Antecedents of time-based competitive advantage in healthcare

David Dobrzykowski
University of Toledo, College of Business and Innovation, Information Operations and Technology Management Dept., School of Healthcare Business Innovation and Excellence, 2801 W. Bancroft, Toledo, Ohio 43606, U.S.A.
david.dobrzykowski@utoledo.edu

Arash Azadegan
991 One Washington Park, Supply Chain Management and Marketing Sciences Department
Rutgers Business School, Rutgers University
Newark, New Jersey 07102-3122
aazadegan@business.rutgers.edu

Abstract
While the potential for process improvement in healthcare is posited to be substantial, translating operational initiatives into competitive advantage has proven thorny. SEM analysis of survey data from 302 hospitals supports relationships among key operational initiatives, patient care process improvement initiatives, and time-based competitive advantage. Important moderation relationships involving information technology are revealed.

Keywords: Lean thinking, agility, IT, process improvement, healthcare.

Introduction
Strategic deployment of operational capabilities can be an elusive process. This is particularly true for healthcare organizations (Boyer, Gardner & Schweikhart, 2012). While the effect of strategic operations management decisions has been at the forefront of discussions on healthcare for some time (Li & Benton, 2006), translating operational capabilities to competitive advantages in healthcare settings has proven to be thorny at best (McKone-Sweet, Hamilton & Willis, 2005; Schneller & Smeltzer, 2006; Boyer & Pronovost, 2010). McDermott and Stock note: "operations strategy has flourished as a field, yet there is still much to be learned regarding how this knowledge base can effectively be applied within the healthcare setting," (McDermott and Stock, 2007: p. 1022).

Some suggest that hospitals carry particularities that hinder broad set implementation and extensive rewards from process improvements (Vest & Gamm, 2009; Winch & Henderson, 2009; Radnor, Holweg & Waring, 2012). The complexity of the hospital operations, shared authority and decentralized decision making are some of the factors that are suggested to limit the implementation and benefit from process improvements (Waring & Bishop, 2010). As such, there are reported cases where the implementation of patient care process improvements have been myopic and limited to small enclosed projects and "pockets of best practice" (Young & McClean, 2008; Brandao de Souza, 2009).

Lean thinking (Womack & Jones, 1996) and operational agility (Gunasekaran, 1999) are two strategic drivers thought to be potential sources of competitive advantage for hospitals by improving the patient care processes (Shafer, Dyer, Kilty, Amos & Ericksen, 2001; Papadopoulos, Radnor & Merali, 2011). Lean thinking focuses process improvements on customer value and provides a systemic perspective (Womack & Jones, 1996). Operational agility focuses process improvements on responsiveness and adaptability to customer needs (Narasimhan, Swink & Kim, 2006; Inman, Sale & Green, 2011).

Drawing from explanations provided by dynamic capabilities (Teece, Pisano & Shuen, 1997), this study explores how anchoring process improvement capabilities in lean thinking and operational agility enhances hospital performance and provides competitive advantage. It outlines lean thinking and operational agility as dynamic capabilities that can "integrate, build, and reconfigure" process improvement capabilities to better face patient needs (Zollo & Winter, 2002). We consider lean thinking and operational agility as necessary antecedents to process improvement capabilities that ensure process improvements are designed and implemented so as to consider a broad and holistic view of the patient care process while considering the need for adaptation to change.

CPOE (computerized physician order entry) is an information technology suggested to have extensive potential for improving hospital operations (Queenan, Angst & Devaraj, 2011). Using arguments based on the knowledge based view of the firm (Grant, 1996) this study argues that CPOE acts to enhance the hospital's ability to acquire, assimilate, transform and exploit of knowledge for its operations towards creating time based competitive advantage (Kogut & Zander, 1992).The hypotheses are tested using survey data collected from 302 acute care hospitals in 47 states in the USA and triangulated using objective archival data.

Operations Capabilities in Healthcare - A Review

Literature provides two categories of operations capabilities in healthcare; the infrastructural and the structural groups (McDermott & Stock, 2007). Infrastructural operations capabilities include investments in hospital processes, quality systems and workforce development and management. Specific to infrastructural elements, researchers have explored aspects such as hospital processes (Tucker, Nembhard & Edmondson, 2007), quality systems (Li & Benton, 2003), workforce management (Li & Benton, 2006) and demand management (LaGanga, 2011). Structural operations capabilities include investments in technology and facilities. Such investments may involve software and hardware technologies (Goldstein, Ward & Leong, 2002), such as computerized order processing entry (CPOE) (Queenan et al., 2011). Although the healthcare profession has a longstanding tradition of using medical technologies, information technology adoption by care-delivery organizations is still relatively limited (Mishra, Anderson, Angst & Agarwal, 2012). Investments in information technology appear to be positively associated with multiple hospital performance metrics including quality efficiency, costs and financial performance (Kumar & Motwani, 1999; Li & Benton, 2003; Li & Benton, 2006).

Among the most important of infrastructural operational capabilities are process improvement capabilities (IC) (Spaite, Bartholomeaux, Guisto, Lindberg, Hull, Eyherabide, Sally Lanyon, Criss, Valenzuela, Conroy & Lindberg, 2002; Thompson, Wolf & Spear, 2003; Kim, Spahlinger, Kin & Billi, 2006). Process improvement capabilities improve healthcare delivery processes by incorporating standardized work, seamless linkages, simple and direct pathways, and process improvements based on scientific methods (Spear & Bowen, 1999). Standardized work defines how clinicians perform their work and ensures that all work is highly specified to its content, sequence, timing, and outcome (Mazzocato, Holden, Brommels, Aronsson, Bäckman, Elg & Thor, 2012). Seamless linkages aim to connect clinicians performing various aspects of the care to one another via direct and unambiguous links. Seamless linkages help eliminate errors (defects and delays) that patient transfers (or patient handoffs) between clinicians may introduce (Sexton, Ho, Green & Caldwell, 2000). Simple and direct pathways aim to design care processes that are short of unnecessary complications. Simple and direct pathways make patient flows predictable so as to ensure that appropriate resources are devoted to the need of the patient (Goktas, Fleiner, Spies, Krieg, Bauer & Sedlmaier, 2010). Finally, improvements based on scientific methods highlight the need for hypothesis testing when designing process improvements. This enhances the process design by discouraging personal experience, intuition and restricted views of the patient care process to overpower the improvement process (Chowanec, 1996; Spear, 2005).

Literature suggests that certain idiosyncrasies of hospitals inhibit the full implementation of operational process improvement strategies (Shah, Goldstein, Unger & Henry, 2008). These idiosyncrasies lead to unique issues when implementing process improvements in hospitals. First, it is essential for processes to be designed so as to meet multiple expectations as hospitals need to address the demands of multiple constituents whose goals may be misaligned (Shortell, Morrison & Friedman, 1990; Butler, Leong & Everett, 1996). The challenge facing hospital management is to devise and implement resource management strategies that ensure that they consistently provide high quality services despite demand fluctuations (Jack & Powers, 2004) and at the same time respond to cost and quality pressures (McDermott & Stock, 2007). It is widely recognized that in considering patient care, there is a fundamental tension between production and protection of the patient (Winch & Henderson, 2009). In other words, hospitals need to simultaneously consider the efficiency of the process and responsiveness necessary to meet a multitude of patient streams and constituents (Schneller & Smeltzer, 2006).

Second, given the socially interactive and professionally intensive nature of the hospital operations, any reference to standardizing work towards simple and repetitive tasks will carry certain level of socially charged resistance (Joosten, Bongers & Janssen, 2009). Healthcare professionals are particularly sensitive to having their work compared to industrial processes, feeling as if it diminishes or simplifies the nature of their roles (Winch & Henderson, 2009). Common arguments against the application of process improvements include comments such as: "You can't apply [the model of] a manufacturing company to our work. Our work is more complicated." (Condel, Sharbaugh & Raab, 2004) and “each patient is unique” (Kim et al., 2006).

Third, while there is evidence of widespread familiarity with process improvement capabilities, implementation has shown to be typically narrow in scope, disjointed, and selective (Locock, 2003; Mazzocato et al., 2010; Radnor et al., 2012). Many of these implementations have been confined to a single department rather than a complete patient pathway (Papadopoulos et al., 2011). 'Rapid Improvement Events', which tend to produce small-scale and localized productivity gains are quite common whereas large scale success stories are but a handful (Ben-Tovim, Bassham, Bolch, Martin, Dougherty & Szwarcbord, 2007; Dickson, Anguelov & Vetterick, 2009). As a result, many process improvements have yet to be fully institutionalized and systemically applied.

In the next section, we develop hypotheses on how lean thinking, operational agility and information technology can help overcome some of the challenges noted above by developing process improvement capabilities and the firm's competitive advantage. See Figure 1 which displays the model. Time-based competitive advantage for hospitals is the extent to which the hospital's efforts and actions result in lower lengths of stays which is important as it has shown to positively affect quality of care (Thomas, Guire & Horvat, 1997), cost and efficiency (Ashby, Guterman & Greene, 2000; Glick, Orzol, Tooley & Mauskopf, 2003) and service delivery in hospitals (McDermott & Stock, 2007).

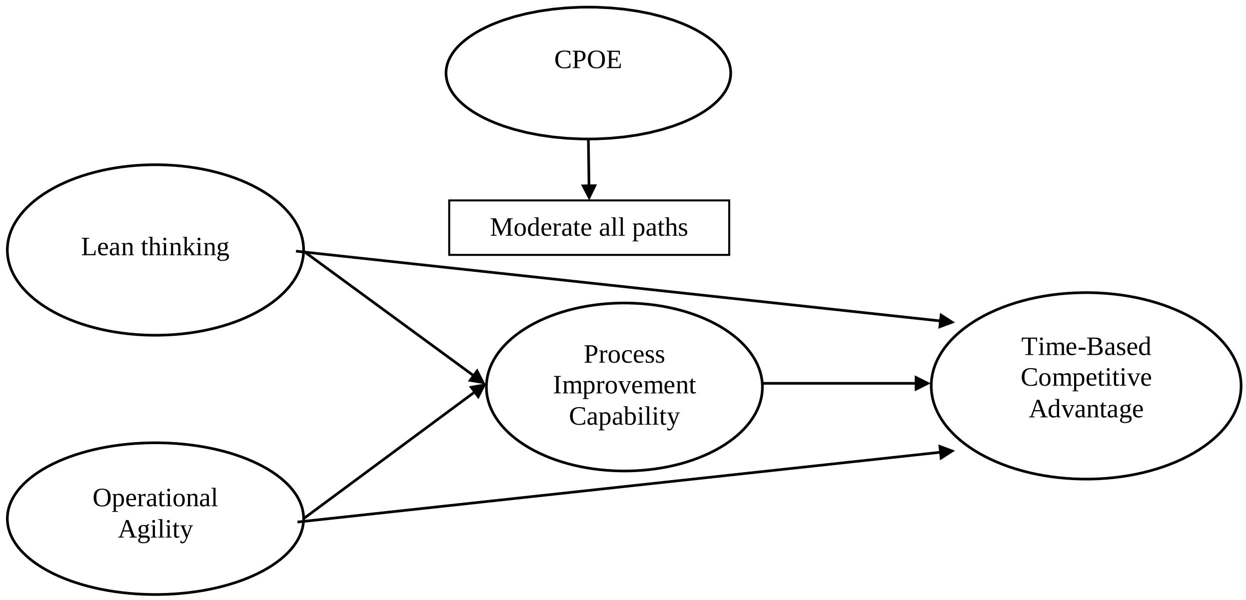

Figure 1 – Proposed Model

Theory and hypotheses

Lean thinking requires a systemic view of the process which changes the focus of management from perfecting individually specific aspects of the operations (technologies, assets, people, and processes) to creating the perfect value stream (Balle & Regnier, 2007; Nelson-Peterson & Leppa, 2007). Identifying the value stream (the end-to-end journey) for each patient pathway is particularly useful for hospitals where deep specializations are an obstruction to visualizing the entire system. This helps develop new ways of looking at the patient pathway by moving away from a craft-group skill base (e.g. medical care, nursing) or a body system orientation (e.g., cardiovascular, respiratory) towards a process view where the care is seen as the outcome of a sequential series of steps (Ben-Tovim, 2007; Waring & Bishop, 2010). Unfortunately, the systemic approach advocated by lean thinking is not simple to execute (Boyer et al., 2012). It requires joint and collaborative efforts by partners who are respected towards the same goal (Shah et al., 2008).

Perhaps more importantly, the systemic perspective of lean thinking requires that the social concerns are incorporated into process development. Lean thinking demands the patient care process to be rationalized and reconfigured in such a way so as the entire system is considered. Lack of social concerns such as job rotations, job redesign, and employee empowerment and autonomy are expected to diminish process performance. Employee empowerment and team work is a central theme of process improvements under the lean thinking (Boyer & Pronovost, 2010). The inclusion of social and systemic aspect of the process creates a need for a significant shift in the mindset of the clinicians may be accustomed to being rewarded for independent problem solving (Chang, 2011).

The combination of these effects suggests that lean thinking can act as a dynamic capability by building process improvement capabilities that can reconfigure and integrate hospital processes to become more effective (Teece et al., 1997). Lean thinking does so while limiting the challenges associated with the idiosyncrasies of hospital operations explained earlier. Because lean thinking starts with the customer value, embedding ICs in lean thinking ensures that their primary aim is on improving what the patients expect. Because lean thinking considers the entire system, by anchoring process improvement capability in lean thinking, processes are improved so as to more effectively consider hospital system complexities, multiple patient streams and the challenges that deep specializations of hospital staff can create. Indeed, literature suggests that the broadly successful process improvement programs in hospitals are the ones in line with what is advocated by lean thinking (Jimmerson, Weber & Sobek, 2005; Dickson et al., 2009). The discussion above leads to the following hypothesis:

H1. Lean thinking enhances the development of time-based competitive advantage through process improvement initiatives.

Operational agility is not only concerned with carrying resources that are flexible and responsive to current demands, but also requires adaptive capability to respond to future changes For instance, Haier, the Chinese white goods manufacturer carefully incorporates operational agility so as to better sense and respond market needs (Huang, Ouyang, Pan & Chou, 2012).

Health care administrators commonly employ two types of operational agility to help coordinate activities: the human type (agility in nurse, administrative and professional staff and the infrastructural resources type (agility in units, beds, etc.) (Gnanlet & Gilland, 2009). These two forms of operational agility can act as a dynamic capability by building process improvement capabilities. They do so by reconfiguring and integrating hospital processes such that they are designed for responsiveness and flexibility, while limiting the challenges associated with the idiosyncrasies of hospital operations explained earlier. For instance, operational agility suggests for staff cross-training and empowerment to be part of process design, which can limit the effects of deep specialization and system complexity in hospital settings (Gowen, Mcfadden, Hoobler & Tallon, 2006). By placing focus on making the hospital’s infrastructure more flexible, process improvement capabilities can better address the challenges associated with multiple patient streams. Finally, by placing emphasis on future patient needs, operational agility helps ensure that process improvements are developed and implemented with customer value in mind. In short, organizational agility can affect process improvement capabilities by ensuring the necessary flexibility and adaptability is incorporated into their design, which in turn can positively influence time based competitive advantage for the hospital. The discussion above leads to the following hypothesis:

H2. Operational agility enhances the development of time-based competitive advantage through process improvement initiatives.

Computerized provider order entry (CPOE) is an electronic application that helps physicians directly enter orders for medications, diagnostic tests, and ancillary services (Ash, Gorman, Seshadri & Hersh, 2004; Poon et al., 2004). CPOE helps with monitoring medications, improving legibility, and checking for drug interactions (McAlearney, Chisolm, Schweikhart, Medow & Kelleher, 2007). The Knowledge Based View (Grant, 1996), would explain the effects of CPOE in terms of expanding the scope and efficiency of knowledge integration. This integration may lead to better patient care, more timely information sharing and fewer medical errors (Davidson & Chismar, 2007; Menachemi, Saunders, Chukmaitov & Brooks, 2007).

Since CPOE is aimed at improving the quality standard in patient care, it fits well to complement process improvement capabilities (Wang, Middleton, Prosser, Bardon, Spurr, Carchidi, Kittler, Goldszer, Fairchild, Sussman, Kuperman & Bates, 2003). More specifically, since CPOE improves recordkeeping and documentation (Campbell et al., 2009), it can also assist with a more scientific approach to process improvements. Along the same lines, CPOE helps with standardization and simplification of order sets and clinical guidelines (Payne, Hoey, Nichol & Lovis, 2003), thereby reducing the likelihood of errors of omission.

CPOE allows for better incorporation of lean thinking in process improvements because of the more effective and simpler visibility of patient information across the hospital, thereby implementing a more systematic implementation of process improvements. CPOE can simplify and clarify patient pathways (e.g., through order sets, codification of procedures, etc.), and can provide a level of consistency in practice that can enhance situation awareness, can bias workflow design towards an organizational perspective all of which can help to broaden the scope of knowledge integration (Grant, 1996). Finally, CPOE can help with agility because it allows for faster accumulation and reporting of changes in patient demands and allows for better adaptation to demand changes. CPOE can expose problems (bottlenecks, mis-specifications and process gaps) during the design (Campbell et al., 2009) so as to enable more responsive processes. Therefore:

> **H3. The use of computerized provider order entry positively moderates the link between (a) lean thinking and lean process initiatives, (b) organizational agility and lean process initiatives and (c) lean process initiatives and time-based competitive advantage.**

Methodology

A cross-sectional self-administered internet survey was conducted. The sample frame consisted of 671 hospital executives from 644 unique acute care facilities. 312 responses were received, generating a response rate of 46.5% (312/671). After screening, two of the surveys were deleted from the analysis database due to excessive missing values, leaving 310 responses in the sample. Next, responses received from multiple raters from eight hospitals were averaged for each item (McFadden, Henagan & Gowen, 2009). This resulted in a final sample for analysis of 302 hospitals. The characteristics of the final respondents and their acute care hospitals are described in Table 3. The final sample of respondents contains over 50% holding the titles of Chief Nursing Officer, VP of Patient Care Services, or Director of Case Management. The balance is primarily comprised of CEOs, COOs, VPs of Medical Staff Affairs, VPs of Case Management, Directors of Nursing, and Directors of Quality Initiatives. Psychometric measurement (survey) instruments were developed to test the hypotheses posited following a three step process: 1) item generation, 2) Q-sort pilot study testing, and 3) large-scale data analysis and instrument validation (Churchill, 1979). The final survey items used in this study will be presented at the conference.

Hypothesis testing procedures, results, and discussion

The theorized model contains mediation and moderation relationships. Structural Equation Modeling (SEM) was utilized to test all of the hypothesized relationships. Moderation testing in SEM involves the computation of interaction terms (Rossetti and Choi, 2008; Kroes and Ghosh, 2010; Liu et al., 2012). The Ping (1995) approach retains all individual measurement items and corresponding latent constructs when analyzing the model in step two, using the summed single-indicators for only the interactions variables. Given an interest in retaining the individual measurement items in the model motivated the selection and application of the Ping (1995) approach in this study. Given the inherent measurement challenges when analyzing interaction variables containing overlapping roots (Marsh et al., 2004; Rossetti and Choi, 2008; Liu et al., 2012), such as Operational Agility * CPOE, and Lean Thinking * CPOE in this study, the interaction variables were correlated when analyzed in the step two model. Correlated models are appropriate when variables are expected to be related as is the case herein (see Rabinovich et al., 2003; Oke et al., 2008).

Results from these tests will be presented at the conference. In addition, we collected archival Adjusted Length of Stay (ALOS) data for 215 hospitals identified in the sample. We repeated the analysis after replacing the dependent variable with the new ALOS variable. Initial results replicate support for H1 and H2, and generally replicate the results for the technology hypothesis (H3). Further analysis will be conducted and discussion provided at the POMS conference. Limitations and potential extensions will also be discussed at the conference.

References (Selected – Please contact the first author for a complete reference list)

AHA, 2005. Forward momentum: hospital use of information technology. American Hospital Association, Chicago, IL. .

Aronsson, H., Abrahamsson, M. and Spens, K., 2011. Developing lean and agile healthcare supply chains. Supply Chain Management: An International Journal 16 (3), 176-183.

Ash, J.S., Gorman, P.N., Seshadri, V. and Hersh, W.R., 2004. Computerized physician order entry in U.S. hospitals: Results of a 2002 survey. Journal of the American Medical Informatics Association 11 (2), 95-99.

Ashby, J., Guterman, S. and Greene, T., 2000. An analysis of hospital productivity and product change. Health Affairs 19 (5), 197-205

Ben-Tovim, D.I., 2007. Seeing the Picture through "Lean Thinking". British Medical Journal 334 (7586), 169.

Boyer, K.K., Gardner, J.W. and Schweikhart, S., 2012. Process quality improvement: An examination of general vs. outcome-specific climate and practices in hospitals. Journal of Operations Management 30 (4), 325-339.

Boyer, K.K. and Pronovost, P., 2010. What medicine can teach operations: What operations can teach medicine. Journal of Operations Management 28 (5), 367-371.

Brandao de Souza, L., 2009. Trends and approaches in lean healthcare. Leadership in Health Services 22 (2), 121-139.

Burns, L.R., Chilingerian, J.A. and Wholey, D.R., 1994. The effect of physician practice organization on efficient utilization of hospital resources. Health Services Research 29 (5), 583=603.

Butler, T.W., Leong, G.K. and Everett, L.N., 1996. The operations management role in hospital strategic planning. Journal of Operations Management 14 (2), 137-156.

Campbell, E.M., Guappone, K.P., Sittig, D.F., Dykstra, R.H. and Ash, J.S., 2009. Computerized Provider Order Entry Adoption: Implications for Clinical Workflow. Journal of General Internal Medicine 24 (1), 21-26.

Carey, S., Lawson, B. and Krause, D.R., 2011. Social capital configuration, legal bonds and performance in buyer-supplier relationships. Journal of Operations Management 29 (4), 277-288.

Chang, L., 2011. The effect of health payment reforms on cost containment in Taiwan hospitals: The Agency Theory perspective. Journal of Healthcare Finance 38 (1), 11-31.

Chowanec, G., 1996. The fall and rise of TQM at a public mental health hospital. Joint Commission Journal on Quality Improvement 22 (1), 19-26.

Cortina, J.M., Chen, G. and Dunlap, W.P., 2001. Testing interaction effects in Lisrel: Examination and illustration of available procedures. Organizational Research Methods 4 (4), 324-360.

Culter, D.M., Feldman, N.E. and J.R., H., 2005. U.S. Adoption of Computerized Physician Order Entry Systems. Health Affairs 24 (6), 1654-1663.
Davidson, E. and Chismar, W.G., 2007. The interaction of institutionally triggered and technology-triggered social structure change: An investigation of computerized physician order entry (CPOE). MIS Quarterly 31 (4), 739-758.
Eisenhardt, K.M. and Martin, J.A., 2000. Dynamic capabilities: what are they? Strategic Management Journal 21 (10-11), 1105-1121.
Ford, E.W. and Scanlon, D.P., 2007. Promise and Problems with Supply Chain Management Approaches to Health Care Purchasing. Health Care Management Review 32 (3), 192-202.
Gnanlet, A. and Gilland, W.G., 2009. Sequential and simultaneous decision making for optimizing health care resource flexibilities. Decision Sciences 40 (2), 295-326.
Goldstein, S., Ward, P. and Leong, G., 2002. The effect of location, strategy, and operations technology on hospital performance. Journal of Operations Management 20 (1), 63-75.
Goldstein, S.M. and Naor, M., 2005. Linking publicness to operations management practices: a study of quality management practices in hospitals. Journal of Operations Management 23 (2), 209-228.
Gowen, C.R.I., Mcfadden, K.L., Hoobler, J.M. and Tallon, W.J., 2006. Exploring the efficacy of healthcare quality practices, employee commitment, and employee control. Journal of Operations Management 24 (6), 765-778.
Grant, R.M., 1996. Toward a Knowledge-Based Theory of the Firm. Strategic Management Journal 17 (Winter Special Issue), 109-122.
Gunasekaran, A., 1999. Agile manufacturing: A framework for research and development. International Journal of Production Economics 62 (1-2), 87-105.
Hallgren, M. and Olhager, J., 2009. Lean and agile manufacturing: external and internal drivers and performance outcomes. International Journal of Operations & Production Management 29 (10), 976-999.
Huang, P.-Y., Ouyang, T.H., Pan, S.L. and Chou, T.-C., 2012. The role of IT in achieving operational agility: A case study of Haier, China. International Journal of Information Management 32 (3), 294-298.
Inman, R.A., Sale, R.S. and Green, K.W., Jr., 2011. Agile manufacturing: Relation to JIT, operational performance and firm performance. Journal of Operations Management 29 (4), 343-355.
Jaccard, J. and Wan, C.K., 1995. Measurement error in the analysis of interaction effects between continuous predictors using multiple regression: Multiple indicator and structural equation approaches. Psychological Bulletin 117 (2), 348-357.
Jack, E.P. and Powers, T.L., 2004. Volume Flexible Strategies in Health Services: A Research Framework. Production and Operations Management 13 (3), 230-244.
Jha, A.K., DesRoches, C.M., Campbell, E.G., Donelan, K., Rao, S.R., Ferrid, T.G., Shields, A. and Rosenmaum, S. (). 2009. Beyond the doctor's office: adoption of electronic health records in U.S. hospitals. In: C. M. DesRoches and A. K. Jha (Eds.). Health Information Technology in the United States: On the Cusp of Change, Robert Wood Johnson Foundation, Princeton, NJ. , pp. 8-20.
Joosten, T., Bongers, I. and Janssen, R., 2009. Application of lean thinking to health care: issues and observations. International Journal for Quality in Health Care 21 (5), 341-347.
Katayama, H. and Bennett, D., 1999. Agility, adaptability and leanness: A comparison of concepts and a study of practice. International Journal of Production Economics 60-61 (April), 43-51.
Kogut, B. and Zander, U., 1992. Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology. Organization Science 3 (3), 383-397.
Kroes, J.R. and Ghosh, S., 2010. Outsourcing congruence with competitive priorities: Impact on supply chain and firm performance. Journal of Operations Management 28 (2), 124-143.
Kumar, A. and Motwani, J., 1995. A methodology for assessing time-based competitive advantage of manufacturing firms. International Journal of Operations and Production Management 15 (2), 36-42.
Kumar, A. and Motwani, J.G., 1999. Management of health care technology literature (1979-1997): a multidimensional introspection. IEEE Transactions on Engineering Management 46 (3), 247-264
LaGanga, L.R., 2011. Lean service operations: Reflections and new directions for capacity expansion in outpatient clinics. Journal of Operations Management 29 (5), 422-433.
Langland-Orban, B., Gapenski, L.C. and Vogel, W.B., 1996. Differences in characteristics of hospitals with sustained high and sustained low profitability. Hospital & Health Services Administration 41 (3), 385-399.
Lapointe, L. and Rivard, S., 2005. Resistance to IT Implementation. MIS Quarterly 29 (3), 461-491.
Li, L. and Benton, W.C., 2003. Hospital capacity management decisions: emphasis on cost control and quality enhancement. . European Journal of Operational Research 146 (3), 596-614.

Li, L. and Benton, W.C., 2006. Hospital technology and nurse staffing management decisions. Journal of Operations Management 24 (5), 676–691.
Li, L.X., Benton, W.C. and Leong, G.K., 2002. The impact of strategic operations management decisions on community hospital performance. Journal of Operations Management 20 (4), 389–408.
Liker, J. and Meier, D., 2006. The Toyota Way Fieldbook. McGraw-Hill, New York.
Lin, Y., Ma, S. and Zhou, L., 2012. Manufacturing strategies for time based competitive advantages. Industrial Management & Data Systems 112 (5-6), 729-747.
Liu, G., Shah, R. and Babakus, E., 2012. When to Mass Customize: The impact of environmental uncertainty. Decision Sciences 43 (5), 85-887.
Locock, L., 2003. Healthcare redesign: meaning, origins and application. Quality and Safety in Health Care 12 53-58.
Marsh, H.W., Wen, Z.L. and Hau, K.T., 2004. Structural equation models of latent interactions: Evaluation of alternative estimation strategies and indicator construction. Psychological Methods 9 (3), 275-300.
Mathieu, J.E., Tannenbaum, S.I. and Salas, E., 1992. Influences of individual and situational characteristics on measures of training effectiveness. Academy of Management Journal 35 (4), 828-847.
Mazzocato, P., Holden, R.J., Brommels, M., Aronsson, H., Bäckman, U., Elg, M. and Thor, J., 2012. How does lean work in emergency care? A case study of a lean-inspired intervention at the Astrid Lindgren Children's hospital, Stockholm, Sweden. BMC Health Services Research 12 (28), 1-13.
Mazzocato, P., Savage, C., Brommels, M., Aronsson, H. and Thor, J., 2010. Lean thinking in healthcare: a realist review of the literature. Quality and Safety in Health Care 19 (5), 376-382.
McAlearney, A.S., Chisolm, D.J., Schweikhart, S., Medow, M.A. and Kelleher, K., 2007. The story behind the story: Physician skepticism about relying on clinical information technologies to reduce medical errors. International Journal of Medical Informatics 76 (11-12), 836–842.
McDermott, C. and Stock, G.N., 2007. Hospital operations and length of stay performance. Journal of Operations Management 27 (9), 1020-1042.
McFadden, K.L., Henagan, S.C. and Gowen, C.R., III, 2009. The patient safety chain: Transformational leadership’s effect on patient safety culture, initiatives, and outcomes. Journal of Operations Management 27 (5), 390-404.
McKone-Sweet, K.E., Hamilton, P. and Willis, S.B., 2005. The Ailing Healthcare Supply Chain: A Prescription for Change. Journal of Supply Chain Management 41 (1), 4-17.
Menachemi, N., Saunders, C., Chukmaitov, M.M.C. and Brooks, R.G., 2007. Hospital adoption of information technologies and improved patient safety: A study of 98 hospitals in Florida. Journal of Healthcare Management 52 (6), 398-409.
Meyer, S.M. and Collier, D.A., 2001. An empirical test of the causal relationships in the Baldrige Health Care Pilot Criteria. Journal of Operations Management 19 (4), 403-425.
Mishra, A.N., Anderson, C., Angst, C.M. and Agarwal, R., 2012. Electronic health records assimilation and physician identity evolution: An identity theory perspective. Information Systems Research 23 (3), 738-760.
Moliner, M.A., 2006. Hospital perceived value. Health Care Management Review 31 (4), 328-336.
Molleman, E., Broekhuis, M. and Stoffels, R., 2010. Complexity of health care needs and interactions in multidisciplinary medical teams. Journal of Occupational and Organizational Psychology 83 (1), 55-76.
Moore, G.C. and Benbasat, I., 1991. Development of an instrument to measure the perceptions of adopting an information technology innovation. Information Systems Research 2 (3), 192-222.
Narasimhan, R., Swink, M. and Kim, S.W., 2006. Disentangling leanness and agility: An empirical investigation. Journal of Operations Management 24 (5), 440–457.
Oke, A., Idiagbon-Oke, M. and Walumbwa, F., 2008. The relationship between brokers’ influence, strength of ties and NPD project outcomes in innovation-driven horizontal networks. Journal of Operations Management 26 (5), 571-589.
Papadopoulos, T., Radnor, Z. and Merali, Y., 2011. The role of actor associations in understanding the implementation of Lean thinking in healthcare. International Journal of Operations and Production Management 31 (2), 167-191.
Ping, R.A., 1995. A parsimonious estimating technique for interaction and quadratic latent variables. Journal of Marketing Research 32 (3), 336-347.
Podsakoff, P.M., MacKenzi, S.B., Lee, J.Y. and Podsakoff, N.P., 2003. Common method biases in behavioral research: a critical review of the literature and recommended remedies. Journal of Applied Psychology, 88 (5), 879-903.

Queenan, C.C., Angst, C.M. and Devaraj, S., 2011. Doctors' orders—If they're electronic, do they improve patient satisfaction? A complements/substitutes perspective. Journal of Operations Management 29 (7-8), 639-649.
Rai, A., Patnayakuni, R. and Seth, N., 2006. Firm performance impacts of digitally enabled supply chain integration capabilities. MIS Quarterly 30 (2), 225-246.
Robinovich, E., Dresner, M.E. and Evers, P.T., 2003. Assessing the effects of operational processes and information systems on inventory performance. Journal of Operations Management 21 (1), 63-80.
Rosenzweig, E.D., 2009. A contingent view of e-collaboration and performance in manufacturing. Journal of Operations Management 27 (6), 462-478.
Rossetti, C. and Choi, T., 2008. Supply management under high goal incongruence: An empirical examination of disintermediation in the aerospace supply chain. Decision Science 39 (3), 507-540.
Schneller, E.S. and Epstein, K.R., 2006. The hospitalist movement in the United States: Agency and common agency issues. Health Care Management Review 31 (4), 308-316.
Schneller, E.S. and Smeltzer, L.R., 2006. Strategic management of the health care supply chain. Jossey-Bass, San Francisco, CA.
Shah, R., Goldstein, S.M., Unger, B.T. and Henry, T.D., 2008. Explaining anomalous high performance in a health care supply chain. Decision Sciences 39 (4), 759-789.
Shang, W. and Liu, L., 2011. Promised Delivery Time and Capacity Games in Time-Based Competition. Management Science 57 (3), 599-610.
Shi, L., 1996. Patient and hospital characteristics associated with average length of stay. Health Care Management Review 21 (2), 46-61.
Song, M., Droge, C., Hanvanich, S. and Calantone, R., 2005. Marketing and technology resource complementarity: An analysis of their interaction effect in two environmental contexts. Strategic Management Journal 26 (3), 259-276.
Spear, S. and Bowen, H.K., 1999. Decoding the DNA of the Toyota production system. Harvard Business Review 77 (5), 97-106.
Spear, S.J., 2005. Fixing health care from the inside, today. Harvard Business Review 83 (9), 78-91.
Stalk, G.J., 1988. Time - the next competitive advantage. Harvard Business Review 66 (4), 41-45.
Teece, D.J., 2007. Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. Strategic Management Journal 28 (13), 1319–1350.
Teece, D.J., Pisano, G. and Shuen, A., 1997. Dynamic Capabilities and Strategic Management. Strategic Management Journal 18 (7), 509-533.
Thomas, J.W., Guire, K.E. and Horvat, G., 1997. Is patient length of stay related to quality of care? Hospital & Health Services Administration 42 (4), 489-507.
Thompson, D.N., Wolf, G.A. and Spear, S.J., 2003. Driving Improvement in Patient Care: Lessons From Toyota. Journal of Nursing Administration 33 (11), 585-595.
Tucker, A.L., Nembhard, I.M. and Edmondson, A.C., 2007. Implementing new practices: an empirical study of organizational learning in hospital intensive care units. Management Science 53 (6), 894-907.
Womack, J. and Jones, D., 1996. Beyond Toyota: How to root out waste and pursue perfection. Harvard Business Review 74 (5), 140-144.
Zollo, M. and Winter, S.G., 2002. Deliberate learning and the evolution of dynamic capabilities. Organization Science 13 (3), 339-351.