A Comparative Assessment of Quality Management Practices in Manufacturing Firms and Service Firms: A Repeated Cross-Sectional Analysis

Mahour M. Parast, Arsalan Safari, and Ismail Gölgeci

***Abstract*—There are significant structural differences between the manufacturing and service sectors at the firm level, but quality management research has not yet identified similarities or differences in the quality management practices of these two sectors. This study examined 15 years of repeated cross-sectional data for manufacturing firms and service firms that applied to the Malcolm Baldrige National Quality Award between 1991 and 2006. Based on contingency theory, we looked for differences between manufacturing firms and service firms in their implementation of quality management. More specifically, we looked for differences between the two sectors in scores on the Baldrige criteria, using 351 observations from both industry sectors. We found significant differences between manufacturing firms and service firms in two quality management practices: *human resource development and management*, and *customer focus and satisfaction*. We also found significant differences between manufacturing firms and service firms in the relationship between the Baldrige criteria and organizational quality outcomes.**

***Index Terms*—Baldrige, manufacturing, quality management, quality outcomes, service.**

I. Introduction

WHILE the origins of quality management can be traced to the pioneering work of several quality leaders in manufacturing settings, these practices have been translated to nonmanufacturing sectors to help other organizations with their quality improvement programs [20]. As such, the critical role of quality in superior, sustained organizational performance has also been acknowledged in the service sector, and quality management has witnessed increasingly widespread application in the service sector [1], [52], [54]. However, despite the popularity of quality management practices (QMPs) in different industrial segments, it is unclear whether these practices are fully effective when transferred from manufacturing to other sectors, or if certain adjustments should be made in other sectors to improve the effectiveness of quality programs.

Although quality management principles can be applied to service organizations, these organizations typically show relatively lower rates of adopting QMPs [33]. The industry sector is an important factor that can influence the drivers, nature, and outcomes of QMPs [51], [54]. Nevertheless, studies about how QMPs differ in different types of organizations are limited because of a lack of available data for examining the dynamics of quality practices over time and across industries. Such a dearth of knowledge is becoming especially problematic amid the growing prevalence of servitization [28], [48], [56], [57] and the increasingly complex interplay between the service sector and the manufacturing sector [13], [14], [38]. Thus, our first research question is to examine the level of implementation of quality management between manufacturing organizations and service organizations, to identify how those two types of organizations differ in their emphasis of QMPs. The contingency theory of management suggests that such differences may exist [69]. However, empirical evidence to support such differences is quite limited.

Understanding the relationships among QMPs is critical for identifying the determinants of operational and business results [51]. The quality management studies for service enterprises have discussed the association between QMPs and service quality results. However, they lack a holistic theoretical framework that considers all key quality management elements and their interrelationships. In addition, the literature does not discuss whether the relationships among the QMPs in service organizations differ from those in manufacturing organizations. Thus, our second research question examines QMPs and their impact on quality results across manufacturing organizations and service organizations.

We seek to address two gaps in the literature for quality management in manufacturing firms and service firms. First, we assess quality management implementations for both industry sectors and identify the similarities and differences in how these two sectors actually implement quality practices. To do this, we use a comprehensive quality management framework developed based on the seven main criteria of the Baldrige model. The Baldrige model is considered an effective platform to examine the quality practices in both manufacturing and service sectors, from both theoretical and practical aspects, because of the nature

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of this quality excellence model, its development, and its adoption by firms worldwide [50], [51], [73]. We discuss these differences from the contingency theory perspective, including factors that operations management scholars have overlooked. Second, for manufacturing and service firms, we examine the relationship between firms' QMPs and their quality outcomes by applying a multi-group analysis of invariance, using objective secondary data collected through professional auditors/examiners of the MBNQA program over an extended period of 15 years. This rigorous, robust approach to collecting and reporting data provides high-quality data, which improves the validity and effectiveness of this study and its findings. It helps us measure the magnitude of changes and trends over this extended period. Using the contingency theory of management, we provide a theoretical perspective that is suitable for examining the similarities and differences in quality management for these two types of firms [16], [67].

To investigate our research questions, we used a sample of 351 observations of repeated cross-sectional data over 15 years for manufacturing and service firms that applied for the Malcolm Baldrige National Quality Award (MBNQA). The MBNQA, which has been developed and adopted by organizations worldwide, provides a framework for assessing quality. This framework is a suitable platform for investigating QMPs in terms of theoretical rigor and managerial relevance, due to the nature of the Baldrige model [32], [50], [51], [62], [73]. Using repeated cross-sectional data from independent reviewers also strengthens the reliability of the data and the rigor of the research design. This repeated cross-sectional data also facilitated an examination of the dynamics of change in manufacturing and service firms over 15 years, which provided further evidence for moving beyond correlations and establishing causality.

Furthermore, using scores from independent reviewers ensured a degree of objectivity for quality assessments, thereby addressing the limitations associated with collecting primary data through surveys completed by managers. Indeed, the rigorous, objective collection and evaluation of data by trained independent reviewers ensure a level of reliability that probably could not be achieved by conducting a survey relying on perceptual measures [70]. Thus, this study makes significant theoretical contributions and has managerial implications for quality management solutions in both the manufacturing and service sectors.

In summary, this study provides two main contributions to the theory and practice of quality management. From a theoretical perspective, this study applies and examines an overreaching quality management framework developed through the Baldrige model that compares manufacturing and service sectors' quality and operational outcomes on a more detailed level. Because quality management principles and solutions emerged from the manufacturing sector, and because of the unique characteristics of service firms that differentiate them from manufacturing firms, evaluating the quality and operational outcomes of these two sectors using a business excellence model such as the Baldrige quality awards is important. From a managerial perspective, managers in manufacturing organizations or service organizations can use the magnitude of impact of quality management elements on quality and operational results to make informed decisions about optimizing the impact of investments in this area.

II. Theoretical Background

A. Contingency Theory of Management

The contingency theory asserts that firms' actions and investments depend upon many internal and external factors [37]. Because of inherent differences across organizations, firms manage their processes differently to better suit their internal and external environments [18]. Contingency theory allows us to address the following three key areas in management research [69]:

1) to identify different contingencies across contexts;
2) to categorize contexts concerning these contingency factors;
3) to determine the most efficient organizational design and processes for a given context.

In operations management, contingency theory has been used to examine the generalizability of operations management practices, thereby challenging the idea of the universal applicability of operations management practices [69], [77]. For example, Senot et al. [63] used contingency theory to examine the role of bottom-up decision-making processes in improving the quality of healthcare service delivery, and Roels [58] used contingency theory to understand the optimal design of productive services. Contingency theory has also been considered in the context of supply chain systems to address supplier insolvency issues and mitigate disruptions in a supply chain [29]. The operations literature also underscores the importance of several key variables—such as national culture [24], strategic context [65], and firm size [64], [76]—in ensuring a good fit between an organization and the environment.

Initial studies took the universal applicability of quality management for granted and promoted a "one size fits all" approach [25], [69]. However, most current thinking and scholarly work in quality management encourage a contingency perspective on quality. A contingency perspective suggests that contextual and organizational factors—such as firm size, culture, level of international competition, operational scope, and firm innovativeness—should be considered in effectively implementing quality systems [60], [65], [77]. Using an approach of multiple case studies, McAdam et al. [40] demonstrated how the contingency factors of strategy, culture, life cycle, and customer focus interact when implementing QMPs.

Despite the wealth of research that has adopted contingency theory, operations management scholars have overlooked some important contingency factors. For example, one important contingency factor that has received limited attention in previous studies is the difference between manufacturing and service firms and how their differing business natures can influence QMPs. We discuss these contingencies in the following section.

B. Quality Management in Manufacturing Firms and Service Firms

Research has noted that implementations of QMPs in service firms should pay attention to the unique characteristics of service

TABLE I
COMPARISON OF CONTINGENCY FACTORS IN MANUFACTURING AND SERVICE FIRMS

Contingency factor	Manufacturing	Service
Financial investment	High	Medium to low
Equipment intensity	High	Medium to low
Nature of processes	Production and consumption can be separated.	Production and delivery are intertwined.
Mitigating quality issues	This can be handled if the product has not been delivered. A product recall can be challenging and requires establishing a reverse logistics system.	This may not be easily fixed as service creation and delivery happen concurrently through interactions with customers. Service recovery can be handled more easily.
Process complexity	It requires more complex production, supply chain, and logistic systems.	More straightforward
Patents	More emphasized	Less emphasized
Inventory management	Greater importance	Lesser importance
Customer contact	Low	High
Product Innovation	High	Medium to low
Process standardization /customization	High, medium, or low standardization, depending upon the firm's strategy	A high level of customization
Assessment and measurement	Less complicated	More complicated
Standards and regulations	Higher level of product, safety, and production standards	Lower level of standards

firms, which differ from those of manufacturing firms [1], [10]. For example, it would be harder to develop performance measures for service firms because of the intangible nature of service products. Such factors make activities like process improvement and service innovation more challenging in service organizations compared to their manufacturing counterparts [20].

Research into quality management for service organizations has followed a similar trajectory to other management practices that translated insights from manufacturing settings to service settings. Thus, the state of quality management research is that there remain inconsistencies between manufacturing and service firms [59]. One group of studies highlights the differences between the manufacturing and service sectors when implementing quality management. They find that practices like statistical process control and process management are emphasized more in manufacturing firms [5], [80]. In contrast, other studies have adopted a more homogeneous approach to quality management in the different sectors. For example, Prajogo [55] did not report any differences in the quality management implementations of manufacturing and service firms in Australia.

Prior studies have not provided a clear empirical assessment of the differences between the manufacturing and service sectors from a quality management perspective [36]. For example, manufacturing firms emphasize technical skills when recruiting, and quality measurement is mainly achieved through statistical tools. Service organizations, however, are more people-oriented, with evaluations of quality being based on customer satisfaction. Thus, building upon the contingency theory of management, we expect to see emerging differences in QMPs and their effects on organizational quality outcomes, especially given the inherent structural differences between these two sectors.

Additionally, organizations design their internal operations and processes to suit their business environment to remain competitive [18], so we expect to see differences in the association between QMPs and organizational processes. Regarding the contingency theory of management, we expect to see differences in two areas: 1) the implementation level of quality management; and 2) the association between quality management and organizational outcomes. We examine these two research questions in the following sections.

C. Comparative Assessment: What Is in the Literature?

Table I provides an overview of the similarities and differences between manufacturing firms and service firms regarding the contingencies inherent in each system. As can be seen, significant differences exist in terms of capital intensity, the nature of organizational processes, quality control, customer contact, and practices for assessment and measurement.

A review of studies pursuing a comparative assessment of quality management in manufacturing and service firms reveals some interesting insights (see Table II). The first such insight is the absence of an overarching theoretical framework for assessing the similarities and differences in the quality management implementations of manufacturing and service firms. Whether studies report such differences (e.g., [4] and [5]) or not (e.g., [57] and [80]), they all lack a theoretical perspective. Likewise, studies investigating the similarities and differences in the quality management implementations of manufacturing and service firms report mixed findings. Thus, only a limited understanding can be gained from reviewing these studies, and the findings are not immediately generalizable.

TABLE II
COMPARATIVE ASSESSMENT OF QUALITY MANAGEMENT IN MANUFACTURING FIRMS AND SERVICE FIRMS (SORTED CHRONOLOGICALLY)

Study	Research	Country	Major findings
Parasuraman and Varadarajan [53]	Conceptual	–	From a quality management point of view, the differences between products and services can only be found in certain employee management issues.
Benson et al. [6]	Survey	USA	In service organizations, the level of quality management is lower, and both external and internal factors influence the quality management of products. In addition, the quality management of services is affected by internal factors.
Troy and Schein [81]	Conceptual	–	The study confirms differences in manufacturing and service organizations regarding their view of quality and quality management.
Beaumont et al. [5]	Survey	Australia	The study compares and identifies significant differences between the manufacturing and service sectors. The manufacturing sector generally applies more quality management solutions and sample inspections than the service sector. In addition, the manufacturing sector is more likely to use single sourcing, while the service sector is more likely to apply multiple sourcing policies. Manufacturers focus more on external customers than service providers do. Finally, the service industry is more inclined than the manufacturing industry to use consultants, especially for training purposes.
Huq and Stolen [33]	Survey	USA	The authors highlight the differences between the manufacturing and service sectors in terms of their quality management implementation. While manufacturing firms fully commit to applying quality management, service firms apply it more selectively. While service firms focus on the human interaction and business process aspects of quality management, manufacturing firms focus more on scientific and structured approaches. Because of these approaches, manufacturing firms perform better than service firms in terms of employee development, empowerment, and communication.
Silvestro [66]	Conceptual	–	The literature on quality management in manufacturing has significantly influenced the literature on service quality management.
Solis et al. [71]	Survey	Taiwan	There is a significant difference between manufacturing and service firms in terms of their quality management results, with manufacturing firms showing better performance in six quality management dimensions and their quality outcomes.
Gowen and Tallon [27]	Survey	USA	Authors confirm that quality management systems are better developed in manufacturing firms than they are in service firms. The higher success rate for QMPs in the manufacturing sector may be associated with more training programs, higher levels of management, and employees' commitment and support.
Woon [80]	Survey	Singapore	Findings demonstrate that service organizations have a significantly lower level of quality management implementation than manufacturing-oriented manufacturing and service organizations.
Antony et al. [4]	Survey	UK	Five out of 11 management factors are significantly different in services and manufacturing, including supplier relationships and management; top leadership commitment and support; communication; and quality systems and practices. Customer focus is the most crucial factor, while the factor of supplier relations and management is the least important factor for the quality systems and practices of both manufacturing and service sectors in the UK.
Prajogo [55]	Survey	Australia	The study found no significant differences in most TQM practices and quality outcomes when comparing the manufacturing and service sectors. The study also validates the Baldrige model to represent quality management constructs across both sectors.
Singh et al. [68]	Survey	Australia	Differences exist between service organizations and manufacturing organizations. These relate to market share, employee engagement and morale, customer loyalty, response to customer needs, and production flexibility, which are higher for service firms.

TABLE II
CONTINUED.

Study	Research	Country	Major findings
Rönnbäck and Witell [59]	Meta-analysis	–	The study's findings reveal various inconsistencies in the literature about the association between quality management and business outcomes when comparing manufacturing and service firms. These inconsistencies relate to top-management commitment, supplier relationships, and customer orientation and focus, among other things. The inconsistencies can be explained by various variables, namely firm size, culture, and the research design used in a study. In terms of consistencies, the two main quality management principles of workforce management and process management approaches are highlighted in several studies as being more central for service firms.
Kumar et al. [35]	Survey	India	According to their findings, both service industries and manufacturing industries agree that implementing quality management success factors is crucial. Continuous improvement is the most important factor in manufacturing, while customer satisfaction is ranked as the top factor in services.
Talib and Rahman [75]	Literature review	–	The study reveals similarities and differences in different aspects of quality management implementations in manufacturing and service firms.
Eriksson [20]	Survey	Sweden	In terms of quality management, the service sector outperforms the manufacturing sector. Both researchers and practitioners should change their mindset about the differences between manufacturing and service firms. Manufacturing firms should review leadership practices, planning, information and analysis, employee commitment, and customer relations management in successful service firms.

A useful and influential study about quality management in the service sector and manufacturing sector was conducted by Rönnbäck and Witell [59]. They performed a meta-analysis and reviewed previous studies of quality management implementations in manufacturing and service firms. They reported several inconsistencies in these studies concerning leadership support and commitment, supplier relationships and management, and customer focus. They attributed these differences to factors such as firm size, organizational culture, and research design. However, the authors also pointed to two similar quality management principles in both sectors: workforce management, and the process management approach.

Overall, our literature review suggests similarities and differences between manufacturing and service firms in their implementation of quality management. Table II lists 16 studies that compared quality management in the service sector and manufacturing sector. Fifteen of those sixteen studies found significant differences between the service sector and the manufacturing sector in implementing quality management and in the impact on business operations. Six studies concluded that the manufacturing sector was more successful than the service sector in implementing QMPs. Only one study found that the service sector outperformed the manufacturing sector: Eriksson (2016), using data from Swedish firms, concluded that manufacturing firms should learn from service organizations about leadership practices, planning, information and analysis, employee commitment, and management of customer relations. Based on the majority of these studies, manufacturing firms are mainly looking for continuous improvement and structural approaches to quality management, and service firms are mainly looking for better management of human resources, customer relations, and customer satisfaction. These studies lack an overarching theoretical perspective and rigorous, reliable data, so they did not produce reliable results. As shown in Table II, except for the work of Prajogo [55], no research has used "actual" Baldrige data as the basis for a comparative assessment of quality management between the service sector and the manufacturing sector. Another major limitation of previous studies is that they all used momentary, cross-sectional survey data, so these studies could not capture the effect of time on the relationships between variables and thereby assess the sustainability of QMPs.

This study aims to address these limitations in the literature by applying a conceptual model developed based on the Baldrige theoretical basis (i.e., the measurement model) and the interrelationships among criteria (i.e., the structural model) for both manufacturing and service firms. In addition to following theories of quality management and operations management, we consider contingency theory and factors discussed in the literature but overlooked by scholars in quality management. Our conceptualization and theorization of the Baldrige model and the interrelationships among its criteria are built upon a theoretical approach considering both the context-free and contingency aspects of quality management. From the context-free aspects, QMPs can be universally implemented in all types of firms located in different regions, industries, and sizes, as shown by numerous examples in the literature discussed earlier. From the aspect of contingency theory, the QMPs and outcomes are contingent upon the specific context, and the associations among the Baldrige criteria and outcomes are different between manufacturing and service firms.

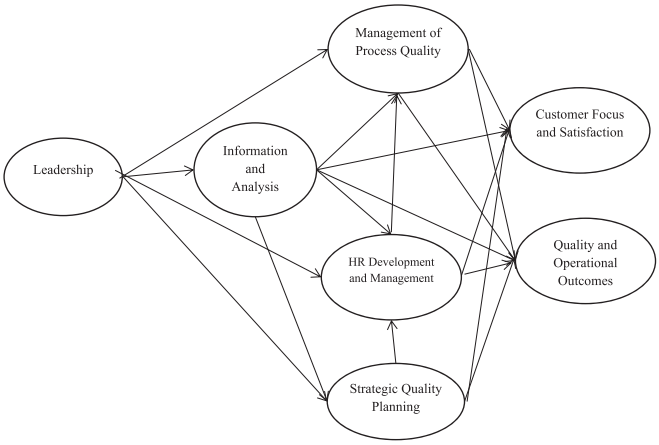

Fig. 1. Structural model for quality management in manufacturing.

III. Hypotheses

We predict that the association between quality management and organizational quality outcomes will follow the studies that have discussed how the Baldrige quality model actually works [49], [50], [51], [78]. Despite some variation in the conceptualization of the relationships among the MBNQA (Baldrige) criteria,[1] the general findings suggest that leadership is the main driver of the model, and this impacts other quality practices, including strategic quality management, information and analysis, the management of process quality, and HR development and management. These practices then collectively determine two quality-related outcomes: quality and operational outcomes and customer focus and satisfaction. We use the framework that is examined in the context of U.S. manufacturing firms, as proposed by Wilson and Collier [78]. This is presented in Fig. 1. Further details on these relationships are presented in Appendix I.

We, therefore, follow two research questions concerning the QMPs of manufacturing and service firms. First, we hypothesize that there are different levels of quality management implementation in manufacturing firms and service firms. Second, we hypothesize that the association between QMPs and quality outcomes varies between manufacturing firms and service firms. These hypotheses are added to the list in Appendix I and examined in the section on results.

VI. Sample and Data

We used the following practices of the Baldrige model for business excellence [44]:

1) leadership;
2) strategic quality planning;
3) information analysis and knowledge management;
4) customer focus and satisfaction;
5) HR development and management;
6) management of process quality;
7) quality and operational outcomes.

A. Data

The data for the manufacturing and service firms were collected as part of the MBNQA program, which is run by NIST [44]. Independent reviewers assign scores for each organization that applied for the MBNQA, so unlike cross-sectional surveys, where respondents in an organization provide their responses according to a Likert scale, independent evaluators assign scores to organizations based on their QMPs. The independent Baldrige examiners work voluntarily, without payment; they receive sufficient training to examine firms through the MBNQA program. Examiners review and evaluate applications on a very detailed level and perform various assessments, including site visits. Then, Baldrige judges determine the recommended award recipients. All examiners and judges sign a Code of Ethical Conduct to follow the principles of professional conduct (integrity, confidentiality, and respect for intellectual property) while participating in all organizational evaluations and assessments and to avoid any real or perceived conflicts of interest [45].

A site visit is an important element of organizational assessment, and it is an extensive process for examiners. As mentioned in the MBNQA program, site visits enable examiners to fully understand the details of organizational conditions from various quality-related perspectives and Baldrige criteria and firms' key strengths and vulnerabilities [45]. During their visits, they need to complete a scorebook package for each firm that includes six types of worksheets: key factors worksheet, key themes worksheet, item worksheet, highest-ranking official (HRO) worksheet, scoring summary sheet, and site visit issue worksheets. Therefore, there is a high level of objectivity and robustness in the MBNQA examination process; this provides greater reliability for the data and minimizes self-reporting biases [22], [50].

B. Sample

This study's sample consists of manufacturing firms and service firms that applied for the MBNQA program between 1991 and 2006 in the United States. We excluded data for 1990 from the analysis because this was the first year of data collection. This left 221 observations for manufacturing firms and 130 observations for service firms during this period. Table III presents a summary and the descriptive statistics of this data for each sector by year. The first column represents the year, with the sample size for that year shown in parentheses. The statistics under each variable present the sample mean $(\bar{X})$ and sample standard deviation (s_x). We calculated both the skewness (asymmetry) and kurtosis (peakedness) of the data. Our analysis found that both the skewness and kurtosis were between -0.582 and 0.158, which is within the recommended range [74].

As shown in Table III, the mean values of some variables improved over time; this could be attributed to the widespread application of quality management solutions in both sectors.

[1] Studies that have used the Baldrige criteria have used a different conceptualization and operationalization for quality and how QMPs impact organizational performance. Thus, there is a lack of an overarching theoretical perspective for how the Baldrige quality works. In the absence of strong theoretical frameworks, we used the most widely accepted framework for the Baldrige model, one that is grounded in the quality management literature.

TABLE III
SUMMARY OF DATA AND DESCRIPTIVE STATISTICS (MANUFACTURING AND SERVICE)

Year (N)	Total samples	Manuf. samples	Service samples	Leadership		Strategic quality planning		Customer focus and satisfaction	
				Manuf.	Service	Manuf.	Service	Manuf.	Service
1990	62	44(71%)	18(29%)	(0.43, 0.25)	(0.38, 0.27)	(0.41, 0.24)	(0.36, 0.24)	(0.38, 0.23)	(0.33, 0.23)
1991	56	35(62.5%)	21(37.5%)	(0.57, 0.15)	(0.54, 0.18)	(0.52, 0.16)	(0.45, 0.17)	(0.52, 0.17)	(0.43, 0.17)
1992	45	30(67%)	15(33%)	(0.59, 0.14)	(0.62, 0.13)	(0.54, 0.15)	(0.59, 0.16)	(0.54, 0.13)	(0.54, 0.15)
1993	43	30(70%)	13(30%)	(0.64, 0.11)	(0.64, 0.10)	(0.55, 0.15)	(0.57, 0.12)	(0.56, 0.13)	(0.52, 0.12)
1994	40	23(57.5%)	17(42.5%)	(0.61, 0.11)	(0.63, 0.10)	(0.52, 0.11)	(0.54, 0.13)	(0.53, 0.12)	(0.50, 0.11)
1995	28	18(64%)	10(36%)	(0.66, 0.08)	(0.63, 0.09)	(0.54, 0.12)	(0.53, 0.14)	(0.56, 0.11)	(0.50, 0.09)
1996	19	13(68%)	6(32%)	(0.59, 0.10)	(0.57, 0.09)	(0.52, 0.11)	(0.55, 0.07)	(0.57, 0.11)	(0.50, 0.09)
1997	15	8(72%)	7(47%)	(0.63, 0.10)	(0.53, 0.12)	(0.58, 0.08)	(0.48, 0.15)	(0.56, 0.07)	(0.53, 0.13)
1998	18	13(72%)	5(28%)	(0.57, 0.10)	(0.49, 0.15)	(0.48, 0.13)	(0.42, 0.12)	(0.58, 0.10)	(0.48, 0.13)
1999	15	4(27%)	11(73%)	(0.58, 0.02)	(0.47, 0.08)	(0.55, 0.13)	(0.40, 0.14)	(0.60, 0.07)	(0.48, 0.12)
2000	19	14(74%)	5(26%)	(0.50, 0.15)	(0.50, 0.09)	(0.46, 0.16)	(0.46, 0.09)	(0.53, 0.015	(0.47, 0.06)
2001	11	7(64%)	4(36%)	(0.58, 0.03)	(0.43, 0.16)	(0.48, 0.05)	(0.39, 0.18)	(0.55, 0.06)	(0.49, 0.18)
2002	11	8(73%)	3(27%)	(0.48, 0.09)	(0.50, 0.13)	(0.40, 0.10)	(0.46, 0.14)	(0.47, 0.09)	(0.49, 0.15)
2003	18	10(55.5%)	8(44.5%)	(0.44, 0.13)	(0.51, 0.11)	(0.40, 0.14)	(0.47, 0.11)	(0.44, 0.13)	(0.54, 0.06)
2004	13	8(61.5%)	5(38.5%)	(0.55, 0.10)	(0.55, 0.14)	(0.50, 0.16)	(0.52, 0.12)	(0.59, 0.08)	(0.54, 0.18)
2005	6	0(0%)	6(100%)		(0.49, 0.17)		(0.44, 0.18)		(0.50,0.16)
2006	4	0(0%)	4(100%)		(0.60, 0.10)		(0.58, 0.08)		(0.57, 0.03)

Year (N)	Total samples	Information and analysis		HR development and management		Management of quality process		Quality and operational outcomes	
		Manuf.	Service	Manuf.	Service	Manuf.	Service	Manuf.	Service
1990	62	(0.37,0.23)	(0.31,0.20)	(0.47, 19)	(0.42, 0.18)	(0.45,0.20)	(0.44,0.21)	(0.32, 0.29)	(0.31, 0.29)
1991	56	(47, 0.14)	(0.41,0.15)	(0.58, 0.12)	(0.50, 0.14)	(0.47,0.18)	(0.41,0.21)	(0.56,0.14)	(0.54, 0.19)
1992	45	(0.45, 0.11)	(0.49,0.11)	(57, 0.11)	(51, 0.11)	(0.48,0.14)	(0.52,0.16)	(0.53, 0.13)	(0.56, 0.12)
1993	43	(0.47, 0.12)	(0.47,0.12)	(0.61, 0.12)	(0.59, 0.10)	(0.48,0.13)	(0.50,0.15)	(0.57, 0.12)	(0.60, 0.14)
1994	40	(0.43, 0.11)	(0.47,0.11)	(0.58, 0.10)	(0.58, 0.10)	(0.49,0.13)	(0.49,0.13)	(0.56, 0.13)	(0.59, 0.09)
1995	28	(0.53, 0.12)	(0.54,0.07)	(0.62, 0.08)	(0.54, 0.12)	(0.55,0.12)	(0.47,0.09)	(0.57, 0.11)	(0.55, 0.08)
1996	19	(0.49, 0.10)	(0.50,0.10)	(0.60, 0.09)	(0.55, 0.08)	(0.52,0.11)	(0.49,0.12)	(0.58, 0.09)	(0.57, 0.06)
1997	15	(0.57, 0.13)	(0.50,0.10)	(0.54, 0.06)	(0.50, 0.12)	(0.60,0.11)	(0.50,0.16)	(0.52, 0.09)	(0.41, 0.16)
1998	18	(0.51, 0.12)	(0.39,0.08)	(0.51, 0.10)	(0.46, 0.13)	(0.57,0.11)	(0.47,0.12)	(0.45, 0.12)	(0.33, 0.13)
1999	15	(0.57, 0.09)	(0.43,0.11)	(0.54, 0.03)	(0.46, 0.08)	(0.62,0.11)	(0.47,0.07)	(0.48, 0.08)	(0.32, 0.12)
2000	19	(0.46, 0.12)	(0.42,0.16)	(0.50, 0.14)	(0.48, 0.05)	(0.52,0.12)	(0.48,0.12)	(0.40, 0.14)	(0.36, 0.13)
2001	11	(0.59, 0.07)	(0.47,0.17)	(0.54, 0.07)	(0.45, 0.13)	(0.57,0.06)	(0.44,0.17)	(0.42, 0.12)	(0.40, 0.17)
2002	11	(0.50, 0.09)	(0.49,0.19)	(0.48, 0.09)	(0.47, 0.11)	(0.50,0.10)	(0.49,0.15)	(0.38, 0.08)	(0.43, 0.15)
2003	18	(0.44, 0.12)	(0.52,0.09)	(0.47, 0.09)	(0.48, 0.10)	(0.47,0.16)	(0.52,0.11)	(0.34, 0.10)	(0.43, 0.10)
2004	13	(0.60, 0.05)	(0.58,0.10)	(0.54, 0.08)	(0.54, 0.06)	(0.55,0.15)	(0.53,0.12)	(0.43, 0.18)	(0.42, 0.13)
2005	6		(0.50,0.19)		(0.48, 0.16)		(0.51,0.20)		(0.37, 0.16)
2006	4		(0.59,0.12)		(0.56, 0.12)		(0.55,0.13)		(0.46, 0.10)

For example, in the manufacturing sector, the average score for Leadership remained relatively stable over the 13 years of available data (from 0.57 in 1991 to 0.55 in 2004), as did strategic planning for quality (from 0.52 to 0.50). In contrast, for service firms, these two criteria improved slightly over the 15 years of available data: the average *leadership* score increased from 0.54 in 1991 to 0.60 in 2006, whereas *strategic planning* increased from 0.45 to 0.58 during the same period. We also see a positive trend for other key variables in the Baldrige model for both sectors: *customer focus and satisfaction* (from 0.52 to 0.59 for manufacturing, and from 0.43 to 0.57 for services); *information and analysis* (from 0.47 to 0.60 for manufacturing, and from 0.41 to 0.59 for services); and *management of process quality* (from 0.47 to 0.55 for manufacturing, and from 0.41 to 0.55 for services). However, we see a significant decline in *quality and operational outcomes*: from 0.56 to 0.43 in manufacturing firms, and from 0.54 to 0.46 in service firms.

In terms of the means, standard deviations, and correlations of the samples, as presented in Table III, the overall average for quality management ranges from 0.47 to 0.60 for manufacturing and from 0.41 to 0.60 for services. (Note that 1.00 is the maximum score for each variable.) This demonstrates that significant gaps exist in the quality management implementations for both sectors. Furthermore, the significant pairwise correlations among the Baldrige model's variables further support interrelationships among the variables, as reported in the literature. The pairwise correlation of variables for manufacturing and service firms is shown in Tables IV and V.

TABLE IV
PAIRWISE CORRELATIONS OF CONSTRUCTS (MANUFACTURING FIRMS)

	Mean	SD	1	2	3	4	5	6	7
1. Leadership	0.58	0.13	1.00						
2. Strategic planning	0.51	0.14	0.78***	1.00					
3. Customer focus and satisfaction	0.54	0.13	0.73***	0.77***	1.00				
4. Information and analysis	0.48	0.12	0.64***	0.63***	0.68***	1.00			
5. HR development and management	0.56	0.11	0.75***	0.68***	0.68***	0.49***	1.00		
6. Process management	0.50	0.14	0.64***	0.63***	0.70***	0.73***	0.57***	1.00	
7. Quality and operational outcomes	0.51	0.14	0.77***	0.74***	0.69***	0.51***	0.76***	0.57***	1.00

*** $p < 0.01$

TABLE V
PAIRWISE CORRELATIONS OF CONSTRUCTS (SERVICE FIRMS)

	Mean	SD	1	2	3	4	5	6	7
1. Leadership	0.56	0.14	1.00						
2. Strategic planning	0.50	0.15	0.79***	1.00					
3. Customer focus and satisfaction	0.50	0.13	0.72***	0.74***	1.00				
4. Information and analysis	0.47	0.13	0.73***	0.70***	0.75***	1.00			
5. HR development and management	0.52	0.11	0.73***	0.73***	0.72***	0.61***	1.00		
6. Process management	0.48	0.15	0.67***	0.75***	0.78***	0.72***	0.64***	1.00	
7. Quality and operational outcomes	0.49	0.16	0.80***	0.73***	0.57***	0.58***	0.71***	0.56***	1.00

*** $p < 0.01$

As can be seen in Tables IV and V, most constructs are highly correlated, indicating the interrelationships among the Baldrige criteria.

V. ANALYSIS AND FINDINGS

A. Comparative Assessment of Quality Management Implementations

Our first analysis relates to assessing quality management implementations in manufacturing firms and service firms. To explore this further, we compare the basic parameters of the seven quality management constructs for manufacturing and service firms over the same period from 1991 to 2004 (as shown in Table VI), even though we have more data points for the manufacturing sector.

The classic statistical procedure is to use a *t*-test to compare means. While the assumption of normality and equality of variances should be met for a *t*-test, we can also use a nonparametric test that is less sensitive to these requirements (as shown in Table VII).

To assess the assumption of the equality of variances, we used Levene's test [30]. We found that aside from the exception of information and analysis, the assumption of the equality of variances was met. To assess the equality of means between manufacturing firms and service firms, we reviewed the t-value and the corresponding *p*-values, and these revealed significant differences between these two sectors for two measures: *HR development and management* ($t = 3.159$, $p < 0.001$); and *customer focus and satisfaction* ($t = 2.205$, $p < 0.05$). Since manufacturing firms have greater mean values, these firms received significantly higher scores for implementing *HR development and management* when compared to service firms. We did not find any significant differences between manufacturing and service firms for other quality practices.

Since the assumption of the equality of variances was not met for *information and analysis*, we could not use a *t*-test for the equality of means. We used two nonparametric tests, the Mann–Whitney test and the two-sample Kolmogorov–Smirnov test, to compare the means for information and analysis in manufacturing and service firms [23], [39]. This provided the following statistics: for the Mann–Whitney test, $z = -0.06$, $p > 0.10$; and for the two-sample Kolmogorov–Smirnov test, $z = 0.688$, $p < 0.10$. Neither of the tests revealed any significant differences in *information and analysis* between the two sectors.

The difference between these two sectors for *HR development and management*, coupled with similar outcomes for *customer focus and satisfaction* and *operational and business outcomes,*

TABLE VI
DESCRIPTIVE STATISTICS FOR QUALITY MANAGEMENT PRACTICES

Construct	Sector	N	Mean	Std. Dev
Leadership	Manufacturing	221	0.58	0.13
	Service	130	0.58	0.13
Strategic planning	Manufacturing	221	0.51	0.14
	Service	130	0.51	0.14
Customer focus and satisfaction	Manufacturing	221	0.54	0.13
	Service	130	0.51	0.12
Information and analysis	Manufacturing	221	0.48	0.12
	Service	130	0.48	0.11
HR development and management	Manufacturing	221	0.57	0.11
	Service	130	0.53	0.11
Management of process quality	Manufacturing	221	0.13	0.07
	Service	130	0.13	0.06
Operations and business outcomes	Manufacturing	221	0.51	0.14
	Service	130	0.51	0.15

TABLE VII
COMPARATIVE ASSESSMENT OF QUALITY MANAGEMENT PRACTICES

Variables		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	Sig.
Leadership	Equal variances assumed	0.04	0.83	0.31	0.76
	Equal variances not assumed			0.32	0.75
Strategic planning	Equal variances assumed	0.00	1.00	0.08	0.94
	Equal variances not assumed			0.08	0.94
Customer focus and satisfaction	Equal variances assumed	0.80	0.37	2.21	0.03
	Equal variances not assumed			2.26	0.03
Information and analysis	Equal variances assumed	3.19	0.08	0.25	0.80
	Equal variances not assumed			0.26	0.79
	Equal variances assumed	0.43	0.51	3.16	0.001
Human resource management	Equal variances not assumed			3.19	0.001
Management of operations	Equal variances assumed	2.21	0.14	0.63	0.53
	Equal variances not assumed			0.65	0.52
Operational outcomes	Equal variances assumed	0.48	0.49	0.09	0.93
	Equal variances not assumed			0.09	0.93

provides some initial evidence for the existence of equifinality in the implementations of quality management systems [19]. We discuss this in the following sections.

B. Comparative Assessment of Quality Management's Impact on Business Outcomes

Our second research question calls for a comparative assessment of QMPs in manufacturing and service firms. Before comparing the measurement model across these two groups, we examined the validity of the measurement model for each group separately. All reliability measures were above the threshold recommended in the literature. Therefore, the measurement model provided an acceptable fit for each group [31], [47].

The process began by testing the measurement invariance between the two groups [12]. This process compared the difference in chi-square between the unconstrained model and the measurement weights, where the measurement weights were set equally. If the difference in the chi-square is statistically significant, we may conclude that a measurement invariance exists in the two groups. The unconstrained model provided the following fit indices: $\chi^2 = 300.894$ and $df = 200$. The measurement weights model provided $\chi^2 = 308.292$ and $df = 208$. To test whether the alternative model is a significant improvement over the original

TABLE VIII
COMPARATIVE ASSESSMENT FOR MANUFACTURING FIRMS AND SERVICE FIRMS

Path	Manufacturing		Service†	
	coefficient	p-value	coefficient	p-value
Leadership→Information and analysis	0.82	0.00	0.77	0.01
Leadership→ Strategic planning	0.72	0.00	−0.94	0.18
Leadership→ HR development	0.70	0.01	−0.06	0.80
Leadership→ Management of quality process	0.04	0.89	−3.50	0.26
Information and analysis→Strategic planning	0.27	0.10	2.31	0.01
Information and analysis→ Management of process quality	0.68	0.00	5.78	0.15
Information and analysis→Customer focus and satisfaction	0.19	0.37	0.97	0.11
Information and analysis→ Operational and business outcomes	−0.04	0.85	−0.60	0.67
Strategic planning→HR Development	0.05	0.86	.84	0.00
Strategic planning→ Customer focus and satisfaction	0.58	0.00	−1.09	0.33
Strategic planning → Operational and business outcomes	0.41	0.03	3.24	0.20
HR Development→ Management of process quality	0.44	0.06	−0.31	0.35
HR Development → Customer focus and satisfaction	0.24	0.18	0.67	0.04
HR Development → Operational and business outcomes	0.29	0.12	−0.26	0.71
Management of process quality → Operational and business outcomes	0.39	0.06	−1.67	0.18
Management of process quality→ Customer focus and satisfaction	0.05	0.75	0.73	0.22

† The structural model is not admissible.

model, we performed a chi-square test of ratio as follows [8], [11]:

$$\Delta\chi^2 = \chi^2_{\text{Full}} - \chi^2_{\text{Nested}} = 308.292 - 300.894 = 7.398$$
$$\Delta df = df_{\text{Full}} - df_{\text{Nested}} = 208 - 200 - 288 = 8.$$

We then calculated whether the difference in the chi-square for the two models ($\Delta\chi^2$) with its corresponding degrees of freedom (Δdf) was statistically significant, with the understanding that $\Delta\chi^2$ follows a chi-square (χ^2) distribution [72]. The corresponding p-value for $\Delta\chi^2 = 7.398$ and $\Delta df = 8$ is 0.494362, suggesting no evidence of measurement invariance between manufacturing and service firms.

To assess the structural invariance, we used the structural model developed for the Baldrige model [78]. In the absence of any definitive model for the Baldrige criteria for service firms, and considering that Wilson and Collier [78] proposed and validated the relationship for manufacturing firms, this model was used as a starting point to assess whether the relationship between the Baldrige criteria is invariant between manufacturing and service firms. Following the same procedure used for assessing measurement invariance, if there is no difference between these two sectors regarding their QMPs, the chi-square difference between the unconstrained model and the structured model, where all regression coefficients are equal, should be insignificant. This multi-group analysis provided the following statistics: for the unconstrained model, $\chi^2 = 1179.2$ and $df = 576$, whereas for the structural weights model, $\chi^2 = 1302.7$ and $df = 677$. To assess whether there is a significant difference between the two models in terms of the structural weights, we used the chi-square difference as follows:

$$\Delta\chi^2 = \chi^2_{\text{Full}} - \chi^2_{\text{Nested}} = 1302.7 - 1179.2 = 123.5$$
$$\Delta df = df_{\text{Full}} - df_{\text{Nested}} = 677 - 576 = 101.$$

The corresponding p-value for $\Delta\chi^2 = 7.398$ and $\Delta df = 8$ is 0.06, suggesting that there is evidence of structural weight differences between manufacturing and service firms. To further evaluate the difference between these sectors, we examined the structural model for both sectors separately; the results are shown in Table VIII.

An overview of the regression coefficient for the two models also suggests significant differences exist between manufacturing firms and service firms in terms of the Baldrige criteria. While the regression coefficients for the manufacturing firms are aligned with the proposed structural model, this is not the case for the regression coefficients for the service firms. For example, for service firms, the coefficient regression between the *management of process quality* and *operational and business outcomes* is statistically significant and negative ($\beta = -1.67$, $p < 0.05$). We also noticed that the variance of the error term for the *management of process quality* is negative, suggesting that the data for service firms do not support the structural model. This provides further evidence that differences exist between manufacturing firms and service firms concerning the Baldrige criteria.

C. Follow-Up Case Study

Since the independent MBNQA examiners' scores beyond 2006 are not available, we used a case study analysis to examine whether our findings and the statistical results can be applicable to the manufacturing and service firms that applied for the MBNQA program after the time of this study. Our goal is to assess the extent to which our statistical results apply to the period after our data.

First, we identified a list of manufacturing and service firms that applied for the MBNQA from 2007 to 2020. We evaluated their information and further examined the critical success factors that enabled manufacturing and service firms to achieve high-quality results. The NIST provides a list of Baldrige awardees in each category, along with a profile and an award application summary for each award recipient. We found this information very useful, as it provides important information about quality practices at top-performing manufacturing and service firms. (This is the official link to the MBNQA list: www.nist.gov/baldrige/award-recipients.) We could find the latest award recipient of the MBNQA program in the service category and the manufacturing category (as published on the above official link): PricewaterhouseCoopers Public Sector (now Guidehouse) (2014) in the service sector; and Lockheed Martin Missiles and Fire Control (2012) in the manufacturing sector. We reviewed the documents related to their quality management efforts, the examiners' evaluations, their best practices, and how they achieved superior quality outcomes.

Our review of their documents found that emphasizing information systems and knowledge management was the key to success in each organization. At Lockheed Martin, the leadership team is fully engaged in developing business strategies (both short-term and long-term) for growth, sustainability, and profitability. In addition, the leadership considers developing their core competencies, and they have close collaboration and effective communication with employees. That promotes a culture of learning and continuous improvement across the company. These leadership evaluations support the critical role of leadership in improving organizational quality and operational outcomes. To ensure a high level of quality in processes, the company has received many quality standard certifications: Capability Maturity Model Integration (CMMI), Management Systems AS9100/ISO 9001, Environmental ISO 14001, and Health and Safety Systems ISO 18001. This observation aligns with the results of the statistical model (see Table VIII) that identified management of process quality as one of the key practices in the Baldrige model for improving operational outcomes in the manufacturing sector.

Reviewing PricewaterhouseCoopers Public Sector (now Guidehouse) company's documents shows two important practices for Guidehouse to receive an award from MBNQA: leadership, and workforce focus. They have an effective process for strategic planning and an approach to continuous improvement in the entire enterprise. The senior leadership team is involved in several important areas: developing strategic plans and short-term plans, promoting innovation and intelligent risk-taking, providing effective collaboration with stakeholders, and promoting open communication with employees, including sharing key messages, decisions, and results. The leadership established a Quality Management Group (QMG) for two purposes: to implement the company's approach to working systems and processes of decision-making; and to develop a mechanism to continuously monitor and improve work systems and processes. The leadership team frequently reviews, analyzes, and applies the defined metrics to monitor and improve the system to ensure that all requirements are met. The company has established an effective workforce management system for planning, recruitment, retention, engagement, and rewards. In addition, the company has comprehensive collaboration plans with other key stakeholders, especially clients. The emphasis on the MBNQA criteria has led to significant improvement in the company's business growth, marketplace position, and revenue growth from 2009 to 2014 (the year that the organization received the last MBNQA award in the service sector), suggesting the effectiveness of the Baldrige model in improving organizational business results.

In summary, our review of the documents of these two top performers, the latest MBNQA awardees in the manufacturing sector and service sector, led to these observations for each awardee. In the manufacturing sector, along with the high commitment and responsibility of the leadership team, the emphasis on strategic planning and management of process quality leads to superior performance in both customer satisfaction and business results. In the service sector, according to this review of a successful service case and effective leadership involvement and commitment, the company's focus on workforce planning has improved customer satisfaction and business results. These two observations from recent MBNQA recipients in the manufacturing and service sectors are consistent with our empirical data findings using independent reviewers' scores. This provides further evidence that our empirical findings can be extended beyond the timeline of the dataset used in this study and are relevant to the current business environment.

VI. Discussion

While quality management in manufacturing and service firms is indispensable, little is known about how QMPs can be transferred from manufacturing firms to service firms. Servitization is rapidly becoming more important [48], [56], [57], and the interplay between manufacturing and service is becoming increasingly prominent and complex [13], [14], [38]. Under these circumstances, the lack of comparative analyses of QMPs in the manufacturing and service sectors hinders the development of quality management at the nexus of manufacturing and service operations. Our study addresses this situation by providing several important theoretical contributions and managerial implications, as discussed below.

A. Theoretical Contributions

This research contributes to the literature on quality management in manufacturing and service operations by showing how manufacturing firms and service firms differ in their implementations of quality management solutions, as evidenced by the MBQNA criteria. The unique dataset of repeated cross-sectional

data for both the manufacturing and service sectors allowed us to examine the dynamics of change in QMPs over an extended period. Thus, we could examine the validity of the structural model for both manufacturing and service firms, and we could assess the association between quality management solutions and quality outcomes for manufacturing and service firms from a longitudinal perspective.

The first contribution of this research is to provide an understanding of the similarities and differences in quality management implementations for these two types of firms. Consistent with the work of Rönnbäck and Witell [59], we showed that the two practices, or dimensions, of *HR Management and Development* and *Customer Focus and Satisfaction* significantly differ between manufacturing and service firms. This result demonstrates that these dimensions are highly behavioral and human-centered, and the differences are profoundly manifest between the two industrial contexts. We grounded our theorization and conceptualization in the contingency theory of quality management; this provides a theoretically and empirically sound perspective that considers our methodological approach and our high-quality data spanning 15 years.

Furthermore, we found that the higher level of *HR Management and Development* in manufacturing firms relates to greater interaction between HR and operations management practices, in agreement with Boudreau et al. [9]. Thus, we argue that manufacturing firms, when compared to their service-based counterparts, are more driven by the output and quality of their operational systems and organizational processes. Therefore, they are more inclined to pay greater attention to HR development and management practices. A more technical workforce is also more crucial to production and manufacturing systems, so it demands more attention to HR development. Manufacturing firms are also more inclined to develop contingency plans for dealing with a volatile business environment. Moreover, the diverse nature of the manufacturing process and its supporting functions—such as logistics, supply chain management, quality control, product recalls, and testing and experiments—require more attention to HR development and management. Manufacturers generally use cross-sectional teams involving production designers, managers, workers, and supervisors. Therefore, HR development and management are more relevant for meeting the technical needs of such interdisciplinary teams.

Our analysis shows that manufacturing firms emphasize customer focus and satisfaction more than service firms. While this may seem counterintuitive, there are several potential explanations for this. One is that quality management originates in manufacturing firms [17], so these firms are better at understanding and incorporating customer-related issues, having previously learned the importance of customer focus and satisfaction. A second possible reason could relate to how quality is defined and perceived in manufacturing firms compared to service firms. Anderson et al. [3] and Johnson and Nilsson [34] assert that the dimensions of reliability and customization have different roles in manufacturing and service firms. Such a difference in customer focus and satisfaction is also supported by previous studies, with customer orientation being shown to have a strong relationship with business outcomes in manufacturing organizations [46], [71].

A second theoretical contribution of this study concerns how QMPs improve organizational quality outcomes for both industry sectors. Although the literature clarifies the differences between manufacturing firms and service firms in their implementation levels of quality management, the association between quality management and organizational quality outcomes remains surprisingly overlooked. This implies that we should not expect differences in this association between manufacturing firms and service firms. Thus, this study provides the first comparative assessment to show the relationship between manufacturing firms and service firms. Furthermore, we show that while leadership is the main driver of the quality system in both sectors, the association dynamics between quality management solutions and organizational quality outcomes differ significantly. This indicates that we cannot use benchmarking techniques to address quality issues in service organizations under the mistaken assumption that the practices used in manufacturing organizations will translate to the service sector.

While we managed to verify the validity of the proposed model for the Baldrige criteria in manufacturing organizations, our analysis showed that service organizations do not follow the same structural model. From the perspective of the contingency theory of quality management, we expect this to be the case. If contingencies exist specific to manufacturing firms or service firms, these will influence the relationship between QMPs and organizational quality outcomes. For example, in a manufacturing setting, we can separate production from product delivery to customers; in a service setting, these two practices are intertwined and inseparable. Thus, quality management in service operations requires emphasizing different QMPs from those used by manufacturing operations.

B. Managerial Implications

This study also has implications for operations managers in manufacturing firms or service firms. Our first recommendation for operations managers is to understand and reflect upon the similarities and differences between manufacturing firms and service firms in the implementation of quality management. The outcomes are also important for manufacturing firms with a substantial service element. This study has also showed that taking benchmarking best practices from manufacturing and extending them to the service segment of an organization may not necessarily support quality outcomes.

The second practical implication of the study is to realize the distinction between manufacturing firms and service firms in terms of the level of quality management implementation. Operations managers should be mindful of the differences that exist between these two segments in terms of *human resource development and management* and *customer focus and satisfaction.* Manufacturing firms have paid more attention to these practices compared to service organizations. This becomes critical in situations where organizations are dealing with both

APPENDIX I
RELATIONSHIPS AMONG THE BALDRIGE CRITERIA FOLLOWING THE BALDRIGE MODEL

Hypothesis	Evidence and Justification
Leadership positively affects the management of process quality.	Wilson and Collier [78], Pannirselvam and Ferguson [49], and Meyer and Collier [41] confirmed the impact of quality leadership on process quality. The positive effect of organizational leadership in enhancing quality in service organizations is addressed in the literature [1], [7].
Leadership positively affects information and analysis.	Both Wilson and Collier [78] and Meyer and Collier [41] confirmed the effect of quality leadership on information and analysis.
Leadership positively affects HR management and development.	Wilson and Collier [78] and Meyer and Collier [41] as well as Pannirselvam and Ferguson [49] confirmed the significant effect of quality leadership on HR management and development.
Leadership positively affects strategic quality planning.	Wilson and Collier [78] also confirmed the significant effect of quality leadership on strategic planning for quality. Mosadeghrad [42] also confirmed the significant effect of leadership on strategic planning in healthcare enterprises.
Process quality management positively affects customer focus-satisfaction.	Wilson and Collier [78], Pannirselvam and Ferguson [49], and Meyer and Collier [41] discussed the positive impact of process quality on customer focus and satisfaction.
The management of process quality positively affects quality and operational outcomes.	Wilson and Collier [78], Pannirselvam and Ferguson [49], Ouzrout et al. (2008), Sekhari and Savino (2009), and Savino and Mazza [82] confirmed the significant impact of process quality on continuous improvement and quality and operational outcomes. Putting lower priority levels for continuous quality improvement negatively influences quality outcomes (Chan and Ho, 1997).
Information and analysis positively affect customer focus and satisfaction.	Both Wilson and Collier [78], and Pannirselvam and Ferguson [49], confirmed the significant effect of information and analysis on customer focus and satisfaction. Healthcare organizations should apply IT solutions to help them deliver higher-quality patient care services.
Information and analysis positively affect the quality and operational outcomes.	Meyer and Collier [41], confirmed the significant effect of information and analysis on quality and operational outcomes. Also, furthermore, Parast and Golmohammadi [51], confirmed the significant effect of information and analysis on quality and operational outcomes using MBNQA data.
HR management and development positively affect customer focus and satisfaction.	Both Wilson and Collier [78] and Pannirselvam and Ferguson [49] confirmed the significant effect of HR management and development on customer focus and satisfaction. In addition, Parast and Golmohammadi [51] confirmed the significant effect of HR management and development on customer focus and satisfaction.
HR management and development positively affect quality and operational outcomes.	Both Wilson and Collier [78] and Pannirselvam and Ferguson [49] confirmed the significant effect of HR management and development on quality and operational outcomes. Savinoa and Batbaatarb [83] discussed the crucial role of strategic HR planning and management in enhancing quality outcomes. Using the Baldrige model, Parast and Golmohammadi [51] showed that HR development and management directly affect the quality and operational outcomes.
Strategic planning for quality positively affects customer focus and satisfaction.	Both Wilson and Collier [78] and Meyer and Collier [41] confirmed the significant effect of strategic planning for quality on customer focus-satisfaction. Using the Baldrige model, Parast and Golmohammadi [51] showed that this strategic planning directly impact the quality and operational outcomes.
Strategic planning for quality positively affects quality and operational outcomes.	The study by Wilson and Collier [78] confirmed the significant effect of strategic planning for quality on quality and operational outcomes. According to Mosadeghrad [42], to improve the quality outcomes of healthcare organizations, managers need to put quality as one of the main strategic priorities of the organization [42].
There are significant differences between the manufacturing and service sectors regarding the overall impact of the MBNQA model on the quality and operational outcomes.	Rönnbäck and Witell [59] performed a meta-analysis and reviewed previous studies into quality management implementations in manufacturing and service firms. They reported several inconsistencies in these studies. They attributed these differences to factors such as firm size, organizational culture, and research design. The authors pointed to two similar quality management principles in both sectors: workforce management and the approach to process management.

manufacturing activities and service activities. The gap between manufacturing and service organizations in these two quality dimensions could create inconsistency in product delivery or quality issues in customer service. For example, if a manufacturing firm is working with a service company to deliver products to the customer, the "quality gap" between these two entities may result in poor coordination and communication, decreasing productivity and increasing costs.

The third managerial insight relates to the dynamic relationship between quality management and organizational quality outcomes. It is important to realize that this relationship varies between manufacturing firms and service firms. Thus, if operations and quality managers seek to benefit from investment in quality initiatives, they must pay attention to this dynamic relationships among QMPs and their impact on quality outcomes. As we have shown, some nuances regarding manufacturing and service quality issues need to be considered, and there is no one-size-fits-all approach. From a practical standpoint, QMPs do not lead to similar results in manufacturing organizations and service organizations. This study has shown that for service organizations, the relations between the Baldrige criteria are not the same as for manufacturing organizations; thus, managers need to realize such differences when implementing quality management systems in manufacturing organizations and service organizations.

C. Limitations and Future Research

This study has limitations that could be addressed in future research. The first limitation of this study is the lack of access to the most recent longitudinal data for the MBNQA program: the data is available only for the 1990–2006 period. The study might be more effective if we had access to the external professional reviewers' most recent MBNQA assessment data. Access to more recent data would provide more efficient parameter estimates because of a larger sample size. In addition, we could obtain a quantitative assessment of potential changes in the implementation of QMPs in both manufacturing firms and service firms. Despite the absence of data after 2006, we believe that our analysis of 15 years of data has enabled a robust long-term assessment of the dynamics of quality for both industry sectors. Additionally, including other control variables—such as the size, age, and annual revenue of firms—could provide valuable insights into the effects of these organizational and contextual variables on the relationship between QMPs and operational outcomes in manufacturing firms and service firms.

We found significant differences between manufacturing firms and service firms regarding their implementations of quality management. However, we did not propose a quality management model suitable for service firms, mostly because we could not find a suitable framework for how quality is practiced for the Baldrige model in service firms. Thus, future studies

could develop quality models that align with the nature of service organizations.

Care should be taken when generalizing the results of this study. Since the data came from U.S. manufacturing firms and service firms, the expectation is that this study's findings could be extended to other economies with comparable management, social, and legal platforms. It would also be interesting to establish the validity of similar quality excellence models (e.g., Deming Prize, EFQM, or other national quality excellence award models) for improving quality and performance results in other economies or regions, as well as to compare, analyze, and generalize the impacts of these quality award programs on different industry sectors.

VII. Conclusion

Our objective in this study was to address the inconsistencies in previous studies on QMPs in manufacturing organizations and service organizations. We found significant differences between manufacturing firms and service firms in implementing two QMPs: human resource development and management, and customer focus and satisfaction. We also found significant differences between manufacturing firms and service firms in the relationship between the Baldrige criteria and organizational quality outcomes. The results demonstrate the importance of the contingency perspective to quality management and highlight the distinction between manufacturing organizations and service organizations in terms of emphasizing QMPs. In terms of future research directions, the study underscores the importance of industry-specific studies in quality management; such studies generate valuable insights for practitioners in the industry to maximize the outcomes from investment in quality management systems.

Appendix

See Table Appendix I.

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