MIS Quarterly

RESEARCH NOTE

HOW INFORMATION MANAGEMENT CAPABILITY INFLUENCES FIRM PERFORMANCE[1]

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How do information technology capabilities contribute to firm performance? This study develops a conceptual model linking IT-enabled information management capability with three important organizational capabilities (customer management capability, process management capability, and performance management capability). We argue that these three capabilities mediate the relationship between information management capability and firm performance. We use a rare archival data set from a conglomerate business group that had adopted a model of performance excellence for organizational transformation based on the Baldrige criteria. This data set contains actual scores from high quality assessments of firms and intraorganizational units of the conglomerate, and hence provides unobtrusive measures of the key constructs to validate our conceptual model.

We find that information management capability plays an important role in developing other firm capabilities for customer management, process management, and performance management. In turn, these capabilities favorably influence customer, financial, human resources, and organizational effectiveness measures of firm performance. Among key managerial implications, senior leaders must focus on creating necessary conditions for developing IT infrastructure and information management capability because they play a foundational role in building other capabilities for improved firm performance. The Baldrige model also needs some changes to more explicitly acknowledge the role and importance of information management capability so that senior leaders know where to begin in their journey toward business excellence.

Keywords: Information management capability, information technology, IT capability, customer management capability, process management capability, performance management capability, organizational capital, firm performance, performance excellence, business excellence, resource-based view

[1]Vivek Choudhury was the accepting senior editor for this paper. K. Ramamurthy served as the associate editor.

The appendices for this paper are located in the "Online Supplements" section of the *MIS Quarterly*'s website (http://www.misq.org).

Introduction

Despite significant progress in answering the question of how information technology contributes to firm performance (see Dedrick et al. 2003; Wade and Hulland 2004), at least three opportunities remain. First, the recent business value of IT literature has highlighted the importance of information management aspects of IT capability (Bhatt and Grover 2005; Cotteleer and Bendoly 2006; Kohli 2007; Kohli and Grover 2008; Marchand 2005; Marchand et al. 2000; Marchand et al. 2002; Mendelson and Pillai 1998). However, with some notable exceptions (e.g., Marchand et al. 2000), few studies have empirically examined the link between information management capability and firm performance. Second, the role and articulation of "the underlying mechanisms" through which IT capabilities improve firm performance remain unclear (Bharadwaj 2000, p. 188). Finally, from an empirical perspective, many of the prior studies linking IT and related capabilities with firm performance do not fully address the issues related to reactive measures and unobserved firm heterogeneity.

This paper draws on the business value of IT and quality management (QM) literature to link information management capability and firm performance and makes three contributions. First, we focus on information management capability—that is, the ability to provide data and information to users with the appropriate levels of accuracy, timeliness, reliability, security, confidentiality, connectivity, and access and the ability to tailor these in response to changing business needs and directions. We use a continuous measure of information management capability to respond to calls for research to develop "a continuous assessment of IT capability and reduce the problems occurring due to the binary nature of the existing measure" (Santhanam and Hartono 2003, p. 151).

Second, we identify three significant organizational capabilities that mediate the links between information management capability and firm performance: (1) performance management capability, or the ability to develop appropriate monitoring, evaluation, and control systems to observe business performance and guide managerial actions (Bourne et al. 2002; Eccles 1991; Kaplan and Norton 1992); (2) customer management capability, or the ability to develop significant customer relationships and nurture customers both as consumers and as innovation partners in new product development (Mithas et al. 2005; Nambisan 2002); and (3) process management capability, or the ability to develop processes with appropriate reach and richness for guiding manufacturing, supply chain, software development, financial, and other important activities (Davenport and Beers 1995; Ramasubbu et al. 2008; Sambamurthy et al. 2003).

Third, we use a rare longitudinal data set with relatively unobtrusive measures based on Baldrige criteria for performance excellence (see NIST 2002). This data set provides continuous and unobtrusive measures of organizational capabilities to obviate some of the inherent limitations of survey-based approaches, which can suffer from reactive measurement and the potential of research and questionnaire design affecting the research outcome (Webb et al. 1966). Because of the panel nature of our data, we rule out concerns related to endogeneity and unobserved time-invariant heterogeneity that are difficult to address in cross-sectional regression or path models.

Background and Hypotheses

Prior Literature

The Business Value of IT Literature

Although information systems researchers have conceptualized several dimensions of IT capabilities (see Table A1 in Appendix A; see also Bhatt and Grover 2005), very few studies have empirically measured these capabilities and assessed their significance for firm performance. Among the studies that measure some IT capabilities, Bhatt and Grover (2005) fail to find a link between the quality of IT infrastructure and competitive advantage and suggest a continuing need for alternative conceptualizations and empirical validation of IT capabilities. Furthermore, prior research suggests that IT infrastructure and related conceptualizations of IT capability alone may not be adequate for firm success (Glazer 1991; Mendelson and Pillai 1998). Instead, the ability of firms to leverage their IT infrastructure to provide accurate, timely, and reliable data and information to users—what we call *the information management capability*—may be more important.

Other arguments in the business value of IT literature suggest that the initial effects of IT should occur at the level of organizational processes that use the IT assets and resources (Barua and Mukhopadhyay 2000; Melville et al. 2004; Tallon et al. 2000). In other words, IT-enabled information management capability enables higher-order business capabilities, which in turn influence firm performance (Kohli and Grover 2008; Sambamurthy et al. 2003). Therefore, we propose a two-stage model with the information management capability as a focal construct and higher-order organizational capabilities (customer management capability, process management capability, and performance management capability) as the mediators between information management capability and firm performance.

The QM Literature

The QM literature has been influential in providing guidance for achieving performance excellence in firms. The Malcolm Baldrige National Quality Improvement Act of 1987, which embodies many elements from QM literature, offers a framework for implementing a set of high-performance management practices, including customer orientation, business process management, and fact-based management. This framework points to the interconnections between information and analysis, process management, customer management, and performance management and acknowledges that the management of IT assets and information flows is a critical enabler of firm success. It directs attention to key organizational capabilities and processes that might mediate the links between information management capability and firm performance.

Although prior research (e.g., Flynn and Saladin 2001) has investigated linkages among Baldrige categories, our study extends that work in several significant ways. First, the prior work by Flynn and Saladin (2001), among others, used the survey-based operationalization of key constructs from the 1992 and 1997 Baldrige criteria, whereas our study uses the actual scores based on a framework modeled after 1999–2002 Baldrige criteria as we discuss later. As Table A2 in Appendix A shows, there are significant differences between the underlying items of the "Information and Analysis" category in earlier conceptualizations and our study. In particular, the operationalization of information and analysis in the 1992 and 1997 Baldrige models is heavily focused on manufacturing operations and quality data, and does not consider IT-enabled information flows.

Second, the conceptualization of information and analysis in prior work encompasses both information management capability and performance management capability and thus does not facilitate an analysis of their independent effects on firm performance. In contrast, our study treats information management capability and performance management capability as separate constructs. An examination of the items in the "Analysis of Company Performance" (see Flynn and Saladin 2001, p. 648) shows that these items are conceptually distinct from those in "Selection of Information and Data" and should be treated as a separate construct—something that we address in our study.

Third, prior work typically does not distinguish among several measures of firm performance and business results and does not investigate the links from "Customer and Market Focus" and "Performance Management Capability" to "Business Results," which is something that we do in this study. In addition, some of these studies do not investigate the possibility of a direct effect of information and analysis on business results.

To be fair, some of the limitations of the prior work in operations management literature are due to the use of older versions of the Baldrige model and use of those models to almost completely dictate the empirical specifications. Our approach relies on the use of data from a more recent, updated Baldrige model that specifically measures IT-enabled information flows. Furthermore, even though we use the Baldrige data, our empirical model specifications are based on theoretical arguments from prior literature focusing on the role of the information management capability in influencing organizational capabilities and firm performance. Thus, our study advances prior work in IS and operations management literature by reconceptualizing the Baldrige model, using real data (as opposed to questionnaire data in Flynn and Saladin) and more sophisticated analyses to explore "alternative…path models," as called for by Flynn and Saladin (2001, p. 642). Tables A1 and A3 in Appendix A summarize the key dimensions along which our study differs from prior IS and QM studies.

Figure 1, derived from an integration of the two literature streams that we reviewed, illustrates the conceptual model for this research.

Theoretical Model and Hypotheses

Conceptualizing Information Management Capability

The notion of information management capability in this study is derived from the work of Marchand et al. (2000) on information management capabilities. They show that three sets of factors explain firm success: (1) the quality of IT management practices (e.g., integrating IT into key operational and managerial processes); (2) the ability to develop appropriate information management processes to sense, gather, organize, and disseminate information; and (3) the ability to instill desired information behaviors and values (e.g., proactiveness, sharing, integrity). While IT infrastructure provides the base foundation, the management of information is of greater salience in influencing firm performance (Cotteleer and Bendoly 2006; Davenport 1998; Davenport and Linder 1994). The focus on *information* as opposed to on *technology* has been echoed by other scholars. For example, Glazer (1991, pp. 1-2) notes the need to go "beyond the technology to view management of 'information' itself as an asset to gain competitive advantage." Mendelson and Pillai (1998, p. 432) also endorse that view, noting that "the relationship between

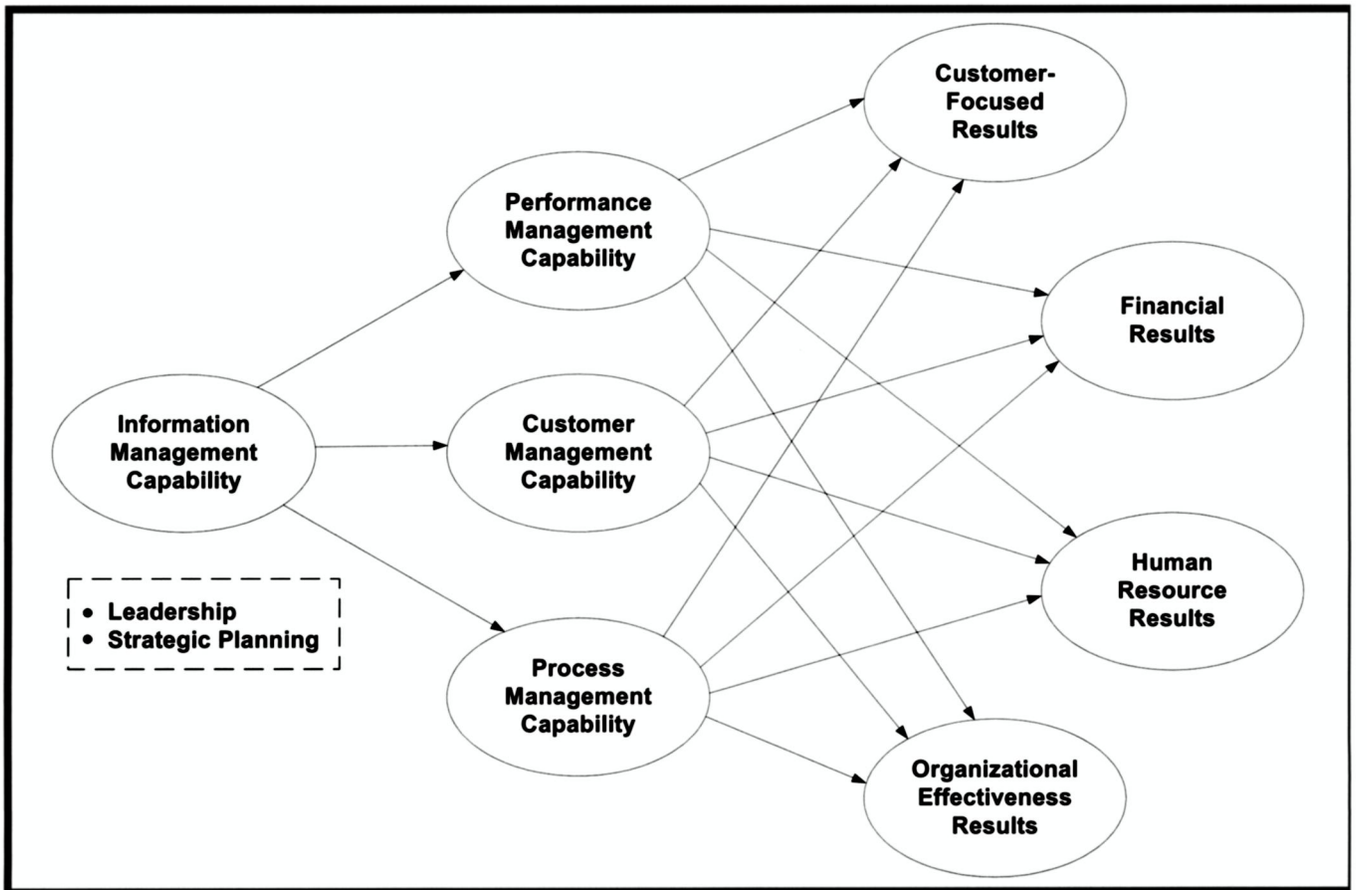


Figure 1. Conceptual Model

firms' information management practices and their business performance" is an important avenue for research. Practitioners also recognize the critical role of information management. As the chief information officer of Wal-Mart noted,

> The driver of change has transitioned from technology to information. Technology at this point is simply a means to an end. What is really strategic is the use of the information and how we exploit and maximize it. We're in a business that competes at the speed of information, and my job is to ensure that we present it in such a way that we use it to drive execution and improvements in our business (Wailgum 2007).

Put differently, the ability to provide accurate, timely, and reliable data and information to relevant entities and stakeholders can enable firms to configure and tailor other organizational capabilities that might influence firm performance. Consistent with Marchand et al.'s (2000) conceptualization, we adapt the operationalization of this capability and define information management capability as the ability to (1) provide data and information to users with the appropriate levels of accuracy, timeliness, reliability, security, and confidentiality; (2) provide universal connectivity and access with adequate reach and range; and (3) tailor the infrastructure to emerging business needs and directions. In other words, we adopt the Baldrige definition for information management capability because it is reasonably compatible with prior conceptualization in the IS literature.

Linking Information Management Capability with Organizational Capabilities

We propose that information management capability influences the development of three significant organizational capabilities: customer management capability, process management capability, and performance management capability. In turn, these are antecedents of superior organizational performance (for a summary of our arguments linking dimensions of information management capability with organizational capabilities, see Table A4 in Appendix A).

Customer management capability defines a firm's ability to determine the requirements, expectations, and preferences of its customers and markets and is of significant importance in the contemporary business environment marked by hypercompetition (Liang and Tanniru 2006-07). It reflects the quality of relationships with customers in terms of how well the firm is positioned to acquire, satisfy, and retain customers. Customer management capability enables firms to leverage the voice of the customer to gain market intelligence and detect opportunities to introduce new products, attract new customers, retain existing customers, and target new markets (Fornell et al. 2006; Jaworski and Kohli 1993). Firms must be sensitive to customers' different roles, and they should be capable of harnessing customer contributions to deliver better products and services.

Information management capability is a critical enabler of firms' customer management capabilities. Ives and Learmonth (1984) describe how firms can benefit from IT-enabled information flows and support different stages of their customers' purchasing process. Karimi et al. (2001) report that firms with a better ability to plan and integrate their IT resources and provide timely, accurate, and reliable information to key stakeholders are more effective in improving customer service and customer relationships. Better information management capabilities enable firms to capture information about customers and disseminate it to customers through the Internet, virtual communities, and personalized information channels (Nambisan 2002). Recent empirical work has shown that shared information and knowledge between IT and customer service units significantly influences a firm's ability to improve customer knowledge and related business processes (Jayachandran et al. 2005; Mithas et al. 2005; Ray et al. 2005). Therefore, we expect the information management capability of a firm to enhance its customer management capability.

H1: Higher levels of information management capability enhance customer management capability.

Process management capability is a firm's ability to attain flexibility, speed, and cost economy through the design and management of three major types of processes: (1) product design and delivery processes, including new product development and manufacturing; (2) nonproduct and nonservice business growth processes, including innovation, research and development, supply chain management, supplier partnering, outsourcing, mergers and acquisitions, global expansion, and project management; and (3) support processes, such as finance and accounting, facilities management, and human resources management. Process management is a key capability to compete in the contemporary business environments and a source of competitive advantage (Kettinger and Grover 1995). Furthermore, the ability to manage the organizational portfolio of processes, including reconfiguring processes for continued effectiveness, designing and using appropriate metrics and controls, and applying processes as strategic options, has emerged as an organizational imperative (Kalakota and Robinson 2003).

Information management capability is a significant enabler of process management capability (Davenport 1993, 2000). Effective information management could minimize process variability by providing a common blueprint that all workers use to perform their jobs, which in turn enhances organizational performance (e.g., Frei et al. 1999). Fisher et al. (2000) note that data accuracy is critical to ensure efficient forecasting and design agile supply chain management processes. We argue that information management capability provides the reach and connectivity to design and manage processes that connect the firm with its customers, suppliers, and other significant business partners (Davenport 1993). Furthermore, a high level of information management capability enables firms to design metrics and analytics that provide visibility for the real-time performance of various processes, integration between processes, and advance warnings of performance degradation in the processes (Kalakota and Robinson 2003). Finally, a high level of information management capability enables a faster and more responsive redesign and reconfiguration of processes in response to changes in business conditions. Therefore, we propose the following:

H2: Higher levels of information management capability enhance process management capability.

Performance management capability describes a firm's ability to design and manage an effective performance measurement and analysis system, including selection of appropriate metrics, gathering of data from appropriate sources of performance, analysis of data to support managerial decision making, communication of performance to appropriate stakeholders, and alignment of the performance management system with current and future business needs and directions (Kaplan and Norton 1992; NIST 2002). Contemporary business environments have been characterized as requiring "sense and respond" capabilities; that is, firms succeed through real-time synchronization of key strategic, tactical, and operational decisions with the challenges and opportunities available in the business environments (D'Aveni 1994). For example, an effective performance management system can enable a firm to detect deterioration in customer order fulfillment rates, understand the root causes of this problem, and experiment with alternative solutions. A good

performance management capability enables firms to conduct "strategic experiments," in which they can evaluate the consequences of alternative product introduction, channel configuration, and/or supplier partnering decisions.

Information management capability is a significant enabler of firms' performance management capabilities. Electronic and real-time operational data (e.g., customer related, financial, supplier related) from various sources (e.g., point-of-sales registers, Internet, intranets, manufacturing plants, third-party and other external sources) enable real-time analysis and decision support to provide the appropriate insights for operational, tactical, and strategic decisions. Lederer and Mendelow (1987) highlight the importance of IT-enabled information flows in synchronizing the objectives of upper management, middle management, and other employees with firms' evolving goals and market conditions. Through these information flows, companies can "measure their activities more precisely and help motivate managers to implement strategies successfully" (Porter and Millar 1985, pp. 159-160). Prior research using case exemplars and large-sample empirical studies (e.g., Davenport and Beers 1995; Davenport and Klahr 1998; Lin and Mithas 2008; Marchand et al. 2002; Mithas et al. 2005; Whitaker et al. 2007) has further underscored the importance of managing real-time information about customers and suppliers to monitor progress on intermediate goals and metrics for timely course correction. Therefore, we hypothesize that a well-developed information management capability facilitates superior performance management capability.

H3: Higher levels of information management capability enhance performance management capability.

Mediating Role of Organizational Capabilities in Firm Performance

We posit that organizational capabilities mediate the links between information management capability and firm performance. We define firm performance as a multidimensional construct that consists of four elements: (1) customer-focused performance, including customer satisfaction, and product or service performance; (2) financial and market performance, including revenue, profits, market position, cash-to-cash cycle time, and earnings per share; (3) human resource performance, including employee satisfaction; and (4) organizational effectiveness, including time to market, level of innovation, and production and supply chain flexibility. Consistent with our theoretical foundations in the capabilities and resource-based perspectives, we argue that organizational capabilities are rent-generating assets, and they enable firms to earn above-normal returns. For example, performance management capability influences various measures of firm performance by allowing business leaders to review and take corrective actions on any potential or actual slippages proactively and in a timely manner (Anthony and Govindarajan 2005; Kaplan and Norton 1992). Likewise, prior studies in marketing and strategy argue that customer management capability (Fornell, Mithas, and Morgenson 2009a, 2009b; Fornell et al. 2006; Peppers and Rogers 2004; Rust et al. 2004) and process management capability (Cotteleer and Bendoly 2006; Davenport 1993) influence several dimensions of firm performance. Thus, we hypothesize the following:

H4: Higher levels of (a) customer management capabilities, (b) process management capabilities, and (c) performance management capabilities enhance organizational performance.

H5: Organizational capabilities mediate effect of information management capability on firm performance.

We control for organizational leadership and strategic planning in our organizational capabilities models. Organizational leadership nurtures the development of organizational capabilities as a platform for competitive moves (Earl and Feeny 2000). It is also an indicator of entrepreneurial alertness, or the ability to appreciate the value of organizational capabilities as a platform for competitive strategy, and to marshal the necessary IT and business resources to build these organizational capabilities. Strategic planning refers to the strategy-making process, including the analysis of customer needs, competition, technology, strengths and weaknesses, and risks (Porter 1996; Porter 2001). It provides a template to blend business and IT resources in the development of desired organizational capabilities (Segars and Grover 1999), even in hypercompetitive and turbulent environments (see Porter and Rivkin 2000).

We control for firm size and industry sector in our firm performance models to account for any difference in performance attributable to organizational resources or interindustry differences (Capon et al. 1990; Hendricks and Singhal 2001).

Research Design and Methodology

Research Context

We obtained the archival data used in this study from a large and highly respected business group that has adopted and

institutionalized a model of performance excellence based on the Baldrige criteria (Mithas and Sinha 2010). Business groups are similar to conglomerates in that firms within the business group share persistent formal (e.g., equity, common directors) and informal (e.g., family ownership) ties. However, unlike in a conglomerate, firms in a business group are independent legal entities, and equity stakes of outside investors can vary significantly across group firms (see Khanna and Yafeh 2007).

The business group had approximately 80 firms with combined annual revenue in excess of $9 billion in 2002. The firms in the business group operate in a wide range of industries, including manufacturing (e.g., steel, automotive, chemicals, consumer durables) and services (e.g., financial, telecommunications, hospitality). We collected not only firm-level data on scores generated from assessments based on the Baldrige performance excellence framework but also data available from evaluations of some of the intraorganizational units within the firms. More than 80 percent of the firms and intraorganizational units in our sample have between 200 and 20,000 employees. The firms and intraorganizational units varied in the extent to which they had adopted and assimilated IT infrastructure, such as enterprise resource planning systems, supply chain management systems, data warehouses, process management tools, and help-desk software. In other words, their IT infrastructures varied in sophistication in terms of reach and range. Most firms and intraorganizational units had a Web site both for informational purposes and for transactional purposes. Some firms had won national and international awards for the design and excellence of their Web sites. Several firms and intraorganizational units reported use of intranets to share knowledge among widely dispersed work groups. Overall, there was enough variation in the information management capability across these firms and intraorganizational units.

Construct Operationalization

We operationalize our constructs based on their measurement following the implementation of a performance excellence model based on the Baldrige framework at our research site (Flynn and Saladin 2001; NIST 2002). Accordingly, information management capability (INFMGMT) is measured as an indicator of the quality, accuracy, reliability, and timeliness of the information. In addition, this construct assesses the appropriateness of the data availability mechanisms and the IT infrastructure to changing business needs and directions. For organizational capabilities, customer management capability (CUSTMGMT) measures the ability to determine customer needs and requirements and to foster relationships with customers for effective acquisition, retention, and satisfaction. Process management capability (PROCMGMT) measures the ability to design and manage product and service processes, growth processes, and support processes. Finally, performance management capability (PERMGMT) measures the ability to gather and monitor key performance metrics and the ability to link metric analysis with decision making.

Baldrige criteria measure organizational performance on four dimensions: customer, financial, human resources, and organizational effectiveness. Customer performance (CUSTPERF) measures the levels and trends in customer satisfaction, customer retention, positive referral, and product and service performance parameters that are important to customers. Financial performance (FINPERF) measures trends in return on investment, profitability, liquidity, market share, and business growth. Human resources performance (HUMPERF) measures employee satisfaction, employee development, job rotation, work layout, and organizational learning. Finally, organizational effectiveness (ORGEFFECT) measures operational performance indicators of important design, production, delivery, and business and support processes, such as productivity, cycle time, and supplier performance. These performance measures include levels, trends, and a competitive dimension and thus satisfy Wade and Hulland's (2004) criteria for desirable dependent variables to assess IT-enabled competitive advantage.

Among control variables, leadership quality (LEAD) is measured as the effectiveness with which senior leaders guide a business unit through values, directions, and performance expectations and their review of organizational performance. Strategic planning quality (STRAT) refers to the strategic planning process in a business unit, including strategy development and deployment. A higher score on this variable indicates that the organization has a well-designed process in place to consider various short- and long-term risks and opportunities and that the organization has translated its strategic objectives into action plans and performance projections. Because our sample had one set of observations for firms and another set of observations for intraorganizational units, we used the dummy term FIRM (1 = firms and 0 = intraorganizational units) to account for this difference. We assessed size (SIZE) using an ordinal scale based on the number of employees in a firm or intraorganizational unit (1 = less than 200 employees, 2 = 201–2000, 3 = 2001–20,000, and 4 = more than 20,000). Finally, we coded industry sector (SERVICE) of firms and intraorganizational units using an indicator variable (1= services and 0 = manufacturing).

The Data-Gathering Process

Because the Baldrige item scores are confidential and not accessible, most of the prior work uses survey instruments to test and validate the Baldrige model (e.g., Flynn and Saladin 2001) and thus suffers from the inherent limitations of survey-based approaches (see Webb et al. 1966). The inadequacy of surveys to fully validate the Baldrige model and its theoretically implied relationships is well recognized in prior work. For example, Flynn and Saladin (2001, p. 642) note that "scales were not an exact match for Baldrige categories and sub-categories," and Kaynak (2003, p. 427) notes that "self reported data constitutes a major limitation." Therefore, we collected the archival data used in this study directly from a business group that has made a significant commitment to performance excellence based on the Baldrige framework.

The first step in the Baldrige process involves self-analysis and reporting on performance and the status of development of key capabilities within the Baldrige framework. The Baldrige criteria provide detailed instructions and guidelines for firms and organizational units to develop rich descriptions of their capabilities and results relative to each Baldrige construct. Baldrige criteria use separate scoring schemes for capabilities and results items (it is possible to aggregate item scores to category-level scores using the point values associated with each item), minimizing the potential for the halo effect to creep into item scores. Table 1 illustrates the types of questions that participating firms are required to consider when developing descriptions of their capabilities and results.

As a next step, depending on the size of the firm or intraorganizational unit, multiple external examiners belonging to a team (teams have typically three to nine members) independently review the responses and allocate scores at the item level solely on the basis of the firm's or intraorganizational unit's detailed responses. While it would be ideal to use examiners who are not affiliated with any firm of the business group, this would be prohibitively expensive, and these expenses would be difficult to justify in terms of any potential gains in objectivity (in the context of audit of IS projects, see Keil and Robey 2001). At our research site, each examiner usually evaluates only one firm or intraorganizational unit per year, and the scores are assigned using a well-documented approach in which the examiners focus on how appropriate the practices are to the development of a capability and how well developed the capability is (NIST 2002, pp. 47-48). After the examiners complete their initial scoring, consensus meetings are held, and the independent examiners clarify their understanding through discussions with fellow examiners and arrive at a common score. Finally, these examiners make site visits and amend the consensus scores on the basis of site inspection findings.

The data generated through the Baldrige type of examination process at our research site have several noteworthy advantages. First, the examination scores are based on multiple sources of input (self-reports, consensus discussion, and site visit) provided by multiple external reviewers (external to a firm or an intraorganizational unit rather than relying solely on executives' self-reports). The business group created a separate unit of full-time examiners and also invested resources to train and develop examiners at most of the firms and intraorganizational units. These examiners were responsible for applying the previously described evaluation process and generating scores for the various firms and intraorganizational units through self-reports, consensus meetings, and site visits. The examiners evaluate the firms and intraorganizational units following the guidelines in the Baldrige criteria, collectively devoting hundreds of person hours to examining each firm or intraorganizational unit. Such a rigorous and time-consuming evaluation process provides high-quality data.

Second, a well-developed and validated training process for examiners reduces biases or drifts in scoring and enhances confidence that the scores reflect the underlying phenomena. We examined the pairwise interrater reliability among examiners in this business group for one firm from which we could obtain examiner-level data and found it to be in the range of .7 to .8 (our research site did not archive the data from the multiple examiners for all firms and intraorganizational units). This range of interrater reliability is a further indicator of the robustness of the Baldrige examination process and training of examiners at our research site. On the basis of the foregoing discussion, we believe that the data from this business group's implementation of the Baldrige model of performance excellence provide a robust context to test our research model.

We obtained the data from the examiners' evaluations of firms and intraorganizational units in the business group for the period 1999–2003. Because Baldrige criteria remained broadly similar in terms of underlying items and categories from 1999 to 2002, and because our research site continued to use 2002 criteria even in 2003, we pooled the observations from 1999 to 2003 to test our theoretical model. We ensured consistent coding of variables across years to account for any minor changes in criteria across the period 1999–2002.[2] We obtained 40 observations for 1999, 10 for 2000, 45 for 2001, 39 for 2002, and 26 for 2003.

[2]The Baldrige criteria makes some minor changes every year; these are mainly related to changes in points assigned to items (e.g., weight of an item might change from 80 in one year to 85 in another year, as was the case of Item 1.1 from 1999 to 2000) and sometimes the renumbering/reorganization of items.

Overall, we have 160 observations from 77 firms and intra-organizational units (52 observations for 29 firms that operated as complete entities and 108 observations for 48 intraorganizational units within firms). Among the firms, 5 firms appear 4 times, 3 firms appear 3 times, 2 firms appear 2 times, and the remaining 19 appear only once. Among intraorganizational units, 2 appear 4 times, 23 appear 3 times, 8 appear 2 times, and the remaining 15 appear only once. Thus, we have only one observation for 34 firms and intra-organizational units and multiple observations for 43 firms and intraorganizational units in our sample. Because we have an unbalanced panel of firms and intraorganizational units, we use multiple observations for firms and intraorganizational units to alleviate concerns due to endogeneity and unobserved heterogeneity, as we discuss subsequently. While we use all 160 observations in our primary analyses that use seemingly unrelated regression estimation (SURE) technique and in robustness check using random effects models for unbalanced panel data and LISREL, we use only 126 observations (160 – 34) for robustness checks for endogeneity of the information management capability variable.

Table 1 illustrates the items and categories for the different constructs used in this study. The Baldrige process specifies multiple indicators and a well-specified coding scheme to generate the numerical scores, which range from 0 to 100 for each item. It also specifies the weights of these items in a particular category. For example, process management capability as a category has three items, and these three items have different weights. We use item- or category-level scores in this study as appropriate for each construct (for details, see Table 1). For example, when the construct in the model corresponds to a category (e.g., customer management and process management capabilities), we use the category-level score, but when it corresponds to an item (e.g., information management and performance management capabilities), we use item-level scores. Whenever we use category scores, we use Baldrige weights to aggregate items, an approach similar to that of Pannirselvam et al. (1998).

Table 2 provides summary statistics and correlations for the variables we used in this study. The standard deviations show that there is adequate variation in scores across all of the constructs. Table 2 also provides correlations among key variables. Our multicollinearity diagnostics indicate that these correlations are not a significant concern in our empirical models, as we discuss subsequently.

Because we use summative indexes for the multiple-item measures available from the Baldrige process, adequate sampling of domain and content validity are more important issues than convergent and discriminant validity concerns (typically convergent and discriminant validity concerns are more important in studies that employ constructs with reflective indicators) (Diamantopoulos and Winklhofer 2001). Because Baldrige categories are close to practice and because of their origin in the total quality management (TQM) literature and their iterations and refinements that span more than a decade, they are fairly comprehensive and have adequate domain sampling and content validity. Moreover, as we discussed previously, the measures used in this study are more objective (because they come from on-site verifications following a standardized approach by multiple trained examiners external to a firm) than the typical survey-based perceptual measures. Nevertheless, in Table 2, we report the reliability (Cronbach's alpha) of Baldrige categories that consist of multiple items. Note that of the ten constructs in Table 1, seven use the most disaggregated score directly, and three use an aggregated score that is weighted according to Baldrige criteria. As such, we report Cronbach's alphas for only the latter three constructs that use multiple items. These values provide evidence for convergent validity of categories that use multiple items. Likewise, there is evidence for discriminant validity of constructs because intercorrelations in Table 2 are generally lower than the reliabilities of the corresponding variables. Although the correlations of STRAT with CUSTMGMT and PROCMGMT are slightly higher than the alpha of STRAT, this does not pose estimation difficulties, because STRAT and these variables do not appear together in any model as explanatory variables.

Empirical Models and Econometric Issues

We use a linear model estimation approach to relate information management capability to organizational performance, mediated through customer management, process management, and performance management capabilities, with the following base specifications:

$$Y = \alpha_{10} + \alpha_{11} INFMGMT + \alpha_{12} LEAD + \alpha_{13} STRAT + \alpha_{14} FIRM + \varepsilon_{1A} \quad (1)$$

$$Z = \beta_{10} + \beta_{11} INFMGMT + \beta_{12} PERFMGMT + \beta_{13} PROCMGMT + \beta_{14} CUSTMGMT + \beta_{15} FIRM + \beta_{16} SIZE + \beta_{17} SERVICE + \varepsilon_{2A} \quad (2)$$

where Y denotes the three organizational capabilities and Z denotes the four measures of organizational performance.

Because of the recursive structure of our research model—it has a lower triangular matrix for the Betas (for a distinction between recursive and non-recursive models, see Bollen 1989)—it is possible to estimate each equation independently using the ordinary least squares (OLS) approach and obtain

Table 1. Illustrative Description of Variables[†]

Variable	Description
Information Management Capability (INFMGMT)	Item 4.2 Information Management: Describe how your organization ensures the quality and availability of needed data and information for employees, suppliers/partners, and customers. Within your response, include answers to the following questions: a. Data Availability (1) How do you make needed data and information available? How do you make them accessible to employees, suppliers/partners, and customers, as appropriate? (2) How do you ensure data and information integrity, reliability, accuracy, timeliness, security, and confidentiality? (3) How do you keep your data and information availability mechanisms current with business needs and directions? b. Hardware and Software Quality (1) How do you ensure that hardware and software are reliable and user friendly? (2) How do you keep your software and hardware systems current with business needs and directions?
Performance Management Capability (PERFMGMT)	Item 4.1 Measurement and Analysis of Organizational Performance: Describe how your organization provides effective performance management systems for measuring, analyzing, aligning, and improving performance at all levels and in all parts of your organization.
Customer Management Capability (CUSTMGMT)	Item 3.1 Customer and Market Knowledge: Describe how your organization determines requirements, expectations, and preferences of customers and markets to ensure the continuing relevance of your products/services and to develop new opportunities. Item 3.2 Customer Relationships and Satisfaction: Describe how your organization builds relationships to acquire, satisfy, and retain customers and to develop new opportunities. Describe also how your organization determines customer satisfaction.
Process Management Capability (PROCMGMT)	Item 6.1 Product and Service Processes: Describe how your organization manages key processes for product and service design and delivery. Item 6.2 Business Processes: Describe how your organization manages its key processes that lead to business growth and success. Item 6.3 Support Processes: Describe how your organization manages its key processes that support your daily operations and your employees in delivering products and services.
Customer focused results (CUSTPERF)	Item 7.1 Customer-Focused Results: Summarize your organization's key customer-focused results, including customer satisfaction and product and service performance results. Segment your results by customer groups and market segments, as appropriate. Include appropriate comparative data.
Financial Results (FINPERF)	Item 7.2 Financial and Market Results: Summarize your organization's key financial and marketplace performance results by market segments, as appropriate. Include appropriate comparative data.
Human Resource Results (HUMPERF)	Item 7.3 Human Resource Results: Summarize your organization's key human resource results, including employee well-being, satisfaction, and development and work system performance. Segment your results to address the diversity of your workforce and the different types and categories of employees, as appropriate. Include appropriate comparative data.
Organizational Effectiveness Results (ORGEFFECT)	Item 7.4 Organizational Effectiveness Results: Summarize your organization's key performance results that contribute to the achievement of organizational effectiveness. Include appropriate comparative data.
Leadership Quality (LEAD)	Item 1.1 Organizational Leadership: Describe how senior leaders guide your organization, including how they review organizational performance.
Strategic Planning Quality (STRAT)	Item 2.1 Strategy Development: Describe how your organization establishes its strategic objectives, including enhancing its competitive position and overall performance. Item 2.2 Strategy Deployment: Describe how your organization converts its strategic objectives into action plans. Summarize your organization's action plans and related key performance measures/indicators. Project your organization's future performance on these key performance measures/indicators.

[†]See Table A5 in Appendix A for more complete details. For a complete description of all items and categories (including related notes and the assessment guidelines) that map to the variables used in this study, see the Baldrige criteria 2002 document available at the NIST website (http://www.baldrige.nist.gov/PDF_files/2002_Business_Criteria.pdf).

Table 2. Summary Statistics and Correlations (N = 160)

		1	2	3	4	5	6	7	8	9	10	11	12	13
1	LEAD	1.00												
2	STRAT	0.90	1.00											
3	INFMGMT	0.84	0.86	1.00										
4	PERFMGMT	0.81	0.80	0.79	1.00									
5	CUSTMGMT	0.88	0.88	0.83	0.81	1.00								
6	PROCMGMT	0.87	0.87	0.83	0.77	0.88	1.00							
7	CUSTPERF	0.80	0.82	0.76	0.79	0.85	0.78	1.00						
8	FINPERF	0.80	0.83	0.81	0.70	0.79	0.82	0.72	1.00					
9	HUMPERF	0.84	0.79	0.75	0.78	0.83	0.80	0.85	0.77	1.00				
10	ORGEFFECT	0.82	0.79	0.76	0.82	0.82	0.80	0.87	0.70	0.86	1.00			
11	SIZE	0.18	0.17	0.14	0.16	0.21	0.20	0.19	0.20	0.26	0.27	1.00		
12	SERVICE	-0.01	-0.01	0.03	0.01	-0.02	-0.04	-0.02	0.03	-0.05	-0.11	-0.37	1.00	
13	FIRM	-0.37	-0.35	-0.31	-0.38	-0.32	-0.28	-0.35	-0.20	-0.35	-0.34	0.24	-0.15	1
	Mean	49.72	41.55	44.78	38.78	47.20	46.51	35.47	42.22	34.16	38.37	2.24	0.41	0.33
	SD	15.61	15.23	18.52	14.35	16.62	16.12	15.07	18.66	14.52	14.59	0.70	0.49	0.47
	Min	10	10	10	2.7	15	8	0	10	0	0	1	0	0
	Max	80	70.6	80	70	75	75	60	75	60	70	4	1	1

Note: Correlations equal to or greater than 0.27 are statistically significant at $p < .05$. Cronbach's alpha for STRAT, CUSTMGMT, and PROCMGMT are 0.85, 0.95, and 0.93, respectively.

unbiased and consistent estimates (Wooldridge 2006). However, the error terms of the individual equations in the organizational capability and firm performance models may be correlated because these equations pertain to the same firm or business unit.

We allowed for these potentially correlated errors to obtain consistent and efficient estimates of parameters by using the SURE technique, which belongs to more general system equation models commonly used in the econometric literature (Goldberger 1972). Although the gains in efficiency do not accrue if equations in the SURE model use the same regressors and although OLS would yield the same results as SURE, the use of SURE in such situations makes it possible to impose restrictions on parameters estimates, such as equality of parameters across equations, a property that we make use of, as we discuss subsequently.[3] The Breusch–Pagan test rejected independence of error terms across equations, providing support for the appropriateness of the SURE technique. We prefer the use of SURE for our main results in comparison to LISREL or partial least squares (PLS) because LISREL or PLS types of path models are typically used when there are perceptual measures from one respondent for constructs that require multiple-item indicators. In our setting, the nature of the data is relatively more objective than what is typical in a conventional survey because the data come from verifications and site visits from multiple examiners external to a firm following a rigorous and well-documented process, as laid down in the Baldrige criteria. As we noted previously, these models use all 160 observations for 77 firms and intra-organizational units because of the use of contemporaneous measures only.

We first estimated SURE parameters without restricting any parameters (for these results, see Columns 1–3 of Table 3 and Columns 1–4 of Table 4). We also restricted the slope parameters in Equations 1a–1c and 2a–2d to be equal to obtain more precise estimates of these parameters. Our restriction of the slope coefficients to be equal in the Equations 1a–1c and 2a–2d led to the estimation of fewer parameters, thus increasing the efficiency with which we could estimate the remaining parameters. The results appear in Column 4 of Table 3 and in Column 5 of Table 4. We tested for multicollinearity by computing variance inflation factors. The maximum variance inflation factor value and condition index number in our models were less than 5.94 and 23.17, respectively, indicating that the effect of multicollinearity on parameter estimates is not a serious concern. We also tested for outliers and influential observations in our sample and did not detect any significant problems.

[3]We thank an anonymous reviewer for the suggestion to include this discussion in the paper.

Results

Results of Main Analyses

Hypotheses 1, 2, and 3 predicted that the information management capability would have a positive association with the three organizational capabilities of customer management, process management, and performance management. Models 1, 2, and 3 in Table 3 (unconstrained SURE models) suggest that information management capability is significantly related to customer management (coef = .158, $p < .05$), process management (coef = .197, $p < .01$), and performance management (coef = .237, $p < .01$). At the same time, the values of coefficients for information management capability indicate that information management capability has the strongest impact on performance management, followed by process management and then customer management. As Model 4 of Table 3 (constrained model) shows, information management capability is significantly related to customer management, process management, and performance management (coef = .200, $p < .01$). Thus, we find support for all three hypothesized effects of information management capability.

Among control variables, as we expected, a firm's leadership and strategic planning have a significant influence on the development of organizational capabilities. While the magnitudes of leadership and strategic planning coefficients are higher than that of information management capability, this does not diminish the importance of information management capability because it is difficult to imagine a well-performing firm in the absence of information management capability.

Hypotheses 4a, 4b, and 4c predicted that organizational capabilities would have a significant association with organizational performance. The results in Table 4 support these hypotheses. Models 1 through 4 (unconstrained SURE models) show the relationships between the capabilities and the individual component measures of firm performance. Customer performance is most significantly affected by customer management capability (coef = .485, $p < .01$) and performance management capability (coef = .241, $p < .01$). Financial performance is affected by process management capability (coef = .430, $p < .01$) and customer management capability (coef = .190, $p < .10$). Human resource performance is affected by all three capabilities: customer management capability (coef = .339, $p < .01$), process management capability (coef = .175, $p < .05$), and performance management capability (coef = .208, $p < .01$). Organizational effectiveness also shows a similar pattern and is affected by all three capabilities: customer management (coef = .213, $p < .05$), process management (coef = .172, $p < .05$), and performance management (coef = .389, $p < .01$). On the basis of these results, we can conclude that customer management capability significantly influences all dimensions of firm performance. However, we did not find statistical significance for the effect of performance management capability on financial performance or for the effect of process management capability on customer performance. The results of the model with constrained parameters (Model 5, Table 4) show that all three organizational capabilities are positively associated with performance: customer management (coef = .289, $p < .01$), process management (coef = .209, $p < .01$), and performance management (coef = .221, $p < .01$). Overall, these results provide strong support for Hypotheses 4a, 4b, and 4c.

Hypothesis 5 predicted that organizational capabilities would mediate the effects of information management capability. To test this hypothesis, we performed mediation analysis using the Sobel test (Baron and Kenny 1986; Sobel 1982). Table 5 presents these results. Using the parameter estimates of constrained SURE models (Column 4 of Table 3 and Column 5 of Table 4), we find that the effects of information management capability on all measures of firm performance are mediated through customer management, process management, and performance management capabilities (see Columns 1–3 in Table 5). Because the coefficient of information management capability is statistically significant in Column 5 of Table 4, our results suggest evidence for partial mediation in these constrained models. These results are consistent with the theoretical reasoning that links information management capability with other organizational capabilities and firm performance.

We also performed mediation analyses using unconstrained models in Tables 2 and 3 (for these results, see Columns 4–6 of Table 5). Broadly, these results show that information management capability affects firm performance through organizational capabilities. Of 12 tests for mediation based on the unconstrained models, 9 show mediation occurring through organizational capabilities. Because the coefficient of information management capability becomes insignificant when we include organization capabilities in our firm performance models for customer performance, human resource performance, and organizational effectiveness, we find broad evidence for full mediation in these models. Although we do not find mediation occurring through all the three individual organizational capabilities for customer performance (see Columns 4–6 of Table 5), this does not affect the inference that the association between information management capability and firm performance is fully mediated through the statistically significant organizational capabilities. Because information management capability also continues to have a direct effect on financial performance, this suggests that

Table 3. SURE Parameter Estimates of Organizational Capability Models (N = 160)

$$PERFMGMT = \alpha_{10} + \alpha_{11}INFMGMT + \alpha_{12}LEAD + \alpha_{13}STRAT + \alpha_{14}FIRM + \varepsilon_{1A} \quad (1a)$$
$$CUSTMGMT = \alpha_{20} + \alpha_{21}INFMGMT + \alpha_{22}LEAD + \alpha_{23}STRAT + \alpha_{24}FIRM + \varepsilon_{1B} \quad (1b)$$
$$PROCMGMT = \alpha_{30} + \alpha_{31}INFMGMT + \alpha_{32}LEAD + \alpha_{33}STRAT + \alpha_{34}FIRM + \varepsilon_{1C} \quad (1c)$$

	Unconstrained Models			Constrained Model†
	(1)	(2)	(3)	(4)
	Performance Management Capability (Equation 1a)	Customer Management Capability (Equation 1b)	Process Management Capability (Equation 1c)	Organizational Capabilities
Information Management Capability	0.237***	0.158**	0.197***	0.200***
	(0.001)	(0.012)	(0.002)	(0.000)
Leadership	0.319***	0.401***	0.405***	0.375***
	(0.001)	(0.000)	(0.000)	(0.000)
Strategic Planning	0.183*	0.434***	0.360***	0.321***
	(0.073)	(0.000)	(0.000)	(0.000)
R-squared	0.711	0.821	0.808	0.69, 0.81, 0.80

We estimated all models including an intercept and a dummy variable FIRM (1=firms, 0=intra-organizational units).
p values are in parentheses; *$p < .10$, **$p < .05$, and ***$p < .01$.
†This model restricts slope parameters to be equal across three measures of organizational capabilities (i.e., across Equations 1a–1c). R-squared values for this model refer to Equations 1a–1c, respectively.

Table 4. SURE Parameter Estimates of the Firm Performance Models (N = 160)

$$CUSTPERF = \beta_{10} + \beta_{11}INFMGMT + \beta_{12}PERFMGMT + \beta_{13}PROCMGMT + \beta_{14}CUSTMGMT + \beta_{15}FIRM + \beta_{16}SIZE + \beta_{17}SERVICE + \varepsilon_{2A} \quad (2a)$$
$$FINPERF = \beta_{20} + \beta_{21}INFMGMT + \beta_{22}PERFMGMT + \beta_{23}PROCMGMT + \beta_{24}CUSTMGMT + \beta_{25}FIRM + \beta_{26}SIZE + \beta_{27}SERVICE + \varepsilon_{2B} \quad (2b)$$
$$HUMPERF = \beta_{30} + \beta_{31}INFMGMT + \beta_{32}PERFMGMT + \beta_{33}PROCMGMT + \beta_{34}CUSTMGMT + \beta_{35}FIRM + \beta_{36}SIZE + \beta_{37}SERVICE + \varepsilon_{2C} \quad (2c)$$
$$ORGEFFECT = \beta_{40} + \beta_{41}INFMGMT + \beta_{42}PERFMGMT + \beta_{43}PROCMGMT + \beta_{44}CUSTMGMT + \beta_{45}FIRM + \beta_{46}SIZE + \beta_{47}SERVICE + \varepsilon_{2D} \quad (2d)$$

	Unconstrained Models				Constrained Model†
	(1)	(2)	(3)	(4)	(5)
	Customer Focused Results (Equation 2a)	Financial Results (Equation 2b)	Human Resource Results (Equation 2c)	Organizational Effectiveness Results (Equation 2d)	Firm Performance
Information Management Capability	0.061	0.391***	0.046	0.050	0.137***
	(0.365)	(0.000)	(0.478)	(0.424)	(0.003)
Performance Management Capability	0.241***	-0.022	0.208***	0.389***	0.221***
	(0.003)	(0.830)	(0.008)	(0.000)	(0.000)
Process Management Capability	0.041	0.430***	0.175**	0.172**	0.209***
	(0.642)	(0.000)	(0.040)	(0.034)	(0.001)
Customer Management Capability	0.485***	0.190*	0.339***	0.213**	0.289***
	(0.000)	(0.098)	(0.000)	(0.011)	(0.000)
R-squared	0.750	0.741	0.751	0.774	0.73, 0.68, 0.74, 0.75

We estimated all models including an intercept, dummy variables FIRM (1=firms, 0=intra-organizational units) and SERVICE, and a control variable SIZE.
p values are in parentheses; *$p < .10$, **$p < .05$, and ***$p < .01$.
†This model restricts slope parameters to be equal across four measures of firm performance (i.e., across Equations 2a–2d). R-squared values for this model refer to Equations 2a–2d, respectively.

Table 5. Mediation Analysis

	Results Using Constrained Models†			Results Using Unconstrained Models‡		
	1	2	3	4	5	6
	Performance Management Capability mediated effect of Information Management Capability on	Process Management Capability mediated effect of Information Management Capability on	Customer Management Capability mediated effect of Information Management Capability on	Performance Management Capability mediated effect of Information Management Capability on	Process Management Capability mediated effect of Information Management Capability on	Customer Management Capability mediated effect of Information Management Capability on
Customer Performance	***	***	***	**	NS	**
Financial Performance	***	***	***	NS	**	NS
Human Resource Performance	***	***	***	**	*	**
Organizational Effectiveness	***	***	***	***	*	*

p values are in parentheses; *$p < .10$, **$p < .05$, and ***$p < .01$.
†Results in columns 1 through 3 use parameter estimates of constrained models in Tables 3 and 4.
‡Results in columns 4 through 6 use parameter estimates of unconstrained models in Tables 3 and 4.

organizational capabilities only partially mediate the effect of information management capability on financial performance. In other words, either information management capability affects financial performance by itself (e.g., through the automation- and efficiency-related benefits), or there are other mediating organizational capabilities besides those we identified in this study. Overall, the results of mediation analyses provide support for organizational capability-mediated effects of information management capability on firm performance, although the extent of mediation varies depending on the specific organizational capability and the measure of firm performance.

Additional Analyses

To test the robustness of our results, we conducted additional analyses, making use of several econometric techniques to deal with issues related to lack of independence of observations for the same firm or business unit over time, endogeneity, and unobserved heterogeneity. We consider lack of independence of observations for the same firm or business unit and unobserved heterogeneity by estimating panel models for unbalanced data, such as random effects models. The panel models also account for any differences among firms and intraorganizational units that are time invariant, such as learning effects (i.e., any unobserved differences in the rate at which firms and intraorganizational units learn). We specify the following equations for the panel models:

$$Y_{it} = X_{1it}\beta + u_i + \varepsilon_{1it} \quad (3)$$

$$Z_{it} = X_{2it}\beta + u_i + \varepsilon_{2it} \quad (4)$$

where Y and Z represent endogenous variables, such as organizational capabilities or firm performance; X_1 and X_2 represent a vector of firm characteristics, such as informational management capability, organizational capabilities, and other control variables; β are the parameters to be estimated; subscript i indicates firms and subscript t indicates time; u_i represents unobserved time-invariant fixed factors associated with a firm i; and ε is the error term associated with each observation. These models yield essentially similar results to those we noted previously (see Appendix B, Tables B1 and B2; see also Figure 2). Because these random effects models also account for the unobserved time-invariant heterogeneity (including learning effects—that is, any differences in rates at which firms learn), they rule out the possibility that time-invariant sources of heterogeneity account for the relationships reported in this study (Baltagi 2001).

We address concerns about potential endogeneity of the information management capability variable by conducting a

Hausman (1978) test. We used a procedure suggested by Wooldridge (2006) to conduct the Hausman test. The Hausman test involves comparing two estimators: under the null hypothesis, both the estimators are consistent, but one of them is more efficient than the other; rejection of the null hypothesis indicates that one or both the estimators are inconsistent. Because the Hausman test fails to reject the null hypothesis, this provides confidence in the use of SURE models that treat information management capability as exogenous. Because we use multiple instruments in the Hausman test, we used the procedure suggested by Sargan (1958) and Basmann (1960) to test the joint null hypothesis for the validity of excluded instruments. Our failure to reject the null hypothesis suggests confidence in the appropriateness of using these lagged variables as instruments.

As a further robustness check, we estimated a structural equation model (SEM) using LISREL to estimate all of the relationships simultaneously. Figure 2 shows the results of SEM estimation using LISREL. The LISREL results for information management capability–organizational capabilities linkages are similar in sign and significance to those in Table 3. The results for organizational capabilities–firm performance linkages are broadly similar to those reported in Table 4 (Columns 1–4), albeit with somewhat higher standard errors, leading to statistical insignificance of the links between customer management capability and human resource performance and between process management capability and organizational effectiveness.

We also estimated models for firms and intraorganizational units separately (see Appendix B, Tables B3 and B4). These models provide broadly similar parameter estimates for information management capability in the organizational capability models and for organizational capabilities in the firm performance models.

Finally, as we noted previously, for reasons of parsimony, we did not explicitly include the human resources management capability (which is also assessed as part of the Baldrige criteria) in our firm performance models. Because human resources management capability may be correlated with information management and other capabilities on the one hand and firm performance on the other hand (Tafti et al. 2007a, 2007b), to alleviate concerns about omitted variable bias, we estimated our firm performance models including the human resources management capability (see Appendix B, Table B5). These models provided qualitatively similar results as we reported previously. Therefore, broadly similar results across a variety of empirical techniques provide confidence in the robustness of the main results of the study.

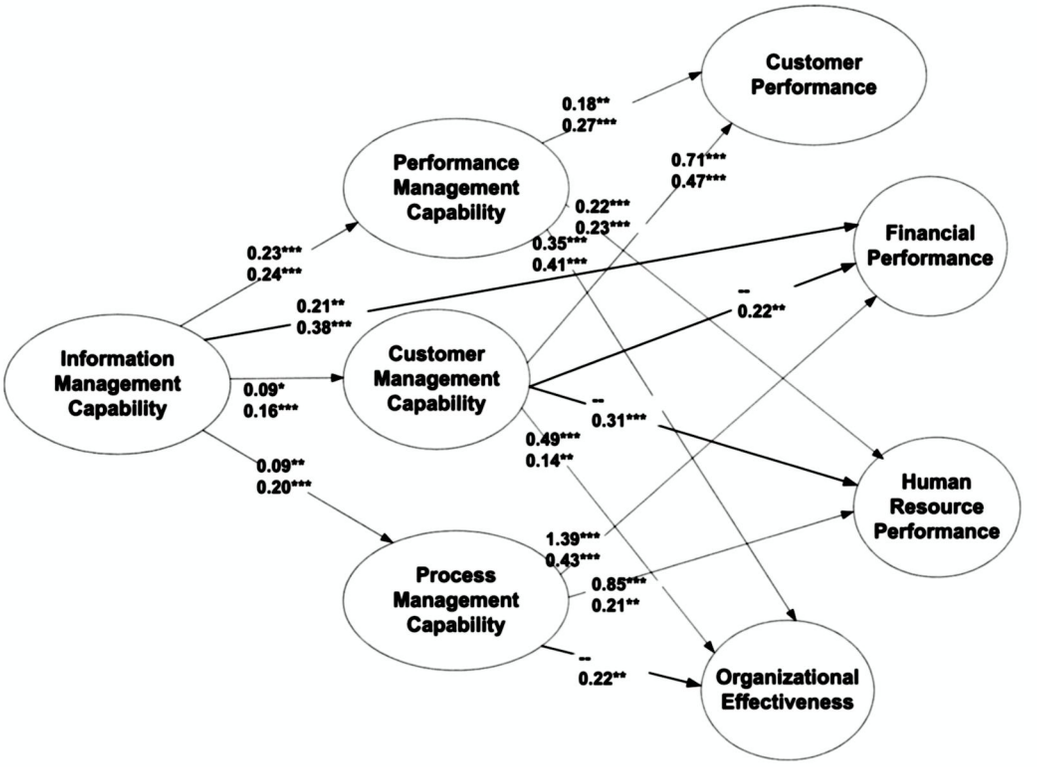
Discussion

The goal of this study was to understand how information management capability affects firm performance. We argued that the three organizational capabilities of customer management, process management, and performance management mediate the links between information management capability and firm performance. We found support for our proposed theoretical model by using actual scores generated through Baldrige performance assessments of firms and intra-organizational units of a large business group.

This study makes two important contributions. First, we contribute to the business value of IT literature (Barua and Mukhopadhyay 2000; Kauffman and Kriebel 1988; Lucas 1993) by uncovering three important organizational capabilities that have not received much attention in previous research and show how these capabilities leverage information management capability and turn it into firm value. We also complement this literature by drawing attention to how *information management* influences firm performance, in contrast to the focus in prior work on how IT assets (e.g., IT investments, IT applications) affect various measures of firm performance, such as productivity, profitability, risk, and shareholder value, and intangibles, such as customer satisfaction (Bharadwaj et al. 1999; Brynjolfsson and Hitt 1996; Dewan et al. 2007; Mithas et al. 2005; Mithas et al. 2008). Our data collection was unobtrusive and is arguably less prone to reactive measurement errors and researcher orientation and characteristics (Webb et al. 1966; Webb and Weick 1979).

Second, we underpin the Baldrige model with theory by synthesizing the academic literature on IS and TQM. This contribution responds to Dean and Bowen's (1994, p. 411) call to identify the need for theory development in several areas and, more specifically, to develop "prescriptions for information processing," and it extends previous work (Flynn and Saladin 2001) by focusing on a subcomponent of the Baldrige model. While Baldrige criteria posit the "Information and Analysis" category as the nerve center of the Baldrige model of performance excellence, our study provides the first empirical test of this conjecture and documents that information management capability is indeed a foundational capability that enhances other organizational capabilities, which in turn affect firm performance.

Before discussing implications, we note some limitations of this research, which also suggest opportunities for further research. First, we restricted our focus to a specific IT capability and to three specific organizational capabilities.



***p < 0.01; **p < 0.05; *p < 0.10 (one-tailed)

First row shows parameter estimates of the Lisrel model, while the second row shows parameter estimates of the random effects model. Fit Statistics for Lisrel model are Chi-Square/df = 1.88, GFI = 0.92, NFI = 0.99, NNFI = 0.99, CFI = 0.99, RMSEA = 0.07, AIC = 298.80. The Lisrel model contains variables such as leadership, strategic planning, industry, firm size, dummy for firm or intra-organizational unit, and HR Management Capability. Nonsignificant paths and paths for control variables are not shown to avoid clutter and for clarity.

Figure 2. Parameter Estimates

Further research could extend this theoretical model by incorporating other IT capabilities, such as IS/business partnerships, IT planning, and vendor relationship management (Feeny and Willcocks 1998). Second, it would be useful to investigate the antecedents of information management capability of firms, including the technological infrastructure evolution at firms along with the role of factors such as organizational leadership. While we interpret the results of our study as associational, a counterfactual or potential outcomes approach would allow for stronger statements regarding the causal nature of relationships (Mithas and Krishnan 2009). Finally, while our data set, which is limited to firms and intraorganizational units of a business group, enables us to control for the effect of factors such as organizational culture, further research is needed to confirm generalizability of our findings by testing our model in other corporate and national settings.

Our results have several implications for research. First, our results point to the role of information management capability as an enabler of organizational capabilities and provide evidence that information management capability provides the base capability through which firms can build higher-order capabilities. In turn, these higher-order capabilities affect various measures of firm performance. Our model and the results point to the need to expand investigations into the performance impacts of information management capability by considering both direct and mediated effects through other capabilities that were not part of this study and by using objective measures of firm performance.

Second, this study provides a template for undertaking similar studies that bridge theory and practice to investigate and understand how implementation of Sarbanes-Oxley compliance procedures, control objectives for information and

related technology (COBIT) practices, and other organizational initiatives affect organizational capabilities and firm performance. Finally, for QM researchers, our research provides additional evidence of the relationships among the constructs embodied within the Baldrige performance excellence process. We extend previous research on validation of the Baldrige process and its constructs (Flynn and Saladin 2001) by proposing and testing a more parsimonious but theoretically motivated model of interrelationships among these constructs. By specifying a model based on prior theory in the IS, strategy, and management literature and going beyond merely validating Baldrige criteria, our study paves the way for further theoretically motivated investigations to refine the Baldrige model and strengthen its rigor and prescriptions for practice.

Our study has at least two managerial implications. First, our findings suggest the necessity to recognize information management capability as enabling valuable organizational capabilities. With the uncertainties and concerns about how to value IT infrastructure investments, our research suggests that well-developed IT infrastructures that give rise to superior information management capability play a role in facilitating development of important customer management, process management, and performance management capabilities and, in turn, superior firm performance. Senior leaders need to focus on IT strategy, IT governance, management of IT resources, IT investments, and information management capability as important levers for organizational transformation and business excellence (see Mithas and Lucas 2010).

Second, our study shows the importance of understanding the deeper linkages among different categories of performance excellence initiatives, such as Baldrige, Deming, and the European Foundation for Quality Management (EFQM), and which categories act as levers to improve performance. When managers understand that organizational capabilities act as a precedent for firm performance and information management capability is a fundamental platform and precedes development of these higher-level organizational capabilities, they are more likely to view IT as an important tool for strategic transformation of an enterprise. In other words, IT is a "first-order factor of strategy making" (Earl and Feeny 2000, p. 14), and it would be a mistake to view it merely as a utility (Carr 2003). Governance bodies such as NIST and others that administer the Baldrige model and other performance excellence frameworks (e.g., Deming and EFQM) should rearticulate and respecify their criteria by incorporating the insights from the findings of this and related studies to highlight the role and importance of IT infrastructure and information management capability.

In conclusion, this study develops a conceptual model that links information management capability with three important organizational capabilities (customer management capability, process management capability, and performance management capability) that mediate the links between information management capability and several measures of firm performance. We use a rare archival data set that contains unobtrusive measures of information management capability, organizational capabilities, and firm performance. We find that information management capability has positive association with customer management capability, process management capability, and performance management capability. In turn, these capabilities are positively associated with customer, financial, human resources, and organizational effectiveness measures of firm performance. Taken together, these findings highlight the role and importance of IT-enabled information management capability to enable business excellence and to create and sustain a competitive advantage.

Acknowledgments

We thank the senior editor, the associate editor, and four anonymous reviewers of *MIS Quarterly*; seminar participants at University of Michigan, University of Southern California, Michigan State University, University of Minnesota, University of Notre Dame, University of Wisconsin-Milwaukee, University of California Riverside, University of Texas at Austin, McGill University, Arizona State University, and Temple University; INFORMS-CIST 2003 participants; M. S. Krishnan, Michael Wade, and Jonathan Whitaker for helpful comments; and Eli Dragolov for research assistance. We thank Jamshed J. Irani, Firdose Vandrevala, and Aspi H. Kapadia for their support of this research; Jehangir Ardeshir, Sunil Sinha, Bimlendra Jha, Ravi Arora, and Shrikant Chandratreya for their help with the necessary data and many useful discussions; and many other executives at our research site for their insights and comments. We thank the National Institute for Standards and Technology (NIST) for permission to reproduce some content from the Baldrige criteria. Financial support for this study was provided in part by the Smith School of Business at the University of Maryland.

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