

INVESTIGATING THE RELATIONSHIP BETWEEN THE BUSINESS PERFORMANCE MANAGEMENT
FRAMEWORK AND THE MALCOLM BALDRIGE NATIONAL QUALITY AWARD FRAMEWORK

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The business performance management (BPM) framework helps an organization continuously adjust and successfully execute its strategies. BPM helps increase flexibility by providing managers with an early alert about changes and, as a result, allows faster response to such changes. The Malcolm Baldrige National Quality Award (MBNQA) framework provides a basis for self-assessment and a systems perspective for managing an organization's key processes for achieving business results. The MBNQA framework is a more comprehensive framework and encapsulates the underlying constructs in the BPM framework.

The objectives of this dissertation are fourfold: (1) to validate the underlying relationships presented in the 2008 MBNQA framework, (2) to explore the MBNQA framework at the dimension level, and develop and test constructs measured at that level in a causal model, (3) to validate and create a common general framework for the business performance model by integrating the practitioner literature with basic theory including existing MBNQA theory, and (4) to integrate the BPM framework and the MBNQA framework into a new framework (BPM-MBNQA framework) that can guide organizations in their journey toward achieving and sustaining competitive and strategic advantages.

The purpose of this study is to achieve these objectives by means of a combination of methodologies including literature reviews, expert opinions, interviews, presentation feedbacks, content analysis, and latent semantic analysis. An initial BPM framework was

developed based on the reviews of literature and expert opinions. There is a paucity of academic research on business performance management. Therefore, this study reviewed the practitioner literature on BPM and from the numerous organization-specific BPM models developed a generic, conceptual BPM framework. With the intent of obtaining valuable feedback, this initial BPM framework was presented to Baldrige Award recipients (BARs) and selected academicians from across the United States who participated in the Fall Summit 2007 held at Caterpillar Financial Headquarter in Nashville, TN on October 1 and 2, 2007. Incorporating the feedback from that group allowed refining and improving the proposed BPM framework.

This study developed a variant of the traditional latent semantic analysis (LSA) called causal latent semantic analysis (cLSA) that enables us to test causal models using textual data. This method was used to validate the 2008 MBNQA framework based on article abstracts on the Baldrige Award and program published in both practitioner and academic journals from 1987 to 2009. The cLSA was also used to validate the BPM framework using the full body text data from all articles published in the practitioner journal entitled the *Business Performance Management Magazine* since its inception in 2003. The results provide the first cLSA study of these frameworks. This is also the first study to examine all the causal relationships within the MBNQA and BPM frameworks.

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CHAPTER 1

INTRODUCTION

The Malcolm Baldrige National Quality Award (MBNQA) framework provides a basis for self-assessment and a systems perspective for managing an organization's key processes for achieving business results. The business performance management (BPM) framework helps an organization continuously adjust and successfully execute its strategies. BPM helps increase flexibility by providing managers with a sense of uncertain changes earlier and allows faster response to such changes. It thus helps organizations address market opportunities. The simultaneous use of the Malcolm Baldrige National Quality Award (MBNQA) framework and the business performance management (BPM) framework by an organization has the potential to help organizations pursue excellence while simultaneously increasing their agility and competitive advantage. Therefore, to facilitate the ability to use both frameworks simultaneously for organizational advantage I examine the existing literature and from it glean the common relationships among the frameworks and use these findings to posit an integrated framework.

The Malcolm Baldrige National Quality Award criteria provide a comprehensive framework for self-assessment and embody a systematic approach to organizational quality (Bemowski & Stratton, 1995; Evans 1997; Pannirselvam & Ferguson, 2001). The criteria are grouped into seven categories that show the underlying relationships among and between organizational performance and various quality management constructs (Pannirselvam & Ferguson, 2001). These relationships are portrayed in the Malcolm Baldrige National Quality Award (MBNQA) framework. The MBNQA criteria define practices in seven categories - (1)

leadership, (2) strategic planning, (3) customer and market focus, (4) measurement, analysis, and knowledge management, (5) workforce focus, (6) process management, and (7) results. These seven categories are composed of a set of 18 performance-oriented criteria items. Each of these categories embodies two or more criteria items. For instance, the leadership category is composed of two criteria items: senior leadership, and governance and social responsibilities. The Baldrige criteria also shed light on asking questions that organizations can use to establish vital linkages in their structure, operations, strategy, and results. For example, a key question item regarding the customer and market knowledge criteria item is how organizations identify customers, customer groups, and market segments. These question items provide practitioners and academicians with invaluable insights for developing self testing instruments. However, because of the use of the same term “items” to indicate criteria items and question items there is the potential for the confusion in academic literature of these question items with the criteria items. Therefore, I intend to make a distinction at the onset between the criteria items and the question items by labeling the criteria items as the dimensions of the categories. Thus, the Baldrige framework is a framework of seven interrelated constructs (categories) with each construct having two or more dimensions with each dimension measured with multiple question items.

The MBNQA framework was first created in 1987 for the purpose of improving organizational competitiveness (Garvin, 1991; Gradig & Harris, 1994) and has evolved continuously since its inception (National Institute of Standards and Technology [NIST], 1993; Bemowski, 1996; NIST, 1997; NIST, 2000; NIST, 2007; NIST, 2008). The 2007 criteria bring significant changes from the 2006 criteria in almost all categories and dimensions, and these

changes include adding seven terms to the Glossary of Key Terms (NIST, 2007, p. 8-9). These changes are reflected in the framework in terms of new and modified underlying relationships. For example, the 2007 criteria assume that strategic planning has a stronger focus than in previous frameworks on innovation, strategic advantages, and resource needs to achieve strategic objectives. However, NIST (2008) posits:

In 2007, the Baldrige Criteria were significantly revised to encourage organizations to consider carefully their strategic advantages, core competencies, and opportunities for innovation and how these considerations drive key decisions on work systems (such as outsourcing, partnerships, and workforce decisions). In recognition of the challenges for organizations to address these opportunities, the decision was made to make no substantive revisions to the Criteria for 2008. (NIST, 2008, p. 27)

The most significant changes in the 2008 booklet include the addition of the term “Strategic Advantages” to the Glossary of Key Terms, and two new diagrams – one of which illustrates the role of core values and concepts in underpinning the criteria, and the other shows maturity levels in organizational learning (NIST, 2008). Therefore, the 2007 framework and the 2008 framework can be used interchangeably. The relationships in the proposed conceptually enhanced 2007/2008 framework are currently not validated in the academic literature. Validating the 2007/2008 framework will support the framework’s current form as well as provide managers with meaningful information that they can use in deciding where they should focus their efforts in achieving performance excellence. Therefore, the first objective of this study is to validate the underlying relationships presented in the 2007/2008 framework.

The MBNQA framework enjoys widespread acceptance at local, national, and international levels (Kochan, 1992; Ettorre, 1996; Pannirselvam, Siferd, & Ruch, 1998). Various studies have used, extended and tested this framework in several industries, such as health

care (Prybutok & Spink, 1999; Meyer & Collier, 2001), government organizations (Pannirselvam et al., 1998; Pannirselvam & Ferguson, 2001), and higher education (Winn & Cameron, 1998). However, these studies tested the framework at the category level. There is a paucity of evidence testing the MBNQA framework at the dimension level. A dimension level analysis will provide academicians and managers with better insight regarding how each item in a category is related to specific items in other categories (Pannirselvam & Ferguson, 2001). That is, dimension level analysis is necessary to better understand how various quality management aspects affect each other and impact business performance (Evans, 1997). Therefore, the second objective of this study is to explore the MBNQA framework at the dimension level, and develop and test constructs measured at that level in a causal model.

The BPM framework embodies a closed-loop. Cokins (2007) posits that business performance management existed decades ago and that organizations were doing performance management long before it was labeled such in 1990s by information technology research firms and software vendors. There is little or no research in academia on business performance management. Several practitioner BPM frameworks exist but these are industry specific and vary from industry to industry (Eckerson, 2004; Cokins, 2007). However, all such frameworks have common constructs – develop strategy; define, measure and manage performance against strategic goal; continuously adjust and refine strategy; and optimize the strategic execution. Therefore, the third objective of this work is to validate and create a common general framework for the business performance management by integrating the practitioner literature with basic theory including existing MBNQA theory.

The 2008 criteria place significant importance on competitive advantages, strategic advantages, core competencies, and innovation. The Baldrige criteria ask thought-provoking, critical questions that emphasize an organizational infrastructure that is essential to maintain and improve competitive advantage and bring about innovation. One impediment to achieving improved organization effectiveness and competitiveness is the huge gap between strategy and execution (Eckerson, 2004). Eckerson (2004) suggests that business performance management (BPM) bridges the gap between strategy and execution. Eckerson also posits that BPM helps organizations exploit market opportunities as they arise, and make organizations more effective, and more competitive. Therefore, the final objective of this study is to integrate the business performance management framework and the MBNQA framework into a new framework (BPM-MBNQA framework) that can guide organizations in their journey toward achieving and sustaining competitive and strategic advantages.

In summary, the objectives are as follows:

1. Validate the underlying relationships presented in the 2008 MBNQA framework at the category level
2. Explore the MBNQA framework at the dimension level, and develop and test constructs measured at that level in a causal model
3. Validate and create a common general framework for the business performance management by integrating the practitioner literature with basic theory including existing MBNQA theory
4. Integrate the BPM framework and the MBNQA framework into a new framework (BPM-MBNQA Framework) that can guide organizations in their journey toward achieving and sustaining competitive and strategic advantages

The purpose of this study is to achieve these objectives by means of a combination of methodologies including literature reviews, expert opinions, interviews, presentation

feedbacks, content analysis, and latent semantic analysis. An initial BPM framework was developed based on the reviews of literature and expert opinions. There is a paucity of evidence of academic research in business performance management. Therefore, this study reviewed the practitioner literature on BPM and developed a generic, conceptual BPM framework. With the intent of obtaining valuable feedback, this initial BPM framework was presented to Baldrige Award recipients (BARs) and selected academicians from across the United States who participated in the Fall Summit 2007 held at Caterpillar Financial Headquarter in Nashville, TN on October 1 and 2, 2007. Incorporating the feedback, a refined, improved BPM framework has been proposed.

In line with the above-mentioned research objectives, the study seeks to address the following research questions:

1. Are the proposed relationships between the categories in the MBNQA 2008 framework supported?
2. How are the dimensions related within each category and between categories in the MBNQA 2008 framework?
3. Is the proposed BPM framework supported by the extant literature?
4. Does BPM framework contribute to enhanced competitiveness and innovation?
5. How is the proposed BPM framework related to the 2008 MBNQA framework?

This study uses causal latent semantic analysis (cLSA) to validate the proposed BPM framework and the 2008 MBNQA framework. The causal LSA (cLSA) is a modification and thus a derivative of the traditional latent semantic analysis. In addition to uncovering the latent factors, the cLSA establishes causal relationships among these factors based on the input and output statements contained in the factors (see Appendix B for detail). To validate the BPM

framework, I performed cLSA on a BPM corpus developed based on the full body text data from all articles published in the practitioner BPM journal entitled the *Business Performance Management Magazine* since its inception in 2003. In addition, the traditional latent semantic analysis (LSA) was used to uncover the latent semantics of the BPM framework from the article abstracts published in the *International Journal of Business Performance Management*. To validate the MBNQA framework, I performed cLSA on an MBNQA corpus obtained from the article abstracts on the Baldrige Award and program published in practitioner and academic journals from 1987 to 2009.

The remaining of the study is organized as follows. Chapter 2 provides a review of the literature on the MBNQA, BPM and latent semantic analysis. Chapter 2 also delineates the research models and generates propositions for testing the research objectives. Chapter 3 articulates the research methods, construct measurement, sample design, scale development, and data collection so as to answer the research questions presented in Chapter 1. Chapter 4 provides the data analysis and results. Finally, Chapter 5 discusses the limitations, contributions and implications of the study.

CHAPTER 2

LITERATURE REVIEW

This chapter provides a review of the literature on the Malcolm Baldrige National Quality Award (MBNQA) framework, the business performance management (BPM) framework and latent semantic analysis (LSA). There are five sections in this chapter. The first section presents a review of the literature on the MBNQA framework. The second section provides a review of the practitioner literature on BPM. A conceptual BPM framework is proposed based on the review of the practitioner literature. The third section discusses latent semantic analysis. Section four discusses how the BPM and the MBNQA framework can be integrated; and it presents the integrated BPM-MBNQA conceptual framework. Finally, research propositions are detailed in section five.

The MBNQA Framework

The Malcolm Baldrige National Quality Award (MBNQA) is considered the highest honor for business excellence in America (TYBEA, 2001). The United States Department of Commerce established the Baldrige Award and the Baldrige National Quality Program in 1987 to jumpstart a small, slowly growing quality movement (TYBEA, 2001). The Baldrige Award and program plays a critical role in strengthening competitiveness (Bell & Keys, 1998) with the intent of achieving three specific goals – to promote quality awareness, to recognize quality achievement of U.S. companies, and to publicize successful strategies (Bemowski & Stratton, 1995; TYBEA, 2001; NIST, 2007). The National Institute of Standards and Technology (NIST) of the US Commerce Department designs and manages the Baldrige Award and program. Congress selected NIST to administer the Baldrige Award because of “its long-standing role in helping

U.S. companies compete, its world-renowned expertise in quality control and assurance, and its reputation as an impartial third party” (TYBEA, 2001, p. 5).

The first Baldrige Awards were presented in 1988 to three companies. The United States president presents the awards to the recipients. From 1988 to 1998, the awards were given to each of three sectors – manufacturing, service, and small business. With the October 1998 passage of legislation, NIST established Baldrige Awards for education organizations and healthcare providers; and the first applications for awards were accepted in 1999 (TYBEA, 2001). NIST was authorized to expand the Baldrige Award program to non-profit organizations by the October 2004 legislation signed into law by President Bush. The first applications for awards in the non-profit organizations sector were accepted in 2007 (NIST, 2007).

Now NIST designs and manages the Baldrige Award and program for manufacturing, service, small business, education, healthcare, and non-profit organizations. Three frameworks are provided by NIST to administer awards in these categories. The first framework embodies criteria for business and non-profit organizations and is used for manufacturing, small business, service and non-profit categories. The second and third frameworks provide criteria for education organizations and healthcare providers, respectively. NIST provides three frameworks to capture the peculiarity that exists across industries. However, the bottom-line purposes and underpinnings of all frameworks are the same. Minor differences in frameworks exist in the name of the dimensions of the frameworks and are needed to reflect the esoteric characteristics of each industry. For instance, the term customer is better suited to businesses and non-profit organizations. The term patient is more appropriate in the healthcare industry. The differences in frameworks are reflected as follows: (1) the category Customer and Market

Focus in the business and non-profit criteria is replaced with Focus on Patients, Other Customers, and Market in healthcare criteria, and with Student, Stakeholder, and Market Focus in education criteria, and (2) the dimensions in the Results category have been named in the frameworks to reflect the distinctive outcomes of each industry.

The underlying causal relationships and the design structure of the frameworks remain unchanged across industries. Therefore, the terms “Malcolm Baldrige National Quality Award framework,” “MBNQA performance excellence framework,” “MBNQA model,” “Baldrige framework,” and “Baldrige model” are used to embody the causal relationships and the skeleton of all frameworks. Because the relationships and the skeleton of the frameworks are the same, the business and non-profit framework is used hereon as a representation of the Baldrige model, the MBNQA model or the MBNQA framework. In line with one of the objectives of this research, the 2008 Baldrige criteria are referred to the theoretical MBNQA framework.

The bottom-line philosophy of the Baldrige framework is to provide a systems perspective for managing organizations and their key activities and processes to obtain results. The MBNQA framework defines seven criteria categories that are designed to endow organizations with an integrated approach to performance excellence. These criteria categories are (1) leadership, (2) strategic planning, (3) customer and market focus, (4) measurement, analysis, and knowledge management, (5) workforce focus, (6) process management, and (7) results. The Baldrige scoring system encompasses these seven criteria categories and divides them into two evaluation dimensions: (1) process and (2) results. “Process” refers to the methods that organizations use to address the requirements in Categories 1 – 6, while “Results” refers to organizations’ outputs and outcomes in achieving the requirements in Category 7

(NIST, 2008). The two evaluation dimensions are central to the Baldrige Award applicant evaluation and feedback. A critical factor in evaluation and feedback is the importance of an organization's reported process and results to its key business factors. NIST suggests that organizations identify the areas of their greatest importance and report them in their organizational profile. NIST posits that organizational profile is the most important starting point for self-assessment and for writing an application. In addition, organizational profile helps organizations identify potential gaps in key information and focus on key performance requirements and results. It sets the context such as operating environment, key working relationships, and strategic challenges and advantages for the way an organization operates. Therefore, organizational profile serves as an overarching guide for an organization's performance management system. However, organizational profile is not considered a criteria category and does not contribute toward the scoring system. This study investigates the underlying relationships among the seven criteria categories and thus considers the discussion of organizational profile for further research. A brief description of the criteria categories is given in Table 1. Table 2 provides a brief description of the MBNQA constructs at the dimension level.

Table 1: Brief description of MBNQA categories

Constructs	Description
1. Leadership	Examines how organization's senior leaders guide and sustain their organization, how organizations view their governance system, and how organizations fulfill their ethical, legal, and community responsibilities (NIST, 2008).
2. Strategic planning	Examines how organizations determine their short and long term goals, and how organizations make plans to enhance relationships with customers, suppliers, and partners (NIST, 2008; Prybutok, Zhang, & Ryan, 2008).
3. Customer and market focus	Describes how organizations determine product and service expectations, identify customer groups and market segments, and measure customer satisfaction levels to ensure the continuing relevance of product and service and to develop new business opportunities (NIST, 2008; Prybutok et al., 2008).
4. Knowledge management	Examines organization's selection, gathering, analysis, management, and improvement of data, information, knowledge, and information technology. Also examines how organizations use review to improve their performance (NIST, 2008).
5. Workforce focus	Examines organization's ability to engage, manage, develop, and assess its workforce in alignment with its overall mission, strategy, and action plans (NIST, 2008).
6. Process management	Examines how organizations determine their core competencies and work systems, and how they design, manage and improve their key processes to implement those work systems (NIST, 2008).
7. Results	Examines organization's performance and improvement in all key areas including product and service outcomes, customer-focused outcomes, financial and market outcomes, workforce-focused outcomes, process effectiveness outcomes, and leadership outcomes (NIST, 2008).

Table 2: Brief description of MBNQA dimension level constructs

Constructs	Description
1.1 Senior leadership	The roles and responsibilities of senior leaders in setting and communicating the organization's vision, values and practices to create a sustainable organization (NIST, 2008).
1.2 Governance and social responsibilities	A responsible, informed, and accountable advisory body to protect shareholders' interests, and to fulfill social responsibilities in legal, ethical, and good citizenship manner (NIST, 2008).
2.1 Strategy development	The formulation of strategy and strategic objectives by weighing strategic challenges and advantages (i.e., strengths, weaknesses, opportunities, and threats) (NIST, 2008).
2.2 Strategy deployment	The conversion of strategic objectives into action plan while optimizing the utilization of available resources (NIST, 2008).
3.1 Customer and market knowledge	The process to understand the needs and expectations of current and future customers and markets (i.e., the process to understand the voice of the customer and market) (NIST, 2008).
3.2 Customer relationships and satisfaction	The process to establish customer relationships, and to ascertain customer satisfaction and dissatisfaction in order to retain the current customers, and acquire new customers and new markets (NIST, 2008).
4.1 Performance analysis, review and improvement	Effective selection and use of financial and non-financial data and information to analyze, review, and improve organizational performance with a view toward achieving strategic objectives and to prepare for unexpected organizational or external changes (NIST, 2008).
4.2 Data and knowledge management	The development and management of knowledge assets (e.g., all sorts of data, information, software and hardware) to improve organization efficiency and effectiveness (NIST, 2008).
5.1 Workforce engagement	The mechanism that engages, develops, and assesses an organization's workforce to foster high employee performance and to enable and encourage employees to contribute to the achievement of strategic objectives and organizational sustainability (NIST, 2008).

Continued

Table 2: Continued

Constructs	Description
5.2 Workforce environment	An effective and supportive workforce environment that encompasses standards for workforce safety, health care services, career counseling and development, recreational and cultural activities, benefits packages, formal and informal recognition, nonwork-related education, etc. (NIST, 2008).
6.1 Work systems design	Identification of core competencies, work systems, and key work processes that are critical for creation of customer value, preparation for potential emergencies, and achievement of organizational success and sustainability. Key work processes include processes for innovation, research and development, technology acquisition, supply chain management, outsourcing, mergers and acquisition, global expansion, project management, sales and marketing, etc. (NIST, 2008).
6.2 Work process management and improvement	The implementation, management and improvement of key work processes that are critical for creation of customer value, and achievement of organizational success and sustainability (NIST, 2008).
7.1 Product and service outcomes	Measures of products and service performance such as internal quality measurements, field performance of products, defect levels, service errors, response time, etc. (NIST, 2008).
7.2 Customer-focused outcomes	Measures of customer-related performance such as customer satisfaction and dissatisfaction; retention, gains, and losses of customers; customer complaints, complaint management, effective complaint resolution, and warranty claims; customer-perceived value based on quality and price; customer assessment of access and ease of use; awards, ratings and recognition from customers and independent rating agencies (NIST, 2008).
7.3 Financial and market outcomes	Measures of financial and market performance such as revenues, profits or losses, budgets, cash position, net assets, debt leverage, earnings per share, financial operations efficiency, financial returns, business growth, donations and grants received, percentage of revenues derived from new products, programs or services, etc. (NIST, 2008).
7.4 Workforce-focused outcomes	Measures of workforce-related performance such as increased workforce retention, leader development, workforce training, workforce safety, employee absenteeism, employee turnover, employee satisfaction, employee complaints, etc. (NIST, 2008).

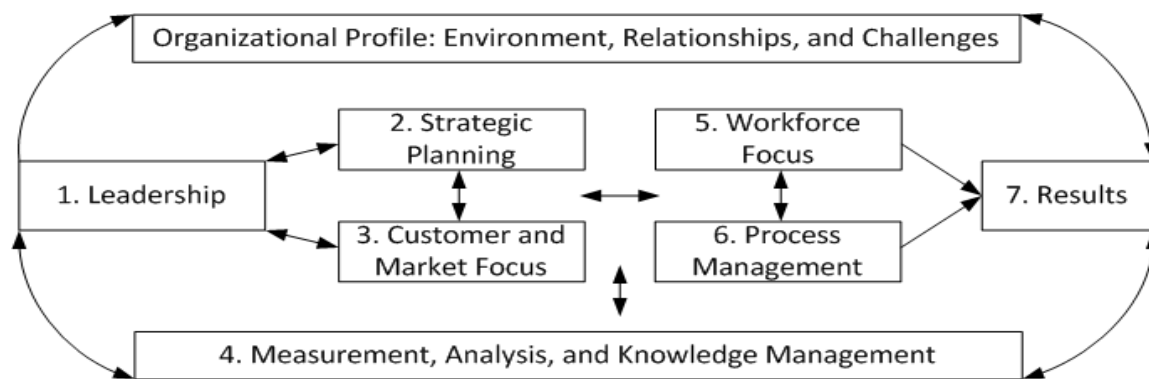
Continued

Table 2: Continued

Constructs	Description
7.5 Process effectiveness outcomes	Measures of organizational and operational performance including measure and indicators of process effectiveness and efficiency (e.g., cost savings, higher productivity, reduced emission levels, etc.), internal responsiveness indicators (e.g., cycle times, production flexibility, lead times, setup times, etc.), improved performance of administrative and other support functions, business-specific indicators (e.g., innovation rates, Six Sigma initiative results, etc.), and supply chain indicators (e.g., reduction in supply chain management costs, reductions in inventory and incoming inspections, improvements in electronic data exchange, etc.) (NIST, 2008).
7.6 Leadership outcomes	Measures of performance in the areas of leadership and governance, achievement of strategic objectives, and societal responsibilities such as environmental, legal and regulatory compliance; results of oversight audits by government or other agencies; indicators of support for key communities and other public purposes; etc. (NIST, 2008).

The MBNQA framework connects and integrates the criteria categories to form the performance excellence framework. Figure 1 illustrates the MBNQA performance excellence framework for 2008 criteria.

Figure 1: The 2008 MBNQA performance excellence framework



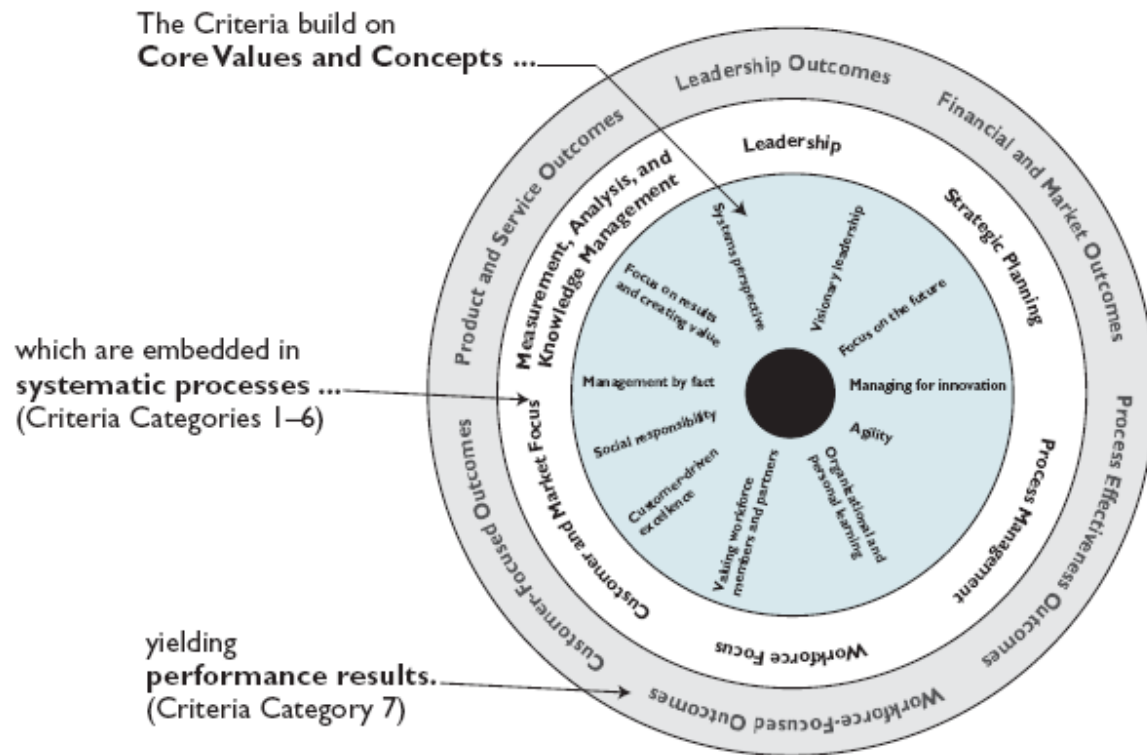
There are three integral parts in the MBNQA performance excellence framework: (1) the leadership triad, (2) the results triad, and (3) measurement, analysis, and knowledge

management. The leadership triad comprises the leadership (Category 1), strategic planning (Category 2), and customer and market focus (Category 3). The leadership, strategic planning, and customer and market focus dimensions are placed together in the leadership triad to recognize their collective importance (Prybutok et al., 2008). The leadership triad emphasizes the importance of a leadership focus on strategy and customers, and implies that senior leaders must set organization's direction and develop new business opportunities. The results triad consists of workforce focus (Category 5), process management (Category 6), and results (Category 7). The focus of the results triad is on the employees and key processes of the organization critical to implement the work system that yields results. Measurement, analysis, and knowledge management (Category 4) provides the foundation for analyzing the performance management system that is critical for improving performance, competitiveness, and strategic advantage (NIST 2008).

The foundation of the MBNQA framework is that “the Criteria build on the Core Values and Concepts which are embedded in systematic processes yielding performance results” (NIST, 2008, p. 49). Figure 2 portrays the general idea behind the 2008 MBNQA framework. This diagram shows the relationship between (1) the criteria's core values and concepts and the criteria items and (2) the criteria process categories and the criteria results. NIST (2008) posits that there are many possible specific relationships between the core values or concepts, the criteria process categories, and the criteria results. NIST (2008) also posits that “the Core Values or Concepts are shown in close proximity to the specific Criteria Process Categories with the most direct relationship”, and that “each Criteria Results Item is shown in close proximity to the Process Category to which it is most closely tied” (NIST, 2008, p. 27). For instance, process

effectiveness results item has the most direct relationship with the process management category, and is thus in close proximity to it. Process effectiveness outcomes also provide key information for analysis, review and improvement of organizational performance, and serve as the operational basis for product and service outcomes, customer-focused outcomes, and financial and market outcomes (NIST, 2008).

Figure 2: MBNQA core values and concepts, criteria, and outcomes (NIST, 2008, p. 49)



The MBNQA framework is one of the most influential frameworks for measuring organizational performance (Evans & Jack, 2003). It enjoys widespread acceptance at local, national, and international levels (Kochan, 1992; Ettore, 1996; Pannirselvam et al., 1998; Dow, Samson, & Ford, 1999; Samson & Terziovski, 1999). For instance, Pannirselvam et al. (1998) mirrored the Baldrige criteria in Arizona Governor’s Quality Award (AGQA) model. Dow et al.

(1999), and Samson and Terziovski (1999) used the Baldrige framework to study the quality of manufacturing firms in Australia and New Zealand. Various studies have used, extended and tested this framework in several industries including manufacturing (Handfield & Ghosh, 1995; Dow et al., 1999; Samson & Terziovski, 1999; Wilson & Collier, 2000; Flynn & Saladin, 2001; Prajogo, 2005), service (Prajogo, 2005), health care (Prybutok & Spink, 1999; Meyer & Collier, 2001), government (Pannirselvam et al., 1998; Pannirselvam & Ferguson, 2001; Prybutok et al., 2008), and higher education (Winn & Cameron, 1998).

Numerous studies have investigated the linkages implied in the Malcolm Baldrige National Quality Award framework. Most of these studies used the MBNQA frameworks released prior to 2000 (Prybutok et al., 2008). There are two salient features of these studies. First, the MBNQA frameworks (different versions of the MBNQA framework) were tested at the category level only. Second, the MBNQA frameworks specified direction of cause from one direction by using unidirectional arrows based on the general proposition that leadership drives the system that creates results (e.g., Dow et al., 1999; Prybutok & Spink, 1999; Samson & Terziovski, 1999; Wilson & Collier, 2000; Meyer & Collier, 2001). Therefore, they were represented as recursive models (Byrne, 1998). For instance, Wilson and Collier (2000) tested the relationships in 1995 MBNQA framework and portrayed the relationships in a recursive causal model. They posited that the Baldrige quality experts did not follow their general theory in defining the specific performance relationships between the criteria categories. Wilson and Collier also argued that the Baldrige quality experts defaulted to the premise that everything is related to everything else because they had no idea how these specific performance relationships and directions of causation should be defined.

The Baldrige framework has undergone significant changes since 1995 and since its inception in 1987. The 2008 Baldrige criteria represent the most recent and highly enhanced framework. Significant changes are reflected in the criteria categories, the underlying relationships, and the Glossary of Key Terms, among others. For example, while the 1995 Baldrige system consisted of four criteria categories – process management, human resource development and management, strategic planning, and information and analysis, the 2008 Baldrige system (Figure 2) consists of six criteria categories – (1) leadership, (2) strategic planning, (3) customer and market focus, (4) measurement, analysis, and knowledge management, (5) workforce focus, and (6) process management.

Like the 1995 and other Baldrige frameworks, the 2008 Baldrige framework has used two-headed arrows among the Baldrige system criteria categories (Categories 1 – 6) (Figure 1). This is in line with NIST's underlying proposition that the Baldrige system categories are reciprocally related – both directly and indirectly. Therefore, the Baldrige system represents a non-recursive causal model (Byrne, 1998). However, the 2008 Baldrige system is connected to performance results (Category 7) with one-directional arrows pointing to the latter. This implies that the Baldrige quality experts did not default to the premise that everything is related to everything else but rather posited the relationships as such. This also implies that there is a recursive causal relationship between the Baldrige system and the performance results.

The BPM Framework

The acronym BPM in this study stands for business performance management, not to be confused with the term business process management. Synonymous with the concept of BPM are the concepts of corporate performance management (CPM) and enterprise performance

management (EPM). These concepts provide a systems perspective for optimizing the execution of business strategy (Ballard, White, McDonald, Myllymaki, McDowell, Goerlich, & Neroda, 2005; Clark, Jones, & Armstrong, 2007). The concept of BPM was introduced to business in the 1990s by information technology research firms and software vendors (Cokins, 2007; Pritchard, 2008). BPM is misunderstood by many companies as being a new category to describe multiple applications including planning, budgeting, financial consolidation and reporting, forecasting and scenario modeling, scorecarding or dashboards, business intelligence, and key performance indicators (KPIs) reports. Eckerson (2004) argues that BPM is a common strategic and technical framework that pulls these applications together in a cohesive and concerted manner with a view to drive the whole organization toward achievement of strategic goals and objectives. Therefore, BPM is a much broader and bigger concept than planning, budgeting, forecasting, reporting, scorecarding, or business intelligence. These latter concepts are all tools underlying the business performance management concept.

BPM defines and refines strategies, and manages them in order to enhance performance. It bridges the gap between strategy and execution by means of improved communication, collaboration, control, and coordination (Eckerson, 2004; Ballard et al., 2005). Business performance management enables organizations to enhance the capabilities of business intelligence systems for better monitoring, measurement, and management of business performance (Clark et al., 2007). Eckerson posits that BPM improves (1) communication of strategy and expectations to all levels of the organization through planning models and performance metrics that are tied to strategic goals and objectives, (2) collaboration across organization through two-way exchange of ideas and information, (3)

control to continuously adjust plans and improve operations through dissemination of up-to-date information about market conditions and operational processes, and (4) coordination among business units and functional groups. He also suggests that BPM helps organizations better exploit opportunities as well as detect and rectify operational problems before they grow out of control.

Practitioners at various consulting firms such as Gartner, IBM and KPMG have used some variants of the concept of business performance management since the late nineteenth century (Business Performance Management Magazine [BPMM], 2005). For instance, the concept of corporate performance management, a variant of business performance management, was introduced into corporate world in 2001 by Gartner Research. However, there is little or no research in academia on business performance management. One of the objectives of this work is to examine the various practitioner versions of the business performance management model and develop a generic BPM framework that can provide both academicians and practitioners alike with a common frame of reference. In this vein, we attempted to critically analyze each practitioner model and synthesize them based on their common, shared foundations. Table 3 provides a brief account of major BPM consulting firms and their BPM-related activities.

Table 3: Major BPM consulting firms and their activities

BPM Consulting Firm	Brief Description
Aster Group	Incepted in 2001. Specializes in implementing OutlookSoft BPM software. OutlookSoft BPM software uses a single, unified web-based application that enables companies to plan, understand and leverage their performance. It unifies strategic planning, budgeting, forecasting, consolidation, reporting, analysis, and scorecarding (BPMM, 2005; Astergroup.com).
BearingPoint Inc.	More than 100 years old. Focuses on business consulting, systems integration, and managed services. Serves Global 2000 and midsize companies, government agencies, and other organizations in the U.S. and around the world. Major services include customer relationship management, enterprise resource planning, key performance indicator (KPI) development, information management, performance management, enterprise strategy development and transformation, and information technology (IT) strategy development and transformation, among others (BPMM, 2005).
BPM Partners Inc.	Established in 2002, BPM Partners Inc. is a vendor-neutral firm that advises its member partners on requirements definition, KPI development, IT assessment, vendor selection, and deployment (BPMM, 2005).
Breakaway Technologies Inc.	Founded in 1996, the Breakaway Technologies Inc. specializes in the development of the business performance management (BPM) and the business intelligence (BI) applications. These BPM and BI applications focus on how enterprises work and how they use information. Major applications include financial and sales reporting, EIS, consolidation systems, balanced scorecard, product costing, budgeting and forecasting systems, production planning, unit level forecasting, and customer product profitability systems (BPMM, 2005).
Cohn Consulting Group	Cohn Consulting Group was established in 1968 and provides strategic, financial, performance and organizational advisory services to private and public companies across a variety of industries (BPMM, 2005).
Creeth, Richman & Associates Inc.	Established in 1985, this firm specializes in developing financial analytics systems using online analytical processing (OLAP), relational database, and Microsoft technologies for midsize to large corporations (BPMM, 2005).
Deloitte	Deloitte, founded in 1996, is a multidisciplinary global consulting firm. However, its specialty is on the implementation of integrated performance management (BPMM, 2005).

Continued

Table 3: Continued

BPM Consulting Firm	Brief Description
Gartner, Inc.	Founded in 1979, Gartner, Inc. is the world's leading information technology research and advisory company. It has four businesses – Gartner Research, Gartner Executive Programs, Gartner Consulting, and Gartner Events. Gartner Research introduced the term corporate performance management in 2001. The fact-based consulting services by Gartner Consulting helps organizations use and manage information technology to enable business performance.
MarketSphere Consulting	This consulting firm was established in 2002. Its BPM practice embodies strategy and process consulting with technical expertise (BPMM, 2005).
Pacific Science & Engineering	Incepted in 1984, Pacific Science & Engineering's approach to BPM is delineated by a system called the "Strategic process management Model". The primary focus of this system is to develop a complete process model that links the organization's business objectives with its KPIs (BPMM, 2005).
PCS Consulting Inc.	Founded in 1997, this consulting firm specializes in activity-based costing and profitability analyses, and implements business performance management software from ALG Software, Hyperion, SAS, Business Objects, Cognos, and Microsoft (BPMM, 2005).
Pinnacle Group Worldwide	A global consulting firm established in 1995, Pinnacle Group Worldwide specializes in implementing Hyperion's business analysis and financial systems solutions. It focuses on project management, implementation, application deployment, and transition management (BPMM, 2005).
Report Source	Report Source, a UK-based consulting company, was founded in 1999. It specializes in enterprise performance management and business intelligence solutions for planning, performance optimization, reporting and analysis (BPMM, 2005; Reportsources.com).
Revelwood Inc.	Established in 1995, Revelwood Inc. serves Fortune 1000 and mid-market companies. Its business performance management solutions enable organizations to strategize, plan, execute and take corrective action enterprisewide on a continual basis (BPMM, 2005; Revelwood.com).
Stratature	Stratature was established in 2001 and offers its services globally. It has developed its own solution called +EDM. +EDM is used for management of dimensions, master data, and reporting hierarchies enterprisewide (BPMM, 2005).

Continued

Table 3: Continued

BPM Consulting Firm	Brief Description
The Buttonwood Group	Established in 1998, the Buttonwood Group specializes in custom programming, requirements definition, KPI development, business case development, vendor selection, strategic road mapping, etc. (BPMM, 2005).
TNT-Technologies	Since its inception in 1986, TNT-Technologies has been an implementer of business performance management and business intelligence software from MicroStrategy, Business Objects, and OutlookSoft (BPMM, 2005).
WhittmanHart	WhittmanHart was established in 1984. WhittmanHart Performance Management specializes in implementing BPM and business intelligence software from Cognos, Business Objects, MicroStrategy, OutlookSoft, etc. (BPMM, 2005; Whittmanhart.com).

Examination of practitioner BPM models suggests that practitioners have been using various concepts such as budgeting, planning, forecasting, scorecarding and dashboarding, reporting, financial consolidation, and operational analytics to encompass business performance management. However, these concepts are much narrower than the concept of BPM and, in fact, are all parts of the latter (BPMM, 2005). Practitioners have also been using various methodologies such as balanced scorecard and technologies such as business intelligence tools and business process management in implementing their business performance frameworks (BPMM, 2005).

While practitioner BPM frameworks vary in their terminology and steps of implementation, they possess many of the same and overlapping constructs. All BPM models use integrated data and data analysis to (1) develop strategies, (2) devise action plan (e.g., definition of targets, models, projects, and initiatives in terms of metrics and key performance indicators (KPIs)) to deploy these strategies, (3) define, measure, and manage performance against these metrics and KPIs, and (4) adjust strategy and/or performance. Based on the above

review, a BPM framework was proposed and presented to the 2007 Monfort Summit. The 2007 Monfort Summit was a gathering of Baldrige Award recipients (BARs) and a small group of selected researchers from across the United States. The summit had a total of 25 participants. Twenty of those were from Baldrige Award winning organizations and 5 were academicians from different universities. The BPM framework was then revised based on the feedback provided by the 2007 Monfort Summit participants. Figure 3 illustrates the BPM framework, and Table 4 presents a brief description of the BPM framework constructs.

Figure 3: The proposed BPM framework

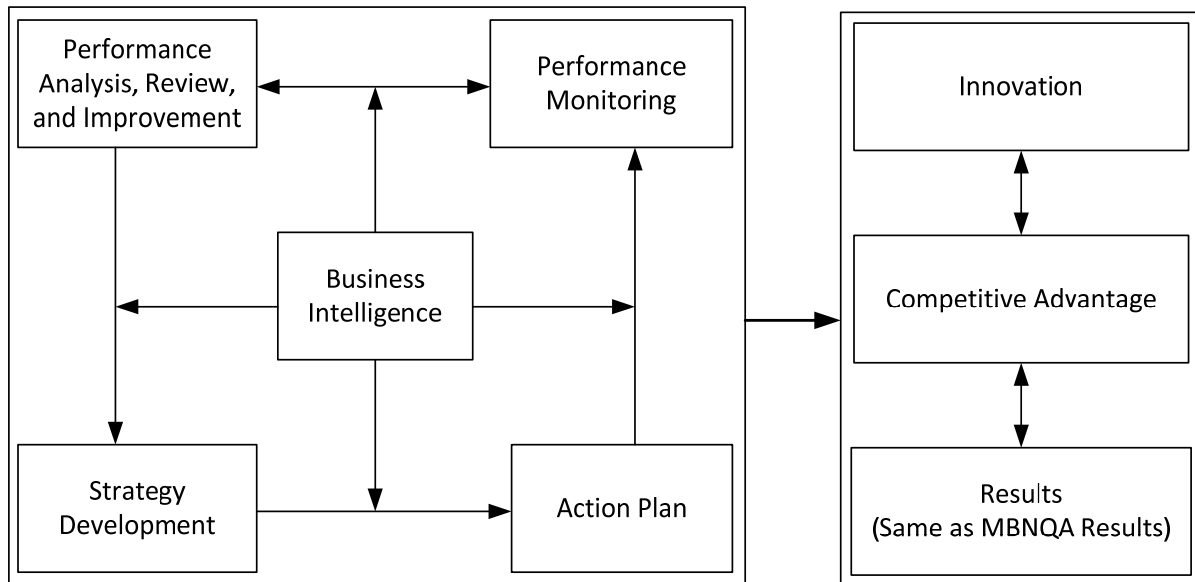


Table 4: Brief description of the BPM framework constructs

Construct	Description
Strategy development	The formulation and refinement of strategy and strategic objectives by weighing strategic challenges and advantages (i.e., strengths, weaknesses, opportunities, and threats) (NIST, 2008; Ariyachandra & Florick, 2008).
Action plan	Break-down of strategic objectives into discrete targets and operating models, and creation of projects and initiatives to meet these targets (Eckerson, 2004; Ariyachandra & Florick, 2008).
Performance monitoring	Continuous gauging and monitoring of performance against the measures (i.e., the right metrics called the Key Performance Indicators, KPIs) defined in action plan process (Eckerson, 2004; Ariyachandra & Florick, 2008).
Performance analysis, review and improvement	Effective selection and use of financial and non-financial data and information to analyze, review, and adjust strategy and/or performance measurement with a view to achieve strategic objectives and to prepare for unexpected organizational or external changes (NIST, 2008).
Business intelligence	A collection of integrated operational and decision-support applications and databases that provide the business community easy access to business data (Moss & Atre, 2003) and thus support sophisticated decision making aimed at improving business performance (Buchanan & O'Connell, 2006).
Innovation	An idea, practice, or product that is perceived as new by an individual or other unit of adoption (Rogers, 2003). Innovation transforms a new idea or concept into a socially usable product or service (Khilji, Mroczkowski, & Bernstein, 2006), brings about changes in organizational processes, and requires conversion of an idea into a product or service that is designed, produced, and adopted by users (Verloop, 2006).
Competitive advantage	The ability of a firm to design, produce, and/or market products or services that are superior in terms of both price and non-price qualities to those offered by competitors (Ambastha & Momaya, 2004).
Product and service outcomes	Measures of products and service performance such as internal quality measurements, field performance of products, defect levels, service errors, response time, etc. (NIST, 2008).

Continued

Table 4: Continued

Construct	Description
Customer-focused outcomes	Measures of customer-related performance such as customer satisfaction and dissatisfaction; retention, gains, and losses of customers; customer complaints, complaint management, effective complaint resolution, and warranty claims; customer-perceived value based on quality and price; customer assessment of access and ease of use; awards, ratings and recognition from customers and independent rating agencies (NIST, 2008).
Financial and market outcomes	Measures of financial and market performance such as revenues, profits or losses, budgets, cash position, net assets, debt leverage, earnings per share, financial operations efficiency, financial returns, business growth, donations and grants received, percentage of revenues derived from new products, programs or services, etc. (NIST, 2008).
Workforce-focused outcomes	Measures of workforce-related performance such as increased workforce retention, leader development, workforce training, workforce safety, employee absenteeism, employee turnover, employee satisfaction, employee complaints, etc. (NIST, 2008).
Process effectiveness outcomes	Measures of organizational and operational performance including measure and indicators of process effectiveness and efficiency (e.g., cost savings, higher productivity, reduced emission levels, etc.), internal responsiveness indicators (e.g., cycle times, production flexibility, lead times, setup times, etc.), improved performance of administrative and other support functions, business-specific indicators (e.g., innovation rates, six sigma initiative results, etc.), and supply chain indicators (e.g., reduction in supply chain management costs, reductions in inventory and incoming inspections, improvements in electronic data exchange, etc.) (NIST, 2008).
Leadership outcomes	Measures of performance in the areas of leadership and governance, achievement of strategic objectives, and societal responsibilities such as environmental, legal and regulatory compliance; results of oversight audits by government or other agencies; indicators of support for key communities and other public purposes; etc. (NIST, 2008).

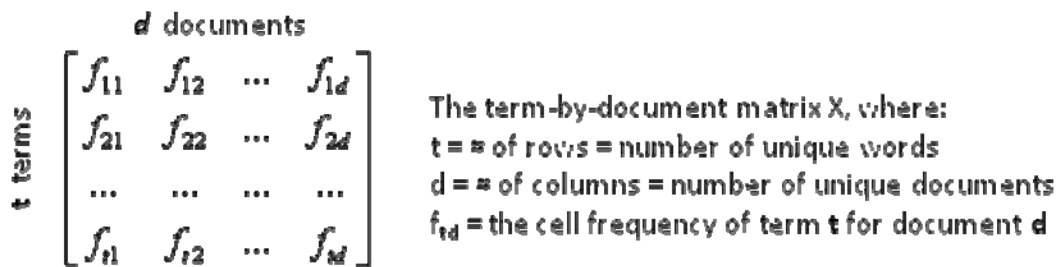
Latent Semantic Analysis (LSA)

LSA is both a theory and a method that extracts the contextual-usage meaning of words and obtains approximate estimates of meaning similarities among words and text segments in a large corpus (Landauer, Foltz, & Laham, 1998). It uses mathematical and statistical techniques

to derive the latent semantic structure within a text corpus (Berry, 1992; Deerwester, Dumais, Furnas, Landauer, & Harshman, 1990). The text corpus comprises of documents that include text passages, essays, research paper abstracts, or other contexts such as customer comments, interview transcripts, etc. The major steps involved in LSA are given below.

First, the text corpus is represented as a term-by-document matrix X , in which the rows and the columns stand for unique words and unique documents, respectively. Each cell of matrix X contains the frequency of the word denoted by its row in the document denoted by its column. Figure 4 shows the schematic of matrix X .

Figure 4: Schematic of term-by-document matrix X



Second, cell frequencies are transformed (weighted) by using some function. Various transformation schemes can be used in weighting the cell frequencies. For instance, the log-entropy transformation method converts each cell frequency (+1) to its log, computes the entropy of each word ($\sum p \log p$) over all entries in its row, and then divides each cell entry by the row entropy value. The columns of the transformed matrix are usually normalized so the final X matrix is represented in terms of vector space model (VSM). The purpose of the transformation is to show a word's importance in a particular document and the degree to which it carries information in the domain of discourse in general (Landauer et al., 1998).

Third, singular value decomposition (SVD) is applied to the X matrix. Using SVD, the rectangular $t \times d$ matrix X with rank $r \leq \min(t, d)$ is decomposed into the product of three matrices such that $X = TSD^T$. Matrix T is the $t \times r$ matrix of term eigenvectors of the square symmetric matrix $Y = XX^T$ where Y is the $t \times t$ matrix of term covariances. Its columns are called the left singular vectors, which are orthonormal (i.e., $T^T T = I$ where I is an $r \times r$ identity matrix). Matrix D is the $d \times r$ matrix of document eigenvectors of the square symmetric matrix $Z = X^T X$ where Z is the $d \times d$ matrix of document covariances. The columns of matrix D are called the right singular vectors, which are also orthonormal (i.e., $D^T D = I$ where I is an $r \times r$ identity matrix). Thus, $T^T T = D^T D = I_r$. Matrix S is the $r \times r$ diagonal matrix of singular values. These singular values are the square roots of eigenvalues of both Y and Z .

In general, the matrices T , S , and D are of full rank for $X = TSD^T$. Given $\text{rank}(X) = r \leq \min(t, d)$, the matrices T , S , and D each will have a $\text{rank}(T) = \text{rank}(S) = \text{rank}(D) = r$. Therefore, an SVD of the $t \times d$ matrix of terms by documents results in the r number of dimensions. For $d \leq t$, this means that each document represents a unique dimension in the domain of discourse. Similarly, for $t \leq d$, this means that each term represents a unique dimension in the domain of discourse.

However, the $t \times d$ term-by-document matrix X can be decomposed using fewer than the r number of factors, and the reconstructed matrix \hat{X} becomes a least-squares best fit of matrix X (Deerwester et al., 1990; Landauer et al., 1998). The fundamental idea behind using fewer than the necessary number of factors is that the $t \times d$ matrix X can be approximated by $\hat{X} = TS_0 D^T$, where S_0 is the diagonal matrix S with the first k largest original singular values

and the remaining $(r-k)$ smaller singular values set to zero. The resulting matrix \hat{X} is of rank k ($k < r$) and is the best approximation of X in the least squares sense. The variability of X is now explained by the first k factors and is equal to the sum of these k squared singular values. The diagonal matrix S_0 can be simplified to the $k \times k$ diagonal matrix \hat{S} by deleting the rows and columns of S_0 containing zeros. The corresponding columns of matrices T and D must also be deleted, resulting in the $t \times k$ matrix \hat{T} and the $d \times k$ matrix \hat{D} , respectively. Thus, we obtain the rank- k reduced model, $\hat{X} = \hat{T}\hat{S}\hat{D}^T$, which is the best possible least-squares-fit to X . This truncated representation of the original structure using only the significant factors reduces synonymy and polysemy effects, and was shown to drastically improve query performance (Landauer et al., 1998; Landauer, 2002).

The choice of k is critical in LSA. Small number of dimensions can be used to detect local unique components. On the other hand, large number of dimensions can capture similarities and differences. The selection of k can be dealt with empirically. Deerwester et al. (1990) suggest 70 to 100 dimensions frequently being the optimal choice for collections of about 5,000 terms by 1,000 documents. Efron (2005) selects k based on non-parametric confidence intervals obtained through simulations and bootstrapping. Interestingly, for collections of similar size, his method selects k values in the range of 80 to 100. Other classic k selection approaches include the total variance explained method (the number of components that explain 85% of total variance) and the Kaiser-Guttman rule (keeping components whose eigenvalues are greater than $\bar{\lambda}$).

LSA provides term and factor representation in the same factor space. From truncated SVD of matrix X , $\hat{X} = \hat{T}\hat{S}\hat{D}^T$, the term and document variance-covariance matrices are given by $\hat{X}\hat{X}^T$ and $\hat{X}^T\hat{X}$, respectively. We see that the term variance-covariance matrix $\hat{X}\hat{X}^T$ is reproduced as $\hat{X}\hat{X}^T = \hat{T}\hat{S}(\hat{T}\hat{S})^T$, therefore $L_T = \hat{T}\hat{S} = \hat{X}\hat{D}$ is a matrix of factor loadings for terms. Similarly, the factor loadings for the documents are given by $L_D = \hat{D}\hat{S} = \hat{X}^T\hat{T}$. Since both the terms and documents are represented in the same factor space, LSA also provides matrix expressions that allow comparison of terms and documents with each other.

LSA has a plethora of applications. It improves library indexing methods and the performance of search engine queries (Berry, Dumais, & O'Brien, 1995; Deerwester et al., 1990; Dumais, 2004). Psychology researchers use LSA to explain natural language processing such as word sorting and category judgments (Landauer, 2002). LSA in combination with document clustering was used on titles and keywords of articles published in 25 animal behavior journals in 1968-2002 (Ord, Martins, Thakur, Mane, & Börner, 2005) to produce lists of terms associated with each research theme. The same method was used on titles, abstracts, and full body text of articles published in the *Proceedings of the National Academy of Science* in 1997-2002 to produce visualization clusters projected on 3 dimensions (Landauer, Laham, & Derr, 2004).

The BPM-MBNQA Conceptual Framework

There is considerable discussion in the literature about how to integrate two or more models into one that provides, or purports to provide, better results than any of the individual models. One widely used approach to integration of two models is to examine the structural characteristics of both models and combine them when they share some common constructs or concepts (Black, Mendenhall, & Oddou, 1991).

Most elements of BPM framework are also critical constructs of the current MBNQA framework. The MBNQA framework embodies six business results and implies that innovation and competitive advantage lead to and are integral parts of the business results. In fact, the MBNQA framework is more comprehensive and provides the basis for the underlying constructs in the BPM framework (Hossain & Prybutok, 2008). The 2007 Monfort Summit participants alluded to this conclusion and posited that the BPM framework be used a subset of the MBNQA framework. Consistent with this I posit that the BPM and MBNQA frameworks be integrated into a new framework (BPM-MBNQA framework) such that the BPM framework serves as the start-up model for the MBNQA framework. In other words, organizations can initially deploy the BPM framework and gradually move to the adoption of MBNQA framework (Hossain & Prybutok, 2008). Figure 5 illustrates the integrated BPM-MBNQA framework.

Examination of the BPM constructs (Table 4) and the MBNQA constructs (Table 1 and Table 2) reveals that the MBNQA framework encompasses the BPM framework. Most BPM constructs – for example, strategy development, action plan (strategy deployment), results, and performance analysis, review and improvement – are directly embedded in the MBNQA frameworks. Table 5 provides the correspondence of the BPM constructs to those of the MBNQA frameworks.

Figure 5: The BPM-MBNQA conceptual framework

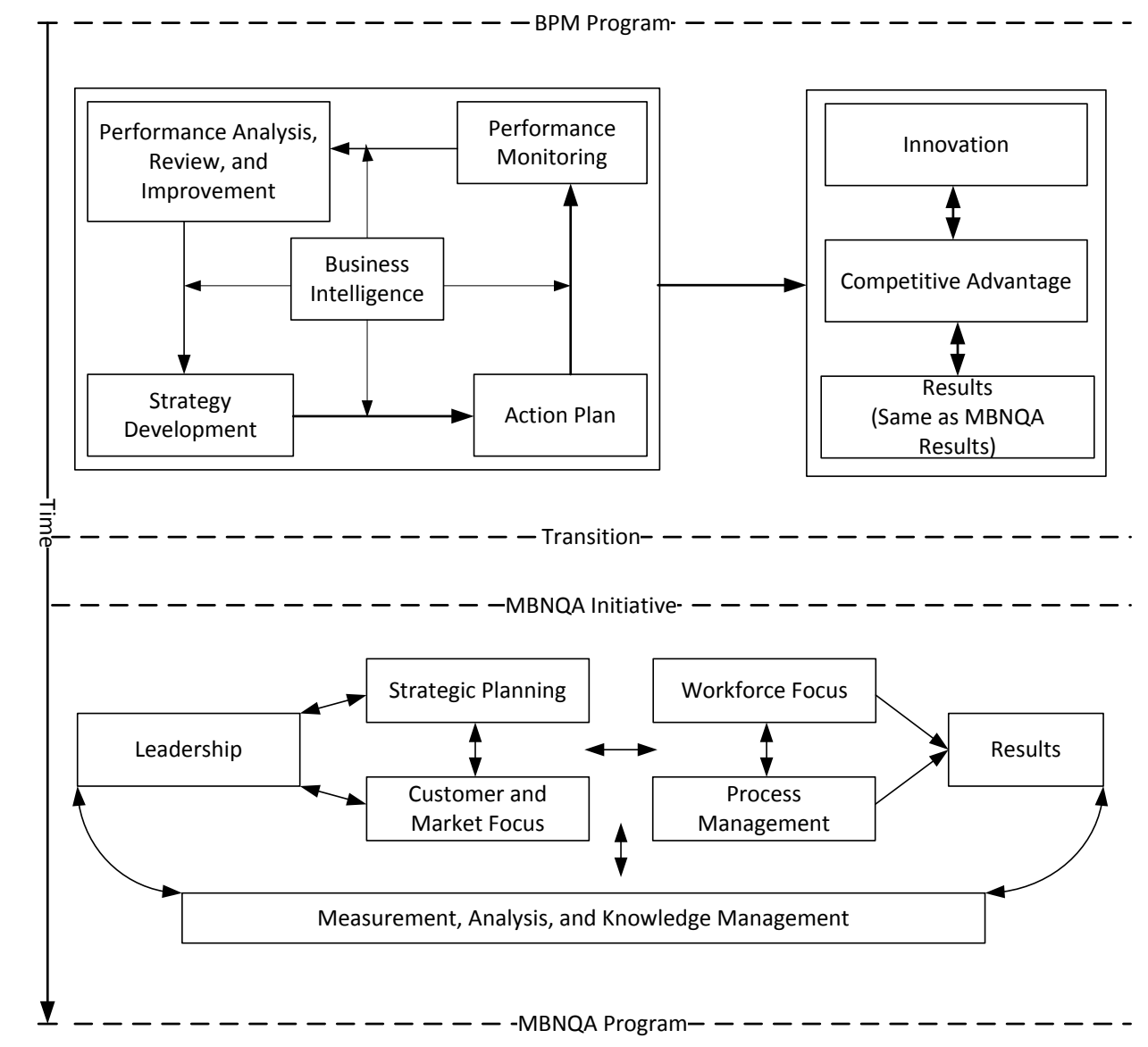


Table 5: Correspondence of the BPM constructs to the MBNQA constructs

BPM Constructs	Corresponding MBNQA Constructs
Strategy development	Strategy development is a construct of the MBNQA framework at the dimension level.
Action plan	By definition, action plan corresponds to strategy deployment, which is a dimension level MBNQA construct.
Performance monitoring	There is no direct correspondence of the construct performance monitoring in the MBNQA frameworks. However, performance monitoring falls within the scope of the measurement, analysis and knowledge management category of the MBNQA category level framework. One question item of the management, analysis and knowledge management category is how organizations track their daily operations and overall performance including progress relative to strategic objectives. This implies that performance monitoring is embedded as a critical question item in the measurement, analysis and knowledge management category of the MBNQA category level framework.
Performance analysis, review, and improvement	Performance analysis, review, and improvement is a dimension level construct of the MBNQA framework.
Business intelligence	Business intelligence largely corresponds to the management, analysis and knowledge management category of the MBNQA framework. Like business intelligence in the BPM framework, the management, analysis and knowledge management works as the “brain center” for all key data and information, and their quality and availability to ensure effective measurement, analysis and improvement of organizational performance (NIST, 2008).
Innovation and competitive advantage	There are no direct corresponding constructs in the MBNQA frameworks. The 2008 MBNQA framework uses the term strategic advantage to encompass competitive advantage. NIST (2008) posits that innovation and strategic advantage are integral parts of the business results. Innovation helps organizations to improve products, services, programs, processes, operations, and business model. Strategic advantages provide sources of current and future competitive success.
Results	This is identical to the MBNQA results category.

Nonetheless, the relationships among the constructs in the BPM framework are different than those in the MBNQA framework. That is what makes the BPM framework distinctive and independent, and not just a mere subset of the MBNQA framework. Therefore, the BPM framework can be implemented independently with the intent of paving the way for the implementation of the MBNQA framework. The use of BPM as a start-up program for the MBNQA program provides two important benefits. First, the BPM framework is a generic performance management model that can be implemented across industries. The MBNQA program uses separate frameworks for each sector that is eligible for the application of the award. Therefore, the BPM framework can provide organizations with more common language to bridge the sector-specific gaps. Second, the MBNQA framework has been evolving since its inception in 1987. Almost every year the criteria are updated and the framework is supposedly enhanced. This has an implication on organizations attempting to implement the Baldrige program because they have to adjust the changes within short period of time. However, BPM helps organizations enhance their agility. Therefore, with the implementation of the BPM framework, organizations can quickly adapt to the changes.

Research Models and Propositions

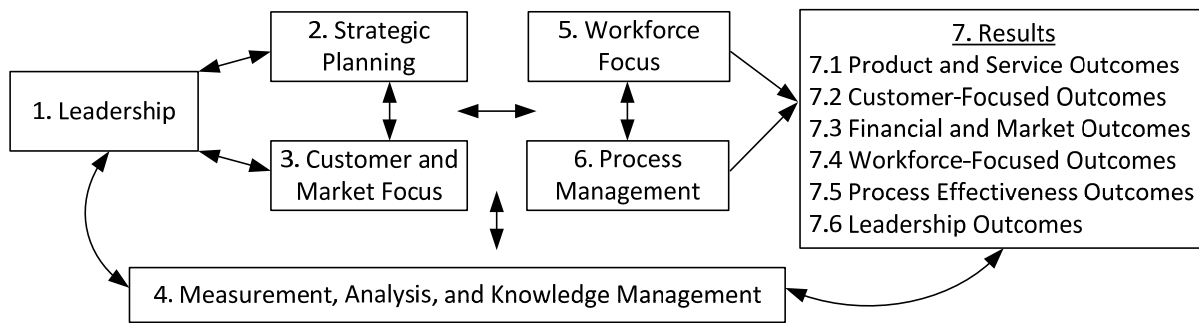
This study uses three research models – the MBNQA framework at the category level, the MBNQA framework at the dimension level, and the proposed BPM framework.

The MBNQA Framework at the Category Level

The 2008 Baldrige framework (Figure 6) comprises the Baldrige system categories (Categories 1 – 6) and the performance results category (Category 7). The system categories are connected to each other with two-headed arrows, implying that there exist non-recursive

causal relationships among them. However, they are linked to the performance results category with one-directional arrows pointing to the latter. This suggests that there are recursive causal relationships between the system categories and the performance results.

Figure 6: The 2008 MBNQA framework at the category level



There are many specific relationships among the criteria categories. No studies have investigated all possible relationships in any Baldrige framework since its inception. Some studies (e.g., Wilson & Collier, 2000; Pannirselvam & Ferguson, 2001) attempted to empirically test the Baldrige causal model. However, none of them tested the model as a non-recursive causal model. The 2008 framework represents the most recent and enhanced version, and it has not yet been tested. Therefore, the underlying relationships purported in the 2008 framework and in prior frameworks from the perspective of non-recursive causality are simply propositions. This study identifies and attempts to validate these propositions from the perspective of both recursive and non-recursive causalities.

The non-recursive causal model of the Baldrige system (Categories 1 – 6) yields 30 $([6!/(6-2)!])$ direct one-to-one causal relationships. That is, two categories give two direct one-to-one causal relationships. For instance, leadership and strategic planning have two direct one-to-one causal relationships: (1) leadership influences strategic planning, and (2) strategic

planning influences leadership. However, there are many indirect paths that can connect leadership with strategic planning. Examples include (1) leadership → customer and market focus → strategic planning, (2) leadership → process management → strategic planning, (3) leadership → customer and market focus → process management → strategic planning, and (3) leadership → customer and market focus → process management → workforce focus → strategic planning. In these relationships, the variables customer and market focus, process management, and workforce focus are called mediators because they attenuate the relationship between leadership and strategic planning. It is important to note that a specific direct one-to-one relationship can be mediated by up to four sequential mediators, yielding in 64 mediations ($[4!/3!]+[4!/2!]+[4!/1!]+[4!/0!] = 64$). This will result in a total of 1950 propositions ($30 + 64 \times 30 = 1950$).

Recall that this study examines three research models and that one is the MBNQA framework at the category level. Another model addresses the MBNQA framework at the dimension level. This section discusses the category level MBNQA framework. However, the results category of the MBNQA framework is too broad to allow substantive discussion at the category level. Thus, for the recursive causal model at the category level, the results category is split into its six components. Nonetheless, the causality among the outcomes is left for consideration at the dimension level framework.

Each system category embodies six recursive causal relationships with the outcomes. However, each of these relationships can be mediated by up to five sequential system categories, producing 325 mediations. This will result in 11,700 propositions about the mediating relationships.

Due to the complexity that the sequential multi-variable mediation can create, this study considers single variable mediation in all relationships. The propositions are grouped into two categories – results-related propositions, and system’s propositions. There are 216 results-related propositions and 150 system’s propositions, totaling 366 propositions at the category level.

Results-Related Propositions

Leadership’s Influence on the Results

- P1 Leadership has a positive influence on product and service outcomes.
- P2 Strategic planning mediates the relationship between leadership, and product and service outcomes.
- P3 Customer and market focus mediates the relationship between leadership, and product and service outcomes.
- P4 Measurement, analysis, and knowledge management mediates the relationship between leadership, and product and service outcomes.
- P5 Workforce focus mediates the relationship between leadership, and product and service outcomes.
- P6 Process management mediates the relationship between leadership, and product and service outcomes.
- P7 Leadership has a positive influence on customer-focused outcomes.
- P8 Strategic planning mediates the relationship between leadership and customer-focused outcomes.
- P9 Customer and market focus mediates the relationship between leadership and customer-focused outcomes.
- P10 Measurement, analysis, and knowledge management mediates the relationship between leadership and customer-focused outcomes.
- P11 Workforce focus mediates the relationship between leadership and customer-focused outcomes.

- P12 Process management mediates the relationship between leadership and customer-focused outcomes.
- P13 Leadership has a positive influence on financial and market outcomes.
- P14 Strategic planning mediates the relationship between leadership, and financial and market outcomes.
- P15 Customer and market focus mediates the relationship between leadership, and financial and market outcomes.
- P16 Measurement, analysis, and knowledge management mediates the relationship between leadership, and financial and market outcomes.
- P17 Workforce focus mediates the relationship between leadership, and financial and market outcomes.
- P18 Process management mediates the relationship between leadership, and financial and market outcomes.
- P19 Leadership has a positive influence on workforce-focused outcomes.
- P20 Strategic planning mediates the relationship between leadership and workforce-focused outcomes.
- P21 Customer and market focus mediates the relationship between leadership and workforce-focused outcomes.
- P22 Measurement, analysis, and knowledge management mediates the relationship between leadership and workforce-focused outcomes.
- P23 Workforce focus mediates the relationship between leadership and workforce-focused outcomes.
- P24 Process management mediates the relationship between leadership and workforce-focused outcomes.
- P25 Leadership has a positive influence on process effectiveness outcomes.
- P26 Strategic planning mediates the relationship between leadership and process effectiveness outcomes.
- P27 Customer and market focus mediates the relationship between leadership and process effectiveness outcomes.
- P28 Measurement, analysis, and knowledge management mediates the relationship between leadership and process effectiveness outcomes.

- P29 Workforce focus mediates the relationship between leadership and process effectiveness outcomes.
- P30 Process management mediates the relationship between leadership and process effectiveness outcomes.
- P31 Leadership has a positive influence on leadership outcomes.
- P32 Strategic planning mediates the relationship between leadership and leadership outcomes.
- P33 Customer and market focus mediates the relationship between leadership and leadership outcomes.
- P34 Measurement, analysis, and knowledge management mediates the relationship between leadership and leadership outcomes.
- P35 Workforce focus mediates the relationship between leadership and leadership outcomes.
- P36 Process management mediates the relationship between leadership and leadership outcomes.

Strategic Planning's Influence on the Results

- P37 Strategic planning has a positive influence on product and service outcomes.
- P38 Leadership mediates the relationship between strategic planning and product and service outcomes.
- P39 Customer and market focus mediates the relationship between strategic planning, and product and service outcomes.
- P40 Measurement, analysis, and knowledge management mediates the relationship between strategic planning, and product and service outcomes.
- P41 Workforce focus mediates the relationship between strategic planning, and product and service outcomes.
- P42 Process management mediates the relationship between strategic planning, and product and service outcomes.
- P43 Strategic planning has a positive influence on customer-focused outcomes.
- P44 Leadership mediates the relationship between strategic planning and customer-focused outcomes.

- P45 Customer and market focus mediates the relationship between strategic planning and customer-focused outcomes.
- P46 Measurement, analysis, and knowledge management mediates the relationship between strategic planning and customer-focused outcomes.
- P47 Workforce focus mediates the relationship between strategic planning and customer-focused outcomes.
- P48 Process management mediates the relationship between strategic planning and customer-focused outcomes.
- P49 Strategic planning has a positive influence on financial and market outcomes.
- P50 Leadership mediates the relationship between strategic planning, and financial and market outcomes.
- P51 Customer and market focus mediates the relationship between strategic planning, and financial and market outcomes.
- P52 Measurement, analysis, and knowledge management mediates the relationship between strategic planning, and financial and market outcomes.
- P53 Workforce focus mediates the relationship between strategic planning, and financial and market outcomes.
- P54 Process management mediates the relationship between strategic planning and financial and market outcomes.
- P55 Strategic planning has a positive influence on workforce-focused outcomes.
- P56 Leadership mediates the relationship between strategic planning and workforce-focused outcomes.
- P57 Customer and market focus mediates the relationship between strategic planning and workforce-focused outcomes.
- P58 Measurement, analysis, and knowledge management mediates the relationship between strategic planning and workforce-focused outcomes.
- P59 Workforce focus mediates the relationship between strategic planning and workforce-focused outcomes.
- P60 Process management mediates the relationship between strategic planning and workforce-focused outcomes.
- P61 Strategic planning has a positive influence on process effectiveness outcomes.

- P62 Leadership mediates the relationship between strategic planning and process effectiveness outcomes.
- P63 Customer and market focus mediates the relationship between strategic planning and process effectiveness outcomes.
- P64 Measurement, analysis, and knowledge management mediates the relationship between strategic planning and process effectiveness outcomes.
- P65 Workforce focus mediates the relationship between strategic planning and process effectiveness outcomes.
- P66 Process management mediates the relationship between strategic planning and process effectiveness outcomes.
- P67 Strategic planning has a positive influence on leadership outcomes.
- P68 Leadership mediates the relationship between strategic planning and leadership outcomes.
- P69 Customer and market focus mediates the relationship between strategic planning and leadership outcomes.
- P70 Measurement, analysis, and knowledge management mediates the relationship between strategic planning and leadership outcomes.
- P71 Workforce focus mediates the relationship between strategic planning and leadership outcomes.
- P72 Process management mediates the relationship between strategic planning and leadership outcomes.

Influence of Customer and Market focus on the Results

- P73 Customer and market focus has a positive influence on product and service outcomes.
- P74 Leadership mediates the relationship between customer and market focus, and product and service outcomes.
- P75 Strategic planning mediates the relationship between customer and market focus, and product and service outcomes.
- P76 Measurement, analysis, and knowledge management mediates the relationship between customer and market focus, and product and service outcomes.

- P77 Workforce focus mediates the relationship between customer and market focus, and product and service outcomes.
- P78 Process management mediates the relationship between customer and market focus, and product and service outcomes.
- P79 Customer and market focus has a positive influence on customer-focused outcomes.
- P80 Leadership mediates the relationship between customer and market focus, and customer-focused outcomes.
- P81 Strategic planning mediates the relationship between customer and market focus, and customer-focused outcomes.
- P82 Measurement, analysis, and knowledge management mediates the relationship between customer and market focus, and customer-focused outcomes.
- P83 Workforce focus mediates the relationship between customer and market focus, and customer-focused outcomes.
- P84 Process management mediates the relationship between customer and market focus, and customer-focused outcomes.
- P85 Customer and market focus has a positive influence on financial and market outcomes.
- P86 Leadership mediates the relationship between customer and market focus, and financial and market outcomes.
- P87 Strategic planning mediates the relationship between customer and market focus, and financial and market outcomes.
- P88 Measurement, analysis, and knowledge management mediates the relationship between customer and market focus, and financial and market outcomes.
- P89 Workforce focus mediates the relationship between customer and market focus, and financial and market outcomes.
- P90 Process management mediates the relationship between customer and market focus, and financial and market outcomes.
- P91 Customer and market focus has a positive influence on workforce-focused outcomes.
- P92 Leadership mediates the relationship between customer and market focus, and workforce-focused outcomes.
- P93 Strategic planning mediates the relationship between customer and market focus, and workforce-focused outcomes.

- P94 Measurement, analysis, and knowledge management mediates the relationship between customer and market focus, and workforce-focused outcomes.
- P95 Workforce focus mediates the relationship between customer and market focus, and workforce-focused outcomes.
- P96 Process management mediates the relationship between customer and market focus, and workforce-focused outcomes.
- P97 Customer and market focus has a positive influence on process effectiveness outcomes.
- P98 Leadership mediates the relationship between customer and market focus, and process effectiveness outcomes.
- P99 Strategic planning mediates the relationship between customer and market focus, and process effectiveness outcomes.
- P100 Measurement, analysis, and knowledge management mediates the relationship between customer and market focus, and process effectiveness outcomes.
- P101 Workforce focus mediates the relationship between customer and market focus, and process effectiveness outcomes.
- P102 Process management mediates the relationship between customer and market focus, and process effectiveness outcomes.
- P103 Customer and market focus has a positive influence on leadership outcomes.
- P104 Leadership mediates the relationship between customer and market focus, and leadership outcomes.
- P105 Strategic planning mediates the relationship between customer and market focus, and leadership outcomes.
- P106 Measurement, analysis, and knowledge management mediates the relationship between customer and market focus, and leadership outcomes.
- P107 Workforce focus mediates the relationship between customer and market focus, and leadership outcomes.
- P108 Process management mediates the relationship between customer and market focus, and leadership outcomes.

Influence of Measurement, Analysis, and Knowledge Management on the Results

- P109 Measurement, analysis, and knowledge management has a positive influence on product and service outcomes.

- P110 Leadership mediates the relationship between measurement, analysis, and knowledge management, and product and service outcomes.
- P111 Strategic planning mediates the relationship between measurement, analysis, and knowledge management, and product and service outcomes.
- P112 Customer and market focus mediates the relationship between measurement, analysis, and knowledge management, and product and service outcomes.
- P113 Workforce focus mediates the relationship between measurement, analysis, and knowledge management, and product and service outcomes.
- P114 Process management mediates the relationship between measurement, analysis, and knowledge management, and product and service outcomes.
- P115 Measurement, analysis, and knowledge management has a positive influence on customer-focused outcomes.
- P116 Leadership mediates the relationship between measurement, analysis, and knowledge management, and customer-focused outcomes.
- P117 Strategic planning mediates the relationship between measurement, analysis, and knowledge management, and customer-focused outcomes.
- P118 Customer and market focus mediates the relationship between measurement, analysis, and knowledge management, and customer-focused outcomes.
- P119 Workforce focus mediates the relationship between measurement, analysis, and knowledge management, and customer-focused outcomes.
- P120 Process management mediates the relationship between measurement, analysis, and knowledge management, and customer-focused outcomes.
- P121 Measurement, analysis, and knowledge management has a positive influence on financial and market outcomes.
- P122 Leadership mediates the relationship between measurement, analysis, and knowledge management, and financial and market outcomes.
- P123 Strategic planning mediates the relationship between measurement, analysis, and knowledge management, and financial and market outcomes.
- P124 Customer and market focus mediates the relationship between measurement, analysis, and knowledge management, and financial and market outcomes.

- P125 Workforce focus mediates the relationship between measurement, analysis, and knowledge management, and financial and market outcomes.
- P126 Process management mediates the relationship between measurement, analysis, and knowledge management, and financial and market outcomes.
- P127 Measurement, analysis, and knowledge management has a positive influence on workforce-focused outcomes.
- P128 Leadership mediates the relationship between measurement, analysis, and knowledge management, and workforce-focused outcomes.
- P129 Strategic planning mediates the relationship between measurement, analysis, and knowledge management, and workforce-focused outcomes.
- P130 Customer and market focus mediates the relationship between measurement, analysis, and knowledge management, and workforce-focused outcomes.
- P131 Workforce focus mediates the relationship between measurement, analysis, and knowledge management, and workforce-focused outcomes.
- P132 Process management mediates the relationship between measurement, analysis, and knowledge management, and workforce-focused outcomes.
- P133 Measurement, analysis, and knowledge management has a positive influence on process effectiveness outcomes.
- P134 Leadership mediates the relationship between measurement, analysis, and knowledge management, and process effectiveness outcomes.
- P135 Strategic planning mediates the relationship between measurement, analysis, and knowledge management, and process effectiveness outcomes.
- P136 Customer and market focus mediates the relationship between measurement, analysis, and knowledge management, and process effectiveness outcomes.
- P137 Workforce focus mediates the relationship between measurement, analysis, and knowledge management, and process effectiveness outcomes.
- P138 Process management mediates the relationship between measurement, analysis, and knowledge management, and process effectiveness outcomes.
- P139 Measurement, analysis, and knowledge management has a positive influence on leadership outcomes.

- P140 Leadership mediates the relationship between measurement, analysis, and knowledge management, and leadership outcomes.
- P141 Strategic planning mediates the relationship between measurement, analysis, and knowledge management, and leadership outcomes.
- P142 Customer and market focus mediates the relationship between measurement, analysis, and knowledge management, and leadership outcomes.
- P143 Workforce focus mediates the relationship between measurement, analysis, and knowledge management, and leadership outcomes.
- P144 Process management mediates the relationship between measurement, analysis, and knowledge management, and leadership outcomes.

Influence of Workforce Focus on the Results

- P145 Workforce focus has a positive influence on product and service outcomes.
- P146 Leadership mediates the relationship between workforce focus, and product and service outcomes.
- P147 Strategic planning mediates the relationship between workforce focus, and product and service outcomes.
- P148 Customer and market focus mediates the relationship between workforce focus, and product and service outcomes.
- P149 Measurement, analysis, and knowledge management mediates the relationship between workforce focus, and product and service outcomes.
- P150 Process management mediates the relationship between workforce focus, and product and service outcomes.
- P151 Workforce focus has a positive influence on customer-focused outcomes.
- P152 Leadership mediates the relationship between workforce focus and customer-focused outcomes.
- P153 Strategic planning mediates the relationship between workforce focus and customer-focused outcomes.
- P154 Customer and market focus mediates the relationship between workforce focus and customer-focused outcomes.
- P155 Measurement, analysis, and knowledge management mediates the relationship between workforce focus and customer-focused outcomes.

- P156 Process management mediates the relationship between workforce focus and customer-focused outcomes.
- P157 Workforce focus has a positive influence on financial and market outcomes.
- P158 Leadership mediates the relationship between workforce focus, and financial and market outcomes.
- P159 Strategic planning mediates the relationship between workforce focus, and financial and market outcomes.
- P160 Customer and market focus mediates the relationship between workforce focus, and financial and market outcomes.
- P161 Measurement, analysis, and knowledge management mediates the relationship between workforce focus, and financial and market outcomes.
- P162 Process management mediates the relationship between workforce focus, and financial and market outcomes.
- P163 Workforce focus has a positive influence on workforce-focused outcomes.
- P164 Leadership mediates the relationship between workforce focus and workforce-focused outcomes.
- P165 Strategic planning mediates the relationship between workforce focus and workforce-focused outcomes.
- P166 Customer and market focus mediates the relationship between workforce focus and workforce-focused outcomes.
- P167 Measurement, analysis, and knowledge management mediates the relationship between workforce focus and workforce-focused outcomes.
- P168 Process management mediates the relationship between workforce focus and workforce-focused outcomes.
- P169 Workforce focus has a positive influence on process effectiveness outcomes.
- P170 Leadership mediates the relationship between workforce focus and process effectiveness outcomes.
- P171 Strategic planning mediates the relationship between workforce focus and process effectiveness outcomes.
- P172 Customer and market focus mediates the relationship between workforce focus and process effectiveness outcomes.

- P173 Measurement, analysis, and knowledge management mediates the relationship between workforce focus and process effectiveness outcomes.
- P174 Process management mediates the relationship between workforce focus and process effectiveness outcomes.
- P175 Workforce focus has a positive influence on leadership outcomes.
- P176 Leadership mediates the relationship between workforce focus and leadership outcomes.
- P177 Strategic planning mediates the relationship between workforce focus and leadership outcomes.
- P178 Customer and market focus mediates the relationship between workforce focus and leadership outcomes.
- P179 Measurement, analysis, and knowledge management mediates the relationship between workforce focus and leadership outcomes.
- P180 Process management mediates the relationship between workforce focus and leadership outcomes.

Process Management's Influence on the Results

- P181 Process management has a positive influence on product and service outcomes.
- P182 Leadership mediates the relationship between process management, and product and service outcomes.
- P183 Strategic planning mediates the relationship between process management, and product and service outcomes.
- P184 Customer and market focus mediates the relationship between process management, and product and service outcomes.
- P185 Measurement, analysis, and knowledge management mediates the relationship between process management, and product and service outcomes.
- P186 Workforce focus mediates the relationship between process management, and product and service outcomes.
- P187 Process management has a positive influence on customer-focused outcomes.
- P188 Leadership mediates the relationship between process management and customer-focused outcomes.

- P189 Strategic planning mediates the relationship between process management and customer-focused outcomes.
- P190 Customer and market focus mediates the relationship between process management and customer-focused outcomes.
- P191 Measurement, analysis, and knowledge management mediates the relationship between process management and customer-focused outcomes.
- P192 Workforce focus mediates the relationship between process management and customer-focused outcomes.
- P193 Process management has a positive influence on financial and market outcomes.
- P194 Leadership mediates the relationship between process management, and financial and market outcomes.
- P195 Strategic planning mediates the relationship between process management, and financial and market outcomes.
- P196 Customer and market focus mediates the relationship between process management, and financial and market outcomes.
- P197 Measurement, analysis, and knowledge management mediates the relationship between process management, and financial and market outcomes.
- P198 Workforce focus mediates the relationship between process management, and financial and market outcomes.
- P199 Process management has a positive influence on workforce-focused outcomes.
- P200 Leadership mediates the relationship between process management and workforce-focused outcomes.
- P201 Strategic planning mediates the relationship between process management and workforce-focused outcomes.
- P202 Customer and market focus mediates the relationship between process management and workforce-focused outcomes.
- P203 Measurement, analysis, and knowledge management mediates the relationship between process management and workforce-focused outcomes.
- P204 Workforce focus mediates the relationship between process management and workforce-focused outcomes.
- P205 Process management has a positive influence on process effectiveness outcomes.

- P206 Leadership mediates the relationship between process management and process effectiveness outcomes.
- P207 Strategic planning mediates the relationship between process management and process effectiveness outcomes.
- P208 Customer and market focus mediates the relationship between process management and process effectiveness outcomes.
- P209 Measurement, analysis, and knowledge management mediates the relationship between process management and process effectiveness outcomes.
- P210 Workforce focus mediates the relationship between process management and process effectiveness outcomes.
- P211 Process management has a positive influence on leadership outcomes.
- P212 Leadership mediates the relationship between process management and leadership outcomes.
- P213 Strategic planning mediates the relationship between process management and leadership outcomes.
- P214 Customer and market focus mediates the relationship between process management and leadership outcomes.
- P215 Measurement, analysis, and knowledge management mediates the relationship between process management and leadership outcomes.
- P216 Workforce focus mediates the relationship between process management and leadership outcomes.

The above propositions are summarized in a tabular form in Table 6. The tabular form provides a more concise reference to the elaborated results-related propositions.

- P226 Process management mediates the relationship between leadership, and customer and market focus.
- P227 Leadership has a positive influence on measurement, analysis, and knowledge management.
- P228 Strategic planning mediates the relationship between leadership, and measurement, analysis, and knowledge management.
- P229 Customer and market focus mediates the relationship between leadership, and measurement, analysis, and knowledge management.
- P230 Workforce focus mediates the relationship between leadership, and measurement, analysis, and knowledge management.
- P231 Process management mediates the relationship between leadership, and measurement, analysis, and knowledge management.
- P232 Leadership has a positive influence on workforce focus.
- P233 Strategic planning mediates the relationship between leadership and workforce focus.
- P234 Customer and market focus mediates the relationship between leadership and workforce focus.
- P235 Measurement, analysis, and knowledge management mediates the relationship between leadership and workforce focus.
- P236 Process management mediates the relationship between leadership and workforce focus.
- P237 Leadership has a positive influence on process management.
- P238 Strategic planning mediates the relationship between leadership and process management.
- P239 Customer and market focus mediates the relationship between leadership and process management.
- P240 Measurement, analysis, and knowledge management mediates the relationship between leadership and process management.
- P241 Workforce focus mediates the relationship between leadership and process management.

Strategic Planning's Influence on Other System Categories

- P242 Strategic planning has a positive influence on leadership.
- P243 Customer and market focus mediates the relationship between strategic planning and leadership.
- P244 Measurement, analysis, and knowledge management mediates the relationship between strategic planning and leadership.
- P245 Workforce focus mediates the relationship between strategic planning and leadership.
- P246 Process management mediates the relationship between strategic planning and leadership.
- P247 Strategic planning has a positive influence on customer and market focus.
- P248 Strategic planning mediates the relationship between strategic planning, and customer and market focus.
- P249 Measurement, analysis, and knowledge management mediates the relationship between strategic planning, and customer and market focus.
- P250 Workforce focus mediates the relationship between strategic planning, and customer and market focus.
- P251 Process management mediates the relationship between strategic planning, and customer and market focus.
- P252 Strategic planning has a positive influence on measurement, analysis, and knowledge management.
- P253 Strategic planning mediates the relationship between strategic planning, and measurement, analysis, and knowledge management.
- P254 customer and market focus mediates the relationship between strategic planning, and measurement, analysis, and knowledge management.
- P255 Workforce focus mediates the relationship between strategic planning, and measurement, analysis, and knowledge management.
- P256 Process management mediates the relationship between strategic planning, and measurement, analysis, and knowledge management.
- P257 Strategic planning has a positive influence on workforce focus.

- P258 Strategic planning mediates the relationship between strategic planning and workforce focus.
- P259 Customer and market focus mediates the relationship between strategic planning and workforce focus.
- P260 Measurement, analysis, and knowledge management mediates the relationship between strategic planning and workforce focus.
- P261 Process management mediates the relationship between strategic planning and workforce focus.
- P262 Strategic planning has a positive influence on process management.
- P263 Strategic planning mediates the relationship between strategic planning and process management.
- P264 Customer and market focus mediates the relationship between strategic planning and process management.
- P265 Measurement, analysis, and knowledge management mediates the relationship between strategic planning and process management.
- P266 Workforce focus mediates the relationship between strategic planning and process management.

Influence of Customer and Market Focus on Other System Categories

- P267 Customer and market focus has a positive influence on leadership.
- P268 Strategic planning mediates the relationship between customer and market focus, and leadership.
- P269 Measurement, analysis, and knowledge management mediates the relationship between customer and market focus, and leadership.
- P270 Workforce focus mediates the relationship between customer and market focus, and leadership.
- P271 Process management mediates the relationship between customer and market focus, and leadership.
- P272 Customer and market focus has a positive influence on strategic planning.
- P273 Leadership mediates the relationship between customer and market focus, and strategic planning.

- P274 Measurement, analysis, and knowledge management mediates the relationship between customer and market focus, and strategic planning.
- P275 Workforce focus mediates the relationship between customer and market focus, and strategic planning.
- P276 Process management mediates the relationship between customer and market focus, and strategic planning.
- P277 Customer and market focus has a positive influence on measurement, analysis, and knowledge management.
- P278 Leadership mediates the relationship between customer and market focus, and measurement, analysis, and knowledge management.
- P279 Strategic planning mediates the relationship between customer and market focus, and measurement, analysis, and knowledge management.
- P280 Workforce focus mediates the relationship between customer and market focus, and measurement, analysis, and knowledge management.
- P281 Process management mediates the relationship between customer and market focus, and measurement, analysis, and knowledge management.
- P282 Customer and market focus has a positive influence on workforce focus.
- P283 Leadership mediates the relationship between customer and market focus, and workforce focus.
- P284 Strategic planning mediates the relationship between customer and market focus, and workforce focus.
- P285 Measurement, analysis, and knowledge management mediates the relationship between customer and market focus, and workforce focus.
- P286 Process management mediates the relationship between customer and market focus, and workforce focus.
- P287 Customer and market focus has a positive influence on process management.
- P288 Leadership mediates the relationship between customer and market focus, and process management.
- P289 Strategic planning mediates the relationship between customer and market focus, and process management.

P290 Measurement, analysis, and knowledge management mediates the relationship between customer and market focus, and process management.

P291 Workforce focus mediates the relationship between customer and market focus, and process management.

Influence of Measurement, Analysis, and Knowledge Management on Other System Categories

P292 Measurement, analysis, and knowledge management has a positive influence on leadership.

P293 Strategic planning mediates the relationship between measurement, analysis, and knowledge management, and leadership.

P294 Customer and market focus mediates the relationship between measurement, analysis, and knowledge management, and leadership.

P295 Workforce focus mediates the relationship between measurement, analysis, and knowledge management, and leadership.

P296 Process management mediates the relationship between measurement, analysis, and knowledge management, and leadership.

P297 Measurement, analysis, and knowledge management has a positive influence on strategic planning.

P298 Leadership mediates the relationship between measurement, analysis, and knowledge management, and strategic planning.

P299 Customer and market focus mediates the relationship between measurement, analysis, and knowledge management, and strategic planning.

P300 Workforce focus mediates the relationship between measurement, analysis, and knowledge management, and strategic planning.

P301 Process management mediates the relationship between measurement, analysis, and knowledge management, and strategic planning.

P302 Measurement, analysis, and knowledge management has a positive influence on customer and market focus.

P303 Leadership mediates the relationship between measurement, analysis, and knowledge management, and customer and market focus.

P304 Strategic planning mediates the relationship between measurement, analysis, and knowledge management, and customer and market focus.

- P305 Workforce focus mediates the relationship between measurement, analysis, and knowledge management, and customer and market focus.
- P306 Process management mediates the relationship between measurement, analysis, and knowledge management, and customer and market focus.
- P307 Measurement, analysis, and knowledge management has a positive influence on workforce focus.
- P308 Leadership mediates the relationship between measurement, analysis, and knowledge management, and workforce focus.
- P309 Strategic planning mediates the relationship between measurement, analysis, and knowledge management, and workforce focus.
- P310 Customer and market focus mediates the relationship between measurement, analysis, and knowledge management, and workforce focus.
- P311 Process management mediates the relationship between measurement, analysis, and knowledge management, and workforce focus.
- P312 Measurement, analysis, and knowledge management has a positive influence on process management.
- P313 Leadership mediates the relationship between measurement, analysis, and knowledge management, and process management.
- P314 Strategic planning mediates the relationship between measurement, analysis, and knowledge management, and process management.
- P315 Customer and market focus mediates the relationship between measurement, analysis, and knowledge management, and process management.
- P316 Workforce focus mediates the relationship between measurement, analysis, and knowledge management, and process management.

Influence of Workforce Focus on Other System Categories

- P317 Workforce focus has a positive influence on leadership.
- P318 Strategic planning mediates the relationship between workforce focus and leadership.
- P319 Customer and market focus mediates the relationship between workforce focus and leadership.
- P320 Measurement, analysis, and knowledge management mediates the relationship between workforce focus and leadership.

- P321 Process management mediates the relationship between workforce focus and leadership.
- P322 Workforce focus has a positive influence on strategic planning.
- P323 Leadership mediates the relationship between workforce focus and strategic planning.
- P324 Customer and market focus mediates the relationship between workforce focus and strategic planning.
- P325 Measurement, analysis, and knowledge management mediates the relationship between workforce focus and strategic planning.
- P326 Process management mediates the relationship between workforce focus and strategic planning.
- P327 Workforce focus has a positive influence on customer and market focus.
- P328 Leadership mediates the relationship between workforce focus and customer and market focus.
- P329 Strategic planning mediates the relationship between workforce focus, and customer and market focus.
- P330 Measurement, analysis, and knowledge management mediates the relationship between workforce focus, and customer and market focus.
- P331 Process management mediates the relationship between workforce focus, and customer and market focus.
- P332 Workforce focus has a positive influence on measurement, analysis, and knowledge management.
- P333 Leadership mediates the relationship between workforce focus, and measurement, analysis, and knowledge management.
- P334 Strategic planning mediates the relationship between workforce focus, and measurement, analysis, and knowledge management.
- P335 Customer and market focus mediates the relationship between workforce focus, and measurement, analysis, and knowledge management.
- P336 Process management mediates the relationship between workforce focus, and measurement, analysis, and knowledge management.
- P337 Workforce focus has a positive influence on process management.

- P338 Leadership mediates the relationship between workforce focus and process management.
- P339 Strategic planning mediates the relationship between workforce focus and process management.
- P340 Customer and market focus mediates the relationship between workforce focus and process management.
- P341 Measurement, analysis, and knowledge management mediates the relationship between workforce focus and process management.

Influence of Process Management on Other System Categories

- P342 Process management has a positive influence on leadership.
- P343 Strategic planning mediates the relationship between process management and leadership.
- P344 Customer and market focus mediates the relationship between process management and leadership.
- P345 Measurement, analysis, and knowledge management mediates the relationship between process management and leadership.
- P346 Workforce focus mediates the relationship between process management and leadership.
- P347 Process management has a positive influence on strategic planning.
- P348 Leadership mediates the relationship between process management and strategic planning.
- P349 Customer and market focus mediates the relationship between process management and strategic planning.
- P350 Measurement, analysis, and knowledge management mediates the relationship between process management and strategic planning.
- P351 Workforce focus mediates the relationship between process management and strategic planning.
- P352 Process management has a positive influence on customer and market focus.
- P353 Leadership mediates the relationship between process management, and customer and market focus.

- P354 Strategic planning mediates the relationship between process management, and customer and market focus.
- P355 Measurement, analysis, and knowledge management mediates the relationship between process management, and customer and market focus.
- P356 Workforce focus mediates the relationship between process management, and customer and market focus.
- P357 Process management has a positive influence on measurement, analysis, and knowledge management.
- P358 Leadership mediates the relationship between process management, and measurement, analysis, and knowledge management.
- P359 Strategic planning mediates the relationship between process management, and measurement, analysis, and knowledge management.
- P360 Customer and market focus mediates the relationship between process management, and measurement, analysis, and knowledge management.
- P361 Workforce focus mediates the relationship between process management, and measurement, analysis, and knowledge management.
- P362 Process management has a positive influence on workforce focus.
- P363 Leadership mediates the relationship between process management and workforce focus.
- P364 Strategic planning mediates the relationship between process management and workforce focus.
- P365 Customer and market focus mediates the relationship between process management and workforce focus.
- P366 Measurement, analysis, and knowledge management mediates the relationship between process management and workforce focus.

Table 7 provides a tabular view of System’s propositions for the MBNQA category level framework.

Table 7: Tabular view of system’s propositions for MBNQA category level framework

Table P2	Con.	Has a positive influence on																																								
		L mediated by						S mediated by						C mediated by						M mediated by						W mediated by						P mediated by										
		L	S	C	M	W	P	L	S	C	M	W	P	L	S	C	M	W	P	L	S	C	M	W	P	L	S	C	M	W	P	L	S	C	M	W	P					
a	L	-	-	-	-	-	-	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y
b	S	Y	-	Y	Y	Y	-	-	-	-	-	Y	-	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	
c	C	Y	Y	-	Y	Y	Y	Y	-	Y	Y	-	-	-	-	-	Y	Y	-	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	-	Y	Y	Y		
d	M	Y	Y	Y	-	Y	Y	Y	Y	-	Y	Y	Y	Y	-	Y	-	-	-	-	-	-	Y	Y	Y	-	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	-	Y	Y		
e	W	Y	Y	Y	Y	-	Y	Y	Y	Y	-	Y	Y	Y	Y	-	Y	Y	Y	Y	-	Y	-	-	-	-	-	-	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	-	Y		
f	P	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	-	-	-	-	-	-	-	-	-	-	-	-	-

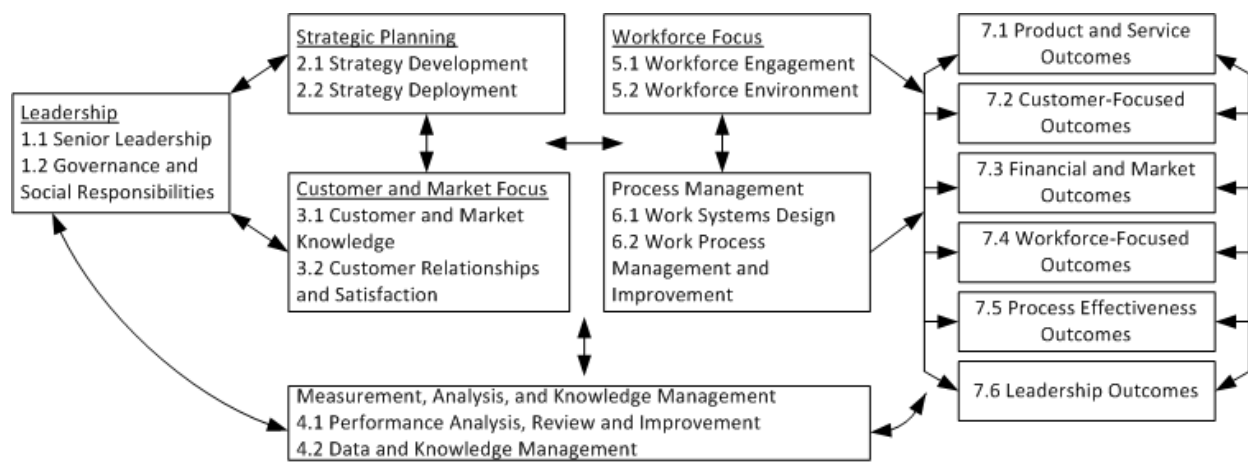
Legends: L = Leadership; S = Strategic Planning; C = Customer and Market Focus; M = Measurement, Analysis, and Knowledge Management; W = Workforce Focus; P = Process Management; Y = Yes; and Con. = Constructs.

Examples: "X has a positive influence on Y mediated by Y" means "X has a positive influence on Y". "X has a positive influence on Y mediated by Z" means "Z mediates the relationship between X and Y". And in "the relationship between X and Y", X indicates the independent variable.

The MBNQA Framework at the Dimension Level

There are 18 dimension level constructs of the MBNQA framework (Table 2). The dimension level MBNQA framework is shown in Figure 7. Considering even a single variable mediation increases the number of propositions dramatically. And since first order mediation has been considered for the category level framework, no mediatory effect is purported to be within the scope of this study.

Figure 7: The 2008 MBNQA framework at the dimension level



The first twelve dimensions comprise the Baldrige system. These dimensions are connected to each other with two-headed arrows and thus form a non-recursive causal model. One-directional arrows connect these dimensions with those of the results category, suggesting that there exist recursive causal relationships between the Baldrige system dimensions and the results dimensions. However, the results dimensions are linked to each other in a non-recursive fashion. Considering only the direct one-to-one relationships, there are 234 propositions for this framework. These propositions are presented below.

P367 Senior leadership has a positive influence on governance and social responsibilities.

P368 Senior leadership has a positive influence on strategy development.

P369 Senior leadership has a positive influence on strategy deployment.

P370 Senior leadership has a positive influence on customer and market knowledge.

P371 Senior leadership has a positive influence on customer relationships and satisfaction.

P372 Senior leadership has a positive influence on performance analysis, review, and improvement.

P373 Senior leadership has a positive influence on data and knowledge management.

P374 Senior leadership has a positive influence on workforce engagement.

P375 Senior leadership has a positive influence on workforce environment.

P376 Senior leadership has a positive influence on work systems design.

P377 Senior leadership has a positive influence on work process management and improvement.

P378 Senior leadership has a positive influence on product and service outcomes.

P379 Senior leadership has a positive influence on customer-focused outcomes.

P380 Senior leadership has a positive influence on financial and market outcomes.

P381 Senior leadership has a positive influence on workforce-focused outcomes.

- P382 Senior leadership has a positive influence on process effectiveness outcomes.
- P383 Senior leadership has a positive influence on leadership outcomes.
- P384 Governance and social responsibilities have a positive influence on senior leadership.
- P385 Governance and social responsibilities have a positive influence on strategy development.
- P386 Governance and social responsibilities have a positive influence on strategy deployment.
- P387 Governance and social responsibilities have a positive influence on customer and market knowledge.
- P388 Governance and social responsibilities have a positive influence on customer relationships and satisfaction.
- P389 Governance and social responsibilities have a positive influence on performance analysis, review, and improvement.
- P390 Governance and social responsibilities have a positive influence on data and knowledge management.
- P391 Governance and social responsibilities have a positive influence on workforce engagement.
- P392 Governance and social responsibilities have a positive influence on workforce environment.
- P393 Governance and social responsibilities have a positive influence on work systems design.
- P394 Governance and social responsibilities have a positive influence on work process management and improvement.
- P395 Governance and social responsibilities have a positive influence on product and service outcomes.
- P396 Governance and social responsibilities have a positive influence on customer-focused outcomes.
- P397 Governance and social responsibilities have a positive influence on financial and market outcomes.
- P398 Governance and social responsibilities have a positive influence on workforce-focused outcomes.

- P399 Governance and social responsibilities have a positive influence on process effectiveness outcomes.
- P400 Governance and social responsibilities have a positive influence on leadership outcomes.
- P401 Strategy development has a positive influence on senior leadership.
- P402 Strategy development has a positive influence on governance and social responsibilities.
- P403 Strategy development has a positive influence on strategy deployment.
- P404 Strategy development has a positive influence on customer and market knowledge.
- P405 Strategy development has a positive influence on customer relationships and satisfaction.
- P406 Strategy development has a positive influence on performance analysis, review, and improvement.
- P407 Strategy development has a positive influence on data and knowledge management.
- P408 Strategy development has a positive influence on workforce engagement.
- P409 Strategy development has a positive influence on workforce environment.
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- P411 Strategy development has a positive influence on work process management and improvement.
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- P414 Strategy development has a positive influence on financial and market outcomes.
- P415 Strategy development has a positive influence on workforce-focused outcomes.
- P416 Strategy development has a positive influence on process effectiveness outcomes.
- P417 Strategy development has a positive influence on leadership outcomes.
- P418 Strategy deployment has a positive influence on senior leadership.
- P419 Strategy deployment has a positive influence on governance and social responsibilities.
- P420 Strategy deployment has a positive influence on strategy development.

- P421 Strategy deployment has a positive influence on customer and market knowledge.
- P422 Strategy deployment has a positive influence on customer relationships and satisfaction.
- P423 Strategy deployment has a positive influence on performance analysis, review, and improvement.
- P424 Strategy deployment has a positive influence on data and knowledge management.
- P425 Strategy deployment has a positive influence on workforce engagement.
- P426 Strategy deployment has a positive influence on workforce environment.
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- P432 Strategy deployment has a positive influence on workforce-focused outcomes.
- P433 Strategy deployment has a positive influence on process effectiveness outcomes.
- P434 Strategy deployment has a positive influence on leadership outcomes.
- P435 Customer and market knowledge has a positive influence on senior leadership.
- P436 Customer and market knowledge has a positive influence on governance and social responsibilities.
- P437 Customer and market knowledge has a positive influence on strategy development.
- P438 Customer and market knowledge has a positive influence on strategy deployment.
- P439 Customer and market knowledge has a positive influence on customer relationships and satisfaction.
- P440 Customer and market knowledge has a positive influence on performance analysis, review, and improvement.
- P441 Customer and market knowledge has a positive influence on data and knowledge management.

- P442 Customer and market knowledge has a positive influence on workforce engagement.
- P443 Customer and market knowledge has a positive influence on workforce environment.
- P444 Customer and market knowledge has a positive influence on work systems design.
- P445 Customer and market knowledge has a positive influence on work process management and improvement.
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- P450 Customer and market knowledge has a positive influence on process effectiveness outcomes.
- P451 Customer and market knowledge has a positive influence on leadership outcomes.
- P452 Customer relationships and satisfaction has a positive influence on senior leadership.
- P453 Customer relationships and satisfaction has a positive influence on governance and social responsibilities.
- P454 Customer relationships and satisfaction has a positive influence on strategy development.
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- P457 Customer relationships and satisfaction has a positive influence on performance analysis, review, and improvement.
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- P460 Customer relationships and satisfaction has a positive influence on workforce environment.
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- P462 Customer relationships and satisfaction has a positive influence on work process management and improvement.
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- P466 Customer relationships and satisfaction has a positive influence on workforce-focused outcomes.
- P467 Customer relationships and satisfaction has a positive influence on process effectiveness outcomes.
- P468 Customer relationships and satisfaction has a positive influence on leadership outcomes.
- P469 Performance analysis, review, and improvement have a positive influence on senior leadership.
- P470 Performance analysis, review, and improvement have a positive influence on governance and social responsibilities.
- P471 Performance analysis, review, and improvement have a positive influence on strategy development.
- P472 Performance analysis, review, and improvement have a positive influence on strategy deployment.
- P473 Performance analysis, review, and improvement have a positive influence on customer and market knowledge.
- P474 Performance analysis, review, and improvement have a positive influence on customer relationships and satisfaction.
- P475 Performance analysis, review, and improvement have a positive influence on data and knowledge management.

- P476 Performance analysis, review, and improvement have a positive influence on workforce engagement.
- P477 Performance analysis, review, and improvement have a positive influence on workforce environment.
- P478 Performance analysis, review, and improvement have a positive influence on work systems design.
- P479 Performance analysis, review, and improvement have a positive influence on work process management and improvement.
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- P483 Performance analysis, review, and improvement have a positive influence on workforce-focused outcomes.
- P484 Performance analysis, review, and improvement have a positive influence on process effectiveness outcomes.
- P485 Performance analysis, review, and improvement have a positive influence on leadership outcomes.
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- P502 Data and knowledge management has a positive influence on leadership outcomes.
- P503 Workforce engagement has a positive influence on senior leadership.
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- P511 Workforce engagement has a positive influence on workforce environment.

- P512 Workforce engagement has a positive influence on work systems design.
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- P517 Workforce engagement has a positive influence on workforce-focused outcomes.
- P518 Workforce engagement has a positive influence on process effectiveness outcomes.
- P519 Workforce engagement has a positive influence on leadership outcomes.
- P520 Workforce environment has a positive influence on senior leadership.
- P521 Workforce environment has a positive influence on governance and social responsibilities.
- P522 Workforce environment has a positive influence on strategy development.
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- P534 Workforce environment has a positive influence on workforce-focused outcomes.
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- P537 Work systems design has a positive influence on senior leadership.
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- P551 Work systems design has a positive influence on workforce-focused outcomes.
- P552 Work systems design has a positive influence on process effectiveness outcomes.
- P553 Work systems design has a positive influence on leadership outcomes.
- P554 Work process management and improvement has a positive influence on senior leadership.
- P555 Work process management and improvement has a positive influence on governance and social responsibilities.

- P556 Work process management and improvement has a positive influence on strategy development.
- P557 Work process management and improvement has a positive influence on strategy deployment.
- P558 Work process management and improvement has a positive influence on customer and market knowledge.
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- P560 Work process management and improvement has a positive influence on performance analysis, review, and improvement.
- P561 Work process management and improvement has a positive influence on data and knowledge management.
- P562 Work process management and improvement has a positive influence on workforce engagement.
- P563 Work process management and improvement has a positive influence on workforce environment.
- P564 Work process management and improvement has a positive influence on work systems design.
- P565 Work process management and improvement has a positive influence on product and service outcomes.
- P566 Work process management and improvement has a positive influence on customer-focused outcomes.
- P567 Work process management and improvement has a positive influence on financial and market outcomes.
- P568 Work process management and improvement has a positive influence on workforce-focused outcomes.
- P569 Work process management and improvement has a positive influence on process effectiveness outcomes.
- P570 Work process management and improvement has a positive influence on leadership outcomes.
- P571 Product and service outcomes have a positive influence on customer-focused outcomes.

- P572 Product and service outcomes have a positive influence on financial and market outcomes.
- P573 Product and service outcomes have a positive influence on workforce-focused outcomes.
- P574 Product and service outcomes have a positive influence on process effectiveness outcomes.
- P575 Product and service outcomes have a positive influence on leadership outcomes.
- P576 Customer-focused outcomes have a positive influence on product and service outcomes.
- P577 Customer-focused outcomes have a positive influence on financial and market outcomes.
- P578 Customer-focused outcomes have a positive influence on workforce-focused outcomes.
- P579 Customer-focused outcomes have a positive influence on process effectiveness outcomes.
- P580 Customer-focused outcomes have a positive influence on leadership outcomes.
- P581 Financial and market outcomes have a positive influence on product and service outcomes.
- P582 Financial and market outcomes have a positive influence on customer-focused outcomes.
- P583 Financial and market outcomes have a positive influence on workforce-focused outcomes.
- P584 Financial and market outcomes have a positive influence on process effectiveness outcomes.
- P585 Financial and market outcomes have a positive influence on leadership outcomes.
- P586 Workforce-focused outcomes have a positive influence on product and service outcomes.
- P587 Workforce-focused outcomes have a positive influence on customer-focused outcomes.
- P588 Workforce-focused outcomes have a positive influence on financial and market outcomes.

- P589 Workforce-focused outcomes have a positive influence on process effectiveness outcomes.
- P590 Workforce-focused outcomes have a positive influence on leadership outcomes.
- P591 Process effectiveness outcomes have a positive influence on product and service outcomes.
- P592 Process effectiveness outcomes have a positive influence on customer-focused outcomes.
- P593 Process effectiveness outcomes have a positive influence on financial and market outcomes.
- P594 Process effectiveness outcomes have a positive influence on workforce-focused outcomes.
- P595 Process effectiveness outcomes have a positive influence on leadership outcomes.
- P596 Leadership outcomes have a positive influence on product and service outcomes.
- P597 Leadership outcomes have a positive influence on customer-focused outcomes.
- P598 Leadership outcomes have a positive influence on financial and market outcomes.
- P599 Leadership outcomes have a positive influence on workforce-focused outcomes.
- P600 Leadership outcomes have a positive influence on process effectiveness outcomes.

Table 8 provides a tabular view of the propositions of the MBNQA dimension level framework.

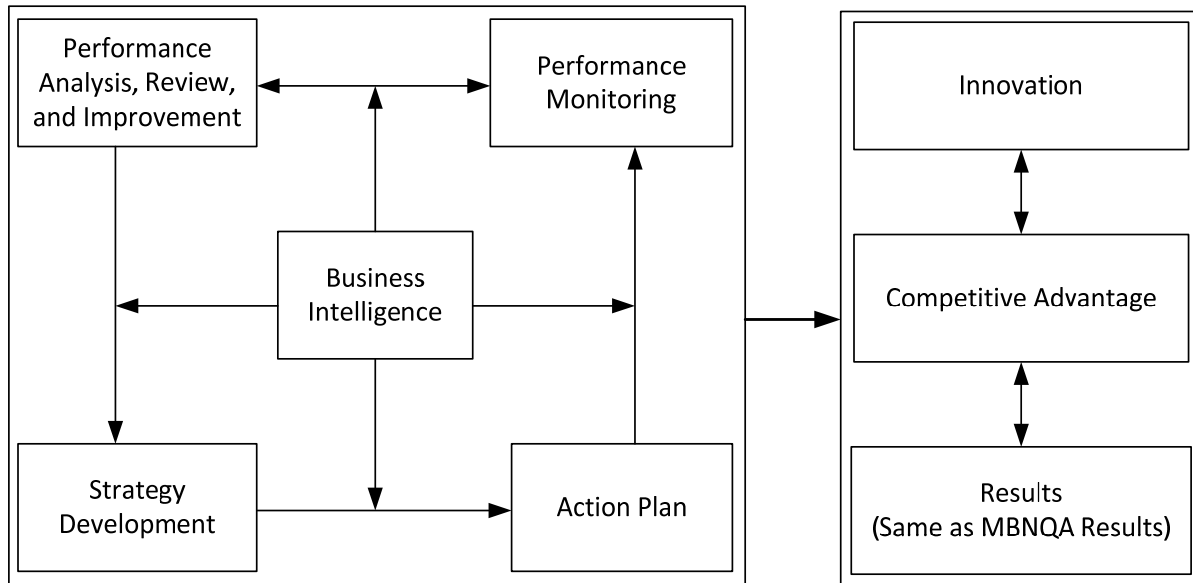
Table 8: Tabular view of the MBNQA dimension level propositions

Table P3		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
		Has a positive influence on																		
Constructs		L1	L2	S1	S2	C1	C2	M1	M2	W1	W2	P1	P2	R1	R2	R3	R4	R5	R6	
a	Senior Leadership (L1)	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
b	Governance and Social Responsibilities (L2)	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
c	Strategy Development (S1)	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
d	Strategy Deployment (S2)	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
e	Customer and Market Knowledge (C1)	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
f	Customer Relationships and Satisfaction (C2)	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
g	Performance Analysis, Review and Improvement (M1)	Y	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
h	Data and Knowledge Management (M2)	Y	Y	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
i	Workforce Engagement (W1)	Y	Y	Y	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
j	Workforce Environment (W2)	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y
k	Work Systems Design (P1)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y
l	Work Process Management and Improvement (P2)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	Y
m	Product and Service Outcomes (R1)																			- Y Y Y Y Y
n	Customer-Focused Outcomes (R2)																			Y - Y Y Y Y
o	Financial and Market Outcomes (R3)																			Y Y - Y Y Y
p	Workforce-Focused Outcomes (R4)																			Y Y Y - Y Y
q	Process Effectiveness Outcomes (R5)																			Y Y Y Y - Y
r	Leadership Outcomes (R6)																			Y Y Y Y Y -

The BPM Framework

The BPM framework is illustrated in Figure 8. As Figure 8 indicates, this framework encompasses a closed-loop process called the BPM process. Within the loop, several sequential multi-variable mediatory effects are possible. Moreover, business intelligence (BI) moderates the relationships between any two variables for the closed-loop process. Since the constructs in the BPM process are also parts of the MBNQA framework and since the mediatory effect of these constructs has been elaborated earlier, the intent here is to focus on the moderating effects.

Figure 8: The proposed BPM framework (repeated)



BI is an enabler of BPM (Eckerson, 2005; Clark et al., 2007). For a successful implementation of the BPM framework, organizations must integrate BI with BPM because such integration allows them to compare, manage, and align business performance with the business strategies, goals, and objectives (Ballard et al., 2005). BI turns available data into information and puts it into the hands of decision makers. Ballard et al. (2005) posit that, by so doing, BI helps BPM in two ways. First, strategic business intelligence helps BPM with strategic issues such as increasing revenues, reducing costs, and introducing new products and services by providing executives with relevant information. Second, tactical and operational business intelligence helps BPM improve business execution in two ways: (1) monitoring workflow and reporting operational results, and (2) monitoring workflow with the objective of improving and managing the overall operational business process.

BI enables organizations to consolidate and leverage vast masses of data to improve decision making and provides information technology (IT) infrastructure and applications to implement BPM (Ariyachandra & Florick, 2008). It helps BPM from identifying business strategy to developing a plan of action to monitoring performance results against benchmark metrics to taking corrective action (Ballard et al., 2005; Ariyachandra & Florick, 2008). Thus BI affects the relationships between the constructs comprising the BPM closed-loop process.

Therefore, considering the moderating effects of BI, the BPM framework provides the following propositions:

- P601 Strategy development has a positive influence on action plan.
- P602 Business intelligence moderates the relationship between strategy development and action plan.
- P603 Action plan has a positive influence on performance monitoring.
- P604 Business intelligence moderates the relationship between action plan and performance monitoring.
- P605 Performance monitoring has a positive influence on performance analysis, review, and improvement.
- P606 Business intelligence moderates the relationship between performance monitoring, and performance analysis, review, and improvement.
- P607 Performance analysis, review, and improvement have a positive influence on strategy development.
- P608 Business intelligence moderates the relationship between performance analysis, review, and improvement, and strategy development.
- P609 Strategy development has a positive influence on innovation.
- P610 Strategy development has a positive influence on competitive advantage.
- P611 Strategy development has a positive influence on product and service outcomes.
- P612 Strategy development has a positive influence on customer-focused outcomes.

- P613 Strategy development has a positive influence on financial and market outcomes.
- P614 Strategy development has a positive influence on workforce-focused outcomes.
- P615 Strategy development has a positive influence on process effectiveness outcomes.
- P616 Strategy development has a positive influence on leadership outcomes.
- P617 Action plan has a positive influence on innovation.
- P618 Action plan has a positive influence on competitive advantage.
- P619 Strategy development has a positive influence on product and service outcomes.
- P620 Strategy development has a positive influence on customer-focused outcomes.
- P621 Strategy development has a positive influence on financial and market outcomes.
- P622 Strategy development has a positive influence on workforce-focused outcomes.
- P623 Strategy development has a positive influence on process effectiveness outcomes.
- P624 Strategy development has a positive influence on leadership outcomes.
- P625 Performance monitoring has a positive influence on innovation.
- P626 Performance monitoring has a positive influence on competitive advantage.
- P627 Strategy development has a positive influence on product and service outcomes.
- P628 Strategy development has a positive influence on customer-focused outcomes.
- P629 Strategy development has a positive influence on financial and market outcomes.
- P630 Strategy development has a positive influence on workforce-focused outcomes.
- P631 Strategy development has a positive influence on process effectiveness outcomes.
- P632 Strategy development has a positive influence on leadership outcomes.
- P633 Performance analysis, review, and improvement have a positive influence on innovation.
- P634 Performance analysis, review, and improvement have a positive influence on competitive advantage.
- P635 Performance analysis, review, and improvement have a positive influence on product and service outcomes.

- P636 Performance analysis, review, and improvement have a positive influence on customer-focused outcomes.
- P637 Performance analysis, review, and improvement have a positive influence on financial and market outcomes.
- P638 Performance analysis, review, and improvement have a positive influence on workforce-focused outcomes.
- P639 Performance analysis, review, and improvement have a positive influence on process effectiveness outcomes.
- P640 Performance analysis, review, and improvement have a positive influence on leadership outcomes.
- P641 Innovation has a positive influence on competitive advantage.
- P642 Innovation has a positive influence on product and service outcomes.
- P643 Innovation has a positive influence on customer-focused outcomes.
- P644 Innovation has a positive influence on financial and market outcomes.
- P645 Innovation has a positive influence on workforce-focused outcomes.
- P646 Innovation has a positive influence on process effectiveness outcomes.
- P647 Innovation has a positive influence on leadership outcomes.
- P648 Competitive advantage has a positive influence on innovation.
- P649 Competitive advantage has a positive influence on product and service outcomes.
- P650 Competitive advantage has a positive influence on customer-focused outcomes.
- P651 Competitive advantage has a positive influence on financial and market outcomes.
- P652 Competitive advantage has a positive influence on workforce-focused outcomes.
- P653 Competitive advantage has a positive influence on process effectiveness outcomes.
- P654 Competitive advantage has a positive influence on leadership outcomes.
- P655 Product and service outcomes have a positive influence on innovation.
- P656 Product and service outcomes have a positive influence on competitive advantage.
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- P658 Product and service outcomes have a positive influence on financial and market outcomes.
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- P660 Product and service outcomes have a positive influence on process effectiveness outcomes.
- P661 Product and service outcomes have a positive influence on leadership outcomes.
- P662 Customer-focused outcomes have a positive influence on innovation.
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- P667 Customer-focused outcomes have a positive influence on process effectiveness outcomes.
- P668 Customer-focused outcomes have a positive influence on leadership outcomes.
- P669 Financial and market outcomes have a positive influence on innovation.
- P670 Financial and market outcomes have a positive influence on competitive advantage.
- P671 Financial and market outcomes have a positive influence on product and service outcomes.
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- P673 Financial and market outcomes have a positive influence on workforce-focused outcomes.
- P674 Financial and market outcomes have a positive influence on process effectiveness outcomes.
- P675 Financial and market outcomes have a positive influence on leadership outcomes.
- P676 Workforce-focused outcomes have a positive influence on innovation.

- P677 Workforce-focused outcomes have a positive influence on competitive advantage.
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- P682 Workforce-focused outcomes have a positive influence on leadership outcomes.
- P683 Process effectiveness outcomes have a positive influence on innovation.
- P684 Process effectiveness outcomes have a positive influence on competitive advantage.
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- P687 Process effectiveness outcomes have a positive influence on workforce-focused outcomes.
- P688 Process effectiveness outcomes have a positive influence on workforce-focused outcomes.
- P689 Process effectiveness outcomes have a positive influence on leadership outcomes.
- P690 Leadership outcomes have a positive influence on innovation.
- P691 Leadership outcomes have a positive influence on competitive advantage.
- P692 Leadership outcomes have a positive influence on product and service outcomes.
- P693 Leadership outcomes have a positive influence on financial and market outcomes.
- P694 Leadership outcomes have a positive influence on workforce-focused outcomes.
- P695 Leadership outcomes have a positive influence on process effectiveness outcomes.

CHAPTER 3

RESEARCH METHODOLOGY

The research methodology used to test the research models posed in Chapter 2 is expounded in this chapter. This study uses the traditional latent semantic analysis (LSA) and the causal latent semantic analysis (cLSA) to validate both the business performance management (BPM) framework and the Malcolm Baldrige National Quality Award (MBNQA) framework.

LSA is both a theory and a method that extracts the contextual-usage meaning of words and obtains approximate estimates of the kinds of meaning similarities among words and text segments in a large corpus (Landauer et al., 1998). Landauer et al. (1998) posit that “the similarity estimates derived by LSA are not simple contiguity frequencies, co-occurrence counts, or correlations in usage, but depend on powerful mathematical analysis that is capable of correctly inferring much deeper relations” (p. 260). Chapter 2 presented an overview of LSA. To illustrate the LSA methodology, a small database of 7 short documents was created. Each step of the latent semantic analysis is illustrated in Appendix A.

The causal LSA (cLSA) is a modification and thus a derivative of the traditional latent semantic analysis. In addition to uncovering the latent factors, the cLSA establishes causal relationships among these factors based on the input and output statements contained in the factors. The cLSA performs LSA on a corpus comprised of input and output statements obtained from text passages. The detail discussion and illustration of cLSA is provided in Appendix B.

The LSA methodology delineated in Appendix A can easily be duplicated in other applications involving text data. This study conducts LSAs of two levels of granularity – a two-factor LSA and a ten-factor LSA – on Corpus 2. These LSAs are used to find two-factor and ten-

factor latent semantic structures from the 229 article abstracts published in the *International Journal of Business Performance Management (IJBPM)* from 1998 to 2008.

The cLSA methodology illustrated in Appendix B can also be duplicated in other applications involving textual data that produces input-output statements. This study uses cLSA to validate the MBNQA and BPM frameworks. I performed cLSAs on Corpus 1 to uncover latent factors and establish relationships between them for the MBNQA framework. Similarly, cLSAs were conducted on Corpus 3 to test the BPM framework.

Corpus 1: MBNQA Input-Output (XY) Statements

The text passages for this corpus include article abstracts on the Baldrige Award and program published in practitioner and academic journals from 1987 to 2009. The EBSCOhost search engine was used to obtain the article abstracts. The keyword search was performed within four databases including Academic Search Complete, Business Source Complete, Education Research Complete, and Health Source: Nursing/Academic Edition. These databases were chosen so as to cover the possible avenues of publications on the Baldrige Award and program in the business/nonprofit, education, and healthcare criteria. The keywords included the following terms: Baldrige, “Baldrige Award,” “Baldrige Awards,” “Baldrige program,” “Baldrige Programs,” “Baldrige Award recipient,” “Baldrige Award recipients,” “Baldrige recipient,” “Baldrige recipients,” “criteria for excellence”, MBNQA, “Malcolm Baldrige Award,” “Malcolm Baldrige program,” and “Malcolm Baldrige National Quality Award”. The search with all publication types (periodical, newspaper, book, primary source document, education report, health report, academic journal, trade publication, industry profile, country report, conference paper, and reference book) resulted in 1827 hits. Limiting the search within scholarly (peer

reviewed) journals produced 576 hits. Removing the editorials, reviews, announcements, news, etc. from the list provided 307 usable abstracts.

The 307 usable abstracts were then examined for potential input-output (i.e., XY) statements. Not all of these abstracts qualified for XY statements. Let's consider the following two abstracts. The sentences that provide XY statements are italicized. While Abstract 1 contains XY statements, Abstract 2 does not.

Abstract 1: US Government organizations are creating value for their citizens and businesses by improving their public service delivery through good websites. Our study examined leadership and IT quality, and their effect on positive delivery outcomes in an e-government environment. We first developed a theoretically based model using elements of the model developed for the Malcolm Baldrige National Quality Award (MBNQA) and DeLone and McLean's IS Success model. To test this model, we conducted a field survey at a municipal city government. The results supported our hypothesis that *the MBNQA leadership triad (leadership, strategic planning, and customer/market focus) had a positive impact on the IT quality triad (information, system, and service quality)*. We also found that *both leadership and IT quality increased the benefits*.

Abstract 2: In this study, a Malcolm Baidrige National Quality Award (MBNQA) criteria-based survey was used to assess the quality status of organizations that employ quality professionals. The objective was to focus on the relationship between leadership (IS), information and analysis, human resource planning, process quality, and customer focus. The result was the development of an MBNQA-based model that demonstrated the relationship between executive IS and the MBNQA factors.

The examination of the 307 abstracts revealed that only 87 abstracts contained input-output statements (see Appendix C for Input-Output Coding Scheme). These final 87 abstracts provided 193 input-output statement pairs. Therefore, this corpus includes 193 input-output statements obtained from 87 article abstracts that were published in 51 journals from 1987 to

2009. Table 9 provides the list of these 51 journals and the respective number of articles and XY statements.

Table 9: List of journals with MBNQA-related abstracts

Journal Title	# of Articles	# of XY Pairs
Academy of Educational Leadership Journal	1	1
Academy of Management Executive	2	4
Applied Energy	1	2
Benchmarking: An International Journal	2	2
College & Research Libraries	1	1
Computers in Industry	1	1
Construction Management & Economics	1	5
Decision Sciences	2	5
Decision Sciences Journal of Innovative Education	2	4
Evaluation & Program Planning	1	2
Expert Systems with Applications	2	3
Human Resource Development Quarterly	1	2
Human Resource Planning	1	2
Industrial Engineer	2	4
Information & Management	1	2
International Journal of Hospitality & Tourism Administration	1	1
International Journal of Management & Enterprise Development	1	1
International Journal of Operations & Production Management	1	2
International Journal of Process Management & Benchmarking	1	2
International Journal of Production Research	3	7
International Journal of Productivity & Performance Management	1	1
International Transactions in Operational Research	1	4
Journal of Continuing Education in the Health Professions	1	1
Journal of Entrepreneurship Education	1	1
Journal of European Industrial Training	1	2
Journal of Healthcare Management	2	6
Journal of Materials Processing Technology	1	3
Journal of Operations Management	6	12
Journal of Organizational Excellence	1	2
Journal of Small Business Management	1	2
Journal of the Academy of Marketing Science	1	2
Journal of Visual Impairment & Blindness	1	1
Long Range Planning	2	3
Marketing Health Services	1	1
Measuring Business Excellence	2	2
Organizational Dynamics	2	7

Continued

Table 9: Continued

Journal Title	# of Articles	# of XY Pairs
Production & Inventory Management Journal	3	3
Production Planning & Control	1	3
Professional Safety	1	2
Public Manager	1	3
Public Performance & Management Review	1	4
Quality & Reliability Engineering International	1	1
Quality Assurance	1	9
Quality Management in Health Care	1	3
Quality Management Journal	3	4
Quality Progress	5	9
SAM Advanced Management Journal	2	14
Sloan Management Review	1	1
Total Quality Management	4	17
Total Quality Management & Business Excellence	5	10
TQM Magazine	4	7
Total	87	193

Corpus 2: IJBPM Abstracts

This corpus consists of all article abstracts from the *International Journal of Business Performance Management* (IJBPM) since its inception in 1998. I selected IJBPM because its objectives are to develop, promote and coordinate the practice of business performance management. IJBPM examines various perspectives in managing business performance and provides an interactive platform for academics, professionals and practitioners working in the areas of performance measurement and management. From 1998 to 2008, IJBPM published 229 articles on business performance management in 10 volumes with 30 issues. The abstracts of these 229 articles make up Corpus 2 for this study.

Corpus 3: BPM Input-Output (XY) Statements

This corpus includes full body text data from all articles published in the practitioner BPM journal entitled the *Business Performance Management Magazine* since its inception in

2003. In addition, some white papers were also considered. The Google Scholar was used to identify these papers by using key words such as business performance, performance management, and business performance management. A total of 128 full body articles were collected. Each of these articles was carefully examined with a view to obtain input-output statements contained in them. Using the input-output coding guidelines presented in Appendix C and thorough examination of the 128 articles resulted in 622 pairs of input and output statements, which comprise the BPM Corpus 3.

CHAPTER 4

ANALYSES AND RESULTS

In this study, I used the latent semantic analysis (LSA) (see Appendix A) and the causal latent semantic analysis (cLSA) (see Appendix B) to analyze textual data. The LSA was performed on Corpus 2 to uncover the latent structures contained in the *International Journal of Business Performance Management (IJBPM)* abstracts. The cLSA was conducted on Corpus 1 to reveal latent factors contained in the data and to validate the Malcolm Baldrige National Quality Award (MBNQA) framework. The cLSA of Corpus 3 was used to validate the proposed business performance management (BPM) framework.

cLSA of Corpus 1

The corpus comprises of 193 input-output statement pairs. Combining the input and the output statements and then removing the duplicates resulted in a corpus of 326 statements with a dictionary of 743 terms. I used a customized list of stopwords. Stopwords are trivial English words such as *a, an, the, and*, etc. My list included several additional words such as model, framework, paper, study, etc. to the list of stopwords developed by the System for the Mechanical Analysis and Retrieval of Text (SMART) at Cornell University (Salton & Buckley, 1988). The elimination of stopwords from the dictionary and then the use of Porter term stemming (Porter, 1980) on the remaining words produced a dictionary of 427 relevant terms. Therefore, the X matrix obtained from Corpus 1 is a 427 X 326 term-by-statement X matrix.

I followed a common method (Frakes & Baeza-Yates, 1992, p. 373; Salton & Buckley, 1988) to transform and normalize the frequencies of the term-by-statement X matrix. The term frequency tf_{ij} was replaced with the product $w_{ij} = tf_{ij} * idf_i$, where $idf_i = \log_2(N/n_i) + 1$, N is the

number of documents in the collection, tf_{ij} is the raw term frequency of term i in document j , n_i is the term frequency of term i in the entire collection of documents, and the inverse document frequency (IDF) idf_i . The product $w_{ij} = tf_{ij} * idf_i$ serves as a metric of rarity of term i in the entire collection of documents. The cLSAs were performed on the transformed X matrix to validate two-factor and seven-factor MBNQA frameworks.

A Two-Factor Causal MBNQA Framework

Table 10 provides a summary of the two factors. The first factor deals with assessment of an organization's management system. This factor embodies self-assessment of a system and a comprehensive assessment of an organization's performance improvements. The focus is on providing a systems perspective of self-assessment and of performance assessment indicators. The principal performance assessment indicators discussed in this factor include the leadership performance, business improvement, success of the total quality management (TQM) implementation, human resource development, and organizational development. The second factor includes components such as leadership, strategic planning, performance management, information analysis, business processes, customer and market, etc. Therefore, this factor describes the Baldrige System.

As discussed in Appendix B (Table B12 and Table B13), the inter-factor frequency measures and their percentages were developed for the MBNQA factors. These measures are presented in Table 11 and Table 12, respectively. Figure 9 portrays the inter-factor relationships based on the percentage measures given in Table 12.

Table 10: Summary of two factors of the causal MBNQA framework

Factor	Factor Label	Factor Description	High Loading Terms (Stemmed)	High Loading Statements
F1	Assessment	Assessment of management's system - leadership performance, process measurement, business improvement, TQM implementation, human resource improvement, results of change, organizational development, etc.	system (2.0053), manag (1.0164), assess (0.8355), perform (0.7839), leadership (0.6994), process (0.6529), measur (0.5664)	Mann and Grigg 2004 X01 (0.7161), Douglas and Fredendall 2004 X02 (0.6667), Douglas and Fredendall 2004 Y01 (0.6667), Wilson and Collier 2000 X02 (0.6667), Wilson and Collier 2000 Y01 (0.6667)
F2	The System	Components of management's system - effective leadership, performance management, organizational processes, strategic planning, business customer and market, information analysis, etc.	leadership (2.2498), effect (0.8085), result (0.64), manag (0.536), perform (0.5257), process (0.3842), organiz (0.3456), plan (0.2794), strateg (0.2579), busi (0.2537), custom (0.2231), market (0.2068)	Bell and Elkins 2004 X06 (0.8136), Douglas and Fredendall 2004 X01 (0.8136), Husain et al. 2001 X05 (0.8136), Prybutok et al. 2008 X01 (0.8136), Wilson and Collier 2000 X01 (0.8136), Warwood and Anthony 2003 X04 (0.7707)

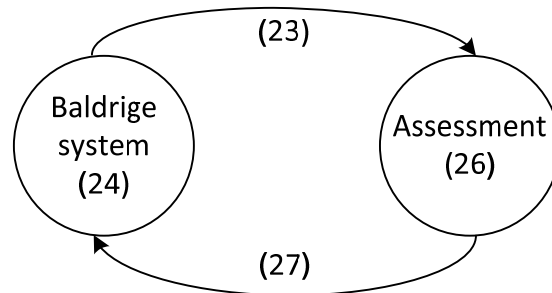
Table 11: Inter-factor frequency measures

Y Factors	X Factors		Y-index
	Assessment	Baldrige System	
Assessment	58	50	108
Baldrige System	59	54	113
X-index	117	104	
X - Y differential	9	-9	

Table 12: Inter-factor percentage measures

Y Factors	X Factors		Y-index
	Assessment	Baldrige System	
Assessment	0.26	0.23	0.49
Baldrige System	0.27	0.24	0.51
X-index	0.53	0.47	
X - Y differential	0.04	-0.04	

Figure 9: Causal semantic net for two-factor MBNQA framework



The inter-factor causal relationship coefficients are shown within parentheses. All figures within parentheses are in percent, totaling 100%. The coefficients within the parentheses of each circle indicate the effect of the factors on themselves. In other words, these numbers show the intra-factor causal relationship.

A Seven-Factor Causal MBNQA Framework

Table 13 provides a summary of the seven factors. Systems assessment is an umbrella term that embodies the assessment of a number of systems including an organization’s management system, measurement system, change management systems, quality

management systems such as total quality management system, strategic quality management system, soft quality system, and cost management system. Leadership triad is comprised of three category level constructs of the Baldrige framework. These constructs are leadership, strategic planning, and customer and market focus. Business results refer to organizational achievements and excellences. The reflection of organizational excellence is exhibited by improved operational and financial results, improved business strategy, improved organizational effectiveness, improved business processes, improved organizational capabilities, and improved organizational performance practices. Management of quality includes the concepts of the quality management program, quality management process, quality management implementation, quality management effectiveness, total quality management, and quality management system. Performance measurement focuses on the management, improvement, and comprehensive assessment of organizational performance. It deals with the alignment of performance measures to overall activities. Process improvement embeds the concepts of business process management, performance, and continuous improvement. Finally, change and organizational culture includes the creation, enforcement, and management of change that is compatible with organizational culture.

Table 13: Summary of seven factors of the causal MBNQA framework

Factor	Factor Label	Factor Description	High Loading Terms (Stemmed)	High Loading Statements
F1	System's assessment	Measurement systems; managing systematic change; comprehensive assessment of the organization's management system; etc.	system (2.5979), assess (0.8583), measur (0.4186), manag (0.3179), chang (0.2202), comprehens (0.1954)	Douglas and Fredendall 2004 X02 (0.9122), Douglas and Fredendall 2004 Y01 (0.9122), Wilson and Collier 2000 X02 (0.9122), Wilson and Collier 2000 Y01 (0.9122), Ka-Chi et al. 2008 X01 (0.8076), Mann and Grigg 2004 X01 (0.7606), Warwood and Anthony 2003 X06 (0.6943), Ohldin et al. 2002 Y01 (0.5975), Howze 2000 Y01 (0.564), Carr 1992 X01 (0.4997), Curkovic et al. 2000 Y02 (0.479), Kennedy 2005 Y02 (0.4182)
F2	Leadership triad	System's components including effective leadership, strategic planning, and customer and market.	leadership (2.5423), effect (0.7995), plan (0.2486), strateg (0.2286), custom (0.2003), market (0.1926)	Bell and Elkins 2004 X06 (0.9255), Douglas and Fredendall 2004 X01 (0.9255), Husain et al. 2001 X05 (0.9255), Prybutok et al. 2008 X01 (0.9255), Wilson and Collier 2000 X01 (0.9255), Warwood and Anthony 2003 X04 (0.8483), Warwood and Roberts 2004 X03 (0.8483), Prybutok et al. 2008 X02 (0.6709), Meyer and Collier 2001 X03 (0.5404), Meyer and Collier 2001 X01 (0.4388)

Continued

Table 13: Continued

Factor	Factor Label	Factor Description	High Loading Terms (Stemmed)	High Loading Statements
F3	Business results	Business results and organizational excellence - improved operational and financial results, improved business strategy, improved organizational effectiveness, improved business processes, improved organizational capabilities, etc.	result (2.4313), busi (0.6546), organiz (0.54), excel (0.4259)	Angell and Corbett 2009 Y01 (0.9113), Douglas and Fredendall 2004 Y02 (0.9113), Lee et al. 2003 Y01 (0.9113), Wilson and Collier 2000 Y02 (0.9113), Mann and Grigg 2004 Y01 (0.7881), Brokaw and Mullins 2007 Y03 (0.7401), Dean and Tomovic 2004 Y02 (0.7272), Meyer and Collier 2001 Y01 (0.5598), Bou-Llusar et al. 2009 Y01 (0.4714), Sila and Ebrahimpur 2003 Y01 (0.4503), Frazier 2008 Y02 (0.4253), Rancour 2005 Y02 (0.391), Mellat-Parast et al. 2007 Y01 (0.385)
F4	Management of quality	Quality management implementation; quality management program; quality management effectiveness; total quality management; etc.	manag (1.7665), implement (0.9354), tqm (0.8538), total (0.724), success (0.6142)	Ka-Chi et al. 2008 X03 (0.643), York and Miree 2004 X01 (0.643), Mellat-Parast et al. 2007 X02 (0.6314), Mellat-Parast et al. 2007a Y02 (0.6314), Ka-Chi et al. 2008 X04 (0.615), Kujala and Lillrank 2004 Y01 (0.569), Warwood and Anthony 2003 Y01 (0.5442), Meyer and Collier 2001 X02 (0.5289), Terziovski et al. 1999 X01 (0.498)

Continued

Table 13: Continued

Factor	Factor Label	Factor Description	High Loading Terms (Stemmed)	High Loading Statements
F5	Performance measurement	Better performance; alignment of performance measures to overall activities; managing and improving performance; and comprehensive assessment of the organization's performance improvements.	perform (2.0276), measur (0.9961), organiz (0.4588), excel (0.3531)	Anonymous 2007 X01 (0.7954), Frazier 2008 X02 (0.7884), Vinyard 2004 X02 (0.5693), Thompson and Mathys 2008 X04 (0.5495), Brokaw and Mullins 2007 Y02 (0.5298), Chin et al. 2003 Y01 (0.5153), Husain et al. 2001 Y01 (0.4971), Angell and Corbett 2009 X02 (0.472), Thompson and Mathys 2008 Y03 (0.4529)
F6	Process improvement	Continuous business process improvement; process management; process performance; change-adaptive business processes; etc.	process (1.4757), improv (1.1363), busi (0.5855), program (0.5338)	Frazier 2008 X03 (0.7561), Mellat-Parast et al. 2007a Y01 (0.7058), Lee et al. 2003 X02 (0.5149), Thompson and Mathys 2008 X04 (0.4848), Werner 2007 X01 (0.4792), Pannirselvam et al. 1998 Y01 (0.4691), Ka-Chi et al. 2008 X02 (0.444), Douglas and Fredendall 2004 Y03 (0.442)
F7	Change and organizational culture	Creating, enabling, and managing change within organizational culture and values.	chang (1.9324), organiz (0.5164), cultur (0.3868)	Bell and Elkins 2004 X01 (0.8539), Bell and Elkins 2004 Y02 (0.8539), Kuratko et al. 2001 Y01 (0.8539), Husain et al. 2001 X02 (0.7867), Howze 2000 Y01 (0.7035), Kujala and Lillrank 2004 X01 (0.5339), Lee and Lo 2003 X01 (0.5191)

The inter-factor frequency measures and their percentages of the above factors are presented in Table 14 and Table 15, respectively. Causal semantic net shows the inter-factor causal relationships among the factors. Figure 10 portrays the causal semantic net developed based on the percentage measures given in Table 15.

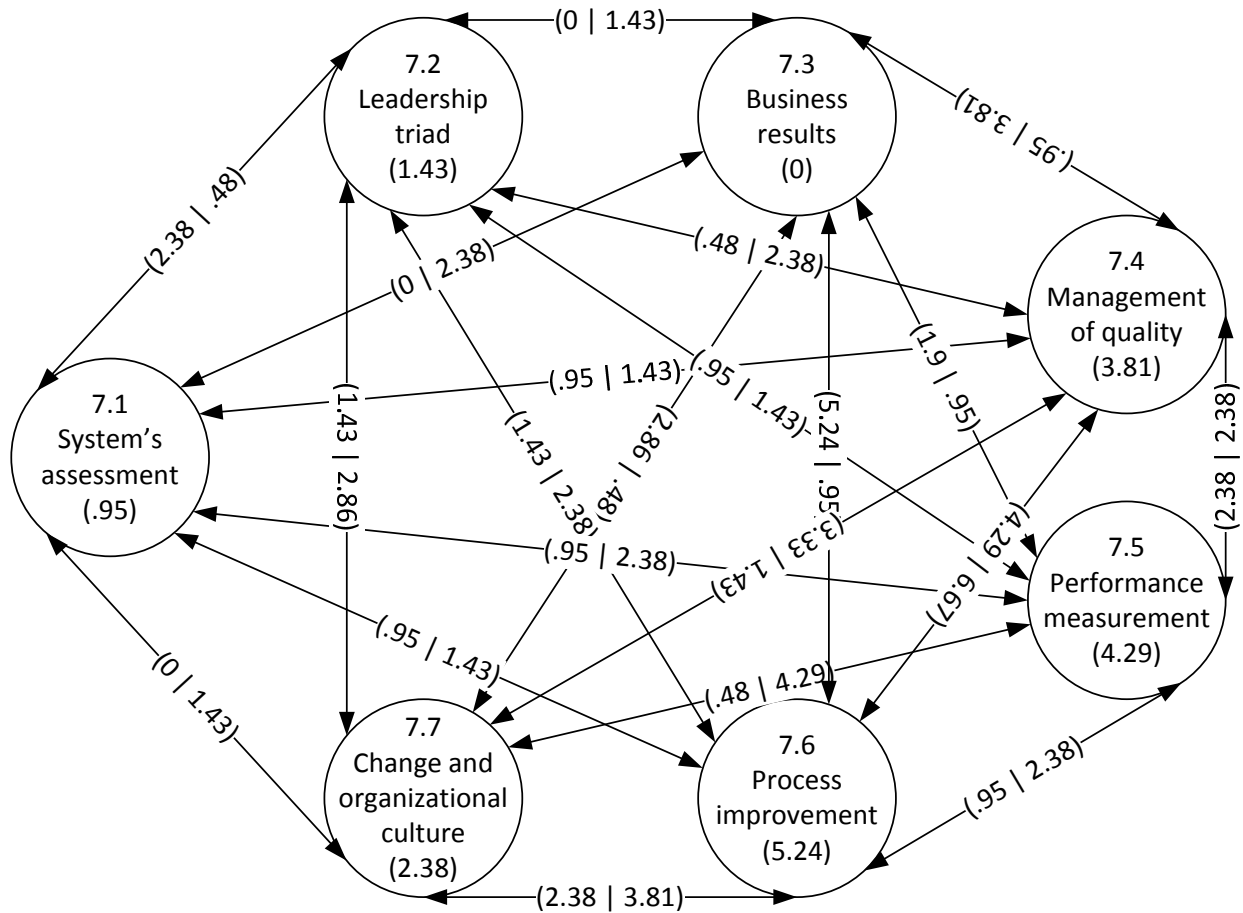
Table 14: Inter-factor frequency measures for seven-factor MBNQA framework

Y Factors	System's assessment	Leadership triad	Business results	Management of quality	Performance measurement	Process improvement	Change and organizational culture	Y-index
System's assessment	2	5	0	2	2	2	0	13
Leadership triad	1	3	0	1	2	3	3	13
Business results	5	3	0	8	4	11	6	37
Management of quality	3	5	2	8	5	9	7	39
Performance measurement	5	3	2	5	9	5	6	35
Process improvement	3	5	2	14	2	11	9	46
Change and organizational culture	3	6	1	3	1	8	5	27
X-index	22	30	7	41	25	49	36	
X - Y differential	9	17	-30	2	-10	3	9	

Table 15: Inter-factor percentage measures for seven-factor MBNQA framework

Y Factors	X Factors							Y-index
	System's assessment	Leadership triad	Business results	Management of quality	Performance measurement	Process improvement	Change and organizational culture	
System's assessment	0.95	2.38	0	0.95	0.95	0.95	0	6.18
Leadership triad	0.48	1.43	0	0.48	0.95	1.43	1.43	6.2
Business results	2.38	1.43	0	3.81	1.9	5.24	2.86	17.62
Management of quality	1.43	2.38	0.95	3.81	2.38	4.29	3.33	18.57
Performance measurement	2.38	1.43	0.95	2.38	4.29	2.38	2.86	16.67
Process improvement	1.43	2.38	0.95	6.67	0.95	5.24	4.29	21.91
Change and organizational culture	1.43	2.86	0.48	1.43	0.48	3.81	2.38	12.87
X-index	10.48	14.29	3.33	19.53	11.9	23.34	17.15	
X - Y differential	4.3	8.09	-14.3	0.96	-4.77	1.43	4.28	

Figure 10: Causal semantic net for seven-factor MBNQA framework



The inter-factor causal relationship coefficients are shown within parentheses. All figures within parentheses are in percent, totaling 100%. A double-headed arrow connecting two factors indicates reciprocal causal relationships between the connected factors. The strengths of the relationships are shown within parentheses positioned in the middle of the arrows. There are two coefficients within the parentheses of each double-headed arrow. The coefficient closer to a factor indicates the strength of the effect that the distant factor has on the closer factor. For instance, the inter-factor causal relationship coefficients between Factor 7.1 and Factor 7.2 are shown as (2.38 | .48). The coefficient 2.38 is closer to Factor 7.1 and thus demonstrates the strength of effect that Factor 7.2 has on Factor 7.1. Similarly, the coefficient .48 shows the strength of effect of Factor 7.1 on Factor 7.2. The coefficients within the parentheses of each circle indicate the effect of the factors on themselves. In other words, these numbers show the intra-factor causal relationship.

LSA of Corpus 2

Corpus 2 consists of all article abstracts published in the *International Journal of Business Performance Management* since its inception in 1998. Considerable care was taken in the data collection process in order to ensure the accuracy of the data. Each abstract was collected individually from the journal's website and recorded to an Excel worksheet. Multiple checks were performed to avoid data anomaly. The final corpus included 229 documents (i.e., article abstracts) with 3,838 words. In order to create a dictionary of relevant terms, the dictionary of these 3,838 raw words was subjected to a process of term filtering, term stemming (Porter, 1980), and communality filtering (Sidorova, Evangelopoulos, Valacich, & Ramakrishnan, 2008). Term filtering included the removal of numbers, dates, symbols, unique words, and stopwords from the dictionary. The removal of numbers, dates, and symbols produced a dictionary of 3,756 words. The elimination of unique words reduced the dictionary size to 1,888. Unique words are the words that appear in only one document. The justification for exclusion of these words from the dictionary is that if a word is mentioned in only one document then it is not part of a semantic pattern. The stopwords such as 'a', 'an', 'for', 'of', 'the', etc. were then eliminated from the dictionary. The list of stopwords consisted of the standard 571 common words developed by the System for the Mechanical Analysis and Retrieval of Text (SMART) at Cornell University (Salton & Buckley, 1988). The dictionary consisted of 1,457 uncommon words after term filtering. The application of Porter (1980) term stemming resulted in 1,128 unique stemmed words. An initial LSA performed on the dictionary of these stemmed words revealed that 33% of the words contributed to only 4% of the total variance. Therefore, these words were filtered out as a result of communality filtering. Thus,

the final dictionary consisted of 752 terms. The LSA method illustrated in Appendix A was applied to the dictionary to extract two and seven latent factors for the BPM framework.

Two Latent Semantic Factors of BPM Framework

Table 16 provides the summary of factor labels, descriptions, and term and document loadings of two factors.

Table 16: Summary of two semantic factors of BPM framework

Factor	Factor Label	Factor Description	High Loading Terms (Stemmed)	High Loading Statements
F1	Enterprise Performance Frameworks	Embodies frameworks of performance modeling such as performance measurement system, effective performance management framework, supply chain performance framework, etc.	perform (0.5805), enterpr (0.3218), framework (0.3019), integr (0.2991), chain (0.2974), qualiti (0.294), design (0.288), organ (0.2839), oper (0.2737), suppli (0.2722), stakehold (0.2696), innov (0.2693), system (0.2638), approach (0.2616)	Chung et al 2006 (0.3403), Teh and Pang 1999 (0.3397), Chung and Lee 2006 (0.335), Alfaro et al 2002 (0.3335), Chan et al 2006 (0.3321), Haque and James-Moore 2005 (0.3318), Jayawama and Pearson 2002 (0.3291), Gaiardelli et al 2007 (0.3268), Ahmad et al 2003 (0.3266), Sadler and Sohal 2005 (0.3216), Sohal et al 2002 (0.3187), Hansen and Riis 1999 (0.3161)
F2	Performance Efficiency Measures	Discussion of various performance measures - product and market efficiency, technical efficiency, scale efficiency, productivity growth, operating efficiency, etc.	effici (0.4508), perform (0.4136), dea (0.4124), bank (0.3885), data (0.3382), industri (0.3247), analysi (0.324), envelop (0.3075), output (0.2971), technic (0.2694), input (0.2585)	Nagarur and Rajbhandari 2001 (0.4615), Debnath and Shankar 2008 (0.4531), Staat 2006 (0.4465), Oglu et al 2008 (0.4364), Chen and Yeh 2005 (0.4333), Fethi et al 2008 (0.3894), Lu et al 2007 (0.3695), Staat and Hammerschmidt 2005 (0.3613)

The first factor represents a number of enterprise performance frameworks. These frameworks include performance measurement systems, e-business models, supply chain performance frameworks, quality management systems, and real time monitoring systems that are implemented across public and private sectors. The second factor delineates a range of performance efficiency measures including product performance efficiency, market efficiency, total factor productivity index, technical efficiency, financial efficiency, productivity growth, and operating efficiency.

Ten Latent Semantic Factors of BPM Framework

Table 17 summarizes the ten semantic factors of the BPM framework. Factor 1 discusses the design, development, and implementation of various types of performance measurement systems. Factor 2 represents corporate social responsibility. It highlights the responsibility of an organization with respect to environment, society, customer, shareholder, and ethical behavior. Factor 3 characterizes logistics performance and supply chain management. It delineates the structure of efficient supply chain management and outlines methods and indicators to measure logistics performances. Factor 4 provides a sketch of the application of data envelopment analysis (DEA). This elucidates that the data envelopment analysis is an assessment tool for efficiency analysis such as productivity growth. Factor 5 expounds how strategic alliance, resource capability, and innovation are interrelated. The identification and definition of public sector services is discussed in Factor 6. Factor 6 also sheds light on the performance measurement of public service organizations. Factor 7 provides insights into cultural differences from two perspectives: (1) differences in practices and performance of businesses operating in different countries, and (2) differences in organizational cultures

between internet and traditional companies operating within the same country. Factor 8 describes several performance ratios that include technical efficiency, product performance, and reliability of processes. Factor 9 discusses the determinants of joint venture partners, and delineates various approaches to measure joint venture performance. Finally, Factor 10 embodies the key variables in default risk analysis, provides a global perspective of risk prediction, and highlights techniques of default risk analysis.

Table 17: Summary of ten semantic factors of BPM framework

Factor	Factor Label	Factor Description	High Loading Terms (Stemmed)	High Loading Statements
F1	Design and implementation of performance	Discussion of design, development, implementation, and types of performance measurement systems	perform (0.4944), design (0.3762), implement (0.3704), facilit (0.3287), scorecard (0.3046), literatur (0.3005), manufactur (0.2985), balanc (0.2867), system (0.2788)	Bourne et al 2003 (0.4655), Bourne et al 2003a (0.4307), Bourne et al. 1999 (0.4045), Cochran et al 2001 (0.39), Ip et al. 1999 (0.3495), Harding et al. 1999 (0.345), Sadler and Sohal 2005 (0.3401), Stone 2000 (0.3199), Lima et al 2008 (0.303), Bititci et al 2001 (0.2959)
F2	Corporate responsibility	Corporate social responsibility in relation to its stakeholders such as environmental responsibility, social responsibility, customer responsibility, and ethics	stakehold (0.5553), corpor (0.5162), social (0.478), respons (0.4042), csr (0.3249), environment (0.2464), custom (0.2172)	Ahmad et al 2003 (0.5676), Colle and Gonella 2003 (0.5164), Stainer and Stainer 2003 (0.4929), Rubinstein 2003 (0.4775), Waddock 2003 (0.4218), Stainer and Grey 2007 (0.421), Hopkins 2003 (0.4182)

Continued

Table 17: Continued

Factor	Factor Label	Factor Description	High Loading Terms (Stemmed)	High Loading Statements
F3	Logistics and supply chain	Supply chain management and logistics performance; material flow, information flow and financing flow of supply network; integration and coordination in supply chain and logistics	suppli (0.6884), chain (0.6646), logist (0.3173), enterpr (0.243)	Yao 2005 (0.5408), Stone and Love 2007 (0.5267), Wadhwa et al 2006 (0.5237), Sohal et al 2002 (0.4828), Weixin 2006 (0.4399), Mo et al 2006 (0.4207), Chan et al 2006 (0.4104), Zhang et al 2006 (0.3977), Grimaldi and Rafele 2007 (0.3765), Chung and Lee 2006 (0.3432), Choy et al 2006 (0.2829)
F4	Efficiency and data envelopment analysis	Application of data envelopment analysis to evaluate efficiency analysis such as productivity growth	bank (0.4593), effici (0.4399), dea (0.4195), technic (0.3283), envelop (0.3169), index (0.2958), industri (0.2906), data (0.269), scale (0.2671), analysi (0.2661)	Oglu et al 2008 (0.5065), Fethi et al 2008 (0.4639), Debnath and Shankar 2008 (0.4386), Chen and Yeh 2005 (0.435), Nagarur and Rajbhandari 2001 (0.4325), Zhao et al 2008 (0.4285), Staat 2006 (0.4012), Uri 2001 (0.3815), Chen et al 2005 (0.3783), Jacobs and Sena 2008 (0.3641), Adesokan 2008 (0.3356), Lu et al 2007 (0.3148)
F5	Resource capability, alliance and innovation	Explain the relationship between resource capabilities, strategic alliance, and innovation	knowledg (0.3873), allianc (0.3703), innov (0.3677), capabl (0.3649), resourc (0.3136), competit (0.3083), asset (0.2889), strateg (0.2796)	Marr et al 2002 (0.432), Kasmai and Iijima 2002 (0.3996), Kouhy and Vedd 2000 (0.3743), Kasmai and Iijima 1999 (0.3728), Bhat and Kumar 2004 (0.3519), Wei and Malik 2005 (0.3369)

Continued

Table 17: Continued

Factor	Factor Label	Factor Description	High Loading Terms (Stemmed)	High Loading Statements
F6	Public sector services	Identification and definition of public sector services; performance measurement of public service organizations; etc.	public (0.5672), sector (0.4694), govern (0.4119), custom (0.3106), servic (0.2993), perform (0.2929)	Ghobadian et al 2007 (0.5143), Jackson 2000 (0.4601), Bartlett 2003 (0.4451), Conroy 2001 (0.3914), Sharma and Wanna 2005 (0.3814)
F7	Cultural difference	Differences in practices and performances of businesses operating in different countries; also included is the difference between internet and traditional companies	differ (0.3117), internet (0.3087), cultur (0.2535), signific (0.2474), find (0.236), report (0.2308), survei (0.2093)	Sohail and Al-Buraey 2005 (0.3117), Marr and Neely 2001 (0.3053), Szwejczewski et al 2003 (0.3016), Terziovski et al 2002 (0.3013), Teo 2003 (0.2995), Udo 1999 (0.2926), Udo 2001 (0.2679), Bennett and James 2000 (0.2658)
F8	Performance ratios	Performance ratios such as technical efficiency, product performance, reliability of processes, etc. are discussed	univers (0.5264), perform (0.3645), ratio (0.3336), internet (0.3162), describ (0.2465), problem (0.2317), reliabl (0.2172)	Pursglove and Simpson 2004 (0.5455), Pursglove and Simpson 2001 (0.5148), Agasisti and Bianco 2006 (0.3539), Carvalho and Laurindo 2003 (0.3029)
F9	Joint venture	Factors determining the selection of joint venture partners; approaches to measure joint venture performance; international joint venture; etc.	knowledg (0.316), partner (0.3049), ventur (0.3031), learn (0.2873), perform (0.2706), joint (0.2632), ijv (0.2599), allianc (0.253)	Gray and Ghosh 2003 (0.3954), Lopez-Navarro and Molina-Morales 2002 (0.3954), Fong et al 2004 (0.392), Julian 2005 (0.3219), Grimaldi and Rafele 2007 (0.3047), Kueng 2002 (0.2565), Lau et al 2006 (0.2471)

Continued

Table 17: Continued

Factor	Factor Label	Factor Description	High Loading Terms (Stemmed)	High Loading Statements
F10	Default risk analysis	The key variables in default risk analysis; global perspective of risk prediction; techniques of default risk analysis; etc.	default (0.3292), variabl (0.2803), pm (0.2507), network (0.246), benchmark (0.218), risk (0.2168), environment (0.2159), method (0.2104), analysi (0.2098)	Falavigna 2008a (0.421), Marassi and Pediroda 2008 (0.4072), Falavigna 2008 (0.3983), Chan and Yung 1999 (0.2651), Vallespir et al. 1999a (0.2649), Altunoglu 2004 (0.2593), Certo 2008 (0.2332)

cLSA of Corpus 3

The corpus comprises of 622 XY statement pairs. Combining the input and the output statements and then removing the duplicates resulted in a corpus of 1004 statements. These statements produced a dictionary of 939 raw terms. The elimination of stopwords from the dictionary and then the use of Porter term stemming (Porter, 1980) on the remaining words produced a dictionary of 671 relevant terms. An initial LSA on this dictionary revealed that 364 (54%) of these terms contributed to only 5% of the variance. Therefore, the communality filtering (Sidorova et al., 2008) was used to remove these terms from the dictionary. The final dictionary comprised 307 terms. The X matrix obtained from Corpus 3 is a 307 X 1004 term-by-statement X matrix. I followed a common method (Frakes & Baeza-Yates, 1992, p. 373; Salton & Buckley, 1988) to transform and normalize the frequencies of the term-by-statement X matrix. I performed cLSAs on the transformed X matrix to validate two-factor and ten-factor BPM frameworks.

A Two-Factor Causal BPM Framework

The first factor represents the operational view of the BPM artifact. The central theme of this factor embodies the BPM system and its organizational use. Various salient features of BPM systems are the key focus of this factor. BPM systems consolidate data from across the enterprise into a centralized data warehouse. They include analytics capabilities to turn the raw data into information that managers use in their decision-making process. BPM software can automate data entry and reporting, and helps companies do business modeling. There is a variety of BPM implementations. Companies can implement their do-it-all BPM systems in-house or can build an integrated BPM system by cobbling together products from several vendors. They can even deploy BPM systems on Excel and integrate BPM solutions with groupware, presentation, and web collaboration tools. The second factor represents the organizational view of BPM. It discusses how BPM helps organizations improve performance, become high performing organizations, foster strong leadership, and achieve better results. Table 18 provides the summary of the two-factor BPM framework. The inter-factor frequency measures and their percentages of the above factors are presented in Table 19 and Table 20, respectively. Causal semantic net shows the inter-factor causal relationships among these factors. Figure 11 portrays the causal semantic net developed based on the percentage measures given in Table 20.

Table 18: Summary of two factors of the causal BPM framework

Factor	Factor Label	Factor Description	High Loading Terms (Stemmed)	High Loading Statements
F1	Operational view: the BPM artifact	What BPM is and what you do with it; Various facts regarding BPM; BPM implementation, benefits, solutions, data, reporting.	bpm (2.4317), compani (1.5509), manag (1.3914), system (1.3741), data (1.3641), busi (1.1865), softwar (0.988), perform (0.9269), solution (0.8941), prov (0.6838), integr (0.6684), inform (0.6218)	The Editors 2007f X04 (0.6008), Hartlen 2004 X01 (0.5449), Kopcke 2003 X01 (0.5449), Ginsberg 2004 X02 (0.5285), Pritchard 2008 X01 (0.5285), Cokins 2004 Y06 (0.515), The Editors 2006g X01 (0.5054), Menninger & Raden 2005 X14 (0.5037), Weismantel 2007 X06 (0.5017), The Editors 2007i X01 (0.4749), Cokins 2004 Y03 (0.4729), Jorgensen 2007 X06 (0.459), Norton & Seewald 2007 X06 (0.4499)
F2	Organizational View of BPM	How BPM improves organizational performance; High performance organization; Strong leadership; Better results.	organ (2.4004), perform (1.3969), manag (1.0852), busi (1.0258), process (1.0041), improv (0.8406), decision (0.8049), result (0.7385)	Buytendijk 2006 Y20 (0.5868), Labovitz 2004 X01 (0.5553), Saksena 2007 Y14 (0.5553), Simms 2004 X02 (0.5342), Smith 2004 X01 (0.5129), Buytendijk 2006 X03 (0.4834), Buytendijk 2006 Y07 (0.4546)

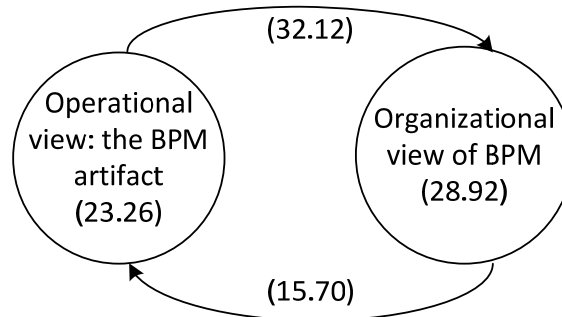
Table 19: Inter-factor frequency measures

Y Factors	X Factors		Y-index
	Operational view: the BPM artifact	Organizational View of BPM	
Operational view: the BPM artifact	160	108	268
Organizational View of BPM	221	199	420
X-index	381	307	
X - Y differential	113	-113	

Table 20: Inter-factor percentage measures

Y Factors	X Factors		Y-index
	Operational view: the BPM artifact	Organizational View of BPM	
Operational view: the BPM artifact	23.26	15.70	38.95
Organizational View of BPM	32.12	28.92	61.05
X-index	55.38	44.62	
X - Y differential	16.42	-16.42	

Figure 11: Causal semantic net for two-factor BPM framework



The inter-factor causal relationship coefficients are shown within parentheses. All figures within parentheses are in percentages, totaling 100%. The coefficients within the parentheses of each circle indicate the effect of the factors on themselves. In other words, these numbers show the intra-factor causal relationship.

A Ten-Factor Causal BPM Framework

Table 21 summarizes the ten-factor causal latent semantics of the BPM framework. Factor 1 encompasses different types of BPM solutions including integrated BPM solutions, managed BPM solutions, Excel-based BPM solutions, and Do-it-all BPM system. Factor 2 discusses performance management initiatives, management of overall organizational performance, and the unified performance management framework. Factor 3 describes an overarching concept of an enterprise that includes leadership, mission and vision, organizational alignment, and strategic objectives. In other words, organization provides the strategic view of an enterprise. Factor 4 represents the operational view of an enterprise, and includes attributes such as customers, employees, goals, and decisions. Factor 5 encompasses different types of business processes including planning, reporting, accounting, budgeting, and forecasting. Factor 6 focuses on collection, centralization, and management of data from different sources. Factor 7 highlights critical attributes of information including reliability, accuracy, timeliness, stability, and contextual usage. Factor 8 discusses the outcomes of BPM that include better results, better decisions, strategic growth, understanding of risks and uncertainties, and better executive strategies. Factor 9 embodies performance improvement indicators. Performance improvements are reflected in terms of improved processes, agility, productivity, satisfaction, efficiency, decision, collaboration, and viability. Lastly, Factor 10 discusses the role of BPM solutions in planning, budgeting, cost reduction, and project management.

Table 21: Summary of ten factors of the causal BPM framework

Factor	Factor Label	Factor Description	High Loading Terms (Stemmed)	High Loading Statements
F1	BPM Software Solutions	Integrated BPM solutions; Managed BPM solutions; Excel-based BPM solutions; Do-it-all BPM.	bpm (2.984), system (1.519), solution (1.1661), softwar (0.9542)	Cokins 2004 Y06 (0.7237), Ginsberg 2004 X02 (0.7139), Pritchard 2008 X01 (0.7139), Baltaxe & Van Decker 2003 Y05 (0.5409), Benchimol 2006 X03 (0.5387), Simms 2004 X03 (0.5379), Ginsberg 2004 X06 (0.531)
F2	Performance Management	Performance management initiatives; Management of overall performance; Unified performance management framework.	perform (2.2405), busi (2.0614), manag (1.8645), model (0.8795)	Kopcke 2003 X05 (0.8503), Hartlen 2004 X01 (0.6118), Kopcke 2003 X01 (0.6118), Kadaba & Singh 2005 X04 (0.6113), Creelman 2007 X01 (0.6097), McKeon 2007 Y05 (0.5082), Smith 2004 Y07 (0.4869)
F3	Organization	The organization; Points of interest include leadership, mission statement, organizational alignment, strategic objectives, etc.	organ (3.2347), align (0.6267), process (0.6191)	Labovitz 2004 X01 (0.8521), Saksena 2007 Y14 (0.8521), Smith 2004 X01 (0.6409), Buytendijk 2006 Y20 (0.6309), Buytendijk 2006 Y07 (0.583)
F4	Company	The company; Company attributes include customers, employees, goals, decisions, etc.	compani (3.3546) organiz (0.9119)	Blamante 2003 X12 (0.8767), Linder 2003 Y4 (0.8767), Menninger & Raden 2005 Y1 (0.8767), Blamante 2003 X13 (0.587)

Continued

Table 21: Continued

Factor	Factor Label	Factor Description	High Loading Terms (Stemmed)	High Loading Statements
F5	Business Processes	Different types of business processes including planning, reporting, accounting, etc.	process (2.152), plan (1.1316), report (0.9319), budget (0.7423)	Sorensen 2005 X01 (0.6151), Kopcke 2003 X02 (0.4975), Morini 2005 Y05 (0.4628)
F6	Data	Data management and data sources; Collection of the right data; Centralization of data from different sources.	data (3.121), sourc (0.677)	Cokins 2004 X02 (0.8624), Creelman 2007 X03 (0.8624), Iervolino & Thomas 2006 X02 (0.7425)
F7	Information	Information reliability, accuracy, timeliness, stability; Garnering information in a timely and contextual manner.	inform (2.5512), provid (0.7999), decision (0.797)	Bichut 2005 Y03 (0.7275), Hotsmann 2007 X02 (0.7021), Cokins 2004 Y01 (0.6066), Sorensen 2005 Y02 (0.6063), Kichuk & Woledge 2006 X06 (0.5969)
F8	Better Results - Better Decisions	Outcomes of BPM; Better results, better decisions, and strategic growth; Understanding of risks and uncertainties; Better executive strategies.	result (1.865), better (1.827), decision (1.659), strateg (0.588)	Baltaxe & Van Decker 2003 Y02 (0.8791), Creelman 2007 Y05 (0.6965), Simms 2004 Y03 (0.6351), Schroeck 2006 Y08 (0.5817)

Continued

Table 21: Continued

Factor	Factor Label	Factor Description	High Loading Terms (Stemmed)	High Loading Statements
F9	Performance Improvement	Performance improvement indicators; Improved processes, agility, productivity, satisfaction, and efficiency; Improved decision, collaboration and viability.	improv (2.5032), perform (1.0611), model (0.836)	Smith 2008 Y09 (0.7389), Buytendijk 2006a Y01 (0.6501), Ginsberg 2004 Y07 (0.5527)
F10	BPM for Planning	BPM Solutions and their role in planning, budgeting, cost reduction; Project management; Web-based budgeting and planning; Use of strategy plans and dashboards.	plan (1.235), manag (0.978), budget (0.961), system (0.9271), cost (0.8223), implement (0.8002), project (0.706)	Scherpenseel 2005 Y01 (0.4883), Scherpenseel 2005 Y05 (0.4416), Schiff 2003 Y06 (0.3795), Smith 2008 X11 (0.3715), Kamlet 2007 X04 (0.367), Van Decker 2006 X02 (0.3632)

The inter-factor frequency measures and their percentages of the above factors are presented in Table 22 and Table 23, respectively.

Table 22: Inter-factor frequency measures

Y Factors	BPM Software Solutions	Performance Management	Organization	Company	Business Processes	Data	Information	Better Results - Better Decisions	Performance Improvement	BPM for Planning	Y-index
BPM Software Solutions	7	4	3	4	12	9	2	1	0	5	47
Performance Management	12	14	6	14	13	8	10	1	6	6	90
Organization	16	20	25	8	16	7	7	0	4	11	114
Company	10	12	5	15	20	3	5	1	3	4	78
Business Processes	14	5	0	4	11	3	1	1	0	4	43
Data	7	1	1	10	3	6	3	1	2	3	37
Information	14	2	1	2	5	13	5	0	4	4	50
Better Results - Better Decisions	16	21	8	7	16	13	6	6	8	13	114
Performance Improvement	17	12	4	15	11	7	3	5	6	10	90
BPM for Planning	11	6	5	3	7	7	1	1	0	7	48
X-index	124	97	58	82	114	76	43	17	33	67	
X - Y differential	77	7	-56	4	71	39	-7	-97	-57	19	

Table 23: Inter-factor percentage measures

Y Factors	X Factors										Y-index
	BPM Software Solutions	Performance Management	Organization	Company	Business Processes	Data	Information	Better Results - Better Decisions	Performance Improvement	BPM for Planning	
BPM Software Solutions	0.98	0.56	0.42	0.56	1.69	1.27	0.28	0.14	0	0.7	6.6
Performance Management	1.69	1.97	0.84	1.97	1.83	1.13	1.41	0.14	0.84	0.84	12.66
Organization	2.25	2.81	3.52	1.13	2.25	0.98	0.98	0	0.56	1.55	16.03
Company	1.41	1.69	0.7	2.11	2.81	0.42	0.7	0.14	0.42	0.56	10.96
Business Processes	1.97	0.7	0	0.56	1.55	0.42	0.14	0.14	0	0.56	6.04
Data	0.98	0.14	0.14	1.41	0.42	0.84	0.42	0.14	0.28	0.42	5.19
Information	1.97	0.28	0.14	0.28	0.7	1.83	0.7	0	0.56	0.56	7.02
Better Results - Better Decisions	2.25	2.95	1.13	0.98	2.25	1.83	0.84	0.84	1.13	1.83	16.03
Performance Improvement	2.39	1.69	0.56	2.11	1.55	0.98	0.42	0.7	0.84	1.41	12.65
BPM for Planning	1.55	0.84	0.7	0.42	0.98	0.98	0.14	0.14	0	0.98	6.73
X-index	17.44	13.63	8.15	11.53	16.03	10.68	6.03	2.38	4.63	9.41	
X - Y differential	10.84	0.97	-7.88	0.57	9.99	5.49	-0.99	-13.7	-8.02	2.68	

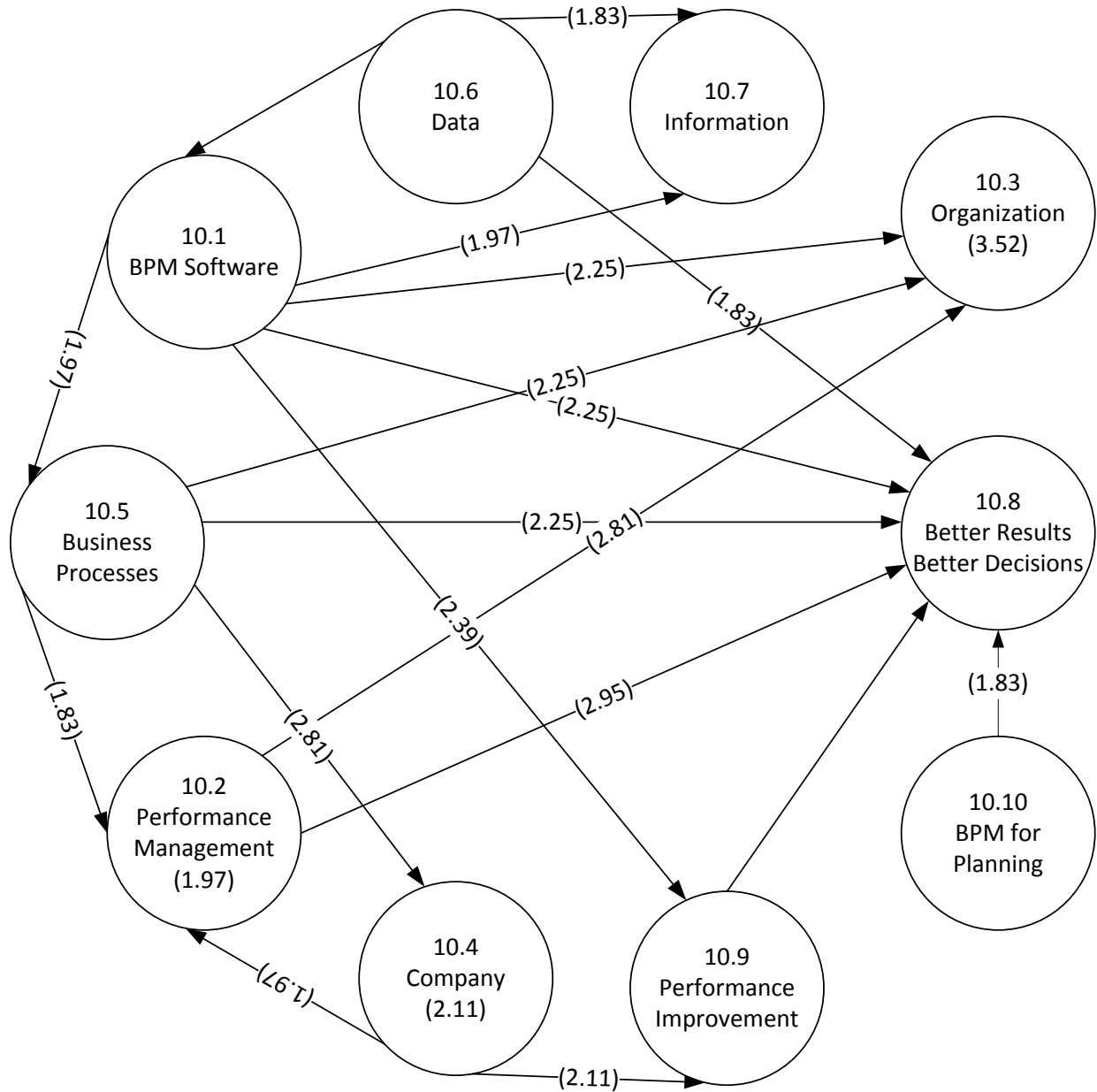
Causal semantic net shows the inter-factor causal relationships among the factors. For a ten-factor cLSA, the causal semantic net portrays 100 causal relationships. As Table 22 and Table 23 indicate, some of these relationships have little or no causal support. Causal supports are given by the cell frequencies in Table 22. These supports can also be shown as percentages of the total support. Table 23 shows the percentage of supports. The relationships that have little support can be eliminated based on some criteria. One such criterion to determine the cutoff point may be to use the average expected percentage of support. For a ten-factor cLSA,

we expect, on average, a percentage support of 1% to fall in each cell in Table 23. Therefore, any relationship with less than the average expected percentage of support can be removed. Yet another method can utilize the relative strength of the percentage of support in relation to the highest percentage of support. Table 23 indicates that the highest percentage of support is 3.52% for the factor, organization, leading to the same factor. The cutoff support can then be established as a percentage of the highest support. For instance, any relation that has a support percentage of less than 50% relative to the highest support percentage can be eliminated. In this study, we use the second method. A cutoff point of 50% of the highest support percentage is used to determine the insignificant relationships that can be removed from the causal semantic net. Table 24 shows the percentage of supports that are deemed significant. A causal semantic net drawn based on Table 24 is portrayed in Figure 12.

Table 24: Significant percentage supports

Y Factors	X Factors										Y-index
	BPM Software Solutions	Performance Management	Organization	Company	Business Processes	Data	Information	Better Results - Better Decisions	Performance Improvement	BPM for Planning	
BPM Software Solutions											0
Performance Management	1.97		1.97		1.83						5.77
Organization	2.25	2.81	3.52	2.25							10.83
Company				2.11	2.81						4.92
Business Processes	1.97										1.97
Data											0
Information	1.97										3.8
Better Results - Better Decisions	2.25	2.95		2.25		1.83		1.83			11.11
Performance Improvement	2.39		2.11							4.5	
BPM for Planning											0
X-index	10.83	7.73	3.52	6.19	9.14	3.66	0	0	0	1.83	
X - Y differential	10.83	1.96	-7.31	1.27	7.17	3.66	-3.8	-11.1	-4.5	1.83	

Figure 12: Causal semantic net for ten-factor BPM framework



The inter-factor causal relationship coefficients are shown within parentheses. All figures within parentheses are in percent. The coefficients within the parentheses of some circles indicate the effect of the factors on themselves. Therefore, they show the intra-factor causal relationships.

CHAPTER 5

DISCUSSION, IMPLICATIONS, and FUTURE DIRECTION

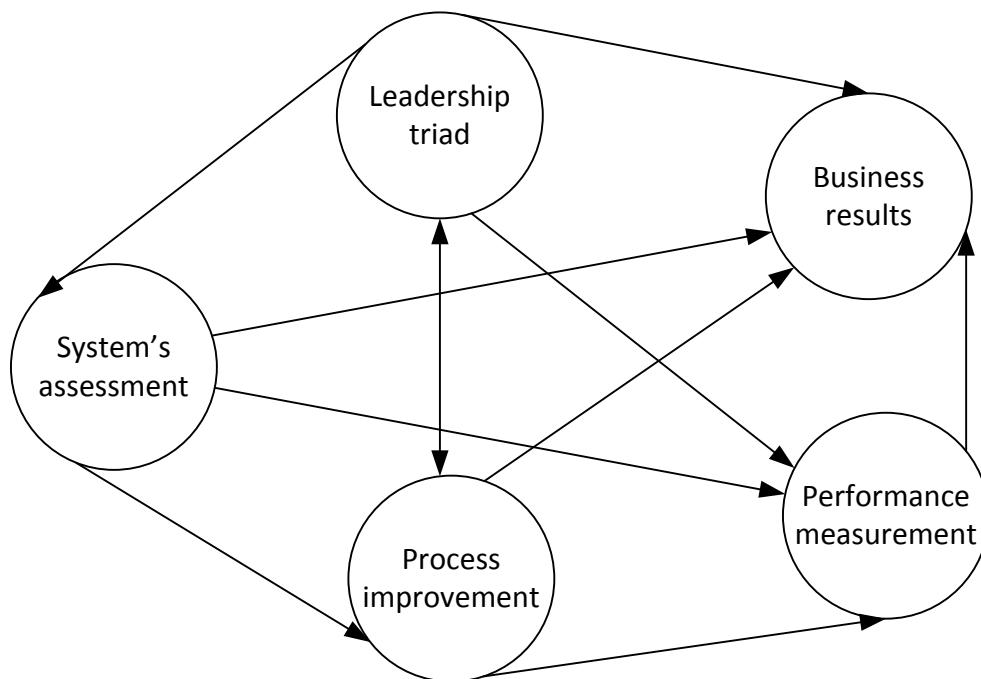
Discussion

First, this study used a two-factor causal latent semantic analysis (cLSA) methodology to examine the Malcolm Baldrige National Quality Award (MBNQA) framework. The identification of two-factors using cLSA suggest that two mega constructs within the MBNQA framework are the Baldrige system and Baldrige assessment. The factor assessment embodies various performance assessments including assessment of leadership performance, process performance, human resource performance, etc. These performances are indicators of respective organizational results. The second factor system delineates the elements that are central to the Baldrige system. These integral components of the Baldrige systems include strategic planning, leadership, process, performance management, customer, and market. The findings also suggest that the factors have substantial influence on each other. There is a positive correlation between the two concepts. A well managed system leads to better assessment of the result indicators; and better assessment of the result indicators yields an improved Baldrige system. I also found that there exist intra-factor relationships for both factors. This suggests that these factors represent broader concepts that are comprised of sub-concepts.

Second, the seven-factor cLSA of the MBNQA framework suggests that the model has not yet been explored in its entirety. However, past research examined several critical components of the MBNQA framework, including the system's assessment, leadership triad, business results, performance measurement, and process improvement. Except for business

results (Figure 10), these factors demonstrate intra-factor relationship. This suggests that these categorical factors are comprised of sub-factors, each of which influences the other. Another important finding is shown in Table 15. The X-Y differential indicates whether a factor is a net giver (i.e., cause) or a net receiver (i.e., effect). As Table 15 indicates, the leadership triad emerged as the most influential factor while business results appeared to be the net receiver. This is consistent with the theoretical foundation of the MBNQA framework. However, the empirical evidence suggests that the MBNQA framework has been seriously understudied by researchers. Figure 13 shows the empirical evidence of the MBNQA framework.

Figure 13: Empirical evidence of the MBNQA framework



Third, the two-factor latent semantic analysis (LSA) of the business performance management (BPM) framework revealed that the BPM researchers investigated different types of BPM frameworks and what performance efficiencies these frameworks brought about in the

organizations. This stream of research suggests that researchers are interested in analyzing what efficiency measures are achieved by the implementation of BPM infrastructures. This also implies that the primary focus of this stream is not to examine what constitutes or should constitute a BPM implementation but rather to highlight the benefit measures of various existing BPM frameworks.

Fourth, the results of the ten-factor LSA are somewhat consistent with those of the two-factor LSA. The second factor of the two-factor LSA – performance efficiency measures – broke down into several individual measures such as performance ratios, corporate responsibility measures, public sector services, logistics and supply chain performance, and the role of data envelopment analysis in efficiency. In addition, several other factors emerged. These include the factors determining joint venture, default risk analysis, and resource capability, alliance and innovation.

Fifth, the two-factor cLSA of the BPM framework revealed that there are two views of the BPM infrastructure – the operational view: the BPM artifact and the organizational view of BPM. As Figure 11 indicates, there is a strong positive causal support between these two views of BPM. Both factors also have a high level of intra-factor causal supports. This suggests that these factors provide a bird's eye view of the BPM framework and can further be decomposed into more specific causal sub-factors.

Sixth, the ten-factor cLSA of the BPM framework provides a more elaborate account of the BPM constructs as perceived by practitioners. These ten factors represent a refined breakdown of the two mega-constructs uncovered by the two-factor cLSA of the BPM framework. Consistent with the results of the two-factor cLSA, these factors can be combined to provide

operational and strategic views of BPM. The operational view of BPM is closely tied to goals and decisions, and thus generates better results and decisions. On the other hand, the strategic view of BPM embodies the overarching concept of an enterprise that encompasses leadership, mission and vision, organizational alignment, and strategic objectives. Therefore, this represents the organizational view of BPM. From the causal semantic net presented in Figure 12, factors leading to better results-better decisions represent the operational paths of BPM. On the other hand, factors leading to organization provide the strategic paths of BPM. The operational and strategic paths of BPM are illustrated in Figure 14 and Figure 15, respectively.

Figure 14: The operational paths of BPM

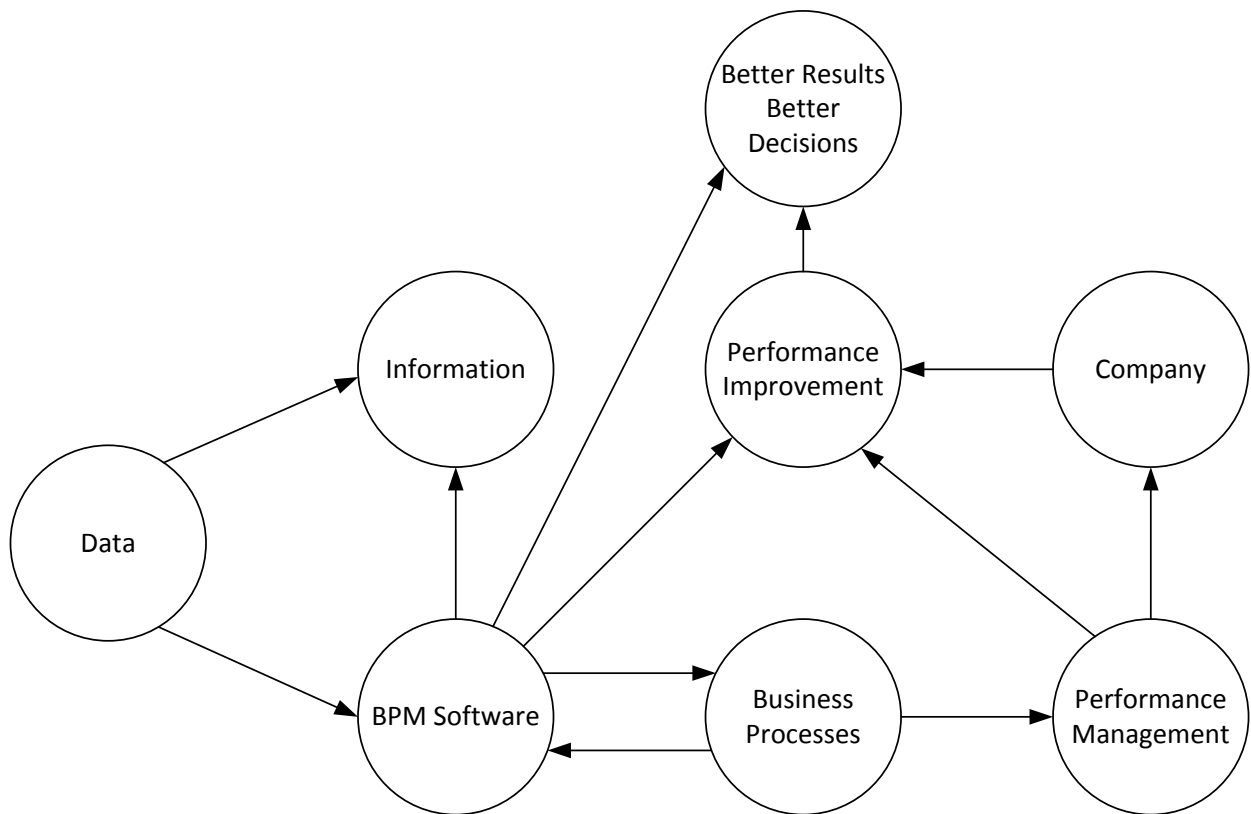
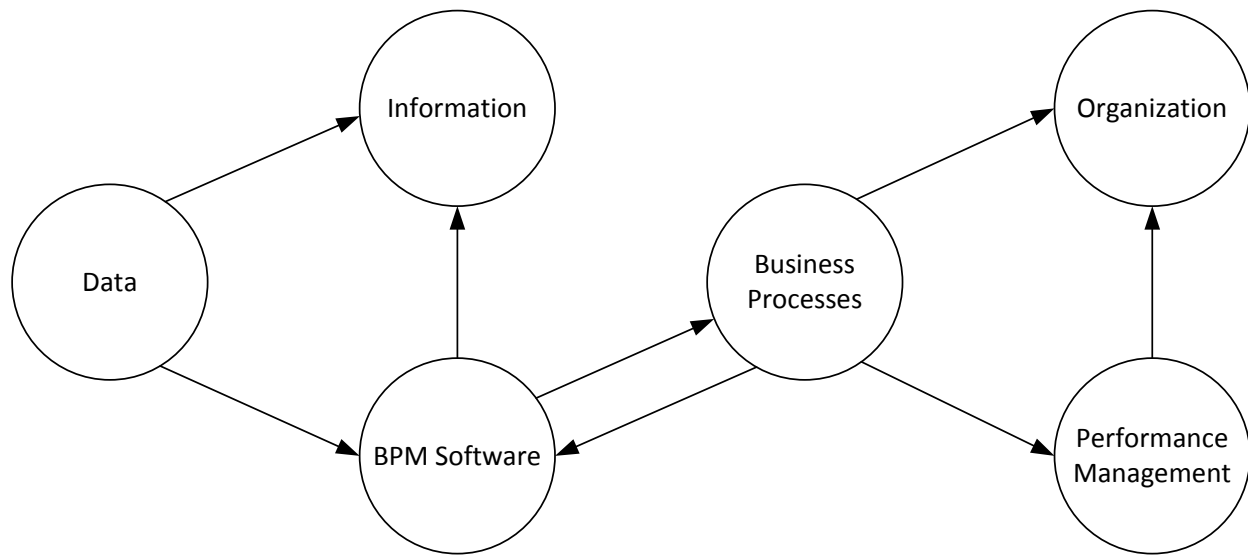


Figure 15: The strategic paths of BPM



Implications

There are several theoretical and practical implications of this study. First, in this study, I developed a variant of the traditional latent semantic analysis (LSA) that enables us to test causal models using textual data. This study is the first that has attempted to develop the causal latent semantic analysis (cLSA) that analyzes input-output statements to establish causal relationships between the factors derived from the analysis. Second, this study is also the first attempt to validate the 2008 MBNQA framework using text data that included article abstracts published in both academic and practitioner journals on the Baldrige Award and program. The managerial implication is that managers should understand that the Baldrige system and the Baldrige results are intertwined and that each is both a cause and an effect of the other. The academic implication of this study is that it provides academicians with a new approach to test causal models based on quantitative analysis of the textual data. Third, the key to ever-increasing competitive advantage is to continuously improve the fit between a dynamic and

changing business environment and organizational strategy, and doing so requires responsiveness and flexible strategies (Porter, 1980). Business performance management (BPM) framework developed in this study provides a structure for enhancing responsiveness and flexibility because it embodies the process of managing an organization's strategy. Since the BPM process embodies a closed-loop process with the objective of continuously adjusting business strategies, it helps organizations to enhance their agility. Therefore, with the implementation of the BPM framework, organizations can quickly adapt to changes. I posit that the proposed BPM framework will help managers create an agile organization that is capable of developing and increasing competitive advantage. Fourth, the BPM framework developed in this paper is a generic performance management model that can be implemented across industries, boundaries, and cultures. It can provide organizations with more common language to bridge sector-specific gaps. Last but not least, this study integrates the BPM and MBNQA frameworks into a new model called the BPM-MBNQA framework such that the BPM framework serves as the start-up model for the MBNQA framework. The BPM framework is a subset of the MBNQA framework, and the former paves the way for the latter. Organizations can initially deploy the BPM framework and gradually move to the adoption of the MBNQA framework.

Future Direction

Future works can extend this study in a number of ways. First, the MBNQA framework can be validated at both the category and the item levels using more comprehensive collection of data. Particularly, the MBNQA winners can be interviewed as to their perception and experience of implementing the MBNQA framework in their organizations. The interview data

can then be used to validate the model. Second, the BPM framework can further be tested with a more comprehensive collection of BPM-related textual data. Third, this study developed a methodology (cLSA) to validate causal models such as the MBNQA and BPM frameworks. Future works can refine the method, especially, with regard to how to reduce the inter-factor causal relationships. Lastly, this study developed an input-output (XY) coding scheme. This scheme is not comprehensive. Therefore, future studies can refine and extend this coding scheme.

APPENDIX A

ILLUSTRATION OF LATENT SEMANTIC ANALYSIS (LSA) METHOD

Illustration of Latent Semantic Analysis (LSA) Method

The corpus consists of a collection of seven select article titles published in volume 10 issues 2/3 and 4 of the *International Journal of Business Performance Management (IJBPM)* in 2008. Table A1 presents the list of these article titles and their reference to IJBPM.

Table A1: Titles of seven select articles published in IJBPM in 2008

ID	Document Title	IJBPM Reference
p1	Deregulation and productivity growth: a study of the Indian commercial banking industry	v. 10, p. 318 - 343
p2	Global productivity growth from 1980–2000: a regional view using the Malmquist total factor productivity index	v. 10, p. 374 - 390
p3	Measuring productivity under different incentive structures	v. 10, p. 366 - 373
R1	A rating model simulation for risk analysis	v. 10, p. 269 - 299
R2	An analysis of the key-variables of default risk using complex systems	v. 10, p. 202 - 230
R3	New contents and perspectives in the risk analysis of enterprises	v. 10, p. 136 - 173
R4	Risk insolvency predictive model maximum expected utility	v. 10, p. 174 - 190

Data Cleaning

The data were subjected to a data cleaning process, in which (1) the hyphens in *key-variables* in R2 and in 1980-200 in P2 were removed and a space was used to separate the words, and (2) the colons in P1 and p2 were removed. Note that the data cleaning process may vary from corpus to corpus and based on the LSA automation algorithm. In this illustration, I consider the use of a space to separate the words. Therefore, the above data cleaning method is deemed appropriate. Table A2 presents the corpus after the cleaning process.

Table A2: The corpus after the data cleaning process

ID	Document Title	IJBPM Reference
p1	Deregulation and productivity growth a study of the Indian commercial banking industry	v. 10, p. 318 - 343
p2	Global productivity growth from 1980 2000 a regional view using the Malmquist total factor productivity index	v. 10, p. 374 - 390
p3	Measuring productivity under different incentive structures	v. 10, p. 366 - 373
R1	A rating model simulation for risk analysis	v. 10, p. 269 - 299
R2	An analysis of the key variables of default risk using complex systems	v. 10, p. 202 - 230
R3	New contents and perspectives in the risk analysis of enterprises	v. 10, p. 136 - 173
R4	Risk insolvency predictive model maximum expected utility	v. 10, p. 174 - 190

Dictionary of Relevant Terms

The initial dictionary comprises of 70 words, of which 40 words appear only in one document. The elimination of these unique words reduces the dictionary size to 30 words. I then remove the stopwords such as 'a', 'an', 'for', 'of', 'the', etc. from the dictionary. The list of stopwords consists of the standard 571 common words developed by the System for the Mechanical Analysis and Retrieval of Text (SMART) at Cornell University (Salton & Buckley, 1988). The removal of stopwords from the dictionary reduces its size to 15 words. The

dictionary, therefore, consists of 15 relevant words. These words are italicized and boldfaced in Table A2. There are only 5 unique words (i.e., terms) in the dictionary of relevant words: *analysis, growth, model, productivity, and risk*.

The Term-by-Document Matrix X

The term-by-document matrix X developed from the dictionary of relevant words is shown in Table A3. The rows of matrix X represent the terms and the columns of matrix X represent the documents. Since there are five terms and seven documents, matrix X is a 5 × 7 rectangular matrix. Table A3 shows matrix X containing the raw term frequencies for each of the seven documents.

Table A3: Matrix X, a 5×7 term frequency matrix for the corpus in Table A2

Term	Document						
	P1	P2	P3	R1	R2	R3	R4
<i>analysis</i>	0	0	0	1	1	1	0
<i>growth</i>	1	1	0	0	0	0	0
<i>model</i>	0	0	0	1	0	0	1
<i>productivity</i>	1	2	1	0	0	0	0
<i>risk</i>	0	0	0	1	1	1	1

Transformation of X

The raw frequencies were transformed by using the traditional term frequency–inverse document frequency (TF-IDF) weighting method (Han and Kamber 2006, p. 619). In the TF-IDF scheme, each raw frequency, f_{id} , is replaced with its corresponding $w_{id} = f_{id} \times idf_{id}$, where f_{id} is the raw term frequency of term t in document d, $idf_{id} = \log_2(N/n_t)$, N is the number of documents in the corpus, and n_t is the number of documents containing term t. The weighted frequencies were then normalized so that $\sum_{i=1}^t w_{id}^2 = 1$ for each document d. Table A4 shows the transformed X matrix.

Table A4: Matrix X, containing TF-IDF weighted normalized frequencies

Term	Document						
	P1	P2	P3	R1	R2	R3	R4
<i>analysis</i>	0	0	0	0.525	0.834	0.834	0
<i>growth</i>	0.913	0.746	0	0	0	0	0
<i>model</i>	0	0	0	0.777	0	0	0.913
<i>productivity</i>	0.408	0.666	1	0	0	0	0
<i>risk</i>	0	0	0	0.347	0.551	0.551	0.408

Singular Value Decomposition (SVD) of X

Singular value decomposition was applied to matrix X in Table A4. Matrix X is of rank 5. The SVD of X is given by $X = TSD^T$, where T is the 5 × 5 matrix of term eigenvectors of the

square symmetric matrix $Y = XX^T$, Y is the 5×5 matrix of term covariances, D is the 5×7 matrix of document eigenvectors of the square symmetric matrix $Z = X^T X$, Z is the 7×7 matrix of document covariances, and S is the 5×5 diagonal matrix of singular values (i.e., the square roots of eigenvalues of both Y and Z). The SVD of X was performed using an online SVD calculator available at <http://www.bluebit.gr/matrix-calculator/> and is shown in Figure A1.

Figure A1: The SVD of X

$$\begin{bmatrix} 0 & 0 & 0 & 0.525 & 0.834 & 0.834 & 0 \\ 0.913 & 0.746 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.777 & 0 & 0 & 0.913 \\ 0.408 & 0.666 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.347 & 0.551 & 0.551 & 0.408 \end{bmatrix} = \begin{bmatrix} 0.694 & 0 & 0.514 & 0 & 0.505 \\ 0 & -0.66 & 0 & 0.75 & 0 \\ 0.463 & 0 & -0.85 & 0 & 0.235 \\ 0 & -0.75 & 0 & -0.66 & 0 \\ 0.552 & 0 & 0.07 & 0 & -0.83 \end{bmatrix} \times \begin{bmatrix} 1.678 & 0 & 0 & 0 & 0 \\ 0 & 1.542 & 0 & 0 & 0 \\ 0 & 0 & 1.067 & 0 & 0 \\ 0 & 0 & 0 & 0.79 & 0 \\ 0 & 0 & 0 & 0 & 0.209 \end{bmatrix} \times \begin{bmatrix} 0 & 0 & 0 & 0.545 & 0.526 & 0.526 & 0.386 \\ -0.59 & -0.64 & -0.49 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -0.35 & 0.438 & 0.438 & -0.7 \\ 0.526 & 0.151 & -0.84 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.763 & -0.18 & -0.18 & -0.6 \end{bmatrix}$$

$\mathbf{X} \qquad = \qquad \mathbf{T} \qquad \times \qquad \mathbf{S} \qquad \times \qquad \mathbf{D}^T$

Reduction of Factors

The rank- k reduced model $\hat{X} = \hat{T}\hat{S}\hat{D}^T$ is the best possible least-squares-fit to X . In this illustration, we selected k based on the Kaiser-Guttman rule, which suggests that we keep the factors whose eigenvalues are greater than $\bar{\lambda}$. The diagonal matrix S contains the singular values $s_i = \{1.678, 1.542, 1.067, 0.790, \text{ and } 0.209\}$. The corresponding eigenvalues are $\lambda_i = s_i^2 = \{1.295, 1.242, 1.033, 0.889, \text{ and } 0.457\}$. Therefore, $\bar{\lambda} = 1.40$ and the Kaiser-Guttman rule suggests keeping the first two principal factors. The reduced model $\hat{X} = \hat{T}\hat{S}\hat{D}^T$ with $k = 2$ is shown in Figure A2.

Figure A2: The SVD of the reduced model

$$\begin{bmatrix} 0 & 0 & 0 & 0.635 & 0.612 & 0.612 & 0.449 \\ 0.602 & 0.657 & 0.496 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.423 & 0.408 & 0.408 & 0.3 \\ 0.683 & 0.745 & 0.563 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.505 & 0.487 & 0.487 & 0.358 \end{bmatrix} = \begin{bmatrix} 0.694 & 0 \\ 0 & -0.66 \\ 0.463 & 0 \\ 0 & -0.75 \\ 0.552 & 0 \end{bmatrix} \times \begin{bmatrix} 1.678 & 0 \\ 0 & 1.542 \end{bmatrix} \times \begin{bmatrix} 0 & 0 & 0 & 0.545 & 0.526 & 0.526 & 0.386 \\ -0.59 & -0.64 & -0.49 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$\mathbf{X-hat} \qquad = \qquad \mathbf{T-hat} \qquad \times \qquad \mathbf{S-hat} \qquad \times \qquad \mathbf{D-hat}^T$

Rotation of Factors

The term and document loadings are given by $L_T = \hat{T}\hat{S}$ and $L_D = \hat{D}\hat{S}$, respectively. Rotations of factors can then be performed to simplify the factor structure and factor interpretations (Sidorova et al. 2008; Thurstone 1947). Here we used varimax rotation for both term loadings and document loading to maintain the same factor space. Varimax rotation simplifies the interpretation of factors because, after varimax rotation, each term and/or document tends to be associated with one or a small number of factors, and vice versa (Kaiser 1958). To obtain the varimax rotated factor matrices L_T^* and L_D^* , matrices L_T and L_D were multiplied by their corresponding orthogonal varimax transformation matrices M_T and M_D . The matrices M_T and M_D were obtained from MINITAB 15 by using L_T and L_D , respectively.

The term loadings before and after varimax rotation are shown in Table A5. Table A6 shows the document loadings before and after varimax rotation.

Table A5: Term loadings before and after varimax rotation

Term	Term Loadings				
	Unrotated		Orthogonal. Tran.	After varimax	
	Factor 1	Factor 2	Matrix (varimax)	Factor 1	Factor 2
analysis	1.1639	0	$\begin{bmatrix} 1.0000 & 0.0000 \\ 0.0000 & 1.0000 \end{bmatrix}$	1.1639	0
growth	0	-1.0193		0	-1.0193
model	0.7762	0		0.7762	0
productivity	0	-1.1564		0	-1.1564
risk	0.9265	0		0.9265	0

Table A6: Document loadings before and after varimax rotation

Document	Document Loadings				
	Unrotated		Orthogonal. Tran.	After varimax	
	Factor 1	Factor 2	Matrix (varimax)	Factor 1	Factor 2
P1	0	-0.9098	$\begin{bmatrix} 1.0000 & 0.0000 \\ 0.0000 & 1.0000 \end{bmatrix}$	0	-0.9098
P2	0	-0.9929		0	-0.9929
P3	0	-0.7502		0	-0.7502
R1	0.9152	0		0.9152	0
R2	0.8827	0		0.8827	0
R3	0.8827	0		0.8827	0
R4	0.6476	0		0.6476	0

Interpretation of Factors

As Table A5 and Table A6 indicate, Factor F1 appears to be highly related to the terms {*analysis*, *model*, and *risk*}, and loads strongly on documents R1, R2, R3, and R4. Factor F2 appears to be primarily related to the terms {*growth*, and *productivity*}, and loads strongly on documents P1, P2, and P3. Reading the corresponding titles from Table A1, it is plausible to infer that factor F1 is about analysis of risk models and factor F2 is about growth and productivity.

APPENDIX B

ILLUSTRATION OF CAUSAL LATENT SEMANTIC ANALYSIS (CLSA) METHOD

Illustration of Causal Latent Semantic Analysis (cLSA) Method

Latent semantic analysis (LSA) is a methodology akin to factor analysis, but applicable to text data, that was introduced in the early 90s. LSA aimed to improve library indexing methods and the performance of search engine queries (Deerwester et al., 1990; Berry et al., 1995; Dumais, 2004). Direct interpretation of the latent semantic factors was never attempted, because the role of the factor space was merely to assist with the investigation of the relationships among text documents. In this paper we attempt to show how a modified latent semantic analysis called cLSA allows uncovering the latent semantic factors and establishing causal relationships among these factors.

The causal LSA (cLSA) is a modification and thus a derivative of the traditional latent semantic analysis. In addition to uncovering the latent factors, the cLSA establishes causal relationships among these factors based on the input and output statements contained in the factors. The cLSA performs LSA on a corpus comprised of input and output statements obtained from text passages. An input-output statement (also, called XY statement) is defined as a pair of statements in which the output statement (the Y statement) is a consequence of the input statement (the X statement). For instance, consider the statement: “Companies must have the necessary organizational structure in order to improve the day-to-day management of their business”. Here the output statement “companies improve the day-to-day management of their business” is considered to be a direct consequence of the input statement “companies must have the necessary organizational structure”. An output statement may be a consequence of one or more input statements and an input statement may influence one or more output statements. In “a company must know its sources of profit and understand its cost structure in order to become competitive”, the output statement “a company becomes competitive” is a consequence of two input statements – “a company must know its sources of profit”, and “a company must understand its cost structure”. A generic coding scheme to obtain the input-output statements from text passages is provided in Appendix C.

In order to better illustrate the cLSA methodology, consider the input-output pairs presented in Table B1.

Table B1: Select input-output pairs

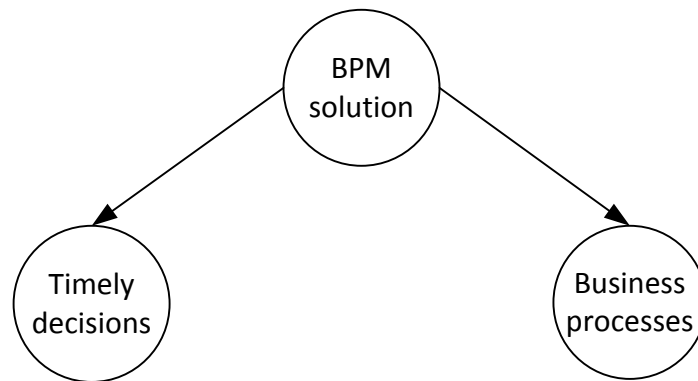
XStatementID	YStatementID	X Statement	Y Statement	Reference
Ginsberg 2004 X1	Ginsberg 2004 Y1	the implementation of a bpm solution	will most definitely generate returns in the form of improved processes	BPM Mag. Oct. 2004
Simms 2004 X1	Simms 2004 Y1	an effective bpm solution	will make better, more timely decisions	BPM Mag. Mar. 2004
Simms 2004 X1	Simms 2004 Y2	an effective bpm solution	will identify where business processes need to be improved or changed	BPM Mag. Mar. 2004

The input-output pairs in Table B1 were taken from two text passages. From the first passage, Ginberg 2004, we obtained one input statement that corresponds to one output

statement. However, from the second passage, Simms 2004, we have had one input statement that corresponds to two output statements. In this example, we use these three input-output pairs to develop our corpus for the cLSA.

However, before we detail the steps of cLSA, let's assume that a knowledgeable researcher is asked to identify the potential factors and their relationships from this set of input-output statements. It is likely that the researcher will recognize and identify three factors – BPM solution/implementation, business processes, and timely decision – and conclude the relationships between the factors as shown in Figure B1.

Figure B1: Relationships between BPM solution, business processes, and timely decisions



The corpus for cLSA consists of the input and output statements obtained from text passages. These text passages may include article abstracts, customer comments, discussion sections of articles, or simply text documents. The input and output statements are referred to as the X and Y statements, respectively. Each XY statement pair is assigned an XStatementID and a YStatementID in order to track the correspondence between the statements. If an X statement corresponds to more than one Y statement, then the X statement is given only one XStatementID and the corresponding Y statements are given separate YStatementIDs. Similarly, if an Y statement corresponds to more than one X statement, then the Y statement is given only one YStatementID and the corresponding X statements are given separate XStatementIDs. For instance, in Table B1, the X statement *an effective bpm solution* with an XStatementID *Simms 2004 X1* has two corresponding Y statements – *will make better, more timely decisions* with an YStatementID *Simms 2004 Y1*, and *will identify where business processes need to be improved or changed* with an YStatementID *Simms 2004 Y2*. Assigning statement IDs in such a manner helps not only to track the XY correspondence but also to eliminate duplicate use of statements in the corpus.

To develop the corpus, first, the X statements are combined with the Y statements. Then the duplicate X and/or Y statements are removed. Finally, the unique statements are sorted by StatementID to form the corpus for LSA. The combined statements from Table B1 are shown in Table B2. Table B3 presents the final corpus.

Table B2: Combined X and Y statements

StatementID	Statement
Ginsberg 2004 X1	the implementation of a bpm solution
Simms 2004 X1	an effective bpm solution
Simms 2004 X1	an effective bpm solution
Ginsberg 2004 Y1	will most definitely generate returns in the form of improved processes
Simms 2004 Y1	will make better, more timely decisions
Simms 2004 Y2	will identify where business processes need to be improved or changed

Table B3: Final corpus

StatementID	Statement
Ginsberg 2004 X1	the implementation of a bpm solution
Ginsberg 2004 Y1	will most definitely generate returns in the form of improved processes
Simms 2004 X1	an effective bpm solution
Simms 2004 Y1	will make better, more timely decisions
Simms 2004 Y2	will identify where business processes need to be improved or changed

It is now possible to perform LSA on the corpus to extract the latent semantic structure. For stepwise illustration of LSA, refer to Sidorova et al. (2008) and Appendix A. The corpus consists of a collection of five statements with 30 words. Due to the small size of the corpus, we used the removal of stopwords and term stemming as the only term filtering techniques. Note that for large corporuses, other term filtering techniques such as the elimination of unique words (i.e., the words that appear in only one statement) and communality filtering can be applied. The removal of stopwords such as *the, an, is, are*, etc. and the Porter term stemming (Porter 1980) produced a dictionary of 9 relevant terms. Table B4 shows matrix X containing the term frequencies. Matrix X with the term frequency–inverse document frequency (TF-IDF) weighted normalized frequencies is presented in Table B5.

Table B4: Matrix X, containing term frequencies

	Ginsberg 2004 X1	Ginsberg 2004 Y1	Simms 2004 X1	Simms 2004 Y1	Simms 2004 Y2
bpm	1	0	1	0	0
business	0	0	0	0	1
decisions	0	0	0	1	0
effective	0	0	1	0	0
implementation	1	0	0	0	0
processes	0	1	0	0	1
returns	0	1	0	0	0
solution	1	0	1	0	0
timely	0	0	0	1	0

Table B5: Matrix X, containing TF-IDF weighted normalized frequencies

	Ginsberg 2004 X1	Ginsberg 2004 Y1	Simms 2004 X1	Simms 2004 Y1	Simms 2004 Y2
bpm	0.4435	0	0.4435	0	0
business	0	0	0	0	0.869
decisions	0	0	0	0.7071	0
effective	0	0	0.7789	0	0
implementation	0.7789	0	0	0	0
processes	0	0.4948	0	0	0.4948
returns	0	0.869	0	0	0
solution	0.4435	0	0.4435	0	0
timely	0	0	0	0.7071	0

Singular value decomposition (SVD) was applied to matrix X in Table B5. Keeping the first three principal components, the SVD of matrix X, $\hat{X} = \hat{T}\hat{S}\hat{D}^T$, produced a 9×3 matrix \hat{T} of term eigenvectors of the square symmetric matrix XX^T , a 5×3 matrix \hat{D} of statement eigenvectors of the square symmetric matrix $X^T X$, and a 3×3 diagonal matrix \hat{S} of singular values. The term and statement loadings were obtained by $L_T = \hat{T}\hat{S}$ and $L_D = \hat{D}\hat{S}$, respectively. Rotations of factors were then performed to simplify the factor structure and factor interpretations (Sidorova et al. 2008). I used varimax rotation for both term loadings and statement loading to maintain the same factor space. The term loadings before and after varimax rotation are shown in Table B6. Table B7 shows the statement loadings before and after varimax rotation.

Table B6: Term loadings before and after varimax rotation

Terms	Term Loadings					
	Unrotated			Rotated		
	F1	F2	F3	F1	F2	F3
bpm	0.6271	0	0	0.6271	0	0
business	0	0.6145	0	0	0.6145	0
decisions	0	0	-0.7071	0	0	0.7071
effective	0.5508	0	0	0.5508	0	0
implementation	0.5508	0	0	0.5508	0	0
processes	0	0.6997	0	0	0.6997	0
returns	0	0.6145	0	0	0.6145	0
solution	0.6271	0	0	0.6271	0	0
timely	0	0	-0.7071	0	0	0.7071

Table B7: Statement loadings before and after varimax rotation

Statements	Statement Loadings					
	Unrotated			Rotated		
	F1	F2	F3	F1	F2	F3
Ginsberg 2004 X1	0.8347	0	0	0.8347	0	0
Ginsberg 2004 Y1	0	0.7889	0	0	0.7889	0
Simms 2004 X1	0.8347	0	0	0.8347	0	0
Simms 2004 Y1	0	0	-1	0	0	1
Simms 2004 Y2	0	0.7889	0	0	0.7889	0

As Table B6 and Table B7 indicate, Factor F1 appears to be highly related to the terms *{bpm, solution, effective, and implementation}*, and loads strongly on statements *{Ginsberg 2004 X1, and Simms 2004 X1}*. Factor F2 appears to be primarily related to the terms *{business, processes, and returns}*, and loads strongly on statements *{Ginsberg 2004 Y1 and Simms 2004 Y2}*. The terms and statements loading highly on Factor F3 are *{decision and timely}* and *{Simms 2004 Y1}*, respectively. Examination of the statements loading in the factors Table B3 reveals that these factors are what the knowledgeable researcher dubbed them earlier.

In cLSA, the X statements and their factor associations from statement loadings matrix (Table B7) are tallied with the corresponding Y statements and their factor associations to determine inter-factor statement frequencies. The factor associations of a statement are determined by the factor loadings of the statement. If a statement has a factor loading of more than zero in a factor, then the statement is said to have an association with that factor. This will yield an $f \times f$ matrix F of inter-factor statement frequencies, where f denotes the number of factors. The cell frequencies of a factor with relation to others provide support for that factor leading to those other factors. In this example, we considered a three-factor LSA. Therefore, we will obtain a 3×3 matrix F of inter-factor statement frequencies. The process of obtaining an inter-factor statement frequency matrix is described in the following.

Step 1: The statement loadings (Table B7) are separated into X statement loadings and Y statement loadings. The separated X and Y statement loadings for Table B7 are provided in Table B8 and Table B9, respectively.

Table B8: X statement loadings

X Statements	Factors		
	F1	F2	F3
Ginsberg 2004 X1	0.8347	0	0
Simms 2004 X1	0.8347	0	0

Table B9: Y statement loadings

Y Statements	Factors		
	F1	F2	F3
Ginsberg 2004 Y1	0	0.7889	0
Simms 2004 Y1	0	0	1
Simms 2004 Y2	0	0.7889	0

Step 2: Each X statement is taken at a time and its factor associations are noted. These factor associations are called the X factor associations or the independent factor associations. For instance, the first X statement *Ginsberg 2004 X1* is associated with Factor F1. Therefore, for this statement, Factor F1 acts as an independent factor.

Step 3: The corresponding Y statement(s) of the X statement in Step 2 are determined based on the XY statement pairs (Table B1). For instance, Table B1 indicates that the corresponding Y statement(s) of *Ginsberg 2004 X1* is *Ginsberg 2004 Y1*.

Step 4: The factor associations of each Y statement in Step 3 are noted. These factor associations are called the Y factor associations or the dependent factor associations. The Y statement *Ginsberg 2004 Y1* is associated with Factor F2. Therefore, for this statement, Factor F2 is a dependent factor.

Step 5: Each X factor association is tallied with all of its corresponding Y factor associations. A tally of an X factor association with a Y factor association provides an entry to the cell of the $f \times f$ matrix F located at the intersection of the X factor and the Y factor. A cell entry of 1 indicates that there is one support for the X factor leading to the Y factor. For *Ginsberg 2004 X1 - Ginsberg 2004 Y1* pair, the X factor is Factor F1 (Step 2) and the corresponding Y factor is Factor F2 (Step 4). By using X factors as the column headers and the Y factors as the row headers, this indicates that there will be a cell entry of 1 at the intersection column 1 and row 2. Figure B2 shows the schematic view of the inter-factor association of the *Ginsberg 2004 X1 - Ginsberg 2004 Y1* pair. Table B10 presents the corresponding cell entry into matrix F.

Figure B2: Inter-factor associations

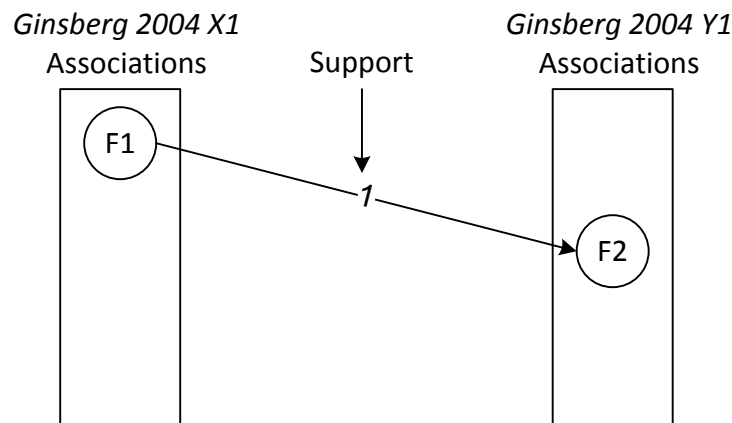


Table B10: Inter-factor matrix F

X Factors lead to Y Factors		X Factors		
		F1	F2	F3
Y Factors	F1	1		
	F2			
	F3			

Step 6: Steps 2 thru 5 are repeated until all X statements (Table B8) are exhausted. Figure B3 provides the schematic view of the inter-factor associations of the *Simms 2004 X1*. The corresponding Y statements of *Simms 2004 X1* are *Simms 2004 Y1* and *Simms 2004 Y2*.

Figure B3: Inter-factor associations

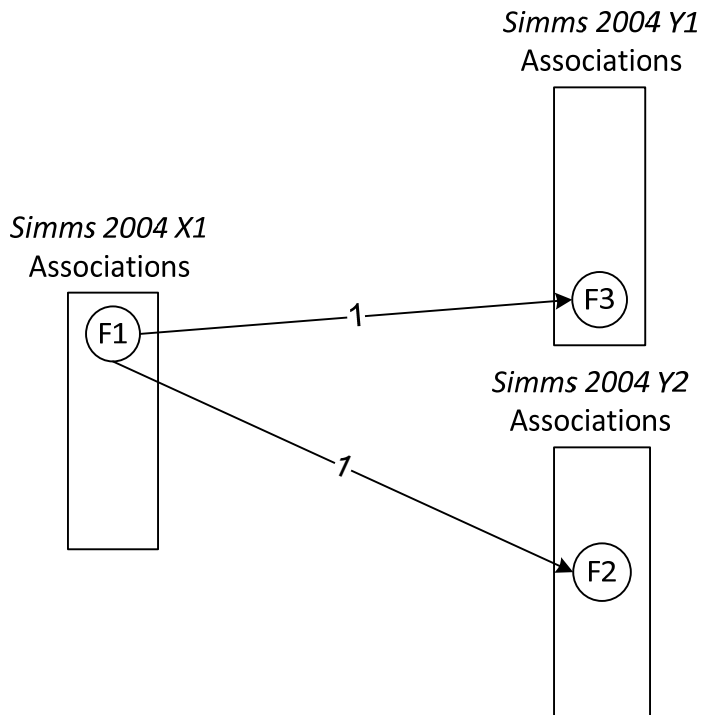


Table B11: Final inter-factor matrix F

X Factors lead to Y Factors		X Factors		
		F1	F2	F3
Y Factors	F1			
	F2	2		
	F3	1		

The cell frequencies of matrix F are of critical importance. They provide the strength of association between the independent factors and the dependent factors. The percentages that the cell frequencies account for can be used to compare two or more relationships among the factors. Various statistics can be developed using matrix F. Two of these statistics are the X-index and the Y-index. An X-index relates to an X factor and is the sum of the cell frequencies of the column that the factor represents. On the other hand, a Y-index relates to a Y factor and is the sum of the cell frequencies of the row that the factor represents. For example, the X-index for F1 as an independent factor is 3; the X-index for F2 as an independent factor is 0; and the X-index for F3 as an independent factor is 0. On the contrary, the Y-index for F1 as a dependent factor is 0; the Y-index for F2 as a dependent factor is 2; and the Y-index for F3 as a dependent factor is 1. Yet another statistic is the X – Y differential. These statistics are shown in Table B12.

Table B12: X-index, Y-index, and X – Y differential

X Factors lead to Y Factors		X Factors			Y-index
		F1	F2	F3	
Y Factors	F1				0
	F2	2			2
	F3	1			1
X-index		3	0	0	
X - Y differential		3	-2	-1	

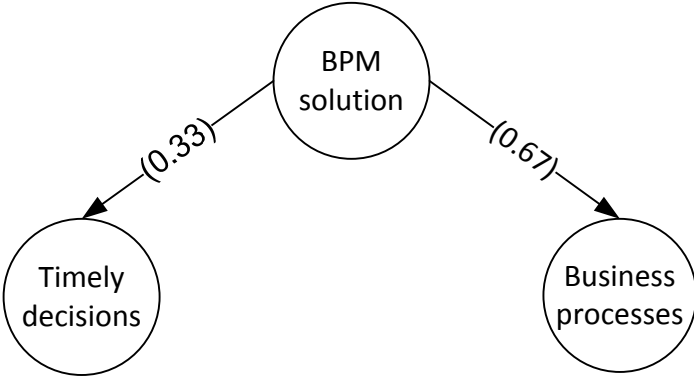
While the X-index of a factor represents the overall impact of the factor as an independent factor, the Y-index shows the overall effect on the factor as a dependent factor. The X – Y differential can be used to decide whether a factor is a net independent or dependent factor. Table B12 indicates that F1 is a net independent factor, and both F2 and F3 are net dependent factors. These statistics along with cell frequencies can be expressed as percentages for better comparison purposes. Table B13 presents these percentages.

Table B13: Matrix F – percentage measures

X Factors lead to Y Factors		X Factors			Y-index
		F1	F2	F3	
Y Factors	F1				0
	F2	0.67			0.67
	F3	0.33			0.33
X-index		1	0	0	
X - Y differential		1	-0.67	-0.33	

Based on the percentage measures in Table B13, the inter-factor relationships and their strength of associations are portrayed in Figure B4.

Figure B4: Inter-factor relationships and their strength of association



APPENDIX C

INPUT-OUTPUT STATEMENT (XY STATEMENT) CODING SCHEME

Table C1: Input-output statement (XY statement) coding scheme

Raw Statements	Input-Output Statements
In order to (verb) Y, X	Input: X
Or, X in order to (verb) Y	Output: Subject of X (verb) Y
<i>Companies must have the necessary organizational structure in order to improve the day-to-day management of their business</i>	Input: <i>companies must have the necessary organizational structure</i> Output: <i>companies improve the day-to-day management of their business</i>
By (verb particle) X, Y	Input: Subject of Y (verb) X
<i>By refocusing customer strategy, retooling measurement mechanics, and taking steps to realign the organization around customers, companies can retain and grow existing customers</i>	Output: Y Inputs: (1) <i>companies refocus customer strategy</i> , (2) <i>companies retool measurement mechanics</i> , (3) <i>companies take steps to realign the organization around customers</i> Output: <i>companies can retain and grow existing customers</i>
When X then Y	Input: X
<i>When an organization take a methodical approach to performance management, it becomes high-performance organization</i>	Output: Y Input: <i>an organization take a methodical approach to performance management</i> Output: <i>an organization becomes high-performance organization</i>
X (yields/ provides/ results in/ causes/ allows/ enables/ achieves/ guides/ ensures /brings /etc.) Y	Input: X
<i>Plans that are developed in a more collaborative environment yield more commitment from the people who have to bring them to fruition</i>	Output: Y Input: <i>plans are developed in a more collaborative environment</i> Output: <i>plans yield more commitment from the people who have to bring them to fruition</i>
If X, then Y	Input: X
<i>If companies do not provide exceptional customer service, customers will not renew their contracts</i>	Output: Y Input: <i>companies do not provide exceptional customer service</i> Output: <i>customers will not renew their contracts</i>
For X to (verb) Y, X (be) to (verb) Z	Input: X (be) to (verb) Z
<i>For BPM to provide the benefits that make it worth the investment, it has to focus on the right data</i>	Output: X (verb) Y Input: <i>BPM has to focus on the right data</i> Output: <i>BPM provides the benefits that make it worth the investment</i>

Continued

Table C1: Continued

X because Y <i>Companies add OLAP technology to their BPM solution because they need to extract transaction information from all parts of their IT infrastructure</i>	Input: X Output: Y Input: <i>companies add OLAP technology to their BPM solution</i> Output: <i>companies need to extract transaction information from all parts of their IT infrastructure</i>
To (do) Y, (need) X <i>To integrate the data from the acquisition's IT systems into its BPM reporting framework, Logistics USA layers OLAP software on top of the acquired organization's disparate data sources</i>	Input: X Output: Y Input: <i>Logistics USA layers OLAP software on top of the acquired organization's disparate data sources</i> Output: <i>Logistics USA integrates the data from the acquisition's IT systems into its BPM reporting framework</i>
Y requires X Or X is required for Y <i>Establishing and sustaining a complexity management program requires dedicated resources and the involvement of the organization's top management</i>	Input: X Output: Y Input: <i>dedicated resources and the involvement of the organization's top management</i> Output: <i>establishing and sustaining a complexity management program</i>
X so as to Y <i>Maintenance should be managed better so as to cultivate a sense of ownership in the operators</i>	Input: X Output: Y Input: <i>maintenance should be managed better</i> Output: <i>cultivate a sense of ownership in the operators</i>
Because of X, Y <i>Because of the wide acclaim received by the Malcolm Baldrige Award, it has served as a model for national quality awards by many countries throughout the world</i>	Input: X Output: Y Input: <i>the wide acclaim received by the Malcolm Baldrige Award</i> Output: <i>it has served as a model for national quality awards by many countries throughout the world</i>
X is associated to/likely to create/etc. Y <i>Firms with higher amounts of intangible assets are more likely to create shareholder value</i>	Input: X Output: Y Input: <i>firms with higher amounts of intangible assets</i> Output: <i>create shareholder value</i>

Continued

Table C1: Continued

Z uses X to improve/cause/enhance/etc. Y <i>faculty members have used the Criteria for Performance Excellence and the underlying concepts of the MBNQA to enhance the learning experiences of their students</i>	Input: X Output: Y Input: <i>the Criteria for Performance Excellence and the underlying concepts of the MBNQA</i> Output: <i>the learning experiences of students</i>
By means of X, Y <i>By means of concrete exercises and experiences, Dale's Cone of Experience is employed to better leverage the student's ability to understand the abstract concepts</i>	Input: X Output: Y Input: <i>concrete exercises and experiences</i> Output: <i>Dale's Cone of Experience is employed to better leverage the student's ability to understand the abstract concepts</i>
Y through X OR Through X, Y <i>The West has created competitiveness through fostering a culture of entrepreneurship</i>	Input: X Output: Y Input: <i>fostering a culture of entrepreneurship</i> Output: <i>the West has created competitiveness</i>

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