Information Systems Research

Publication details, including instructions for authors and subscription information:
http://pubsonline.informs.org

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To cite this article:
William J. Kettinger, Chen Zhang, Kuo-Chung Chang (2013) Research Note—A View from the Top: Integrated Information Delivery and Effective Information Use from the Senior Executive's Perspective. Information Systems Research 24(3):842-860.
https://doi.org/10.1287/isre.1120.0473

Information Systems Research
Vol. 24, No. 3, September 2013, pp. 842–860
ISSN 1047-7047 (print) | ISSN 1526-5536 (online)

http://dx.doi.org/10.1287/isre.1120.0473

Research Note

A View from the Top: Integrated Information Delivery and Effective Information Use from the Senior Executive's Perspective

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This study frames antecedents of effective information use, outlining a nomological network that firms follow to achieve integrated information delivery and effective information use. Our focus is on senior business executives' assessment of information delivered by their organizations' information systems. We first clarify the definition of information as it relates to information delivery and effective use. Then, drawing from institutional theory and the resource-based view of the firm, we propose a research model consisting of external institutional pressure, internal information systems (IS) resources, integrated information delivery, and effective information use and empirically test it through a field survey of senior business executives and post hoc qualitative analysis. Our findings position information delivery as an important research construct leading to effective information use and value. Our study also highlights the important role of the IS function as a facilitator of effective information use and a nurturer of a strong information culture in organizations. Finally, we offer practical advice on how senior executives assess and improve integrated information delivery and effective use.

Key words: senior executive; integrated information delivery; effective information use; IS resource-based view; institutional forces; information orientation; information view; information management
History: Vallabh Sambamurthy; Michael Wade, Associate Editor. This paper was received on May 25, 2010, and was with the authors 18 months for 3 revisions. Published online in *Articles in Advance* March 13, 2013.

1. Introduction

Information technology (IT) generates vast amounts of information at all levels of organizations. A myriad of technologies and tools, such as data warehouses, master data management systems, cloud-based business intelligence platforms, and business analytics software, exist to help organizations better manage the exploding amount of information and extract value from it.[1] However, a study of global CEOs reveals that senior executives continue to be frustrated with their organizations' inability to transform the growing body of information to business insights and well-informed action plans (IBM Global Business Services 2010). Scholars also recognize that what companies value the most about IT is its role in delivering and managing the information that the organization relies on regardless of specific information technologies adopted or the unique governance relationships that control its operations (Applegate et al. 2007, McKeen and Smith 2007, Ragowsky et al. 2008, Smith and McKeen 2005).

Numerous studies have examined the relationship between IT related inputs and business performance at the organizational level (see Melville et al. 2004 for a review). Yet the "how" and "why" questions related to business value of IT remain largely unanswered. Kohli and Grover (2008) contend that by focusing on firms' "information" capabilities, we can better understand the business processes and capabilities enhanced by IT that lead to increased business value. Adopting an information-oriented perspective, some research has focused on the information provided by IT (e.g., McKeen and Smith 2007, Patnayakuni et al. 2006) and demonstrated that firms' information use and information management capabilities can positively impact business performance (e.g., Mithas et al. 2011). Other studies have investigated the

[1] We use the taxonomy of information presented in McKinney and Yoos (2010) and use the term information accordingly. In the next section we will elaborate on the views of information that we adopt in this study.

delivery of information such as strategic information flow between buyers and suppliers (e.g., Klein and Rai 2009) and information integration from disparate information systems (e.g., Bernstein and Haas 2008). However, little research examines both information delivery and information use in a nomological network, although these two aspects are closely related and serve as key steps in extracting the value of information. Furthermore, despite various underlying assumptions of past studies around information delivery and information use, the information concept tends to be treated as a universal label without a clear definition of its meaning.

In this research note we extend this stream of research by further exploring the concept of information and empirically investigating both information delivery and effective information use in organizations. Furthermore, we do so by presenting a *view from the top* from the senior executives' perspective because of their strong stakeholder responsibility and holistic influence on how organizations gather, interpret, and respond to external and internal events affecting organizational routines, resources, and strategies (Daft and Weick 1984, Thomas et al. 1993). When compared with individuals working in specific functional areas at lower levels of the organization, senior executives are better able to have an overarching assessment of information delivery and information use throughout the organization. Through direct and indirect reports, capabilities audits (Ulrich and Smallwood 2004), exception reporting (Wu 2005), and observations of employees' behavior and performance, together with an understanding of the connections between multiple business processes and between functional departments, senior executives have the ability to obtain a panoramic view of the information that is available and used.

We propose a key construct, *integrated information delivery*, which refers to the ability of the amalgam of the organization's information systems to deliver needed information to individuals at hierarchical levels and across processes. The other key construct, *effective information use*, refers to the extent to which information provided by the organization's information systems is successfully utilized to enable and support its business strategies and value-chain activities. We examine the relationship between these two key constructs and also explore their external and internal antecedents. Drawing from institutional theory and the resource-based view of the firm, we propose and empirically test a nomological network that consists of external institutional pressure, internal IS resources, integrated information delivery, and effective information use.

This research note is organized as follows: we review the relevant research in §2 and develop hypotheses in §3. We then describe our methodology to test the hypotheses and present our findings in §§4 and 5, respectively. We present post hoc qualitative interviews with senior business executives in §6 and conclude with implications, limitations, and future research.

2. Theoretical Background

2.1. Information Integration, Information Use, and Information Management

Porter and Millar (1985) point out that information provided by information systems is an important asset helping organizations gain competitive advantage. In response, several studies have investigated information flow in organizations. From a technical perspective, Giachetti (2004) and Bernstein and Haas (2008) review tools and technologies that can be used to integrate information from disparate information systems. In the supply chain context, researchers have examined various topics such as strategic information flow between buyers and suppliers (e.g., Klein and Rai 2009); information flow integration for supply chain coordination (e.g., Patnayakuni et al. 2006); and supply chain process integration in terms of information, physical flow, and financial flow integration (e.g., Rai et al. 2006).

Another stream of literature has emphasized the role of information use and management in organizations. For example, from a marketing perspective, Glazer (1991) argues that organizations need to see beyond the technology and focus on how to manage their information to gain competitive advantage. Dewett and Jones (2001) propose the ability of IT to create information efficiencies, which occur when information enables employees to better perform their tasks and expand their roles, as well as information synergies, whereby information enables multiple employees or divisions to cooperate and collaborate across boundaries. Bendoly et al. (2009) empirically explore how firms' use of different types of enterprise information influences their strategic performance in terms of operational excellence, customer intimacy, and product leadership. Kettinger and Marchand (2011) develop an empirical measure of information management practices, which refer to "the overall capabilities of an organization to manage information effectively over the life cycle of information use" (p. 387). Finally, Mithas et al. (2011) empirically demonstrate that a firm's information management capability influences its customer management, process management, and performance management capabilities, leading to improved organizational performance.

In sum, although the link between effective information use and organizational performance has now

been established, there is a need for upstream research to "investigate the antecedents of information management capability" (Mithas et al. 2011, p. 252). Specifically, although information delivery as a precondition of information use appears to be critical to the way information creates value in organizations, to the best of our knowledge, no studies have examined both aspects in an integrated causal framework. Therefore, in this research note, we answer calls for upstream research and focus on the relationship between information delivery and information use, highlighting the path that leads to effective information use.

2.2. Information

Before we propose a nomological network of information delivery and information use, we note that most literature on information delivery, information use, and information management treats *information* "as a ubiquitous label whose meaning is almost never specified" (McKinney and Yoos 2010, p. 329), and many studies have various underlying assumptions about information (Boland 1987, Checkland and Howell 2006). Given that information is a fundamental concept in our research, we next specify the definition used in this study based on the taxonomy of information views introduced by McKinney and Yoos (2010).

Information, a concept that has been widely studied in the information systems (IS) field, has been defined in many different ways. Recognizing the need to build a coherent theoretical foundation around information among IS researchers, McKinney and Yoos (2010) provide a taxonomy of four information views: token, syntax, representation, and adaption. In the token view, information is data and refers to tokens that are inputs and outputs of cognitive, computational, or organizational processes. For example, when a purchase order is entered into a database, data about this order, such as order date, are tokens that are then transformed to an appropriate format. When information represents "an undifferentiated commodity of data bits that are processed" (McKinney and Yoos 2010, p. 331), the emphasis is on how the process transforms input tokens into output tokens; no meaning is attached to tokens (Bremer and Cohnitz 2005). In the syntax view, information represents "the objective, measurable relationship of tokens that reduces entropy in a system" (McKinney and Yoos 2010, p. 333). When viewed as syntax, information is measurable and helps achieve efficiency. In both the token and the syntax views, information is objective, devoid of meaning, and does not depend on the observer. In other words, what information represents is not relevant because these views ignore the interpretation of information.

In the representation view, which is the most widely adopted view in the existing IS literature, information is "a model of something to someone" (McKinney and Yoos 2010, p. 334), involving a sign, an object, and an observer (Floridi 2005). Information as representation is dependent on the observer's experience (Checkland and Howell 2006), knowledge (Kettinger and Li 2010), and interpretation (Tuomi 1999). Perhaps given the same sign, even about the same object, different observers may interpret the information in different ways. Information in the adaptation view refers to the subject's perception that results in an adaptation in his/her actual behavior. Information as adaptation exists only when the subject makes use of his/her perception by modifying his/her behavior. Both the representation view and the adaptation view are dependent on the context and the specific observer.

Our study adopts multiple views of information. When senior executives assess information delivery, information refers both to tokens delivered by information systems and to individuals' interpretation of tokens. When they evaluate organizational information use, information refers to the adaptation in the organization's behavior as a result of individuals' use of information.

We adopt both the *token view* and the *representation view* of information when focusing on information delivery because delivery of information depends on whether information systems are able to reliably provide data to individuals (i.e., the token view) and, once data are delivered, on whether individuals are able to derive the meaning of the data in their work context (i.e., the representation view). Information delivery first relies on a successfully operating IT infrastructure such as hardware, software applications, networking, and communications. When any technological component involved in token delivery is unavailable or malfunctioning, the processes that accept input tokens, perform transformations, and produce output tokens no longer work. As a result, tokens or data are unable to be delivered regardless of the intended purposes of tokens. Therefore, when assessing information delivery, senior executives tend to first assess whether overall the IT infrastructure, especially the information systems, are operating properly without distinguishing the specific types or purposes of the systems or the tokens. This view is consistent with the *token view* of information as defined by McKinney and Yoos (2010).[2]

[2] According to McKinney and Yoos (2010), "information in the syntax view is the measured relationship among tokens" (p. 332). The lack of meaning and the lack of an emphasis on a specific person as information observer in the syntax view make it less relevant to senior executives, to whom meaning and measured relationships of tokens are crucial to their decision making. Measuring the relationship among tokens is often of concern to data analysts; senior executives at the top level of the organization are less likely to be concerned with how to measure the relationship or the criteria for measures.

Assessment of information delivery also includes evaluating whether individuals working at different levels of the organization and involved in different business processes can interpret and understand what objects are being represented by the tokens they receive. Interpretation of tokens often depends on individuals' specific work context and the tasks they perform (Burton-Jones and Grange 2013). Thus, senior executives' assessments involve signs (i.e., tokens), objects, and observers (i.e., recipients of tokens) in particular contexts. Therefore, the most applicable view is the *representation view* of information.

Furthermore, in order for such information to have an impact, tokens must be provided to (i.e., the token view) and understood by (i.e., the representation view) individuals in the organization and, more importantly, must cause a change in individuals' behavior (i.e., the adaptation view). When evaluating the organizational use of the delivered information, senior executives are concerned with how and in what context people have put the representations (i.e., interpretations of what objects are represented by the tokens delivered by information systems) to use. Hence, the assessment of information use is associated with the *adaptation view* of information.

3. Research Hypotheses

In this study, as shown in our research model (Figure 1), we introduce *integrated information delivery* and *effective information use* as two key theoretical constructs and propose a nomological network consisting of these constructs and their antecedents.[3]

3.1. Integrated Information Delivery

Information can be delivered in an integrated fashion both hierarchically and across processes. Hierarchical information delivery represents the extent to which the firm's information systems are integrated to deliver contextually meaningful information to individuals at different organizational levels—operational, managerial, and strategic. Managers and employees at every level are provided with timely and relevant information on which decisions may be based. This dimension also illustrates increasing levels of information aggregation, consistent with the "informate up" and the "informate down" strategic roles of IT in organizations (Armstrong and Sambamurthy 1999, Schein 1992).

"Informate up" represents the role of IT in providing information to higher levels of the firm more efficiently and easily to facilitate organizational control and coordination activities. For example, line managers require useful and accurate information about daily activities to make decisions about both current and future operations (Heijnen and Lukszo 2006). When a deviation from the target performance occurs in operational activities, they need timely notification and relevant information that help them analyze the issue and determine the appropriate corrective action. Availability of timely and accurate information to middle managers enables them to make effective managerial decisions related to budget, sales, and production planning (Marchand et al. 2002). Top executives need information (e.g., profitability of each business segment, future market prospectus) to make strategic decisions, such as entering a new market or launching a new product line, that have significant impact on their organizations. The importance of information to strategic decision making has been examined extensively (e.g., Kumar and Palvia 2001, Vandenbosch and Huff 1997).

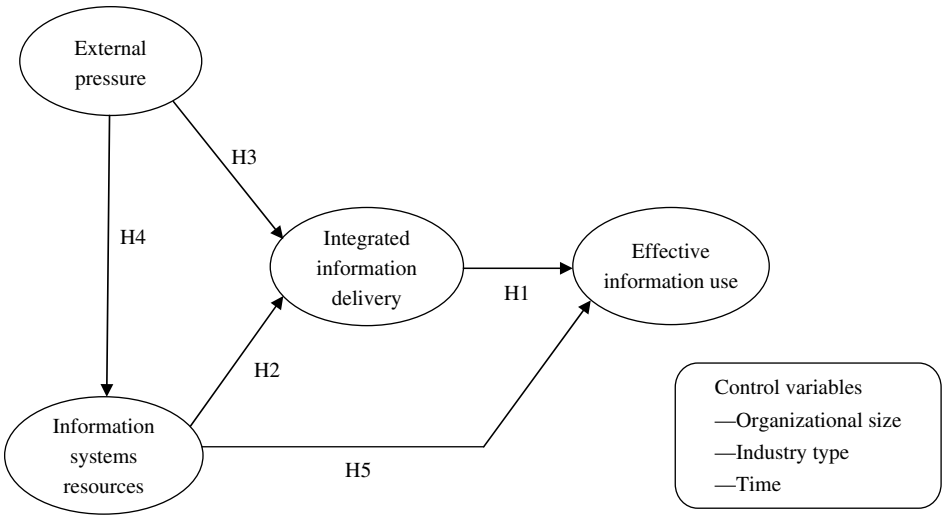
"Informate down" represents IT's role in sharing key information about business strategies and activities to lower levels of the firm, increasing front line employees' access to relevant information (Armstrong and Sambamurthy 1999). Information flowing down to front line employees enables them to become more familiar with organizational structures and processes, leading to a higher level of employee autonomy. Providing a fuller picture of the organization to lower levels of the hierarchy also has the potential to support employee-driven performance improvement (Tai and Phelps 2000).

The horizontal, or process, aspect of integrated information delivery represents the extent to which the company's information systems are integrated to deliver the necessary information along business processes within the company and across its supply chains (Kelly et al. 1999). Process information delivery reflects the interconnection of the information systems located in different functional areas within organizations and also between organizations and their business partners (Iacovou et al. 1995). Information about process characteristics and performance assists with predicting and diagnosing problems and suggests the direction of future process improvements (Davenport and Beers 1995). For example, plant operations management systems allow engineers to create and share information about product specifications with other design teams and help monitor internal plant processes (Banker et al. 2006).

Sharing operational, tactical, and strategic information between firms and their business partners improves the accuracy of forecasts as well as the synchronization and coordination of production and

[3] Based on an upper echelon theoretical approach, the measures in this study are perceptual from the perspective of the senior executive. We have chosen not to use "perceived" when naming all constructs to avoid redundancy and improve reading flow.

Figure 1 Research Model



delivery (Rai et al. 2006). For example, strategic information flows between buyers and suppliers benefit each party financially in terms of asset management, operations costs, and productivity as well as operationally in terms of resources planning, control, and flexibility (Klein and Rai 2009). The extent to which the firm shares information (i.e., sales forecasts, marketing plans, sales or campaign results, customer demographics, customer loyalty, and satisfaction metrics) with its supply chain partners moderates the firm's gains in customer knowledge from customer relationship management applications (Mithas et al. 2005).

3.2. Effective Information Use

A firm's effective use of information in value chain activities and strategic decision making can result in improved business capabilities and/or creation of new capabilities (Kohli and Grover 2008), which then lead to better business performance.[4] To achieve effective information use, information not only must be provided to and understood by individuals but also must be applied to improve their job performance.[5] Based on the existing literature that examines the organizational impact of information technology on business strategies (e.g., Bakos and Treacy 1986) and value-chain activities (e.g., Glazer 1993), we also identify organizational use of information along these dimensions. Extending Armstrong and Sambamurthy's (1999, p. 306) definition of effective IT assimilation as "the effective application of IT in supporting, shaping, and enabling firms' business strategies and value-chain activities," we define effective information use as the extent to which information provided by an organization's information systems is successfully utilized to enable and support its business strategies and value-chain activities.

The first dimension of effective information use is the extent to which information is successfully applied to develop and implement corporate strategies for reducing production costs, increasing operations flexibility, providing value-added customer service, and attracting new customers (Armstrong and Sambamurthy 1999, Chatterjee et al. 2002), all of which require accurate and timely information (Ramamurthy et al. 1999, Truman 2000). Information allows the organization to be flexible and agile in planning and incorporating enterprise-wide resources in response to an increasingly complex and turbulent business world (Sambamurthy et al. 2003). Hence, we propose that when the organization's information systems are integrated in a manner that relevant information can be effectively delivered and used, the firm has the ability to successfully apply that information to strategies.

The second dimension of effective information use is associated with the extent to which information is successfully used to support value-chain activities. Conducting essential business activities such as those related to supply chain operations requires accurate and up-to-date information to facilitate coordination.

[4] Mithas et al. (2011) identify that accurate, timely, and reliable information, if used, can enable firms to "configure and tailor other organizational capabilities" (p. 240). Given the link between organizational information management capability and business performance is established (Mithas et al. 2011; Marchand et al. 2000, 2002), we focus on effective information use as our dependent variable and do not explicitly include business performance in our research model.

[5] For example, Kettinger and Marchand (2011) recognize that effective information management practices require "the company's efforts to execute this information life cycle within an information usage context that is personal, situational, and dynamic" (p. 389).

For example, the supply chain process takes inputs in the form of material, people, and equipment and transforms them into goods and services for customers. This process involves a series of activities that are mutually interdependent. Effective supply chain performance is based on seamless coordination, which is the result of the improved information exchanges (Rai et al. 2006, Ramamurthy et al. 1999). Integrated information delivery facilitates the collection, comparison, and aggregation of information from various processes in various parts of the organization, leading to a better use of information in operational decision making and coordination. Therefore, we hypothesize the following:

Hypothesis 1 (H1). *The level of integrated information delivery by the organization's information systems positively influences effective information use.*

3.3. Information Systems Resources and Integrated Information Delivery

According to the resource-based view of the firm, a firm's resources include its assets and capabilities available and useful to detect and react to opportunities or threats (Christensen and Overdorf 2000). Recognizing the variety of conceptual frameworks defining what constitutes IS resources (e.g., Bharadwaj 2000, Sambamurthy et al. 2003), we adopt the definition of IS resources suggested by Wade and Hulland (2004) and identify that IS resources consist of both assets and capabilities associated with external relationships management, IS/business partnership, market responsiveness capability, IS planning and change management, IS infrastructure, IS technical skills, IS development, and cost effective IS operations.

Because of the complexity and scope involved in achieving integrated information delivery throughout the organization's heterogeneous information systems, several relevant IS resources are needed to cope with the technical and organizational challenges that the organization may face during the process. First, IS/business partnerships reflect a firm's ability to manage internal relationships such as the alignment between IS functions and other functional areas or departments. Because integrated information delivery throughout the firm will have organization-level impacts, the firm needs to shape consensus among managers around the potential opportunities and risks when integrating the information systems in the entire enterprise. IS/business partnerships represent an organizational capability to form such consensus between senior managers in IS and business stakeholders (Armstrong and Sambamurthy 1999). Second, the IS function's capability to respond rapidly to market changes affects a firm's integrated information delivery status. This capability involves the collection of information from external sources, the dissemination of a firm's market intelligence across departments, and the organization's response to that learning. Information can be effectively updated because firms know where and to whom the collected information should be delivered. Thus, when a firm can vigilantly respond to market situations, it is likely that its information systems can be integrated so that accurate and up-to-date information is effectively delivered. Third, the ability for effective IS planning and change management could have a profound impact on integrated information delivery status because integrated information delivery requires an overarching plan from which a firm can evaluate and use appropriate technologies to integrate a network of information systems dispersed within and across organizations. Fourth, an effective IS operation is critical to achieving a high level of integrated information delivery. If the IS function of a firm does not have the capability to provide dependable IS services, the firm is unlikely to make the amalgam of information systems operate as expected. Hence, we hypothesize the following:

Hypothesis 2 (H2). *The organization's information systems resources positively influence the extent of integrated information delivery by the organization's information systems.*

3.4. External Pressure and Integrated Information Delivery

According to institutional theory, organizations operate in an open environment and unavoidably come across various external pressures that constrain their behaviors (DiMaggio and Powell 1983). These external pressures represent socially prescribed norms, values, and expectations to which organizations must conform in order to sustain necessary social resources for their survival (Meyer and Rowan 1977). DiMaggio and Powell (1983) identify three institutional pressures: mimetic, coercive, and normative. Mimetic forces arise when an innovation is taken by the leading companies in the industry or by a majority of a firm's competitors (Oliver 1997). A firm may perceive pressures from what its competitors and leading companies in the industry have done and respond by imitating them. Coercive forces are largely caused by pressures from other organizations on which the focal organization is dependent (Mukhopadhyay and Kekre 2002). Firms tend to comply with coercive pressures derived from the demands of their important business partners in order to maintain a business relationship. Normative forces stem from a process of professionalization, involving social learning in the network context (Swanson and Ramiller 1997). Such forces arise from exposure to influential third parties

such as professional and industrial associations, consultants, and vendors, which may influence the organization's perception about a particular innovation or practice. As a result, the organization feels the need to take actions suggested by these parties (Wilson et al. 1994). Empirical studies have shown that institutional pressures influence the way a firm reacts to an IT innovation (e.g., Teo et al. 2003).

We define external pressure as the extent to which the organization (through its senior managers' influence) experiences the need to integrate its information systems in order to achieve integrated information delivery by responding to mimetic, coercive, and normative pressures exerted by the institutional environment. Achieving integrated information delivery throughout the organization often incurs a high cost and involves a prolonged and continuing process that requires the organization to devote substantial organizational resources. In addition, it often entails extensive changes in terms of organizational structures, culture, and ways of doing business (Markus et al. 2000). Given the complexity and uncertainty involved in the prolonged process and extensive organizational changes, the organization may not consider enhancing the integrated information delivery of its information systems unless it senses a strong need from the external environment demanding it to do so. Therefore, we propose a direct relationship between the external pressure faced by the organization and the extent of integrated information delivery:

Hypothesis 3 (H3). *External pressure has a direct positive influence on the extent of integrated information delivery by the organization's information systems.*

3.5. External Pressure and Information Systems Resources

Senior executives' formulation and implementation of organizational initiatives, which help organizations take advantage of opportunities and mitigate risks, is a key to their organizations' success. According to upper echelons theory (e.g., Hambrick 2007), senior executives affect their organizations by acting based on their personal views of "the strategic situations they face" (p. 334), cultural values, experiences, and personalities. They act as the key human agency (Liang et al. 2007) by sensing the external influences in the institutional environment and translating them into strategies and actions, which are then implemented within the organization. Many of these strategies and actions are associated with the allocation of resources (i.e., human resources, financial resources) to organizational units (Miller 1987) in order to support corporate strategies and objectives. More specifically, given that successful information delivery throughout the organization to a large extent relies on its internal IT resources and capabilities, senior executives may recognize the critical role of information systems resources and capabilities in developing and implementing organizational initiatives to achieve integrated information delivery. Hence, when senior executives are faced with external pressure, they are likely to make resource allocation decisions that help strengthen the organization's information systems resources and capabilities. Therefore, we propose that perceived external pressure influences information systems resources, which may lead to a greater extent of integrated information delivery:

Hypothesis 4 (H4). *External pressure to achieve integrated information delivery positively influences the organization's information systems resources.*

3.6. Information Systems Resources and Effective Information Use

Along with integrated information delivery, other factors such as people's information-oriented values, behavior, and culture contribute to more effective information use. Marchand et al. (2000, 2002) suggest that the IT function improves business performance only if information is managed well and employees have been instilled with the appropriate values and behaviors for working with information. The IS function plays a key role in cultivating the information management culture throughout the organization. A firm with slack IS resources is more likely to devote resources to promote employees' effective use of information through training activities and educating employees about what information is made available by the information systems and what are the most efficient ways to access such information. IS resources enable the IS function to better communicate and work with business units to obtain feedback from the business users and to encourage their effective information use behavior (Mithas et al. 2011). The greater the IS resources possessed by the organization, the more likely it will create the organizational information culture emphasizing effective information usage. Therefore, we propose the following:

Hypothesis 5 (H5). *The organization's information systems resources positively influence the extent of effective information use.*

3.7. Control Variables

In the research model, we also include a set of control variables: organization size, industry type, and time. Past studies (e.g., Armstrong and Sambamurthy 1999, Liang et al. 2007) recognize that larger organizations have more slack resources that allow them to experiment with innovative practices and absorb the cost of such experimentation more easily than

can smaller organizations. Industry type may also affect effective information use. For example, in manufacturing industries the role of information may be greater in supporting value-chain activities than in supporting business strategies. Additionally, the time since the organization started investing heavily in achieving integrated information delivery by its information systems may also influence effective information use because of organizational learning effects (Fichman 2001).

4. Research Methods

4.1. Data Collection

We empirically tested the model and the proposed hypotheses using a field survey of non-IS top executives, such as CEOs, CFOs, and vice presidents, who are key informants in the organization. IS senior executives were excluded from the survey to mitigate potential response bias because constructs such as information systems resources and integrated information delivery may be highly related to the performance of IS function. The unit of analysis is the organization because this study focuses on entire organizational information systems and all the constructs are associated with the organization.

The alumni database of a business school at a major U.S. state university was adopted as the sampling frame of potential respondents. We identified 726 non-IS senior executives and invited them to participate in the survey. Eighty-six (86) of them declined to participate and 173 completed the survey, yielding a response rate of 27%. Because we are interested in the impact of integrated information delivery in firms that have multiple information systems, we dropped the responses from senior executives of small firms that are unlikely to have multiple information systems due to their organizational size and financial resources.[6] As a result, our sample consisted of 103 observations. Firms included in the sample have a diverse demographical profile in terms of firm size and industry (such as manufacturing, telecommunication, health care, financial services, information technology, and pharmaceuticals). They are geographically located in 41 different states in the United States, with most of them located outside of the state where the university resides. Table 1 summarizes the demographics of the respondents and the profile of the responding firms in the sample.[7]

To assess the severity of potential nonresponse bias in the sample, we compared the early respondent firms and late respondent firms (i.e., surveys filled out three weeks after they were sent out) with respect to their annual sales and the number of employees.[8] Results suggest no significant difference between the two groups on these dimensions at the 0.05 level. We further assessed potential nonresponse bias by randomly selecting a subset of 50 executives who did not complete the original survey and inviting them to participate in the survey again. We received seven responses from these nonrespondents. After testing the differences between the two samples (original sample of 103 observations and nonresponse sample of 7 observations) using the Mann-Whitney U test and the Kolmogorov-Smirnov two-sample test as suggested by Hill and Lewicki (2005), the two samples' distributions are not statistically different for all survey items at the 0.05 level.

4.2. Construct Development

To develop and refine the constructs, we followed the scale development program outlined in Moore and Benbasat (1991). An extensive literature review was conducted to specify construct domains and identify scales used in prior studies. A panel of five IS experts evaluated the preliminary questionnaire and sorted the scale items into different construct categories. We measured item validity by computing the inter-judge agreement ratio based on the proportion of items sorted into their designated construct categories. The overall inter-rater agreement was 0.97, confirming the adequacy of the developed scale items in capturing the prespecified constructs. To ensure proper interpretation of the survey questions, we conducted a pilot test on a representative sample of non-IS senior executives. Internal reliabilities for each scale were assessed and all scales exhibited high internal reliabilities, with Cronbach's α varying from 0.82 to 0.97. Based on feedback from the pilot test respondents, we modified the instrument further, then conducted interviews with five senior managers from different companies who indicated that they understood and could accurately answer the survey questions.

4.3. Measures

We operationalized the *integrated information delivery* construct in terms of two dimensions—process information delivery and hierarchical information delivery—and developed a scale for each dimension

[6] Consistent with prior studies on IT in small firms (Soh et al. 1992), we identified firms with fewer than 100 employees as small firms and dropped the corresponding responses from further analysis because their financial resources and IT resources may prevent them from having multiple, sophisticated information systems.

[7] Out of 103 observations, most companies have one respondent except three companies have two respondents. We tested the robustness of our results by taking the average of the responses from senior executives of the same company and obtained similar results.

[8] This approach was used largely because the sampling frame consists of both public and privately held firms and it would be difficult to obtain profiles of nonresponding private firms.

Table 1 Respondent Demographics

Respondent demographics									
Title	CEO	CFO	COO	President	Senior vice president	Vice president	Director	Other	Total
N	14	9	2	15	10	35	12	4	103

Sales profile of responding firms		
Sales (in millions of dollars)	*N*	Percentage
1–10	10	10
11–100	30	29
101–1,000	27	26
More than 1,000	36	35

Employee profile of responding firms		
Number of employees	*N*	Percentage
101–1,000	54	52
1,001–10,000	19	18
More than 10,000	30	29

based on prior studies such as Massetti and Zmud (1996) and Scheer (1994). We measured *process information delivery* by the extent senior executives perceive their firms' information systems are linked to facilitate information exchange among various parts of a process, among people in different functional areas, and among people in their firms and people from their trading partners. *Hierarchical information delivery* is measured by perceived availability of information for line managers to carry out operational activities, for middle managers to make managerial decisions, and for top executives to formulate strategic policies. Integrated information delivery is a formative latent construct due to two considerations (e.g., Chin 1998). First, the level of integrated information delivery comprises two facets: hierarchical information delivery and process information delivery. A firm's extent of integrated information delivery is influenced by, and is not the underlying cause of, hierarchical and process information delivery. Second, a change in one facet of the construct does not necessarily imply a similar change in the other facet of the construct (Chin 1998, Cohen 1990). The final scale items used in the survey are presented in Table 2.[9]

We adapted the items developed by Armstrong and Sambamurthy (1999) to assess the degree of *effective information use*, our dependent variable, by two dimensions. The first dimension is associated with the organization's successful use of information to execute various value-chain activities (e.g., marketing activities, customer service activities); the second dimension is associated with the organization's successful use of information to support business strategies (e.g., being a low-cost producer, enhancing existing products or services). We identified effective information use as a formative construct.

To measure *information systems resources*, we developed a formative scale based on Wade and Hulland (2004) that identifies eight key information systems resources including external and internal relationships management, market responsiveness, IS planning, managerial and technical IT skills, IS development, and effective IS operation. The respondents were presented with a description of these key IS resources and asked to indicate the extent to which their firms possess these resources. To measure *external pressure* to achieve integrated information delivery, we adopted indicators used in prior studies such as Rai and Patnayakuni (1996) and Teo et al. (2003).

5. Analysis and Results

5.1. Hypothesis Testing Results

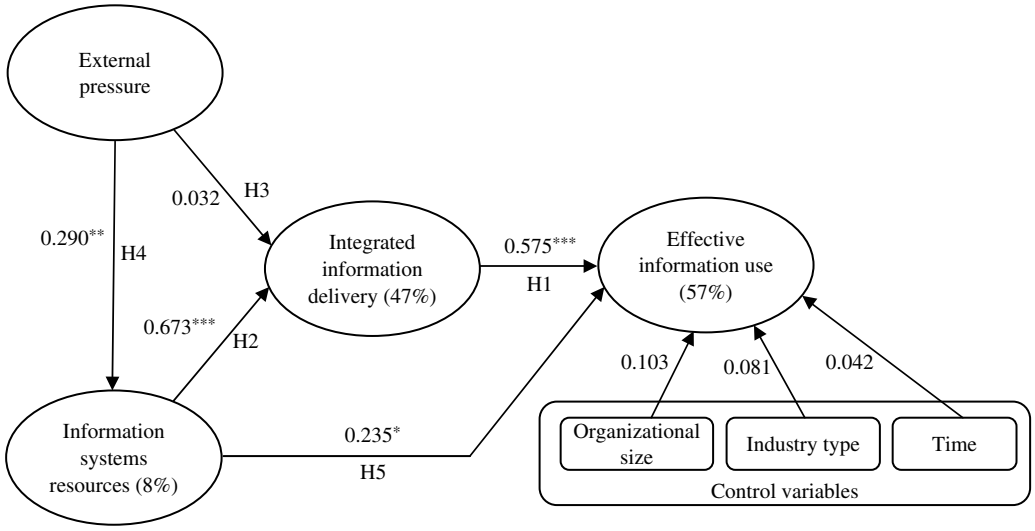
We evaluated psychometric properties of the measures for the latent constructs in the model using exploratory factor analysis. We also checked the convergent validity and the discriminant validity of the constructs as well as the potential for common method bias. Appendix A presents the details of these assessments. We adopted the partial least squares (PLS) approach to test the hypotheses because the main theoretical constructs in our model are formative latent constructs and PLS has been shown to be

[9] Although executives used the term *information* interchangeably in the survey, the context of the survey questions clearly implies token/representations (delivery) and adaptation (use).

Table 2 Scale Items for Constructs

Construct	Measures
Hierarchical information delivery (HID)	Information systems in our firm are linked in such a manner that —Information is available as the line managers need to effectively track operational transactions (e.g., inventory control, sales, receipts, cash deposits, payroll). —Information is available for the managers who are responsible to properly carry out operational transactions to effectively fulfill organizational goals. —Information is available for middle managers to effectively allocate resources. —Information is available as middle managers need to make effective managerial decisions (e.g., budget, sales, and production planning). —Information is available as top executives need to make effective strategic decisions (e.g., mergers and acquisitions, R&D planning, and long term profit planning). —Information is available for top executives to effectively form corporate strategies and policies.
Process information delivery (PID)	Information systems in our firm are linked in such a manner that —Information captured in one part of a business process is available to other parts. —People working in different departments within a business process can easily exchange information. —Within a business process, our company and trading partners can access each other's information at any time. —Within a business process, people working in our firm and trading partners can easily exchange information with each other.
Effective information use in strategies (EIUS)	Relative to other firms in our industry, our firm is successful in applying information to support the business strategy of —Having manufacturing/operations flexibility. —Providing value-added services. —Entering new markets. —Enhancing supplier linkages. —Enhancing existing products/services.
Effective information use in activities (EIUA)	Relative to other firms in our industry, our firm is successful in applying information to execute —Manufacturing/operations activities. —Marketing activities. —Customer services activities. —Enhancing supplier linkages. —Sales activities.
Coercive pressure (CP)	We perceive pressures to integrate our enterprise systems because our dominant business partners (e.g., customers, suppliers, strategic alliances, joint venture partners) —Ask that we review information regarding system integration. —Recommend that we do so. —Request that we do so. —Require that we do so. —Promise benefits to be received from integrating enterprise systems (e.g., discounts, faster orders). —Make threats regarding detriments (e.g., discontinuing the relationship, receiving poorer services) that would result if our organization does not integrate our information systems.
Mimetic pressure (MP)	We perceive pressures to integrate our enterprise systems because —Many companies that we compete with have integrated their enterprise systems. —A majority of companies in our industry have integrated their enterprise systems. —Prestigious companies in our industry have integrated their enterprise systems. —Large companies in our industry have integrated their enterprise systems. —Our competitors that have integrated their enterprise systems are benefited greatly. —Our competitors that have integrated their enterprise systems are perceived favorably by others in our industry.
Normative pressure (NP)	We perceive the ——— as a reliable and important source in learning the benefits of systems integration. —Industry association —Professional association —Trade media (e.g., videos, audio tapes, books, or trade publication) —Academic institute (e.g., university)
Information systems resources (ISR)	Our IS function has the ability to effectively —Manage its IS-related relationships with the key stakeholders outside the firm. —Develop IS projects rapidly based on market conditions. —Build strong partnerships with other areas within the firm. —Accommodate change. —Keep the IS infrastructure running smoothly. —Leverage technical expertise. —Bring new technologies into the firm that address competitive needs. —Provide cost-effective IS services.

Figure 2 Hypotheses Testing Results



Note. Significant levels: * < 0.05, ** < 0.01, *** < 0.001.

particularly robust in handling formative constructs, whereas alternative measurement methods may have identification problems (Chin 1998, Gefen et al. 2011, Yi and Davis 2003). Furthermore, it has been recognized that PLS can accommodate relatively smaller sample sizes (Gefen et al. 2011). We tested our structural model using a two-step procedure as described in Agarwal and Karahanna (2000) as well as Yi and Davis (2003). To obtain valid and stable estimates of the significance level for the path coefficients in the PLS model, we used a bootstrapping approach to generate 200 random samples of observations from the original data set.[10] Figure 2 presents the path coefficients and explained variances in our research model. The outer model loadings are summarized in Appendix B.

The results support our argument about the critical role of integrated information delivery in organizations. Hypothesis 1 proposes that the extent of integrated information delivery by the organization's information systems has a positive influence on effective information use, which is supported ($\beta = 0.575$, $p < 0.001$). Overall, it is confirmed that the organization's information systems' ability to deliver integrated information to people in the organization's hierarchy and processes positively influences the effective organizational use of information to support business activities and strategies.

[10] Organizational size is measured by both the number of employees in the company and the company's revenue in the most recent reporting year, both of which are reported by the survey respondents. Industry is a categorical variable representing whether the company is in the manufacturing, service, or other industry. Time represents the number of years that the company has invested heavily in integrating its amalgam of information systems.

Second, the findings indicate that the relationship between external pressure and integrated information delivery is mediated through IS resources rather than a direct relationship. H3, which hypothesizes a direct link between external pressure and integrated information delivery, is not supported ($\beta = 0.032$, n.s.). In contrast, the results show strong support for both H2 and H4. The external pressure perceived by senior managers positively influences the amount of IS resources that the organization has ($\beta = 0.290$, $p < 0.01$), which in turn directly influences the extent of integrated information delivery by the organization's information systems ($\beta = 0.673$, $p < 0.001$). Although senior executives may realize the importance of achieving integrated information delivery in their companies, in an environment where partners, trade organizations, and other institutions exert an influence on businesses' practices, such pressure may not necessarily lead to actual improvement of information delivery. Instead, the perceived pressure influences the degree of integrated information delivery through IS resources as a mediator because the organization needs to possess sufficient IS resources and capabilities to cope with the technical challenges that organization-wide integrated information delivery may entail.

Third, we argue that the ability of the firm's information systems to deliver information to people throughout the firm may not always lead to better utilization if people are unable to interpret or effectively use the information delivered to them. Our results suggest that IS resources have a positive impact on the effective use of information to support value-chain activities and business strategies (H5) ($\beta = 0.235$, $p < 0.05$). Such a direct effect of IS resources on effective information use may indicate that the

Table 3 Interviewee Demographics

Company name	Industry	Number of employees	Job title
FinancialA	Financial services	More than 5,000	Chief operating officer
FinancialA	Financial services	More than 5,000	Chief human resource officer
ManufB	Consumer goods manufacturing	More than 10,000	Vice president of strategic planning and finance
ManufC	Equipment manufacturing	More than 5,000	Chief operating officer
ManufC	Equipment manufacturing	More than 5,000	President of Canadian subsidiary
MgmtD	Claim management services	More than 5,000	Executive vice president
MgmtE	IT services	More than 1,000	Chief executive officer
PharmF	Pharmaceutical	More than 10,000	Global director of R&D engineering

IS function plays an important role in cultivating the appropriate information culture and encouraging proper use of information in the organization. This role may be achieved by communicating with business users, bringing them up to speed with the systems, and helping them become aware of the informating capabilities of the systems (i.e., what information is made available to them and how to access information in an efficient manner).

5.2. Post Hoc Interviews with Senior Executives

Given the results above providing quantitative support for all but one of our hypothesized relationships, we conducted in-depth post hoc interviews with a group of senior executives to further explore their "view from the top" related to the nomological network proposed in this study. The post hoc qualitative interviews were with medium to large organizations outside of the original survey sample to minimize the influence of the original survey instruments on the interviewees' responses and to further support the external validity of the study. These companies were selected from multiple sectors such as industrial goods, consumer goods, financial, services, etc. We conducted eight semi-structured interviews for six case sites with senior business executives (see Table 3 for details). These executives include CEO, COO, president, chief human resource officer, and so on.

Interviews confirmed our hypothesized relationships. Companies effectively use information provided by their information systems for strategic and value-chain activities such as refining strategic focus, improving customer relationships, reducing cost, honing product pricing, and restructuring.

> "Information forms the starting point for dialogues among people. It is a shared language to communicate with managers and front-line specialists." (EVP of MgmtD)

> "We rolled out the Salesforce.com relationship management platform.... You load it with customer information.... We are able to send leads to relationship managers and front-line people relative to specific customers for specific products.... If a customer calls a branch or relationship manager, we can go to that customer's profile and see if there are any leads, recommendations, offers that we need to be talking about with that customer... [it] may be a service request or question, and we turn it into a selling opportunity." (COO of FinanialA)

When asked about the role of the IT function and information systems resources in achieving integrated information delivery, these senior executives emphasized that "IT isn't about just running hardware and software but it is about providing business information" and setting the strategic IT direction for the company. Consistent with our argument earlier about the token view of information, these executives indicated that the IS department is responsible for making sure that the systems are functioning properly and are delivering the tokens.

> "At the front line, the supervisory, and the middle management level, I think the industry and the bank is becoming reasonably successful in providing data about what has happened in the work process during the previous day, the previous week, any previous period. The higher you go up the management chain, the less satisfaction and the bigger the gap. Much more data is needed to be a senior or an executive leader. And the issue is that data [delivered] needs to be integrated." (Chief human resource officer of FinancialA)

More importantly, the IS department and the business departments jointly play a critical role in ensuring the right information is being delivered (representation view of information). The business users need to be involved in the decision making process related to implementing or modifying information systems by clearly articulating what information is critical to their business needs.

> "There is a person who directly reports to the CIO who is working on enterprise data services project, where we are very thoroughly going through and finding data silos, consolidating them, finding what we call satellite reporting areas, and figuring out how to rationalize them into a single source of the truth." (COO of FinancialA)

Senior executives also confirmed the influence of the IT function on effective information use. When

changes are introduced to the systems that deliver information, IT personnel need to be concerned with not only the technical implementations but also the business people who will be affected by these changes. Training, change management, and collaboration with business users of information are critical to ensure successful application of the right information delivered to them.

> "We have a formal process, a project management process that involves also change management around people. So for introducing changes to the system, have we thought about the training, the communications, the enthusiasm of the people who are going to use the system, and make sure they actually use it?" (Chief human resource officer of FinancialA)

Furthermore, the interviews also shed light on how senior business executives evaluate the extent of integrated information delivery and effective information use in their organizations. They distinguish information delivery along the organizational hierarchy and also tend to evaluate information delivery by functional areas.

> "On the manufacturing side, I think they are receiving the data that they need to manage their floor very well on a daily basis. They have the tools. The information is more readily available.... On the sales side...the information is not available to mine at a granular level...as a sales person, you have to move around. When you order, you have to be able to determine what the margins look like. That's not readily available." (President of Canadian subsidiary of ManufC)

Senior executives adopt a number of practices to assess whether the people in their companies have access to information (tokens delivered by information systems) that is tailored to their specific needs at work (whether they are able to interpret the tokens in a meaningful way). They do so through understanding the systems that have built-in information push capabilities, formal meetings, reports, and conversations that allow them to drill down to the levels below as well as informal interactions where they directly observe, probe, and listen to people at lower levels. Table 4 shows some representative practices that senior executives employ to assess information delivery and improve information use.

6. Discussion

6.1. Implications for Research and Practice

First, although information delivery and information use are closely related aspects of how information creates value in organizations, existing IS literature lacks empirical studies that describe the role of IT in delivering integrated information and the corresponding effect on successful use of such information. Our findings indicate that pressure from the external environment in which the firm operates influences the development of its information systems resources, which then influences the information delivery throughout the firm as well as the extent of the firm's effective information use. Both quantitative and qualitative results highlight the importance of the IS function as the core facilitator of integrated information delivery as well as an educator and nurturer of a strong organizational information culture that leads to effective information use.

Secondly, this study extends the theoretical development related to information. Building upon the taxonomy of information proposed by McKinney and Yoos (2010), we adopt multiple views of information (token view, representation view, and adaptation view) and incorporate these views in a theoretical framework by examining the *process* of making information available and making use of information. Compared with the McKinney and Yoos argument that the series of views have recursive relationships, our emphasis is that the series of views may be considered as steps of an information process associated with providing information that is contextually meaningful and applying information to adapt behaviors (Beynon-Davies 2010).

This study highlights the need for researchers to articulate which perspective they are adopting when studying the concept of information because the scope, definition, and granularity of information in research is dependent on its specific perspective. In this research we adopt a senior business executive's perspective to examine how they perceive the information delivery and use in their organizations, extending the senior executive oriented IS research (e.g., Armstrong and Sambamurthy 1999, Liang et al. 2007, Tai and Phelps 2000, Teo et al. 2003). However, a bottom-up study of information use from the front-line employee's standpoint is likely to require a somewhat different informational perspective because the front-line employee has less knowledge of the overall organization's information behavior than the senior executive does.

Third, this research emphasizes the need for senior executives to adopt an information-oriented focus given the critical role of information capabilities in enabling and improving business strategies and capabilities (e.g., Granados and Gupta 2012, Kettinger and Marchand 2011, Mithas et al. 2011). It is increasingly imperative for firms to adopt a holistic approach to information management and to develop an explicit information strategy that is aligned with both the business strategies and the IT strategies (Granados and Gupta 2012). In our qualitative interviews, senior executives echoed the importance of treating integrated information delivery as a strategic issue.

The integrated information delivery construct proposed in this research and how it is measured provide

Table 4 Representative Practices Employed by Senior Business Executives to Assess and Improve Integrated Information Delivery and Effective Information Use

Practices	Quote
Setting the strategic direction for the IS resources with an emphasis on integrated information delivery	"We'd like to see (information delivery) happen (through) a centralized utility or group because when you start creating segregated data silos, you start getting inconsistency in numbers, both from the standpoint of the amount and format. You talk about people getting the right information and they understand what we think is important; if you can drive that through intentional development of your reports, then you diminish or mitigate the risk that the message gets diluted, that the priority gets changed, or that the data gets inaccurate . . . ." FinancialA, COO
Gaining operational understanding of information systems and their use	"On one hand, technology enables front-line specialists' use of information in an automated manner. On the other hand, we have custom-built software solutions and commercial off-the-shelf systems . . . (that) prompt a person to enter the information. If the information is not entered, the report will escalate up to the managers." MgmtD, EVP
Periodic formal meetings that are fact based demonstrating effective information use	"(Our senior executives) expect you will take the time and effort to do those proof points . . . (and) show the analysis to substantiate the conclusions that you draw . . . it would be expected that you have gone through your proofs before you make that comment . . . I have to present to our CEO frequently and my backup slides contain all the proof points for everything I just said when the presentation is presented. And that is not uncommon in (our company)." ManufB, VP
Use cascading dashboards and performance indicators to facilitate monitoring and communication both hierarchically and cross-functionally	"Through systems we have developed cascading internal operational scorecards, including a series of operational performance and financial metrics, with over 50 key business metrics. These metrics are monitored daily, weekly, and monthly. These measures are summarized to every level of the organization. Some measures are entered at the job level by front end specialists, a lot of them are automated and entered by systems, others are manually created and filled in by managers. About 75% of the specialists, managers, and executives have information delivered to them in dashboards. Of course these are aggregated up through the levels and I am consistently drilling down and probing to see we are on track." MgmtD, EVP
Exception reporting when there are problems with information delivery	"The users at that time communicated with the IT department on how they want this transaction to be handled. In one program they didn't highlight it and in another program they did. An exception report came out showing that difference." ManufC, COO "We would break down the projects into the smallest elements and then summarize them up by activity, task, and the whole project management structure. We watched it at the activity level and the stage. When there were issues and there was anything that looked flashing red, they would bring it to me and we discussed how to technically try to get around it or conserve time or use other resources." MgmtE, CEO
Management by walking around: informal conversations with individuals on the quality of information delivered and how it is effectively used	"From a manufacturing standpoint, people do daily walks on the floor on a daily basis. Go and see what we call a whiteboard indicators" ManufC, President "The other thing I would tell you is, you walk around, going into a branch, or you join a call with an individual, you will find out quickly if they are talking the same language as you are. And I would tell you that generally speaking they are . . . if you want to find out . . . what information isn't being used, all you've got to do is to ask somebody where do you think we are wasting your time, what do we ask you to do you don't think is productive. . . . If you are giving them bad leads, they are going to tell you. If you are giving them information that is no good, they are going to tell you." FinancialA, COO
Making information available and holding people accountable for their information usage behavior	"I believe in providing individuals access to data regardless of their levels in the organization. Information needs to be transparent and we need to hold people accountable for their information behavior . . . . It is important to translate data to people through an emotional connection. We need to be sensitive to individuals' context and needs." MgmtD, EVP

guidance for information-oriented senior executives to evaluate the delivery of information by IT. Furthermore, as evidenced in Table 4, this study provides practices that senior executives may use to assess and improve information delivery and information use in their organizations. Our qualitative interviews with senior executives indicated they made special efforts to gain deep knowledge of how information delivery and use adds value in their companies. They conveyed this knowledge in strategic directives, formal meetings, and personal conversations at all levels of the company. They promoted formalization and transparency of information use where possible, fact based communication and a culture where people can demonstrate their proof-of-concept, periodic coaching and feedback sessions on proper information use, design of metrics capturing impactful information use, and exception reporting and correction when information delivery and use did not produce expected results.

Furthermore, the IS department and the business departments jointly play a critical role in ensuring the *right* information is being delivered and used. Business stakeholders need to clearly articulate what information is critical to their business needs and how such information will be used. IS staff members need to improve their business knowledge regarding how information is embedded in business processes and practices when communicating with business stakeholders. Equipped with sufficient understanding of how information is used by business stakeholders, IS people can, and should, play an important role in promoting a strong information-oriented culture in the organization. This probably requires that they move beyond their technical comfort zone and take on more responsibility for the *people* side of change management when new systems are put in place. For example, they can provide training to business users on the information capabilities of the systems and how to access information in an efficient manner. They can develop metrics capturing how well business users are accessing information provided by the systems and how such metrics may become part of a scorecard that measures individual information usage behavior. In essence, as was empirically represented in the research model, the IS function has a dual responsibility to ensure effective information delivery and effective use, and senior business executives can be expected to hold the IS function accountable for both roles.

6.2. Limitations and Future Research Directions

We also recognize the limitations of this research. Our sampling frame, the alumni database of a business school at a major U.S. state university, is a convenience sample and may limit the generalizability of our findings. However, our sample consists of senior executives from firms of various sizes in various industries and geographic regions. Future research may broaden the sampling frame to improve the generalizability of the results. In addition, the use of a single informant from each firm in the survey may result in possible overreporting or underreporting of certain phenomenon because of the top executive's personal traits, experience, and background. We recognize that having multiple responses from the same firm enables cross-validation and provides evidence with respect to inter-rater reliability.

A stream of organizational information-oriented research may be built upon this study that focuses on various perspectives, adopts alternative research methodologies and data sources, or investigates alternative theoretical lenses. For example, the delivery and use of information may be investigated from the perspective of middle business managers, front-line employees, or IS managers using appropriate units of analysis. With each perspective, information has a different level of granularity and scope. The findings from various perspectives help build a more comprehensive theory around information in organizations and advance our understanding of how individuals gather, interpret, and act upon information at different organizational levels and functional areas.

The multilevel perspective of information usage in organizations presents a research opportunity to expose the dynamics of the individual-collective perspective, identify the antecedents of the emergence of collective information usage, and understand the configurable relationships between individual and collective usage patterns. We would like to conduct a more in-depth study and present information use as a multilevel construct (i.e., firm level, functional area level, individual level) examining the whole as well as its parts (Burton-Jones and Gallivan 2007, Burton-Jones and Grange 2013, Kozlowski and Klein 2000, Nan 2011).

Future research methods may utilize a combination of primary and secondary data. For instance, objective data capturing employees' actual use of delivered information as well as their subjective assessment of information delivery and use would help us better understand actual usage behavior and what factors influence such behavior, providing insights to managers on how to facilitate and encourage effective information use. Relatedly, research should delve into the quantification of the cumulative effect of individual use of information and how it results in cumulative organizational use impacts, as suggested by Burton-Jones and Grange (2013) and Nan (2011). This appears to be a good opportunity to employ multilevel quantitative and qualitative research techniques. Other theoretical lenses such as critical realism and knowledge-based view of the firm may be applied to examine information behavior in the organizational context.

Information delivery from a technical perspective may be examined by measuring the extent to which the information infrastructure is integrated within a particular firm, such as by mapping the connectivity of information elements on a corporate information model and assessing the degree to which the elements are available across different information systems and business processes. Further effort can then focus on the relationship between such an objective measure of integrated information delivery and individuals' use of information in the organization. Finally, the role of integrated information delivery may be contingent on organizational factors such as information intensity and geographic dispersion of the firm. A contingency model would be useful to identify under what conditions integrated information delivery leads to greater improvement in effective information use.

Acknowledgments

The authors acknowledge the important guidance provided by Senior Editor Vallabh Sambamurthy, Associate Editor Michael Wade, and the anonymous reviewers for suggesting the addition of post hoc qualitative analysis and their constructive comments.

Appendix A. Measurement Validation

We evaluated psychometric properties of the measures for the latent constructs in the model using exploratory factor analysis. In an iterative process we dropped the items with loadings lower than 0.70 and reran the factor analysis until all items loaded on their intended constructs with loadings above 0.70. The construct *integrated information delivery* (IID) was assessed along two dimensions: hierarchical information delivery (HID) and process information delivery (PID). Each dimension was evaluated with six items. All items for HID loaded highly onto a single construct. Two out of six items measuring PID were dropped. The construct *effective information use* (EIU) was measured by two dimensions—effective information use in activities (EIUA) and effective information use in strategies (EIUS). All items had loadings above 0.70 on their intended constructs. The construct *external pressure* was measured in three dimensions: coercive pressure (CP), mimetic pressure (MP), and normative pressure (MP). Each dimension consisted of six items. Two items measuring NP were dropped and the remaining items all exhibited high loadings on the construct that they intended to measure. For the construct *information systems resources* (ISR), factor analysis showed that the eight items loaded onto a single construct.

Convergent validity for each first order construct was assessed with item loadings, internal consistency reliability (ICR), and average variance extracted (AVE). Table A.1 presents the factor structure matrix of loadings and cross loadings. Despite the presence of some cross loading, all items load more highly on their intended latent constructs than on other constructs. Item loadings on assigned constructs are high (> 0.70), well above the 0.55 threshold suggested by prior studies (Hair et al. 1998). Furthermore, we computed ICR or composite reliability based on the standardized component loading of an indicator on a latent construct (Chin 1998). The ICR for each construct ranges from 0.88 to 0.96, above the recommended 0.70 threshold (e.g., Agarwal and Karahanna 2000, Yi and Davis 2003). In addition, the square root of the AVEs, shown in the diagonal of Table A.2, ranges from 0.81 to 0.90, exceeding the threshold of 0.707 suggested by Chin (1998).

Discriminant validity indicates the extent to which a given construct differs from other constructs. Chin (1998) suggests adequate discriminant validity is demonstrated through two criteria. First, a construct's square root of AVE should be greater than that construct's correlation with other constructs (Fornell and Larcker 1981). Second, the loadings to latent variables that an item intends to measure should be greater than those to other latent variables. When the inter-construct correlations and square root of AVEs were compared, all constructs shared more variance with their indicators than with other constructs (see Table A.2). All items exhibited higher loadings on their respective constructs than those in the corresponding rows and columns. The results provide evidence of discriminant validity.

Table A.1 Results of Factor Analysis

Construct/items	HID	PID	EIUS	EIUA	CP	MP	NP	ISR
HID1	**0.83**	0.51	0.48	0.50	−0.03	0.15	0.20	0.53
HID2	**0.90**	0.56	0.53	0.59	−0.03	0.01	0.17	0.61
HID3	**0.87**	0.55	0.59	0.51	0.06	0.12	0.20	0.53
HID4	**0.92**	0.60	0.66	0.60	0.12	0.18	0.21	0.64
HID5	**0.93**	0.64	0.69	0.64	0.06	0.11	0.27	0.64
HID6	**0.91**	0.63	0.62	0.68	−0.02	0.09	0.24	0.64
PID1	0.58	**0.82**	0.50	0.43	0.05	0.11	0.11	0.54
PID2	0.59	**0.92**	0.43	0.47	−0.01	0.03	0.09	0.56
PID3	0.52	**0.82**	0.39	0.34	−0.08	−0.02	0.07	0.45
PID4	0.46	**0.76**	0.32	0.39	0.04	0.07	0.10	0.52
EIUS1	0.49	0.42	**0.75**	0.57	0.07	−0.04	0.12	0.37
EIUS2	0.46	0.31	**0.71**	0.42	0.33	0.18	0.31	0.42
EIUS3	0.59	0.38	**0.90**	0.64	0.24	0.03	0.25	0.52
EIUS4	0.64	0.52	**0.93**	0.66	0.15	0.08	0.26	0.58
EIUS5	0.51	0.37	**0.74**	0.58	0.07	0.13	0.16	0.55
EIUA1	0.58	0.39	0.59	**0.85**	0.09	0.09	0.17	0.45
EIUA2	0.53	0.35	0.60	**0.85**	0.18	0.04	0.16	0.50
EIUA3	0.59	0.44	0.58	**0.81**	0.15	0.11	0.16	0.45
EIUA4	0.48	0.44	0.53	**0.76**	0.10	−0.08	0.18	0.47
CP1	0.00	−0.03	0.16	0.10	**0.89**	0.29	0.31	0.13
CP2	0.03	−0.01	0.18	0.12	**0.94**	0.31	0.33	0.15
CP3	−0.03	−0.04	0.19	0.11	**0.95**	0.21	0.30	0.11
CP4	0.03	0.02	0.21	0.15	**0.92**	0.17	0.27	0.12
CP5	0.09	0.05	0.27	0.22	**0.89**	0.31	0.24	0.14
CP6	0.00	0.00	0.15	0.06	**0.77**	0.14	0.24	0.06
MP1	0.10	0.01	0.08	−0.01	0.22	**0.91**	0.32	0.12
MP2	0.14	0.10	0.06	0.00	0.26	**0.89**	0.35	0.15
MP3	0.02	0.07	0.05	−0.04	0.21	**0.86**	0.33	0.09
MP4	0.10	0.11	0.09	0.04	0.13	**0.85**	0.30	0.10
MP5	0.14	0.04	0.12	0.09	0.31	**0.92**	0.42	0.19
MP6	0.10	0.01	0.10	0.03	0.28	**0.92**	0.40	0.14
NP1	0.27	0.12	0.17	0.11	0.21	0.47	**0.78**	0.26
NP2	0.19	0.07	0.17	0.07	0.17	0.37	**0.79**	0.23
NP3	0.19	0.13	0.25	0.21	0.27	0.24	**0.83**	0.23
NP4	0.16	0.05	0.31	0.24	0.33	0.28	**0.84**	0.20
ISR1	0.49	0.45	0.50	0.45	0.18	0.27	0.23	**0.77**
ISR2	0.59	0.55	0.51	0.53	0.07	0.18	0.26	**0.88**
ISR3	0.61	0.52	0.50	0.54	0.13	0.25	0.29	**0.88**
ISR4	0.60	0.59	0.57	0.46	0.12	0.09	0.20	**0.89**
ISR5	0.53	0.52	0.43	0.40	0.04	0.12	0.13	**0.75**
ISR6	0.58	0.50	0.48	0.42	0.03	0.20	0.21	**0.80**
ISR7	0.55	0.51	0.57	0.48	0.17	0.12	0.24	**0.85**
ISR8	0.46	0.37	0.42	0.47	0.16	0.09	0.32	**0.71**

Note. Bolded loadings are associated with items included in each construct.

Because our measures of the latent constructs were self-reported from the same respondent, common method biases, caused by variance attributable to the measurement method instead of the intended constructs that the measures represent, may be problematic. We used two statistical techniques to determine the severity of common method bias in our data. First, we used Harman's one-factor test to detect whether a single factor can account for all variances in our data (Podsakoff and Organ 1986). Exploratory factor analysis indicates that one factor is not sufficient to capture all of the variance in our data. Next, we adopted another statistical technique suggested by Podsakoff et al. (2003) to evaluate the severity of common method bias. We controlled for the effects of an unmeasured latent methods factor by adding a latent common methods variance factor to our

Table A.2 Composite Reliability and Inter-Construct Correlations

Construct (number of items)	Composite reliability	HID	PID	EIUS	EIUA	CP	MP	NP	ISR
HID (6)	**0.96**	0.90							
PID (4)	**0.90**	0.65	0.83						
EIUS (5)	**0.90**	0.67	0.50	0.81					
EIUA (4)	**0.89**	0.66	0.49	0.70	0.82				
CP (6)	**0.96**	0.03	0.00	0.23	0.16	0.90			
MP (6)	**0.96**	0.12	0.06	0.10	0.03	0.27	0.89		
NP (4)	**0.88**	0.24	0.11	0.29	0.21	0.31	0.41	0.81	
ISR (8)	**0.94**	0.67	0.63	0.61	0.58	0.14	0.16	0.28	0.82

Appendix B. PLS Outer Model Loading

Construct	PLS outer model loading
Integrated information delivery	
Hierarchical information delivery	0.811***
Process information delivery	0.260*
Effective information use	
Effective information use in strategies	0.632***
Effective information use in activities	0.449**
External pressure	
Coercive pressure	0.019
Mimetic pressure	0.266
Normative pressure	0.869***
Information systems resources	
ISR1	0.861***
ISR2	0.843***
ISR3	0.881***
ISR4	0.878***
ISR5	0.829***
ISR6	0.908***
ISR7	0.834***
ISR8	0.779***

Note. Significant levels: * < 0.05, ** < 0.01, *** < 0.001.

structural model and the variance of each observed indicator consists of trait variance, method variance, and random error (Podsakoff et al. 2003). We followed the approach described in Liang et al. (2007) to compute and compare the amount of variances caused by the intended constructs and the method for each measurable indicator. Most of the method factor loadings are insignificant. The ratio of average trait variance to method variance is 50:1. These results suggest that common method variances are unlikely to be problematic in our data.

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