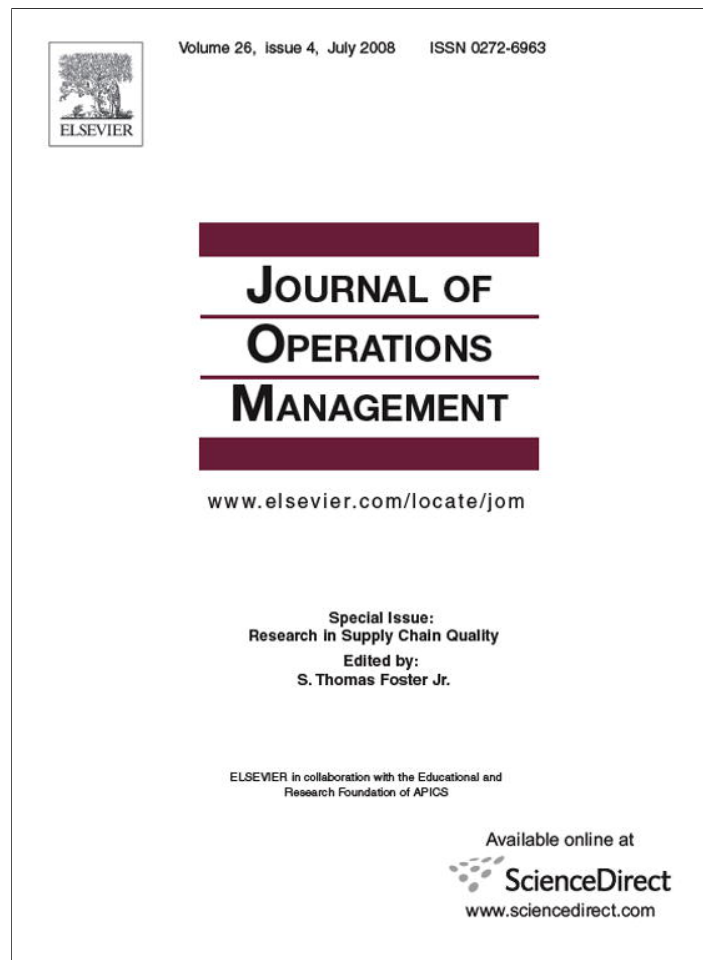


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An examination of ISO 9000:2000 and supply chain quality assurance

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Abstract

ISO 9000:2000 is the latest version of the quality standard developed by the International Organization for Standardization (ISO). The standard aims to evaluate a firm's ability to effectively design, produce, and deliver quality products and services. This version of the standard tries to enhance customer satisfaction by including more top-management involvement and continual improvement. Despite widespread international acceptance, the new standard is surrounded by controversy similar to that surrounding its predecessor, the 1994 version. The literature is clearly divided in its assessment of ISO 9000:2000, which is viewed as either a quality management (QM)-based system or as another paper-driven process that increases risk, uncertainty, and costs. This study utilizes case-based research to address the competing views of the ISO 9000:2000 standard in an attempt to see if a sample of firms in the automotive industry can be positioned within the Miles and Snow [Miles, R.E., Snow, C.C., 1978. *Organizational Strategy, Structure and Process*. McGraw-Hill, New York] strategic typology. We compare different amounts of quality standard integration and quality assurance in the supply chain of firms with ISO 9000:2000 registration while positing several research propositions.

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1. Introduction

Quality assurance (QA) covers all activities, including design, development, production, installation, servicing, and documentation (Deming, 1981, 1986; Garvin, 1983, 1984, 1986, 1987), and is important to the competitive capabilities of any organization or supply chain. The importance of assuring quality requires that quality not be dealt with on an ad hoc basis. Only a

properly implemented quality management system (QMS) within an organization and across its supply chain can provide protection from short-term actions that do not serve long-term goals. For many firms, obtaining acceptable levels of quality comes with the registration of a QMS for itself and its suppliers. In the new ISO 9000:2000 standards, the International Organization for Standardization (ISO) provides what is regarded as the most prevalent approach to developing a QMS. To date, over half a million organizations in over 150 countries have achieved quality registration through ISO standards. Over 50,000 companies within the United States alone have obtained the new ISO 9000:2000 registration (IQNet, 2006). The continued growth of this standard for nearly 20 years

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suggests that it is, and will continue to be, an influential global metastandard (Curkovic and Handfield, 1996; Curkovic and Pagell, 1999; Uzumeri, 1997; Kartha, 2004).

Despite the international acceptance of ISO 9000:2000, the standard is still subject to controversy for individual firms and supply chains. A widespread criticism of the program is that it is not connected directly enough to product quality (Wayhan et al., 2002; Naveh and Marcus, 2004). For example, a registered company can still have substandard processes and products because registration does not tell a company how to design more efficient and reliable products. When registration is used as a requirement for a supply base, buyers like to think that registered suppliers will have a leg up on the competition, but this may not be the case. Basically, the ISO quality standards ensure only that a quality system exists but cannot guarantee its functionality within a particular firm or supply chain (Curkovic and Handfield, 1996; Gotzamani, 2005). Other important criticisms include the idea that registration will not ensure improved firm performance (Anderson et al., 1999; Sun, 2000; Tsekouras et al., 2002; Wayhan et al., 2002; Dimara et al., 2004; Naveh and Marcus, 2004; Morris, 2006). There is also uncertainty as to the amount of resources necessary to implement a QMS and whether these resources actually improve quality assurance (Douglas and Judge, 2001; Hendricks and Singhal, 2001; Nicolau and Sellers, 2002; Quazi and Jacobs, 2004).

Mixed results from research on quality initiatives show that organizations achieved a distinct operating advantage when they used the ISO standards in daily practice and when these standards served as a catalyst for change (Naveh and Marcus, 2004). However, these same researchers also demonstrated that while applying the ISO standards may lead to operational benefits, doing so does not necessarily lead to improved business performance. Kaynak (2003) identified multiple relationships among total quality management (TQM) practices and performance and then found significant positive relationships by examining the direct and indirect effects of these practices on various performance levels. Comments from managers in our study mirror these findings. Some said ISO 9000:2000 had hindered the firm, others praised accompanying process improvements and benefits to the firm and its suppliers, while still others were undecided on the standards and their impact on supply chain performance.

Since the 1980s and the call to improve quality in the United States, a large amount of research has been conducted under the domain of “quality” (Juran, 1978,

1981a,b; Deming, 1981; Garvin, 1986, 1987; Juran and Gryna, 1988). Given the research to date, there is yet to be a consensus on the state of quality assurance in supply chain management and the roles of customers in driving quality assurance by requiring registrations such as ISO 9000. Existing frameworks for quality and supply chain management stress the importance of relationships (Liker and Choi, 2004), communication (Cai et al., 2006), agility (Lee, 2004; Swafford et al., 2006), speed (Fine, 1998; Foster and Adam, 1996), and supplier selection (Choi and Hartley, 1996), to name a few. However, no research has focused on the strategic aspects of quality assurance programs and the use of international standards for supplier selection and supply chain performance. Thus, a lack of consensus exists regarding the effects ISO quality standards have on quality assurance and supply chain performance. There also appears to be little treatment as to where quality standards fit within existing frameworks.

Miles and Snow (1978) produced a typology of business-level strategies that can be used as a lens through which to view the integration of ISO 9000:2000 within supply chain management quality assurance efforts. Miles and Snow proposed that firms develop relatively stable patterns of behavior in order to survive within their perceived industry environments and that they take on one of four basic typologies/strategies: defenders, reactors, analyzers, or prospectors. While obtaining ISO registration in itself does not constitute a shift in strategy, registration does become part of a history of decisions that help constitute an overall strategy for a firm. Within the Miles and Snow typology, *defenders* have narrow product domains. Managers in this type of plant are experts in their organization's area of operation but do not search outside their domain for new opportunities. These managers seldom need to make major adjustments in structure or methods of operation unless customers demand it. They look primarily at improving the efficiency of existing operations. *Reactors* include managers who frequently perceive change and uncertainty occurring in their organizational environments but are unable to respond effectively. Management lacks a consistent strategy–structure relationship and seldom makes adjustments until forced to do so. Reactors may also be considered *laggards* when adopting new systems (Moore, 1991). *Analyzers* include firms that operate in two types of product-market domains, one relatively stable, the other changing. Within the stable areas, these companies operate routinely and efficiently through formalized structures and processes. Alternatively, in the more turbulent product areas, management will watch their

competitors closely for new ideas and rapidly adopt those that appear to be the most promising. The final typology involves *prospectors*, who continuously search for market opportunities and experiment with responses to emerging environmental trends. Managers in this category often create the change and uncertainty to which the competition must respond and are much the same as the *innovators* described by Moore (1991). Because of their strong position on product and market innovation, prospector organizations lead by example. For the purpose of this study, we use the Miles and Snow typology to provide a better understanding of why and how some firms implement QMS. Later in this study, we lay a foundation for research propositions based on the existing literature in general and the Miles and Snow (1978) typology specifically.

Given a lack of research on strategic frameworks and quality standards, the primary objective of this study is to explore the implications of ISO 9000:2000 adoption. The aim is to build theory in quality assurance and supply chain management. Before exploring the factors that influence the decision to adopt the international quality standard, we first review the relevant literature regarding ISO quality standards and supply chain frameworks. Next, we examine relevant supply chain management theory before discussing methods for a replicated field study. We then reveal insights from multiple site visits and develop several research propositions. We conclude with an evaluation of ISO 9000:2000 and its benefits and offer suggestions on how supply chain theory should be expanded for future research.

2. The evolution of ISO standards

Garvin (1984, 1986, 1987) and Deming (1981, 1982, 1986) discuss several reasons why quality is important to the firm; for example, as quality improves, waste is eliminated, costs are reduced, and firm performance improves. While the importance of quality received much attention in the United States during the 1980s (Crosby, 1979; Garvin, 1983, 1984, 1986, 1987; Ishikawa, 1985; Juran, 1978, 1981a,b, 1986, 1988), formal attempts to develop quality management systems and audits of these systems did not come about until the International Organization for Standardization and the British Standards Institute became involved. Located in Switzerland, the International Organization for Standardization was established in 1947 to develop common international standards in many areas. In 1979, the British Standards Institute introduced a new set of standards aimed at promoting quality of goods and services

provided by United Kingdom industries. In 1987, the International Organization for Standardization released the 9000 quality standard series, which was the direct equivalent of BS 5750.

The original ISO quality standards from 1987 underwent a major revision in 1994. Registration to the standard required that an organization have a documented, verifiable quality system in place to ensure that it consistently produced what it said it would produce. In fact, compliance to the standards did not necessarily prevent an organization from producing poor-quality products, and there was no emphasis on continual improvement or defect prevention.

ISO 9000:2000 is the most recently approved revision of the standard. It actually addresses a number of issues in the 1994 version that created widespread criticism (see Table 1). The new standards have a completely new structure and are based on eight principles that emphasize the core values and concepts of quality management (see Table 2). The new revision also incorporates several of the principles underlying the Malcolm Baldrige National Quality Award criteria. Some of the most significant aspects of the revised standard include its emphasis on using a process-related structure, using information from the system to facilitate quality improvement, and including customer satisfaction in improvement activities.

The new revision is based on a process model approach and structures 21 elements into 4 major sections: (1) management responsibility, (2) resource management, (3) product realization and measurement, and (4) analysis and improvement. The eight quality management principles as defined by ISO, with explanations as to how they should be interpreted in the standards, are listed in Table 2, and the actual requirements are listed in Appendix A.

Table 1
Items not covered by ISO 9000:1994 version

Competitive comparisons and benchmarks
Analysis and uses of company-level data
Strategic quality and company performance planning process
Quality and performance plans
Employee involvement
Employee well-being and morale
Product and service quality results
Company operational results
Business process and support service results
Customer relationship management
Commitment to customers
Customer satisfaction determination, results, and comparison
Continuous improvement

Source: Curkovic and Pagell (1999).

Table 2

ISO 9000:2000 quality management principles

-
- Principle 1:* Customer focus. Organizations depend on their customers and therefore should understand current and future customer needs, meet customer requirements, and strive to exceed customer expectations
- Principle 2:* Leadership. Leaders establish unity of purpose and the direction of the organization. They should create and maintain an internal environment in which people can become fully involved in achieving the organization's objectives
- Principle 3:* Involvement of people. People at all levels are the essence of an organization, and their full involvement enables their abilities to be used for the organization's benefit
- Principle 4:* Process approach. A desired result is achieved more efficiently when activities and related resources are managed as a process
- Principle 5:* System approach to management. Identifying, understanding, and managing interrelated processes as a system contributes to the organization's effectiveness and efficiency in achieving its objectives
- Principle 6:* Continual improvement. Continual improvement of the organization's overall performance should be a permanent objective of the organization
- Principle 7:* Factual approach to decision making. Effective decisions are based on the analysis of data and information
- Principle 8:* Mutually beneficial supplier relationships. An organization and its suppliers are interdependent, and a mutually beneficial relationship enhances the ability of both to create value
-

Source: Kartha (2004). ISO 9000:2000 Quality Management Systems, ISO Website.

Making the decision to develop and certify a QMS becomes more difficult if customers are from different industries, as there are many industry-specific standards derived from ISO 9000. These included QS 9000 for the automotive industry. In 1995, a joint venture between Ford, General Motors, and Chrysler published QS 9000, which was derived from the 1994 version of ISO 9000 (Kartha, 2004; Bandyopadhyay, 2005a). In 2000, ISO 9000 was rewritten and became the foundation for ISO/TS 16949, which is replacing QS 9000. The International Automotive Task Force (IATF), which consists of an international group of vehicle manufacturers and trade associations, developed TS 16949 in conjunction with ISO 9000:2000. GM and Ford insisted that all suppliers should make the transition from QS 9000 to ISO/TS 16949 by the end of 2006. Daimler Chrysler called for the transition in 2004. Over 6000 Tier 1 and Tier 2 suppliers worldwide have already achieved ISO/TS 16949 registration. U.S. firms lead the way, followed by firms in Germany, France, Spain, Italy, China, Brazil, and India (Davis, 2004).

Other industry-specific standards derived from ISO 9000 include AS 9000 for the aerospace industry, PS 9000 for pharmaceutical packaging materials, TL 9000 for the telecommunications industry, and TE 9000 for the tooling and equipment industry. Suppliers to these specific industries are required to have specific registration. Typically, the OEMs across these different industries require that all their facilities be registered. However, they also require their first-tier suppliers to obtain registration, and they place pressure on their suppliers to likewise require the same from their suppliers. For example, the ISO/TS 16949 requirement for supplier development states that an organization's suppliers must be third-party registered to ISO 9000:2000 at a minimum (Davis, 2004; Willem,

2004; Bandyopadhyay, 2005a). The end result is that the entire supply chain is impacted by these ISO-related registrations.

We perceive customers requiring ISO registration of suppliers as part of a larger QA effort. QA includes the regulation of the quality of raw materials, assemblies, products, and components; services related to production; and management, production, and inspection processes. The main goal of QA is to ensure that products fulfill or exceed customer expectations. One approach to QA is through the development of a formal QMS, and for many firms this has meant ISO 9000:2000 registration. However, the decision to obtain ISO registration is not always straightforward since many issues still surround the quality standard.

Although ISO 9000:2000 addressed several criticisms of the previous version, it is still met with uncertainty. Most of this uncertainty is related to perceived weaknesses in its ability to deliver real benefits and a continued overemphasis on bureaucratic processes and documentation. Other criticisms generally point to misapplication or extension of its use in companies and the effect this can have on organizational resources and culture. While the criticism focuses on the standard, the problems typically arise from the failure of organizations to understand the underlying philosophy of the standard and the idea that this is a process-driven, systematic approach to QA.

Studies show that many companies acquire ISO registration under pressure from their customers (Anderson et al., 1999; Marcus and Geffen, 1998; Davis, 2004; Willem, 2004). "No registration, no sales," says a buyer from one automotive Tier 1 supplier in this study. Lack of internal enthusiasm and motivation can hinder the impact of ISO 9000 on performance. If QM is viewed as a process emphasizing

management practices, as Flynn et al. (1994) have claimed, then firms pressured into registration may overlook the opportunity to change management practices and enhance quality performance. Beer (2003) supports this way of thinking when discussing how top-down QA programs often fail to create deep and sustained change in organizations. Complicating the decision to obtain registration is the idea that meeting registration requirements may have no impact on performance. Terziovski et al. (1997) found that ISO 9000 registration has not been shown to have a significantly positive effect on organizational performance in the presence of a QMS. A further look at this lack of performance improvement is supported by Johnson (2002) when looking at QS 9000 in the automotive industry. Alternatively, Corbett et al. (2005) demonstrate significant improvements in financial performance for plants registered to ISO 9000 standards. These potential issues with certifying a QMS make the decision more difficult to understand for managers.

Much criticism has been attached to ISO 9000 over its impact on resources. Smaller firms have often been slow to adopt QM systems (Brown and Loughton, 1998; Yusof and Aspinwall, 2000). Emphasis on the demonstrated compliance to the standard for suppliers has led some businesses to seek registration only in order to win customers or remain on approved supplier lists (Brown and Van der Wiele, 1995; McTeer and Dale, 1994; Bendell and Boulter, 2004). When smaller companies are pushed into implementing ISO 9000 because of external factors, those firms may have little intention of extending the quality program further unless required to do so by a customer (Guilhon et al., 1998; Lee and Palmer, 1999).

The updated ISO 9000 standards maintain a philosophy of planning and control, whereas managers should learn about the process-level implications of poor quality before tackling quality control. There is also need for a considerably higher level of senior management awareness and active participation in the QMS. Managers who were early adopters of the ISO standard may be considered prospectors (Miles and Snow, 1978) within a given industry and demonstrate a more opportunistic strategic approach to integrating a QMS.

In summary, there are many potential issues surrounding ISO 9000:2000, and there is conflicting evidence concerning implications of ISO adoption for supply chain management. The next section discusses supply chain management frameworks that include quality assurance in general and ISO quality standards specifically.

2.1. *Quality frameworks and standards*

Empirical attempts to measure and establish dimensions of quality management include Saraph et al. (1989), Benson et al. (1991), Dean and Bowen (1994), Flynn et al. (1994), Powell (1995), Ahire et al. (1996), Narasimhan and Jayaram (1998) and Curkovic et al. (2000). These dimensions help focus research on important elements of quality such as information, process management and design, workforce management, supplier involvement, and customer involvement. Other research on quality emphasizes the importance of both internal and external coordination with supply chain members (e.g., Mondon, 1982; Lee and Billington, 1995; Choi and Rungtusanatham, 1999; Stank and Goldsby, 2000; Croxton et al., 2001; Kuei et al., 2002; Vokurka et al., 2002; Bandyopadhyay, 2005b; Fynes et al., 2005; Lambert et al., 2005) and supply chain orientation at the business unit level impacting supply chain competence (Stank et al., 2005). Some have even stressed the importance of these relationships specifically within the ISO 9000 context (Curkovic and Handfield, 1996; Curkovic and Pagell, 1999; Chandra and Kumar, 2000; Naveh and Marcus, 2004; Casadesús and de Castro, 2005; Morris, 2006).

Mondon (1982) called for supplier participation in quality control activities through strong, interdependent, and long-term relationships with suppliers. Saraph et al. (1989) saw eight critical factors of quality management that included the role of management leadership and quality policies, along with supplier quality management and the important role of having strong interdependencies between suppliers and customers. There has been considerable research to date on how to measure quality and on the importance of internal and external coordination with supply chain members. However, research has not supported a supply chain framework that includes ISO 9000 as a measure of QA within a supply base, strategic orientation, and the subsequent impacts of registration when the standard is an order qualifier.

ISO 9000:2000 has been widely criticized. However, in the course of reviewing the literature and interviewing managers, there is conflicting information regarding the criticism of ISO quality standards and the embrace of this registration. We found many examples where a new measurement system, maintenance program, or significant improvement in quality resulted directly or indirectly from ISO registration. What follows is an attempt to reconceptualize ISO 9000 as a program that can lead to QA internally and externally with supply chain members. After discussing the methodology, we

review information from several case studies and then posit several research propositions.

3. Methods

The objective of this study is to explore the strategic implications of ISO 9000:2000 adoption with the aim of building theory. Because the focus of this research is exploratory, we chose qualitative data collection methods – primarily field-based data collection – to help ensure that important variables and relationships were identified. Qualitative data collection and analysis also helps develop an understanding of why variables or concepts are important (Eisenhardt, 1989). A small, detailed sample fit the needs of the research because we wanted to focus our examination on one industry that had multiple firms involved with ISO quality standards.

Our method was similar to the theory development methodology suggested by Yin (2003) in conjunction with qualitative data collection and analysis techniques suggested by Eisenhardt (1989) and Miles and Huberman (1994). The end result is a series of case studies in which each case is treated as a replication in order to follow Yin's paradigm of a testing-oriented case study methodology. The data collected for this study involved primarily interviews with managers coupled with internal documents provided by the interviewees and information from company websites.

3.1. Sample selection

The sample selected for qualitative research such as in this study should be purposeful and based on theoretical underpinnings (Eisenhardt, 1989; Miles and Huberman, 1994). The goal of this study is to identify differences that can explain the acceptance of ISO 9000:2000 across a single industry, build theory, and find where QA programs utilizing ISO 9000:2000 fit within existing theoretical frameworks. For the purpose of this study, we wanted to work with companies in a well-established industry in which ISO registration was prevalent. Thus, we targeted automotive industry companies and limited our efforts to plants having experience with ISO 9000:2000. An initial list of 10 automotive suppliers was generated based on geographic proximity, a Web-based search of ISO-registered plants, contacting managers at registered plants, and obtaining recommendations from those same managers. Companies were identified or added to our sample during the interviewing process based on the recommendations of respondents. The sample included automobile OEMs and Tier 1 suppliers. These plants

and this approach to sampling fit well within Yin's (2003) suggested research design, in which replication is achieved by making sure the same methods are applied in each case so that the findings can be compared.

In line with much of the research in operations strategy, we chose a single industry (Swamidass and Newell, 1987; Vickery et al., 1993; Whybark and Vastag, 1993; Ahire et al., 1996; Curkovic et al., 2000). Focusing on a single industry controls for variance due to industry-specific conditions. Industries may also differ in consensus understanding of the meanings of terms. Controlling for industry effects can compensate for variability between industries in terms of workforce management, general market conditions, degree of unionization, and so forth. Controlling for these industry-specific differences through focusing on one industry means that firm-specific variance is highlighted in subsequent analyses (Flynn et al., 1994).

Restricting the sample permits the control of several variables that often differ between industries, including the scope and complexity of quality concerns. Within the automotive industry, the types of quality issues and range of programs used offer sufficient variability for study. This variability within the sample provides a basis for external generalizability. Most importantly, the automotive industry was selected because it has been a leader in implementing progressive quality management strategies in the U.S. (Cole, 1990). The industry has already been the focus of many empirical studies that address quality management (Womack et al., 1991; Ahire et al., 1996; Curkovic et al., 2000).

3.2. Interview protocol

Eisenhardt (1989) suggested that a researcher should have a well-developed interview protocol before making site visits. We used a structured interview protocol at all site visits. The protocol covered a number of topics relating to ISO adoption, performance, reasons for adoption, reasons that would change the adoption decision, costs, risks, and general descriptive information about the respondents and the site at which the interview took place. The key areas of interest for this research were ISO 9000:2000 adoption and other quality registrations (i.e., QS9000 or ISO/TS 14969). Appendix B details the items in the protocol that pertain specifically to QMS registration. The protocol items were derived from criticisms of ISO 9000:2000 in the literature. We further developed the protocol based on our observations from previous research studies that included ISO 9000 and TQM. Finally, the researchers

involved in this study assumed that differences between respondents' information regarding the above topics could be mapped according to the Miles and Snow typology. Of the 14 companies in this study, all have a registered QMS, and most have experience with both the 1994 ISO standards and the revised 2000 ISO standards.

Qualitative theory building research is an iterative process (Eisenhardt, 1989; Miles and Huberman, 1994; Yin, 2003). Eisenhardt (1989) suggested that data collection and data analysis should be done simultaneously: the data from one case is collected and then analyzed before the next replication is performed. This same procedure was followed for this study. If needed, any improvements in the protocol were made between replications. Important issues raised in early cases were included in the protocol for subsequent replications. This ability to refine and improve upon the protocol between cases is a significant advantage to this type of research. The data collection and analysis are described separately in the following sections.

3.3. Data collection

The primary data was collected using structured interviews in a field setting. For the purpose of this study, 14 plants were visited, including 11 Tier 1 automotive suppliers and four plants at two automotive OEMs (see Tables 3 and 4). The plants were located in the Midwestern United States.

Structured interviews at each plant generally took place with the ISO compliance manager, quality manager, general managers, and/or quality engineers. When possible, the use of multiple respondents and

multiple interviewers helped limit biases introduced by a single respondent and researcher. A high involvement of plant and quality managers is the optimal goal in this type of study, though this may not be achieved by every study because of practical considerations for all parties. Both quality managers and plant managers have been used as key respondents in empirical studies for quality management (Schonberger, 1983; Griffin, 1988; Ahire et al., 1996; Curkovic et al., 2000). With the focus of this study being ISO 9000 and QA, the researchers involved needed to interview those managers directly involved in quality initiatives. When conducting the interviews, the field notes identified responses to all of the protocol questions, provided answers to other questions that were raised during the interview and plant tour, identified other companies we should talk to, and included other information, such as company publications.

3.4. Qualitative data analysis

The two main components of data analysis included within- and across-case analysis. Within-case analysis helped examine ISO 9000:2000 in a single context, while across-case analysis served as a form of replication (Yin, 2003) where the constructs of interest in one setting were tested in other settings. One concern was controlling for the effects of the researchers' a priori beliefs as to why ISO 9000:2000 would be embraced and where plants might fit within the Miles and Snow typology. This was accomplished in a variety of ways. First, the field notes were written up prior to coding. Then, the field interview notes were consolidated and coded. This two-phased approach allowed

Table 3
ISO 9000/2000 respondents

Plant #	Respondent: title	Years in pos.	# of employees at location
1	Buyer/Purchasing Agent	2	250
2	Quality Engineering Manager/QMS Representative	10	550
3	Director of Manufacturing, VP Human Resources, Master Scheduler	4, 11, 3	184
4	Senior Staff Engineer in the Quality Assurance Department	10	13,000 locally
5	Supplier Quality Engineer	5	950
6	2 ISO Compliance Coordinators	15, 28	500
7	Quality Systems Engineer; ISO & QS Process Support Manager	9, 7	7,500
8	ISO Compliance Coordinator	5	9,200
9	Senior Vice President	6	275
10	Quality Improvement Manager	3	3,000
11	Associate Quality Specialist and Quality Systems Coordinator	7, 6	445
12	Quality Control Manager	15	45
13	Product Control—Scheduler	2	980
14	Purchasing Manager; Quality Specialist	20, 7	250

Table 4
ISO 9000:2000 company summary information

Plant #	Products/services	(Registration)—Reasons
1	Automotive Tier 1 supplier of fluid reservoirs and filters	(ISO 9000:2000)—customers require registration
2	Tier 2 and 3 electrical connectors for the automotive industry	(ISO/TS 16949:2002 & ISO 14000)—OEM customer requires both registrations from this supplier
3	Automotive Tier 1 headliners, overhead assemblies	(QS 9000 & ISO/TS 16949)—OEM requires registration
4	OEM plant—automobiles, motorcycles, ATVs	(ISO 9000:2000)—confirm quality image, do not require it for their supply base
5	Automotive Tier 1—transmission components	(QS 9000; AS 9000; ISO 9000:2000 & TS 16949)—OEMs require it
6	Automobile OEM (Plant 1)	(ISO 9000:2000)—firm-level directive for their own plants and their suppliers
7	Automobile OEM (Plant 2)	(QS 9000; ISO 9000:2000)—firm-level directive for their own plants and suppliers
8	Automobile OEM (Plant 3)	(ISO 9000:2000)—firm-level directive for their own plants and their suppliers
9	Contract packaging services and corrugated paper and plastic packaging materials	(ISO 9000:1994; QS 9000 and ISO 9000:2000)—already registered, good fit
10	Automotive Tier 1 supplier of HVACs, radiators, condensers, heater cores, and thermal systems	(ISO 9000:2000)—customer wants and requires registration of suppliers
11	Automotive Tier 1 parts supplier	(ISO 9000:2000)—customers require minimum of TS registration
12	Tier 1 automotive supplier	(ISO 9000:2000)—improve current QMS and to bid automotive OEM contracts
13	Tier 1 auto axles and driveshafts	(ISO/TS 16949)—primary OEM customer requires registration
14	Heavy trucking equipment and axels	(QS9000 & working on ISO 9000:2000 and TS16949)—required by customers

multiple people to review the field notes. Any discrepancies between researchers were clarified through follow-up contact with the respondent.

Next came a step intended to mitigate confirmation bias. Miles and Huberman (1994) noted that the acts of coding and data reduction are actually forms of data analysis and that the act of coding could lead to confirmation bias problems in future cases. Therefore, coding within case analysis was limited to categorizing the individual case on previously identified constructs and identifying new issues to pursue at future sites. By taking this approach, the researchers were open to alternative explanations raised in future replications.

The between-case analysis consisted of looking for patterns of data regarding plant level experiences with ISO 9000 across the various organizations. Between-case analysis is facilitated by using a variety of tools to reduce the amount of data and to display the data in a meaningful fashion (Miles and Huberman, 1994; Yin, 2003). Data reduction was accomplished primarily through categorization. With the help of Nonnumerical Unstructured Data Indexing, Searching and Theorizing (NUDIST) using QSR[©] software (Gahan and Hannibal, 1999), important information, or nodes, was identified as a way of cataloging topics, ideas, attributes, and such. Next, the equivalent of a tree node system was used as a way of hierarchical indexing—categorizing nodes. Categories were developed in two ways. First, a

number of categories were formed based on the literature (i.e., impact on performance, costs of registration, risks, reasons for registration, etc.). Then, categories and concepts that respondents identified as being related to ISO 9000:2000 usefulness were compiled (i.e., focus on performance, quality assurance of supply base, etc.). Through a process of combination, renaming, and redefining, the data was reduced to two main concepts that were most frequently noted as reasons for not embracing ISO 9000:2000 and four main categories most frequently noted as reasons for embracing ISO 9000:2000 (see Tables 5 and 6).

4. Findings

Respondents were asked to provide perceptual information at the plant level regarding ISO 9000:2000. The coding of field data confirmed many of the main reasons, as previously presented, for not embracing ISO 9000:2000. Reasons for not embracing the new standard are now generally categorized as uncertainty and risk. These include (1) uncertainty of benefits, (2) risk of bureaucracy, (3) costs, and (4) risk to the plant's image if there is a problem with registration. These risks are typically more scrutinized by smaller plants or by plants that choose not to undertake registration when others in the industry are seeking registration. These general categories, listed from the

Table 5

Reasons against ISO 9000:2000

Reasons NOT to adopt (5 categories—22 nodes)

1. Uncertainty—relationships
 - Unsure of relationship to improved quality
 - Long-term vs. short-term impact on firm
 - Question motivation for registration
 - Lack of top management involvement
2. Uncertainty—resources (other than costs)
 - Usefulness to different sizes and types of organizations (who is it best positioned to help?)
 - Size of the firm: in small firms management wears too many hats; this is one more thing to add to their list of responsibilities
3. Risk—cost
 - Registration fees
 - Continued internal and external audit fees
 - Conformance to ISO standard changes in the future
 - Continuous improvement
 - Loss of productivity during training/registration/auditing
 - Existing systems exceed requirements; why pay for registration
 - Selecting a bad/inconsistent registrar
 - Impact on productivity: having to continue to build product while attempting to remedy noncompliance issues
4. Risk—bureaucratic processes
 - Increased paperwork and documentation
 - Creates a bureaucratic system
 - Cumbersome to conform processes to standards
 - Old standards were difficult to understand; same fear with new ones
5. Risk—image
 - Loss of internal credibility to shareholders if registration fails
 - Negative external publicity if registration fails
 - Does not help in marketing their product
 - Noncompliance after registration

most prevalent to the least prevalent, and the underlying subcategories/reasons from the plants in this study confirm many of the preexisting issues with ISO registration. This also shows that not much has changed to diminish concerns about the standards. So why have so many plants conformed to the new ISO standards in the face of so much criticism? In a word, “customers.”

The data reduction and categorization process created the following four main concepts for embracing ISO registration, listed from most prevalent to least prevalent: (1) customers, (2) documentation, (3) costs/benefits, and (4) management involvement. In other words, the vast majority of the issues raised and explanations offered fit into one of these four categories. These categories encompass some of the major criticisms of ISO 9000. The following sections illustrate how companies turned what many perceived as shortcomings of ISO 9000 into a compelling picture of why ISO 9000 registration is beneficial. Based on the above

Table 6

Benefits from adoption

Reasons to adopt and benefits (4 categories—27 nodes)

1. Registration required by customers
 - Remain part of supply base
 - Companies in EU started demanding it
 - Suppliers one tier away are required to have it by OEMS and Tier 1 suppliers
 - Cost of business/requirement
2. Documentation
 - Already have QS 9000 or ISO 9000:1994 registration and documentation
 - 2000 better, more organized than previous standards (ease of documentation)
 - System helps record knowledge and helps plant retain memory
 - ISO has industry-specific standards, e.g., TS16949 system
3. Costs/benefits seen within industry or other plants
 - Some benefits not known until after implementation of QMS
 - Quality assurance through process improvement
 - Promotes discipline within plant and within supply chain
 - Better calibration of tools and documentation of calibration
 - Prevents shortcutting engineering tests by using old test results
 - Achieves higher goals (100% on-time delivery, decrease defects/million units)
 - Possibility of new business after registration
 - Is not static and pushes for continuous improvement
 - Internal motivator when parent company sets a goal of registration
 - ISO registration facilitates expansion into new international markets
 - Uniform training/processes applicable to all locations/plants, lowers expenses and allows learning and improvements across now-common platforms
 - More consistent internal operations—increased quality assurance
 - Medium and small firms: differentiates them from their competitors
 - Can fend off nonregistered competition
 - If brand image is “good quality,” then ISO fits with image and should be done
4. Management involvement/communication
 - Transfer responsibility away from just the quality department to include top management
 - Communicate level of quality system to own plants, suppliers, customers, and government
 - Increased communication across functions and between own mfg plants
 - Drive cultural change

categories and additional information from the case studies, we offer several research propositions. These propositions link existing theory to our findings and position testable hypotheses for future research.

4.1. Registration is an order qualifier

Most of the plants in this study acquired registration because of pressure from customers, as reflected in

information from Plant 2: “If you are a supplier in the automotive industry, registration and the resources necessary to maintain registration are simply a cost of doing business.” This same sentiment is supported by Plant 5, where registration is seen as a customer requirement and not a competitive advantage. In the past, the drivers were foreign competition, eroding market share, and a poor quality reputation for U.S. products. While U.S. manufacturing plants have become much better at quality management, quality by itself is not the order winner it was in the 1980s. Instead, quality is an order qualifier, and plants wanting to make sure they have a more stable supply chain can use supplier assessment programs that include ISO registration to help ensure good quality suppliers. One of the easiest ways for a plant to do this is through working with suppliers that have obtained an industry standard for quality systems, namely, ISO 9000:2000.

Registration itself, while a good starting point, is not enough. Customers wanting to ensure a better quality supply base should also work in house with suppliers. They should continue to share more information across the supply chain so that all firms in the supply chain have a chance to collaborate with customers rather than simply reacting to changing customer needs. At one OEM, Plant 4, corporate holds all plants to the ISO standard. Generally, this company has practices they consider to be well above the ISO standard. Purchasing teams set the requirements for their suppliers, and each supplier must have at least one quality system in place. This is also found at OEM Plant 5, where the success of ISO registration is seen as an international standard for finding good quality suppliers. A Tier 1 supplier at Plant 11 claims that “requiring registration of our suppliers has resulted in higher quality products being produced at this plant because parts produced from our suppliers’ plants are better.” Level of commitment to ISO 9000:2000 should be used to assess success of a QMS. Basically, customers should try to determine whether the supplier is doing only the minimal amount of work necessary to comply with registration. Plant 13 adopted ISO registration to improve quality and reduce the overall cost of quality. A manager at Plant 13 said, “We did it to remain competitive and to gain a competitive advantage through the continuous improvement of processes and practices and to arm employees and our suppliers with the information necessary to accomplish our organizational goals.” While requiring your suppliers to have ISO registration does not constitute a shift in strategy, obtaining registration can become part of a supplier’s strategy.

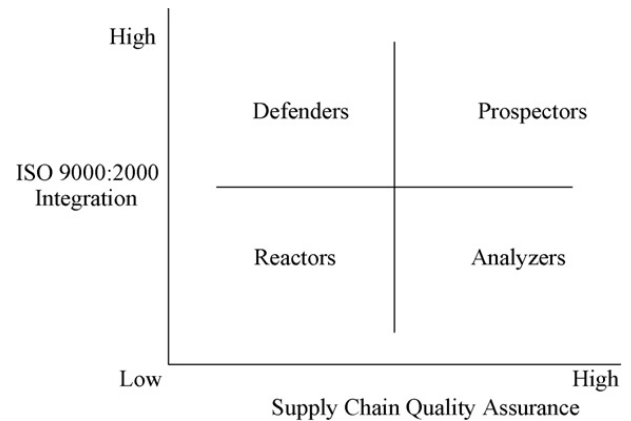


Fig. 1. ISO integration and supply chain quality assurance: an application of the miles and snow typology.

The Miles and Snow (1978) framework (see Fig. 1) can be used to help differentiate between plants that are involved in ISO registration only because customers require it and plants that go beyond registration to strengthen certain aspects of quality assurance. Based on the data in this study, Defenders operate within a narrow product domain (one industry), look primarily at improving efficiency in existing operations, and are focused on costs. Efficiency can be gained from higher levels of QMS integration and registration, but because these types of plants do not look for opportunities outside their own efficiencies, they do not obtain much quality assurance upstream in their supply chain. Obtaining ISO 9000:2000 registration will be an order qualifier and not an order winner. In much the same way, reactors seldom make changes to their systems until forced to do so. Reactors perceive ISO registration as a cost of doing business and may struggle with finding real benefits from the QMS, as these types of plants may be part of the *late majority* or *laggards* (Moore, 1991). They will be slower to adopt new systems or standards. Thus, our first research proposition is

RPI: There is a negative relationship between the number of defenders and reactors in a supply base and quality assurance throughout a supply chain.

Alternatively, prospector plants continuously search for opportunities to improve quality and go beyond QMS registration simply because a customer has required it. These plants have the best opportunity for a competitive advantage from ISO registration. They can make it an order winner early in the game of QA, while their competitors have registration forced on them as an order qualifier. Prospectors include registered OEMs that lead by example and require registration of their Tier 1 and Tier 2 suppliers. Finding prospectors among a supply base will involve site visits and having the supplier demonstrate compliance, the ability to

collaborate, and visibility of their QMS, as well as finding evidence of adoption of new and innovative practices. Analyzers will be successfully operating in more than one product domain but will not have ISO-registered systems in all domains. These plants will leverage the results of a registered QMS in one domain in order to integrate quality assurance within their supply chain for the benefits of a more stable product environment.

4.2. ISO 9000:2000 documentation

One of the major criticisms of ISO 9000:2000 is the amount of paperwork involved in obtaining registration. A large number of critics perceive the paperwork as excessive and unnecessary. When any organization wants to become registered, they often think of the paperwork associated with registration. The prominence that paperwork has attained was never intended by the original authors of the standard. This resulted in many plants producing large manuals of highly detailed procedures, ignoring the fact that the personnel performing these tasks may not have been highly trained or closely supervised. Often, these manuals contained large sections of material reproduced from other sources, such as equipment suppliers' manuals. Happily, that old approach has been discouraged in the new standard. For example, in the auto industry, ISO/TS 16949 is modeled after the new ISO 9000:2000. With ISO/TS 16949 and ISO 9000:2000, registration is meant to put greater focus on quality rather than on whether the necessary paperwork is completed. In fact, there are only six instances within the ISO standard where a documented procedure is prescribed: control of documents, control of records, internal audit, nonconformity, corrective action, and preventive action. The positive side to this is that the documentation process has forced companies to formally establish procedures and to train all employees in them. Plant 3 claims that "concerns when seeking registration included the risk of creating an ineffective and bureaucratic system and spending a large amount of money. One year after obtaining ISO/TS 16949 registration, we found that on-time delivery had improved, and that defective parts per million had decreased as well. This attribute was due to the fact that we had a defined process for everything and that we were holding monthly continuous improvement sessions."

In the case of Plant 1, the company had most of the documentation prior to deciding to get registered. By comparing the existing procedures to what is required for registration, the plant is able to uncover the gaps in

the processes, which enables them to add value to the plant. The manager from an OEM at Plant 4 supports this by adding, "Documentation is the key to finding the gaps in business processes, and we would not have done this without going through the registration process." Additionally, the Plant 6 OEM says, "Employees here used to cut corners and just pull old files when an engineer asked for a test to be performed. ISO has put a stop to this due to the standard's proactive documentation system. ISO really helped create a culture change as people have griped, but it is well worth the temporary discomfort. The documentation is better. Tools are calibrated better. People are starting to understand more as discipline improves. ISO forces change, which is good for the organization. We now use the latest and greatest procedures." The process of documenting quality processes, problems faced, steps taken to correct them, and the measurement of customer satisfaction has helped the plant to achieve success in the long run. A quality engineer at Plant 5 also felt that using measures in the documentation such as meeting timelines and satisfying internal and external customers has helped to keep the whole program focused. At this same plant, they created ISO 9000:2000 flowcharts with performance measures that tie into their goals. This has made training easier and also provided employees with a better understanding of their role in the department.

Most of the plants used the documentation as a way of codifying knowledge. The formalized processes for engineering changes, defects encountered, correction procedures, and maintenance and customer satisfaction may seem a burden, but many companies also look at it as a record of lessons learned, thereby adding value. The ability of a plant to document and learn is reflected in the extent that ISO 9000:2000 is integrated within the plant. Defenders are positioned to gain more benefits from ISO integration than are reactors. Defenders have the ability to translate registration into internal efficiency improvement. Reactors have difficulty responding effectively to change and will do what is necessary for compliance but not full integration. Alternatively, prospectors are receptive to change and innovation because integration of new practices is not only accepted but part of their culture. Analyzers will not realize the same amount of integration as defenders and prospectors because integration will be limited in its application across multiple product domains.

RP2: Defenders and prospectors will have higher levels of ISO 9000:2000 integration internally and externally with supply chain members.

4.3. Costs/benefits within industry or other plants

A major criticism associated with registration is cost. This includes the costs of implementation and maintenance. As mentioned before by Plant 2, some see “registration and the resources necessary to maintain registration [as] . . . simply a cost of doing business.” This same sentiment was felt by other managers when they first faced the issue of what to do when ISO registration was forced on suppliers. Mandated registration brings about many costs, uncertainty, and risks. Some managers have seen competitors’ plants obtain registration only to meet minimum requirements for customers. For more adaptive plants, being ISO 9000:2000 registered is a way to actually save money. According to one respondent, the positive side of obtaining the registration is that the plant can expect to get money back within 12 months of when it was spent. In fact, it is not unreasonable to expect a return of four to one (Willem, 2004; Bandyopadhyay, 2005a). Small companies may take longer to realize a return on investment. Despite barriers, the promise of good returns on investment helped persuade some companies to seek registration.

The 1994 version of ISO 9000 has been criticized for some uncertainties surrounding the standard and because registration does nothing to guarantee continuous improvement. Once the plant has the registration, it does not have to ensure improvement. Instead, managers can just make sure that all the policies and procedures are in place. Thus, the 1994 version of the standard did not go far enough to ensure quality assurance for registered plants. When a plant adopts the new ISO 9000:2000 registration, it must have a process in place that revolves around customer satisfaction. Information from Plant 2 includes the comment that “benefits include more focus on customer satisfaction with ISO/TS 16949 compared to the older programs such as QS 9000.” It is not sufficient to just satisfy customers: plants must also show continuous improvement in customer satisfaction. ISO 9000:2000 places primary emphasis on results rather than on methods employed and compliance with documented procedures. At two OEMs in this study, respondents now see less variation between their own plants. This has been one benefit of implementing ISO at Plant 7 and at OEM Plant 8. The respondent at Plant 8 said, “Since adopting these international procedures, we have reduced rework and repair costs.” These types of improvements positively impact financial performance, supporting the findings of Corbett et al. (2005). Continually improving customer satisfaction is a process of

increasing the plant’s effectiveness in fulfilling its quality policy and objectives. Processes at Plant 12 have improved to the point where they have been able to get down to 20 defective ppm and maintain better than a 1.33 Cpk. Management at Plant 12 supports the claim that costs are low compared to results produced from the QMS. The measures of performance recommended by ISO standards help keep the program focused, thereby contributing to continual improvement. Additional benefits of the ISO/TS 16949 registration, touted by one supplier in this study at Plant 10, include signaling a quality image to potential customers, added business, increased sales, and reassurance of quality, which retains current business.

When contrasting opposite diagonals of the Miles and Snow (1978) typology, the greatest contrast in benefits can be found between prospectors and reactors. While prospectors can be seen as proactive *innovators* or *early adopters* (Moore, 1991) in seeking out new quality assurance practices, these plants have a high risk of failure when using new practices. They also have the highest opportunity for benefits from successfully implementing these practices before others in the same industry do. Reactors do not see competitive advantage from ISO 9000:2000, as registration will be an order qualifier with benefits limited to remaining in the supply base for customers demanding registration. These *laggards* (Moore, 1991), or reactive plants, do not see the benefits of registration as a catalyst for better quality assurance; instead, registration is a cost of doing business and may involve too many risks or uncertainties.

RP3: ISO 9000:2000 benefits in the form of integration and quality assurance will be greater for prospectors than reactors.

4.4. Management involvement/communication

Since the beginning, the ISO 9000 standards have contained very basic requirements for management. First, management was required to establish a quality policy and communicate this policy to the rest of the organization. This typically meant that slogans were written and communicated by means of signs posted on walls. Responsibility was passed on to a management representative to set up documentation, and key members of management sat through long meetings over the course of a year to review the system.

As was pointed out by the manager at Plant 1, management responsibility takes on a new dimension with the new ISO 9000:2000. One key criticism of the previous version has been that management had a

minimal role that did not require them to move beyond maintenance into the improvement arena. ISO 9000:2000 is designed to transfer responsibility for the QMS from a quality assurance function to top management. This ensures that customer satisfaction is achieved, customer requirements are fully understood and met, planning activities include objectives at each relevant level within the organization, internal communications are established, and information within the system is used to facilitate improvement. When talking to management at Plant 10, we found that they are now required to understand the results of actions internally as well as the impact of these actions on their customers. Additionally, OEM Plant 6 talked to us about how the ISO standards have been implemented within the organization from the top down. “ISO has been a long time coming and should have happened 10 years ago. If there is a no-compliance on an audit, then everyone hears about it; a no-compliance is taken very seriously by our management.”

As shown by Naveh and Marcus (2004), and as demonstrated by the plants in this study, organizations will need to analyze how actively management is involved in promoting system-wide improvement. Planning activities will now need to be more focused and will have to be documented. Changes occurring within the organization must be planned in order to protect the integrity of the QMS. Management will also face the challenge of pulling together the information from their system and using that information effectively for management review. Quality systems registrars will look for evidence of the shift in responsibility to top management when assessing organizations. Consistent QA practices at all levels of the plant demonstrate increased supply chain orientation and eventual competence (Stank et al., 2005), while different views lead to conflict between functions and different perceptions of ISO 9000:2000 benefits.

In the case of OEM Plant 4, respondents felt “very strongly that ISO registration is a good way to communicate top management’s support of high-level quality systems and commitment to our customers.” ISO registration has forced management at some plants to tie tier quality systems into a customer requirements management system. The biggest benefit Plant 7 has found is the improved communication and uniform training between plants across all levels of management. This has helped quality assurance within their supply chain. Finally, Plant 14 wanted us to know that “ISO/TS registration seems more flexible now, less prescriptive than the old task-based way of doing things. The new standards integrate culture and task. Also,

senior leaders must know what’s going on and be on the cutting edge of registration and training. This is done not only to inform those working below the managers but to communicate the importance to suppliers and customers.”

When mapping the amount of management involvement to the Miles and Snow typology, we find that reactors have the least amount of management involvement due to their reactive nature. This results in lower integration and quality assurance within their supply chain. Defenders and analyzers typically will have more management involvement, but in different ways. Management with defenders will get involved in ISO registration because of potential efficiency gains. Because of their myopic approach to quality assurance, Defenders will lose out on involving top management in their supply chain as performance measurement in these plants is more focused on costs and efficiency. Analyzers, on the other hand, watch over multiple product domains and, in the more turbulent product areas, watch their competitors closely for new ideas and rapidly adopt those that appear to be the most promising. Here there is an opportunity to adopt ISO benefits that can result in higher quality assurance but lower levels of internal integration across the plant’s multiple product domains.

RP4: Comparatively, ISO 9000:2000-registered plants have higher levels of management involvement, and communication will be positively related to higher levels of integration and quality assurance.

5. Discussion

Many of the criticisms of ISO 9000:2000 espoused by managers seem valid on the surface but may actually mask an underlying strategic position of a plant. This study attempts to demonstrate that companies who fully integrate a QMS can reap significant benefits internally and externally in terms of quality assurance. ISO 9000:2000 does not have to be a non-value-added, paper-driven process. However, companies that see registration as a game to keep business will not obtain the additional benefits seen in more proactive plants where more effort is put into quality standards integration and supply chain quality assurance. Much like the findings from Naveh and Marcus (2004), we find differences between plants that install a registered QMS with external coordination and integration and plants that do not. Those plants that see ISO registration as an opportunity to improve QA and supply chain integration of quality standards will be part of a more effective supply chain. Buyers wanting to improve the

integration of quality within their supply base should seek out suppliers that are prospectors. Prospectors have the greatest opportunity for a competitive advantage from ISO registration. Plants with a lesser amount of integration and plants that do not use ISO registration as a catalyst for change and quality assurance tend to be reactors and should not be sought out by buying firms. Interestingly, buyers wanting to increase either ISO standards integration or quality assurance should seek out defenders or analyzers. These types of plants, while not as desirable as prospectors, can improve a supply base and a supply chain to varying degrees.

ISO registration contains important foundations for QA. Registered plants are forced to examine all of their processes and, in doing so, their own competitive priorities. Many plants with a strong focus on QMS integration have used the documentation process as a tool to discover and later solve problems. Much the same as any new initiative, low-hanging fruits will be found early in the implementation of a quality system and its registration. Those plants that do a good job of integration will reap early benefits. They will also find more long-term returns through inclusion in a customer's supply base, less variance in manufacturing processes, visibility and communication with supply chain members, an external image of quality, and the ability to attract new customers that understand and work with registered suppliers.

ISO 9000:2000 forces plants to measure many things that they may not have previously measured. These metrics are useful in both finding and solving problems. Without a proper performance measurement system it is difficult to measure, manage, and hold people accountable for their actions. The importance of performance measurement cannot be stressed enough, as good performance measurement systems facilitate a better understanding of processes and products both internally and externally. A repeated sentiment from managers involved in this study is that without the structured approach of the ISO registration process, many quality system implementations would have fallen short of delivering the benefits discussed in this study. These same benefits help facilitate quality assurance upstream and downstream within a supply chain.

The results of this study contribute to theory development by exploring a strategic dimension of QA (i.e., ISO 9000:2000), positing new research propositions, and confirming relationships posited in previous research. They also suggest that future research should take into consideration the strategic position of a plant when assessing the impacts of ISO 9000:2000 or when modeling supplier selection practices that include ISO

registration of a supply base. In this study we show that ISO 9000:2000 has the potential, when used under the right circumstances, to improve QA across the supply chain. In other words, it is a tool for QA. It can be applied across firms so as to tap into the synergies associated with QA, such as better understanding of processes, lower costs, and improved performance. Through the use of a structured interview protocol and qualitative data collection methods, the information from the respondents in this study also helps to develop theory in a broader context. It does this through providing a better understanding of the ISO 9000:2000 uncertainties, risks, benefits, and implications for quality assurance within a supply chain. We find that ISO registration does not make for a level playing field and that the level of integration and impact on supply chain QA varies. This variance allows some plants to actually obtain competitive advantages from registration, while other plants will always struggle with QMS development, integration, and compliance with registration.

Limitations of this study include generalizability, causality, and empirical testing. The limited sample size and the industry involved constrains the generalizability of the findings. The qualitative approach does not support causality or the ability to empirically test propositions surrounding ISO 9000:2000 and objective measures of uncertainty, risk, benefits, and management support. Suggestions for future research focus on the evolutionary rather than the revolutionary nature of QA within supply chains. There is a need for a quantitative assessment of relationships identified from this study. Researchers should expand supply chain constructs to include a supplier's strategic orientation toward QA and ISO 9000:2000 registration. Additional research should test relationships between strategic orientation toward QA, ISO registration, competence, and performance. Additionally, the development of a QMS to aid in the process of quality assessment is necessary to further advance supply chain integration and quality assurance.

To date, there is a lack of empirical research comparing plants that have sought registration on their own versus plants whose customers mandated registration. Focusing on the automotive industry has allowed our research to be conducted from secondary data sources such as Compustat, with the help of event study analysis, since the automotive OEMs mandated ISO 9000:2000 registration. This would be an extension of Naveh and Marcus (2004) or Corbett et al. (2005). Further examination of their data sets should be able to distinguish between plants with and without mandates for registration simply based on industry codes while taking signaling into consideration.

This study provides support for the idea that ISO 9000:2000 itself does not provide competitive advantage. The way a plant implements and uses the registration as a catalyst for change can lead to plant-specific advantages and is an indication of the strategic orientation of the facility. The differences in implementation lead to differences in supply chain QA among a supply base that is required to have registration. If the objective of the buying firm is to create a uniform dialog and a quality platform among its suppliers, ISO registration goes a long way in helping to do this. There will always be differences between plants and additional measures of quality, risk, and performance. The ability to communicate and share information needs to be included in the purchasing decision. ISO registration alone is not enough to ensure anything beyond compliance with the registration standard.

Appendix A. ISO 9000:2000 requirements

1. Scope
 - 1.1 General
 - 1.2 Permissible exclusions
2. Normative references
3. Terms and definitions
4. Quality management system
 - 4.1 General requirements
 - 4.2 General documentation requirements
5. Management responsibility
 - 5.1 Management commitment
 - 5.2 Customer focus
 - 5.3 Quality policy
 - 5.4 Planning
 - 5.4.1 Quality objectives
 - 5.4.2 Quality planning
 - 5.5 Administration
 - 5.5.1 General
 - 5.5.2 Responsibility and authority
 - 5.5.3 Management representative
 - 5.5.4 Internal communication
 - 5.5.5 Quality manual
 - 5.5.6 Control of documents
 - 5.5.7 Control of quality records
 - 5.6 Management review
 - 5.6.1 Review input
 - 5.6.2 Review output
6. Resource management
 - 6.1 Provision of resources
 - 6.2 Human resources
 - 6.2.1 Assignment of personnel
 - 6.2.2 Training, awareness, and competency
- 6.3 Facilities
- 6.4 Work environment
7. Product realization
 - 7.1 Planning of realization processes
 - 7.2 Customer-related processes
 - 7.2.1 Identification of customer requirements
 - 7.2.2 Review of product requirements
 - 7.2.3 Customer communication
 - 7.3 Design and/or development
 - 7.3.1 Design and/or development planning
 - 7.3.2 Design and/or development inputs
 - 7.3.3 Design and/or development outputs
 - 7.3.4 Design and/or development review
 - 7.3.5 Design and/or development verification
 - 7.3.6 Design and/or development validation
 - 7.3.7 Control of design and/or development changes
 - 7.4 Purchasing
 - 7.4.1 Purchasing control
 - 7.4.2 Purchasing information
 - 7.4.3 Verification of purchased products
 - 7.5 Production and service operations
 - 7.5.1 Operations control
 - 7.5.2 Identification and traceability
 - 7.5.3 Customer property
 - 7.5.4 Preservation of product
 - 7.5.5 Validation of processes
 - 7.6 Control of measuring and monitoring devices
8. Measurements, analysis, and improvement
 - 8.1 Planning
 - 8.2 Measurement and monitoring
 - 8.2.1 Customer satisfaction
 - 8.2.2 Internal audit
 - 8.2.3 Measurement and monitoring of processes
 - 8.2.4 Measurement and monitoring of product
 - 8.3 Control of nonconformity
 - 8.4 Analysis of data
 - 8.5 Improvement
 - 8.5.1 Planning for continual improvement
 - 8.5.2 Corrective action
 - 8.5.3 Preventive action

Source: Kartha (2004). ISO 9000:2000 quality management systems, ISO website.

Appendix B. Interview protocol questions directly pertaining to ISO 9000:2000

- What is/are your job titles?
- Number of years in current position?
- What are the primary products produced by your company?

- Number of employees in company?
- What is your company's export sales as a percentage of total sales?
- What percentage of sales are made to the European Union?
- What is your company's consumer/end user sales as a percentage of total sales?
- Is your company publicly traded?
- Is your company privately owned?
- Is your company a foreign-owned subsidiary/trans-plant?
- Is your company a joint venture?
- What are the major competitive thrusts in your industry (current and near future)?
- What type of quality management system is in place, and what is its role in the planning and execution of activities?
- What is your understanding of ISO 9000:2000 at this time?
- What is your firm's position on ISO 9000 in the past? Current position?
- How was this decision arrived at?
- What factors influenced this decision?
- Under what conditions would management change this decision?
- What are the benefits you can see being generated by this form of registration?
- Costs?
- Risks?
- What are the primary reasons for your firm to seek ISO 9000:2000 registration?
- How do you measure performance in your department/area how has ISO impacted this?
- Do you have any final comments that you would like to make before we finish this interview?
- Are there people in this firm you think we should talk with?
- Can we use your name when we introduce ourselves?

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