3547.96136
MODEL AIC = -92.91248 MODEL CAIC = -1233.07072
CHI-SQUARE = 399.088 BASED ON 246 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS LESS THAN 0.001
SATORRA-BENTLER SCALED CHI-SQUARE = 398.9018
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS 0.00000
BENTLER-BONETT NORMED FIT INDEX = 0.926
BENTLER-BONETT NONNORMED FIT INDEX = 0.966
COMPARATIVE FIT INDEX (CFI) = 0.970
ROBUST COMPARATIVE FIT INDEX = 0.968

MEASUREMENT EQUATIONS WITH STANDARD ERRORS AND TEST STATISTICS
(ROBUST STATISTICS IN PARENTHESES)

Q6_P =V2 = 1.000 F1 + 1.000 E2

Q7_P =V4 = .895*F1 + 1.000 E4
.141
6.345
(.140)
(6.415)

Q9_P =V8 = 1.064*F1 + 1.000 E8
.148
7.175
(.129)
(8.242)

Q10_P =V10 = 1.000 F2 + 1.000 E10

Q11_P =V12 = 1.346*F2 + 1.000 E12
.183
7.356
(.144)
(9.357)

Q12_P =V14 = 1.047*F2 + 1.000 E14
.167
6.261
(.137)
(7.656)

Q13_P =V16 = .993*F2 + 1.000 E16
.169
5.865
(.158)
(6.279)

Q14_P =V18 = 1.000 F3 + 1.000 E18

Q15_P =V20 = 1.059*F3 + 1.000 E20
.107
9.857
(.085)
(12.508)

Q16_P =V22 = .922*F3 + 1.000 E22
.111
8.313
(.103)
(8.975)

Q17_P =V24 = 1.000 F5 + 1.000 E24

Q18_P =V26 = 1.000 F4 + 1.000 E26

Q19_P =V28 = 1.085*F4 + 1.000 E28
.158
6.869
(.147)
(7.401)

Q20_P =V30 = 1.115*F4 + 1.000 E30
.173
6.452
(.144)
(7.747)

Q21_P =V32 = 1.018*F5 + 1.000 E32
.215
4.731
(.192)
(5.302)

Q22_P =V34 = 1.038*F5 + 1.000 E34
.227
4.567
(.205)
(5.070)

Q23_P =V36 = 1.000 F6 + 1.000 E36

Q24_P =V38 = .962*F6 + 1.000 E38
.120
8.026
(.103)
(9.365)

Q25_P =V40 = .765*F6 + 1.000 E40
.109
7.018
(.095)
(8.077)

Q28_P =V46 = 1.000 F7 + 1.000 E46

Q29_P =V48 = 1.176*F7 + 1.000 E48
.075

15.596
(.070)
(16.811)

Q30_P =V50 = 1.133*F7 + 1.000 E50
.076
14.870
(.091)
(12.469)

Q31_P =V52 = .741*F7 + 1.000 E52
.088
8.390
(.091)
(8.136)

Q32_P =V54 = .907*F7 + 1.000 E54
.069
13.227
(.071)
(12.709)

F1 =F1 = .556*F8 + 1.000 D1
.065
8.492
(.056)
(10.018)

F2 =F2 = .570*F8 + 1.000 D2
.073
7.781
(.062)
(9.205)

F3 =F3 = .491*F8 + 1.000 D3
.058
8.445
(.061)
(8.065)

F4 =F4 = .554*F8 + 1.000 D4
.073
7.574
(.068)
(8.160)

F5 =F5 = .417*F8 + 1.000 D5
.080
5.185
(.079)
(5.312)

F6 =F6 = .461*F8 + 1.000 D6
.062
7.435
(.062)
(7.385)

F7 =F7 = .569*F8 + 1.000 D7
.066
8.595
(.061)
(9.279)

STANDARDIZED SOLUTION:		R-SQUARED
Q6_P =V2 =	.577 F1 + .817 E2	.333
Q7_P =V4 =	.522*F1 + .853 E4	.272
Q9_P =V8 =	.622*F1 + .783 E8	.387
Q10_P =V10 =	.531 F2 + .848 E10	.281
Q11_P =V12 =	.716*F2 + .698 E12	.513
Q12_P =V14 =	.541*F2 + .841 E14	.293
Q13_P =V16 =	.492*F2 + .871 E16	.242
Q14_P =V18 =	.726 F3 + .688 E18	.527
Q15_P =V20 =	.807*F3 + .591 E20	.651
Q16_P =V22 =	.616*F3 + .788 E22	.380
Q17_P =V24 =	.540 F5 + .841 E24	.292
Q18_P =V26 =	.581 F4 + .814 E26	.338
Q19_P =V28 =	.651*F4 + .759 E28	.424
Q20_P =V30 =	.584*F4 + .812 E30	.341
Q21_P =V32 =	.554*F5 + .833 E32	.307
Q22_P =V34 =	.501*F5 + .865 E34	.251
Q23_P =V36 =	.745 F6 + .667 E36	.555
Q24_P =V38 =	.703*F6 + .711 E38	.494
Q25_P =V40 =	.559*F6 + .829 E40	.313
Q28_P =V46 =	.790 F7 + .613 E46	.625
Q29_P =V48 =	.897*F7 + .441 E48	.805
Q30_P =V50 =	.862*F7 + .508 E50	.742
Q31_P =V52 =	.535*F7 + .845 E52	.286
Q32_P =V54 =	.786*F7 + .618 E54	.618
F1 =F1 =	.953*F8 + .303 D1	.908
F2 =F2 =	.955*F8 + .297 D2	.912

F3	=F3	=	.716*F8	+ .698 D3	.513
F4	=F4	=	.831*F8	+ .556 D4	.691
F5	=F5	=	.602*F8	+ .798 D5	.363
F6	=F6	=	.631*F8	+ .776 D6	.398
F7	=F7	=	.629*F8	+ .777 D7	.396

Appendix H-3 Covariance Matrix

	Q6	Q7	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q28	Q29	Q30	Q31	Q32
Q6	1.004																							
Q7	0.241	1.004																						
Q9	0.280	0.348	0.996																					
Q10	0.318	0.292	0.240	1.293																				
Q11	0.434	0.355	0.408	0.635	1.261																			
Q12	0.502	0.198	0.340	0.350	0.439	1.335																		
Q13	0.400	0.305	0.284	0.348	0.520	0.409	1.453																	
Q14	0.255	0.323	0.279	0.272	0.378	0.290	0.199	0.894																
Q15	0.209	0.359	0.346	0.255	0.357	0.270	0.241	0.525	0.811															
Q16	0.269	0.358	0.342	0.286	0.427	0.423	0.285	0.359	0.464	1.054														
Q17	0.198	0.183	0.418	0.355	0.484	0.148	0.189	0.398	0.279	0.284	1.645													
Q18	0.357	0.363	0.418	0.449	0.457	0.247	0.189	0.336	0.299	0.249	0.289	1.315												
Q19	0.284	0.288	0.470	0.316	0.395	0.387	0.292	0.343	0.262	0.329	0.292	0.396	1.234											
Q20	0.197	0.336	0.398	0.287	0.467	0.385	0.306	0.345	0.276	0.247	0.272	0.462	0.658	1.620										
Q21	0.104	0.207	0.278	0.264	0.277	0.147	0.130	0.164	0.184	0.145	0.487	0.277	0.230	0.275	1.621									
Q22	0.282	0.141	0.340	0.326	0.141	0.323	0.185	0.187	0.158	0.196	0.373	0.452	0.246	0.255	0.629	2.061								
Q23	0.244	0.222	0.264	0.253	0.298	0.185	0.311	0.163	0.202	0.278	0.172	0.264	0.189	0.204	0.117	0.234	0.964							
Q24	0.288	0.203	0.210	0.289	0.436	0.253	0.313	0.149	0.137	0.223	0.170	0.264	0.252	0.136	0.148	0.289	0.542	1.003						
Q25	0.290	0.189	0.263	0.132	0.362	0.372	0.399	0.218	0.156	0.307	0.131	0.206	0.286	0.255	0.101	0.176	0.416	0.328	1.000					
Q28	0.439	0.251	0.311	0.350	0.473	0.519	0.314	0.299	0.250	0.371	0.234	0.363	0.368	0.235	0.225	0.245	0.162	0.311	0.289	1.310				
Q29	0.427	0.261	0.356	0.254	0.379	0.497	0.346	0.300	0.243	0.323	0.219	0.384	0.365	0.255	0.117	0.236	0.214	0.355	0.281	0.977	1.405			
Q30	0.370	0.285	0.381	0.345	0.454	0.458	0.344	0.277	0.294	0.362	0.272	0.481	0.344	0.317	0.162	0.292	0.294	0.363	0.302	0.849	1.146	1.416		
Q31	0.295	0.209	0.273	0.205	0.240	0.407	0.421	0.241	0.199	0.401	0.155	0.312	0.371	0.279	0.142	0.315	0.215	0.265	0.217	0.586	0.666	0.708	1.572	
Q32	0.419	0.237	0.454	0.285	0.448	0.453	0.240	0.291	0.329	0.466	0.264	0.384	0.444	0.333	0.231	0.349	0.256	0.336	0.342	0.817	0.828	0.804	0.606	1.089

4. ANOVA: Frequency of each item vs. 7 Factors

Significance:	*** < 0.01		** <0.05		* < 0.10		
Question / *Frequency*	*1 product*	*2 process*	*3 custom*	*4 employ*	*5 behav*	*6 supply*	*7 finance*
Q6 *Productivity of firm*	0.002 ***	0.001 ***	0.008 ***	0.032 **	0.202	0.134	0.111
Q7 *Reliability of product*	0.000 ***	0.000 ***	0.015 **	0.000 ***	0.017 **	0.001 ***	0.017 **
Q9 *Conformance to standards*	0.000 ***	0.009 ***	0.063 *	0.001 ***	0.145	0.046 **	0.275
Q10 *On-time delivery*	0.010 **	0.000 ***	0.335	0.001 ***	0.223	0.251	0.548
Q11 *Production Cycle-time*	0.005 ***	0.000 ***	0.003 ***	0.003 ***	0.044 **	0.006 ***	0.002 ***
Q12 *Production cost-reduction*	0.018 **	0.000 ***	0.133	0.029 **	0.008 ***	0.206	0.000 ***
Q13 *Inventory turnover*	0.002 ***	0.001 ***	0.174	0.410	0.300	0.001 ***	0.120
Q14 *Customer satisfaction*	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.131	0.001 ***	0.465
Q15 *Customer confidence*	0.003 ***	0.000 ***	0.000 ***	0.001 ***	0.197	0.064 *	0.216
Q16 *Customer loyalty*	0.000 ***	0.000 ***	0.000 ***	0.001 ***	0.053 *	0.004 ***	0.000 ***
Q17 *Customer complaint rate*	0.467	0.003 ***	0.131	0.648	0.473	0.060 *	0.270
Q18 *Employee satisfaction*	0.001 ***	0.000 ***	0.009 ***	0.000 ***	0.040 **	0.000 ***	0.002 ***

Question *Frequency*	*1 product*	*2 process*	*3 custom*	*4 employ*	*5 behav*	*6 supply supply*	*7 finance*
Q19 *Training effectiveness*	0.000 ***	0.020 **	0.062 *	0.000 ***	0.286	0.054 *	0.032 **
Q20 *Employee suggestions*	0.000 ***	0.000 ***	0.297	0.000 ***	0.144	0.001 ***	0.139
Q21 *Employee absenteeism*	0.187	0.064 *	0.017 **	0.113	0.065 *	0.232	0.726
Q22 *Employee turnover*	0.070 *	0.321	0.463	0.032 **	0.001 ***	0.133	0.031 **
Q23 *Supplier product quality*	0.013 **	0.014 **	0.591	0.017 **	0.567	0.000 ***	0.568
Q24 *Supplier on-time delivery*	0.053 *	0.001 ***	0.674	0.012 **	0.074 *	0.000 ***	0.342
Q25 *Competitive supplier prices*	0.081 *	0.017 **	0.768	0.742	0.739	0.000 ***	0.277
Q28 *Net income of firm*	0.208	0.426	0.887	0.354	0.907	0.870	0.210
Q29 *Return on investment*	0.114	0.014 **	0.871	0.189	0.892	0.882	0.001 ***
Q30 *Return on assets*	0.131	0.013 **	0.852	0.287	0.604	0.683	0.000 ***
Q31 *Market share*	0.000 ***	0.004 ***	0.330	0.003 ***	0.079 *	0.199	0.000 ***
Q32 operating income *revenue*	0.000 ***	0.005 ***	0.296	0.010 **	0.037 **	0.045 **	0.019 **

Appendix H-5

Descriptive Statistics for 27 Questions on the Frequency of Item Measurement

Question #	Mean	Std Dev	Skewness	Kurtosis	A - frequency	B - frequency	C - frequency	D - frequency
6 F	3.654	0.746	-2.309	4.672	11	13	38	218
7 F	3.629	0.779	-2.266	4.414	14	10	42	214
8 F	3.514	0.880	-1.789	2.093	18	19	43	200
9 F	3.686	0.780	-2.586	5.858	14	8	30	228
10 F	3.721	0.694	-2.744	7.040	10	9	30	231
11 F	3.232	1.101	-1.121	-0.268	40	24	47	169
12 F	3.332	0.977	-1.358	0.667	28	18	67	167
13 F	3.464	0.965	-1.696	1.527	27	14	41	198
14 F	3.457	0.854	-1.587	1.699	16	19	66	179
15 F	3.071	1.152	-0.890	-0.740	53	17	67	143
16 F	3.182	1.139	-1.067	-0.434	48	16	53	163
17 F	3.450	0.907	-1.565	1.334	19	23	51	187
18 F	2.621	1.126	-0.245	-1.318	68	46	90	76
19 F	2.893	1.131	-0.597	-1.060	54	33	82	111
20 F	2.600	1.220	-0.187	-1.544	83	37	69	91
21 F	3.457	0.915	-1.598	1.396	20	22	48	190
22 F	3.096	1.098	-0.880	-0.643	42	30	67	141
23 F	3.443	0.918	-1.637	1.608	23	14	59	184
24 F	3.407	0.965	-1.520	1.061	26	18	52	184
25 F	3.532	0.816	-1.859	2.772	15	13	60	192
26 F	3.911	0.373	-5.187	31.213	2	2	15	261
27 F	3.775	0.589	-3.080	9.977	6	6	33	235
28 F	3.882	0.355	-3.568	17.136	1	0	30	249
29 F	3.686	0.646	-2.408	6.119	7	7	53	213
30 F	3.475	0.859	-1.734	2.232	19	11	68	182
31 F	3.121	1.113	-0.948	-0.565	45	23	65	147
32 F	3.550	0.837	-2.027	3.330	19	6	57	198
Average	**3.402**	**0.886**			**27.0**	**17.0**	**52.7**	**183.4**
Percent					**9.6%**	**6.1%**	**18.8%**	**65.5%**
Average *(exclude 25F - 32F)*					**31.5**	**20.2**	**55.1**	**173.3**
Percent *(exclude 25F - 32F)*					**11.2%**	**7.2%**	**19.7%**	**61.9%**

6. Frequency of Quality Practices

Which quality improvement programs or techniques has your firm used?

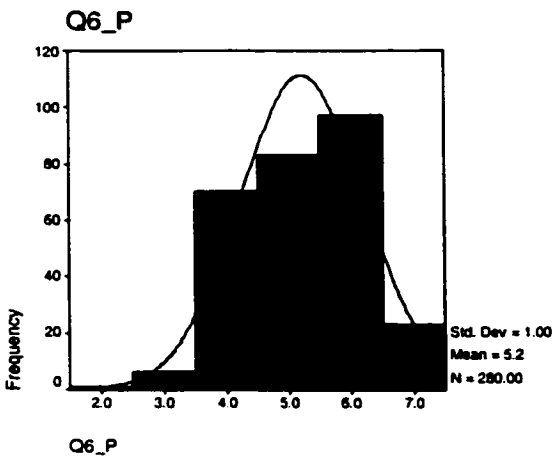
		#	%
❑1	Benchmarking	146	52
❑2	Quality Circles	81	29
❑3	Just in Time (JIT)	118	42
❑4	Kaizen / Continuous Quality Improvement	86	30
❑5	Six Sigma	31	11
❑6	Industry Standards Compliance Programs	106	38
❑6	ISO 14000	16	6
❑8	Quality Assurance system	173	62
❑9	Total Quality Management Approach	102	36
	Does your firm perform self-audits (practice) using the standards of any quality recognition program (ex. Canada Awards of Excellence, Malcolm Baldrige National Quality Awards, Qualimètre? European Quality Awards?		
	❑1 Yes	11	4

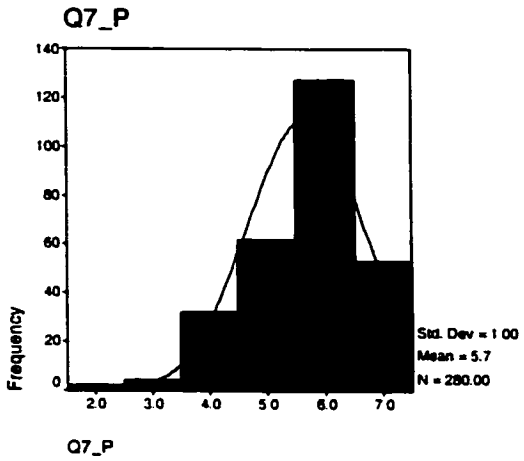
Appendix H-7

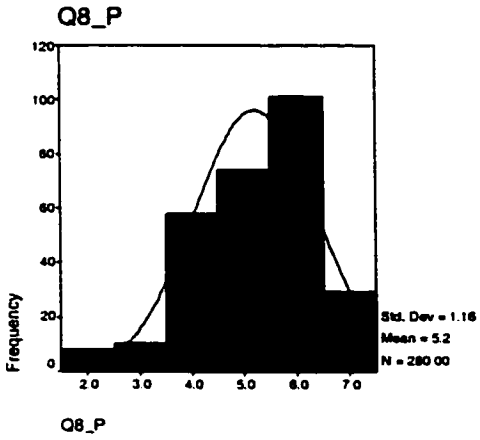
Frequency of Use of Tools

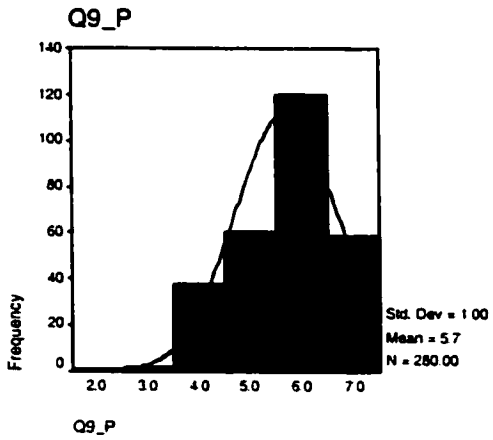
		Don't know	Not Used	Rarely	Sometimes	Often
Q34 How often does your firm use these quality management tools?						
a	Tools to understand a situation (flowcharts, run charts, control charts - SPC)	16	55	43	67	101
b	Tools to find facts (check sheets)	30	38	35	40	139
c	Tools to identify problems (Pareto charts, histograms)	26	60	47	57	92
d	Tools to generate ideas (brainstorming, cause & effect diagrams)	7	39	59	92	85
e	Tools to develop solutions (scatter diagrams)	29	97	70	52	34
	Average	**21.6**	**57.8**	**50.8**	**61.6**	**90.2**
Q35 How often does your firm use these policy deployment and planning tools?						
a	Affinity Diagrams	107	112	45	13	4
b	Interrelationship Digraph	98	96	41	31	15
c	Tree Diagrams	66	97	52	47	19
d	Matrix Diagrams	66	92	40	49	34
e	Matrix Data Analysis	71	104	37	34	35
f	Process Decision Program Charts	78	94	46	36	27
g	Arrow Diagrams	79	102	33	43	21
	Average	**80.7**	**99.6**	**42.0**	**36.1**	**22.1**
Q36 How often does your firm use these process design tools?						
a	Statistical Experimentation (DOE)	76	108	43	30	23
b	Taguchi Loss Function	103	126	36	10	5
c	Quality Function deployment (QFD)	94	118	28	24	16
d	Fail-Safing (Poka Yoke)	96	118	24	24	18
	Average	**92.3**	**117.5**	**32.8**	**22.0**	**15.5**
Q37 How often does your firm use these process analysis tools?						
a	Enterprise Resource Planning (e.g., SAP, Oracle, Baan, PeopleSoft)	70	125	22	23	40
b	Balanced Scorecard	76	122	27	23	33
c	Activity Based Costing (ABC)	58	84	25	41	73
d	Failure Mode and Effect Analysis (FMEA) for reliability	72	113	32	23	41
e	Fault Tree Analysis (FTA) for reliability	90	135	29	12	9
	Average	**73.2**	**115.8**	**27.0**	**24.4**	**39.2**

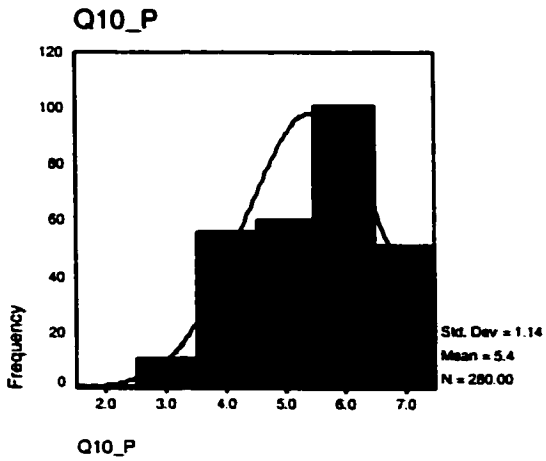
8. Distribution of the Performance Indicators

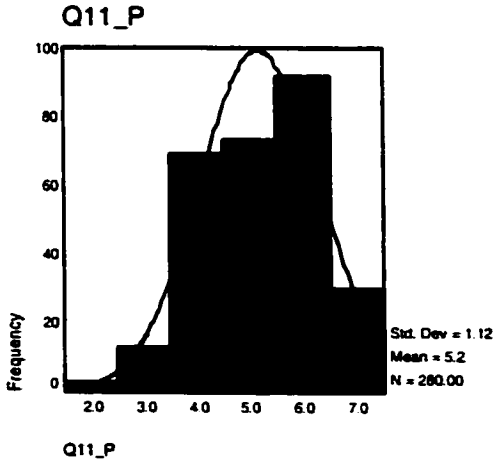


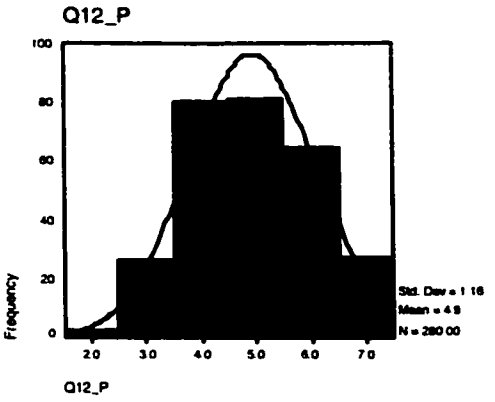








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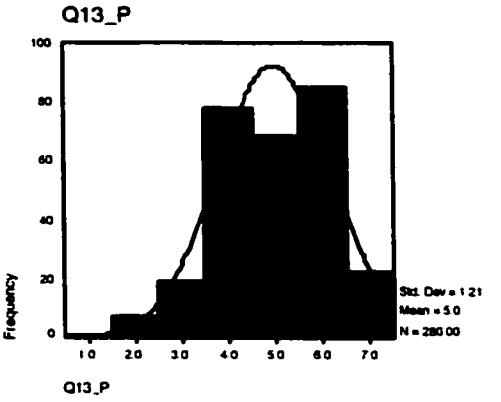
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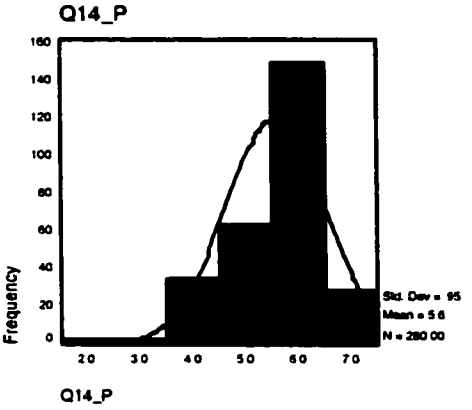
Q13_P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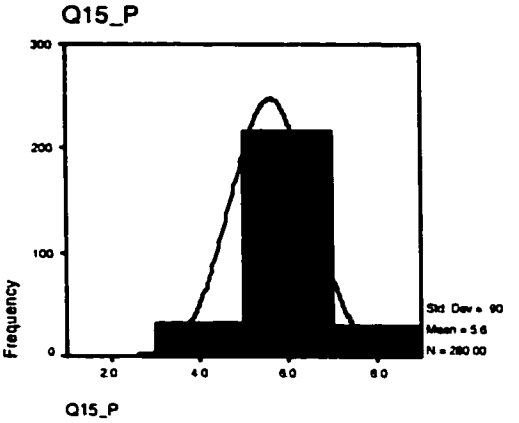
Q14_P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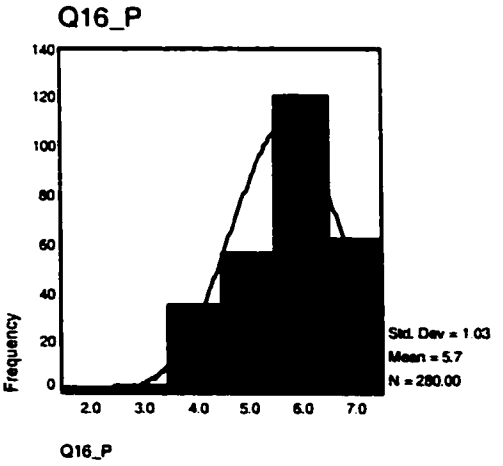
Q15_P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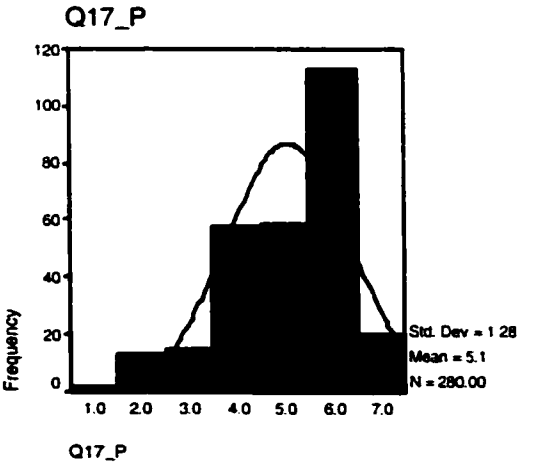
Q16_P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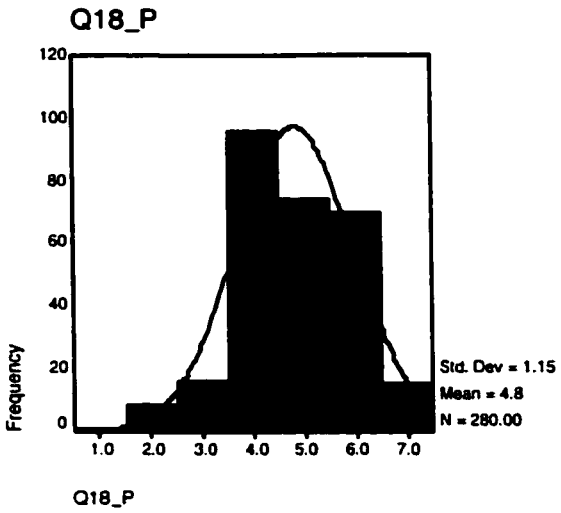
Q17_P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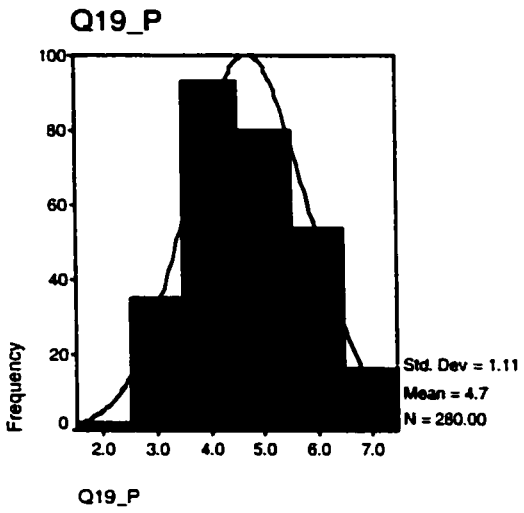
Q18_P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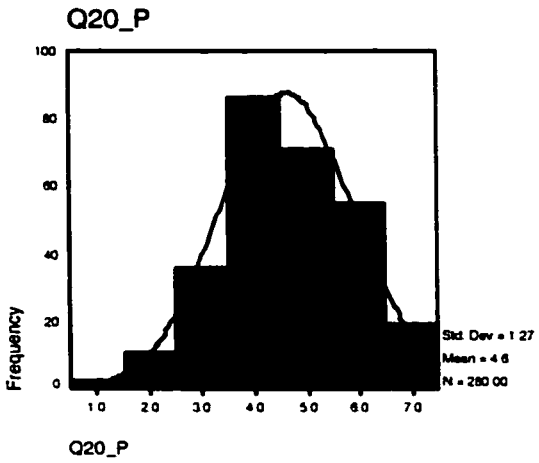
Q19_P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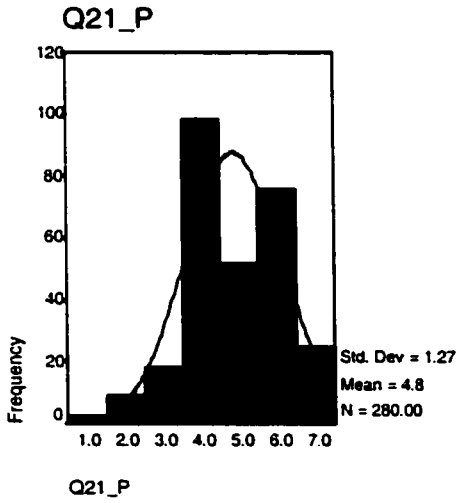
Q20_P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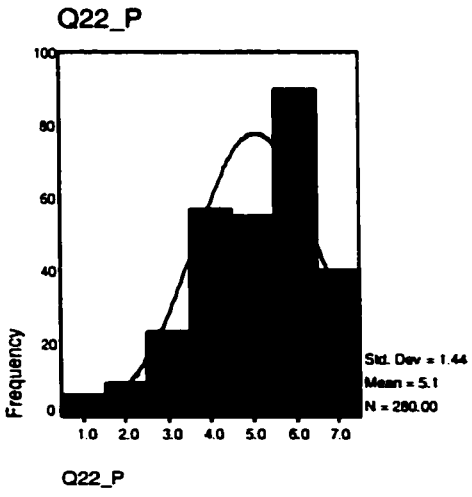
Q21_P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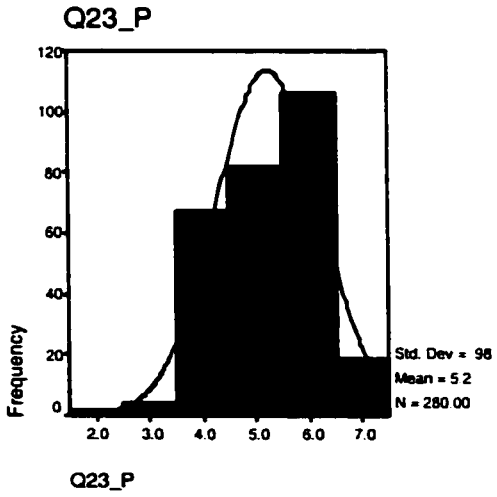
Q22_P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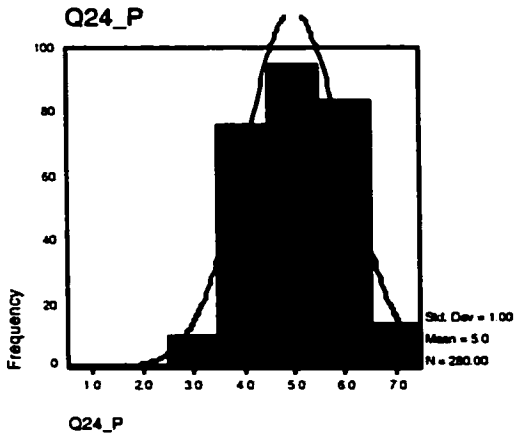
Q23_P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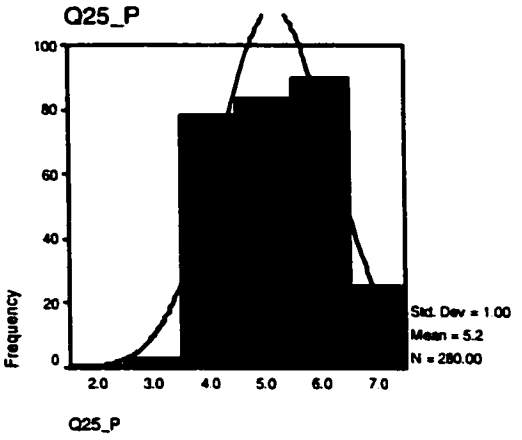
Q24_P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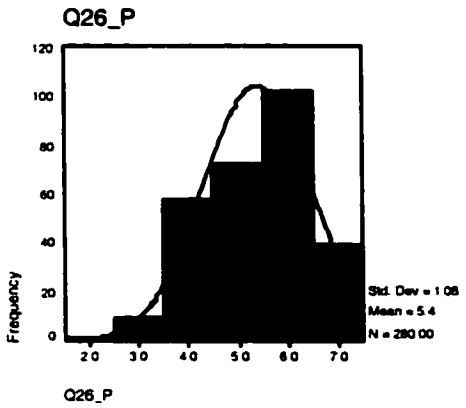
Q25_P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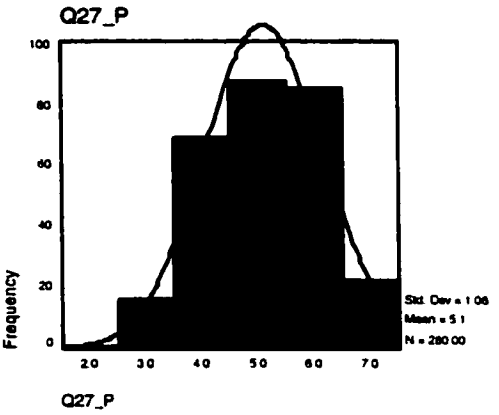
Q26_P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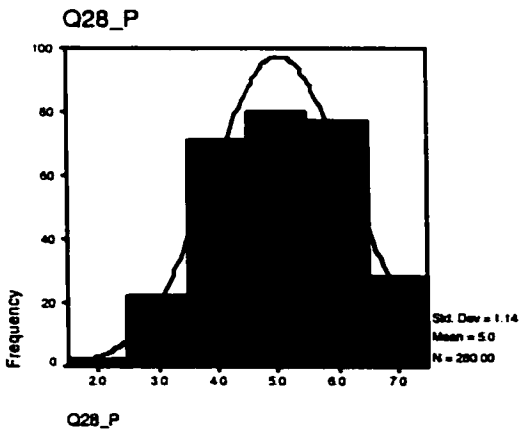
Q27_P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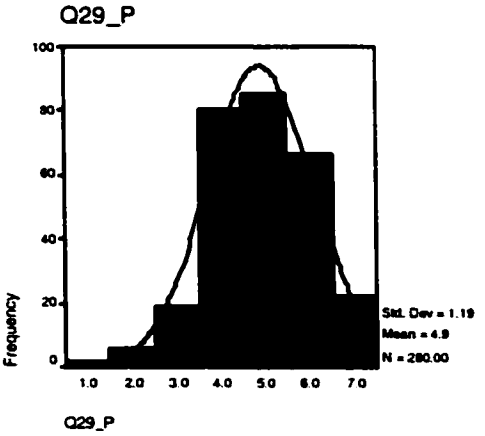
Q29_P
Frequency
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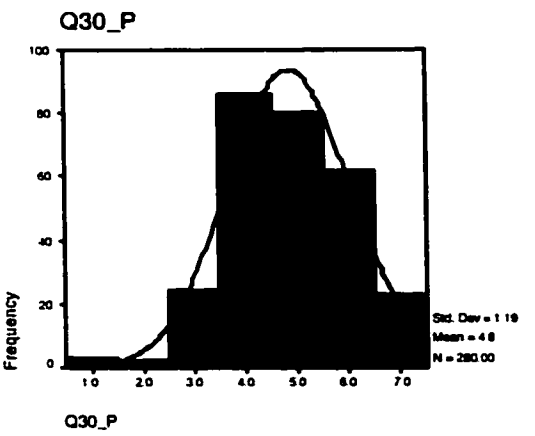
Q29_P


Q30_P
Frequency
Std. Dev = 1.19
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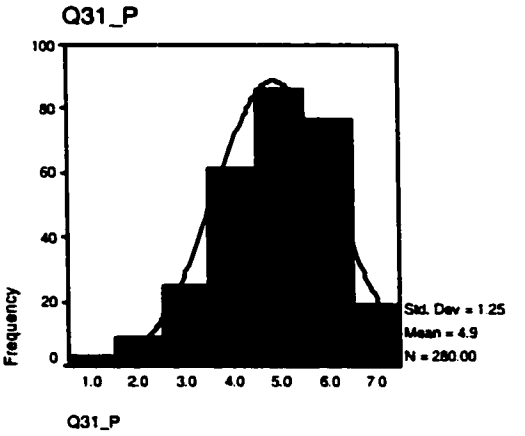
Q30_P


Q31_P
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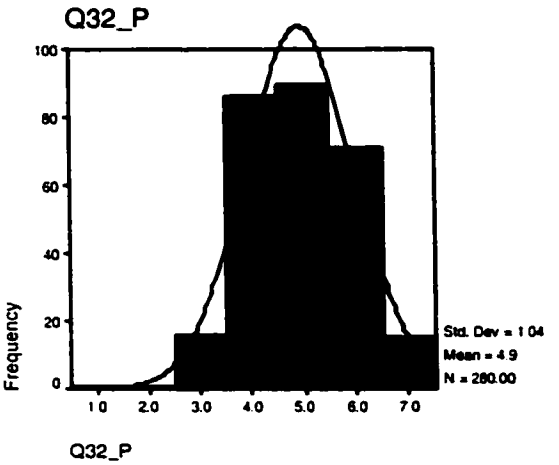
Q31_P


Q32_P
Frequency
Std. Dev = 1.04
Mean = 4.9
N = 280.00
Q32_P

Appendix I – List of Hypotheses

1	That the factor "product quality effectiveness" may be measured using four items. These items are Q6, Q7, Q8, and Q9
2	That the factor "operational efficiency" may be measured using four items. These items are Q10, Q11, Q12, and Q1
3	That the factor "customer focus" may be measured using four items. These items are Q14, Q15, Q16, and Q17
4	That the factor "employee status" may be measured using five items. These items are Q18, Q19, Q20, Q21 and Q22
5	That the factor "supplier role" may be measured using three items. These items are Q23, Q24, and Q25
6	That the factor "financial results" may be measured seven items. These items are Q26, Q27, Q28, Q29, Q30, Q31, and Q32
7a	That business performance may be defined as a multi-factor correlated model
7b	That business performance excellence may be operationalised in a second order factor model as a holistic measure of performance of six factors
8a	That the presence of ISO certification would positively affect performance excellence
8b	That firms that have instituted quality initiatives, but which have not obtained ISO certification, will demonstrate business performance as good as firms with a quality program as well as being ISO certified.
8c	That firms that have instituted both ISO certification and other quality initiatives will demonstrate business performance greater than firms that are ISO 9000 certified only
8d	That the measured benefits for business performance show greatest positive improvement when ISO certification is used in combination with business excellence practices of national quality award programs or other high-level quality initiatives
9a	That regarding business performance excellence, there is no perceived advantage for large firms over small or medium sized firms
9b	That regarding business performance excellence, there is no perceived advantage for either manufacturing firms or distribution firms, or service firms
9c	That regarding business performance excellence, there is no perceived advantage whether the firm is located in Quebec or Ontario
9d	That regarding business performance excellence, there is no perceived advantage whether the firm is privately or publicly owned