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Governance of Supply Chain Information Flows

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Governance of Supply Chain Information Flows

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ABSTRACT

With the recognition of the criticality of information flow in the supply chain, much research has examined various pertinent areas such as information sharing and the use of IT applications, and generated valuable insights about how an organization could reap the benefits through an effective supply chain information flow by building on the implicit assumption that organizations in the supply chain cope with issues around supply chain information in a similar way, which would lead to the conjecture that the quality of supply chain information is equivalent across supply chain members. However, many organizations still struggle for poor information flow in the supply chain. This suggests that the implicit assumption made in the literature may not hold in practice. By challenging this unstated and flawed assumption, this dissertation adopts a governance perspective on supply chain information flow, i.e., information governance, and positions information governance in the realm of supply chain management. Specifically, this dissertation unpacks information governance by identifying its key elements and delves into the nature of the relationships between the key elements of information governance and supply chain performance. This dissertation further investigates the arrangement of the information governance and supply chain strategies and its performance implications in a hospital context. The findings of this dissertation contribute to facilitating an understanding of information governance in the supply chain context by providing theoretical and empirical support. Managerial implications and future research directions are also presented.

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CHAPTER 1 DEFINING THE RESEARCH

BACKGROUND AND MOTIVATION

The purpose of supply chain management (SCM) is to integrate business processes that span the organizational boundaries of supply network members to create value for each stakeholder (e.g. consumers, buyers, suppliers, and shareholders) (Cooper, Lambert, & Pagh, 1997; Silvestro & Lustrato, 2014). The effective SCM requires not only the integration of material flows but also the integration of information flows in the supply chain (Frohlich & Westbrook, 2001; Trent & Monczka, 1998). According to the SCM framework developed by Cooper et al. (1997), information flows represent a key management component that can influence the integration of business processes across the supply chain. Information flows are also recognized as a foundation of supply chain integration because they are designed around material flows and streamline material flows throughout the supply chain (Lewis & Talalayevsky, 2004; Moberg, Whipple, Cutler, & Speh, 2004; Vanpoucke, Boyer, & Vereecke, 2009). Hence, information flows are deemed critical to supply chain performance (Cooper et al., 1997; Ellram, Tate, & Billington, 2004; Sahin & Robinson, 2002).

A prevailing sentiment in the supply chain literature is that supply chain information flows enable better responsiveness and coordination of business processes that span the entire supply chain, through greater access to vital supply chain information (Kembro, Selviaridis, & Näslund, 2014; Williams, Roh, Tokar, & Swink, 2013). Access to and the exchange of vital supply chain information in the supply chain is typically facilitated by IT applications (e.g. enterprise systems, vendor managed

inventory solutions and electronic data interchange) (Petersen, Ragatz, & Monczka, 2005). Extant research on supply chain information flows can be grouped into a variety topical areas. Those topical areas include information sharing (Chatfield, Kim, Harrison, & Hayya, 2004; Samaddar, Nargundkar, & Daley, 2006; Zhou & Benton, 2007), adoption and use of inter-organizational IT applications (Autry, Grawe, Daugherty, & Richey, 2010; Craighead, Patterson, Roth, & Segars, 2006; Sanders, 2007; Vijayasarathy & Robey, 1997), types of information (e.g., inventory, product location and condition, and warehouse operations information) (Lumsden & Mirzabeiki, 2008; Moberg et al., 2004), and information quality (e.g., accuracy, timeliness, completeness, and relevance) (Forslund, 2007; Li & Lin, 2006; Petersen et al., 2005). Of the areas of research, the predominant focus is on investigating issues around information sharing, in terms of the advantages of information sharing and the ensuing impact on supply chain performance.

In essence, a large body of the research on supply chain information flows focuses on behaviors, such as how much information and which information to share and frequency of information sharing, and activities, such as the use of IT applications to increase the volume and expedite the movement of the information in the supply chain. Hence, it can be argued that, to date, the supply chain literature has primarily taken either a tactical or operational perspective with respect to investigating information flows. However, given the strategic importance of SCM, and the instrumental role that information flows play in the effectiveness of SCM, there is a need for rigorous research that examines information flows from a more strategic perspective. More specifically, there is an opportunity to explain what contributes to desirable

behaviors with respect to information flows and exchanges in the supply chain, and quantify the organizational impact of those desirable behaviors.

But, how can an organization ensure such behaviors or activities associated with supply chain information flows? For example, how can an organization ensure the appropriateness of information sharing? How can an organization ensure that the information exchanged with supply chain partners is accurate, timely, and relevant? In practice, many organizations still struggle for poor information flow in the supply chain (Oracle, 2010). For instance, the supply chain glitches facing Target Canada Inc. demystify why addressing the questions mentioned above is so critical to organization's success. In Target Canada Inc, some barcode information did not match the information stored in the information systems of Target's logistics contractor, which resulted in errors in inventory levels at warehouses and delays in deliveries to stores. As a result, Target stores in Canada experienced understocked shelves, which in turn dissatisfied customers who visited stores. Although such issues may have occurred due to the mistakes of supply chain members (e.g. buyers and vendors) and/ or a glitch in their warehouse information system (Norton, 2014), the more serious problem was that Target Canada Inc. could not identify and trace where the problem originated in the supply chain, due to a lack of information governance, referred to as an organization-wide approach that specifies the roles and responsibilities and implements the policy and procedures with respect to the information (Khatri & Brown, 2010; Tallon, Ramirez, & Short, 2013a). In consequence, customers' complaints about empty shelves that seem to be indicative of a lack of information governance in the supply chain were considered one of the reasons for Target's decision to close all stores in Canada.

Although the criticality of governing information in the supply chain is evident in practice, there has been little guidance from academia in terms of how to *govern information* in the supply chain and whether there is value in governing such information. To further this point, most supply chain research does not delineate the quality of the information exchanged in the supply chain when touting the benefits of information sharing in supply chains. As such, there appears to be an implicit assumption that the quality of information exchanged, or at least treatment of the information shared between supply chain members, is equivalent across organizations in the supply chain. Such flawed assumption could lead to erroneous conclusions about the value of information sharing in the supply chain; some previous studies indicate that the benefits of information sharing are limited or doubtful due to the complexity and risks associated with the SCM (Samaddar et al., 2006; Vanpoucke et al., 2009). This may account for inconclusive results with respect to the advantages of the information exchange in the supply chain. This empirical ambiguity indicates that there exists a lack of governance perspective on supply chain information in the extant literature.

Governance, in general, refers to a set of mechanisms (e.g., structures and processes) designed to encourage desirable behaviors (Armstrong, Guay, & Weber, 2010; Weill, 2004). Paralleling the concept of governance, information governance can be viewed as a set of mechanisms that an organization designs and implements to cope with issues around the direction and control of supply chain information, which could influence the way of performing tasks associated with information processing and exchange in the supply chain context. Hence, the discussion above points to the need

for exploring the implications of information governance from a supply chain perspective.

STATEMENT OF OBJECTIVE

The extant literature offers a rudimentary understanding of the concept of information governance in the realm of the SCM. Although the meaning of information governance has been discussed in both academia and practice, there exist divergent perspectives on information governance. For example, whereas Silic and Back (2013) conceptualize information governance as a set of mechanisms (e.g., policies, procedures, and processes) for managing organizational information, Hulme (2012) defines information governance as a holistic approach that deals with the information quality, security, and lifecycle management for the business benefits. These divergent perspectives could lead to the ambiguity of the concept of information governance in the academic literature. This confusion as to its meaning may account for the current status that the notion of information governance garners little academic attention in the supply chain literature. Likewise, there exists a lack of understanding of how information governance contributes to supply chain excellence. To date, I was not able to find any theory-based research that explores the implications of information governance in the supply chain context. Even the information systems (IS) literature is silent on how an organization can benefit from information governance (Tallon et al., 2013a; Tallon, Short, & Harkins, 2013b).

In addition, there is no empirical research that investigates the relationship between information governance and supply chain performance. Most of the academic

literature pertaining to the benefits of information governance is anecdotal or speculative (Blackmer, 2014; White, 2013). In other words, the extant literature lacks the empirical support that could not only advance the understanding of the importance of the governance of supply chain information flow but also guide practitioners on addressing issues associated with information flows in the supply chain.

Therefore, this dissertation aims to (a) conceptualize information governance in the supply chain context, (b) develop a theory-based framework to delineate how information governance translates to superior supply chain performance, and (c) quantify the benefits of information governance from a strategic perspective by empirically testing the nomological net of relationships that take into account a supply chain strategy. Specifically, this dissertation addresses the following research questions:

RQ1: What are the key aspects of information governance in the supply chain context?

RQ2: Which aspect of information governance is more deterministic of information quality?

RQ3: To what degree does information quality in supply chains affect supply chain performance?

RQ4: What is the role of IT infrastructure integration in the relationships between (i) information governance and information quality and (ii) information quality and supply chain performance?

RQ5: How does the arrangement of information governance and supply chain strategies impact supply chain performance and organizational performance?

Consistent with the previously stated research objectives, this dissertation unpacks the concept of information governance and its relationships with the key supply chain concepts by taking two approaches: theoretical and empirical approaches (i.e., first study and second study, respectively). The focus of the first study is on (i) defining and clarifying the conceptual boundary of information governance and (ii) exploring its criticality in the domain of the SCM by using a theory-based approach. The theory-based approach begins with developing a comprehensive definition of information governance as it could demarcate the conceptual boundary of information governance and help to understand it as a multifaceted concept. The first step is to survey the governance literature in multiple disciplines such as management, economics, accounting, and IS and review the existing definitions accepted in practice in order to identify the key tenets of information governance. Then, the results are synthesized to develop a comprehensive definition. The association between information governance and information management is discussed to clarify the boundary of information governance in a nomological network. Subsequently, based on the proposed definition, the key elements of information governance are delineated because the relationships between the key elements help to understand how information governance can affect supply chain performance. This dissertation proposes that information governance is a combination of strategy, structure, and processes by drawing upon multiple disciplines such as organizational theory, strategic management, and IT governance. The second step is to develop a conceptual framework for delineating the nature of the relationships between the key elements of information governance, information quality, and supply chain performance by using the strategy-structure-process-performance (SSPP)

framework as a theoretical lens. Furthermore, the first study explores the role of an organization's IT environment, i.e., IT infrastructure integration, given that an organization utilizes a variety of supply chain technologies to coordinate the flow of supply chain information (Davis-Sramek, Germain, & Iyer, 2010).

The focus of the second study is to empirically investigate the relationship between information governance and the key supply chain concept (i.e., supply chain strategy) and its performance implications from a strategic perspective. By using multiple sources of archival data, the second study assesses the relationships between the configuration of information governance and supply chain strategies, information governance processes, supply chain performance, and organizational performance in a healthcare context. A healthcare setting is appropriate for testing the hypotheses developed because of the following reasons. Information governance was first introduced for tasks at the National Health Society in terms of security and confidentiality arrangements in a healthcare setting (Donaldson & Walker, 2004) and 43% of U.S. hospitals initiated information governance program (Knight & Stainbrook, 2014). The criticality of information governance with respect to SCM is expected to become more salient in a healthcare setting in the near future due to financial and operational challenges facing hospitals from the complicated business environments, depicted as the frequent introduction of new policy programs and initiatives (e.g., ICD-10), the rapid changes in business and technological environments, and the increase in healthcare IT investments (e.g., clinical and business intelligence). Additionally, a hospital supply chain represents a service supply chain that has received little academic attention in the supply chain literature despite the increasing awareness that a hospital's

competitive advantage could be realized from SCM practices (McKone-Sweet, Hamilton, & Willis, 2005). Thus, the healthcare industry forms an appropriate context for testing the predicted relationships.

RESEARCH CONTRIBUTION

This dissertation offers theoretical contributions to multiple streams of research as well as managerial implications. First, this study introduces and positions the notion of IG in the realm of SCM by challenging the unstated and flawed assumption, i.e., the equivalence of information quality in the supply chain. The notion of information governance is positioned as a key theoretical concept that should be considered when the phenomenon of interest is supply chain information flow. In addition, the governance of supply chain information flow, represented as a combination of strategy, structure, and processes, would open up new areas of future research in the supply chain literature and would provide managerial insights into how an organization could address poor supply chain information flow.

Second, this dissertation facilitates the understanding of the nature of information governance in the supply chain context. By using the SSPP framework as a theoretical lens, this dissertation delineates the relationships between the key elements of information governance, information quality, and supply chain performance. The proposed conceptual framework would provide insights into how an organization can benefit from the governance of supply chain information flows as well as mitigate the likelihood of poor information flows in the supply chain.

Third, this dissertation contributes to the literature on the SSPP framework by contextualizing strategy, structure, and processes in the SCM domain from the perspective of information, which extends the SSPP literature that primarily focuses on product-market positioning (Galunic & Eisenhardt, 1994) and examines structural characteristics separately. In this dissertation, information governance strategy refers to an organization's strategic posture toward governing supply chain information while information governance structure is conceptualized as a higher-order construct that includes multiple structural characteristics. This broad view of information governance structure combined with the consideration of information governance strategy facilitates a comprehensive understanding of the role of organization's structural characteristics with respect to information governance.

Fourth, this dissertation is one of the first to examine the benefits of information governance by empirically testing the association between the configuration of the information governance and supply chain strategies, information governance process, supply chain performance, and organizational performance. This dissertation considers information governance and supply chain strategies simultaneously and investigates how the arrangement of the two strategies translates to supply chain performance and organizational performance. The results of this dissertation would provide the empirical evidence that supports the importance of information governance in the supply chain context and would serve as a basis for future research in the governance of supply chain information flows.

Fifth, this dissertation uses a proxy for a hospital's supply chain strategy by using archival data. Given that little research has examined supply chain strategies in a

service context, the findings of this dissertation would advance the service supply chain literature by developing a classification scheme of a hospital's supply chain strategy and providing empirical evidence relating to a supply chain strategy in the service context.

From a managerial standpoint, the proposed framework provides managers the guide on what information governance strategy and structures are appropriate for their organizations and what processes should be implemented for an effective supply chain information flow. This dissertation delves into the blackbox of information governance and depicts it as a combination of strategy, structure, and processes. By identifying three key elements of information governance, this dissertation suggests that an organization be mindful of taking into consideration the multiple aspects of information governance when they adopt and implement information governance programs.

Additionally, the findings of this dissertation offer the empirical evidence of the benefits of information governance in the supply chain context because most of the academic literature pertinent to performance implications of information governance is anecdotal or speculative. In particular, this dissertation considers both information governance and supply chain strategies as an organization's overall strategic orientation towards managing the supply chain. The findings of this study would provide a more comprehensive understanding of the way in which an organization's strategies pertaining to SCM can contribute to performance improvement. Hence, the empirical evidence of this dissertation would serve as a basis for the decision on adopting information governance within the organization and across the supply chain.

Finally, the findings of this dissertation generate insights into what conditions lead to the realization of the information governance benefits from a supply chain

perspective. This dissertation delves into the boundary conditions of the association between information governance and supply chain performance in terms of IT infrastructure integration. Thus, the proposed conceptual framework would provide insights into the complementary role of IT environments in realizing the supply chain benefits from information governance.

ORGANIZATION OF THE DISSERTATION

This dissertation is organized into five chapters. Chapter One introduces the phenomenon of interest of this dissertation and describes the research questions based on the gaps in the literature. Subsequently, the theoretical and managerial contributions of this dissertation are presented. Chapter Two defines the concept of information governance based on a comprehensive literature review, identifies the key elements of information governance, and discusses the relationship between information governance and information management. Chapter Three focuses on delineating the relationships between the key elements of information governance, information quality, and supply chain performance by employing a theoretical approach. A conceptual framework for unpacking the nature of the relationship between information governance and supply chain performance is developed, and five propositions are formulated. Chapter Four empirically investigates the relationships between the configuration of information governance and supply chain strategies, information governance process, supply chain performance, and organizational performance by using archival data in the healthcare context. Both Chapters Three and Four provide a thorough discussion of the current research and future research opportunities. Finally, Chapter Five is devoted to

drawing an overarching conclusion to the dissertation by discussing and integrating the implications of two studies.

CHAPTER 2 CONCEPTUAL DEVELOPMENT

DEFINING INFORMATION GOVERNANCE

Donaldson and Walker (2004) introduced information governance as a comprehensive approach to processing information for the National Health Society (NHS). Since then, information governance has received much popularity from practitioners (Economist Intelligence Unit, 2008; Nguyen, Sargent, Stockdale, & Scheepers, 2014). For instance, the survey results by Economist Intelligence Unit (EIU) show that 77% of respondents expected the importance of information governance for their company's success to increase over the following three years (Economist Intelligence Unit, 2008). According to the survey results by Information Governance Initiative, 75% of practitioners expected that the information governance market would grow in 2015 (Information Governance Initiative, 2014a). On the contrary, research in information governance remains to be scant in the academic literature with the exception of a limited number of studies, most of which used case studies or framework analysis (Tallon et al., 2013a). While there is no agreed-upon definition of information governance in the literature, there exists a lack of understanding of the concept of information governance and its role in the literature (Nguyen et al., 2014). Hence, a comprehensive definition of information governance that reconciles divergent perspectives needs to be developed before discussing why information governance is critical and relevant in the domain of SCM. In order to gain a comprehensive picture, this dissertation follows the steps described below.

Given that research on information governance is in its infancy, this dissertation first reviews the existing definitions of corporate and IT governance, as those definitions can clarify the concept and domain of governance, which could serve as a basis for delineating the concept of information governance, and the proposed definition should be consistent with the concept of governance. In particular, research in IT governance is included in the reviews because it represents a subset of corporate governance and deals with governance issues on IT artifacts in organizations (Prasad, Heales, & Green, 2010; Weill & Ross, 2004).

Second, the existing definitions of information governance in both academic articles and practitioner reports are reviewed to understand and synthesize divergent perspectives on information governance and to identify the key elements of information governance. Then, the key aspects of information governance are delineated by analyzing and categorizing the existing definitions. These key aspects of information governance are used as a foundation for defining information governance. Subsequently, the findings from the first and second steps are synthesized to provide a comprehensive picture of information governance. A comprehensive definition of information governance is proposed from a focal organization's perspective and evaluated whether the proposed definition is consistent with the concept of governance.

Concept of Corporate Governance

The concept of corporate governance has been used in different ways across multiple disciplines such as management, economics, accounting, finance, law, sociology, and politics (Aguilera, Desender, Bednar, & Lee, 2015). For instance, while

the sociology discipline emphasizes the role of corporate governance as a mechanism for allocating power and resources among the participants of the firm (Davis, 2005), the managerial perspective primarily investigates structures (i.e., formal and informal) and processes with respect to roles and responsibilities within the organization (Hambrick, Werder, & Zajac, 2008).

Research on corporate governance focuses primarily on controlling the self-interest of executives while protecting shareholders via mechanisms (e.g., board composition, ownership structure and executive compensation) to ensure return on investments given the separation of management and control (Daily, Dalton, & Cannella, 2003; Shleifer & Vishny, 1997; Zahra, 1996). The corporate governance literature posits that such governance mechanisms can mitigate information asymmetries between executives and investors (Ernstberger & Gruning, 2013), but the direct association between governance mechanisms and organizational performance is inconclusive and weak at best (Aguilera et al., 2015). While multiple theoretical perspectives (e.g., stewardship, resource dependence theory, and power perspective) have been applied in the corporate governance literature, agency theory is the dominant theoretical lens that assumes the self-interests of executives and deals with agency problems between shareholders and managers that arise due to the conflict over the desires or goals (Daily et al., 2003; Durisin & Puzone, 2009; Jensen, 1993).

Table 1 provides the representative definitions of corporate and IT governance used in the literature. The notion of *governance* is distinct from that of *management*; *governance* discusses mechanisms pertinent to decision rights and decision-making domains while *management* relates to the implementation of governance decisions

(Khatri & Brown, 2010). While existing definitions of (corporate) governance represent diverse features (e.g., rules, formal and informal structures) (see Table 1), governance in general refers to a set of mechanisms (e.g., structures and processes) pertaining to roles and responsibilities in the corporate context (Armstrong et al., 2010; Hambrick et al., 2008); such mechanisms provide a way of supervising organization's assets and activities. For example, Hambrick et al. (2008) emphasize organizational structural elements or mechanisms such as structure, processes, and rules in their governance definitions. Armstrong et al. (2010)'s definition encompasses a set of mechanisms (e.g., monitoring and informal contracts). In comparison, Daily et al. (2003)' definition is different from other definitions of corporate governance in that it incorporates decisions about the use of resources. Regarding IT governance, the definition of IT governance, in general, specifies decision rights and locus of accountability for IT assets and/ or IT investment decisions to encourage desirable behaviors (Khatri & Brown, 2010; Weill, 2004). It also specifies decision domains about IT investment (Khatri & Brown, 2010; Weill, 2004).

The definitions mentioned above reflect the following conceptual domains: mechanisms, adherence, and decisions. Most definitions state a set of mechanisms such as structures and processes that an organization designs and implements (see Table 1). These mechanisms are indicative of the fact that an organization exercises a set of mechanisms to direct or control behaviors in a certain way consistent with the goal and such mechanisms engender the adherence to predefined rules and procedures. This accounts for the dominant use of agency theory as a theoretical lens that focuses on resolving the conflict from divergent goals. From a set of the definitions

of IT governance, it can be inferred that the decision domain or boundary should be specified because IT governance is a subset of corporate governance and deals with one type of organization's assets (i.e., IT assets). A set of governance mechanisms also can shape the way employees behave in the use of IT artifacts. Therefore, the analysis of the existing governance definitions indicates that the definition of information governance should encompass a set of mechanisms such as organizational structural elements (e.g., structures and processes) in order to encourage desirable behaviors associated with information, and specify decision rights and accountability with respect to information.

Table 1 Representative definitions of governance

Author and year	Type of governance	Definition
Daily et al. (2003)	Corporate governance	The determination of the broad uses to which organizational resources will be deployed and the resolution of conflicts among the myriad participants in organizations
Hambrick et al. (2008)	Corporate governance	Formal structures, informal structures, and processes that exist in oversight roles and responsibilities in the corporate context
Shleifer and Vishny (1997)	Corporate governance	The way in which suppliers of finance assure themselves a return on their investment
Armstrong et al. (2010)	Corporate governance	The set of mechanisms designed to mitigate agency problems that arise between shareholders and managers because of the separation of ownership and control
Davidson, Goodwin-Stewart, and Kent (2005)	Internal governance	The functions and processes established to oversee and influence the actions of the firm's management
Khatri and Brown (2010)	IT governance	The person who holds the decision rights and is held accountable for an organization's decision-making about IT assets
Bradley et al. (2012)	IT governance	The capacity of top management to control the formulation and implementation of the IT strategy via organizational structures and processes that produce desirable behaviors, which will ensure that IT initiatives sustain and extend the organization's strategy and objectives
Weill (2004)	IT governance	Specifying the framework for decision rights and accountabilities to encourage desirable behavior in the use of IT

Definition of Information Governance

The term *information governance* has been defined in multiple ways in the literature (see Table 2). While the definitions vary across the authors, they can be stated based on a combination of the following three aspects: (a) philosophy, (b) activities, and (c) management/ control.

Table 2 Representative definitions of information governance (extended from Nguyen et al. (2014))

Author and year	Definition
Tallon et al. (2013a)	Collection of capabilities or practices for the creation, capture, valuation, storage, usage, control, access, archival, and deletion of information over its life cycle
Kooper, Maes, and Lindgreen (2011)	The set of activities aimed at establishing a normative foundation to facilitate and stimulate sense making interactions
Hulme (2012)	A holistic approach to managing and using information for business benefits that encompass information quality, information life-cycle management, and security, privacy and compliance
Silic and Back (2013)	Policies, procedures, and processes aimed at managing information at an organizational level providing support for regulatory, legal, operational, managerial and environmental risks
Gartner (2015)	The specification of decision rights and an accountability framework to ensure appropriate behavior in the valuation, creation, storage, use, archiving and deletion of information. It includes the processes, roles and policies, standards and metrics that ensure the effective and efficient use of information in enabling an organization to achieve its goals
American Health Information Management Association (2015)	Organization-wide framework for managing information throughout its life cycle and supporting the organization's strategy, operations, regulatory, legal, risk, and environmental requirements
Deloitte Consulting LLP (2014)	Strategic framework composed of standards, processes, roles, and metrics that hold organizations and individuals accountable to create, organize, secure, maintain, use, and dispose of information in ways that align with and contribute to the organization's goals
Information Governance Initiative (2014a)	Activities and technologies that organizations employ to maximize the value of their information while minimizing risks and costs
Cohasset Associates (2014)	A comprehensive platform for the effective and efficient management of the information life cycle. Information governance establishes policy-level rules • Defines investment priorities • Institutes accountabilities • Aligns implementation outcomes to business priorities • Measures results

First, information governance as a philosophy takes a strategic or holistic perspective by viewing information governance as an organization-wide approach (Cohasset Associates, 2014; Hulme, 2012). This organization-wide framework can influence the flow of information within a particular organization and across supply chain partners, and is not confined to particular business functions. This philosophical aspect suggests that an organization should develop an organization-wide strategic plan associated with the information.

The second aspect emphasizes activities related to dealing with or processing information (Information Governance Initiative, 2014a; Kooper et al., 2011; Tallon et al., 2013a). The definition by Tallon et al. (2013a) encompasses activities for managing the information lifecycle, ranging from creation to the disposition of information. Gartner (2015)'s definition also describes behaviors pertinent to the life cycle of information. It emphasizes desirable behaviors with respect to the information life cycle. Thus, the second aspect confines the scope of information governance to the life cycle of information and emphasizes activities that correspond to the life cycle of information.

The third aspect concentrates on managing or controlling the information by specifying policies, procedures, processes, and accountability (Gartner, 2015; Silic & Back, 2013). This aspect reflects a mechanism or means for governing the information that can meet the needs of businesses (Silic & Back, 2013). In addition, Gartner (2015)'s definition explicitly states the decision rights and accountability framework to ensure that the behaviors pertinent to information life cycle are consistent with an organization's goal. Thus, the third aspect encompasses a set of structural mechanisms including decision rights and locus of the accountability framework.

Based on three aspects of information governance, the analysis above reveals that a new definition of information governance should incorporate the following features; it is an organization-wide approach and should state a clear goal associated with information from a strategic perspective; it should encompass organizational structural elements such as processes, policies, standards, and metrics with respect to the life cycle of information that delimits the scope of information governance; and it should specify decision rights and accountability framework. These features are consistent with the concept of governance that includes a set of mechanisms to direct or control behaviors in an appropriate way in an organizational context. For the purpose of this dissertation, information governance is defined as follows:

> *Information governance refers to an organization-wide approach that includes 1) the specification of decision rights and an accountability framework and 2) the implementation of processes, policies, standards, and metrics involved in valuating and managing the life cycle of supply chain information to create the value of supply chain information for relevant customers while securing that information.*

The proposed definition states that the purpose of information governance is to provide and secure an organization's supply chain information that meets the business needs via its value creation. An organization attains such goal by specifying authority relationships and implementing organizational structures that can govern activities over the life cycle of supply chain information, which can ensure appropriate behaviors in terms of processing and managing information. From a supply chain perspective, an

organization strives to improve supply chain performance by streamlining information flows and exchanging strategic/ operational information with supply chain partners. Decisions on what information to share with which partners as well as how to design organizations to support the implementation of such information flows could enable the flow of supply chain information to be streamlined and synchronized, which would result in an organization's competitive advantage. Such decisions can depend on an organization's perspective on governing supply chain information. Further, organizational structural elements (e.g., policy, formalization, and standardization) can provide guidance on the desirable behaviors of employees in terms of what information to acquire, retain, and dispose of as well as how to assess performance that pertains to information flows within and across the businesses.

RELATIONSHIP TO OTHER CONCEPTS

Information Governance and Information Management

According to Wang (2010), information governance and information management are often used interchangeably in the literature. A lack of consensus on the notion of information governance and its newness in the literature may account for such confusion. A limited number of studies have explored the association between information governance and management (Nguyen et al., 2014). When it comes to the relationship between information governance and management, it is anecdotally recognized that information management supports information governance because effective information management has implications for information quality (Nguyen et al., 2014). This section not only delineates the difference in meanings between

information governance and management but also discusses their relationship. This distinction thus can help to clarify the boundary of information governance and to position its notion in relation to relevant concepts in other disciplines.

Although the meanings of information management are used in different ways in the literature, information management, in general, refers to the control of the information life cycle (Nguyen et al., 2014). Nguyen et al. (2014) identified thirty definitions used in the literature and classified them into five categories (see Table 3).

Table 3 Categories of information management definitions, adopted from (Nguyen et al., 2014)

Category	Typical definition
Broad term referring to directing information life cycle management (ILM)	Planning, operation, and control of the resources which are considered as falling within information (Entsua-Mensah, 1996)
Focusing on operationalizing the whole process of ILM	Management of the processes and systems that create, acquire, organize, store, distribute, and use information (Choo, 2002)
Focusing on some stages of ILM process	Collection and dissemination of information (Karim & Hussein, 2008)
Referring to information technology support	All management tasks within an organization or another business entity that are concerned with a computer supported or computer supportable information and communication system (Rick, Vossen, Richert, & Henning, 2011)
Library perspective	Subject indexing, cataloging, classification and coding; database design and data structures; storage and retrieval of information resources; information audits and reviews; uploading of information into the system; and information extraction, publishing, distribution, and access. (Mutula, 2008)

This dissertation adopts the second perspective on information management that encompasses ILM processes because the process perspective on information management is well accepted in the literature (Nguyen et al., 2014) and the notion of management refers to “operationalization of decisions” directed by governance (Khatri &

Brown, 2010). In consideration of the definition, focus, and subject of information governance and management, this dissertation proposes the relationship between information governance and management as shown in Figure 1.

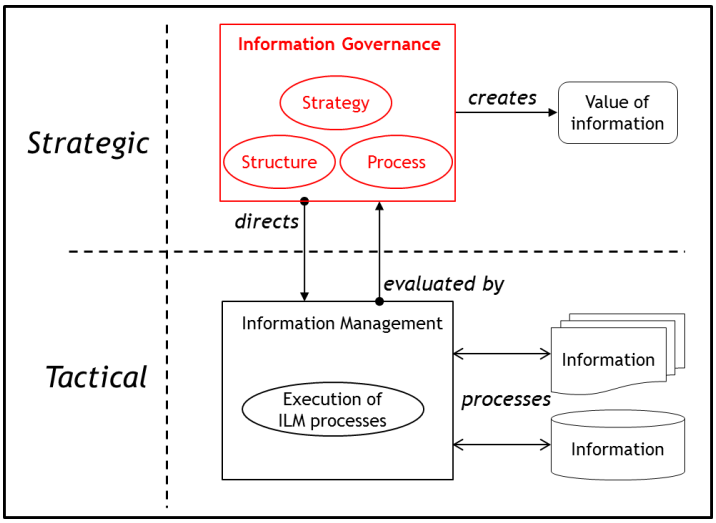

Figure 1 Relationship between information governance and information management

Although the subject of both information governance and management is "information" that resides or will reside in an organization, the focus of information governance differs from that of information management. While information management centers on implementing and executing ILM processes by which employees deal with organizational information, information governance develops and implements an organizational design from a strategic perspective to meet the business needs of information. As an organization's holistic approach, information governance offers structural mechanisms such as rules, regulations, standards, and organizational structure to streamline information flows. Information governance directs the execution of ILM processes by (a) specifying roles and responsibilities and (b) providing guidance

on how to perform ILM processes. Information governance also oversees ILM processes to ensure that such processes are executed in a way that is consistent with information governance strategies. Thus, it can be argued that information governance represents an organization-wide strategic approach, whereas information management can be considered a tactical approach.

CHAPTER SUMMARY

Although the benefits of effective supply chain information flows are well recognized in the literature, the SCM literature has overlooked the governance of information in the supply chain. Considering that research on information governance is at an early stage, this chapter conceptualized information governance by synthesizing the existing definitions in both academia and practice, and argued that information governance is a function of information governance strategy, structure, and processes and interacts with the elements of the SCM framework. Furthermore, it was articulated that information governance is distinctly different from information management in that information governance represents a strategic approach that guides and directs information management. Next, Chapter Three would delve into the nature of the relationships between the key elements of information governance and supply chain performance by applying the underlying premise of the SSPP framework from the perspective of information.

CHAPTER 3

MANUSCRIPT #1. IMPLICATIONS OF GOVERNING SUPPLY CHAIN INFORMATION FLOWS: A THEORY-BASED PERSPECTIVE

ABSTRACT

Supply chain information flows have been a phenomenon of interest for decades in the supply chain literature. Although a variety of topics such as information sharing and the use of IT applications have been examined, much of the prior research is built upon the implicit assumption that organizations in the supply chain deal with issues around information in a similar way, leading to the conjecture that the quality of supply chain information is equivalent across supply chain members. This assumption may account for the fact that many organizations still struggle for poor information flow in the supply chain. By challenging this unstated and flawed assumption, the current study introduces the concept of information governance in the supply chain context, which represents an organization-wide framework for directing and controlling issues around supply chain information flows, and positions information governance in the realm of supply chain management. The notion of information governance is posited as a key theoretical concept an organization should consider for the realization of the benefits from supply chain information flows.

By drawing upon the strategy-structure-process-performance framework, the current study proposes that information governance consists of information governance strategy, structure, and processes and illuminates how the governance of supply chain information translates to superior supply chain performance. The proposed framework would not only advance an understanding of the relationship between information governance and supply chain performance but also provide managerial insights into how to effectively manage supply chain information flow.

INTRODUCTION

There has been a growing awareness that supply chain information flow is critical in effectively managing the supply chain (Cheong, Goh, & Song, 2015; Cooper et al., 1997; Ellram et al., 2004; Sahin & Robinson, 2002). For decades, supply chain scholars have argued that supply chain information flow enables an organization to better coordinate supply chain business processes that span the entire supply chain through greater access to vital supply chain information (Kembro et al., 2014; Williams et al., 2013). Given its importance, it is plausible that an organization should encourage desirable behaviors with respect to an effective management of supply chain information and cope with pertinent issues in an appropriate way.

But, how can an organization encourage desirable behaviors pertaining to the flow of supply chain information? How can an organization identify, trace, and resolve supply chain information issues? How can an organization guarantee that the information exchanged in the supply chain is accurate, complete, timely, and relevant? The supply chain disaster facing Target Canada Inc. demystifies why addressing the questions above is so critical to effective management of the supply chain. In 2014, a supply chain disaster, considered one of the worst in Canadian history, befell Target Canada (www.supplychain247.com, 2015). Inconsistencies in inventory information resulted in inventory errors at warehouses and delays in deliveries to stores and left store shelves nearly empty while vast quantities of items languished in warehouses. Yet, the more serious problem was that Target Canada could not identify and trace the origin of the problem in the supply chain, due to a lack of governance with respect to supply chain information, referred to as an organization-wide framework that specifies

the roles and responsibilities and implements the policy and procedures with respect to supply chain the information (Khatri & Brown, 2010; Tallon et al., 2013a).

However, research addressing governance issues around supply chain information flow is virtually silent in the literature. Much of the existing research focuses on information sharing (Kembro & Näslund, 2014) or the use of information technology (Craighead et al., 2006). The vast majority of the existing research does not delineate the varying level of supply chain information quality. This implies that most supply chain research makes an implicit assumption in that the quality or treatment of the information exchanged between supply chain members is equivalent across organizations in the supply chain. In practice, this assumption may not hold because an organization could adopt different approaches in directing and controlling issues around supply chain information flows. Such a flawed assumption may account for the controversy about the benefits of supply chain information sharing. One stream of research claims that an organization could realize tangible benefits through supply chain information sharing (Moberg, Cutler, Gross, & Speh, 2002; Sahin & Robinson, 2002). Another stream of research argues that the benefits of information sharing are limited or doubtful due to the complexity and risks associated with the SCM (Samaddar et al., 2006; Vanpoucke et al., 2009). This controversy may suggest that the facilitation or quantity of the information exchanged is not sufficient to achieve superior supply chain performance. Rather, it suggests that an organization-wide framework for coping with issues around supply chain information flows should be in place to reap the benefits of the flow of information in the supply chain because the approaches and practices dictating the governance of supply chain information could drastically affect the flow of supply chain

information. Hence, it is reasonable to speculate that an organization should consider a governance perspective of the supply chain with respect to information flow (hereafter referred to as information governance (IG)).

The main goal of this study is to unravel and position the concept of IG in the realm of supply chain management. Toward this end, IG is conceptualized in the supply chain context based on a comprehensive literature review. Next, this study identifies the key elements of IG and delineates each element and its implications for supply chain management. Finally, a theoretical framework is presented that illuminates how the governance of supply chain information flows can translate to superior supply chain performance.

In doing so, this study generates two key contributions to the literature. First, this study advances an understanding of supply chain information flow by challenging the unstated and flawed assumption, i.e., the equivalence of information quality in the supply chain. The notion of IG is posited as a key theoretical concept an organization should consider to realize the benefits from information flow in the supply chain. Furthermore, the governance of supply chain with respect to information flow would not only open up new areas of research in the literature but also provide managerial insights into how to address poor supply chain information flow. Second, this study provides theoretical support that enhances the understanding of how IG contributes to superior supply chain performance. The framework presented would serve as a theoretical basis for future research in the governance of supply chain information flows and as guidance for organizations that plan to adopt IG in the supply chain context.

LITERATURE REVIEW

Concept of Information Governance (IG)

In this study, IG is conceptualized as an organization-wide approach that includes 1) the specification of decision rights and an accountability framework and 2) the implementation of processes, policies, standards, and metrics involved in valuating and managing the life cycle of supply chain information. This conceptualization views IG as an organization-wide framework for streamlining and coordinating supply chain information that flows throughout the supply chain. An organization's IG provides guidance on what information to share with which supply chain members and how to design mechanisms to support the facilitation and coordination of the information flows within the supply chain. It also specifies the authority relationships for pertinent decision rights and implements the mechanisms such as policy, procedures, and standards that can direct activities associated with the acquisition, retention, access, and dissemination of supply chain information.

The concept of IG was first introduced as a comprehensive approach to processing information for the National Health Society by Donaldson and Walker (2004). Since then, IG has garnered the attention of business executives (Economist Intelligence Unit, 2008; Nguyen et al., 2014). For example, the survey results by Economist Intelligence Unit (EIU) show that 77% of respondents expected the importance of IG for their company's success to increase over the following three years (Economist Intelligence Unit, 2008). Practitioners have also emphasized the importance of IG in relation to managing master data, which defines key supply chain-related

entities (e.g., customers, products, suppliers) and is the basis for all supply chain transactions (White, 2013). In addition, one large manufacturing company adopted the governance of product data to better manage the supply chain in terms of inventory management and demand planning (Deloitte Consulting LLP, 2009). The examples above suggest that the notion of IG has become increasingly recognized by practitioners, even in the supply chain context.

But, the notion of IG has been used in different ways. For instance, it is often considered an organization-wide framework, not confined to particular business functions within organizations (Cohasset Associates, 2014; Hulme, 2012). Another perspective considers IG as activities or controls (e.g., procedures, policies, accountability) for dealing with organizational information (Gartner, 2015; Silic & Back, 2013; Tallon et al., 2013a). These divergent perspectives increase the conceptual ambiguity of IG. Such ambiguity could hinder the examination of the phenomenon of IG within the domain of SCM. Hence, a comprehensive definition of IG would clarify the concept and its conceptual boundary, which would help unpack the black box of IG in the supply chain context.

A Framework of IG in the Supply Chain

In the organizational theory literature, an open-system perspective states that an organization should process information, ranging from acquisition to synthesis, in a way that reduces uncertainty and ambiguity in decision making, (Daft & Lengel, 1986; Tushman & Nadler, 1978). If an open system perspective is extended to the supply chain context, an organization should coordinate and streamline the flow of supply chain

information to execute supply chain business processes. In the supply chain where a focal organization collaborates with upstream and downstream partners, the focal organization should determine the features of information flow, i.e., types of information shared, the degree of information sharing, the use of inter-organizational IT applications, and information quality to meet the needs of supply chain information used for supply chain processes. To meet a variety of information requirements, the focal organization should take into consideration certain organizational features, such as organizational structure because organizational features can affect the speed, quantity, and richness of information (Daft & Lengel, 1986; Galbraith, 1973). In consideration of the relationship between organizational features and characteristics of information flows (Daft & Lengel, 1986), this study proposes that IG can be represented as a set of organizational features.

First, this study suggests that an IG strategy represents one key element of IG. From the focal organization's perspective, the focal organization in the supply chain needs to design and implement both intra- and inter-business processes in terms of the work activity, information flow, and authority relationships (Hewitt, 1994). Furthermore, It organization should consider its position in the supply chain and supply chain structure because its supply chain partners can demand different supply chain information (Lumsden & Mirzabeiki, 2008). This implies that the focal organization should adopt the right approach with respect to the governance of information flows in order to cope with a variety of informational needs in the supply chain; this can be viewed as an IG strategy. Additionally, the differences in an organization's IG approach are consistent with the concept of fit. For example, the pertinent literature suggests that an

organization's business strategy demands specific information requirements (Habib & Victor, 1991) and mirrors environments from the standpoint of the focal organization (Egelhoff, 1982). Likewise, in the supply chain where an organization is involved in various activities in upstream and downstream linkages, the focal organization should take an organization-wide approach to governing supply chain information that is unique to the focal organization by incorporating the features of its supply chain structure and environments. Thus, an IG strategy constitutes one element of IG.

Second, based on the definition, IG encompasses a set of organizational design features to ensure appropriate behaviors pertaining to the governance of the life cycle of supply chain information, referred to as IG structure. Such mechanisms have been examined in the organizational design, governance, and marketing literature as a means for governance and control purposes. The organizational design literature posits that organizational structural characteristics are related to information requirements (Galbraith, 1973). The types of organizational forms also differently influence the organization's information flow (Troy, Szymanski, & Varadarajan, 2001) in that the level of information sharing and the type of information provided to managers depend on organizational design features (Daft & Lengel, 1986). Furthermore, research in the IT governance has investigated various governance practices such as structural, procedural, and relational practices (Tallon et al., 2013a). For instance, an IT governance structure refers to the distribution of decision rights between line functions and IT function (Tiwana & Konsynski, 2010) where decisions rights can be categorized into the specification (i.e., what) and implementation (i.e., how) (Fama & Jensen, 1983). Research on procedural practices for the IT governance focuses on shaping behaviors

by using rules, norms, policies, and standards that are discussed in the control literature (Tallon et al., 2013a).

In the context of IG, such mechanisms not only specify the roles and responsibilities pertaining to what information to exchange with supply chain partners, with which suppliers to share information, and how to exchange information with supply chain partners. IG mechanisms also encourage the desirable behaviors of employees pertaining to information processing. Furthermore, the policy, rules, and procedures allow the organization to trace the origin of and address issues associated with the flow of information in the supply chain. Thus, it can be argued that IG structure is the second element of IG.

Third, it is proposed that a set of IG processes constitute one element of IG. Based on its definition, IG specifies activities with respect to the life cycle of information. Given that IG directs and controls issues around information, it is logical that IG processes reflect the extent to which employees follow predefined processes pertinent to the information life cycle (i.e., capture, retention, access, and distribution); IG processes focus primarily on employees' adherence to processes rather than the implementation of processes. In the supply chain context, IG processes allow the employees of the focal organization to not only provide the right supply chain members the right information but also acquire and retain the right information by following the predefined processes. In addition, IG processes are distinct from IG structure in that IG processes ensure that employees follow pre-defined procedures for information management while IG structure states a set of control mechanisms to encourage desirable behaviors for the attainment of an IG goal. In other words, IG processes

(implementation) ensure that IG structure (design) is operational and functioning effectively. Therefore, this study argues that IG consists of three key elements: IG strategy, IG structure, and IG processes (see Figure 2).

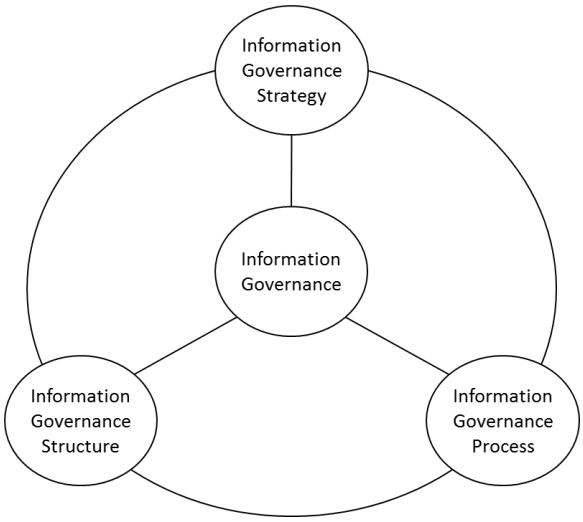

Figure 2 Key elements of information governance (IG)

IG Strategy

An IG strategy is defined as an organization's deliberate posture toward governing supply chain information, which is a realized strategy as manifested in an organization's actions or observed behaviors in strategic decision-making with respect to the governance of supply chain information. Given that an organization needs to govern a distinctive information flow in the supply chain, an organization could employ a different kind of IG strategies. In the strategic management literature, Miles (1982)' typology has been used as a framework for an organization's strategic decision patterns (Fairbank, Labianca, Steensma, & Metters, 2006; Plambeck & Weber, 2010). The strategic orientation framework by Miles (1982) addresses two strategic patterns:

domain-offensive and domain-defensive. With domain-offensive strategies, an organization seeks to explore and leverage new opportunities, whereas an organization using a domain-defensive strategy focuses primarily on exploiting existing capabilities to secure organizational information (Gioia & Thomas, 1996).

Following domain-offensive and domain-defensive strategic orientation typology as identified by Miles (1982), this study argues that there are two types of IG strategy an organization can adopt: offensive and defensive IG strategies. An offensive IG strategy aims to realize business value from supply chain information. Organizations pursuing an offensive IG strategy tend to demonstrate a progressive mindset when making major governance decisions (e.g., owners, priorities, accountability) about supply chain information. As such, those organizations are often considered IG leaders in the market by capitalizing on IG programs to quickly respond to changing markets, regulatory frameworks, and technological environments. In contrast, organizations pursuing a defensive IG strategy demonstrate a conservative mindset when making major governance decisions about supply chain information. Furthermore, they focus on compliance and legal obligations regarding supply chain information by viewing changes in their environments as threats, unlike offensive IG strategy, which views such changes as opportunities. Hence, conservative organizations with respect to governing information tend to favor protecting over realizing business value from supply chain information.

Moreover, it needs to be noted that an organization's IG strategy can evolve over time. For instance, Intel traditionally focused on protecting or restricting access to its information (i.e. defensive IG strategy). But, they changed their approach toward

governing information to maximize its business value by making the relevant departments take ownership of pertinent information (i.e. offensive IG strategy) (Tallon et al., 2013b). This transition led employees at Intel to proactively engage in IG programs.

IG structure

IG structure represents a set of organizational structural features that encourage desirable behaviors pertaining to the governance of supply chain information. Organizational structural features have been conceptualized in different ways in multiple disciplines (Galunic & Eisenhardt, 1994; Pennings, 1992; Sambamurthy & Zmud, 1999; Weill & Ross, 2005). One of most comprehensive conceptualizations is Pennings (1992)'s definition. Pennings (1992) views organizational structure as a set of primary structures (i.e. formal structure) and secondary structures (i.e., informal patterns of interaction). The primary structure encompasses structural elements such as organizational form, hierarchy, and job descriptions; the secondary structure includes patterns of influence and communication networks (Pennings, 1992). This study employs a broad definition of an organizational structure composed of both primary and secondary structures to comprehensively explore the composite effects of various structural mechanisms in the supply chain context. Therefore, IG structure is a higher-level concept that includes a formal organizational form such as the locus of accountability, patterns of influence, which can be referred to as structural power, and behavior controls, which include formalization and standardization (Galunic & Eisenhardt, 1994; Pennings, 1992); this study does not take into consideration informal or relational mechanisms (e.g., personal interaction and social networks). When it

comes to structural characteristics, a formal organizational form and patterns of influence are directly associated with IG-related decision-making. Behavior controls represent control mechanisms that influence the way employees perform activities related to supply chain information processing.

The locus of accountability refers to how primary responsibilities for IG specification and implementation decisions are distributed within the organization, which determines who holds the decision-making accountability and who performs which roles in IG domains (Khatri & Brown, 2010). IG decisions include determinations about budget, objectives, priorities, planning, enforcement, performance metrics, and the definition of roles (e.g., owner, steward, and custodian). In essence, the locus of accountability represents the formal authority relating to decision rights and accountability for IG domains (Preston, Chen, & Leidner, 2008).

Structural power reflects an IG leader's capability to exercise influence on strategic decision-making associated with IG agenda within the organization (Preston et al., 2008). For example, the Chief Data Officer (CDO) represents a position primarily associated with an organization's IG programs (Eckerson, Loshin, & Vaughan, 2015). Thus, the presence of a CDO in a top management team (TMT) legitimizes the level of power within the organization and signifies the criticality of IG. As a result, a CDO can have a good deal of leeway in making strategic decisions relating to IG programs.

Formalization is defined as the extent to which procedures and methods for activities related to IG are explicitly formulated (Rondeau, Vonderembse, & Ragu-Nathan, 2000). In essence, formalization is a mechanism that specifies how to get the work done (Cardinal, Sitkin, & Long, 2004), acting as a shared frame of reference within

the organization. By codifying procedures and methods, formalization can improve the efficiency of information processing by reducing conflict, role ambiguity, and deviant behaviors of employees (Cardinal, 2001; Turner & Makhija, 2006). However, it can also inhibit the acquisition and assimilation of new external knowledge (Jansen, Van Den Bosch, & Volberda, 2005).

Standardization refers to the extent to which uniform vocabulary, methods and procedures for IG are used across the organization (Rondeau et al., 2000). It encompasses uniform measures, common vocabulary/ terminology, and consistent metadata (e.g., data type, data length) about supply chain information (Speier, Mollenkopf, & Stank, 2008) and access control to supply chain information (Gunasekaran & Ngai, 2004). Standardization is included as one aspect of the IG structure, which is distinct from formalization, because common vocabulary/ terminology, for instance, allows employees to have a single view of shared information and is considered one of the key challenges facing most of the organizations. Additionally, formalization does not guarantee that consistent and uniform approaches are used within the organization.

IG processes

IG processes refer to the degree of adherence to processes for capturing, retaining, accessing, and distributing supply chain information within and beyond the organizational boundary. Information capture refers to the degree of adherence to processes for acquiring information from internal and external sources (Jayachandran, Sharma, Kaufman, & Raman, 2005). In the supply chain, a focal organization needs to balance demand and supply market information for successful supply and demand

integration (Esper, Ellinger, Stank, Flint, & Moon, 2010). This implies that a focal organization should continue to acquire relevant supply chain information from downstream and upstream supply chain members. For example, the information from downstream organizations can serve as a basis for the demand, production, and logistics planning to serve upstream organizations better. Feedback information from upstream organizations can help downstream organizations to serve customers better. Basically, information capture reflects one aspect of IG processes pertinent to the inflow of information.

Information retention is defined as the degree of adherence to processes with respect to which information to store, how to store it, and how long to store it. Sampler (1998) states that certain information separable from transactions needs to be captured and stored in order to use that information in the future. Such characteristic of information suggests that an organization should perform activities associated with classifying and storing supply chain information depending on its characteristics and value. In the supply chain context, an organization exchanges supply chain information about point of sales, order status, inventory information, and planning with supply chain partners. A diversity of supply chain information implies that certain information should be maintained for a specific duration within the organizational boundary based on the classification scheme of information. Thus, information retention represents one of IG processes to ensure that an organization stores and retains relevant information in a way to meet business and compliance requirements.

Information access represents the degree of adherence to processes in order to provide a relevant employee access to pertinent information (i.e., access control). In the

supply chain, various types of information reside within an organization such as transactional information (e.g., advanced shipping notice), status information (e.g., order status and inventory levels), master information (e.g., SKU features), and operational plans (e.g., production and delivery schedules) (Caridi, Moretto, Perego, & Tumino, 2014). An organization exchanges such information with supply chain partners to streamline material flows. However, such information should be available only to the appropriate supply chain partners because the information leakage can increase information flow risk, such as intellectual property risk (Barry, 2004; Tang & Musa, 2011). Furthermore, information overload can increase the complexity of information exchange, and non-value-added information sharing could undermine supply chain efficiency. Hence, information access reflects one of IG processes to ensure that the right information is available to the right person.

The last IG process relates to information distribution, defined as the degree of adherence to a process for sharing information within an organization as well as with customers and key suppliers (i.e., the process of disseminating and sharing information). Many organizations use supply chain technologies to facilitate information distribution in a supply chain (Sanders, 2007; Tokman, Richey, Deitz, & Adams, 2012). According to the Gartner report (Trebilcock, 2014), the SCM software market was $8.9 billion in 2013 and is expected to rise with a growth rate of 9.9% until 2018. Given the sheer number of supply chain information technologies, organizations are likely to continue implementing processes associated with information distribution. Further, the breadth and depth of supply chain information technologies in combination with the supply chain intricacies will result in an increase in the complexity of supply chain

information flow, which in turn will require organizations to standardize their activities associated with distributing information within the organization. In essence, information distribution ensures that employees follow processes for exchanging supply chain information within and beyond organizational boundaries.

THEORETICAL FOUNDATIONS AND DEVELOPMENT

Strategy-Structure-Process-Performance (SSPP) framework

The discussion of IG above provides a basis for understanding the nature of the relationship between IG and supply chain performance. In essence, the governance of supply chain information means that the three key elements, IG strategy, IG structure, and IG processes, are in place within the organization and that the relationships between these three elements could influence the flow of supply chain information, which in turn affects supply chain performance. In other words, the fit among strategy, structure, and processes in terms of the flow of information can have performance implications. This strategy-structure fit, referred to as the strategy-structure-performance (SSP) framework, was originally introduced by Chandler (1962) and Rumelt (1974). Later, it was extended to the strategy-structure-process-performance (SSPP) framework that takes processes into account (Galbraith & Nathanson, 1978).

The underlying premise of the SSP framework is that the congruence between strategy and structure is associated with organizational performance (Galbraith & Nathanson, 1978; Galunic & Eisenhardt, 1994; Rumelt, 1974). Rumelt (1974) is the first study that investigated performance implications of the fit between strategy (i.e., diversification) and structure (U-form vs. M-form). Rumelt (1974)'s findings reveal that

organizations that follow a product diversification strategy in combination with a multi-divisional form experienced improved organizational performance over time, the results of which provide some evidence of the positive association between strategy-structure fit and organizational performance. Subsequent studies have explored the association between the strategy-structure fit and organizational performance in various contexts by building on and extending Chandler's (1962) and Rumelt's (1974) findings (Harris & Ruefli, 2000). For instance, Rodrigues, Stank, and Lynch (2004) examined the impact of the interrelationships of relational strategy, information and measurement systems, and operational integration on logistics performance. Their results provide evidence that supports the sequential relationships among strategy, structure, processes, and performance in a logistics context. In a supply chain context, Speier et al. (2008) developed a framework for the fit between supply chain orientation (strategy) and information system integration (structure) and delineated the linkage between their fit and supply chain performance by drawing upon the SSP framework.

Given that IG is conceptualized as a function of IG strategy, IG structure, and IG processes, this study translates the premise of the SSP/SSPP framework from the perspective of information (characteristics and requirements) to unravel the nature of the relationship between IG and supply chain performance. However, to apply the SSP/SSPP framework to the IG context, the key variables of the framework must be reconsidered, especially the performance variable because the other variables (IG strategy, IG structure, and IG processes) are already contextualized. This study views information quality as an intermediate as well as immediate outcome of IG. Tallon et al. (2013a) interviewed executives from various industries regarding their IG practices and

the benefits received. The findings suggested that IG practices are related to various intermediate or process-level performance metrics. Information quality represents one intermediate performance of IG practices because IG can offer mechanisms to ensure the quality of organizational information (KPMG, 2012). In addition, survey results conducted by the Economist Intelligence Unit also note information quality as a benefit of IG (Economist Intelligence Unit, 2008). To sum up, the empirical evidence above supports the notion that information quality is an appropriate intermediate performance metric for evaluating the consequences of IG practices.

The SSP framework posits that an organization is likely to experience superior performance when their strategy is congruent with their structure (Galunic & Eisenhardt, 1994; Wasserman, 2008). In a similar vein, the SSPP framework states that an organization can achieve superior organizational performance when it can match strategy and structure with processes (Galbraith & Nathanson, 1978; Nakano & Akikawa, 2014). It also posits that processes can influence the successful implementation of an organization's strategy (Galbraith & Nathanson, 1978) and thus, should emerge from organizational structural characteristics (Galbraith & Nathanson, 1978; Rodrigues et al., 2004), which suggests that a process can be represented as a function of an organization's strategy and structure. Therefore, the application of the underlying logic of the SSPP framework to an IG context makes it theoretically plausible that the fit between IG strategy, IG structure, and IG processes can have performance implications. Moreover, given information quality as an intermediate outcome of IG practices, this study proposes that an organization's IG strategy and IG structure jointly

influence IG processes, which enables an organization to attain superior supply chain performance via high-quality information.

Research Propositions

An IG strategy represents a realized strategy that captures a pattern in a stream of IG decisions (Mintzberg, 1987; Mintzberg & Waters, 1982). It is an important means of helping employees to understand and adhere to the directions consistent with IG objectives as established by their organizations (Mintzberg, 1987). In an IG context, an organization adopts an organization-wide approach that resembles either offensive or defensive strategic orientation. An organization following an offensive IG strategy seeks to sense and quickly respond to changes in the market, regulatory, and technological environments to realize business value from supply chain information. The use of an offensive IG strategy leads to an increase in the flow of supply chain information into the organization. The inflow of relatively new and diverse information implies that a focal organization should concentrate on interpreting, appraising the value of, and classifying that information because information acquired or generated by the focal organization is relatively dissimilar to the existing information and thus, requires a shared understanding of its meaning across the organization. Hence, an offensive IG strategy tends to favor acquiring and retaining information which is diverse and novel to the organization. To effectively govern supply chain information, a focal organization with an offensive IG strategy needs a flexible IG structure that can deal with relatively ambiguous and equivocal information because structural characteristics have different capabilities for dealing with information (Daft & Lengel, 1986; Tushman & Nadler, 1978).

For an offensive IG strategy, the rules and procedures pertinent to the interpretation, appraisal, and classification of supply chain information should be flexible enough to effectively accommodate new or dissimilar types of information. Furthermore, the decision rights with respect to processing supply chain information should be distributed to line functions rather than IT functions to understand business implications of such information. Therefore, when IG structure is aligned with IG strategy, employees are more likely to be motivated to perform activities associated with governing supply chain information and to adhere to pre-defined processes without resistance.

In contrast, the focus of a defensive IG strategy is on protecting information with an emphasis on external regulatory, compliance, or legal obligations; a defensive IG strategy, in general, is more concerned about the control over access to information and efficiency of the supply chain information flow. An organization following a defensive IG strategy is less likely to increase its commitment to the inflow of new information due to its conservative mindset. This indicates that information newly acquired or created by organizations can be codified in a similar manner to that routinely done for information exchanged within the organization and across the supply chain. With an emphasis on speed and volume of the information flow, an organization with a defensive IG strategy tends to focus more on facilitating the movement of supply chain information than on interpreting it. In other words, the rules and procedures relating to information processing are standardized within the organization to streamline the flow of information. Such IG structure allows an organization to provide the right information at the right time with reduced transaction costs. Thus, when IG structure is commensurate with IG strategy, an organization can reduce deviant behaviors of employees and direct

their behaviors in a way consistent with IG objectives. Given the interplay between IG strategy and IG structure and their impact on employee behavior, the discussion above suggests that the fit between IG strategy and structure can determine the extent to which employees follow the predefined IG processes. This leads to the following proposition:

Proposition 1. The fit between IG strategy and IG structure is positively associated with IG processes.

IG processes refer to the degree of adherence to procedures for governing supply chain information. A high degree of IG processes means that employees understand the meaning of and follow pre-defined procedures for IG. In other words, if IG programs are well established within the organization, employees will acquire, retain, access, and distribute relevant information based on the predefined IG activities, which support the associated business processes. For instance, information access represents a process that enables the right person to access the right information in a timely manner. IG process for information distribution can speed up the flow of information within the organization and across the supply chain through the timely delivery of information to business functions, customers, and supply chain partners. Thus, this study claims that IG processes can contribute to the availability of quality information within and across organizational boundaries. This leads to the following proposition:

Proposition 2. IG processes are positively associated with the level of information quality.

Extant research examines the impact of information quality on performance in the supply chain context, considering various information quality dimensions: intrinsic (e.g., accuracy), contextual (e.g., timeliness, completeness), and representational (e.g., format) (Forslund, 2007; Nelson, Todd, & Wixom, 2005; Petersen et al., 2005; Zhou & Benton, 2007). The findings of prior research provide evidence that information quality is positively associated with operational efficiency (e.g., delivery performance), supply chain performance, and customer service (Gosain, Malhotra, & El Sawy, 2004; Sum, Yang, Ang, & Quek, 1995; Zhou & Benton, 2007). For instance, Petersen et al. (2005) examined the relationship between information quality and decision-making effectiveness for collaborative planning. The results of Petersen et al. (2005) demonstrated that the quality of the information shared with supply chain partners led to effective decision-making for all types of collaborative planning, independent of the mode of communications (i.e., traditional modes and information systems). Moberg et al. (2004) examined performance implications of SCM components, and their results revealed that information quality is associated with logistics costs and logistics customer service. Another stream of research examined the detrimental effects of low-quality information (e.g., inventory record inaccuracy) on supply chain performance (Cheong et al., 2015; Hardgrave, Aloysius, & Goyal, 2013; Heese, 2007). For instance, Heese (2007) developed an analytical model for exploring the effects of the inventory information discrepancy and the RFID benefits and demonstrated that the discrepancy

in inventory information magnifies the inefficiencies in a supply chain. The research summarized above suggests that an organization can realize the benefits of information as a competitive advantage by ensuring that supply chain members can access the right information at the right time (Evans & Wurster, 1997). Therefore, the discussion above leads to the following proposition:

Proposition 3. The level of information quality is positively associated with supply chain performance.

Though three propositions formulated above delineate how the governance of information can translate to superior supply chain performance, it is not unreasonable to argue that the benefits of IG in enhancing supply chain performance can vary depending on an organization's IT environment. An organization leverages diverse information technologies to manage and exchange information with supply chain members (Davis-Sramek et al., 2010), indicating that an organization typically assembles a unique portfolio of information technologies. Hence, the role of an organization's IT environment must be taken into account to understand the nature of the relationship between the governance of supply chain information flows and supply chain performance. Of particular interest in the current study is an organization's IT infrastructure integration.

IT infrastructure integration refers to the integrated IS capability of an organization (Bharadwaj, Bharadwaj, & Bendoly, 2007) and captures the technical aspects of IT infrastructure in terms of IT connectivity and IT compatibility (Duncan, 1995) rather than information integration (Closs, Swink, & Nair, 2005). Whereas IT

connectivity reflects the level of ability of any technology component to attach to any of the other components inside and outside the organizational environment (Byrd & Turner, 2000), IT compatibility refers to the level of ability to share any type of information across any technology components (Byrd & Turner, 2000; Duncan, 1995).

IT connectivity offers a seamless connection through which employees can reach supply chain technologies and other IT resources, regardless of physical location (both inside and outside the organization) (Byrd & Turner, 2000; Duncan, 1995). Through IT connectivity (e.g., EDI), a focal organization can exchange information (e.g., invoice, purchase order, and forecasting) with supply chain partners to perform business-to-business transactions, which enables a focal organization to coordinate transactions across the businesses (Grover & Saeed, 2007) and to enhance inventory visibility, labor efficiency, and customer service (Lee, Padmanabhan, & Whang, 1997; Narayanan, Marucheck, & Handfield, 2009; Saraf, Langdon, & Gosain, 2007).

IT compatibility, referred to as range, relates to the capacity to exchange organizational information across various information systems. It is more related to the facilitation of information in that it increases the speed of information delivery by eliminating additional steps or procedures associated with information conversion. In consideration of increasing IT investment and the SCM software market condition, it is evident that supply chain managers are likely to face future challenges in determining and managing the right portfolio of SCM software products from various software suppliers (Autry et al., 2010). Additionally, the use of various supply chain technologies implies that employees should transfer and share different types of information across multiple supply chain IT applications running on different platforms for the facilitation of

information flows within the organization and with supply chain partners. Hence, IT compatibility ensures that an organization's information can be exchanged among their various IT applications, regardless of information type (e.g., document, video, or text) (Tallon & Pinsonneault, 2011).

Organizations retrieve supply chain information that is located across the organization in order to meet business needs and to handle different user interfaces or use various methods (e.g., documents and information systems) in order to locate the right information for SCM while following predefined rules and information processes. This implies that the ease of locating and retrieving organizational information is associated with IG processes. Given that various types of information systems (e.g., Enterprise Resource Planning, Warehouse Management System, and Manufacturing Execution System) and document formats are used within organizations and that information systems running on heterogeneous platforms handle different information formats, employees should be able to deal with the complexity and diversity of information. IT compatibility enables organizational information to flow in a seamless way throughout the organization, as information does not need to be modified or transformed into different information types to generate the complete and accurate information. In other words, if the information stored in various information systems is compatible, employees can meet business needs with reduced transaction costs. In a similar vein, IT connectivity is related to the configuration of the platform and implementation of communication technologies (e.g., network and telecommunications). IT connectivity provides employees the capacity to reach electronic information in various information systems. Because IT connectivity offers the conduit through which

employees can reach the right information independent of locations, employees can efficiently perform IG processes. Therefore, the discussion above suggests that IT infrastructure integration, in conjunction with IG processes, provides an environment that is conducive to generating high-quality information in an efficient way. This leads to the following proposition:

Proposition 4. IG processes will have a greater impact on information quality for an organization that has a higher level of IT infrastructure integration.

IT infrastructure integration also plays a critical role in facilitating the flow of high-quality information in the supply chain. Information quality reflects the characteristics of information (i.e., timeliness, accuracy, and, completeness) that enables an organization to sense and respond to changes in customer needs via a better decision-making based on the assumption that organizational information is used in a rational way (Petersen et al., 2005; Pratt, Raiffa, & Schlaifer, 1995). Additionally, a decision maker tends to use information of higher quality more frequently since it can be utilized as the basis for rationalizing the decision (O'Reilly, 1982). For instance, information quality results in information visibility in the organization; thus, employees can respond to changes in supply chain conditions and communicate with supply chain partners effectively. Additionally, the visibility of information about inventory can reduce supply chain costs by maintaining the appropriate level of inventory and streamlining order fulfillment processes. Put differently, information quality is positively associated with supply chain performance. However, achieving the benefits from high-quality information in supply

chains requires that high-quality information should move along both within the organization and across an entire supply chain in a seamless way.

IT infrastructure integration offers a platform that links the focal organization with supply chain members, which allows supply chain information flow to be streamlined in the supply chain. For instance, a focal organization can meet information needs of suppliers with respect to the order fulfillment process by taking advantage of IT infrastructure integration with suppliers; suppliers can access to order, forecast, or inventory information of high quality, which will result in improved supplier's logistics performance (e.g., on-time delivery) (Forslund, 2007). Thus, IT infrastructure integration enables a focal organization to coordinate order fulfillment process effectively and efficiently by allowing key suppliers to leverage information of high quality, which will lead to the increase in supply chain performance. Therefore, the following proposition is formulated:

> *Proposition 5. The level of IT infrastructure integration strengthens the association between information quality and supply chain performance.*

Figure 3 depicts the interplay between three elements of IG and their impact on supply chain performance via information quality in that the fit between IG strategy and structure shapes employees' behaviors for governing supply chain information and their behaviors would lead to supply chain excellence through high-quality information. Further, it describes the role of IT infrastructure integration in strengthening the relationship between the relationship between IG process and information quality and the relationship between information quality and supply chain performance.

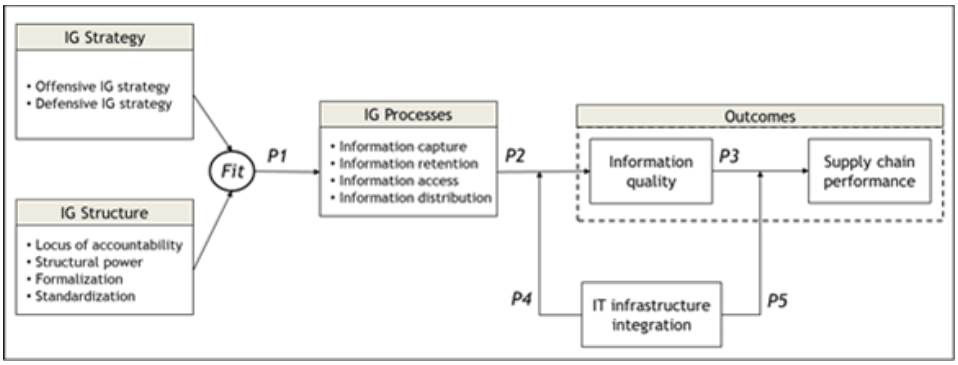

Figure 3 A Conceptual framework of the relationship between IG and Supply chain performance

DISCUSSION

It is well recognized that information flows are critical to supply chain performance (Cooper et al., 1997; Ellram et al., 2004; Sahin & Robinson, 2002). Although supply chain information flows have been a topic of interest for decades in the supply chain literature, much of the previous research is built on the implicit assumption that organizations in the supply chain deal with issues around supply chain information in a similar way. This flawed assumption misleads to the inference that quality of information is deemed equivalent throughout the entire supply chain. The current study challenges this assumption by bringing the concept of IG within the realm of SCM and provides theoretical support that such an assumption is unwarranted by detailing the nature of the linkage between IG and supply chain performance.

This study contends that IG is an organization-wide approach that consists of IG strategy, IG structure, and IG processes and that these three elements can shape the flow of supply chain information. Moreover, by applying the SSPP framework as a theoretical lens, it illuminates how the governance of supply chain information by an organization can contribute to improvements in supply chain performance. The main

premise is that the alignment between IG strategy and IG structure shapes employees' behaviors to follow predefined processes (i.e., IG processes), which positively affects supply chain performance through high-quality information. Moreover, an organization's IT infrastructure integration strengthens the relationships between IG processes and information quality and between information quality and supply chain performance because it creates an environment conducive to streamlining the flow of information in supply chains.

A major contribution of this study is to advance the appreciation of the key tenets of supply chain information flows by bringing a governance perspective to the supply chain literature. The extant literature offers a rudimentary understanding of the concept of IG and its implications in the supply chain context. With the criticality of information flows in the supply chain, the awareness of the notion of IG is imperative to both supply chain scholars and professionals. Moreover, there exists considerable confusion as to the meaning of "IG" although it has been discussed in both academia and practice (Cohasset Associates, 2014; Tallon et al., 2013a). This confusion may account for the current status that the notion of IG garners little academic attention in the supply chain literature. Therefore, this study facilitates an understanding of why the notion of IG is critical in effectively managing the supply chain by identifying and articulating three elements of IG.

A second contribution is to provide theoretical support that advances the understanding of supply chain governance with respect to information flows and offer managerial insights into how to effectively manage supply chain information flow. Drawing on the concept of fit, this study suggests that organizations should take a

holistic view of the relationships between three IG elements in that organizations should design IG structure congruent with IG strategy to promote desirable behaviors of employees (IG process) with respect to supply chain information flow. Moreover, the framework offers managerial insights into how to realize the supply chain benefits from IG. There is anecdotal evidence that IG contributes to organizational performance (Blackmer, 2014; White, 2013). However, practitioners still struggle to identify business cases that detail the benefits of IG. Needless to say, supply chain business cases pertaining to IG are rarely discussed in either practice or academia. Thus, the conceptual framework presented would help supply chain professionals to understand how to attain supply chain excellence via IG.

Implications and Future Research Directions

In the supply chain context, an organization collects, assimilate, and synthesizes information from multiple sources, both internal and external. For a focal organization to gain the benefits from the flow of supply chain information, that information should represent a single source of truth; in other words, supply chain information should be consistent and accurate across the business functions and the entire supply chain (e.g., common terms and definitions). IG clarifies the roles and responsibilities with regard to coping with supply chain information and acts as a frame of reference for an effective information flow, which enables an organization to access to the right information necessary for performing its business processes at the right time. Given that under the IG umbrella an organization can readily obtain information needed for supply chain decisions (e.g., purchasing and inventory) as well as for tracking the origin of the

problems, IG allows an organization to become more responsive to (unexpected) changes in business environments, and enhances the clarity when handling issues around supply chain information. This helps employees across the organization to stay on the same page with respect to what tasks to perform with whom in order to streamline the flow of information in the supply chain. Hence, when IG programs are established and working well, an organization can provide the right person (e.g., internal customers and supply chain partner) the right information at the right time under the IG umbrella. As such, an organization should consider organizational factors that have an impact on the flow of information in the supply chain context: IG strategy, IG structure, and IG processes.

As a multifaceted concept, IG is an endogenous factor (internal to the organization) that can be represented as a function of IG strategy, IG structure, and IG processes. This implies that research on supply chain information flows should consider these organizational factors beyond the aspects of information such as information sharing, information quality, and IT applications to unravel performance implications of supply chain information flows. The ignorance of such factors, i.e., IG strategy, IG structure, and IG processes, may account for inconclusive results about the advantages of information flow in the supply chain. Furthermore, research on empirical investigations of IG elements could reveal a missing relationship pertinent to supply chain information flows. Therefore, the introduction of IG would open up a new research agenda in the supply chain literature.

This study has taken a theory-based perspective to understanding the notion of governance of supply chain information flows and its implications. This approach

contributes to unpack the black box of IG in the supply chain context. Although the propositions can be intuitively appealing to both practitioners and scholars, future research should empirical empirically investigate the concept of IG in the supply chain context and confirm the proposed conceptual model. Furthermore, given the paucity of studies that have examined the phenomenon of service supply chains, future research efforts directed toward the governance of supply chain information flows in the service supply chain will generate insights to advance the supply chain discipline.

Moreover, it is well accepted that supply chain information flows help to streamline material flows throughout the supply chain (Lewis & Talalayevsky, 2004; Moberg et al., 2004; Vanpoucke et al., 2009). As an IG strategy is associated with supply chain information flows, a supply chain strategy could influence material flows by determining a decoupling point in the material flows (Qi, Zhao, & Sheu, 2011). Hence, it is reasonable that the interplay between IG strategy and supply chain strategy can have an impact on supply chain performance. Future research can, therefore, extend the current study to explore how the linkage between an IG strategy and supply chain strategy translates to improvements in supply chain performance.

While the discussion of this study focuses on the consequence of the interplay between three IG elements, the IG elements can not only interact with each other but also be influenced by other contextual factors (e.g., business strategy, supply chain relationships, business environments). Those contextual factors are driving forces that shape an organization's IG elements. Given the importance of IG in the supply chain context espoused by the current study, understanding of which factors are important in the IG context and whether those factors are complementary or substitutive is

imperative to managers. Hence, future research needs to identify antecedents to IG and to examine differential effects of those contextual factors to IG elements.

CHAPTER 4

MANUSCRIPT #2. CONFIGURATION OF SUPPLY CHAIN AND INFORMATION GOVERNANCE STRATEGIES: IMPLICATIONS FOR SUPPLY CHAIN AND ORGANIZATIONAL PERFORMANCE

ABSTRACT

Although much research in supply chain (SC) information flow has provided valuable insights for both academicians and practitioners, most of the extant research adopts a tactical or operational perspective rather than a strategic perspective without considering the fact that an organization could use a distinctively different supply chain (i.e., lean or agile). Moreover, there is the pressing need for exploring the key theoretical concepts in a service context within the supply chain management discipline. The current study addresses this void by developing a taxonomy of SC strategies and exploring an SC strategy combined with an organization's strategic orientation toward governing SC information, referred to as an information governance (IG) strategy in U.S. hospitals.

Using the configuration theory and capability perspective, the current study proposes that the configuration of the two strategies affect supply chain performance through an organization's capability to execute the processes for the governance of supply chain information (i.e., IG process). Empirical results reveal two distinct SC strategies employed by hospitals: responsive and efficient. The configuration of the SC and IG strategies has a differential impact on IG process, which in turn influences SC performance; IG process is highest when a hospital employs the configuration of an efficient SC strategy and an offensive IG strategy. The use of an efficient SC strategy and a defensive IG strategy is shown to be a mismatch between the two strategies. Furthermore, the results demonstrate the positive association between SC performance and hospital performance.

INTRODUCTION

Supply chain management (SCM) research has highlighted and demonstrated the instrumental role of information flow in the effectiveness of SCM for decades (Cooper et al., 1997; Ellram et al., 2004; Fugate, Sahin, & Mentzer, 2006; Kembro & Näslund, 2014). As one of the key flows in the supply chain, supply chain (SC) information flow is considered the first component that should be integrated throughout the supply chain (Cooper et al., 1997). In essence, the information that moves along the supply chain is recognized as the foundation of supply chain integration (Cooper et al., 1997; Davis, 1993; Ellram et al., 2004; Sahin & Robinson, 2002). The criticality of SC information flow seems to suggest that an organization should have a strategy pertaining to information flow that could guide pertinent decisions and specify how to manage and resolve pertinent issues to effectively manage the supply chain, given that a strategy represents a stream of an organization's decisions and offers the means (i.e., actions) to attain its goal (Mintzberg & Waters, 1982; Venkatraman, 1989).

However, most of the extant research addressing SC information flow has adopted a tactical or operational perspective with a focus on the topics such as information sharing (e.g., how much to share) (Samaddar et al., 2006) and the use of IT applications (e.g., how to share) (Craighead et al., 2006). Although few studies examined information systems strategy in the supply chain context (Qrunfleh & Tarafdar, 2014), research addressing a strategy with respect to SC information flow (hereafter referred to as information governance (IG) strategy) remains scant in the literature. Moreover, the SC literature posits that an organization should have a right type of supply chain (i.e., lean or agile) that is matched with product characteristics

(Fisher, 1997; Lee, 2002); an organization could employ a different SC strategy that reflects the characteristics of its supply chain (Fisher, 1997; Lee, 2002). Given that information flows are designed around product flows within the supply chain (Lewis & Talalayevsky, 2004; Moberg et al., 2004; Vanpoucke et al., 2009), it is reasonable that an organization's strategic approach to SC information flows (i.e., IG strategy) could interact with an SC strategy an organization employs and that the two strategies should be investigated simultaneously, not in isolation.

The overarching goal of the current study is to understand how an IG strategy and SC strategy could interact to influence performance. Specifically, this study conceptualizes an IG strategy and develops a classification scheme of an SC strategy in a service context. Next, the nature of the relationship between the arrangement of the IG and SC strategies and performance is empirically investigated in a service context. Furthermore, this study examines an organization's capability to execute processes for controlling SC information flows (hereafter referred to as the IG process) as an intervening mechanism because previous studies have provided evidence that an organization's strategy can indirectly influence its performance through its capabilities (Morgan, Vorhies, & Mason, 2009; Sinkovics & Roath, 2004). A conceptual model is developed by drawing upon the configuration theory (Meyer, Tsui, & Hinings, 1993; Siggelkow, 2002; Vorhies & Morgan, 2003) and the capabilities perspective (Day, 1994). The configuration theory provides a framework for understanding the way the arrangement of the two strategies relates to the IG process, while the capabilities perspective provides a framework for understanding the relationships between the IG process, supply chain performance (SCP), and organizational performance.

This study offers three primary contributions to the SC literature. It is among the first that considers both SC and IG strategies as reflecting an organization's overall strategic orientation towards two major flows in the supply chain, which have been shown to affect SCP. The findings of this study provide a more comprehensive understanding of the way in which an organization's strategies pertaining to SCM can contribute to performance improvement. Second, it is one of the first studies that takes a strategic perspective on SC information flow (i.e., IG strategy), which captures an organization's strategic approach to governing SC information flows. The conceptualization of an IG strategy would generate novel insights with respect to information flow by adopting a governance perspective. Furthermore, this would initiate a new discussion on the governance of supply chains with respect to SC information flows. Finally, an SC strategy in a service context is operationalized via the use of multiple sources of archival data. Given that research on SC strategies in a service context is scant in the literature (Sampson & Spring, 2012), the findings of this study contribute to the advancement of the service SC literature by providing empirical evidence pertaining to SC strategies in a service context.

This study empirically investigates the proposed relationships in the context of U.S. hospitals. A hospital supply chain is one type of service supply chains (Sampson, Schmidt, Gardner, & Van Orden, 2015). SC topics in a hospital context have received little academic attention from academic scholars despite the increasing awareness of the importance of SCM in a healthcare context (McKone-Sweet et al., 2005). Furthermore, the survey results from the Information Governance Initiatives showed that more than 40% of participating healthcare organizations have initiated an IG program

(Information Governance Initiative, 2014b). Thus, the healthcare industry forms an appropriate context for the current study.

This paper begins by introducing the concept of IG and discussing an SC strategy in a hospital context. Next, the way that the configuration theory and the capabilities perspective assist in understanding the relationships between the configuration of the two strategies, the IG process, SCP, and hospital performance is described. In the subsequent sections, the research methodology and results of the analysis are detailed. The paper concludes with implications as well as future research directions.

LITERATURE REVIEW

Concept of Information Governance (IG)

The concept of IG was first introduced from a compliance perspective with an emphasis on defining policies and procedures for managing information (Donaldson & Walker, 2004; Kooper et al., 2011). In essence, IG represents an organization-wide framework that encompasses the specification of decision rights and accountability as well as the implementation of the structure, processes, policies, and metrics for managing the life cycle of information (American Health Information Management Association, 2015; Gartner, 2015). The current study argues that in the SC context, the concept of an IG lays out the foundation for the way an organization directs and controls issues around SC information flow.

From a process perspective, a focal organization's SC network represents a set of process links that connect SC partners (Lambert, Cooper, & Pagh, 1998). This

indicates that a focal organization needs to create, acquire, exchange, and maintain different types of SC information depending on the criticality of the process links. Given that SC partners' informational needs depend on their positions within the supply chain (Lumsden & Mirzabeiki, 2008), a focal organization must make strategic decisions about SC information flows and implement practices consistent with its decisions. This study proposes that the governance of SC information flows serves as a basis for pertinent strategic decisions and practices.

This study, in particular, considers two aspects of IG in the supply chain: IG strategy and IG process. First, an IG strategy refers to an organization's strategic posture toward governing SC information flows, and it reflects an organization's pattern pertaining to major IG decisions. Based on the typology developed by Miles (1982), which provides a framework for an organization's strategic orientation (Plambeck & Weber, 2010), this study classifies an IG strategy into two types: offensive and defensive. An organization that uses an offensive IG strategy pursues the realization of the business value of SC information by leveraging IG programs. For an offensive IG strategy, an organization tends to adopt a forward-looking and progressive perspective when making strategic decisions pertaining to the governance of SC information. It focuses on leveraging and enhancing IG programs to quickly respond to uncertain and changing business environments. Hence, offensive organizations with respect to the governance of SC information flows are often considered early adopters of IG practices and IG leaders in the market. In contrast, an organization using a defensive strategy adopts a conservative approach toward governing SC information. By viewing environmental changes as threats, an organization with a defensive strategy focuses on

securing SC information for the purpose of compliance and legal obligations. Thus, defensive organizations tend to favor exploiting existing IG practices over implementing and experimenting with new SC information governance practices when coping with changes in regulatory requirements and business environments (Gioia & Thomas, 1996).

Second, the conceptualization of an IG process is intended to capture an organizational capability to implement and execute the processes required to govern SC information (Day, 1994; Dutta, Zbaracki, & Bergen, 2003; Jaakkola, Frösén, & Tikkanen, 2015). An organizational capability, in general, represents an organization's capacity to consistently perform relevant activities that can contribute to value creation (Grant, 1996). In an IG context, to acquire, retain, access, and distribute relevant SC information an organization must develop the ability to perform pertinent activities in that an organization should define what SC information to govern and deploy resources to design, implement, and tailor relevant tasks to effectively manage SC information flow over time (Dutta et al., 2003; Jaakkola et al., 2015). This IG process could be unique, causally ambiguous, and complex (Wright, Dunford, & Snell, 2001), which would be impossible imitate. Thus, this study regards IG process as an organizational capability.

The processes required to govern information encompass various activities pertaining to acquisition, retention, access, and distribution. Information acquisition refers to an organization's capability to perform the activities required to capture SC information, while information retention refers to an organization's ability to implement the activities associated with retaining and storing SC information. Information access and information distribution refer to an organization's capability to grant access to and to

disseminate SC information within and beyond the organizational boundaries, respectively. Therefore, if an organization is equipped with IG process, the execution of pertinent IG activities would become more effective and efficient across the organization in that it would facilitate and streamline the flow of SC information within the organization and its supply chain.

Supply Chain (SC) Strategy

Much of research in the SC literature has specified the relationships between an SC strategy and other concepts. But, there is no consensus on the definition of an SC strategy. For instance, Simichi, Kaminsky, and Simichi (2008) defines an SC strategy as a set of approaches utilized for the integration of end-to-end supply chain business processes in order to create value for customers (i.e., strategy as intentions). It is also conceptualized as patterns of decisions about sourcing, production, and logistics activities (i.e., strategy as realizations) (Salam, 2005). Regarding the conceptualization of a strategy, the strategic management literature advises strategy as realizations because such conceptualization makes a strategy become "the consistency in an organization's behaviors" (Mintzberg & Waters, 1982; Venkatraman, 1989). In line with this recommendation, an SC strategy refers to a realized strategy that is manifested as patterns of a stream of decisions in managing the supply chain. Furthermore, it reflects the characteristics of its supply chain and determines its supply chain priorities (Fisher, 1997; Lee, 2002).

Two primary SC strategies, i.e., lean and agile, are well recognized in the SC literature (Christopher & Towill, 2000; Fisher, 1997; Yusuf, Gunasekaran, Adeleye, &

Sivayoganathan, 2004). The underlying premise is that demand characteristics, reflected in functional or innovative products, require a distinct SC strategy that is either lean or agile (Fisher, 1997; Sebastiao & Golicic, 2008). The key tenet of a lean strategy is waste elimination and time compression (Fisher, 1997; Qi et al., 2011; Womak & Jones, 1996). A lean strategy is the right approach for products with a predictable demand and a long lifecycle (Fisher, 1997). In contrast, an agile strategy emphasizes the responsiveness to uncertain and changing environments (e.g., customer demands) (Fisher, 1997), which is more appropriate for innovative products characterized by unpredictable demands and short lifecycles (Christopher, 2000). Supply chain scholars have also identified and examined a hybrid SC strategy: leagile (Christopher & Towill, 2001; Goldsby, Griffis, & Roath, 2006; Naylor, Naim, & Berry, 1999), which creates a decoupling point in product flows to balance supply and demand (Qi et al., 2011).

Nevertheless, existing classification schemes of SC strategies developed for product-based supply chains may not be directly applicable to a hospital context given the differences between product and service supply chains (Ellram et al., 2004; Sampson & Spring, 2012; Sengupta, Heiser, & Cook, 2006). For instance, a hospital supply chain is described as a combination of internal and external supply chains (Sampson et al., 2015). An external supply chain mainly relates to the supply of medical devices and pharmaceuticals used for delivering healthcare services; this is similar to a traditional supply chain that primarily deals with product flows. An internal supply chain, which is the phenomenon of interest for the current study, represents a service supply chain that pertains to the delivery of a variety of healthcare services to meet different needs of patients, who communicate with physicians and nurses in the service delivery

processes in hospitals. In this case, it is plausible that service delivery can be viewed as an outcome of complex and interdependent relationships between patients, physicians, nurses, and physical resources (Niranjan & Weaver, 2011; Sampson et al., 2015). For seamless service delivery process integration, SC professionals should ensure the availability of medical devices, equipment, and pharmaceuticals while acquiring the right materials and maintaining the appropriate level of inventory. In addition, the extant literature provides a rudimentary understanding of the classification of service SC strategies; research on service SC strategies remains scant in the literature (Sengupta et al., 2006). Hence, given the lack of understanding regarding a classification scheme of SC strategies in a hospital context, it is appropriate to develop an empirically-based classification scheme of hospital SC strategies (i.e., cluster analysis) that incorporates unique aspects of a hospital supply chain.

In the literature, there is ample guidance regarding the selection of empirical variables for classifications (Bailey, 1994; Dess, Newport, & Rasheed, 1993); it has been recommended that for research that is exploratory in nature, variables should be selected in a way that helps delineate the phenomenon of interest (Ketchen & Shook, 1996; Meyer et al., 1993). Furthermore, as input variables for a cluster analysis, organizational elements should be carefully chosen based on theories. Against this backdrop, input variables are selected based on the underlying premise of SC strategy literature in combination with the characteristics associated with service delivery in hospitals. In essence, consistent with Fisher's (1997) framework, it is argued that the service characteristics (i.e., service complexity and service diversity) determine the choice of an SC strategy in that a hospital incorporates demand patterns or

characteristics into service delivery processes and makes distinct strategic supply chain decisions pertaining to resource allocation to integrate and facilitate service delivery processes. To meet patients' needs, a hospital must perform a series of activities associated with service delivery processes. Each activity requires different resources, both tangible (e.g., medical devices and pharmaceuticals) and intangible (e.g., skills and information), which depend on complexity, uncertainty, and the interdependence of workflows (Galbraith, 1973). This suggests that the choice of a hospital's SC strategy may depend on the characteristics of services offered by a hospital.

Based on this discussion, service complexity and service diversity are employed as two determinants of a hospital's SC strategy for the current research. Service complexity refers to the intricacy and number of activities required for service delivery (Shostack, 1987). A high level of service complexity indicates that a hospital performs relatively complicated procedures to deliver healthcare services to patients, which requires a hospital to deal with a variety of service-related information (Galbraith, 1973) and increases coordination challenges (Novak & Eppinger, 2001) and unpredictability (Tien, 2008). To cope with these issues, it is plausible that a hospital would require a more flexible supply chain.

The complexity of services rendered varies between hospitals, which is reflected by the Case Mix Index (CMI). The CMI refers to a normalized composite index that captures the proportion of patients in each diagnosis-related group (Nath & Sudharshan, 1994). The CMI is also considered a key variable that characterizes a hospital's business (Nath & Sudharshan, 1994). In general, the higher a hospital's CMI, the more complex procedures rendered. In a supply chain context, a high level of CMI

indicates that a hospital provides complicated and sophisticated procedures that demand unique and diverse resources. Given the rapid advancement of medical research and the increasing change of products and services in a healthcare context (de Vries, Huijsman, Aronsson, Abrahamsson, & Spens, 2011), the supply chain of a hospital with a higher CMI must continue to foresee changes in environments and quickly respond to those changes.

Service diversity refers to a compositional pattern of a set of services (Harrison & Klein, 2007). Analogous to service diversity, the implications of product diversity for SCM has been investigated in the literature (Ramdas, 2003). Research on product variety has shown that product variety increases uncertainty and creates demand uncertainty (Swaminathan & Lee, 2003). The literature also suggests that an organization's decisions regarding product variety are related to the way the organization responds to uncertain demand patterns (Ramdas, 2003). Similarly, it can be inferred that service diversity increases uncertainty in the service supply context and that an organization offering a variety of services requires a supply chain that can cope with unpredictability. Regarding service diversity, prior research in a healthcare setting has supported the notion of "focus as emphasis", which means that hospitals have specialties in a specific service as well as offer various services to patients (KC & Terwiesch, 2011; McDermott & Stock, 2011). A hospital that offers diversified services must manage more diverse resources (a greater asset base) than a focused hospital and must deal with a high level of uncertainty from a variety of resources, although the hospital may be able to employ economies of scope to reduce costs (Nath & Sudharshan, 1994). Furthermore, the literature describes service focus as an important

source of efficiency improvement (Herzlinger, 1997; Singh & Terwiesch, 2011). Thus, a service-focused hospital's supply chain is more efficient compared to a service-diversified hospital.

Based on the characteristics of a hospital context, two types of service diversity are examined: service diversity based on volume and service diversity based on customer segments (inpatient vs. outpatient). The first type of service diversity evaluates the diversity based on the number of cases for each service category, which is a commonly used approach in the literature (Goerzen & Beamish, 2005). The second type of service diversity captures the diversity with respect to customer segments. In a hospital context, patients can be classified into two types: inpatients and outpatients (CMS, 2014a); inpatient services require patients to be admitted to the hospital, whereas outpatient services do not. The classification of patients indicates that inpatients and outpatients may each demand a different set of clinical services.

THEORETICAL FOUNDATIONS AND HYPOTHESES DEVELOPMENT

Configurational Approach and Capabilities Perspective

Strategic fit and internal consistency have been investigated using a configurational approach as a theoretical lens in various disciplines (Dess et al., 1993; Fang, Palmatier, & Grewal, 2011; Flynn, Huo, & Zhao, 2010; Miller, 1987). The premise of a configurational approach, which roots in contingency theory, posits that there exist(s) (an) ideal configurations for an organization's superior performance by adopting a holistic perspective (Drazin & Van de Ven, 1985; Meyer et al., 1993), which is based on two principles: (i) the concept of coherence and (ii) the holistic nature of

organizational phenomena (Meyer et al., 1993). The configurational approach states that the arrangement of organizational elements ultimately affects organizational performance (Siggelkow, 2002). Furthermore, Miles and Snow (1978) views strategy as a constellation of decisions and argues that an organization designs its managerial processes, including its capabilities, based on its strategy.

In this study, a strategy refers to a realized strategy (i.e., patterns in a stream of decisions) (Mintzberg, 1987; Venkatraman, 1989). An organization's SC and IG strategies represent its strategic patterns in decisions associated with managing supply chains; SC and IG strategies primarily pertain to products and information flows, respectively. This suggests that a distinct constellation of the SC and IG strategies could reflect an organization's overall and comprehensive strategic posture towards managing the supply chain. Given the criticality of information flow to product availability and service delivery in the supply chain, it can be argued that the arrangement of the SC and IG strategies could have a differential impact on performance.

Capabilities refer to complex bundles of skills and accumulated knowledge embedded in organizational processes (Day, 1994; Helfat & Peteraf, 2003). Skills and knowledge enable an organization to effectively coordinate relevant activities by leveraging its organizational assets (Day, 1994). They can be assimilated and disseminated across the organization through approaches such as training and technical systems (Leonard-Barton, 1992). An organization's capabilities are well-recognized as critical sources of competitive advantage to achieve superior performance (Day, 1994; Helfat & Peteraf, 2003; Krasnikov & Jayachandran, 2008). Relating to the governance of SC information, an IG process represents an

organizational capability that is exercised through activities associated with SC information that moves throughout the organization and beyond organizational boundaries (Day, 1994). For instance, a focal organization exchanges a variety of SC information with SC members. SC information from SC members is acquired, retained, and disseminated throughout the organization. By leveraging the IG process, a focal organization can better coordinate and streamline activities associated with the governance of information that flows throughout the supply chain, which enables a focal organization to effectively manage the supply chain. Furthermore, it can also trace the origin issues around the flow of information in the supply chain and can resolve those issues by leveraging the IG process. The discussion above suggests that IG process is conducive to enhancing supply chain performance (SCP). Hence, the capability perspective provides a theoretical framework that delineates the link between IG process and SCP.

In summary, this study delineates the linkages between the configuration of the SC and IG strategies, the IG process, SCP, and hospital performance based on the configurational and capability perspectives. It is posited that the arrangement of SC and IG strategies is related to the IG process by which an organization can achieve superior SCP. Furthermore, a hospital's SCP is positively associated with hospital performance in terms of financial performance and customer-centric performance. Figure 4 outlines the potential impact of the configuration of the SC and IG strategies on SCP and the association between SCP and hospital performance. The IG process is depicted as an intervening mechanism through which the configuration of the SC and IG strategies affects SCP.

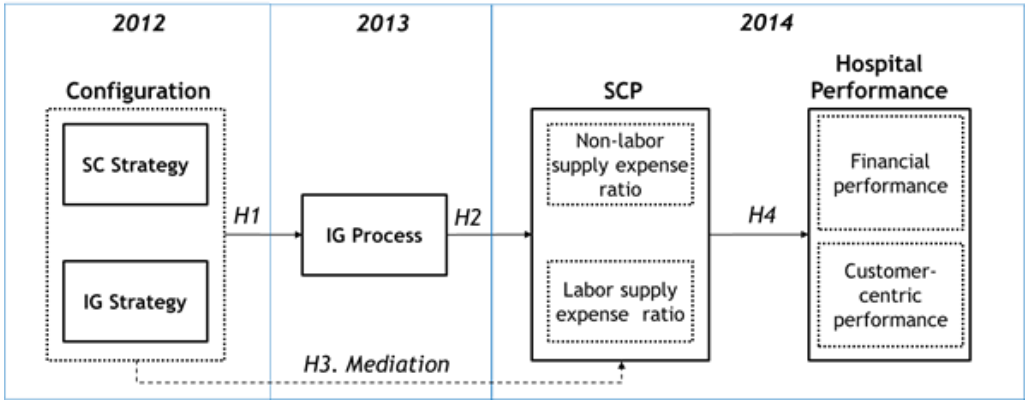

Figure 4 Configuration of SC and IG strategies, the IG Process, SCP, and Hospital Performance

Hypotheses Development

This study proposes that the configuration of the SC and IG strategies, which reflects a hospital's overall strategic approach towards managing its supply chain, should be related to the IG process. For instance, a hospital that offers complex and diverse services should employ a responsive supply chain strategy to cope with demand uncertainty (Fisher, 1997). To implement a responsive supply chain, a hospital continues to sense the changes in customer needs and environments and seeks to acquire and assimilate relevant SC information to make timely decisions associated with managing its supply chain (Qrunfleh & Tarafdar, 2014). In this environment, a hospital needs to be flexible in terms of acquiring and interpreting new or dissimilar information from multiple sources (e.g., customers, supply chain members) in order to support complex service delivery processes as well as to match a supply chain with unpredictable demand patterns (Daft & Lengel, 1986). An offensive IG strategy could generate an environment in which a hospital can be more flexible when making decisions around the flow of SC information.

In contrast, a hospital that uses an efficient SC strategy aims to facilitate and expedite the flows of materials and SC information to efficiently manage its supply chain (Qrunfleh & Tarafdar, 2014). This type of hospital focuses primarily on routinizing tasks associated with the movement of SC information, and it could easily codify newly acquired information similarly to the existing information (Sampler, 1998). In this case, a defensive IG strategy could provide an environment that enables a hospital to streamline the existing activities to reduce the ambiguity and equivocality of SC information (Daft & Lengel, 1986). The discussion above suggests that a hospital's patterns in a series of strategic decisions and actions depend on the arrangement of the two strategies, i.e., SC and IG strategies, in that a hospital with a responsive SC strategy and an offensive IG strategy show distinctively different decision patterns from a hospital with an efficient SC strategy and a defensive IG strategy.

Research in the strategic management literature suggests that an organization's strategy shapes its organizational structure and processes (Galbraith & Nathanson, 1978; Miles & Snow, 1978). In general, a strategy provides a foundation for the direction of an organization (Matsuno & Mentzer, 2000; Sinkovics & Roath, 2004), which allows the organization to develop certain capabilities that are consistent with its direction (Miles & Snow, 1978). The literature also emphasizes the consistency of decisions across the organization (Hayes & Wheelwright, 1984). As such, the literature suggests that an organization's strategy affects the development of certain capabilities by which its strategy can be translated into strategic actions. Likewise, it can be posited that a specific configuration of SC and IG strategies can be related to capabilities pertaining to the flow of SC information, i.e., the IG process. Because SC and IG strategies can

provide a foundation for directing an organization's supply chain decisions, a combination of the two strategies would affect the IG process. When the IG strategy is aligned with the SC strategy, an organization can effectively deploy its resources to develop an IG process. The alignment between the two strategies can allow a hospital to design its processes and to determine resource deployment in a certain way (Miles & Snow, 1978). In other words, a hospital's strategic approach could drive the development of its capabilities pertaining to the flow of SC information. Hence, it is hypothesized that a hospital's IG process depends on its overall strategic approach towards managing its supply chain:

Hypothesis 1. The configuration of SC and IG strategies is associated with the IG process.

The underlying premise of the capabilities perspective is that capabilities are embedded in organizational processes and allow organizations to effectively deploy organizational resources to obtain competitive advantages (Krasnikov & Jayachandran, 2008; Teece, Pisano, & Shuen, 1997). Furthermore, capabilities enable an organization to execute activities in business processes. Similarly, the IG process provides an organization with the ability to carry out activities associated with the governance of information flows, such as information acquisition, information retention, and information distribution. Given the use of a sheer number of available technologies, the IG process is deemed to be implemented within various SC information systems. In practice, organizations utilize multiple SC information systems (e.g., ERP, WMS, EDI, and MES) to integrate and support supply chain processes and to improve supply chain visibility.

These systems provide organizations with the ability to obtain seamless information flows within and across the organizational boundary.

In a healthcare context, a hospital exchanges SC information (e.g., invoices, purchase orders, and forecasting) with suppliers and group purchasing organizations, referred to as supply chain intermediaries, to perform business to business transactions. The information exchanged enables the focal organization to coordinate transactions across the businesses (Grover & Saeed, 2007) and to enhance inventory visibility/ reduction, labor efficiency, and customer service (Lee et al., 1997; Narayanan et al., 2009; Saraf et al., 2007). For instance, a hospital uses multiple EDI messages associated with insurance (e.g., healthcare claim billing) and SCM processes (e.g., purchase orders) (Iossifova & Meyer-Goldstein, 2013). This indicates that a hospital has the capability to carry out a set of processes to generate standardized messages compliant with EDI rules and to exchange them with suppliers and group purchasing organizations. This capability, which is an IG process, ultimately ensures accurate, timely, and relevant SC information.

High-quality SC information allows for visibility in a hospital's SC resources (e.g., inventory), which means that a hospital can easily locate products and equipment and can prevent unnecessary product orders; thus, the increase in inventory visibility can reduce inventory costs as well as provide effective service delivery to patients. In addition, accurate and timely inventory information can allow supply chain managers to make effective purchasing decisions in a timely manner. Therefore, the discussion above leads to the following hypothesis:

Hypothesis 2. An organization's IG process is positively associated with its SCP.

The strategy-performance linkage has been examined in multiple disciplines, such as strategic management, SCM, and marketing (Cavusgil & Zou, 1994; Chandler, 1962; Porter, 1980; Qi et al., 2011). Although prior research has provided empirical evidence that supports the direct relationship between strategy and performance, it is also suggested that strategy does not automatically translate to organizational performance (Zhou, Yim, & Tse, 2005). Hence, prior research hints at an indirect link between strategy and organizational performance (Sinkovics & Roath, 2004). For instance, Sinkovics and Roath (2004) examined the mediating role of operational flexibility and collaboration in the relationship between strategic orientation and performance in the 3PL context. Murray, Gao, and Kotabe (2011) empirically investigated the role of marketing capabilities in intervening the relationship between the market orientation and performance. As such, prior research suggests that the configuration of SC and IG strategies influence SCP via the IG process. In other words, H1 and H2 together imply that the IG process plays an intervening role through which the configuration of SC and IG strategies influences SCP.

The configuration of the SC and IG strategies directs resource deployment for an effective SCM; however, the realization of resource deployment as a competitive advantage depends on an organization's capability to leverage organizational resources pertaining to the governance of SC information. Therefore, it is hypothesized that the configuration of SC and IG strategies affects SCP through the IG process:

Hypothesis 3. The IG process mediates the effect of the configuration of a hospital's SC and IG strategies on its SCP.

SCP is a multifaceted concept (Hult, Ketchen Jr, Cavusgil, & Calantone, 2006), and divergent SCP frameworks are proposed in the literature (Beamon, 1999; Cho, Lee, Ahn, & Hwang, 2012; Melnyk, Davis, Sandor, & Spekman, 2010; Neely, Gregory, & Platts, 2005). In a hospital context, there is no consistent way to assess SCP (McKone-Sweet et al., 2005). The literature also indicates that there is a lack of consensus on the SCP framework (Beamon, 1999), even for product-based supply chains. But, the efficiency of resource utilization is commonly used as SCP in the literature (Cohen & Lee, 1989; Lai, Ngai, & Cheng, 2002). In a hospital context, supply expenses account for 15 % to 50 % of a hospital's total operating expenses (Langabeer & Helton, 2016). Hence, SCP evaluates the efficiency aspect of a hospital's supply chain.

Prior research has provided empirical evidence that supports the positive association between SCP and firm performance (Qrunfleh & Tarafdar, 2014) in that superior SCP means a reduction in supply costs (e.g., medical suppliers, inventory), leading to the improvement in a hospital's profitability (Vonderembse, Uppal, Huang, & Dismukes, 2006). Furthermore, superior SCP implies that the flow of supplies, such as medical devices, equipment, and pharmaceuticals, is streamlined and coordinated within a hospital. It enables doctors and nurses to receive the right supplies when needed, which may enhance patients' experiences through a seamless service delivery process. Therefore, it is hypothesized that:

Hypothesis 4. SCP is positively associated with hospital performance.

RESEARCH METHODOLOGY

Data Collection Procedure

The proposed model in Figure 4 is tested by using longitudinal data from multiple sources of archival data. Archival data is considered more objective than survey data and reflects the consequences of the arrangement of SC and IG strategies (Calantone & Vickery, 2010; Rabinovich & Cheon, 2011); thus, the use of archival data helps to objectively assess the impacts of the arrangement of SC and IG strategies on SCP as well as the association between SCP and hospital performance. Sources include the Center for Medicare and Medicaid Services (CMS) cost reports (CMS, 2010, 2011, 2012, 2013, 2014b), CMS impact files for CMI, Medicare provider utilization and payment data for service focus (Medicare Provider Utilization and Payment Data, 2011, 2012), Hospital Compare database (Hospital Compare, 2014), Healthcare Information and Management Systems Society (HIMSS) Analytics Database (HIMSS Analytics, 2013), and publicly available reports about GS1 Healthcare (Healthcare, 2016) and Strategic Market Initiative (SMI) (SMI, 2016). While the CMS cost reports provide the data on measuring supply expenses, financial data, and most hospital characteristics (e.g., location, ownership, and the number of bed), the data on experiential quality come from the Hospital Compare database. The HIMSS Analytics Database provides the data on hospitals' IT environment, which is used to evaluate a hospital's IG process. Additionally, the information from GS1 Healthcare and SMI reports is used to assess a hospital's IG strategy.

Measurement

Hospital performance. Hospital performance is comprehensively evaluated based on a set of performance metrics that capture profitability (i.e., operating margin and ROA) and experiential quality because financial and customer-centric performance metrics are commonly used to evaluate firm performance in the literature (Leuschner, Charvet, & Rogers, 2013). This study employs operating margin (Harkey & Vraciu, 1992; Shortell et al., 1995; Smith, Bradley, Bichescu, & Tremblay, 2013) and ROA (Germain, Davis-Sramek, Lonial, & Raju, 2011; Smith et al., 2013) to measure a hospital's profitability. Experiential quality reflects the level of patient satisfaction with a hospital's care experienced, which comes from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey results (Gardner, Boyer, & Gray, 2015; Sharma, Chandrasekaran, Boyer, & McDermott, 2016). The HCAHPS survey asks patients about their experience on delivered care by using questions such as 1) nurses communicated well, (2) help received quickly, (3) pain controlled well, (4) staff explained medicines, (5) overall hospital rating, and (6) would recommend hospital. The current study uses the unweighted score from Hospital Compare database, which ranges from 1 to 100, as scores for a hospital's experiential quality.

SCP. This is a measure of supply expense ratio reflecting costs associated with delivering patient care and supporting the care environment (Langabeer & Helton, 2016). Supply expenses are further decomposed into non-labor supply expenses and labor supply expenses to gain a comprehensive understanding of the linkage between IG process and SCP. Non-labor supply expense includes non-labor costs (total costs – direct salaries) associated with Ancillary service, (ii) Central Services and Supply, and

(iii) Pharmacy, whereas labor supply expense refers to direct salaries associated with those activities. Adjusted non-labor supply expense ratio and labor supply expense ratio are calculated as non-labor supply expenses divided by total net patient revenue and CMI (Langabeer & Helton, 2016) and labor supply expenses divided by net patient revenue and CMI, respectively.

IG Strategy. IG strategy is evaluated based on the Saidin index of GS1 Healthcare and SMI memberships in 2010 and 2012 (Queenan, Angst, & Devaraj, 2011; Spetz & Maiuro, 2004). The literature suggests that membership in a business association relates to a firm's propensity to invest in assets (Grosman & Leiponen, 2013). This implies that a member organization of SC information governance-related associations is more likely to escalate its strategic commitment toward governing its SC information. This study considers members in two associations: GS1 Healthcare and Strategic Market Initiative (SMI), both of which emphasize the importance of SC information standards in a healthcare context (e.g., Global Location Number) and aim to adopt and apply standards for healthcare supply chains.

A hospital's IG strategy is determined using Saidin Index (Spetz & Maiuro, 2004). The key characteristic of Saidin index is that the lower the percentage of hospitals with memberships of GS1 Healthcare and SMI, the higher Saidin index. Hospitals joining these associations are deemed to have the propensity to engage more actively in SC information practices. Hence, hospitals with the higher Saidin index are expected to have more offensive posture toward SC information governance. The Saidin index for IG strategy is given by,

$\sum_{k=1}^{2}\left(a_k^{2012}\tau_{i,k}^{2012} + a_k^{2010}\tau_{i,k}^{2010}\right)$, if a hospital is either a member of GS1 and/or SMI in 2012; otherwise 0.

Where,

$$a_k^t = 1 - \frac{1}{N_t}\sum_{i=1}^{N_t}\tau_{i,k}^t$$

N_t : The number of hospitals under consideration for year *t*

$\tau_{i,k}^t$:1 if hospital i is a member of association *k* in year *t*

k: 1 (GS1 Healthcare); 2 (SMI)

SC Strategy. SC strategy is measured based on the results of cluster analysis that uses CMI, service diversity based on volume, and service diversity based on customer segments (i.e., the ratio of the number of inpatient services to the number of outpatient services). The data on CMI come from CMS impact files. Service diversification is evaluated based on the entropy index of heterogeneity based on the top 100 most frequently billed discharges (Teachman, 1980), which come from Medicare provider utilization and payment data (Medicare Provider Utilization and Payment Data, 2011, 2012). Service diversity based on volume is defined as the average of the entropy index over two years and calculated as follows:

$$\left(-\sum_{i=1}^{100} p_i^{2011} ln(p_i^{2011}) - \sum_{i=1}^{100} p_i^{2012} ln(p_i^{2012})\right)/_2$$

Where p_i^t equals the percentage of discharges in Medicare Severity-Diagnosis Related Group (MS-DRG) code i in year t

Lastly, service diversity based on customer segments is calculated as the average of the number of MS-DRG codes a hospital discharge is assigned to over the number of ambulatory payment groups offered by a hospital over two years, 2011 and 2012. The procedures for identifying SC strategy clusters will be detailed in the subsequent section.

IG Process. IG process is evaluated based on a hospital's capability to execute the processes for governing inventory-related information. This study focuses on inventory-related information due to its criticality for an effective inventory management: (i) a hospital's inventory management directly impacts patient care (Vila-Parrish & Ivy, 2013) and (ii) a hospital deals with diverse types of supplies with unique demand characteristics (e.g., short life-cycle, lack of standardization, high-quality requirements) (Chen, Preston, & Xia, 2013). The level of IG process includes (i) We do not track inventory management, (ii) Inventory management is tracked through the pharmacy management system, (iii) A separate product is used for inventory management in pharmacy, and (iv) Inventory management is tracked through the hospital's inventory management system. The score for IG process ranges from 1 to 4.

Control variables. To account for the differences across hospitals, several control variables that capture hospital characteristics are included in the model (Breaugh, 2006; Chen et al., 2013). Hospital characteristics are measured by using the data from the CMS database (CMS, 2014b). Location is a binary variable (0 = rural; 1 = urban); profit status is coded as 1 if a hospital is a for-profit hospital and 0 otherwise; governmental control is a binary variable (0: not controlled by a government entity; 1: controlled by a government entity); member of multi-hospital system is a binary variable (0: not a

member; 1: member). To control for a hospital's size and patient volume, the number of beds and total discharges are included (Langabeer & Helton, 2016).

Taxonomy Development of SC Strategy

Two-stage clustering approach

Following the procedures recommended by Sharma (1996), the current study took a two-stage clustering approach. All cluster analysis was performed with SAS 9.3. At the first stage, a hierarchical clustering algorithm developed by (Sarle, 1985) in combination with the Cubic Clustering Criterion (CCC) (Sarle, 1983) and *pseudo-t^2* index (Duda & Hart, 1973) were used to determine the appropriate number of clusters (Milligan & Cooper, 1985). Furthermore, given the sensitivity of outliers to cluster analysis (Punj & Stewart, 1983), this study used percentile rank to standardize variables (Sneath & Sokal, 1973) and dropped multivariate outliers from the sample. 7.6% of the observations were identified as outliers and removed from the data set. As shown in Table 4, these analyses provided evidence that there exist two clusters (i.e., two distinct SC strategy groups).

Table 4 Criteria for determining the number of clusters

No. of Clusters	Cubic Clustering Criterion (CCC)	Pseudo-*F*	Pseudo-t^2
9	-51	1015	370
8	-50	1066	188
7	-48	1157	132
6	-37	1301	139
5	-36	1412	302
4	-29	1762	125
3	-20	2336	239
2	2.13	4232	185
1	0	.	4232

There exists a local peak when the number of clusters is two and Pseudo-F statistic has the largest value at two clusters that indicate a possible stopping point. Thus, both CCC and Pseudo-F lend support to the two-cluster model. At the second stage, the non-hierarchical *K*-means approach was used to assign hospitals in the sample to one of SC strategy groups (Autry, Zacharia, & Lamb, 2008; Yarbrough, Morgan, & Vorhies, 2011). The results of the non-hierarchical *K*-means approach with T-tests supported the differences in CMI, service diversity by volume, and service diversity by customer segments between two SC strategies (see Table 5).

Table 5 Tests for difference across two SC strategies

	T-Statistic	Cluster 1 (n = 1508; 53.2%)	Cluster 2 (n = 1325; 46.8%)
		Mean	Mean
CMI	55.21***	.694	.278
Service diversity by volume	77.09***	.722	.246
Service diversity by customer segments	69.40***	.714	.255

*Note. Mean represents the average of standardized variables by clusters; ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.*

As represented in Table 5, hospitals in Cluster 1 provide more complex and diversified services to patients and put more emphasis on inpatient service offerings than outpatient service offerings. In contrast, hospitals in the second SC strategy cluster emphasize the focus of services and offer less complicated services. They offer more diverse outpatient services than hospitals in Cluster 1. The findings seem to reveal two distinct SC strategies employed by hospitals. For illustrative purposes, some descriptive statistics of hospitals in each SC strategy group are presented in Table 6.

Table 6 Cluster description based on top 20 % of hospitals close to centroids of clusters

	Responsive SC strategy (*N= 303*)	Efficient SC strategy (*N=267*)
Cluster variables		
CMI	1.57	1.25
Service diversity by volume	4.06	3.07
Service diversity by customer segments	4.46	2.10
Demographics		
Number of beds	228.7	71.2
Profit status	.16	.18
Location	.89	.40
Financial metrics		
Days of working capital	49.5	40.0
Performance metrics		
Occupancy rate	.73	.46
Average length of stay	4.47	3.83

Cluster 1 ("Responsive SC strategy"). The first SC strategy group is identified as *Responsive SC strategy group*. A responsive SC strategy emphasizes the responsiveness to patients' complex and diverse care service needs coming from a high level of CMI and service diversification. To treat those patients, it aims to maintain a high degree of resource availability, both financial and physical because the failure of service delivery at the right time can lead to a detrimental impact on patients' health conditions (see days of working capital in Table 6). Furthermore, to be responsive to patients' needs and technological changes, a hospital with a responsive SC strategy needs to engage actively in acquiring and interpreting information from downstream and upstream in the supply chain.

Cluster 2 ("Efficient SC strategy"). The second SC strategy group is identified as *Efficient SC strategy group.* An efficient SC strategy focuses primarily on how to efficiently and effectively utilize resources for healthcare service delivery. A hospital using an efficient SC strategy provides relatively less complicated procedures than

hospitals with a responsive SC strategy (see Table 6). With an efficient SC strategy, hospitals seek to streamline the flows of products and information for the purpose of cost containment. In addition, they tend to use a service-focused approach compared to hospitals with a responsive SC strategy, which allows them to leverage economies of scale, resulting in efficiency improvement.

Model Estimation

As presented in Figure 4 Configuration of SC and IG strategies, the IG Process, SCP, and Hospital Performance, the proposed research model includes a series of regression models. The full research model to test hypotheses developed is specified as follows:

$$(1)\ IGProc_{2013} = \alpha_1 + \beta_{11}SCStr_{2012} + \beta_{12}IGStr_{2012} + \beta_{13}SCStr_{2012} \times IGStr_{2012} + \beta_{14}CV_{2012} + \varepsilon_{IGProc}$$

$$(2,3)\ SCP_{2014} = \alpha_2 + \beta_{21}IGP_{2013} + \beta_{22}CV_{2013} + \varepsilon_{SCP}$$

$$(4,5,6)\ HospPerf_{2014} = \alpha_3 + \beta_{31}SCP_t + \beta_{22}CV_{2014} + \varepsilon_{HostPerf}$$

Where,

$SCStr_t$: $SC\ strategy\ in\ year\ t$

$IGStr_t$: $IG\ strategy\ in\ year\ t$

$IGProc_t$: $IG\ process\ in\ year\ t$

SCP_t: $Supply\ chain\ performance\ in\ year\ t$

$HospPerf_t$: $Hospital\ performance\ in\ year\ t$

CV_t: $vector\ of\ control\ variables\ measured\ in\ year\ t$

In testing the hypotheses, a robust approach was employed instead of Ordinary Least Square (OLS) regression because of concerns about heteroscedasticity and outliers.

Table 7 Checks for heteroscedasticity and outliers

	Breusch-Pagan / Cook-Weisberg test (Chi-square)	Proportion of outliers	Proportion of leverage points
Eq. 1 (DV = IG Process)	.26	.000	.194
Eq. 2 (DV = adjusted non-labor supply expense ratio)	110.50***	.013	.187
Eq. 3 (DV = adjusted labor supply expense ratio)	324.33***	.028	.187
Eq. 4 (DV = Operating margin)	3686.61***	.042	.258
Eq. 5 (DV = ROA)	1605.04***	.071	.258
Eq. 6 (DV = Experiential quality)	32.87***	.003	.244

*Note. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level; SAS 9.3 was used to detect outliers and leverage points*

As shown in Table 7 Checks for heteroscedasticity and outliers, there is heteroscedasticity in the data used for testing the models except for Eq. 1. In addition, there are some outliers and leverage points in the model, which violate assumptions for OLS. Hence, the current employs a robust approach that is less sensitive to heteroscedasticity and outliers. For Eq. 2 – Eq.5, quantile regression was used because it can address statistical issues such as heteroscedasticity and outliers (Barreto & Hughes, 2004; Koenker & Bassett Jr, 1978; Ramdani & Witteloostuijn, 2010). In testing H1 (i.e., Eq. 1), robust regression was employed because it can deal with extreme points (Schwab, Abrahamson, Starbuck, & Fidler, 2011) and there is no heteroscedasticity issue in the data for testing H1. Furthermore, the use of quantile regression can provide a comprehensive understanding of the relationships between IG

process, SCP, and hospital performance because it allows analyzing the relationships at different quantiles of the distribution of SCP and hospital performance. In addition, the intervening role of IG process between the arrangement of SC and IG strategies and SCP, which is posited as H3, was tested by using a bootstrap mediation analysis (Hayes, 2013; Rungtusanatham, Miller, & Boyer, 2014).

RESULTS

The descriptive statistics for all variables are presented in Appendix A. It summarizes mean, standard deviation, and Pearson Product-Moment correlations. As seen from Appendix A, IG process is positively correlated with SC strategy (r = .165) and IG strategy (r = .173). Both non-labor supply expense ratio and labor supply expense ratio are negatively correlated with operating margin (r = - .403 and -.488, respectively) and ROA (r = - .156 and -.152, respectively). Both of them are positively correlated with experiential quality (r = .114 and .207, respectively).

H1, which posited the association between the arrangement of SC and IG strategies and IG process, was tested by using Eq 1. The fourth column in Table 8 (Model 3) shows that the configuration of two strategies has a negative and statistically significant relationship with IG process ($\beta = -.078, p < .01$). The results indicate that IG Process depends on the configuration of the SC and IG stratgies, yielding suppport for H1. Specifically, both the SC and IG strategies impact a level of IG process (see Model 2); a responsive SC strategy and offensive IG strategy positively influence IG process. Moreover, the impact of IG strategy on IG process is greater when a hospital employs an efficient SC strategy than a responsive SC strategy.

Table 8 Testing H1: Configuration of SC and IG strategies – IG Process

	Robust regression		
	Model 1	Model 2	Model 3
Control variable			
Profit	-.184***	-.116*	-.104*
Gov. ctrl	-.148**	-.123**	-.115*
Location	-.004	-.02	-.029
System	-.146***	-.088*	-.079
# of beds (log)	.137***	.102**	.107**
CMI	.238*	.15	.145
Main effects			
SC Str.		**.058***	.083**
IG Str.		**.102*****	.133***
Interaction (Configuration)			
SC Str. × IG Str.			**-.078*****
R^2	.0496	.0582	.0629
Change in R^2		.0086	.0047
F		15.00***	8.23***

*Note. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level*

To see the effect of the configuration of the two strategies, the Johnson-Neyman regions of significance, which shows IG strategy values where the difference in IG process occurs between responsive and efficient SC strategies at α = .1 level (Hayes & Matthes, 2009; Jose, 2013), was depicted in Figure 5. The shaded areas represent the region in which the difference between a responsive and efficient strategies is statistically different with respect to IG process. As shown in Figure 5, the difference is significant when the value of an IG strategy is zero and is greater than 2.04, meaning that when a hospital is using a defensive IG strategy, a responsive SC strategy has a greater impact on IG process than an efficient SC strategy. Furthermore, when an offensive IG strategy is employed, a hospital using an efficient SC strategy has a higher level of IG process than a responsive SC strategy. These results can be depicted as SC strategy× IG strategy matrix (see Figure 6).

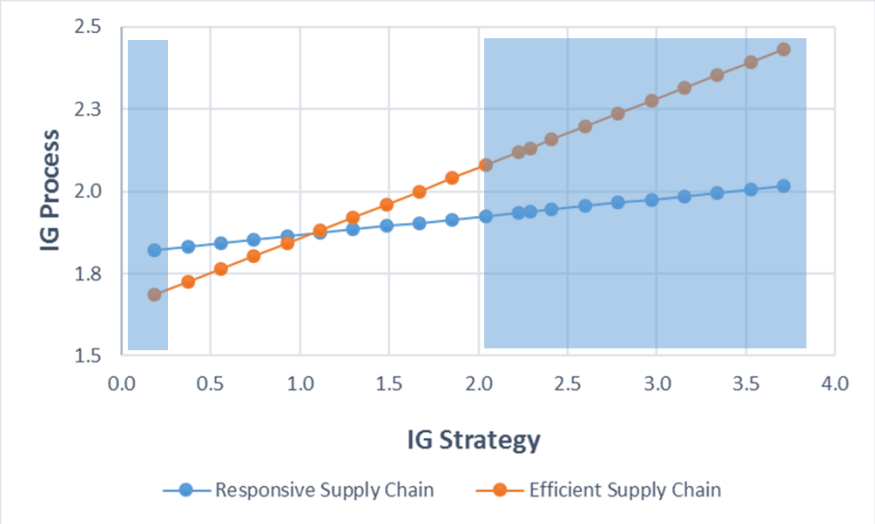

Figure 5 Configuration of SC and IG strategies and IG Process: Johnson-Neyman regions of significance

	Offensive IG Strategy	Defensive IG Strategy
Efficient SC strategy	Match	Mismatch
Responsive SC strategy	-	Match

Figure 6 SC strategy- IG strategy matrix

In essence, the importance of the arrangement of the two strategies becomes more salient when an efficient SC strategy is employed than when a responsive SC strategy. When a hospital uses a responsive SC strategy, an IG strategy is not a key factor that determines a hospital's IG process. However, when an efficient SC strategy is employed, a hospital should use an offensive IG strategy, not a defensive IG strategy. Furthermore, a hospital that emphasizes compliance and legal obligations relating to SC information should have a responsive supply chain.

H2 suggests a positive association between IG process and SCP. Table 9 and Table 10 present the results of testing H2 at a variety of quantiles of adjusted non-labor supply expense ratio and adjusted labor supply expense ratio, respectively.

Table 9. Testing H2: IG process – SCP (DV = Adjusted non-labor supply expense ratio)

	Eq. 2 DV = Adjusted Non-labor supply expense ratio													
	Quantile													
	0.1		0.3		0.4		0.5		0.6		0.7		0.9	
	Model 1	Model2	Model3	Model4	Model5	Model6	Model7	Model8	Model9	Model 10	Model 11	Model 12	Model 13	Model 14
Indep. vars.														
SC Str.	-.003	-.003	0	0	-.002	-.001	-.003	-.001	.001	.002	.001	.002	-.01*	-.008
IG Str.	.002	.002	0	0	0	-.001	-.002	-.001	-.002	-.002	-.004	-.004	-.007	-.004
SC Str. × IG Str.	-.002	-.002	-.001	-.001	.003	.001	**.003***	.004**	**.004****	**.005*****	**.006*****	**.005****	.007	.007
IG Process		-.003		-.001		-.003		**-.005***		-.002		-.003		-.006
Control vars.														
Profit	-.003	-.005	.001	.002	.005	.002	.006	.005	.007	.005	.004	.004	.005	.003
Gov. ctrl	.000	-.004	.01*	.01*	.011*	.009	.015**	.013**	.021***	.021***	.019**	.019***	.027**	.026**
Location	-.006	-.007	.003	.004	.008	.01*	.009*	.008*	.009	.009	.006	.008	.008	.005
System	-.011	-.011	-.006	-.006	-.006	-.006	-.009**	-.008**	-.009*	-.009*	-.009*	-.011*	.005	.009
log (number of beds)	-.001	-.004	.01	.009	.012*	.011*	.007	.011*	.004	.004	.01	.011	-.006	-.004
log (Total discharges)	-.012*	-.009	-.029***	-.029***	-.033***	-.033***	-.032***	-.035***	-.035***	-.036***	-.043***	-.045	-.035***	-.038***

*Note. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level*

As seen from Table 9 (Model 8), the relationship between IG process and SCP is significant at 0.5th quantile of adjusted non-labor supply expense ratio ($\beta = -.005, p <$ .1). But, the association between IG process and adjusted non-labor supply expense ratio was not significant at different quantiles. The results suggest that for only intermediate performers, IG process reduces adjusted non-labor supply expense ratio. Hence, the results revealed empirical evidence that partially supports H2.

Regarding the association between IG process and adjusted labor supply expense ratio, the results revealed the significant relationships at the 0.6th and 0.7th quantiles of adjusted labor supply expense ratio ($\beta = -0.002, p <$ .1 and $\beta = -0.002, p <$ .05, respectively) (see Model 10 and 12 in Table 10). But, no significant relationship was found at other quantiles.

Table 10 Testing H2: IG process – SCP (DV = Adjusted labor supply expense ratio)

	Eq. 3 DV = Adjusted labor supply expense ratio													
	Quantile													
	0.1		0.3		0.4		0.5		0.6		0.7		0.9	
	Model1	Model2	Model3	Model4	Model5	Model6	Model7	Model8	Model9	Model 10	Model 11	Model 12	Model 13	Model 14
Indep. vars.														
SC Str.	-.003**	-.003*	-.002	-.002*	-.001	-.001	0	0	-.001	-.001	-.001	-.001	-.004**	-.004*
IG Str.	0	0	-.001*	-.001*	-.001	-.001	-.001	-.001	-.001	-.001	-.002***	-.002***	-.002	-.002
SC Str. × IG Str.	0	0	0	0	-.001	-.001	**-.001****	-.001**	-.001	-.001	0	0	-.001	-.001
IG Process		-.001		0		0		-.001		**-.002***		**-.002****		0
Control vars.														
Profit	-.002	-.001	-.005***	-.005***	-.006***	-.006***	-.007***	-.007***	-.007***	-.007***	-.008***	-.009***	-.013***	-.013***
Gov. ctrl	.004*	.003	.004**	.004**	.004**	.004**	.006***	.006**	.006**	.007**	.007***	.008***	.013***	.012***
Location	-.001	-.001	0	0	.001	.002	.002	.002	.001	.002	.003	.002	.002	.002
System	.001	.002	-.001	-.002	0	-.001	0	0	.001	0	.001	0	.003	.003
log (number of beds)	.001	.001	.002	.002	.002	.003	.003	.004	.006**	.005*	.005	.006*	.015***	.015***
log (Total discharges)	-.006***	-.006***	-.011***	-.011***	-.013***	-.013***	-.015	-.015***	-.017***	-.017***	-.019***	-.019***	-.03***	-.03***

Note. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level

The results suggest that for only intermediate performers (i.e., mediocre), IG process reduces adjusted labor supply expense ratio. Therefore, H2 is partially supported.

H3 predicts that IG process mediates the impact of the arrangement of the SC and IG strategies on SCP. Hayes' (2013) process Macro (Model 4) was used to test the indirect effect by repeating the resampling 5,000 times. The bootstrap mediation analysis revealed that IG process mediates the impact of the arrangement of two strategies on adjusted non-labor supply expense ratio; the analysis for the indirect effect of the arrangement of the SC and IG strategies on adjusted non-labor supply expense ratio generated a 90% confidence interval that does not include zero (0.00002, 0.00076) (total indirect effect = 0.00030, SE = 0.00022) and the direct effect was not significant (total direct effect = 0.0012, SE = 0.0021, 90% confidence interval = [-0.0022, 0.0046]), indicative of the full mediation. With regards to adjusted labor supply expense ratio, the results of the bootstrap procedure revealed that the indirect effect (total indirect effect = 0.00012, SE = 0.00008, 90% confidence interval = [0.00002, 0.00028]) is significant, but the direct effect (total direct effect = -0.0007, SE = 0.0007, 90% confidence interval = [-0.0018, 0.0004]) is not significant. Thus, the results of the bootstrap procedure analysis yield support for H3 (i.e., indirect-only mediation).

H4, which posited the relationship between SCP and hospital performance, was tested by using Eqs. 4-6. The results of testing the relationship between SCP and operating margin were presented in Table 11. As seen from Table 11, the results reveal that the relationship between SCP and operating margin are significant at all quantiles of operating margin and that the magnitude of the relationship between SCP and operating margin varies across quantiles of operating margin.

Table 11 Testing H4: SCP- Hospital performance (DV = Operating Margin)

	Eq. 4 DV = Operating Margin						
	Quantile						
	0.1	0.3	0.4	0.5	0.6	0.7	0.9
Independent vars.							
Non-labor Supply expense ratio	**-.391*** **	**-.157** **	**-.133** **	**-.159** **	**-.188*** **	**-.199*** **	**-.461*** **
Labor supply expense ratio	**-4.019*** **	**-2.389*** **	**-2.127*** **	**-2.098*** **	**-1.968*** **	**-2.082*** **	**-2.047*** **
Control vars.							
Profit	.038*	.048***	.049***	.049***	.056***	.056***	.039***
Gov. ctrl	-.136***	-.04***	-.039***	-.032***	-.035***	-.038***	-.043***
Location	-.008	-.008	-.006	-.001	.008	.009	.012
# of beds (log)	-.127***	-.099***	-.093***	-.098***	-.093***	-.098***	-.077***
CMI	-.195***	-.128***	-.096***	-.094***	-.079***	-.084***	-.113***
log (Total discharges)	.123***	.104***	.095***	.095***	.085***	.084***	.052***

*Note. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level*

To investigate estimates at different quantiles, the quantile plots are presented (see Figure 7). The quantile plot on the left panel represents the coefficient estimates of adjusted non-labor supply expense ratio at different quantiles. The quantile plot on the right panel depicts the coefficient estimates of adjusted labor supply expense ratio at different quantiles. In the quantile plots, the solid line and shaded areas represent the coefficient estimates and 90% confidence intervals, respectively. Regarding non-labor supply expense ratio, the results suggest that the association differs across the quantiles in that the magnitude of its association with operating margin follows an inverted U-shape in that the magnitude of the association decreases as the quantile increases from 0.1th quantile to 0.4th quantile but, the magnitude increases again beyond 40%. This implies that the association is more salient for lower and higher performers. With respect to adjusted labor supply expense, the relationship was found to be the strongest at the 0.1th quantile of operating margin. But, the overall magnitude of the relationship decreases as the quantile increases.

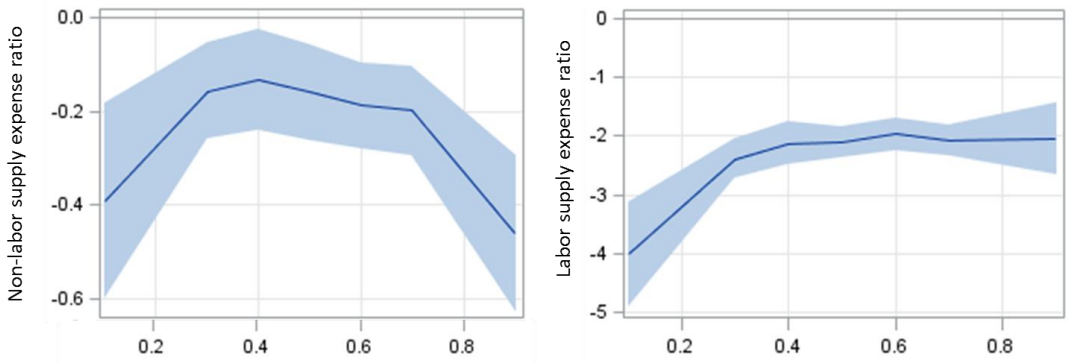

Figure 7 Estimated parameter by quantiles for Operating margin

This suggests that the association between adjusted labor supply expense ratio and operating margin is more salient for lower performers.

The results of testing the relationship between SCP and ROA at different quantiles are presented in Table 12. The results reveal that the relationships between adjusted labor supply expense ratio and ROA are significant at all quantiles of ROA. For non-labor supply expense ratio, the associations are not significant at the 0.4th and 0.9th quantiles of ROA. Figure 8 depicts coefficient estimates of adjusted non-labor supply expense ratio and adjusted labor supply expense ratio at different quantiles of ROA. As shown in Figure 8, the overall pattern is that the magnitude of the association between adjusted non-labor supply expense and ROA decreases from the 0.1th quantile to the 0.4th quantile of ROA, but increases again beyond the 0.6th quantile of ROA. In addition, the association becomes non-significant at the 0.9th quantile of ROA. The results suggest that the association between adjusted non-labor supply expense ratio and ROA is more salient for lower performers. Regarding labor supply-expense ratio, its relationship with ROA at lower quantiles is stronger than at higher quantiles. But, the relationship is strengthened again at the 0.9th quantile of ROA.

Table 12 Testing H4: SCP- Hospital performance (DV = ROA)

	Eq. 5 DV = ROA						
	Quantile						
	0.1	0.3	0.4	0.5	0.6	0.7	0.9
Independent vars.							
Non-labor Supply expense ratio	**-.285****	**-.114***	-.068	**-.114*****	**-.112****	**-.161*****	-.197
Labor supply expense ratio	**-1.451*****	**-1.089*****	**-1.112*****	**-.978*****	**-.825*****	**-.73*****	**-.943*****
Control vars.							
Profit	-.045	.009	.028***	.041***	.057***	.078***	.196***
Gov. ctrl	.011	-.002	-.006	-.008*	-.01**	-.008	-.025
Location	-.006	.003	-.002	.002	-.001	.009	.029
# of beds (log)	-.118***	-.076***	-.063***	-.057***	-.054***	-.059***	-.072**
CMI	-.06*	-.054***	-.053***	-.035**	-.031**	-.039*	.045
log (Total discharges)	.13***	.077***	.064***	.053***	.049***	.052***	.025

*Note. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level*

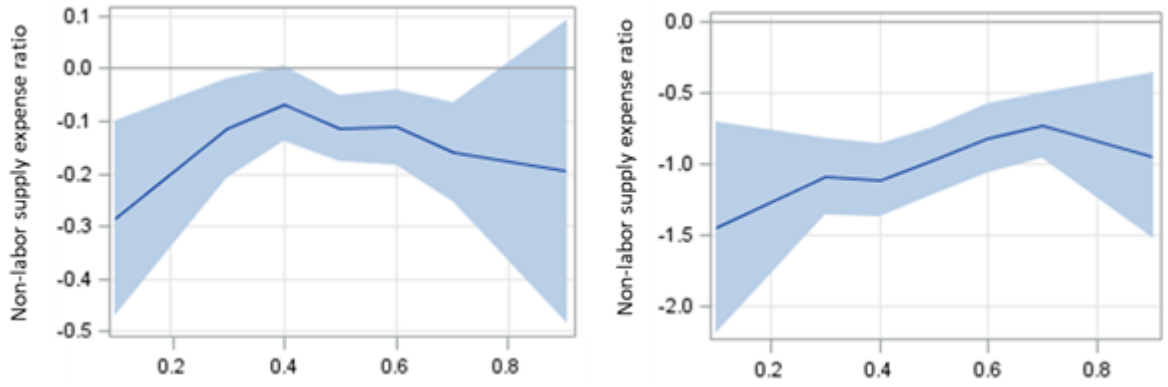

Figure 8 Estimated parameter by quantiles for ROA

Table 13 shows the results of testing the relationship between SCP and experiential quality. As seen from Table 13, the relationships are significant only at the 0.1th and 0.9th quantiles of experiential quality. Specifically, the relationship between adjusted non-labor supply expense and experiential quality is significant at the 0.9th quantile of experiential quality ($\beta = -24.001, p < .1$). The relationship between adjusted labor supply expense ratio and experiential quality is positive and statistically significant at 0.1th and 0.9th quantiles of experiential quality ($\beta = 47.652, p < .1$ and $\beta = 71.098, p < .05$, respectively).

Table 13 Testing H4: SCP- Hospital performance (DV = Experiential Quality)

	Eq. 6 DV = Experiential Quality						
	Quantile						
	10%	30%	40%	50%	60%	70%	90%
Independent vars.							
Non-labor Supply expense ratio	-0.946	-0.587	2.342	0.97	0.157	-3.975	**-24.001***
Labor supply expense ratio	**47.652***	28.733	14.313	31.672	18.476	30.696	**71.098****
Control vars.							
Profit	-7.131***	-8.973***	-10.775***	-12.923***	-13.336***	-13.052***	-10.1***
Gov. ctrl	-1.927	-1.967	-1.181	0.956	-0.401	-1.222	0.886
Location	-2.564*	-3.992***	-4.527***	-4.074***	-4.474***	-4.718***	-1.346
# of beds (log)	-3.848**	-2.531	-3.052*	-2.039	-4.133**	-3.818**	-1.224
CMI	8.552***	13.676***	13.771***	14.618***	15.091***	14.603***	18.126***
log (Total discharges)	-0.847	-3.846**	-4.196***	-6.146***	-5.523***	-5.625***	-9.853***

*Note. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level*

Figure 9 depicts coefficient estimates of adjusted non-labor supply expense ratio and adjusted labor supply expense ratio at different quantiles of experiential quality. As shown in Figure 9, the overall pattern is that adjusted non-labor and adjusted labor supply expense ratios are weakly associated with experiential quality. Therefore, the results yield support for H4.

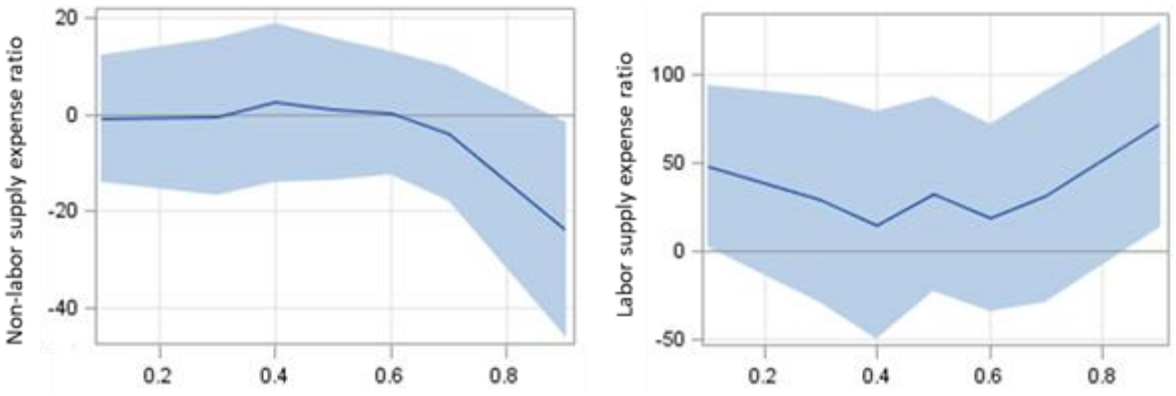

Figure 9 Estimated parameter by quantiles for Experiential Quality

DISCUSSION

This research explored a hospital's supply chain (SC) strategy in combination with a hospital's strategic orientation toward governing SC information, referred to as an IG strategy, and empirically investigated how the configuration of the two strategies can translate to supply chain performance (SCP) and organizational performance. The findings of the current study advance an understanding of an SC strategy in a hospital context and provide a comprehensive picture of an organization's strategic approach to managing the supply chain by incorporating SC information flows.

Theoretical Implications

By building on and expanding the idea of matching supply chains with products' characteristics, much of the SC research has explored the performance implications of SC strategies that can direct and control products flows throughout the supply chain (Fisher, 1997; Goldsby et al., 2006; Kristal, Huang, & Roth, 2010; Lee, 2002; Qi et al., 2011). However, much of the existing research has provided a rudimentary understanding of an SC strategy in service supply chains (Ellram et al., 2004; Sampson

& Spring, 2012). Given that the service industry accounts for about 80% of the U.S. economy (Bureau of Economic Analysis, 2016), there is the pressing need to explore the nature of SC strategies in a service context. To advance an understanding of service SC strategies, this study developed a taxonomy of SC strategies in the context of U.S. hospitals.

The results of this study revealed two distinct SC strategies employed by a hospital. Similar to Fisher's (1997) framework, a responsive SC strategy is appropriate for coping with uncertainty and complexity from demand and service characteristics. A hospital using a responsive SC strategy maintains relatively a high level of working capital that encompasses inventory and financial resources. Relatively large and urban hospitals fall under this SC strategy group. In contrast, a hospital using an efficient SC strategy focuses more on outpatient services than a responsive supply chain and provides less diversified services because those services require fewer resources, both tangible and intangible. Furthermore, a shorter length of stay in hospitals using an efficient SC strategy also implies that those hospitals emphasize the throughput (i.e., how efficiently a hospital completes its clinical services to patients). Consistent with research addressing an SC strategy in product-based supply chains, the findings indicate that a hospital should match a supply chain with healthcare services. In other words, a hospital should take into account service characteristics in terms of service complexity and diversification when making supply chain decisions.

As a hospital's SC strategy reflects its strategic approach pertaining to products/services flows, an IG strategy represents its strategic posture governing SC information flows. Two types of IG strategies are identified based on the Miles' (1982)

framework: offensive and defensive. While an organization employing an offensive IG strategy tends to adopt a progressive and forward-looking perspective with an emphasis on the realization of benefits from IG programs, an organization using a defensive IG strategy favors a conservative approach when making IG-related decisions. An organization with a defensive IG strategy emphasizes mainly compliance and legal obligations. The results revealed that in a healthcare context most hospitals (more than 80%) use a defensive IG strategy rather than an offensive IG strategy. These findings suggest that most hospitals are conservative in terms of governing SC information flow. A strong institutional environment of a healthcare industry (Bhakoo & Choi, 2013; Spaulding, Furukawa, Raghu, & Vinze, 2013) may account for a hospital's overall posture toward the governance of SC information flow. Moreover, the empirical evidence that an organization employs a distinctively different IG strategy supports that research addressing SC information flow should take into account an IG strategy.

Both an SC strategy and IG strategy could have an impact on the effectiveness of SCM separately. Yet, given that the demand for the SC resources, both physical (e.g., supplies) and intangible (SC information), depends on service characteristics, a hospital should assure the coherence between the two strategies rather than develop an SC strategy and IG strategy in isolation in order to gain a competence in the management of the supply chain (Natarajan, 1999; Nath & Sudharshan, 1994; Qi et al., 2011). Against this backdrop, the configuration of the two strategies was positioned as a hospital's overall strategic approach to managing its supply chain and was predicted to have performance implications drawing upon the configuration theory and capability perspective. The empirical results supported this prediction in that the arrangement of

the two strategies translate to SCP through IG process. This finding suggests that a hospital with a certain configuration of the SC and IG strategies develops its capability to capture, retain, track, and disseminate SC information throughout the organization. Consequently, a hospital can better coordinate and integrate SC business processes by leveraging high-quality SC information. Therefore, this study demonstrated the importance of the configuration of the SC and IG strategies and identified a significant mediation mechanism that helps to appreciate the impact of the arrangement of two strategies on SCP.

Furthermore, the empirical findings of this study affirm that SCP is directly associated with hospital performance in terms of profitability and experiential quality. Although it is well recognized in the literature that SCP is positively associated with organizational performance (Qrunfleh & Tarafdar, 2014), little research has provided the empirical evidence that supports the relationship between SCP and organizational performance in a hospital context. Specifically, the results suggest that supply expense ratio is associated with a hospital's profitability (i.e., operating margin and ROA). In addition, the association between SCP and profitability becomes more salient at lower and higher performers. But, the results did not provide apparent empirical evidence that supports the relationship between SCP and experiential quality; the relation was significant only at the lower and higher quantiles of experiential quality. Further, the results also suggest that for high performers, a hospital that spends more labor supply expenses have a higher level of experiential quality from patients.

Managerial Implications

Although much research in the field of SCM has generated valuable insights for both academicians and practitioners, research with a focus on product-based supply chains has offered a limited understanding of how the key theoretical concepts can be applied in the service context (Carter, Rogers, & Choi, 2015; Niranjan & Weaver, 2011). This may account for the fact that the healthcare industry is slow to embrace the key concepts and practices relevant to SCM (McKone-Sweet et al., 2005). As such, the results of this study offer important managerial implications for supply chain professionals, particularly in U.S. hospitals. The current study recommends that a hospital should develop an SC strategy based on the service characteristics in terms of service complexity and service diversification. If service offerings are relatively complicated and diversified, a hospital should employ a responsive SC strategy in that it needs to maintain a higher level of working capital (e.g., financial resources and inventory). In contrast, an efficient SC strategy is right for hospitals that offer less complex and diversified services.

But, the results of this study point out that an SC strategy is not sufficient in that a hospital should also take into account the governance of SC information flow. The findings of this study strongly suggest that a hospital should consider both an SC and IG strategies simultaneously, not in isolation in that a hospital should pay attention to matching an SC strategy with an IG strategy. In particular, the results suggest that a hospital with an efficient SC strategy could enhance SCP by employing an offensive IG strategy. Hence, this study provides managerial insights into how a hospital should configure its strategies to manage the supply chain effectively and efficiently

Finally, this study demonstrated the importance of SCM in a healthcare context by showing the direct relationship between SCP and organizational performance (i.e., cost containment and profitability). Despite the awareness that the benefits from supply chain practices are well understood in a healthcare context (McKone-Sweet et al., 2005), there is a lack of empirical evidence that supports the contribution of SCP to organizational performance; most research addressing supply chain issues in the healthcare context has examined operational performance and organizational performance separately (Chen et al., 2013; Goldstein, Ward, Leong, & Butler, 2002b; Goldstein, Ward, Leong, & Butler, 2002a). Hence, the results of this study show that a hospital needs to pay more attention to effectively managing the supply chain to enhance the bottom line.

Future Research Directions

Using multiple sources of archival data, this study empirically examined the relationships between the configurations of the SC and IG strategies, IG process, SCP, and hospital performance. All constructs are operationalized by using proxies; an SC strategy classification scheme was developed by using proxies for service characteristics. Although the proxies were selected based on the literature, there is a need for assessing the validity of the proxies (Houston, 2004). Survey data and other proxies can further the validity of the proxies.

As with other empirical studies, future research efforts need to be directed toward investigating contingency factors that would affect the proposed relationships in the current study and identifying additional mediation mechanisms. For instance, various

governance mechanisms for governing SC information (e.g., procedures, policies) may strengthen the impact of the arrangement of the two strategies on IG process and the association between IG process and SCP because the management literature suggests that the mechanisms could shape behaviors in a certain way and reduce deviant behaviors of employees (Cardinal, 2001; Ouchi, 1979). In addition, this study proposed IG process as a mediation mechanism and found empirical evidence that supported the mediation effect. However, the mediated effect through IG process was relatively small, implying that some important mechanisms are missing in the relationship between the arrangement of the two strategies and SCP. Hence, future research needs to identify and explore intervening factors that would be able to unpack the relationships between an SC strategy, IG strategy, IG process, and SCP.

CHAPTER 5 CONCLUSION

Supply chain information flow has garnered much attention for decades from both researchers and practitioners. The integration of information flows in the supply chain is deemed a foundation for an effective supply chain management (Frohlich & Westbrook, 2001; Trent & Monczka, 1998). Prior research has also provided some empirical evidence that supports its benefits in the supply chain and offered managerial insights into the importance of supply chain information flow. However, poor information flow in the supply chain is still a challenge for many organizations (Oracle, 2010). This seems to suggest that research in supply chain information flow is missing a certain perspective. The purpose of this dissertation was to identify and understand a missing perspective, i.e., governance perspective on supply chain information flows by challenging the assumption implicitly used in the literature that organizations in the supply chain similarly cope with the issues around supply chain information, which would lead to the flawed inference that the quality of information is deemed equivalent throughout the entire supply chain. Specifically, this dissertation introduced the concept of information governance in the supply chain context and delved into what the core elements of information governance are and how the key elements work together in order to achieve superior supply chain performance by using a theory-based approach. Furthermore, this dissertation empirically evaluated the impact of information governance combined with a supply chain strategy on supply chain performance and organizational performance in the context of U.S. hospitals.

Information governance is conceptualized as an organization-wide framework that encompasses the specification of decision rights and accountability framework and the implementation of a set of mechanisms for managing the life cycle of supply chain information. The conceptual framework presented depicts information governance as a combination of three key elements (i.e., strategy, structure, and processes) and predicted that the alignment between information governance strategy and structure influences information governance processes, which would result in enhanced supply chain performance through high-quality information. This framework recommends that an organization should adopt a more comprehensive view rather than a myopic view with respect to the governance of supply chain information flow in that an organization must consider all three elements and understand the relationships between the key elements to attain a single source of truth in terms of supply chain information flow.

In addition, this dissertation provides empirical evidence of how the interplay between information governance and a key supply chain concept (i.e., supply chain strategy) influences supply chain performance and organizational performance. The results revealed that the arrangement of the supply chain and information governance strategies affects supply chain performance through information governance processes. These findings demonstrate the importance of the governance of supply chain information in the context of U.S. hospitals and suggest that an organization should take into account both supply chain and information governance strategies simultaneously, not in isolation to improve the bottom line. Specifically, the findings revealed that an efficient supply chain strategy should be employed in combination with an offensive information governance strategy, not defensive information governance strategy. When

a defensive information governance strategy is used by a hospital, a responsive supply chain strategy is more appropriate than an efficient supply chain strategy. Furthermore, this dissertation affirmed that SCP is directly related to hospital performance in terms of profitability and experiential quality in the context of U.S. hospitals.

FUTURE RESEARCH DIRECTIONS

Given that this dissertation is one of the first studies to discuss the concept of information governance in the supply chain context, future research efforts need to be directed toward investigating the following issues. The focus of this dissertation was on conceptualizing information governance and facilitating an understanding of the consequence of information governance from a supply chain perspective to demonstrate why a governance perspective on information flow is critical in the supply chain context. From a conceptual standpoint, future research needs to identify antecedents to information governance and to examine differential effects of those factors on the key aspects of information governance. For instance, the organizational theory literature posits that various factors such as environment, structure, leadership, and strategy have an impact on shaping organizational configurations (Miller, 1987). The literature suggests that such factors may influence the relationships between the key information governance elements. Thus, research investigating the determinants of a constellation of the three key elements would further an understanding of the nature of information governance and generate valuable insights into how an organization should design and implement the core elements of information governance in managing the supply chain.

Another suggestion is to investigate various contextual factors (e.g., supply chain relationships and IT environment) that could strengthen or weaken the relationships between the key elements of information governance and information governance. These contextual factors would provide managerial insights into how an organization could realize the benefits of information governance in the supply chain context.

This dissertation provides empirical evidence that information governance process intervenes the relationship between the arrangement of the information governance and supply chain strategies and supply chain performance. Given that the configuration of an information governance and supply chain strategies have a direct on supply chain performance, future research efforts need to be directed toward identifying other possible intervening mechanisms that would further an understanding of the nature of the relationships between an information governance strategy, supply chain strategy, and supply chain performance.

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APPENDICES

Appendix A. Descriptive statistics of variables

	Mean	STD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1.SC Strategy	0.05	1.00	1																										
2.IG Strategy	0.35	0.93	0.101	1																									
3.IG Process	2.16	0.87	0.157	0.146	1																								
4.Adj. Non-labor supply exp. Ratio	0.28	0.08	-0.304	-0.082	-0.115	1																							
5.Adj. Labor supply exp. Ratio	0.08	0.03	-0.436	-0.129	-0.137	0.640	1																						
6.ROA(2014)	0.05	0.29	0.098	0.066	0.024	-0.262	-0.286	1																					
7.Operating margin(2014)	-0.03	0.23	0.166	0.087	0.094	-0.439	-0.520	0.413	1																				
8.Exp. Quality	40.8	17.8	-0.260	0.030	-0.043	0.105	0.190	-0.062	-0.021	1																			
9.Profit(2012)	0.18	0.38	-0.043	-0.162	-0.088	0.060	-0.024	0.063	0.101	-0.178	1																		
1.Gov(2012)	0.18	0.38	-0.140	-0.131	-0.084	0.117	0.195	-0.044	-0.244	0.072	-0.219	1																	
11.Loc (2012)	0.70	0.46	0.437	0.105	0.103	-0.192	-0.276	0.074	0.104	-0.256	0.064	-0.167	1																
12.Sys (2012)	0.38	0.49	-0.199	-0.281	-0.111	0.080	0.195	-0.100	-0.210	0.109	-0.246	0.343	-0.223	1															
13.Bed(2012)	173	152	0.606	0.115	0.164	-0.308	-0.394	0.092	0.081	-0.229	-0.091	-0.073	0.397	-0.193	1														
14.CMI(2012)	1.44	0.27	0.685	0.194	0.168	-0.437	-0.617	0.183	0.207	-0.197	-0.077	-0.151	0.474	-0.244	0.626	1													
15.Profit(2013)	0.19	0.39	-0.051	-0.167	-0.066	0.055	-0.038	0.064	0.107	-0.189	0.980	-0.220	0.060	-0.256	-0.090	-0.074	1												
16.Gov(2013)	0.18	0.38	-0.133	-0.129	-0.093	0.133	0.217	-0.040	-0.267	0.081	-0.209	0.977	-0.170	0.342	-0.072	-0.155	-0.221	1											
17.Loc (2013)	0.69	0.46	0.432	0.102	0.093	-0.188	-0.283	0.072	0.132	-0.247	0.060	-0.174	0.966	-0.221	0.395	0.461	0.055	-0.176	1										
18.Sys(2013)	0.39	0.49	-0.190	-0.285	-0.105	0.073	0.196	-0.102	-0.244	0.116	-0.247	0.347	-0.223	0.979	-0.194	-0.232	-0.245	0.344	-0.218	1									
19.Bed(2013)	171	152	0.599	0.134	0.163	-0.315	-0.397	0.095	0.088	-0.233	-0.096	-0.068	0.394	-0.193	0.984	0.623	-0.099	-0.065	0.392	-0.188	1								
20.CMI(2013)	1.45	0.27	0.668	0.182	0.166	-0.442	-0.619	0.180	0.199	-0.192	-0.074	-0.135	0.468	-0.232	0.621	0.975	-0.069	-0.141	0.453	-0.221	0.616	1							
21.Profit(2014)	0.19	0.39	-0.051	-0.164	-0.070	0.070	-0.026	0.064	0.102	-0.192	0.964	-0.220	0.048	-0.261	-0.092	-0.075	0.991	-0.212	0.046	-0.251	-0.099	-0.073	1						
22.Gov(2014)	0.18	0.38	-0.124	-0.120	-0.077	0.122	0.199	-0.046	-0.236	0.084	-0.215	0.964	-0.151	0.345	-0.056	-0.136	-0.224	0.979	-0.165	0.350	-0.055	-0.124	-0.225	1					
23.Loc (2014)	0.69	0.46	0.446	0.098	0.109	-0.212	-0.306	0.077	0.123	-0.266	0.048	-0.164	0.949	-0.231	0.407	0.483	0.047	-0.178	0.961	-0.223	0.400	0.473	0.044	-0.164	1				
24.Bed(2014)	172	154	0.596	0.134	0.160	-0.318	-0.395	0.095	0.089	-0.230	-0.091	-0.062	0.397	-0.183	0.975	0.624	-0.094	-0.065	0.392	-0.186	0.990	0.618	-0.100	-0.046	0.402	1			
25.CMI(2014)	1.47	0.27	0.648	0.177	0.163	-0.458	-0.636	0.178	0.211	-0.183	-0.081	-0.131	0.471	-0.219	0.619	0.953	-0.079	-0.135	0.453	-0.212	0.613	0.973	-0.079	-0.119	0.477	0.614	1		
26.Discharge (2013)	8.65	1.12	0.767	0.171	0.162	-0.398	-0.556	0.194	0.260	-0.332	-0.116	-0.152	0.517	-0.223	0.788	0.781	-0.122	-0.146	0.507	-0.218	0.787	0.766	-0.114	-0.132	0.529	0.795	0.759	1	
27.Discharge (2014)	8.64	1.15	0.751	0.162	0.170	-0.419	-0.571	0.207	0.297	-0.339	-0.106	-0.144	0.511	-0.224	0.779	0.775	-0.111	-0.149	0.499	-0.232	0.782	0.761	-0.109	-0.130	0.517	0.781	0.759	0.985	1

VITA

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