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Healthcare Supply Chain and IS Strategies for Improved Outcomes

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Abstract

Rising costs and concerns over quality have increased attention on the potential gains that can be realized by developing and implementing healthcare supply chain and Information Systems (IS) strategies. However, the development and implementation of such strategies in healthcare has lagged behind other sectors. This study explores some of the unique characteristics of the healthcare industry, specifically the complexity of service delivery, and proposes a theoretically grounded research model positing supply chain and IS strategies that can be implemented to create high quality, cost efficient care delivery to patients. In doing so, two theories (complexity theory and value co-creation theory) provide support for a four stage causal model proposing relationships between; (1) operational complexity, (2) supply chain and IS strategies, (3) supply chain practices, and finally (4) quality and cost outcomes.

1. Introduction

According to the Centers for Medicare and Medicaid Services (CMS) 2006 report, healthcare expenditures in the United States have dramatically and rapidly increased from $253 billion in 1980, to $714 billion in 1990, to over $2 trillion in 2006, and are estimated to surpass 20% of GDP or $4 trillion dollars by 2015. Concomitant to these increases has been a decline in consumer confidence related to quality, as Cogan et. al. (2004) report that 67% of survey respondents are concerned about their ability to access the best medical treatment. Given that approximately 25% of healthcare costs (or $500 billion) are supply related (Scalise, 2005), many practitioners and scholars alike are focusing attention on supply chain management (SCM) as a means of improving outcomes.

Facing a multitude of challenges among those, cost and quality as well as the need for reform, the healthcare industry is actively seeking to implement supply chain management practices by partnering with customers, suppliers, and many other strategic service partners (Naidu, Parvatiyar, Sheth, and Westgate, 1999). It is recognized that an efficient and user-friendly supply chain can produce positive financial outcomes for providers and improve service

to patients (McKone-Sweet, et. al., 2005). Such supply chain outcomes are not easily achieved however, as many providers experience poor performance due to complex processes and a lag in IT investment (Scalise, 2005).

Many healthcare supply chains exist as highly fragmented systems in which manufacturers, distributors, wholesalers, group purchasing organizations, and providers operate independently from one another (Byrnes, 2004). Further, they are recognized as highly complex, as there are hundreds of thousands of stakeholders, all who possess divergent objectives, with limited communication, and very blurry boundaries (Byrnes, 2004; Singh, 2006; Ford and Scanlon, 2007). As a result, some suggest that the healthcare supply chain has emerged as "the home of some of the worst practices in supply chain management" (Byrnes, 2004). That said, others suggest that some provider's supply chain management performance is better than others, by observing "enormous variability in supply chain performance in hospitals and health systems across the United States," (Schneller and Smeltzer, 2006: p. Preface X). This variation in performance provides hope for researchers in search of best practices for healthcare supply chain management.

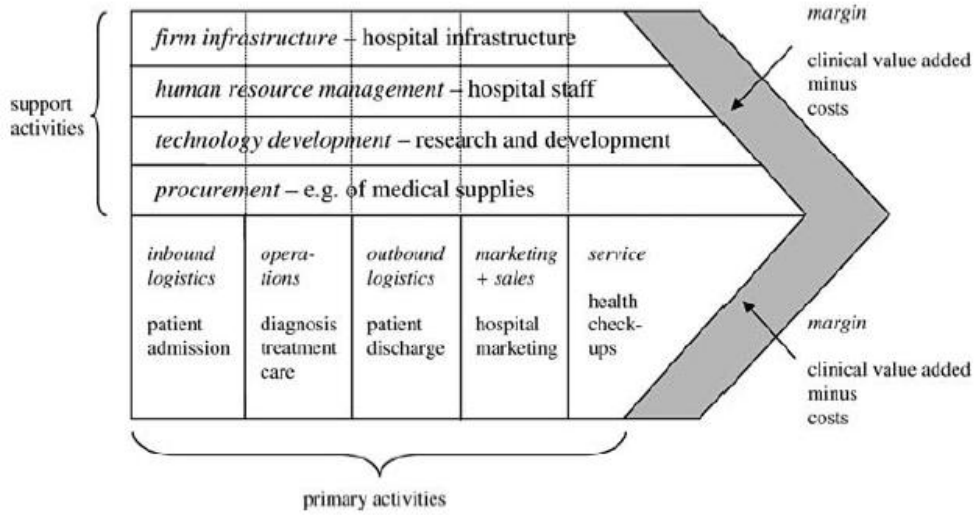
Therefore, the purpose of the present study rests in; (1) exploring the complexity faced by the healthcare industry, and (2) suggesting supply chain and IS strategies that can effectively enhance outcomes for patients and providers. The primary focus is the conceptualization of a theoretically grounded research framework for future study.

2. Theory Development

2.1 Value Co-creation

Porter's (1985) value chain model has long been accepted as a meaningful explanation of a firm's competitive advantage owing to its identification of cost drivers and sources of differentiation. The value chain concept describes the primary and secondary activities of a firm necessary to create margin and in doing so provides direction on those activities which may be outsourced or retained inside the firm to "pursue exactly what is required: inbound materials, raw materials inventories (both considered inbound logistics by Porter), manufacturing (called operations by Porter), finished goods inventories, and distribution within a single organization (considered outbound logistics by Porter)," (Gehmlich, 2008: p. 31). Value chain has been applied in and outside of manufacturing as is modeled using a healthcare example in figure 1 (Gehmlich, 2008).

Figure 1 Porter (1985) value chain illustrated for healthcare (Gehmlich, 2008)



Herein, primary activities include patient admission (representing inbound logistics), diagnosis and treatment (representing operations), patient discharge (representing outbound logistics), hospital marketing (representing marketing and sales), and health check ups (representing follow up service). The secondary or supporting activities are shown as hospital infrastructure (representing firm infrastructure), hospital staff (representing human resource management), research and development (representing technological development), and medical supplies (representing procurement) (Gehmlich, 2008). According to Porter (1985), a firm manages these activities in a unique way to create margin in the space between it and the patient, placing the customer on the outside of the value creation process (Prahalad and Ramaswamy, 2004).

The supply chain then can be viewed as a linear collection of value chains. According to this perspective, every company occupies a position in the supply chain with upstream suppliers providing value in their inputs prior to sending them downstream to the focal firm where it then performs a process comprised of a collection of the primary and secondary activities described earlier to add value before sending the product or service downstream again to the next actor or end consumer (Normann and Ramirez, 1993). An example of this approach in a healthcare context might be a primary care physician who examines and diagnosis an elderly patient with severe Bronchitis prior to referring the patient for hospital admission. The hospital then coordinates treatment and discharges the patient home and involves home care. This is described in figure 2.

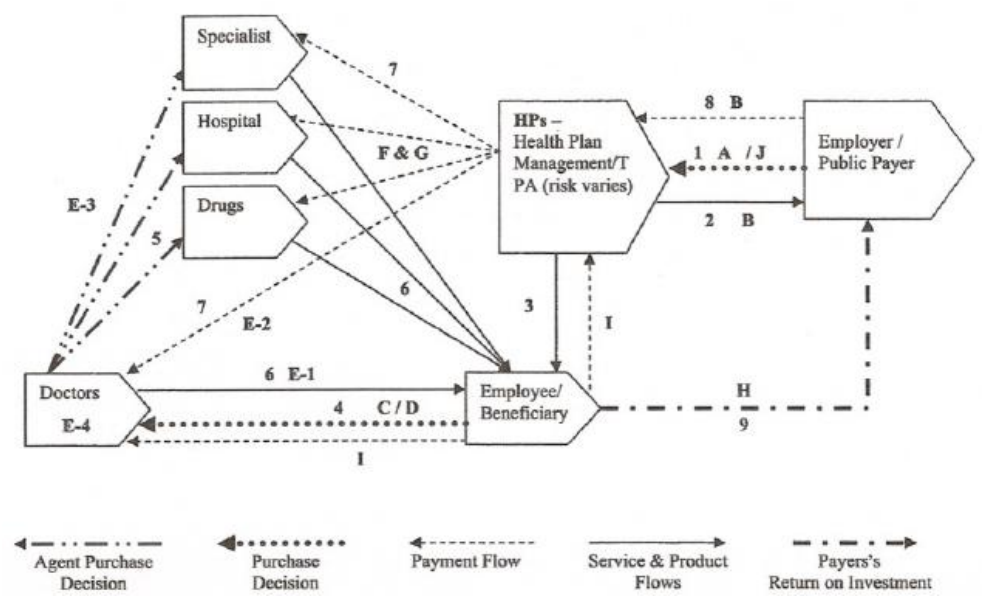
Figure 2 Linear value chain representation in a healthcare context

Some scholars believe that this paradigm has become outdated (e.g., Normann and Ramirez, 1993). Instead, today many believe that competition and consequently value creation centers on personalized interactions between customers, the focal firm's employees, and other supply chain actors (Prahalad and Ramaswamy, 2004; Prahalad and Krishnan, 2008). As such, the customer is no longer placed outside of the value chain, (Prahalad and Ramaswamy, 2004), but instead can participate in a myriad of value creation activities throughout the entire supply chain or network (Zhang and Chen, 2006). In this way, the customer's role transitions from that of a *consumer* of value to a *creator* of value (Normann and Ramirez, 1993). These value co-production activities are very similar to those discussed in Porter's (1985) value chain and include co-development of new products and services, production, assembly, distribution, use, and after sale service (von Hipple, 1998; Ross, 1996; Duray, 2002; Zhang and Chen, 2008). As was the case with Porter's (1985) value chain, these activities have relevance in a healthcare setting as co-development of new services represents (technological) development, diagnosis and treatment represents production and assembly, patient discharge represents distribution, and health check ups represents use and after sales service.

This movement toward value co-creation has caused firms to realize that they do not simply add value in a discrete process stage, but instead they partner with customers/patients, suppliers, and other business partners to repeatedly reinvent it (Normann and Ramirez, 1993). As such, the focus of these firms has shifted from the *product*/*service* itself to the *value creation system* which comprises these actors. The continual quest to improve the fit between the composition and competencies of the *value creation system* and the customer has emerged as a primary goal centering attention on the "reconfiguration of roles and relationships among this

constellation of actors in order to mobilize the creation of value in new forms and by new players," (Normann and Ramirez, 1993: 66). Ford and Scanlon (2007) present a network approach describing the healthcare supply chain that well represents such a constellation or value creation system as described by Normann and Ramirez (1993). See figure 3.

Figure 3 Example of a simplified health system supply chain from an employer's perspective (Ford and Scanlon, 2007).



The figure provided by Ford and Scanlon (2007) illustrates: (1) the critical role of the consumer as a value co-creator inside the supply chain, (2) the myriad of possible value creation interactions among the various economic actors of the supply chain, and finally (3) the consequent complexity of the value creation system. Success in this environment therefore hinges upon the interactions that occur between the actors of the *value creation system*, particularly those related to the customer, as these interactions facilitate co-creation experiences (Prahalad and Ramaswamy, 2004). The building blocks of these interactions, and thus the *value*

creation system itself, rests in the nature and volume of information and resource sharing possible in the system (Norman and Ramirez, 1993).

Prahalad and Ramaswamy (2004) describe these building blocks – dialog, access, risk-benefits, and transparency (DART) – as the basis for interactions between customers and the other economic actors in the *value co-creation system*. Dialog refers to the deep engagement, interaction, ability, and very importantly, the willingness of both sides to engage in conversation. Access describes the notion that the effectiveness of the *value creation system* depends on the firm availing the customer to as much information as he/she needs from the firm as well as the other actors in the system. This goes hand in hand with transparency of information, the third building block. Finally, the risk-benefits dimension of DART refers to the ability of the customer to fairly assess the advantages and disadvantages associated with his/her decisions in the *value creation system.* In healthcare, these decisions may be related to taking medications or seeking treatment. In an effective *value creation system,* "instead of just depending on the doctor – the expert – the patient has the tools and the support structure to help make that decision – not in some generic risk category but for 'me' – with a medical condition, a lifestyle, or social obligations," (Prahalad and Ramaswamy, 2004: p. 9).

When successful, the *value creation system* of the firm develops a *value dense environment,* characterized by the amount of information, knowledge, and other resources available to the economic actors of the *value creation system* enabling them to leverage their value creation capacity (Normann and Ramirez, 1993). In doing so, the firm creates "systematic social innovation: the continuous design and redesign of complex business systems," (Normann and Ramirez, 1993: p. 66).

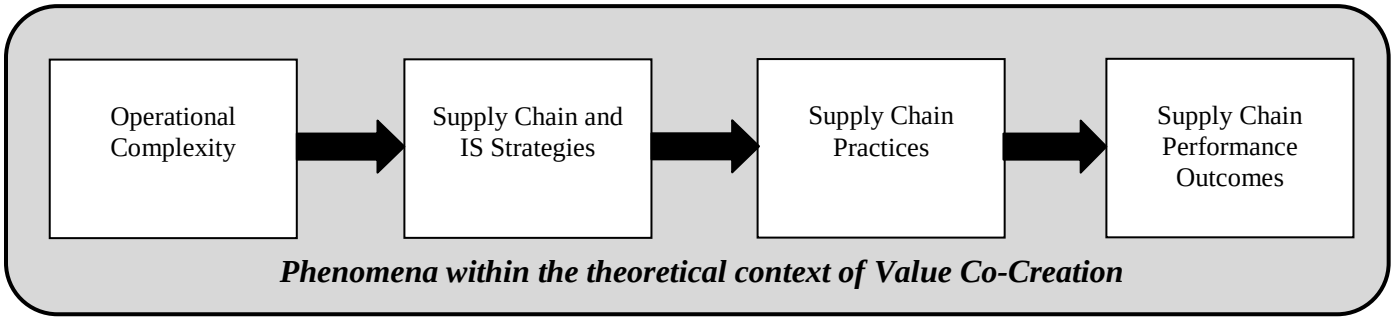
Value co-creation therefore provides a useful theoretical perspective in grounding the understanding of supply chain practices in healthcare. Its focus on connecting the key actors involved in value creation regardless of their specific role (Normann and Ramirez, 1993) is highly applicable in healthcare as the demarcations defining the role of each actor in the primary care delivery supply chain are far more blurry than in other industry sectors. Schneller and Smeltzer (2006) discuss this issue as the mix of external and internal clients.

Physicians, nurses and other clinical staff members influence the supply chain practices of a hospital in terms of selection, supply management and use (or the provision of care to patients). These clinicians may function as employees of the hospital and thus daily participants in supply chain management practices, or function as temporary suppliers of service within the hospital. Attending physicians and contingent nursing staff for example, may practice in several different facilities and as a result possess little familiarity with the supply chain practices of a particular hospital, but at the same time have great reliance and influence on the supply chain (Schneller and Smeltzer, 2006). In this way, these clinicians are customers of the supply chain as they rely on it for material and information in their endeavor to treat patients, and they are also suppliers to it as they add value to the material flowing through the supply chain and also participate in the provision of new information flow. The patient is obviously the ultimate client or beneficiary of the healthcare supply chain (Schneller and Smeltzer, 2006) and also influences outcomes through his/her medical decisions and compliance with treatment protocols requiring connectivity to other members of the *value creation system* such as clinicians.

Considering all of this, the healthcare supply chain is very different from most business sectors as decisions influencing the supply chain or *value creation system* are “left to the discretion of thousands of different employees [internal and external clients] serving thousands

of different clients whose needs change daily," (Schneller and Smeltzer, 2006: p. 6). In this unique context, by seeking to connect these critical value creating actors, value co-creation can explicate how the operational complexity faced by hospitals can lead to the development of supply chain and information systems (IS) strategies which enable effective supply chain practices and improved outcomes. This relationship is illustrated in figure 4 and now discussed.

Figure 4 Proposed Research Framework



2.2 Operational Complexity

Operational complexity has been studied in scholarly business research using a multitude of approaches. Two approaches emerge when considering the healthcare supply chain. One approach, that of Luhmann (1996), describes complexity in terms of the number of parts and the interactions of those parts in a system (Blecker and Abdelkafi, 2006). The authors posit that complexity level can be measured as a function of the number of individual parts in a given system as well as their interactions in that system. In this way, complexity increases as the number of parts increase and the number of interactions increase. The aforementioned discussion of the *value creation system* in healthcare highlights the large volume of supply chain actors and their interactions. Given this, Luhmann's (1996) definition appears to be very applicable, but

falls short of emphasizing the nature of information sharing that occurs which is essential during actor interactions in the healthcare supply chain. This is critical when considering supply chain as the study of information and material flows across various functions within and outside of a firm with trading partners involved in the value creation process (Lambert and Cooper, 2000). Thus, it is useful to explore another conceptualization of complexity to augment Luhmann (1996) which addresses the material and information flows of a supply chain.

Sivadasan et. al. (2002) offers a second conceptualization of complexity. Here the author employs an information-theoretic perspective to propose an entropic methodology for measuring the operational complexity of supplier – customer systems, applicable when discussing supply chain relationships. The qualitative definition focuses on the uncertainty characteristics associated with material and information flows between supply chain actors. Information flow in the healthcare context has been explicitly discussed, however, in order to fully understand the conceptualization of complexity put forth by Sivadasan et al. (2002) in a healthcare context, it is now useful to explicate the view of *material* adopted by this study. The notion of material flow can be illuminated by exploring the distinguishing characteristics between manufacturing and service firms.

Perishability and inseparability are two primary characteristics which distinguishing service and manufacturing firms (Rathmell, 1966; Kaplan and Haenlin, 2006). Perishability refers to the notion that unlike physical products, services are consumed at the moment of production and cannot be inventoried for use at a later time. Inseparability refers to the patient's role as a co-producer in the service experience. This condition is exacerbated in healthcare as the patient not only participates in, but also provides the material input for the service experience. In healthcare, not only is material input critically important to the outcome, but information

[sharing] is also necessary before, during, and following the service experience as was discussed in the development of a *value creation system*.

Owing to the large volume of supply chain actors and actor interactions in the healthcare environment as well as the variation and uncertainty in material input and extant information asymmetries (Ford and Scanlon, 2007), the present study adapts the work Luhmann (1996) and Sivadan et. al. (2002) to define operational complexity as degree to which a firm's environment can be characterized by a large number of supply chain actors, a large number of interactions among those actors, a high degree of material uncertainty, and a higher degree of information uncertainty.

2.3 Supply Chain and IS Strategies

The external environment of a firm (e.g., complexity level) influences its behavior. "A strategy may be considered a pattern in a stream of decisions (past or intended) that (a) guides the organization's ongoing alignment with its environment and (b) shapes internal policies and procedures," (Hambrick, 1983; pg. 5). The strategies of a firm are therefore essential in guiding employees' behavior or in the case of this study, the behavior of the value creation actors.

Vonderembse et. al. (2006) developed a supply chain strategy typology which includes a hybrid supply chain type. Firms employing the hybrid supply chain strategy apply lean production methods while maintaining customer and market responsiveness by integrating suppliers, operations, purchasing, and quality at the component (or treatment event) level, and simultaneously integrating with marketing and distribution at the product line level. In traditional manufacturing terms, this is an 'assemble to order' approach which enables the cost effective practices of a lean supply chain in inventorying and managing components, but postpones the

final assembly of the components in a fashion similar to agile supply chains. In healthcare, this could mean handling the components of a surgical procedure (i.e., a hip replacement device) using lean supply chain methods such as low set up (or order lead) times, small economic order quantities, cost reductions, flexibility, and internal responsiveness, while handling the surgical procedure (or product) itself using agile supply chain methods such as strong interface with customers (in this case, physicians and clinicians) to postpone final assembly. In this example final assembly could be the configuration of the Operating Room (OR) theatre, equipping it with the materials needed by clinicians to perform the hip replacement.

Hybrid firms, thus maintain a comprehensive list of criteria for their key component suppliers (low cost, high quality, speed, and flexibility) which enables them to maintain responsiveness to customers. These strategies require an accurate decoupling point in order to afford product differentiation downstream (the hip replacement procedure itself), yet minimize functional components and work on fixed orders (the hip replacement device) and reliable forecast with a level scheduling upstream (van Hoek et al., 2001; Agarwal et al., 2006).

Sabherwal and Chan (2001) developed an IS strategy typology which includes an IS for comprehensiveness type, employing interorganizational systems, coordinating flows across functions resulting in benefits ranging from better purchasing programs to expanded service range. Specifically, firms which employ the IS for comprehensiveness strategy incorporate marketing information systems, interorganizational systems, and strategic support decision systems into their operations in a significant way.

Marketing information systems, according to Sabherwal and Chan (2001) manage information with great focus on the firm's markets and product/service sales. A hospital example might be the tracking of patient volumes by procedure type. This allows the hospital to track

which service lines are performing better than others perhaps in terms of growth or profitability. For example, such a system would enable a hospital to identify whether or not the cardiac service line is outperforming the emergency department service line. Interorganizational systems enable the electronic sharing of information among supply chain partners. An example in the context of this study might be that of a PACS systems used to enable physicians to view radiological films remotely from their home or office. Strategic support systems allow for the tracking and analysis of information necessary in long range planning. Shortell and Zajac (1990) provide and example of this in healthcare as a hospital planner opined that he uses such systems in determining which new markets or catchment areas to pursue. To a lesser extent, firms employing the IS for comprehensiveness strategy use operational support systems to monitor day-to-day operations in search of efficiency. In summary, the IS for comprehensiveness strategy facilitates information flows and coordinate activities across functional units, broad geographic regions, and network partners (Broadbent et al. 1999; Rai, et. al., 2006).

The delivery of care creates value by linking consumers with appropriate suppliers (Stabell and Fjeldstad, 1998). Timely and accurate information flows serve as the foundation for these activities (Ford and Scanlon, 2007). As a result, strategies that accommodate the proper linkages are essential in dealing with the complexity of the healthcare supply chain environment. As such, these supply chain and IS strategies can serve as an effective means of dealing with operational complexity. This study therefore posits the following.

P1: Operational complexity is positively associated with the supply chain and IS strategies of a hospital.

2.4 Supply Chain Practices

In view of its unique challenges, it is useful to examine the macro-level processes of the healthcare supply chain (Schneller and Smeltzer, 2006). Among these Chopra and Meindl (2004) identify customer relationship management (CRM), internal supply management (ISM), and supplier relationship management (SRM).

Li et al. (2005) developed an instrument to measure macro-level supply chain practices which includes strategic supplier partnership, customer relationship, and information sharing. These dimensions are consistent with those suggested by Chopra and Meindl (2004) and can be described as follows.

Considering the work of Li et al. (2005), strategic supplier partnership can be described as a long-term relationship between a hospital and its suppliers of service (e.g., attending physicians). This relationship is developed in such a way to create significant mutual and ongoing benefit to both actors, similar to Chopra and Meindl's (2004) SRM. Customer relationship can be thought of as a variety of practices initiated to manage customer complaints, enhance customer satisfaction, and foster long-term relationships with customers. This aligns well with Chopra and Meindl's (2004) CRM. In hospitals, customer relationship practices may take the form of patient advocacy or patient centeredness programs. Finally, information sharing, according to Li et al. (2005) is the degree of proprietary information sharing with a firm's supply chain partners. This, to some extent, is consistent with Chopra and Meindl's (2004) ISM, in that ISM while multi-faceted, must include information sharing, particularly in the healthcare *value creation system* described earlier, if a hospital is to effectively manage supplies. An example of information sharing of this type in a hospital might be the provision, perhaps electronically, of medical reports to patients and referring physicians.

Doty et al. (1993) suggest that firms seek fit or alignment by configuring practices that are consistent with their strategies. This is referred to as vertical alignment or the alignment of strategies, objectives, action plans, and decisions throughout different hierarchical levels of the organization (Kathuria, et al., 2007). Firm performance is highest when such alignment exists (Doty et al., 1993). As such, this study posits that hybrid and IS for comprehensives strategies can enhance the *value creation system* of a hospital's supply chain and improve strategic supplier partnerships, customer relationships, and information sharing for a hospital. This study therefore posits the following.

P2: The supply chain and IS strategies of a hospital are positively associated with its supply chain practices.

2.4 Supply Chain Outcomes

Cost and quality outcomes are among the key factors constituting a "[…] *burning platform* for elevating the contribution of efficient and effective supply chain management [in healthcare]," (Schneller and Smeltzer, 2006: p. 2). Success related to these outcomes comes is the fruit of the interactions of the actors in the *value creation system.* These interactions can be facilitated by the linkages between these actors that result from the strategies and practices described earlier.

The linkages can increase the involvement of patients and physician suppliers in the value co-creation process. For example, CRM can be used to push information to post-op patients guiding them regarding convalescent care, ultimately improving quality outcomes and reducing costs through reduced re-admissions. In light of the earlier discussion of co-creation and continual reinvention of value/innovation, service delivery can benefit from Product Development research findings. As such, consistent with Tan and Tracey (2007), involvement of customers (patients) and suppliers in the care delivery process can result in improvements in

quality, reductions in cost, and increases in customer satisfaction. This supports the notion of this study, that improvements in cost and quality through supply chain practices can result from supply chain and IS strategy.

P3: The supply chain practices of a hospital are positively associated with its supply chain outcomes.

3. Proposed Research Methods

Hypotheses will be developed to test the relationships between the variables under study using data from completed surveys of chief executive officers (CEOs). Structural equation modeling will be employed. All firms will be members of the American Hospital Association (AHA), a group of nearly 6,000 firms representing the healthcare sector.

4. Anticipated Findings and Implications

Positively correlated relationships are expected to be found between the variables. These findings will carry important scholarly and practical implications. The complexity variable will provide a novel approach to exploring the antecedents of, and providing explanation for strategy development. The theoretical grounding of value co-creation will also provide useful insights for scholars into this phenomenon.

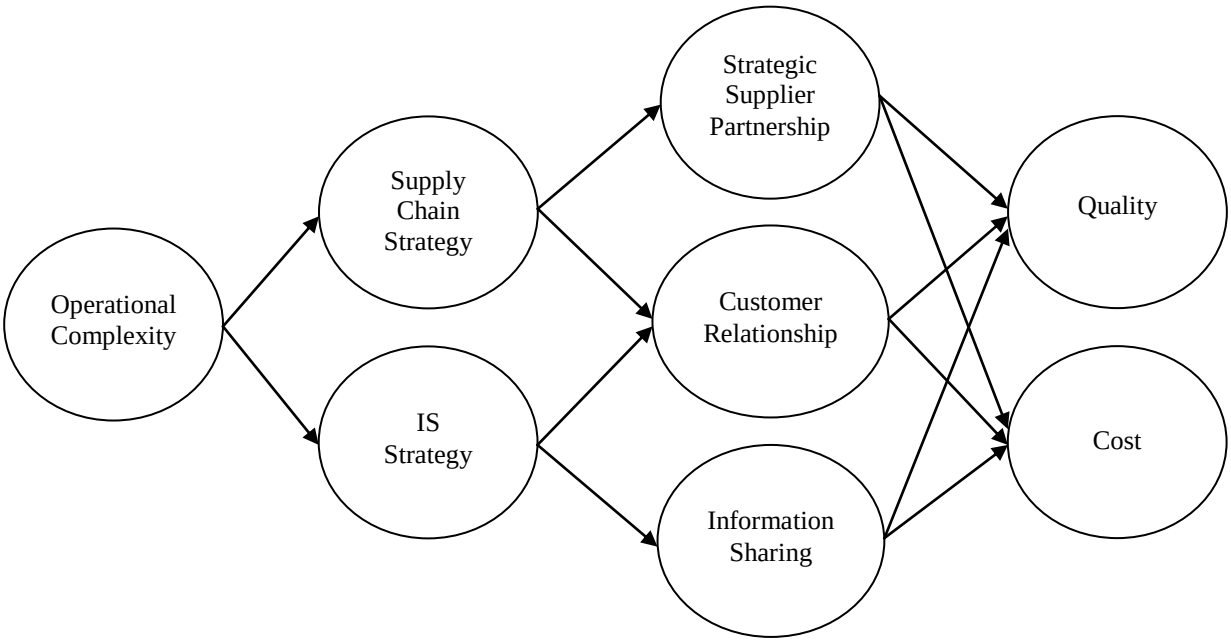
Further, such strategies can be used to predict physician and patient practices which are critical to favorable outcomes. This patient-centered approach will likely result in improvements in cost and quality, consistent with the findings of Campling, et. al. (2008) who found in a wound care supply chain study that disconnection or a lack of user focus prevents the transfer of important information to healthcare providers. Finally, this study will offer an alternative

approach to relatively unpopular consumer driven healthcare (CDH) movement, which endeavors to motivate patient involvement primarily through shifting financial risk to patients.

4.1 Future Research

While a theoretical research framework was presented and discussed in this study, a clear limitation rests in the fact that these relationships have not been tested. Future empirical testing will be useful in advancing this line of research. To that end, figure 5 illustrates some potential relationships related to this study for further development and future testing.

Figure 5 Proposed testable model



REFERENCES

Agarwal, A., Shankar, R., and Tiwari, M.K. (2006). Modeling the metrics of lean, agile, and leagile supply chain: An ANP-based approach. *European Journal of Operational Research,* 173, 211-225.

Blecker, T. and Abdelkafi, N. (2006). Complexity and variety in mass customization systems: analysis and recommendations. *Management Decision,* 44(7), 908-929.

Byrnes, Jonathan L.S. (2004). Fixing the Healthcare Supply Chain. *Harvard Business School: Working Knowledge*. Retrieved February 26, 2009. <http://hbswk.hbs.edu/archive/4036.html.>

Campling, N. Grocott, P., and Cowley, S. (2008). Disconnection: the user voice within the wound dressing supply chain. *Journal of Nursing* Management, 16 , 204-213.

Chopra, S. and Meindl, P. (2004). *Supply Chain Management: Strategy, Planning, and Operations.* Upper Saddle River, N.J.: Prentice Hall.

Cogan, J., Hubbard, R. and Kessler, D. (2004). Healthy, wealthy, and wise. *Wall Street Journal*, A. 20.

Doty, H.D., Glick, W.H., and Huber, G.P. (1993). Fit, equifinality, and organizational effectiveness: A test of two configurational theories. *Academy of Management Review,* 36(6), 1196-1250.

Duray, R. (2002). Mass customization origins: Mass or custom manufacturing? *International Journal of Operations and Production Management*, 22(3), 314–328.

Ford, E. and Scanlon, D. (2007). Promise and problems with supply chain management approaches to healthcare purchasing. *Healthcare Management* Review, 32 (3), 192-202.

Gehmlich, V. (2008). 'Opportunities of supply chain management in healthcare', *In* Hübner, U. and Elmhorst, M. (eds.), *eBusiness in healthcare; from eprocurement to supply chain management,* Springer-Verlag London Limited.

Hambrick, D. (1983). Some Tests of the Effectiveness and Functional Attributes of Miles and Snow's Strategic Types. *Academy of Management Journal,* 26(1), 5-26.

Kaplan, A. and Haenlein, M. (2006) Toward a Parsimonious Definition of Traditional and Electronic Mass Customization. *Journal of Product Innovation Management. 23, 168-182.*

Kathuria, R., Joshi, M.P, and Porth, S.J. (2007). Organizational alignment and performance: Past, present and future. *Management Decision,* 45(3), 503-517.

Lambert, D. and Cooper, M. (2000). Issues in supply chain management. *Industrial Marketing Management,* 29 65-83.

Li, S., Rao, S., Ragu-Nathan, T. and Ragu-Nathan, B. (2005). Development and validation f a measurement instrument for studying supply chain management practices. *Journal of Operations Management,* 23, 618-641.

Luhmann, N. (1996). Soziale Systeme, Grundriss einer allgemeinen Theorie, 7th ed., Suhrkamp, Frankfurt am Main.

McKone-Sweet, K. E.; Hamilton, P. ,Willis, S. B. (2005). The Ailing Healthcare Supply Chain: A Prescription for Change. *Journal of Supply Chain Management: A Global Review of Purchasing & Supply*, 41 (1) 4-17.

Naidu, G.M., Parvatiyar, A., Sheth, J.N. and Westgate, L. (1999). Does relationship marketing pay? An empirical investigation of relationship marketing practices in hospitals. *Journal of Business Research*, 46 207-218.

Normann, R. and Ramirez, R. (1993). From value chain to value constellation: Designing interactive strategy. *Harvard Business Review*, July/August, 65-77.

Porter, M. (1987). From competitive advantage to corporate strategy. *Harvard Business Review*, May/June , 43-59.

Porter, M. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. New York: The Free Press.

Prahalad, C. and Krishnan, M. (2008). The New Age of Innovation: Driving Co-created Value through Global Networks. McGraw-Hill, New York.

Prahalad, C. and Ramaswamy, V. (2004). Co-creation experiences: the next practice in value creation, *Journal of Interactive Marketing*, 18 (3), 5-14.

Rathmell, John M. (1966). What Is Meant by Services? *Journal of Marketing. 30 (4).*

Ross,A. (1996). Selling uniqueness — Mass customization: The new religion for manufacturers? *Management Engineer*, 75(6), 260–263.

Sabherwal, R. and Chan, Y. (2001). Alignment between business and IS strategies: A study of prospectors, analyzers, and *defenders. Information Systems* Research, 12 (1) 11-33.

Scalise, D. (2005) Building an efficient supply chain. *Hospital & Health Networks*, Aug.79 (8) 47-52.

Schneller, E. and Smeltzer, L. (2006). *Strategic management of the health care supply chain.* San Francisco, CA: Jossey-Bass.

Singh, Mahender. (2006). *Transforming the Global Health Care Supply Chain*. MIT Center for Transportation and Logistics.

Sivadasan, S., Efstathiou, J., Frizelle, G., Shirazi, R., and Calinescu, A. (2002) An information-theoretic methodology for measuring the operational complexity of supplier-customer systems. *International Journal of Operations.* 22 (1), 80-102.

Shortell, S. and Zajac, E. (1990). Perceptual and archival measures of Miles and Snow's strategic types: a comprehensive assessment of reliability and validity. *Academy of Management Journal*, 33(4), 817-832.

Stabell, C. and Fjeldstad, O. (1998). Configuring value for competitive advantage: On chain, shops and networks. *Strategic Management Journal*, 19 (5), 413-437.

Tan, C.L. and Tracey, M. (2007) Collaboratiove New Product Development Environemnts: Implications for Supply Chain Management. *Journal of Supply Chain Management. Summer.*

Van Hoek, R.I. Harrison, A., and Christopher, M. (2001). Measuring agile capabilities in the supply chain*. International Journal of Operations and Production Management*, 21(1/2), 126-147.

von Hippel, E., (1988). The Sources of Innovation. Oxford University Press, New York.

Vondrembse, M.A., Uppal, M., Huang, S.H., and Dismukes, J.P. (2006). Designing supply chains: *Towards theory development. International Journal of* Production Economics, 100, 223-238.

Zhang, X. and Chen, R. (2008). Examining the mechanism of the value co-creation with customers. *International Journal of Production Economics*, 116, 242-250.

Zhang, X., Chen, R.Q., (2006). Customer participative chain: Linking customers and firm to co-create competitive advantages. *Management Review* 18 (1), 51–56 (in Chinese with English abstract).