LEADERSHIP AND HEALTHCARE PERFORMANCE

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Abstract

The U.S. health care delivery system faces serious challenges such as an increasing demand for services due to an aging population, unhealthy lifestyles, growth in the number of uninsured individuals, and an increase in chronic diseases. At the same time, the system has to cope with a limited supply of money, physicians, and nurses inferior quality of care delivered by U.S. hospitals. While the U.S. hospital industry is adapting to address these issues, not much progress in improving the quality of care delivered has been made over the last decade. However, theories exist that management systems, organizational traits, and leadership are key factors for hospitals to improve quality of care outcomes. This study takes a holistic look at these factors to identify and analyze critical drivers for better quality of care outcomes of U.S. hospitals. The study also aims to identify differences between chief executive officers' (CEOs) leadership traits among lean (mediocre performance), high (top 20th percentile), and low performing (bottom 20th percentile) U.S. hospitals in regards to their quality of care measures.

Two separate online surveys were conducted. The first online survey was targeted at all 4,697 U.S. hospitals that are required to disclose quality of care measures to the Federal government. Results of this first survey revealed that two management system factors drive quality of care outcomes of U.S. hospitals. Furthermore, findings also show that critical access hospitals have a lower quality of care performance than acute care hospitals. Thus, based on the results from this survey, we concluded that management system factors are main drivers of hospital performance, whereas organizational trait and leadership factors did not significantly contribute to hospital performance.

A second survey to CEOs and CEO followers in 9 selected hospitals found significant differences between CEO traits leading lean and low performing hospitals, and, to a lesser degree, significant differences among high and low performing hospitals. However, the study did not find any significant differences in CEO traits between lean and high performing hospitals. Findings also include that some management system factors differed significantly between lean and high performing hospitals, but no evidence for such differences could be found between lean and high and high and low performing hospitals, respectively. These results suggest that management systems and CEO leadership traits play an important role in determining U.S. hospital performance as measured by their quality of care.

Dedication

This dissertation is dedicated to my mother Rosel Schmitt, who passed away during my doctoral studies. She was always there for me when I needed help, motivation, encouragement, and strength throughout my life.

Mom … we did it!

This dissertation is also dedicated to my father Robert Schmitt, my brother Christoph Schmitt, and my sister Carolin Susewind as well as to an anonymous person, for being somebody really special in my life.

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Table of Contents

List of tables

List of figures

1. Introduction

During the last decade, the U.S. health care delivery system has faced serious challenges. An increasing demand for services due to an aging population, unhealthy lifestyles of individuals, and increasing numbers of individuals with chronic diseases faces a limited supply of money, physicians, and nurses, among other things (Bohmer and Knoop 2007). Especially the financial situation of the U.S. health care industry in general and the U.S. hospital industry in particular receives considerable attention at present. Reasons for this focus are, among others, that financial health care support from federal and state governments is declining (Levit et al. 2003; McGlynn et al. 2003), an increasing number of uninsured individuals requires treatment (Bohmer and Knoop 2007; Garson 2000), and continued cost pressure from stakeholders in the hospital industry persist (Levin-Scherz 2010; Porter 2009; Porter and Teisberg 2006). Most importantly, according to several studies (Porter 2009; Kohn 2000), the quality of care provided by U.S. hospitals is lacking. Kohn (2000) and Bootman (2000) pointed out that between 44,000 to 98,000 U.S. hospital patients die and almost a million patients are injured every year as a result of preventable medical errors. In response to these disappointing numbers, the U.S. federal government is undertaking initiatives to improve patient safety and to make healthcare more cost effective (Shortell and Singer 2008; Porter and Teisberg 2006; Singer et al. 2003). Given the dilemma of U.S. hospitals, the Department of Health and Human Services (HHS) and the Centers for Medicare & Medicaid Services (CMS) launched a quality initiative requiring all hospitals to publicly disclose their quality of care measures (CMS 2012) for benchmarking purposes and to hold hospitals accountable. Despite all these efforts, the

U.S. healthcare system has not shown much progress in improving the quality of care over the last decade (Jewell and McGiffert 2009; Leape and Berwick 2005).

Thus, much research has been directed towards identifying the drivers that determine quality of care performance outcomes (Boyer et al. 2012; Dye 2000; Kovner et al. 2009; Gray 1997). Leadership, besides management systems, has been proven to be an important driver of hospital quality of care outcomes (Marley et al. 2004; Flynn et al. 1994). Indeed, the importance of leadership on hospital performance has been recognized and is measured in the Malcolm Baldrige National Quality Award Health Care Criteria (MBNQA, Marley et al. 2004). Also, scientific arguments in support of the importance of hospital leadership and its influence on patient safety exist (Singer and Shortell 2008; Marley et al. 2004; Kohn et al. 2001), but few investigations have addressed the potential diverging influence of specific leadership traits on organizational performance (McGuire and Kennerly 2006; Spinelli 2006; Collins 2001).

Besides leadership, another area of interest to research is the management system employed at a given hospital and its influence on quality of care performance outcomes (Boyer and Pronovost 2010; Meyer and Collier 2001). Existing reports related to process management (in this dissertation, process management is used synonymously with lean management) in the U.S. hospital industry, however, covers mainly case studies of individual hospitals (Aherne and Whelton 2010; Kenney 2010) and only a few studies are based on a holistic approach (Boyer et al. 2012; Boyer and Pronovost 2010). Thus, this research investigated the influence of different management systems, organizational, and leadership traits on hospital performance (as measured by quality of care outcomes, CMS 2011). In particular, this research tries to give answers on three objectives: 1) Identifying organizational factors that influence hospital performance; 2) evaluating differences in leadership traits of chief executive officers (CEOs) and their effects on hospital performance; and 3) evaluating differences in management system factors and their relationship with hospital performance.

The first chapter (1.0 Introduction) summarizes some background information and the motivation for this research. Chapter 1.0 also presents the research questions. The second chapter (2.0 Objectives and Hypotheses) provides the research hypotheses. The third chapter (3.0 Literature Review) delivers an assessment on Lean Management (3.1), Leadership theories (3.2), the U.S. healthcare industry (3.3), current findings on leadership in healthcare and hospital performance measures (3.4), survey research design (3.5), and statistical modeling and analysis (3.6). The fourth chapter (4.0 Methodology) explains the methodology used to answer the research questions. The fifth chapter (5.0 Management Styles and Hospital Performance) contains a manuscript that answers research objective 1 - gauging factors that influence hospital performance. This chapter is prepared in manuscript format for submission to the Strategic Management Journal (SMJ). Chapter 6 (6.0 Chief Executive Leadership Traits) describes objective 2 - leadership traits of chief executive officers (CEOs) and their effects on hospital performance and was prepared for submission to the California Management Journal. Chapter 7 (7.0 Differences in Management Systems) deals with objective 3 - differences in management systems associated with lean, higher, and lower performing hospitals across the U.S. and has been prepared for submission to the Academy of Management Science Journal. Chapter 8 (8.0 General Results, Discussions, Future Research) provides a discussion of findings that go beyond what is discussed in the manuscripts. Finally, Chapter 9 (9.0 Summary and Conclusions) summarizes the findings and provides conclusions.

1.1. Problem statement and research questions

Given the extensive debate about the future of health care in the U.S. (Dellit et al. 2007; Elwood 2007; Porter and Teisberg 2007) and the financial implications of healthcare on the future prosperity of the nation (Busse et al. 2003), extensive resources are expended to better understand the current state of health care and to search for solutions. Evidence exists that leadership and management systems provide a key to improve the quality of care in the U.S. healthcare industry. However, limited knowledge exists about the influence of specific leadership traits, organizational factors, and the influence of management systems factors on organizational performance (McGuire and Kennerly 2006; Spinelli 2006; Collins 2001), To address those shortcomings, the next chapter describes three research objectives, namely gauging organizational factors that influence hospital performance, identifying differences in leadership traits of chief executive officers (CEOs) and their relationship to hospital performance, and studying management systems factors and their impact on hospital performance.

1.2. References

Aherne, J., and J. Whelton. 2010. “Applying Lean in Healthcare: a Collection of International Case Studies.” *Recherche* 67: 02.

Bohmer, R., and C. I. Knoop. 2007. “The Challenge Facing the US Healthcare Delivery System.” *HBS Case*: 9–606.

Boyer, K.K., J. Gardner, and S. Schweikhart. 2012. “Process Quality Improvement: An Examination of General vs. Outcome-specific Climate and Practices in Hospitals.” *Journal of Operations Management*.

Boyer, K.K., and P. Pronovost. 2010. “What Medicine Can Teach Operations: What Operations Can Teach Medicine.” *Journal of Operations Management* 28 (5).

Bootman, J. Lyle. 2000. “To Err Is Human.” *Arch Intern Med* 160 (21) (November 27): 3189. doi:10.1001/archinte.160.21.3189.

Busse, R., G. Wurzburg, and M. Zappacosta. 2003. “Shaping the Societal Bill: Past and Future Trends in Education, Pensions and Healthcare Expenditure.” *Futures* 35 (1): 7–24.

CMS. 2011. “https://www.cms.gov/HospitalQualityInits/downloads/HospitalOverviewOfSpecs200512.pdf - Google Search.” https://www.google.com/#hl=en&sclient=psy-ab&q=https:%2F%2Fwww.cms.gov%2FHospitalQualityInits%2Fdownloads%

———. 2012. “Quality Initiative.” http://www.cms.hhs.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/QualityInitiativesGenInfo/index.html?redirect=/QualityInitiativesGenInfo/.

Collins, Jim. 2001. *Good to Great: Why Some Companies Make the Leap... and Others Don’t*. 1st ed. Harper Business.

Dellit, T. H., R. C. Owens, J. E. McGowan, D. N. Gerding, R. A. Weinstein, J. P. Burke, W. C. Huskins, et al. 2007. “Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America Guidelines for Developing an Institutional Program to Enhance Antimicrobial Stewardship.” *Clinical Infectious Diseases* 44 (2): 159–177.

Dye, C. F. 2000. *Leadership in Healthcare: Values at the Top*. Health Administration Press.

Elwood, T. W. 2007. “The Future of Health Care in the United States.” *International Quarterly of Community Health Education* 26 (1): 5–21.

Flynn, B.B., R.G. Schroeder, and S. Sakakibara. 1994. "A Framework for Quality Management Research and an Associated Measurement Instrument." *Journal of Operations Management* 11 (4): 339–366.

Garson, Arthur. 2000. "The US Healthcare System 2010: Problems, Principles, and Potential Solutions." *Circulation* 101 (16) (April 25): 2015–2016. doi:10.1161/01.CIR.101.16.2015.

Gray, J. A.M. 1997. *Evidence-based Healthcare: How to Make Health Policy and Management Decisions*. Churchill Livingstone New York.

Jewell, K., and L. McGiffert. 2009. "To Err Is Human—to Delay Is Deadly." *Austin, TX, Consumers Union*.

Kenney, Charles. 2010. *Transforming Health Care: Virginia Mason Medical Center's Pursuit of the Perfect Patient Experience*. 1st ed. CRC Press.

Kohn, Linda T. 2000. "To Err Is Human : Building a Safer Health System."

Kohn, L. T., J. M. Corrigan, and M. S. Donaldson. 2001. "Crossing the Quality Chasm: a New Health System for the 21st Century." *Washington, DC: Committee on Quality of Health Care in America, Institute of Medicine*.

Kovner, A. R., D. J. Fine, R. D'Aquila, and Association of University Programs in Health Administration. 2009. *Evidence-based Management in Healthcare*. Health Administration Press.

Leape, Lucian L., and Donald M. Berwick. 2005. "Five Years After To Err Is Human What Have We Learned?" *JAMA: The Journal of the American Medical Association* 293 (19) (May 18): 2384–2390. doi:10.1001/jama.293.19.2384.

Levin-Scherz, J. 2010. "What Drives High Health Care Costs—and How to Fight Back?" *Pediatrics* 8: 4.

Levit, K., C. Smith, C. Cowan, H. Lazenby, A. Sensenig, and A. Catlin. 2003. "Trends in US Health Care Spending, 2001." *Health Affairs* 22 (1): 154–164.

Marley, Kathryn A., David A. Collier, and Susan Meyer Goldstein. 2004. "The Role of Clinical and Process Quality in Achieving Patient Satisfaction in Hospitals." *Decision Sciences* 35 (3) (August 1): 349–369. doi:10.1111/j.0011-7315.2004.02570.x.

McGlynn, E. A., S. M. Asch, J. Adams, J. Keesey, J. Hicks, A. DeCristofaro, and E. A. Kerr. 2003. "The Quality of Health Care Delivered to Adults in the United States." *New England Journal of Medicine* 348 (26): 2635–2645.

McGuire, E., and S. M. Kennerly. 2006. “Nurse Managers as Transformational and Transactional Leaders.” *Nursing Economics* 24 (4): 179.

Meyer, Susan M., and David A. Collier. 2001. “An Empirical Test of the Causal Relationships in the Baldrige Health Care Pilot Criteria.” *Journal of Operations Management* 19 (4) (July): 403–426. Doi:10.1016/S0272-6963(01)00053-5.

Porter, M.E. 2009. “A Strategy for Health Care Reform—toward a Value-based System.” *New England Journal of Medicine* 361 (2): 109–112.

Porter, M.E., and E.O. Teisberg. 2006. *Redefining Health Care: Creating Value-based Competition on Results*. Harvard Business Press.

———. 2007. “How Physicians Can Change the Future of Health Care.” *JAMA: The Journal of the American Medical Association* 297 (10): 1103–1111.

Shortell, S. M., and S. J. Singer. 2008. “Improving Patient Safety by Taking Systems Seriously.” *JAMA: The Journal of the American Medical Association* 299 (4): 445–447.

Singer, S. J., D. M. Gaba, J. J. Geppert, A. D. Sinaiko, S. K. Howard, and K. C. Park. 2003. “The Culture of Safety: Results of an Organization-wide Survey in 15 California Hospitals.” *Quality and Safety in Health Care* 12 (2): 112–118.

Singer, Sara J., and Stephen M. Shortell. 2008. “Improving Patient Safety by Taking Systems Seriously.” *JAMA : the Journal of the American Medical Association* 299 (4) (January 30): 445–447. doi:10.1001/jama.299.4.445.

Spinelli, R. J. 2006. “The Applicability of Bass’s Model of Transformational, Transactional, and Laissez-faire Leadership in the Hospital Administrative Environment.” *Hospital Topics* 84 (2): 11–19.

2. Objectives and Hypotheses

2.1. Factors that influence hospitals performance

Despite the fact that extensive resources are expended to investigate the current state of the U.S. hospital industry, little knowledge exists about drivers of hospital performance (Boyer et al. 2012). To address these shortcomings, the following research questions were proposed: 1) what are the driving forces behind hospital performance (quality of care measures)?; 2) has process management (e.g. lean management, Womack 2009) an impact on hospital performance?; 3) has modern management (Womack 2009) an impact on hospital performance?; 4) do organizational traits influence hospital performance?; and does leadership impact hospital performance? To test for the influence of these factors, the following null hypotheses were created:

$H1_0$ *Process Management has no impact on hospital performance.*

$H2_0$ *Modern Management has no impact on hospital performance.*

$H3_0$ *Organizational traits have no impact on hospital performance.*

$H4_0$ *Leadership has no impact on hospital performance.*

2.2. Leadership traits of chief executive officers (CEOs)

The link of leadership and hospital performance is poorly understood and was selected for in-depth analysis. Only limited research has dealt with leadership traits and hospital performance, and most of these efforts have focused on leadership and employee motivation (Robbins et al. 2001; Dye 2000). To lighten these shortcomings, we investigated if CEOs’ leadership traits differ among lean, high, and low performing hospitals. Thus, our null hypotheses are:

H5$_0$ *There is no difference in CEO traits between lean and low performing U.S. hospitals.*

H6$_0$ *There is no difference in CEO traits between high and low performing U.S. hospitals.*

H7$_0$ *There is no difference in CEO traits between high and lean performing U.S. hospitals.*

2.3. Management systems and hospital performance

Another area of interest is the link of management systems and hospital performance. Evidence exists (Institute for Healthcare Improvement 2012; Boyer and Pronovost 2010; Meyer and Collier 2001) that different management systems provide a potential solution to improve the quality of care provided by U.S. hospitals. However, little knowledge exists about the differences of specific management system factors. Thus, to tackle this lack of insight, this research investigated differences in hospital performance due to the management system factors employed. Thus, the null hypotheses tested are:

H8$_0$ *There is no difference in management system factors between lean and low performing U.S. hospitals.*

H9$_0$ *There is no difference in management system factors between high and low performing U.S. hospitals.*

H10$_0$ *There is no difference in management system factors between high and lean performing U.S. hospitals.*

2.4. References

Boyer, K.K., J. Gardner, and S. Schweikhart. 2012. “Process Quality Improvement: An Examination of General vs. Outcome-specific Climate and Practices in Hospitals.” *Journal of Operations Management*.

Boyer, K.K., and P. Pronovost. 2010. “What Medicine Can Teach Operations: What Operations Can Teach Medicine.” *Journal of Operations Management* 28 (5).

Dye, C. F. 2000. *Leadership in Healthcare: Values at the Top*. Health Administration Press.

Institute for Healthcare Improvement. 2012. “White Paper, Lean Principles, Throughput Time, Lean Thinking, Kanban, Muda, Value Stream, A Priori, Kaizen, Takt Time, Lean Management Trystorm,” http://www.ids-healthcare.com/Common/Paper/Paper_51/Going%20Lean%20in%20Health%20Care1.htm.

Meyer, Susan M., and David A. Collier. 2001. “An Empirical Test of the Causal Relationships in the Baldrige Health Care Pilot Criteria.” *Journal of Operations Management* 19 (4) (July): 403–426. Doi:10.1016/S0272-6963(01)00053-5.

Robbins, C. J., E. H. Bradley, M. Spicer, and others. 2001. “Developing Leadership in Healthcare Administration: a Competency Assessment Tool.” *Journal of Healthcare Management* 46: 188–202.

Womack, J. P. 2009. “Womack Modern vs. Lean Management” August 25. http://www.slideshare.net/cmarchwi/womack-modern-vs-lean-management.

3. Literature Review

3.1. Lean Management

3.1.1. Introduction

During the 1970s, a combination of increasing government regulations (mandating improved safety, better energy efficiency, and enhanced emissions control, among other things), high oil prices, and increased competition from foreign auto manufacturers severely affected the "*big three*" US auto makers, General Motors, Chrysler, and Ford (Cooney and Yacobucci 2007; Cooney et al. 2005). The impact of such regulations combined with changes in the economy on the U.S. auto industry were so severe, that Chrysler nearly collapsed (Rubenstein 1987; Blanchard 1983). The dramatic gains in market share of foreign car companies was mainly based on consumers' perception that foreign automobiles were more fuel efficient, less expensive, and of higher quality then U.S. made cars (Ramey and Vine 2005). At that time it was mostly the Japanese auto manufacturers who seemed to be unbeatable (Womack et al. 1991; Plunkert 1990; Imai 1986). In fact, by 1980, Japan had taken over as the largest automobile producing nation in the world (Cooney and Yacobucci 2007; Ramey and Vine 2005) Cars exported from Japan to the U.S. accounted for a large portion of annual car sales in the U.S. In the 1980s, every fourth car sold in the U.S. was imported (Cooney and Yacobucci 2007; Singleton 1992; Plunkert 1990). In response, the United Auto Workers (UAW), the U.S. car manufacturers workers' union and the "*big three*" US auto makers demanded that the U.S. government would help to curtail the flood of auto imports from abroad. The U.S. government finally got the Japanese automakers to enter into a voluntary restraint agreement (e.g., a system of import quotas) that limited the numbers of cars that could be imported to the United States annually (Ford 2009; Cooney and Yacobucci 2007; Singleton 1992; Rubenstein 1987). This trade barrier, however, resulted in the establishment of foreign-owned car production plants in the U.S. to forego the import quota. Also, the import quota forced the Japanese auto manufacturers to be innovative as to how to maximize the benefits achieved from the limited number of course that they still could export to the U.S. As a result, the Japanese developed and introduced luxury cars (Acura, Lexus, and Infiniti); as such cars carry higher profit margins and thus were financially more interesting to be exported to the U.S. Unfortunately for the U.S., the success story of the Japanese car manufacturers mirrored successes of other foreign industries in trades like steel, textiles, electronics, or shipbuilding, to name a few. By the 1990s, the U.S. government had to acknowledge that the U.S. manufacturing industries had fallen behind other, international suppliers of goods in respect to price and quality (Cooney et al. 2005; Plunkert 1990; Rubenstein 1987).

Given the challenges faced by U.S. manufacturers in the late 1970s and the 1980s, a five year, 5 million dollar global research project to explore and understand **different production methods** in the automotive industry worldwide was launched in 1984 by the Federal Government. The project was carried out by the International Motor Vehicle Program (IMVP) hosted at the Massachusetts Institute of Technology (MIT). Results from this project are presented and discussed in the national bestseller *"The Machine that Changed the World – How Japan's Secret Weapon in the Global Auto Wars will Revolutionize Western Industries* (Womack et al. 1991)." In their book, Womack et al. (1991) describe in-depth the **differences between mass (batch-and-queue) and lean production** in the automotive industry. The authors acknowledge and emphasize the superiority of Japanese manufacturing and management techniques. The study showed that Japanese companies, especially the Toyota Corporation, were prospering because they invented, applied, and continuously improved *"lean production methods* (Womack et al. 1991; Krafcik 1988)." IMVP researcher John Krafcik, who travelled to fifteen countries and surveyed and benchmarked more than 90 auto assembly plants in what is considered *"…The most comprehensive industrial survey ever undertaken …* (Womack et al. 1991, p. 6)," coined the term "*LEAN*" to describe these powerful Japanese manufacturing and management methods. Womack et al.'s (1991) research conveyed that auto assembly plants applying lean principles required less human effort, half the manufacturing space, less than half the inventory, while producing fewer defects yet being capable to produce an even *"… Greater and ever growing variety of products …*(Womack et al. 1991, p. 13)" compared to auto assembly plants practicing traditional mass production. In fact, lean manufacturers combine and adapt mutually exclusive advantages from mass and craft production, while avoiding the inflexibility of mass production as well as the high costs associated with craft production. However, the most remarkable difference in manufacturing philosophy that the IMVP research documented (Takeuchi et al. 2008; Womack et al. 1991) was that mass producers set imperfect goals, whereas lean producers do not settle for less than perfection, e.g., they set their true north towards perfection – zero inventory, zero defects, zero machine changeover time, endless variety of products, and zero accident rates (Takeuchi et al. 2008; Womack et al. 1991).

History explains part of the emergence of the lean production system. Automotive manufacturers in Japan, the country of origin of the lean production system, had to deal with a variety of difficulties after World War II (Shimokawa and Fujimoto 2009; Monden 1998; Ohno

1988). The Japanese market, compared to other countries and surely compared to the vast U.S. market, was small and demanded a variety of cars, e.g., small cars suitable for high gasoline prices and crowded inner cities, and luxury cars for the rich and for government officials (Womack et al. 1991). New labor laws allowed workers to negotiate better conditions of employment and therefore made labor more expensive. The lack of guest workers, who were the main work force in mass production companies in the Western world (Shimokawa and Fujimoto 2009; Womack et al. 1991) made it difficult to fill existing manufacturing jobs. Furthermore, the war-torn economy after World War II in Japan was short on capital and foreign exchange, making the purchase of state of the art manufacturing equipment and technology impossible. In addition, foreign countries and their auto manufacturers were ready to defend their markets to foreign imports (Womack and Jones 2003; Womack et al. 1991). Given this scarcity of material, labor, and money, Japanese companies were needing to find new approaches to manufacturing to produce for mass markets (Shimokawa and Fujimoto 2009; Krauss 1992; Womack et al. 1991).

Japan, being occupied by allied powers after World War II, however, was also benefiting from the contributions of the U.S. Government to rebuild and stabilize the domestic economy (Krauss 1992). Walter Deming, an expert in quality control techniques, who was involved in planning the census in Japan after World War II, was asked by the Japanese Union of Scientists and Engineers (JUSE) to train engineers and managers in statistical process control (SPC) and other quality techniques (Tsutsui 1996; Deming 1967). The main theme of his lectures and coaching's was that quality would reduce costs while increasing productivity (Tsutsui 1996; Aguayo 1991; Walton 1986; Deming 1967). And indeed, Japanese companies that followed his advice and knowledge experienced high levels of productivity and quality at lower costs. Thus, the evolution of lean manufacturing and management in Japan into a powerful competitive tool evolved from difficult external conditions in a war-ravaged nation combined with the innovative spirit of humans determined to overcome these challenges. However, to fully understand the origins of lean it is necessary to go farther back in time. The following sub-chapter will point out events in human and industrial development that supported the evolution of lean.

3.1.2. The origins of Lean

The evolution of Lean Management is based on breakthroughs throughout the history of industrial development. While drawing a line into the past to identify the real starting point for lean is challenging if not impossible, the year **1452** at the Venetian Arsenal in Italy, was where the first **standardized processes** in ship construction were applied to push a boat of standard design through standard assembly stations within a day (Lean Enterprise Institute 2010; Davis 2007; Schmenner 2001). Centuries later, in **the late 1760s**, the concept of **interchangeable parts and standardized designs** was more formally developed by the French general Jean-Baptiste Vacquette de Gribeauval to expedite battlefield repairs (Moravcsik 1991; Falk 1964; Cavé 1953). In **1799** the concept of interchangeable parts then was perfected and used by Eli Whitney, known as the inventor of the cotton gin, to manufacture and sustain the supply of thousands of muskets to the U.S. Army at low prices (Woodbury 1960; Green and Whitney 1956; Mirsky and Nevins 1952). **1799** was also the year of the first **automatic production**. Rope blocks for ships were produced at the Portsmouth Dockyard in England with no manual labor recorded using water-powered machinery (LEI 2010; National Portrait Gallery 1862). Thus, the second half of the 18th century represents the development of a manufacturing system that allowed mass production and repair of products with interchangeable parts at prices customers could afford.

First instances of **cellular manufacturing** can be traced back to the **time between 1813 and 1830**, where Thomas Blanchard at the arsenal in Springfield, CT arranged 14 machines in a cellular arrangement in a room to produce gun stocks for rifles by moving one piece at a time from machine to machine without manual labor for processing involved (LEI 2010; Brown 2007). A novel set-up of process steps resulted later in a patented lathe to produce an entire wooden gun stock without the piece having to be moved around (Brown 2007; Moore and Goss 1980; Hammond 1930).

In the **1880s**, the **first moving line** (conveyor) was used to progressively move carcasses from meat packer to meat packer in order to remove the carcasses' meat from the bones - known as moving disassembly line (LEI 2010; Cooper et al. 1986). The moving line and, maybe even more notable, the breakdown of a complex task into simple, repetitive tasks, allowed the replacement of skilled butchers by unskilled workers (LEI 2010; Ufkes 1995; Cooper et al. 1986; Walsh 1977).

By **1890**, Frederick Taylor coined the term **"Scientific Management,"** also called Taylorism (Taylor 2005; Wren 2004)**.** Scientific Management is a theory on analyzing and synthesizing manual work (Urwick and Brech 1949; Taylor 1911a). Scientific Management is aimed at discovering and implementing the best way to do a job to gain the highest possible efficiency and worker productivity. Taylor thus introduced **best practices and standardization of work tasks** into the arsenal of industrialists. The standardization of work tasks went as far as to the dictum that doing and thinking was strictly separated and none of the shop floor jobs included both (Locke 1982; Urwick and Brech 1949; Taylor 1911b). Taylor's scientific management postulated to first design the best sequence of process steps in which a job could be done; then introduced a piece-rate pay bonus system and documented the production route for every part (Lean Enterprise Institute 2010; Lean Enterprise Institute 2008). Taylor also introduced "Standard Cost Accounting" methods, e.g., the allocation of overhead costs to labor and machine hours, which is seen as a basic management tool in the era of **mass production** (Drucker 1990; Locke 1982). In the early **1900s**, Frank Gilbreth added process charting and **motion studies** to scientific management theory (Barnes and Barnes 1958). By analyzing the motion and habits of each worker, Gilbreth increased the efficiency of the worker (Barnes and Barnes 1958; Gilbreth and Gilbreth 1919). Indeed, Gilbreth's method of increasing worker efficiency using motion studies and process charting is seen as the beginning of the continuous improvement movement (Barnes and Barnes 1958).

While progress was being made on how to help workers maximize their productivity, Sakichi Toyoda, in 1902, invented a device to detect broken threads in looms (Shimokawa et al. 2009). In Sakichi's system, when a broken thread was detected, the loom automatically stopped to prevent the production of defective clothes (Ohno 1988). Further improvements of the loom allowed multi-machine operations by a single worker. Sakichi's idea was the origin of the creation of systems or devices that prevent below-par production from happening, something referred to as **"Jidoka"** in lean (Lean Enterprise Institute 2010; Shimokawa et al. 2009).

Around **1908**, Henry Ford started the production of the "Model T," a modular car with **part interchangeability** (using a standard gauging system). The Model-T was limited to one color and one specification, so that all parts of the chassis were identical (Drucker 2000; Gartman 1979). Henry Ford also assigned single tasks to assemblers, who then performed those tasks while moving with each vehicle on the assembly line (Lean Enterprise Institute 2010; Womack 2002; Ford 2009). In **1913**, when Henry Ford introduced the **continuous-flow assembly line** for the Model T, Ford placed machines for the pre-fabrication of parts, which were producing solely one part, in a sequence along the assembly line so that parts were supplied exactly at the consumption rate of the assembly line (Ford et al. 1988; Abernathy and Clark 1985; Jardim 1970). The introduction of Ford's moving assembly line resulted in considerable productivity improvements and induced a sizeable decrease in production costs, making sensationally low sales price possible while providing unusually high pay to the company's workers'. Ford's continuous-flow assembly line also reduced the amount of human effort needed to assemble a vehicle since workers remained at one workstation and repeated only a limited number of tasks, leading to steep gains in experience and productivity (Ford 2009; Womack et al. 1991; Ford et al. 1988; Gartman 1979). Ford named this system the **"mass assembly manufacturing system,"** which evolved out of the "craft production system" that Ford was using when he started to produce the Model T back in 1908 (Lean Enterprise Institute 2010; Ford 2009; Womack 2002; Williams et al. 1993). However, Womack (2002) pointed out that the truly revolutionary change for industrial development was that Ford produced a car that was designed for manufacture and was seen as user-friendly by customers. Indeed, Womack et al. (1991) did not see the key to mass production in the moving assembly line. They rather see it in *"…The complete and consistent interchangeability of parts and the simplicity of attaching them to each other* (Womack et al. 1991, p. 27)."

On the other side of the Pacific, in Japan in **1924**, the first G-type loom was employed at Toyoda Automatic Loom Works (or known as Toyoda Boshoku). The special feature of this loom was "*a zero-time shuttle changeover* (Lean Enterprise Institute 2010)," which allowed a continuous run of the looms. The zero-time shuttle changeover was later recognized as the origin of the **quick changeover philosophy** at Toyota Motor Company (Lean Enterprise Institute 2010; Shimokawa and Fujimoto 2009).

Then, in the **1930s**, the term **"takt time"** was pioneered in the German aircraft-industry to synchronize the movement of major aircraft or airframe sections to the next assembly station at set times, like to a beat (the German word "takt" describes the duration of a recurring cycle, Shimokawa et al. 2009; Holweg 2007; Womack and Jones 2003; Monden 1998). This idea then was taken and transferred to Japan by Mitsubishi (a company that worked in cooperation with the German aircraft industry prior to World War II) and was later embraced by Toyota (Furst 2007; Leone and Rahn 2002; Monden 1998; Davies n.a.).

In **1937**, Kiichiro Toyoda, the brother of Sakichi Toyoda (owner of the loom factory), established the **Toyota Motor Company** with the idea to introduce **just-in-time** delivery of automotive and engine parts (Shimokawa et al. 2009; Holweg 2007; Fujimoto 1999). However, Toyoda's just-in-time approach was undermined by a lack of supplier relations and basic stability in Toyota Motor Company's production processes (Shimokawa et al. 2009; Womack et al. 1991). As Kiichiro Toyoda and others studied mass production at Ford in the **1930s**, and again after World War II, it occurred to them that simple modifications of the **Ford Production System** might make it possible to maintain stable process flows while providing customers with a large variety of automobiles (Womack, 2002). Kiichiro Toyoda and his colleagues also found the "**Training within Industry**" system developed by the U.S. Department of War between **1941 and 1945**, which is based on job instructions, job methods, and job relations to train workers, helpful. These methods, once introduced to Japan, were incorporated in Toyota's set of standard work (Lean Enterprise Institute 2010; Dinero 2005; Dooley 2001). In **1950,** Eiji Toyoda (the nephew of Kiichiro Toyoda) and Taiichi Ohno (production manager), concluded that a mass production system would not work in Japan because of the smaller domestic market requiring fewer cars but more variety (Shimokawa et al. 2009). Thus, Eiji Toyoda and Taiichi Ohno started to develop a manufacturing system that relied on Ford's thinking that was decidedly adapted to Japanese culture. Thus, the **Toyota Production System (TPS)** was born (Shimokawa et al. 2009; Monden 1998; Womack et al. 1991)**.** Then, in the **1950s**, Taiichi Ohno, using the early versions of the TPS as his guide, developed additional systems like "**Kanbans**" and "**Supermarkets**" to implement **just-in time** delivery of parts while initiating a change from push to pull production (Shimokawa et al. 2009; Monden 1998; Womack et al. 1991). At the same time, the contributions to quality management by Deming, Ishikawa, and Juran (Lee 2008; Imai 1986; Ishikawa and Lu 1985; Deming 1967) added to the basic principles of the TPS to what became today's **quality management** movement also known as **total quality control (TQC**, Shimokawa et al. 2009). Especially Deming's work focused on teaching managers how to eliminate waste and improve quality, while improving the competitive position of businesses through **statistical control** (Tsutsui 1996; Aguayo 1991; Deming 1967). Ishikawa's contributions to quality management in Japan were focused on quality control systems to regulate and control production processes (Ishikawa and Lu 1985), while Juran worked on design for quality and on quality problems to improve overall manufacturing performance using root cause analysis methods (Gryna et al. 2005; Juran 1988).

Other selected breakthrough moments in the evolution of Lean Management (which up to this point in time was synonymous with TPS) happened during the 1960s. In fact, **the 1960s** were critical in the gradual emergence of a new **management system at Toyota**, including new approaches in customer support, supplier development, leadership, internal training, problem solving, product and process development, and quality (Lean Enterprise Institute 2010; Womack and Jones 1996; Womack and Jones 1994; Womack et al. 1991). Also, at the beginning of the **1960s**, the Japanese Union of Scientists and Engineers announced the creation and annual awarding of the Deming Prize to encourage companies (originally the Deming Prize was restricted to Japan) to foster the use of statistical control tools and the application of Deming's **Plan-Do-Check-Act** cycle (PDCA) of continuous improvement (Lean Enterprise Institute 2010; Walton 1986). In **1965**, Toyota won the Deming Prize after incorporating quality as a key element of their management system combined with intense training in **problem solving** following Deming's PDCA cycle (Lean Enterprise Institute 2010).

In **1973**, Cho, Sugimori and others wrote the first Toyota production manual for internal use (Sugimori et al. 1977b). This was followed by the **dissemination** of the TPS trough publications and the first academic investigations (MIT) in the years **1977 to 1979** (Lean Enterprise Institute 2010; Monden 1998; Womack et al. 1991). A comprehensive description and in-depth analysis of the entire TPS was translated and published in **1982** under the title the *"Toyota Production System"* by Monden (1998). A year later, in **1983**, under pressure from the U.S. Government, Toyota started a joint-venture with General Motors (GM) and formed the New United Motors Manufacturing (NUMMI) subsidiary to share the Toyota Production System knowledge with competitors abroad (Towill 2007; Lander and Liker 2007; Inkpen 1998). In **1987**, International Motor Vehicle Program (IMVP) researcher John Krafcik coined the term **"*LEAN,*"** which described the comprehensive production and management method that the Toyota Motor Corporation pioneered. Then, in **1990**, Womack et al. (1990) published the book "*The Machine that changed the world*," which revealed the differences between traditional mass production systems in the western world and lean production systems in Japan. Womack and Jones, in **1996,** followed up on their thoughts with the book "Lean Thinking," mainly describing critical lean elements such as the five lean principles (1. Identify value, 2. Map the value stream, 3. Create flow, 4. Establish pull, 5. Seek perfection; Womack and Jones 1996). Since then, the exploration and dissemination of insights of **Lean Principles** and the **Toyota Production System (TPS)** is ongoing. Some of the more pertinent publications, among others, are: Learning to See - Value Stream Mapping (Rother and Shook 1999), 5S (Hirano 1996), Creating Level Pull (Smalley 2004), Lean Solutions (Womack and Jones 2005), and Lean Product and Process Development (Ward 2007), just to name a few. However, starting in **2006 to the present**, the focus of publications and books shifted from **Lean Tools** towards **Lean Management**, e.g., instead of describing tools that could be employed, the focus shifted to getting the right things done, managing to learn, and to issues related to strategy deployment (Hoshin Kanri, Lean Enterprise Institute 2008; Womack, 2006).

Given the evolution of lean based on the breakthrough moments discussed above, the following paragraphs will discuss the unique Japanese manufacturing techniques that were originated at the Toyota Motor Corporation and which are typically referred to as the Toyota Production System (TPS). These techniques are at the core of the foundation of lean and thus, a discussion of lean principles in detail will follow. A discussion of applications of lean knowledge across industries and nations will conclude the chapter.

3.1.3. The Toyota Production System (TPS)

The Toyota Production System (TPS), is known by various names (Emiliani 2006) such as "Lean Production (Emiliani 2006; Womack et al. 1991)," the "Toyota Production System (TPS, Liker 2003; Ohno 1988)," the "Toyota Management System (Monden 1998)," or "Lean Management (Emiliani 2006)." For the following discussion, whenever applicable, the term "Toyota Production System (TPS)" is used.

The success of Toyota can be attributed to the ideas summarized in the Toyota Production System (TPS), a manufacturing system that enabled the Toyota Motor Corporation to become the world's largest motor vehicle producer in 2007 (Lean Enterprise Institute 2010; Takeuchi et al. 2008; Liker 2004a; Liker 2003). However, Toyota's drive to become the world's largest motor vehicle producer required the company to sacrifice some of Toyota's renowned quality achievements (Shirouzu et al. 2010). This lack of focus on the essential tenets of the TPS (focus on the customer, continuous improvement, quality) eventually resulted in a dramatic increase in quality issues in Toyota's products, thereby increasing the number of vehicles recalled in 2009 and 2010 (Heller and Darling 2011). Jim Press, a former Toyota executive, stated that *"The root cause of Toyotas problems is that the company was hijacked, some years ago, by anti-family, financially oriented pirates* (Shirouzu et al. 2010 p.2)*"* and that those executives *"… Did not have the character to maintain a customer-first focus …* (Shirouzu et al. 2010 p.2)*"* like the Toyoda family had done in the past. This changed in 2009, when a family member, Akio Toyoda, took over as president and CEO of the Toyota Motor Corporation. Akio Toyoda instilled renewed focus on the customer, continuous improvement, and quality. Indeed, Akio did take the blame for past mistakes and focused internally on managing the crisis while adhering to the principles of the Toyota Production System (Andrews et al. 2011; Heller and Darling 2011; Shirouzu et al. 2010). Despite the crisis, Toyota had to take on even more challenges. Production cutbacks in the aftermath of the tsunami in Japan and the flooding of their manufacturing facilities in Thailand let net profits decline by 13.5 percent (NYTimes 2012).

The Toyota Production System (TPS), as discussed previously, is based on numerous breakthrough innovations throughout Toyota's history. Taiichi Ohno, who is widely credited as the major force behind the comprehensive development of the TPS in the 1960s and 70s (Liker 2004; Womack et al. 1991; Ohno 1988) is often referred to as the father of the TPS (Shimokawa and Fujimoto 2009). However, Shimokawa and Fujimoto (2009) also state that the TPS is not the Ohno Production system and that, in fact, the TPS rests on two pillars coined by Sakichi Toyoda (owner of the loom business before WWII) and Kiichiro Toyoda (founder of Toyota). One pillar is Sakichi Toyoda's "Jidoka," e.g., the prevention of the production of defective parts and the other pillar is Kiichiro Toyoda's "Just-in-time" philosophy, e.g., the production of only what is needed, when it is needed, and at the exact quantity demanded (Shimokawa et al. 2009; Ohno 1984). In an effort to represent the elements of the TPS to employees, customers, and suppliers, Toyota uses the structure of a house (Figure 1, Shimokawa et al. 2009; Liker 2003). Fujio Cho, who created this representation of the TPS, wanted to visualize and stress that the TPS can only succeed if applied as a comprehensive system and not as a piecemeal combination of elements (Lander and Liker 2007; Liker and Meier 2005; Liker 2004; Liker 2003; Monden 1998).

Figure 1 - The Toyota Production System (Liker 2003, p.33)

The TPS-house contains a foundation, two supporting columns, a roof, and a middle section, symbolizing a strong structural system standing on solid foundations. Continuous improvement is at the core of the house. However, Liker (2003) explains that each of the elements is crucial to the entire structure, with the elements reinforcing each other.

The roof of the TPS house contains the **high level goals of Toyota**, e.g., to deliver the best quality at the lowest cost with the shortest lead time, while maintaining high employee safety and employee moral (Liker 2003). These goals are supported by the two columns labeled “Just in Time (JIT)” and “Jidoka” (Shimokawa et al. 2009), as shown in Figure 1.

The first column **"Just-in-Time"** stands for delivering the right parts in the right quantity at the right time to the right place (Ohno and Mito 1988). The goal of the Just-in-Time philosophy is to improve return on investment by reducing raw material, in-process, and finished goods inventory and associated carrying costs (Ohno and Mito 1988; Schonberger 1982). Monden (1998) and Levy (1997) both agree that JIT production is the backbone of the Toyota Production System. JIT, also referred to as **"make to order (MTO)"** production, utilizes a **"pull system,"** working from the customer upstream. Costumer demand, which generates the order, sends the first signal for the need of one additional unit to shipping and final assembly. As a result, the product gets pulled out of the final assembly process for delivery to satisfy customer demand. Withdrawing one unit from final assembly triggers the preceding processes to replenish the parts that final assembly withdrew to make the product (Balle 2005; Liker 2003; Monden 1998; Ohno 1988). The process of withdrawing and replenishing by the proceeding process goes on as each process pulls the required parts from the preceding process further upstream. Shimokawa and Fujimoto (2009, p.xiii) describe the JIT manufacturing process as *"… Each process withdrew material from the previous process only to replace material it had actually used, and each process generated additional output only to replace material that the following process had withdrawn."* To make such a JIT system manageable, Kanban systems, a Japanese word meaning card in English, are used. Thus, a Kanban system is a manual information system that is visible to all employees involved in a process and is used to control the number of parts to be produced in every process step (Monden 1998). Such Kanban systems coordinate the whole material delivery in a JIT system. Taichii Ohno mentioned that the reason for adopting a Kanban system was Toyota's *"…Desire to reduce the administrative* *burden of running a factory. We were looking for ways to reduce paperwork* (Shimokawa et al. 2009, 16)*.”* Kanbans, if correctly used, are useful in reducing WIP in a production plant. Furthermore, Kanban systems enable one-piece-flow to make one product at a time at the rate of customer demand (Linck and Cochran 1999; Monden 1998; Davies n.a.). The rate of customer demand is expressed by the “Takt time” as shown in equation 1 (REFA, 2002).

$$\textbf{Takt Time} = \frac{\textbf{Available worktime per day}}{\textbf{Costumer demand per day}} \tag{1}$$

The purpose of Takt time is to match the pace of production with customer demand (Lean Enterprise Institute 2008; Womack and Jones 2004; Rother and Shook 1999). For example, if the actual available work time per day is 400 minutes and customer demand is 200 units per day, the takt time is one product every two minutes. Takt time combined with JIT minimizes work in process inventory (WIP) to the degree that process instabilities become visible. However, if JIT is done right, buffer inventory does not exist and thus process instabilities have severe consequences. Thus, JIT reinforces “Jidoka,” the requirement to have built-in quality as represented by the second pillar in the TPS house (Figure 1, Shimokawa et al. 2009; Emiliani 2007; Balle and Balle 2005; Monden 1998).

The second column in the TPS house called **“Jidoka”** (Figure 1) stands for making problems visible and never letting a component with a defect pass to the next process (Liker 2003; Monden 1998; Ohno 1988). Toyota uses machines that are "autonomous," e.g., machines where defective parts are automatically detected and upon which occurrence the machine stops. The first loom with a device to detect broken threads that was used by Sakichi Toyoda in 1902 incorporated Jidoka (Shimokawa and Fujimoto 2009). To develop autonomous machines, Toyota employees have to clearly define acceptable and non-acceptable quality or conditions (Shimokawa et al. 2009; Ohno and Mito 1988; Ohno 1984). The outcome of such definitions and its supervision by the operators or machines leads to "in station quality" (Liker 2004; Ohno and Mito 1988; Ohno 1984). Each jidoka-driven stop is visualized on the "Andon Board," a visual management board that highlights the status of the operation (Furuya 2006; Liker 2003; Monden 1998; Taiichi Ohno 1988). Ohno (1988, p. 6) describes this autonomation process as "*…Automation with a human touch*." According to Shimokawa et al. (2009), Ohno reported that the Toyota Motor Company adopted the line-stop system in the late 1960s, a time when good sensors to supervise the process and parts were not available (Shook 2010; Shimokawa et al. 2009; Monden 1998). Therefore, back then, employees stopped the conveyor rather than having the line stop automatically. Thus, when abnormal conditions occurred, the assembly line worker at Toyota had to pull a robe lightning an Andon light, signalizing that something was wrong (Womack and Jones 2004). Once the Andon light went on, the team leader would come and help solve the root problem (Liker and Meier 2005; Liker 2004; Monden 1998). If the problem was solved within takt time, the robe was pulled again and the assembly line did not stop. If the root cause of the problem could not be solved within takt time, the entire conveyor line stopped and would only restart after the root cause for the problem was resolved (Shimokawa et al. 2009; Lean Enterprise Institute 2008; Sugimori et al. 1977a). Thus, Jidoka highlights problems because the work stops when abnormal conditions occur. Jidoka therefore is essential for any organization that strives for perfection using continuous improvement (Liker 2004a; Shimokawa et al. 2009).

The foundation of the Toyota house, as shown in Figure 1, contains four elements, Heijunka (leveled production); stable and standardized processes; visual management, and the Toyota way philosophy (Liker 2003). All four elements are necessary in conjunction to provide a stable foundation for the Toyota Production System (TPS) to be successful. The element “leveled production” (Heijunka) refers to leveling the type and volume of production over a given period of time. Production leveling achieves minimum inventories and hence reduces capital costs, manpower needed, and makes shorter lead times throughout the value chain possible (Monden 1998; Ohno 1988; Ohno and Mito 1988). “Stable and standardized processes” is an element of the TPS that establishes standard procedures for each process and operator. Standard procedures include the work sequence an employee has to follow within a given takt time, describes the standard inventory required to operate a process, just to name two examples. Once standard procedures are in place and visualized at the work stations, these standardized work procedures (current state) are used as a foundation for continuous improvement efforts through Kaizen events (Monden 1998; Ohno 1988). The third element of the TPS’ foundation is “visual management,” which specifies that all processes, activities, and measurements at Toyota have to be displayed visually. Visualization is an important element to make abnormalities from the standard visible and easily to spot (Holweg 2007; Liker 2004; Monden 1998). The very bottom of the Toyota-house, “philosophy,” is regarded as the most critical element of the foundation. Philosophy provides guidance to employees and to stakeholders regarding the direction and the goals of the organization (Liker and Hoseus 2010; Liker 2004).

The **central part** of the TPS-house (Figure 1) represents the employees. Employees are central to the philosophy of the TPS since only through continuous improvement by all employees can the stability and progress of the production system be attained, assured, and advanced (Liker 2003). Therefore, employees must be trained to identify waste and to solve the root cause of problems. Liker (2003) conveys that real problem solving is to find the root cause of problems (genchi genbutsu). Ohno (1988) stresses the importance of teamwork to continuously improve the processes over time, making the point that teams consisting of excellent athletes with little or no coordination do not necessarily win against teams where everyone pulls in the same direction and towards the same goal (Liker and Meier 2007; Ohno 1988). Delivering value to the customer without waste thus requires having the right people on board and each working in the right seats while everybody strives for perfection through continuous improvement (Collins 2009; Liker and Meier 2007; Liker 2003; Ohno 1988).

3.1.4. The Principles of Toyota and Lean Management

Liker, in his 2003 book "The Toyota Way," emphasizes that the Toyota Production System is not just a set of tools like Jidoka, Kanban, Just-in-time, 5S, Kaizen, and others but rather it is a sophisticated system in which all parts (Figure 1) reinforce each other and contribute to a bigger whole (Lander and Liker 2007; Liker 2003; Emiliani 2006). This sophisticated system includes culture, the understanding of individuals, and human motivation. Toyota's success is *"…Ultimately based on its ability to cultivate leadership, teams, and culture, to devise strategy, to build supplier relationships, and to maintain a learning organization* (Liker 2003, p. 6)." In "The Toyota Way," Liker (2003) describes 14 Management Principles that encompass, in his view, the "Toyota Way." He divides those 14 principles in four categories, Problem Solving, People and Partners, Process, and Philosophy into what is known as the “4P-model." A graphical representation of the model is shown in Figure 2 (Liker 2003, p. 33).

Figure 2 - The Toyota Production System Principles (adapted from Liker 2003, p.33)

A majority of companies implementing lean do focus their efforts on **second level** “process improvement” activities (Figure 2, Liker 2003; Womack and Jones 1994; Ohno 1988). Thus, their efforts focuses on principles 2 to 8 (process improvement - flow) through redesigning processes, creating flow to move information and material, leveling the workload, creating customer pull throughout their operations, eliminating waste, adjusting to build-in quality, standardizing tasks and process steps using repeatable methods, introducing visual controls, reducing reports, and using reliable technologies to support their worker (Liker 2003; Monden 1998; Ohno 1988; Schonberger 1982).

The **first category** listed by Liker (2003, Figure 2), "philosophy - long term thinking," focuses on the principle to have all management decisions based on a long-term philosophy, sacrificing short term financial goals, if necessary. Liker (2003, p. 37) describes the philosophy as: *"Work, grow, and align the whole organization toward a common purpose that is bigger than making money*." Using this long-term vision, every subsequent decision is based on the goal to generate value for the customer, the economy, and society (Pius et al. 2006; Liker 2003).

While Toyota's ultimate focus is the customer, Liker's (2003) **third category** "people and partner (Figure 2)," stresses the importance of employees and partners of an organization. The execution of principles 9 to 11 (people and partners - respect, challenge, and grow them) should be achieved by growing leaders from within the organization (Liker and Meier 2007; Liker 2004a). Growing leaders from inside the organization implies that current leaders have to be seen as role models of the company's philosophy (e.g., the foundation of the pyramid). These leaders are held responsible and accountable for training other exceptional individuals and to grow teams to work towards the common goal while following Toyota's philosophy (Liker and Convis 2011; Liker 2003). In fact, Toyota strives to treat their employees as their most valuable asset (Emiliani 2007; Liker and Meier 2007; Liker 2003; Ohno and Mito 1988). Based on this principle, Toyota invests heavily in the future of the company by investing into employee development. However, not only company employees are valued, but so are external partners and suppliers, which are tightly involved in development and training programs at the Toyota Motor Corporation (Liker and Meier 2007; Liker 2004; Spear 2004). Liker and Meier summarize Toyota's commitment to their partners as *"Respect your extended* *network of partners and suppliers by challenging them and helping them improve* (Liker and Meier 2005 p.12)."

The fourth category in Figure 2, e.g. **Category 4**, labeled "problem solving," deals with the creation of a learning organization through continuous improvement initiatives focused on solving the root causes of problems. Category 4 includes principles 12 to 14 (problem solving, continuous improvement, and learning) which describes the need for solving problems by seeing in person at the source what happens, referred to as "go and see ("*genchi genbutsu*" in Japanese)." Liker (2003) emphasizes that even senior managers and executives should go and see to understand the actual situation (called "*Gemba*" in Japanese, meaning "actual place"). Once the root cause of a problem is identified and alternative solutions have been designed, a decision as to how to solve the problem is made. Discussing the problems and possible solutions jointly with all employees is referred to as "*Nemawashi*" in Japanese. This process includes the gathering of employee ideas to broaden the range of possible solutions and to achieve consent on the path to be taken (Liker and Meier 2007; Liker 2003; Ohno 1988). To become such a learning-organization requires standardized and stable processes and the use of continuous improvement (Kaizen). Additionally, organizational knowledge has to be conserved through reflection sessions (*"hansei"* in Japanese) at key milestones. Furthermore, the development of standardized best practices, of a stable workforce, and the establishment of succession and promotion plans are critically important according to Lewis (2006) and Liker (2003).

Spear and Bowen, in 1999, described the Toyota Production System (TPS) from a different viewpoint than Liker (2003). Spear and Bowen (1999) described the TPS as a framework of four activities, also known as the "*4 rules of the TPS*." These four rules consist of 1) guide the design, 2) operation, 3) administration, and 4) improvement of all activities for all services or products within Toyota. The first rule is about the way people have to do their work at Toyota. Thus, *"All work shall be highly specified as to content, sequence, timing, and outcome* (Spear and Bowen 1999 p.3).*"* This rule specifies in detail what Toyota expects from their worker in a particular job. Thus, deviations from the specifications become instantly clear and the problem can be corrected by the worker or supervisor. The second rule is *"Every customer-supplier connection must be direct and there must be an unambiguous yes-or-no way to send requests and receive responses* (Spear and Bowen 1999 p.3).*"* The rule describes the supplier-customer relationship between each person and applies internally as well as externally. In fact, this description specifies exactly who is responsible to provide whom with a specific good or service, in what quantity, and at the right time. This rule is applied throughout the entire value chain and includes all stakeholders involved. The third rule is *"The pathway for every product and service must be simple and direct* (Spear and Bowen 1999 p.3).*"* Rule 3 describes explicitly how the value chain has to be constructed to allow every product and service to flow along a specified and simple path. Finally, the fourth rule is *"Any improvement must be made in accordance with the scientific method, under the guidance of a teacher, at the lowest possible level in the organization* (Spear and Bowen 1999 p.3).*"* This rule specifies how improvements have to be made. There is more to continuous improvement than just identifying and fixing problems. At Toyota, people explicitly get taught on the job how to design improvement efforts. Most notably, Toyota's improvement efforts are always structured as experiments with a clearly articulated and verifiable hypothesis (the scientific method). Using this method, clear expectations as to a specific outcome are documented (Towill 2007; Spear and Bowen 1999). Rule number four also describes specifically who is responsible for the improvement. At Toyota, workers do the improvements at their workstations with assistance of their supervisors. Supervisors do improve their work on their own with assistance of their managers and so forth (Spear 2004; Spear and Bowen 1999). Liker (2003) points out that, *"Lean is not about imitating the tools used by Toyota in a particular manufacturing process. Lean is about developing principles that are right for your organization and diligently practicing them to achieve high performance that continues to add value to customer and society* (Liker 2003, p. 41)." Several authors also stress that, although the initial focus in lean thinking has been the shop floor, the Toyota principles apply to any organization (Womack and Jones 2003; Liker 2003; Ohno 1988). In fact, Womack and Jones (LEI 2010) state: "*A popular misconception is that lean is suited only for manufacturing. Not true. Lean applies in every business and every process. It is not a tactic or a cost reduction program, but a way of thinking and acting for an entire organization*."

However, based on Womack and Jones' (LEI 2010) insights into the Toyota Production System, five principles describe a thought-process for guiding company transformations from mass production to lean production. A visual representation of these five principles is shown in Figure 3.

Figure 3 – Five Lean Principles (adapted from Womack and Jones 2004)

The first principle, **Identify value**, requires an entity to identify the value of a company's product or service from their customers' perspective. A company needs to clearly understand who its customers are and what needs these customers want to satisfy. Thus, the customer defines value and decides the price for a given product and/or service (Womack and Jones 2003).

The second principle, **map the value stream**, implies that, after having identified the value and the customer in step 1, all requirements and activities required to fulfill the customers' needs have to be identified and mapped out using a value-stream-map (VSM). A VSM is a simple diagram, a flow chart containing all processes involved in the flow of information and material to make a product or service, from placing the order to final delivery (Rother and Shook 1999). All activities along any value stream can be classified into three categories: a) activities that **add value** to the product or service (these are activities for which the customer is willing to pay for); b) activities that are **non-value added but necessary** to offer that product or service (these are activities for which the customer is not willing to pay for but without which the product or service cannot be created); and c) activities that are **non-value-**

added and unnecessary, e.g., waste (these are unnecessary activities that can be eliminated without any detrimental impact on the product or service, Womack and Jones 2003; Rother and Shook 1999). The wiring of an electrical panel can be used as an example: The wiring itself is a value added activity, while the inspection of the wiring is non-value added but necessary. However, the re-wiring due to an error in the schematic-plan is waste.

The third principle shown in Figure 3, **creating flow**, stands for aligning value-adding activities so that the product or service can move through the entire value chain to the customer unimpeded, e.g., that the product or service flows through the entire value chain (Womack and Jones 2003; Rother and Shook 1999; Ohno and Mito 1988). This principle, according to Womack and Jones (2003), requires a different way of thinking, a change from our functional queue-batch processing to value stream thinking. Functional queue-batch processing calls for clustering machines and process steps according to functions to achieve better utilization and higher efficiency. However, functional queue-batch processing requires products to be manufactured in batches. Batches, however, lead to waiting times and work in process inventories, which impede the flow of products or services. Therefore, Womack and Jones (2003) insist that through creating flow and overcoming functional thinking, that higher effectiveness and efficiency can be achieved. Once flow is established along the value chain, the time required from order entry to delivery is shortened (Womack and Jones 2003; Rother and Shook 1999; Monden 1998). However, using flow to produce without taking into account current customer demand creates overproduction and thus, an undesired finished goods inventory. Since finished goods inventory causes costs and does not add value from a customer point of view, it is considered waste. Thus, the fourth principle of lean thinking, shown in

Figure 3, is to create **customer pull**. Pull means to conceive, design, construct, schedule, make, and deliver products or services according to customer's demand (Womack and Jones 2003; Rother and Shook 1999; Ohno and Mito 1988). The product or service provider lets customers pull the product from them rather than pushing the product or service onto the customer (pull rather than push). As described before, pulling products or services has to be implemented and executed throughout the entire value chain by letting the proceeding process pull parts and services from the next upstream activity. Having pull and a shortened throughput time in place, a product or service will be only produced when a customer order is received, thus no finished goods inventory will accumulate. Pull also reduces work in process inventory, generating a greater amount of free cash flow and a more stable demand, since customers know that they can get the product when they need it (Shimokawa et al. 2009; Emiliani 2007; Furuya 2006; Womack and Jones 2003; Ohno 1988).

Once a product's or a service's value is defined by the customer, the value stream is mapped, wasteful activities are eliminated, non-value-adding but necessary activities are minimized, and customers pull value through the value chain, a cycle of continuous improvement evolves as shown as the fifth principle in Figure 3. Properly implemented, the first four principles support each other to eliminate waste throughout the value chain (Womack and Jones 2003). Thus, principle 5 (Figure 3), **seeking perfection**, requires making the entire value stream transparent for all stakeholders. Such a transparent value stream makes detecting waste possible and allows for its removal, thus increasing the value of the customer's experience (Jones and Womack 2002; Rother and Shook 1999; Ohno 1988; Ohno and Mito 1988).

The five principles of lean (Figure 3) are widely recognized and used across industries (Ben-Tovim et al. 2007; Emiliani 1998). Ohno (1988), the incubator and executor of the original Toyota Production System, summarized these principles as follows: "*All that we are doing is looking at the time line from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that time line by removing the non-value added waste* (Ohno 1988, p.ix)."

Purpose, Process, People - Womack, in one of his newsletters (2006), strongly recommends that senior executives of companies contemplating a lean transformation should investigate three fundamental business issues: Purpose, process, and people.

To define the **purpose** of a business, two questions need to be answered (Womack 2010; Womack 2006): 1) what does the business need to do to prosper and survive in the future and 2) what does the business need to do to better to satisfy the customer? Womack (2006) points out that addressing the second question first, often solves the issue of what the business needs to do to prosper and survive. Womack (2010, p. 1) further states that *"… I'm often amazed that there seems to be little or no connection between current lean projects and any clearly identified business purpose*." Once the business' purpose is defined, the organization needs to assess and evaluate the **processes** of providing value to the customer. Value stream maps (VSMs) serve this purpose. The current state of processes mapped in a VSM shows all the process steps currently required to deliver value to the customers (Womack 2006; Rother and Shook 1999). The VSM also shows the flow of information that controls the entire value chain of a product or service. Finally, each process step in the value chain should be evaluated as to whether the process is valuable, available, capable, flexible, and adequate (Womack 2010). Processes that are in alignment with the business' purpose can only be created by teams that are led by a person **(people)** responsible for the entire value stream, called a value stream manager (Womack 2010; Emiliani 2007; Liker and Meier 2007). Therefore, when thinking about lean transformations, management has to consider the following questions: 1) do all important processes have someone responsible to constantly evaluate, question, and continuously improve the process' value stream in terms of business purpose? And 2), is everyone that belongs to the value stream actively engaged in improving and operating it towards the defined business purpose (Womack 2010)?

3.1.5. The 3Ms – Mura, Muri, Muda

Ohno (1988) stated that all they do at Toyota is to look at the timeline and reduce the timeline from order entry to cash by removing and eliminating wasteful practices. Mura, Muri, and Muda are the three terms frequently used in the Toyota Production System (TPS) when identifying wasteful practices (Shimokawa et al. 2009; Emiliani 2007; Balle and Balle 2005; Liker 2003; Monden 1998; Ohno 1988; Ohno and Mito 1988; Schonberger 1982). Figure 4 shows the basic concept of Mura, Muri, and Muda (Lean Enterprise Institute 2008; Womack and Jones 2003).

Figure 4 - The three M's (adapted from Lean Enterprise Institute 2008).

Mura, stands for uneven results from fluctuating production volumes and/or from unbalanced schedules. Mura is variation that is forced on the process by fluctuations in the production schedule, rather than variations in the process itself (Shimokawa et al. 2009; Lean Enterprise Institute 2008; Emiliani 2007; Balle and Balle 2005; Glenday 2005; Smalley 2004; Liker 2003; Monden 1998; Ohno 1988; Ohno and Mito 1988).

Muri is the overburdening of people or equipment. Overburdening a machine or person means to utilize a resource beyond their limits. Overburdening equipment causes defects and machine downtimes, whereas overburdening personnel leads to quality problems, safety issues, and, possibly, health issues (Womack 2010; Shimokawa et al. 2009; Lean Enterprise Institute 2008; Dennis 2007; Emiliani 2007; Balle and Balle 2005; Liker 2003). Balle (2005) also describes muri as the imposing of unreasonable work on employees by management.

Muda stands for non-value-added activities and is any activity that consumes resources without creating value for the customer. In Japanese, Muda distinguishes two types of waste, namely 1) activities that can be eliminated right away through Kaizen, and 2) activities that cannot be eliminated and therefore their impact needs to be minimized and removed over time

(Womack 2010; Shimokawa et al. 2009; Smalley 2004; Womack and Jones 2003; Monden 1998; Ohno 1988). Toyota originally identified seven major types of waste (muda) in their manufacturing processes. These seven wastes (overproduction, waiting, unnecessary transport or conveyance, over-processing or incorrect processing, excess inventory, unnecessary movement, and defects) are discussed below. However, these seven types of non-value-adding activities, originally drawn-up for manufacturing environments, also apply to any other type of business activities, such as, for example office environments, product development activities, or engineering activities, to name a few (Shimokawa et al. 2009; Liker and Meier 2005; Liker 2003; Monden 1998; Ohno 1988; Schonberger 1982).

Overproduction describes producing products without an order or producing products too early. Ohno (1988) considered overproduction a fundamental waste, as it causes other kinds of waste, such as the building-up of inventory. Therefore, businesses should only produce to customer demand (Liker and Meier 2005; Liker 2003; Monden 1998; Ohno 1988).

Waiting (time on hand) stands for employees that have to wait for an automated machine or process to be executed, or employees who stand empty instead of performing their next task due to missing parts, tools, or supplies, machine downtimes, capacity bottlenecks, or processing delays (Liker 2003; Ohno 1988; Schonberger 1982).

Unnecessary transport or conveyance describes all transports that carry work in process (WIP), raw material, parts, and finished goods to other process steps as well as movements in and out of storage (Liker 2003; Monden 1998; Productivity Press 1998; Ohno 1988).

Over-processing or incorrect processing depicts unnecessary steps to process parts and materials as well as the practice of inefficiently producing those parts due to poor product design or the use of inappropriate processes or tools. Waste can also be generated by producing a higher quality product than is requested by the customer (Liker 2003; Monden 1998; Productivity Press 1998; Ohno 1988).

Excess Inventory accounts for raw material, work in process (WIP), or finished goods stored along the supply chain. Such inventories cause long lead times where products have to wait to be processed. These inventories are also responsible for damaged parts, higher logistic costs, and delays. Inventory also hides problems like late deliveries, production peaks and valleys, defects, unreliable processes, and long setup times, to name a few (Liker 2003; Monden 1998; Productivity Press 1998; Ohno 1988).

Unnecessary Movement describes everything that causes wasted motion by individuals. Unnecessary movements include activities like searching for, walking to, reaching for, or stacking components, materials, or tools to carry out one's job (Liker 2003; Monden 1998; Productivity Press 1998; Ohno 1988).

Defects are items that need to be reworked or scraped, creating a need for replacement, repair, and inspection (Liker 2003; Ohno 1988).

Several authors (Cooke 2007; Liker 2003) add an eighth type of waste to the list, namely *"Unused employee creativity. Losing time, ideas, skills, improvements, and learning opportunities by not engaging or listening to your employees* (Liker 2003, p. 29)."

Womack (2003) mentions that organizations have to continuously rethink practices that create muri and mura. If the company can overcome and eliminate mura and muri from the beginning of the value chain and create a stable environment for supply chain management, operations, and sales, it will make the process of removing muda from the value chain easier.

3.1.6. Applications and the Dissemination of Lean across industries

The origins of lean can be found in manufacturing, but Womack (2010) explains that businesses in all industries are using lean principles today. These businesses, however, do not always use the word lean for their efforts. Examples include The Toyota Production System (Liker and Convis 2011; Lander and Liker 2007), the Siemens Production System (Lee-Mortimer 2006), the Bosch Production System (Hinterhuber 1997), or the Danaher Business System (Womack and Jones 2003). Almost all automotive manufacturers and their suppliers, and many other industries and sectors have discovered and actively implemented lean principles in their operations. The following paragraphs discuss some of the more noteworthy efforts to implement lean principles in selected industries. Special attention is paid to the healthcare sector.

Aeronautics – In the late 1990s, **Lockheed Martin Corporation** was facing severe international competition (e.g., British Aerospace), resulting in the loss of market share and decreasing company profitability. Lockheed Martin's management realized that they had to drastically lower costs of operations to maintain competitiveness and customer satisfaction while delivering quality products and services (George and Maxey 2005; Kandebo 1999). In 1999, the management team of Lockheed Martin developed an approach to identify best practices that would deliver increased efficiency, thus improving operating and financial performance of the company in the future. This approach was called “Lockheed Martin in the 21st century (LM21, Joyce 2004).” However, management realized that identifying best practices wasn’t enough and that the goal was to create their own production system that consistently would achieve excellence for customers, employees, suppliers, shareholders, and other stakeholders. Thus, Lockheed Martin’s corporate management looked closely to one of their divisions, Lockheed Martin Aeronautics Sector (LMAS). LMAS had already started their lean transformation in the late 1990s and could show considerable improvements in operations thanks to their lean efforts. The results from LMAS’ lean production initiative were a 73 percent reduction in space requirements; work-in-process (WIP) was reduced by more than 90 percent; first time through (the times a product comes out of the line defect-free) increased by 50 percent; and the labor force shrunk to 55 percent of pre-lean times. With the roll-out of their lean conversion to all other company areas (e.g. supply chain, administration, engineering), LMAS was able to reduce overall lead-time dramatically (Kandebo 1999; Landsbergis et al. 1999). For example, the time to release a new product was cut to nearly one-fourth of the original duration. As a result of these improvements, LMAS saved several million Dollars (Browning and Heath 2009). Other results of this initiative were increased customer satisfaction. For example, the Secretary of Defense (PCRP) stated that LMAS is now able to deliver products that are of good quality, delivered on time, and sold at a fair and competitive price (Cook and Graser 2001). Having witnessed the success of LMAS’ lean transformation initiative, Lockheed Martin Corporation started to roll-out lean principles throughout the entire corporation while trying to establish a company culture of continuous improvement. Such a culture is of critical importance for a sustainable, successful and long-term oriented lean transformation (Cooke 2007; Cook and Graser 2001; Kandebo 1999).

One of the remarkable initiatives to disseminate lean knowledge throughout the aerospace industry is the Lean Advancement Initiative (LAI) based at MIT in Boston. Originally, LAI was established in 1990, named the "Lean Aircraft Initiative (LAI)," and initially grounded on findings from the International Motor Vehicle Program (IMVP) at MIT (Lean Advancement Initiative 2012a). LAIs' focus was to develop and support the implementation of lean processes across the aerospace industry and to investigate if lean principles can be applied to military aircraft production (Murman 2002). By 1996, LAI increased its expertise and research focus to space-focused entities evolving into the **Lean Aerospace Initiative (LAI,** Murman 2002), and since 2007 the initiative is known as the Lean Advancement Initiative (LAI). However, the purpose of LAI is to act as an independent entity to carry out research, do benchmarking of best practices, and analyze lean principles for aerospace applications (Lean Advancement Initiative 2012a; Murman 2002). The consortium consists of well-known organizations like Boeing, Rockwell Collins, Pratt & Whitney, the United Launch Alliance, Siemens, the Department of Defense (DoD), and a growing network of international universities to achieve the common goal of "Enterprise Excellence (Murman 2002; Slack 1999)." Results from this open consortium are, for example, lead time reduction of the atlas launch vehicle program from 48.5 months to 18 months; cost savings for the Boeing *C-17* Globemaster unit price from $260M to $178M, and the F18 super hornet engineering completed on time and within budget, to name just a few successes (Murman 2002). Thomas Farmer, president of Pratt & Whitney states that LAI's impact on their lean transformation is of great importance and that LAI *"… will continue to be* *sought out as guide for the future development path of both industry and the services associated with aerospace* (Lean Advancement Initiative 2012a, p.20)."

Service Sector – Service oriented companies like **Jefferson Pilot Financial (JPF)** have proven that lean principles applied in manufacturing can be used to improve performance and boost financial outcomes in service organizations (Swank 2003). In 2000, JPFs top manager recognized that they have to differentiate JPF in the eyes of the customers to maintain revenue streams and to stay ahead of the competition. JPF analyzed their operations to better understand variations in quality of existing services, such as, for example, the processing time for new applications of life insurance policies that required a statement from a physician. JPF learned that the application process could take from one month to two months (Swank 2003). JPF's top management understood that they could increase revenues by reducing the time required for issuing policies to three weeks. JPF's management believed that lean would help them achieve that goal. In late 2000, JPF created the first team to implement lean. The lean initiative delivered impressive results within the first two years of the team's inception. While the time for issuing policies was reduced to less than three weeks, labor required was reduced by 26%; rework due to errors decreased by 40%; and revenues in new annualized life premiums increased by more than 60% (Swank 2003).

Another example of applying lean to the service sector is the story of **Wipro Technologies**, an Indian software services firm. Wipro started their lean initiative in 2004 with 10 projects, of which 8 resulted in improvements in efficiency greater than 10 percent. Wipro applied lean principles to the process of software development, but most importantly customers and software development teams learned collectively from their errors while doing continuous improvement on software development projects (Hanna 2007). This resulted in better and faster product development since software bugs could be located and fixed earlier in the process. Based on these initial successes Wipro rolled out the lean approach throughout their organization. By 2006, Wipro had 603 lean projects underway or completed using a bottom-up approach (Staats and Upton 2009; Hanna 2007). The bottom-up approach allowed Wipro to break the inertia that employees usually face when implementing a new system or initiative. Bradley Staats, doctoral student at the Harvard Business School (HBS) and Professor **David Upton** involved in the project with Wipro summarize the Wipro way as *"…it is about unlocking the power of thousands of software engineers* (Hanna 2007 p. 2)*."* During Wipro's journey, the organization had to learn that their production system changes with the way the organization learns, improves, and challenges ideas through problem solving and standardization. Furthermore, Wipro was successful because their lean transformation started with a pilot project that allowed them to learn from mistakes, to improve and specialize the tools necessary for a roll out, and to simplify hierarchical structures (Staats et al. 2010; Staats and Upton 2009). However, despite the success at Wipro and other software service firms, Staats and Upton (2009) claim that the service industry is still behind in utilizing lean compared to the manufacturing industry.

Public Sector – Today, governments around the world are required to deliver better infrastructure, better education, better retirement services, and improved and more affordable health care, to name a few (Bhatia and Drew 2006). However, given recent budget cuts and limited funding, governments have to search for new approaches to become more effective and efficient (Radnor and Walley 2008; Bhatia and Drew 2006). Thus, governments became interested in the principles of lean manufacturing and wondered if they could use lean to improve their processes and services (Radnor and Boaden 2008). In the U.S., there are numerous known initiatives at federal, state, and local levels that try to tap into the power of lean to achieve improved service for their constituents. One such example is the U.S. Environmental Protection Agency (EPA) conjoint project with the Delaware Department of Natural Resources and Environmental Control, the Iowa Department of Natural Resources, the Michigan Department of Environmental Quality, the Minnesota Pollution Control Agency, and the Nebraska Department of Environmental Quality. This project has shown impressive results by applying Lean and Six Sigma principles to public services operations (US EPA 2012). Results from this effort include reduced application backlogs, a 50 percent reduction in lead time of permit reviews, simpler and mistake-proven permit application forms, and freed-up staff time for more critical tasks within the agencies. Even more impressive are some of the outcomes from individual agencies, such as, for example, the average time to issue standard air quality construction permits was reduced from 62 to 6 days through the elimination of 70 percent of the process steps originally needed (US EPA 2012). Lessons learned from this lean government implementation project were that top management buy-in and support, staff engagement in all stages of the implementation process, clear and precise communication, transparency of findings and problem descriptions, and follow-ups were main drivers for success (US EPA 2012).

Another example of a lean implementation in the public sector is the City of Grand Rapids in Michigan. The City of Grand Rapids started its lean journey in 2005 due to budget cuts and resulting layoffs (Drickhamer 2012). The need to handle the growing amount of work with fewer employees was the initial start to implement and experiment with lean (Scorsone 2008). The City officials did set up a team that consisted of the deputy city manager and employees from different functional areas to drive their lean implementation. This team and an external coach were working on three value streams (engineering, purchasing, and public library). The elimination of waste and the reduction of non-value adding process steps resulted in reduced lead times, better services, and higher customer satisfaction (Drickhamer 2012). However, as Radnor and Boaden (2008) point out, the public sector has so far used only a limited number of lean principles and thus has still considerable potential for further improvements.

Health care Sector – The **Bahri Dental Group** in Jacksonville, Florida is an example of how lean can be applied to small organizations in the health care industry. Bahri Dental Group is a dentist practice with ten chairs for general dentistry and seven chairs for orthodontics. Their lean transformation journey started in 1996 while experimenting with total quality management and six sigma techniques. However, having achieved promising results from using lean principles by the end of 2004, one major problem remained: their constant struggle to run on schedule. Patient wait times were unacceptably long and the clinic’s staff was overwhelmed with work. Thus, Bahri Dental Group aimed to solve the root cause of the problem and experimented with one patient flow/continuous flow of patients to shorten patient lead times and customers’ length of stay (Bahri 2009). The implementation of continuous flow by doing more value added work in the same session resulted in a 90 percent decrease of time needed per patient for complete treatment. In fact, the length of treatment for the average customer was reduced from 99 days to 10 days, while patients treated completely (e.g., only one visit) was achieved for 95 percent of patients. Also, a reduction of 40 percent in space requirements (patient rooms, from 10 to 6) was achieved, while the number of staff was reduced by 35 percent. At the same time, the amount of time in which dentists performed value added activities increased by 82 percent, thus, generating improved revenue streams (Bahri 2009).

Another example of a lean implementation in health care is the **Flinders Medical Center** in Adelaide, Australia. The Flinders Medical Center is a 500 bed general hospital that provides a full range of health care services to more than 300,000 people in the Adelaide area. Fifty thousand patients are seen in the emergency department every year, admitting roughly 40 percent of them to the hospital (Ben-Tovim et al. 2007). By 2003, the Medical Center had problems to deal with the growing demand for services by the population served, which ultimately led to problems in patient safety. The overburdened personnel caused unnecessary deaths, higher infection rates, and other health issues (Ben-Tovim et al. 2007). A group of interdisciplinary emergency department staff was formed to map and improve the patient flow through the emergency department employing lean principles. However, the process was not just mapped, but team members also observed the patient flow throughout the emergency department, literally following patients to document the process (Ben-Tovim et al. 2007). The activity of process mapping patient journeys *"… had a profound impact on all involved. It created a shared awareness of how chaotic the care processes had become …*(Ben-Tovim et al. 2007, 12)." Based on these experiences, the first change made to eliminate waste and to create more value for patients was to split the patient stream in "likely to be discharged" and "likely to be admitted," while eliminating the complicated triage process of allocating patients. Each of the two streams (likely to be discharged and likely to be admitted) had now a separate team of doctors and nurses assigned. Patients were treated and seen in order and sequence of arrival if *"… the threat of life and limb …*(Ben-Tovim et al. 2007 p.13)*"* was absent. Creating better patient flow and streaming patients along simplified pathways provided staff with more control of their tasks and processes. Furthermore, processes were sequenced and aligned with the wards so that a better flow of patients across the entire hospital resulted. Results of the Flinders Medical Center lean transformation effort are, among other things, a reduction of 50 percent of the numbers of patients leaving the emergency department without completion of care. In addition, the average time patients spend in the emergency department was reduced from 5.7 hours to 5 hours (Ben-Tovim et al. 2007). After Flinders' success of using lean thinking in emergency care, the management was convinced that lean principles had to be rolled out to medical and surgical care, too. Over the years, Flinders' lean implementation was extended to support services, mental health, and community care.

The **Virginia Mason Production System (VMPS)** is another example of a hospital pursuing the "perfect" patient experience using lean management principles (Nelson-Peterson and Leppa 2007). The Virginia Mason Medical Center, a 340 bed hospital with 400 physicians and more than 5,000 employees, located in Seattle, WA is using lean management principles since 2002 aiming for zero defects in health care while continuously improving their processes (Institute for Healthcare Improvement 2012; Kenney 2010). A pivotal role in Virginia Mason's lean transformation played a strategic plan that was developed in late 2001 by Virginia Mason's senior management team and is shown in Figure 5 (Institute for Healthcare Improvement 2012). The pyramid is a visual representation of the VMPS with the patient at the top. Even though focusing on the patient seems to be common sense, focusing on the patient was a dramatic change from a physician centered organization to a patient centered organization at Virginia Mason (Kenney 2010).

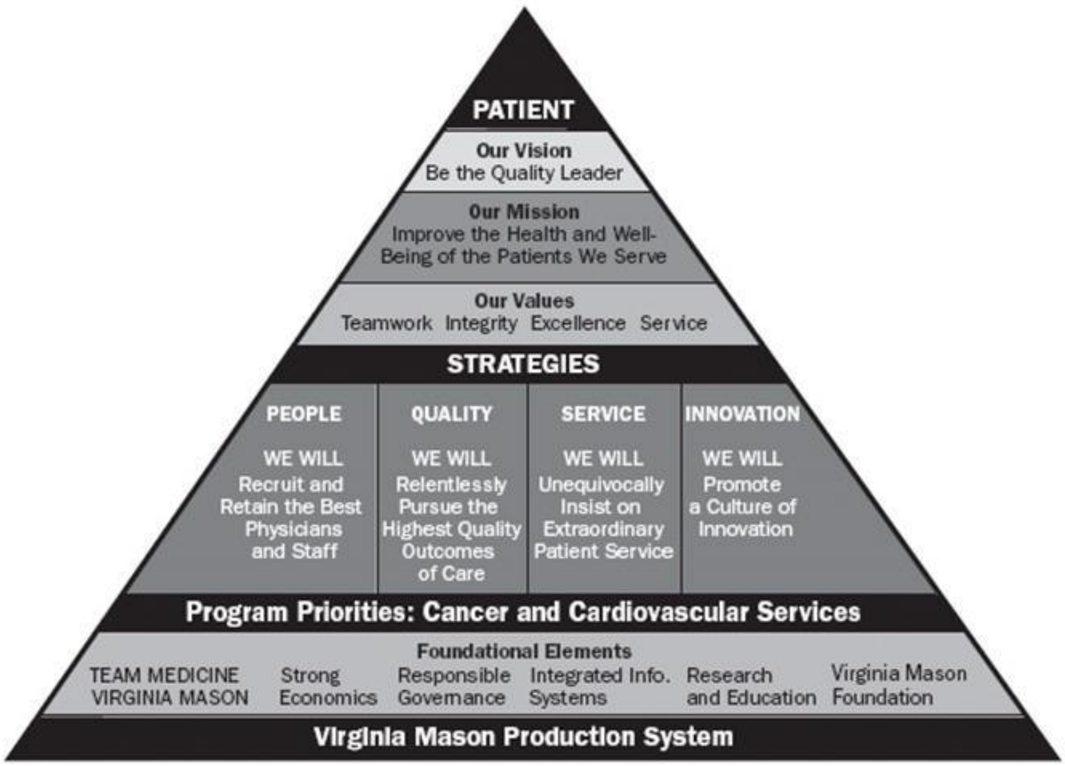

Figure 5 – The Virginia Mason Medical Center Strategic Plan (Institute for Healthcare Improvement 2012)

Figure 5, also shows that Virginia Mason's vision to "Be the Quality Leader" emphasizes their need to focus on quality rather than finances. The CEO and the management team believed that *"… providing high quality care would solve the financial issue* (Kenney 2010, p.4)*."* As Kenney (2010, p.4) further states *"… Virginia Mason's leaders believed that if it was truly about the patient, then the solution had to focus on quality care. Yes, governance changes would be required, budgets trimmed, and personnel shifted. But at its core, the journey Virginia Mason would embark on was not about any of those things; …"* but the journey would be about the patient and finding ways to deliver the highest quality of care. Thus, the idea behind the VMPS is to practice continuous improvement and to eliminate waste from the point of view of patients. The VMPS consists of 6 focus areas to achieve that goal. Areas include: 1) obeying the "Patient first" policy; 2) creating an environment in which employees feel safe and free to engage in improvements (no-layoff policy); 3) focusing on an organization wide defect alert system (similar to Toyota's Andon system, Furman and Caplan 2007); 4) encouraging new ideas and innovation; 5) achieving an economic and prosperous organization by applying lean management principles and eliminating waste; and 6) holding leadership and management accountable (Institute for Healthcare Improvement 2012; Kenney 2010; Nelson-Peterson and Leppa 2007). Virginia Mason's results within the first two years of their lean journey were impressive, resulting in more capacity while saving significant capital expenses for planned expansions. The number of full-time equivalents (FTEs, a measure that indicates the workload of an employed person with 1.0 FTE being the equivalent to a full-time employee) was decreased despite a no-layoff policy. Improving and redesigning processes to eliminate waste through more than 175 rapid process improvement weeks at Virginia Mason also resulted in less rework, less inventory (amount of inventory reduced by 53 percent), better quality, higher patient satisfaction, improved productivity, and cost savings of more than 10 million dollars (Institute for Healthcare Improvement 2012; Kenney 2010; Nelson-Peterson and Leppa 2007).

ThedaCare, Inc. is seen as another example of a lean management transformation in healthcare. ThedaCare's health care delivery system is located in northeastern Wisconsin and consists of 3 hospitals and 27 physician clinics with more than 5,000 employees (Institute for Healthcare Improvement 2012). ThedaCare has its own pyramid of principles that describes the organization's goals and metrics (Figure 6). The center of the pyramid describes the patient first philosophy and each of the corners describes one of ThedaCare's main goals.

Figure 6 – ThedaCare's pyramid (Institute for Healthcare Improvement 2012)

Three goals describe ThedaCare's goals. The organization's quality goal is to be better than the 95th percentile while delivering world-class clinical service. The second corner describes ThedaCare's business goals regarding productivity and savings (10 million dollar/ year). The third corner emphasizes the importance of employee engagement and Thedacare's aim to be on the list of the Fortune 100 list of best employers (Institute for Healthcare Improvement 2012; Wysocki 2004). Having worked on six rapid improvement event topics each week, Thedacare has achieved impressive results in savings (3.3 million dollar in 2004), improved accounts receivable (reduction from 56 to 44 days resulting in 12 million dollar free cash flow), reduced medication distribution time (a decrease from 15 to 8 minutes per patient), and minimized paperwork (time reduced to complete clinical paperwork on admission by more than 50 percent, Institute for Healthcare Improvement 2012). Other results from applying lean management principles to health care include: individual hospitals achieved an 85 percent reduction in hospital acquired infections, patient satisfaction rate increased by more than 5 percent, and length-of-stay (LoS) at one of the hospitals could be reduced by more than 4 days per patient (Graban 2008; Savary and Crawford-Mason 2006). Indeed, results of lean implementations in health care operations in the U.S. have shown that delivering health care in the U.S. can benefit from lean if all stakeholders, e.g., the public sector, the government, the insurers, and the health care provider work together (Miller 2005).

3.1.7. Difficulties and Obstacles of Lean

Even though lean principles have been implemented in various organizations and industries, Womack (2007) expresses concerns about the lean movement as being tool driven rather than lean being a philosophy that focuses on the management of the entire system fitting all elements of an enterprise together and thereby releasing the full power of lean (Womack 2007). Given the complexity of organizational change, most organizations understandably rely on tools first: 5S, JIT, Kanban, setup time reduction, or target costing (Womack 2007). However, using just tools and not considering the necessary change in organizational culture will lead to mediocrity at best. Liker (2003) addresses the same concern and states that a successful lean transformation consists of more than a few tools, concepts, and initiatives. Liker (2003) also stresses the point that only employees of an organization can create the culture necessary to make the leap. Thus, managers and leaders need to be mentors and coaches to continuously improve the skills of their employees. Coaching and training of employees is essential to achieve a culture that drives the lean transformation towards the ultimate goal, e.g., the "true north" of an organization (Hogan 2009; Liker and Meier 2007; Emiliani, 1998). Furthermore, to create a lean culture, employees need to be actively engaged in continuous improvement events, trainings, and they have to have the freedom to experiment. A lack of engaging employees in a lean transformation from the beginning was an issue during the initial stages of the lean transformation at Lockheed Martin Corporation (George and Maxey 2005; Kandebo 1999), Jefferson Pilot Financials (Swank 2003), Wipro (Hanna 2007), Virginia Mason (Institute for Healthcare Improvement 2012; Kenney 2010), and ThedaCare (Institute for Healthcare Improvement 2012). As senior management is often reluctant to buy in, to promote, and to teach subordinates about the changes to be pursued, the lean transformation loses its initial drive and enforces inertia. The cases listed above have shown that once an organization's inertia is broken through involving and training all employees, lean initiatives start to accelerate in speed and result in better outcomes. However, this often leads to managers leaving the company or being substituted by managers that are willing and committed to change and to train employees about lean (George and Maxey 2005; Kandebo 1999).

Mehri (2006), a pronounced critic of lean, maintains that lean is biased and forgets the culture behind the management system. Mehri's (2006) article, relying on qualitative research, describes the human costs of lean and how it exploits employees. He explicitly portrays the culture of Japanese companies employing lean principles and describes the differences between "*tatemae*" (a Japanese term for what an employee is supposed to feel or do) and "*hone*" (what an employee actually feels or does). Mehri (2006, p.1) states that *"… The curtain of formality and messages from management at Toyota – the tatemae – that obscures the realities – the hone – of the Toyota way …*(Mehri 2006, 1)*"* is never expressed in articles or descriptions about the lean management system. Furthermore, Mehri (2006) explains that the Japanese-influenced company culture limits creativity and innovation, leads to worker isolation and harassment, accident cover-ups, unsafe conditions, and exploits employees to a degree of creating a poor quality of life to employees. However, Conti et. al (2006) describe that lean production is not inherently stressful and point out that stress levels of workers are related to management decisions.

3.2. Leadership

To study and understand the influence of leadership on hospital performance, the following subchapter provides a review of factors affecting leadership and hospital performance. In particular, key concepts and definitions are discussed and the difference between leadership and management are discoursed. Emphasis is also given on a review of leadership traits and theories.

3.2.1. Leadership definition

Bass and Bass (2008, p.45) defined **leadership** as "*… The art of motivating a group of people to act towards achieving a common goal*." Indeed, leadership puts its stamp on all aspects of our lives early on in kindergartens, schools, social communities, universities, religious organizations, state and national governments, public agencies, businesses, health care organizations, associations, and any other grouping of people (Northouse and Northouse 2009; Bass and Bass 2008; Hesselbein and Shrader 2008; McGregor and Cutcher-Gershenfeld 2006; Wheatley 1999; Gardner 1993; Kotter 1988). Thus, we all exert or experience leadership throughout our life. Bass and Bass (2008, p. 3) state that "… *Leadership has been built into the human psyche because of the long period we need to be nurtured by parents for our survival. Early on, we learned to follow the leadership of parents and their proxies for satisfaction of our needs for food and comforting. Our mothers or their surrogates became our leaders in early childhood. They still are. Fathers came next when they were recognized. With socialization, as we grew, peers and other significant people gradually took the place of parental leadership. How we think and behave as leaders and followers when we reach adulthood is still likely to be affected by our earlier relations with our parents, as well as by our genetic makeup. So it is not* *surprising that leadership is a universal phenomenon*." Another insightful definition of leadership was created by Bass (1990a p. 21), who wrote: Leadership is "*… An interaction between members of a group. Leaders are agents of change; persons whose acts affect other people more than other people's acts affect them. Leadership occurs when one group member modifies the motivation or competencies of others in the group.*"

3.2.2. Management definition

Leadership and **management** are not synonyms. While leadership is about motivating a group of people, management is about the organization of the group of people and what they do. However, management is an ambiguous term. It can be interpreted in two different ways. One view of management is 'the management,' which stands for the **institutional perspective** and refers to a group of people (at all levels in the organization) that have the disciplinary power over employees, e.g., supervisors, mid-level managers, VPs, and CEOs. The second view on management is the **functional perspective**, without position or person focus**,** that describes which tasks are necessary to create value and to assure that the company meets its objectives (Allman 2009; Gibson 2008; Bass 1985). Management is also sometimes referred as to be the administration of an organization that keeps careful records and sees that things are done according to the rules (Gibson 2008). Thus, a manager's task is to plan things that have to be accomplished by determining budgets and resources required, decide on employee assignments, supervise employees, ensure that things get done right, solve problems, and make sure that no resources are wasted (Bass 1985). Consequently, the role of a manager is to assure that operations are run effectively and efficiently (Allman 2009; Bass 1990a).

3.2.3. Leadership and management

Leadership and management have been used in literature and daily usage both with clearly differentiated meanings as well as synonymous ones. Leadership is a narrower concept than management, but that does not necessarily mean that one contains the other. Management in an organization is usually associated with the entrustment and responsibility of a person with functions like organizing, planning, and controlling, but not necessarily with leading (Brewer 1995; Hersey et al. 1977; Likert 1961). Kotter (1996) explains the difference between leadership and management in his model of ”*Different objectives of leadership and management*,” that leadership creates the vision and the strategies required by an organization by creating an appealing and easy to understand picture of the future (vision), while at the same time showing the individuals of the organization how the vision can be achieved (strategy). In contrast, management creates the plans, executes, corrects, and reviews the specific steps to execute the strategies and to convert the plans into results. Figure 7 summarizes those facts (Kotter 1996).

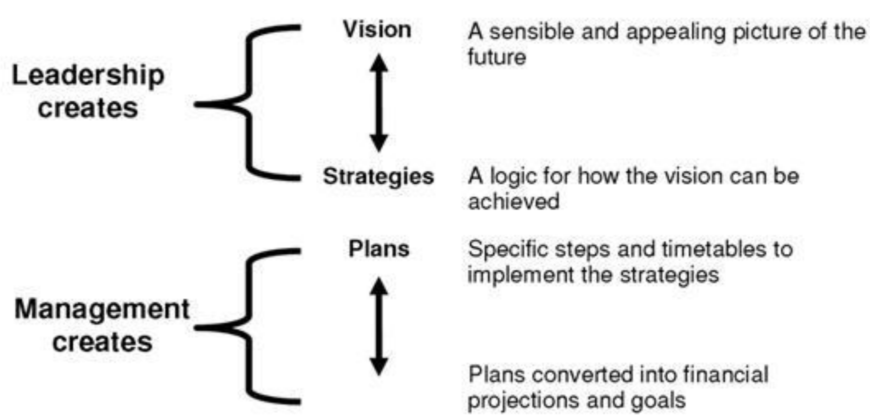

Figure 7: Different Objectives of Leadership and Management (Kotter 1996, p. 71)

However, Kotter's definition is just one of many. For example, Kouzes and Posner (2007) describe the difference between leadership and management by the divergent extent to which leaders and managers are forward looking (Figure 8). An important point to notice in Figure 8 is that tactical leaders are referred to as managers, whereas strategical leaders are not managers.

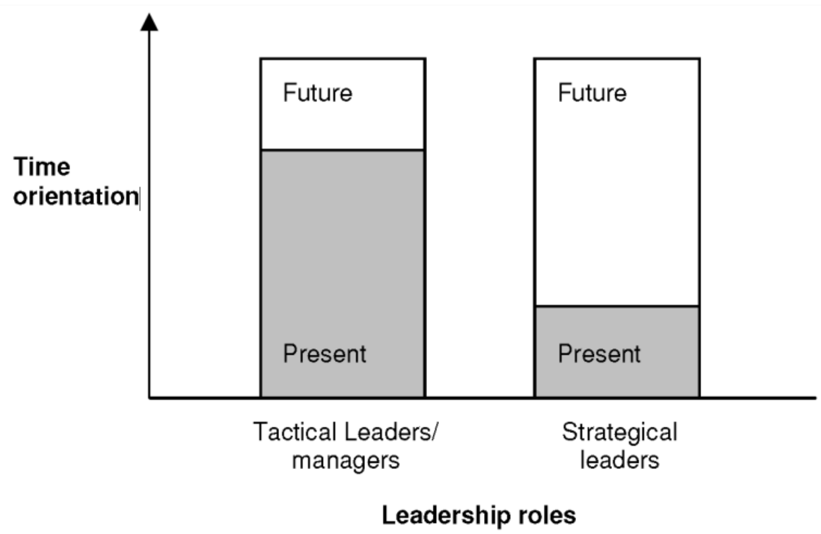

Figure 8: Mix of present and future orientation of leaders (Kouzes and Posner 2007, p. 129)

Another definition explaining the differences between leadership and management points out that leadership is about what to do and why, whereas management focuses on the way of how to do it, or in Doppler and Lauterburg's words (2002, p. 29) *"A leader does the right things - A manager does the things right*." However, undoubtedly, a leader also has to be a good manager to turn a vision into reality (Bass 1990a). For an organization, it is critically important to understand how both a visionary leadership style and a conventional management style work together. Kotter (2008) pointed out that most often, if a change initiative fails, too many managers worked with too few leaders.

3.2.4. Leadership theories

Research in leadership consists of a wide range of conceptual models and theories involving traits, function, behavior, power, vision, values, charisma, intelligence, gender, and situational interaction, to name just a few (Bass and Bass 2008; Avolio 1999). However, existing research can be grouped into the following four theories: (1) trait theory, (2) behavioral theory, (3) situational and contingency theory, and (4) transformational theory (Bass and Bass 2008). These four theories are explained in detail below.

Trait theory

The **trait theory of leadership** is based on the idea that leadership is rooted in the characteristics that certain people possess (Northouse and Northouse 2009; Bass and Bass 2008; Hesselbein and Shrader 2008; Gardner 1993; Kirkpatrick and Locke 1991; Burns 1979; Stogdill and Melvin 1974). Early research on leadership was based on a psychological focus, e.g., a focus on people that inherited characteristics or traits (Bass and Bass 2008; Avolio and Bernard 2004; Stogdill and Melvin 1974; Stogdill and Coons 1957). Therefore, emphasis was put on discovering these traits by studying successful leaders in areas like politics, business, military, and religion. The first well-known and well-researched theory is the **'Great Man'** theory (sometimes also misleadingly referred to as "trait theory," even though "trait theory" encompasses more than just the "Great Man" theory), that states that leaders are born and that the capacity to lead is inherent (Borgatta et al. 1954). Leaders, according to the 'Great Man' theory are described to be heroic, male, mythic, and are destined to rise in power when needed. Thus, traits refer to trends in a person's behavior, implying that people behave the way they do because of the strength of their traits. Stogdill and Melvin (1974) identified the following traits and skills as crucial for a successful leader:

Traits – A leader is adaptable to situations, assertive, cooperative, ambitious and achievement-oriented, alert to the social environment, decisive, dependable, dominant, energetic, persistent, self-confident, tolerant of stress, and willing to assume responsibility (Stogdill and Melvin 1974).

Skills – A leader is intelligent (clever), conceptually skilled, diplomatic and tactful, creative, fluent in speaking, organized, persuasive, socially skilled, and knowledgeable about group tasks (Stogdill and Melvin 1974).

McCall and Lombardo (1983) researched and identified four primary traits by which leaders can succeed or fail: 1) *Intellectual breadth*, e.g., the leader needs to understand a wide range of areas, rather than being narrow-minded or myopic; 2) *Emotional stability and composure,* e.g., the leader needs to be confident, predictable, and calm, particularly in stress situations; 3) *Good interpersonal skills* e.g., the leader must be able to communicate and persuade people without using negative or coercive strategies; and 4) *Admitting faults*, e.g., the leader owes mistakes publicly and is not trying to put effort into hiding them (McCall and Lombardo 1983).

Another facet of trait theory is described by the **'Big Five' personality dimensions** (OCEAN, openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism), details of which are listed in Figure 9 (Morden 2004). The 'Big Five' personality dimension theory provides explanations of leaders' and followers' tendencies across personality dimensions and assumes that personality traits tend to be constant over time. According to Bass and Bass (2008), these traits are proven to work in a wide range of environments and cultures. Furthermore, the 'Big Five' personality dimension theory (Figure 9) assumes that the leader needs to understand one's own traits, strengths, and weaknesses to assess the likelihood to be successful in different environments (Bass and Bass 2008; Baker 2007; Avolio 1999; Burns 1979).

Trait	Description
Openness	Being curious, original, intellectual, creative, and open to new ideas.
Conscientiousness	Being organized, systematic, punctual, achievement-oriented, and dependable.
Extraversion	Being outgoing, talkative, sociable, and enjoying social situations.
Agreeableness	Being affable, tolerant, sensitive, trusting, kind, and warm.
Neuroticism	Being anxious, irritable, temperamental, and moody.

Figure 9: Big Five Personality trait (from http://faculty.txwes.edu/mskerr/files/3304_ ch3_files/image010.jpg)

Some researchers argue that the big five model only consists of the selected five categories and does not adequately embrace all the different personality traits that coexist (Bass and Bass 2008; Wheatley 1999; Bass 1998; Burns 1979). Despite the critics, trait theory experienced a resurgence in recent years because charismatic and visionary leadership styles use trait theory as a foundation (Baker 2007; Bass and Avolio 1994; Bennis and Townsend 1995; Bryman 1992; Lord et al. 1986; Zaccaro 2007).

Behavioral and style theory

Following an era of focus on trait theory, leadership research put more emphasis on the concept of what leaders do (leadership behavior) rather than on leaders' traits. Research revealed that there are basically two behaviors apparent in leadership – **task behavior** and **relationship behavior**. Task behavior describes the behavior that facilitates goal accomplishment, whereas relationship behavior describes behavior that helps subordinates/followers to feel comfortable with others, the situation they are in, and themselves (Evans 1970; Bourantas and Papalexandris 1990; Bass 1990a; Hersey et al. 1977).

The most widely known research carried out in the field of behavioral and style theories are the Ohio State study, the Michigan studies, the managerial grid, and the Blake and Mouton model. The **Ohio State study**, originally initiated in the 1950s (Schriesheim and Kerr 1974; Stogdill and Coons 1957) showed that responses about leader’s behavior can be clustered around two types, **initiating behavior** and **consideration**. Initiating behavior includes acts such as scheduling activities, defining roles, organizing work, and giving structure to work. Consideration is comprised of building teams, respect, trust, and linking leaders with followers. These two behaviors are considered to be separate and the degree to which a leader demonstrates one behavior is not related to the degree the other behavior is demonstrated (Bass and Bass 2008; Stogdill 2004; Brewer 1995; Kinder and Robertson 1994; Bass 1990a). The **Michigan studies**, also conducted at around the same time as the Ohio State study, also identified two behaviors, which were **employee orientation** and **production orientation.** Employee orientation is associated with an approach to strong human relations emphasis, whereas production orientation is considered to stress technical and production aspects of the job. However, in contrast to the Ohio State study, the Michigan researchers conceptualized these behaviors as two ends of the same continuum, but had to realize that the behaviors were independent and could be exhibited at the same time. Another problem with the Michigan study is that the research was inconclusive and spotty (Bass and Bass 2008; Gordon and Yukl 2004; Brewer 1995; Butler 1993). In any case, Blake and Mouton (Blake and Mouton 1985; Blake and Mouton 1968a) used the results of these two studies (Ohio State and Michigan) to develop the 'Managerial Grid' shown in Figure 10. The Managerial Grid is a matrix in which the x-axis tracks the concern for results and the y-axis describes the concern for people.

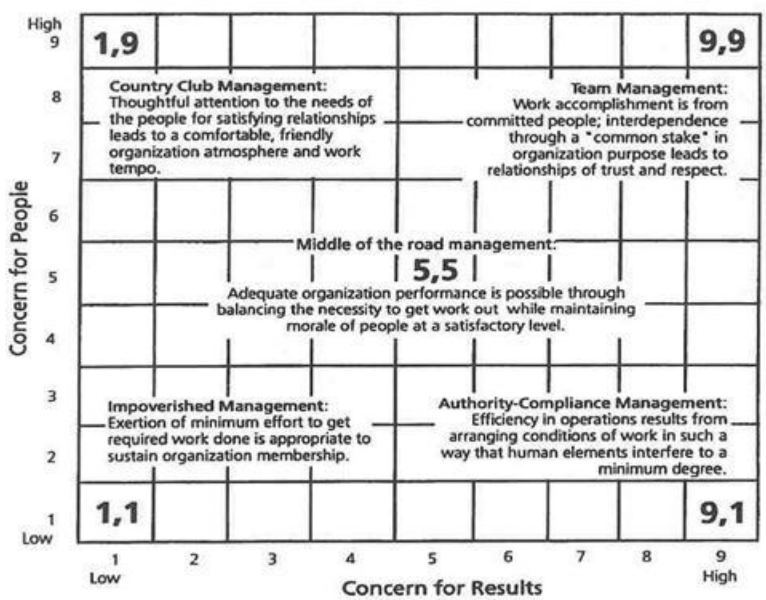

Figure 10: The Managerial Grid (adapted http://1.bp.blogspot.com/-eUni-49CBrs/Ta44toN_7PI/ T205_2_010i.jpg)

The managerial grid leadership model depends on the situation the leader and the organization finds itself situated at a given time (Bass and Bass 2008; Blake and Mouton 1985). The five Management/Leadership styles described in the managerial grid (Blake and Mouton 1968b) are the Impoverished Management (1,1), the Authority-Compliance Management (9,1), the Middle of the Road Management (5,5), the Country Club Management (1,9), and the Team Management (9,9) style. The managerial grid analysis allows deciding which leadership style is most appropriate in a given situation and thus gives the leader an indication of how to adapt his own leadership style. More recent research has demonstrated that the broadened scope of leadership research that includes behaviors of leaders and the various situations as described by the managerial grid, gives a good representation of how an effective leader acts (Mary and George 1995). Thus, since the managerial grid is composed of task and relationship behavior, the key to be an effective leader rests on how the leader balances the two behaviors.

Critics of the managerial grid approach state that the method does not link task and relationship behaviors with outcomes such as morale, job satisfaction, and productivity (Blake and Mouton 1985; Blake and Mouton 1968c; Blake and Mouton 1968b). Thus, a universal style of leadership that can be effective in almost every situation does not exist and research has revealed that the implied high-high behavior (9,9) in the managerial grid is not present in a leader and therefore cannot be supported by research findings (Bass and Bass 2008; Bass 1998; Bennis and Nanus 1986; Bass 1985; Blake and Mouton 1985).

Situational theory

The **Situational Leadership theory** is one of the most recognized leadership theories. Situational leadership theory was developed by Hersey and Blanchard in 1969 (Hersey and Blanchard 1982) and answers the question if there is an optimum way for leaders to adjust their behavior to different followers/subordinates, thereby increasing their likelihood of success. The premise of the situational leadership theory is that different situations demand different kinds of leadership, as depicted in Figure 11. Given that motivation and competence of followers varies over time, leaders have to change the degree to which they are directive or supportive to allow their followers to succeed and to meet the needs of their followers. Thus, in the situational leadership model, the situation is always described by the followers' need (Blanchard et al. 1985). In Figure 11, each quadrant shows a different leadership style that is based on different levels of follower development.

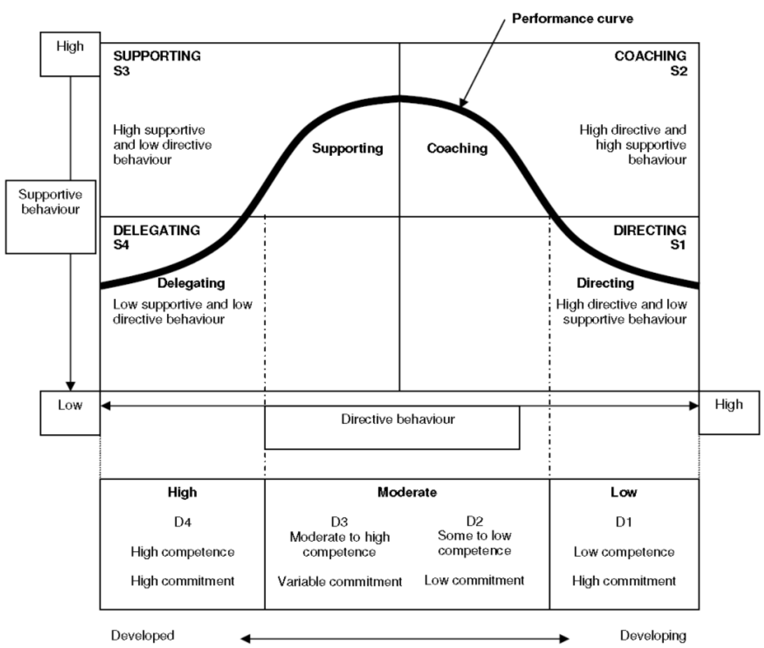

Figure 11: The Situational Leadership Approach (Blanchard et al. 1985, p. 68)

Thus, there are four leadership styles along the follower development continuum on the x-axis. In particular, the leadership styles applicable are: directing (S1), coaching (S2), supporting (S3), and delegating (S4). S1, the directing style can range from highly directive and less supportive to low directive and supportive. Whereas the behavior of the leader in S2, the coaching style can be highly directive and highly supportive. S3, a supporting style requires a behavior that is highly supportive, but less directive. Finally, S4, a delegating style requires a behavior of the leader that is low on support and low on giving directions (Hersey and Blanchard 1982).

As followers move forward and backward along the performance curve continuum, leaders have to adjust their leadership style according to the followers' positions to allow their followers to be effective, efficient, and successful. Supporters of the situational leadership approach (Sashkin and Sashkin 2003; Staehle 1976) point out that the strength of the situational leadership theory is that it is practical, easy to understand, and that it is a proven theory widely used in research. Other advantages of situational leadership theory are its prescriptive nature and its ability to tell leaders what to do. Situational leadership theory emphasize the importance of the leader to react in a flexible manner and constantly reminds leaders that individual employees have to be treated differently based on their individual needs and tasks at hand. Above all, leaders following the situational leadership theory always seek opportunities to coach and develop subordinates to become more confident. However, there are critics that maintain that the assumptions and propositions of the situational leadership theory model are only supported by a few research studies (Kouzes and Posner 2007; Yukl and Lepsinger 2004; Butler 1993; Nicholls 1985; Stogdill and Coons 1957).

Contingency theory

Fiedler's **Contingency Theory** (Fiedler 1967) is a "leader-match" theory that requires leaders' style to match the situation (Fiedler 1996; Jago and Ragan 1986). Two leadership styles can be employed: **task-motivated** and **relationship motivated** (Fiedler 1967). However, Fiedler stresses that leaders cannot be effective at both styles. According to Fiedler (1967), leadership styles appropriate for given situations are determined by the Least Preferred Worker (LPC) scale as shown in Figure 12. The top level of Figure 12 shows the leader-member relations that can vary from good to poor. Each of the two categories (good and poor) can have a task structure that is highly structured or low structured. The third level from the top, position power, splits each of the task structure categories (high structured vs. low structured) in strong and weak power. According to Fiedler (1967) those outcomes then are translated into the preferred leadership styles.

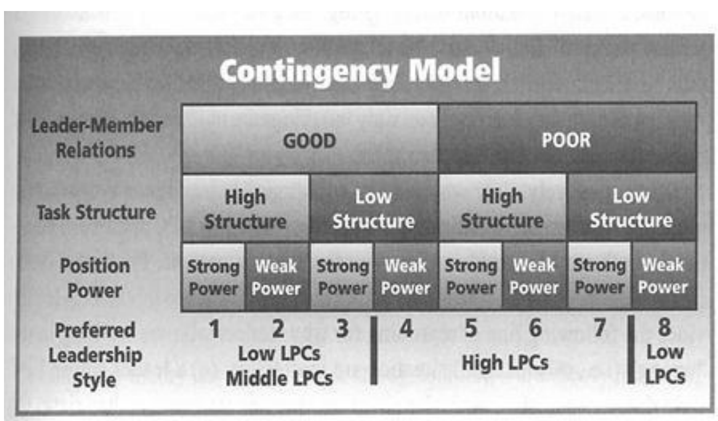

Figure 12: Contingency Model (Radford, 2010)

Situations in the contingency model are characterized by three variables: 1) Leader-member relations that describe the group atmosphere, loyalty, and the attraction the follower feels for the leader; 2) Task structures that make a distinction between structured versus unstructured tasks; and 3) Positional power, describing the amount of authority a leader has to reward or punish a subordinate (Pearce et al. 2008; Yun et al. 2006; Miller et al. 2004; Lapidus et al. 1996; Greene 1975; Graen et al. 1971). Contingency theories' strengths are that it is supported by a large number of studies and that the theory is predictive, e.g., it helps to understand what type of leader is most effective in different situations (Greene 1975; Lapidus et al. 1996). Critics, however, claim that the contingency theory fails to explain why leaders are effective in certain situations but not in others (Pearce et al. 2008). Another point of contention for critics is that contingency theory is burdensome to use in the "*real world*" and does not explain how to overcome mismatches if they appear (Pearce et al. 2008; Yun et al. 2006; Graen et al. 1971).

Leader-Member Exchange Theory

All theories mentioned so far (trait, behavioral, style, situational, and contingency theory) are theories that emphasize leadership from the point of the leader. Other theories, discussed below, look at the interactions between leader and follower. The **Leader-Member Exchange (LMX) Theory** uses situational and contingency theory, but looks at it from the point of the follower (Boies and Howell 2006; Mary and George 1995; Graen et al. 1982). LMX theory suggests that there should be differences between the leader and each follower. Therefore, LMX theory clusters followers in succinct groups of "**In-Groups**" and "**Out-Groups**." "In-Groups" are all individuals with expanded roles and responsibilities in a given organization through negotiations with the leader. "In-Groups" the negotiations within the group involve exchanges where subordinates do certain things in exchange for the leader doing more for the subordinates in the group. Followers in these "In-Groups" usually get more information, influence, and confidence, but also more concern from the leader. “Out-Group” members instead are the members of a team that have a formal contract and defined roles that they fulfill day in and out. Thus, members of the “Out-Group” perform their duties required but not more and they do not receive special treatment from the leader.

In later years, the LMX theory began focusing on how to enhance the quality of relationships so that membership in “Out-groups” decreased and membership in “In-groups” increased (Boies and Howell 2006). Research studies revealed that a well-developed Leader-Member exchange (LMXs) fostered an environment that increased membership in “In-groups (Winkler 2009; Boies and Howell 2006; Liden et al. 1997).” The high quality relationships in “In-Groups” results in more positive performance evaluations, lower turnover, higher frequency of promotions, greater organizational commitment, better job attitudes, and results in better performance outcomes of the groups. Thus, the most current version of the LMX theory emphasize that a leader should develop high quality Leader-Member exchanges with all subordinates and develop them to partners in the “In-group” (Boies and Howell 2006; Mary and George 1995). To establish and promote those partnerships, the **“leadership making”** model (Figure 13), presents the different phases of partnership evolvement (Graen and Uhl-Bien 1991). In fact, the “leadership making” model is known to promote the building of dyads and networks within an organization (Schriesheim et al. 1999; Liden et al. 1997).

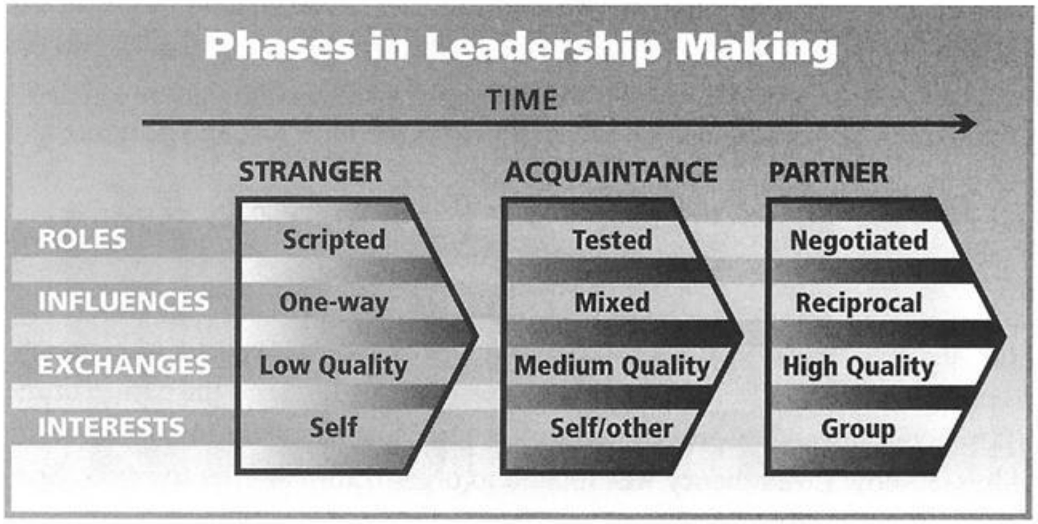

Figure 13: Phases to develop high quality exchange with subordinates (Radford, 2010)

According to Elkins and Keller (2003), LMX theory's strengths are the descriptive theory of “In- and Out-groups” (Elkins and Keller 2003). LMX theory also underlines the importance of communication throughout the entire organization with “In- and Out-groups.” However, criticism comes from studies that have concluded that the LMX theory's ideas are not fully developed (Dienesch and Liden 1986). Criticism is also raised about the lack of insights in the way exchanges of information are created or improved (Dienesch and Liden 1986). Furthermore, the theory provides no insights on building trust, respect, and commitment (Yukl 1999a). Also, critics claim that the measurements underlying LMX theory are vague (Boies and Howell 2006; Mary and George 1995; Graen et al. 1982).

Transformational theory

Transformational theory, originating from work by Burns (1978), is one of the most recent leadership theories based on two assumptions (Burns 1979): Assumption one is people will follow others who inspire them, and the second assumption is that a person with vision and passion can achieve more if supported by others. The theory is concerned with values, ethics, standards, and long-term goals by assessing followers' motives, satisfying their needs, and the treatment of them as human beings (Gordon and Yukl 2004; Bass 1990b; Burns 1979). Transformational leadership is often associated with charismatic leadership described in trait theory (Den Hartog et al. 1999; Bycio et al. 1995). These charismatic traits are an essential part of transformational theory (Shamir et al. 1993; Bass 1990b). **Charismatic leadership** is associated with traits such as a dominant, strong desire to influence others, self-confidence, and a strong sense of one's own moral values (Pearce et al. 2008; Tuomo 2006; Sankowsky 1995; Howell and Avolio 1992; Conger 1989). The charismatic behavioral characteristics can be grouped into two groups: the first group includes inspirational characteristics such as strong role models for beliefs, competent appearance to followers, articulate ideological goals with moral overtones, while the second group consists of motives. Effects of charismatic leadership are described as follower obedience, identification with the leader, emotional involvement with leaders' goals, followers' confidence in achieving tasks, expressions of warmth toward leaders, trust in leaders' ideology, and a similarity between leader and follower beliefs (Conger et al. 2000; Conger et al. 1988; Conger and Kanungo 1988).

At present, transformational leadership theory receives considerable attention (Dvir et al. 2002; Bass 1999). Transformational theory places strong emphasis on followers' needs, morals, and values; and treats leadership as a process between followers and leaders, e.g., leadership is not the sole responsibility of the leader but emerges from the interplay between leaders and followers. Critics claim that transformational theory lacks conceptual clarity (Yukl 1999a; Yukl 1999b; Yammarino and Dubinsky 1994). Transformational theory also is often interpreted as too simplistic or an either-or approach (Eagly et al. 2003; Wofford-Vicki et al. 1998; Pawar and Eastman 1997).

Transactional Leadership theory

Transactional leadership, unlike transformational leadership, is not future oriented and looks merely at the things on hand. Which means that leaders try to maintain things how they are (status quo), thus followers have to perform work tasks as they were established and according to procedures (Bass and Bass 2008; Eagly et al. 2003). Leaders using transactional leadership theory pay attention to their followers' work to spot deviations from standards and to find errors. Follower compliance to the system and the leader are promoted through punishment and rewards (extrinsic motivators). Transactional leadership includes: 1) management-by-exception, which means that a leader avoids giving directions as long as old ways of doing a job meets performance goals (Hater and Bass 1988); and 2) contingent rewards, a motivation-based system that is used to reward employees that meet their goals (Vansteenkiste and Deci 2003; Harackiewicz and Manderlink 1984). Thus, transactional leaders are seen to be directive and action-oriented (Wofford-Vicki et al. 1998; Bass 1990b). Despite the drawbacks of transactional leadership being short-term focused (not forward looking), compliance based, and lacking employee development, transactional leadership still has merit (Hater and Bass 1988). Transactional leadership has proven to be effective in crisis and emergency situations, as well as when projects need to be carried out in a specific way (McGuire and Kennerly 2006; Den Hartog et al. 1997; Bass 1990b).

Transformational and Transactional leadership

Burns (1979) describes transformational leaders as leaders who focus on higher intrinsic needs, engage with followers, and raise awareness for new ways to accomplish goals. In comparison, Burns sees the transactional leader as a leader who exchanges extrinsic rewards for the work done by compliant followers (Burns 1979; McGregor and Cutcher-Gershenfeld 2006). Taking advantage from both leadership styles, Bass (1990) argues that transactional leadership can be used to maintain a robust organization, whereas transformational leadership can be an additive to move the organization into the future as shown in Figure 14 (Bass and Avolio 1994; Bass and Avolio 1990). According to other researchers, if transformational leadership is added to transactional leadership, process performance beyond expectations can be achieved (Hirst et al. 2004; Eagly et al. 2003; Wofford-Vicki et al. 1998; Pawar and Eastman 1997; Greene 1975).

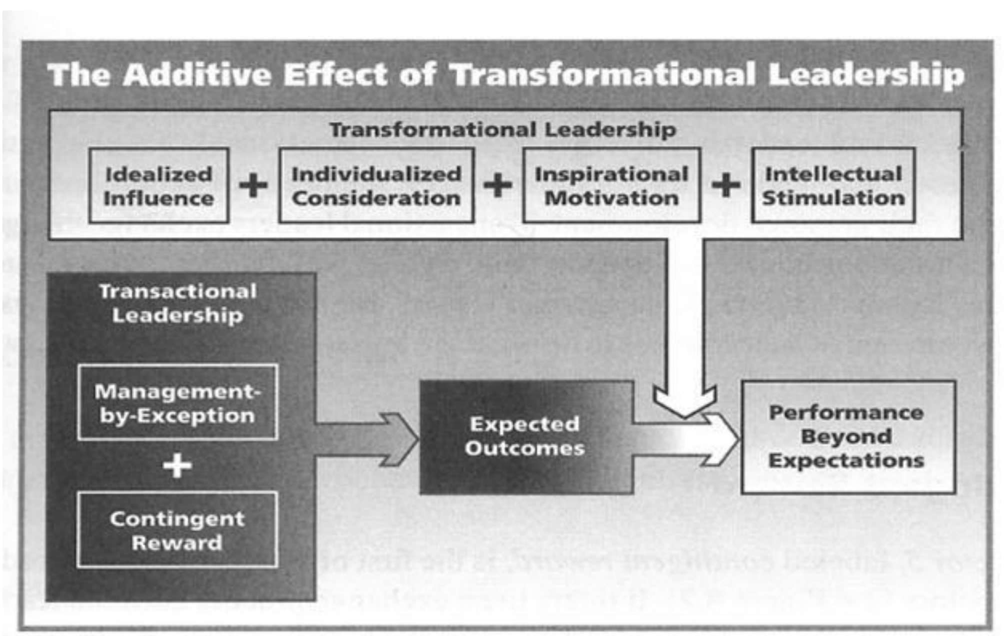

Figure 14: The additive effect of transformational leadership (Bass and Avolio 1990, p. 231)

3.3. Health care

3.3.1. Introduction to Health care

During the last decades, the U.S. health care delivery system has faced challenges that have drawn considerable attention from industry participants, politicians, and society. An increasing demand for health care services due to an increase in chronic diseases, an aging population, and technological advances faces a limited supply of physicians and nurses, an increase in the number of uninsured, continued cost pressure from healthcare stakeholders, and reduced funding from federal and state governments (Bohmer and Knoop 2007; Levit et al. 2003; McGlynn et al. 2003; Garson 2000; Levin-Scherz 2010; Porter 2009; Porter and Teisberg 2006). Also, U.S. hospitals are challenged to deliver better quality of care (Porter 2009; Kohn 2000). A report by Kohn et al. (2000) *"To Err is Human: Building a Safer Health system*," in which they reported that between 44,000 and 98,000 hospital patients die and almost a million patients are injured every year as a result of preventable medical errors (Bootman 2000; Kohn et al. 2001). These dramatic numbers induced the federal government to start an initiative to improve patient safety and to make the entire U.S healthcare system safer and more cost effective (Shortell and Singer 2008; Porter and Teisberg 2006; Singer et al. 2003). As a result, in 2001, the Federal Department of Health and Human Services (HHS), and the Centers for Medicare & Medicaid Services (CMS) launched a quality initiative to assure the delivery of quality health care for hospitals through accountability and public disclosure of quality of care measures (CMS 2012).

However, despite all these efforts, Porter (2009, pg.1) maintains that "*…The U.S. health care system remains largely the same as it was a decade ago. We have seen no convincing approach to changing the unsustainable trajectory of the system, much less to offsetting the rising costs of an aging population and new medical advances."* Porter's (2009) claim is substantiated by the ten-year anniversary report of Kohn et al.'s 2000 report "*To err is human*" by Jewell and McGiffert (2009) entitled "*To Err is Human – To Delay is Deadly. Ten years later, a million lives lost, billions of dollars wasted*." Jewell and McGiffert's (2009) report how little progress on improving the quality of care provided by U.S. hospitals has been made. These two authors' claims are supported by findings of Nolte and McKee (2008) that showed that the number of preventable deaths in the U.S. declined less over the last 10 years than in 18 other industrialized nations.

Given the challenging situation in which U.S. hospitals find themselves, one stream of discussion at the hospital level centers on ideas that promise improvements in the quality of the care delivered. Thus, research efforts have been directed towards identifying the drivers that determine quality of care performance outcomes. Examples of such drivers include hospital leadership, (Boyer et al. 2012; Dye 2000) management systems (Kovner et al. 2009; Gray 1997), or organizational factors.

3.3.2. The current state of health care

The World Health Organization (WHO) in its 2009 World Health Statistics annual report (WHO 2009) stated that in 2008, the U.S. spent more on healthcare than any other nation (roughly 15.2 percent of its Gross Domestic Product (GDP), WHO 2009). Indeed, U.S.

government spending on healthcare has dramatically increased and strains the budgets of government, corporate, and individuals. In fact, healthcare spending in the U.S. reached 17.9 percent of GDP in 2010 (Martin et al. 2012). Forecasts exists predicting that the percentage of U.S. GDP spent on health care will reach 19.5 percent by 2017 (Keehan et al. 2008), and that, thus, healthcare expenditures will grow roughly 6.7 percent per year (WHO 2009). Thus, healthcare costs in the U.S. are expected to rise faster than wages or inflation (Berk and Monheit 2001). Indeed, the U.S. has the fourth highest level of government spending per capita on healthcare (about $7,146 per capita in 2008), just behind Norway, Monaco, and Luxembourg (WHO 2011, Davis et al. 2010). Also, half of the filers for bankruptcy in the U.S. claim medical causes as the main reason (Himmelstein et al. 2005).

Health expenditures in the U.S. reached $2.6 trillion in 2010, more than ten times what was spent in 1980 (Kaiser 2012). While the growth rate of healthcare expenditures in the U.S. slowed down recently relative to the early 2000s, those expenditures are still growing faster than GDP (Ginsburg 2008). Today, with the U.S. economy struggling to regain its footing after the recent recession and unemployment still high, healthcare affordability is a topic of critical importance (Ginsburg 2004; Chernew et al. 2003). According to the Centers for Medicare which covers elderly and disabled people, and Medicaid, which serves low-income families, enrollment to Medicare and Medicaid services has grown due to the aging of the baby boomers (Reinhardt 2003), increased unemployment (Stewart 2001; Jin et al. 1995), and lower incomes for families (2009).

Healthcare spending in the U.S. is shared between hospital care (31 percent); physicians and clinical services (20 percent); other professional services (7 percent); other health, residential, and personal care (5 percent); nursing home care (5 percent), home health care (3 percent); pharmaceuticals (10 percent); retail for other products (3 percent); government administration (1 percent); health insurance administration (6 percent); allocation to investments (6 percent); and dental work (3 percent, Martin et al. 2012). Martin et al. (2012) also state that, even though there is an agreement that costs have to be better controlled, disagreement exists about the true cost drivers of U.S. healthcare. The three main cost drivers according to a report by Kaiser (2012) are: 1) technology and prescription drugs; 2) rise in chronic diseases; and 3) administrative costs. For example, the U.S. Center for Disease Control and Prevention estimated that 75 percent of healthcare expenditures in the U.S. are related to healthcare treatments for chronic diseases (Kaiser 2012; Gorwitz et al. 2009). A focus to control and reduce costs in the U.S. healthcare system has been on the rising rates of obesity and overweight, as well as their impact on chronic illness and healthcare costs (Wagner 2009; Bodenheimer et al. 2002).

While the current state of healthcare in the U.S. is challenging, the aging baby boomers, an increase in uninsured citizens, and advancements in technology, to name the most pressing issues, will put a further strain on this overextended system in the future (Kimball and O'Neil 2002; Lee et al. 2003; Oberlander 2002; O'Neil and Seago 2002).

Current discussions about healthcare in the U.S. revolve around issues like healthcare access, fairness, efficiency, and the right to receive healthcare. Another important consideration is the quality of healthcare delivered, which has been shown to be mediocre at best (Clancy 2009; Porter and Teisberg 2006). According to the WHO (2009), the U.S. has a higher infant mortality rate than most other industrialized nations (MacDorman et al. 2008) and has a life expectancy (78.40 years) that is ranked in the World Health Statistics report as being 42nd, behind most developed nations and lagging nations like Chile (35th) and Cuba (37th) (WHO 2011). Another study ranked the U.S. last in quality of care delivered among developed countries (Roehr 2008) while having the highest costs compared to GDP and per capita expenditures (Davis et al. 2010).

3.3.3. Cost drivers

3.3.3.1. Technology and prescription drugs

Today's patients demand the best technology available to cure their diseases (Altman and Blendon 1977), thereby driving up healthcare costs and insurance premiums (Baker et al. 2003). Healthcare and insurance providers have two differing views to this matter. Shactman et al.'s (2003) viewpoint is that advancements in technology can cure diseases and will prevent follow-up treatments, thereby reducing the use of the healthcare system in the future. In addition, technology can also be used to help prevent and mitigate larger health issues later in life, saving money in the long run (Shactman et al. 2003; Altman and Blendon 1977). The other viewpoint of Shactman et al.'s position is that technological advancements in healthcare do just the opposite and increase the utilization of hospitals and their equipment, because patients want to have the best and newest equipment for treatment and their care. For example, Shactman et al. (2003) point out that new advancements in technologies can lead to the extensive use of technologies just to see the entire picture of patients' health (reassurance), driving-up costs unnecessarily (Shactmann et al. 2003, Baker et al. 2003). The challenge is to find the right balance between the health of the country's citizens and the financial implications of a healthcare system achieving this goal (Shactman et al. 2003).

Another cost driver in the U.S. health care system is prescription drugs. In the late 1990s, prescription drug prices increased exponentially. For 2003, the OECD reported that U.S. national expenditure on pharmaceuticals reached 17.7 percent of total healthcare costs, compared to an average of 12.9 percent of all OECD members in 2003 (Oxley et al. 2004). This claim is substantiated by the WHO showing that the U.S. spends more on pharmaceuticals per capita than any other country in the world (WHO 2009; Hadley and Holahan 2003). The U.S. government, while being criticized for not doing enough to rein in prescription drug prices, claims that U.S. prices are increasing at this fast rate because U.S. consumers are subsidizing costs which drug companies cannot recover from consumers in other nations that use bulk-purchasing power to negotiate lower drug prices for their citizens (Bond et al. 1999). The U.S. government is trying to negotiate some drug prices, but has its hands tied due to the Medicare Prescription Drug, Improvement, and Modernization Act of 2003 (Berenson 2006) which limits such negotiated prices. Furthermore, in the U.S., drug advertisement to consumers is legal unlike in all other countries worldwide except one, giving the pharmaceutical industry even more leverage to achieve high prices and high demand (Bell et al. 1999; Holmer 1999, Wilkes et al. 2000).

3.3.3.2. Aging population and chronic diseases

To further exaggerate the challenges in the U.S. health care sector, the aging baby boomer generation, with a majority reaching retirement age in this decade (Kimball and O'Neil 2002), will stress the system even further. Lee and Skinner (1999) have shown that individuals over 65 years old consume more than four times the amount of healthcare than do those under 65. Also, Shactman et al. (2003) speculate that the assumption that there is a medical cure for almost any health condition and that baby boomers have better financial backing through quality insurance plans, may make the baby boomer generation use healthcare more extensively than past generations. Thus, indications exist that the demand for healthcare services may increase over-proportionally in the years to come (Kimball and O'Neil 2002).

Also, chronic conditions, such as diabetes, lung and heart diseases, or Alzheimer's, to name just a few, cost vast amounts of money, as mentioned before (75 percent of healthcare expenditures in the U.S. are related to chronic conditions, Kaiser 2012; Gorwitz et al. 2009). Chronic conditions also exist more frequently in older people, thus burdening the U.S. health care system ever more in the decades to come due to the aging population (Gorwitz et al. 2009). Also, as the Kaiser (2012) report discusses, obesity has doubled in adults and tripled in children in the last 20 years. It is commonly accepted that obesity increases the risk of a person needing healthcare services, thus further increasing the demand for healthcare in the U.S. (Wagner 2009).

3.3.3.3. Healthcare coverage

In 2004, the Institute of Medicine (IOM) stated that the U.S. is among the few industrialized nations globally that does not guarantee access to healthcare for its entire population (Uninsurance 2004). The only exception of nations who are members of the OECD (Organization for Economic Co-operation and Development) that did not achieve universal healthcare coverage (definition of universal healthcare coverage is 98.4 percent or more of the population being insured) by 1990 were the U.S., Turkey, and Mexico (Oxley et al. 2004). The same IOM report (Oxley et al. 2004) also stated that about 18,000 unnecessary deaths due to a lack of healthcare coverage occur every year in the U.S. (Uninsurance 2004). Another study by Harvard University in 2009 estimated that nearly 45,000 deaths per year occur because of a lack of insurance (Wilper et al. 2009). Thus, recent legislation has been passed to deal with the problem (details can be found in subchapter 2.3.4. below).

In the U.S., healthcare facilities and hospitals in particular are owned and operated by private for profit and not for profit entities, whereas health insurance is primarily provided by the government as a healthcare provision that comes from programs like Medicare, Medicaid, Veterans Health Administration, Prescription Assistance (SPAP), Military Health System (TRICARE), State Children's Health Insurance Program (CHIP), the Program of All-Inclusive Care for the Elderly (PACE), the Indian Health Service, and the Federal Employees Health Benefits Program, to name a few (Connors and Gostin 2010). However, private health coverage consists of so called consumer-driven vehicles like flexible spending accounts (FSA), health reimbursement accounts, and health savings accounts such as high deductible health plans

(HDHP) and medical savings accounts (MSA). Private health coverage also includes private health insurance, managed care products, and services from the health maintenance organization (HMO), and preferred provider organization (PPO, Uninsurance 2004).

As administrative overhead costs can be attributed to the highly complex private health insurance system in the U.S., and as more regulations by the government are issued, costs are more likely to soar (Anon. 2011). Woolhandler et al. (2003) shows evidence that the U.S. health care's bureaucratic system is growing and thus will add more costs. Overall administrative costs include insurer costs, costs borne by employers, health care providers, government and patients.

The U.S. healthcare sector is funded by payments from insurance plans (as discussed above) or patients, in a scheme called fee for service (FFS). Overall, about 83.7 percent of the U.S. population has some kind of health insurance: 59.3 percent are covered through their employer or the employer of the spouse or parents; 8.9 percent have individually purchased coverage; and about 27.8 percent are covered by government programs (HHS 2007).

Funding for the U.S. healthcare sector is provided by private insurance (36 percent), private out-of-pocket payments (15 percent), the Federal government (34 percent), state and local governments (11 percent), and other private funds (4 percent, HHS 2007). Insurance for dental and vision care usually are sold separately.

The two major federal laws that regulate the private healthcare insurance sector are the Consolidated Omnibus Budget Reconciliation Act (COBRA) that requires health plans to provide a temporary continuation of group health coverage that would otherwise be lost due to certain events like death (Zuckerman et al. 2001; Rogowski et al. 2000) or the Health Insurance Portability and Accountability Act (HIPAA) that protects health insurance coverage for workers and their families when changing or losing their jobs (Annas 2003). With all the healthcare bills passed and new legislations (Consolidated Omnibus Budget Reconciliation Act (COBRA); Medicare Prescription Drug, Improvement, and Modernization Act, Patient Protection and Affordable Care Act (PPACA); Care of Education Reconciliation Act to name a few), the U.S. health insurance system is complex, thus causing considerable administrative costs (Woolhandler et al. 2003).

3.3.3.3.1. The uninsured

Some members of the U.S. population are not able to get health insurance by their employer while they also do not qualify for government-provided health insurance but cannot afford to purchase private health insurance. These individuals remain uninsured and the U.S. Census Bureau in 2010 estimated that 16.3 percent (roughly 50 million residents) of the U.S. population are indeed uninsured (Proctor 2010). In fact, the number of uninsured individuals increased by almost a million from 2009 to 2010 due to the economic challenges that the nation faced. An estimated 80 percent (40 million) of the uninsured individuals were aged between 18 to 64, of which 28 million reported that they work at least part-time (Proctor 2010). Also, strikingly, 37 percent (18.5 million) of the uninsured lived in households with an income greater than $50,000 (WHO 2011). Furthermore, about 10 percent (5 million) of the uninsured were without health insurance because of pre-existing conditions and thus are considered as “uninsurable” (Proctor 2010). Interestingly, the WHO (2011) estimated that 19 percent (9.5 million) of the uninsured U.S. population appears to be able to afford insurance while about 25 percent (12.5 million) of these individuals are eligible for public coverage.

Health care providers in the U.S. have a mandate to provide emergency care to all patients regardless of the presence or the absence of insurance. The cost of delivering healthcare to uninsured individuals is largely absorbed by health care providers (e.g., hospitals) through charity care, cost-shifting to the insured (e.g. by increasing the prices for services to insured individuals), or in some cases, costs are covered by taxpayers, if Medicare and Medicaid becomes involved. Hadley and Holahan, in 2003, estimated that about $35 billion worth of uncompensated health care was delivered to the uninsured in 2001 in the U.S. (Hadley and Holahan 2003; Hadley 2003). However, these estimates of healthcare not covered for the uninsured vary widely. Another study estimated the cost for the healthcare waived for uninsured in the U.S. to be up to $130 billion per year (Miller et al. 2004).

Despite some access to health care by the uninsured, Davis et al. (2010) states that in many cases, the lack of health insurance does not allow the uninsured to obtain timely medical care. These uninsured individuals have an estimated 40 percent higher risk of death than individuals with health insurance, resulting in about 45,000 preventable deaths per year (Davis et al. 2010). Furthermore, the failure to provide access to healthcare for the uninsured and deny them preventative care increases healthcare costs in the future as the uninsured grow older and will need more care than if they would have been able to obtain proper care throughout their life (Ayanian et al. 2000).

3.3.4. Healthcare reform

The history of healthcare reform in the U.S. is full of initiatives for a comprehensive, national health insurance system to support universal coverage. In the 1960s, Senator Robert Kennedy suggested a universal single payer system, to which President Nixon reacted with a proposal based on mandates and incentives for employers to offer healthcare coverage, while establishing public coverage for the unemployed (Wainess 1999; Marmor 1994). However, consent was never reached. Years later, in the 1990s, Bill Clinton proposed a new universal health insurance system similar to Nixon's plan (Wainess 1999). However, this time, the mandates were binding for individuals and insurers. Under Clinton's plan, public subsidies would have been offered for people that could not afford insurance. As before, the bill was opposed and ultimately failed in 1994 after the takeover of the Senate by the Republicans (Skocpol 1997). Nevertheless, the universal health coverage goal remained an important priority among democrats. Similar to Nixon's (President 1969 – 1974) and Clinton's (1993 – 2001) proposals, the Obama administration, in 2009, proposed the Patient Protection and Affordable Care Act (PPACA), mandating coverage for everyone and disciplining employers that do not offer healthcare coverage to their employees (Kaiser 2012). Also, the PPACA extends coverage to uninsured individuals by making them eligible for Medicaid (Uninsurance 2004). The PPACA bill includes financial incentives (e.g. tax cuts) for employers to provide health insurance to employees and requires citizens without employer or without public coverage to purchase health insurance from state insurance exchanges. Furthermore, the bill enacted modifications on public coverage like Medicare and Medicaid.

In 2010, the Congressional Budget Office estimated that about 33 million uninsured citizens would receive healthcare coverage based on the PPACA legislation by 2022 (Congressional Budget Office 2010, Uninsurance 2004). The Patient Protection and Affordable Care Act (PPACA) was signed into law on March 23, 2010 and was amended by the Care of Education Reconciliation Act that became law on March 30, 2010.

3.3.5. U.S. hospitals

In 2009, according to the American Hospital Association (AHA), there were a total of 5,008 U.S. registered community hospitals covering 805,593 beds (accredited by the Joint Commission on Accreditation of Healthcare Organizations or certified under title 18 of the Social Security Act, AHA 2011a; AHA 2011b). Community hospitals are classified as nonfederal, short-term general, and special hospitals with facilities and services that are available to the public. Special hospitals, which include children's hospitals, are comprised of rehabilitation; orthopedic; eye, ear, nose, and throat; obstetrics and gynecology; and other described specialty services (2011). Figure 15 shows the distribution of community hospitals in each state of the Union, with only 7 hospitals located in Delaware (DE) to 428 hospitals spread throughout Texas (TX).

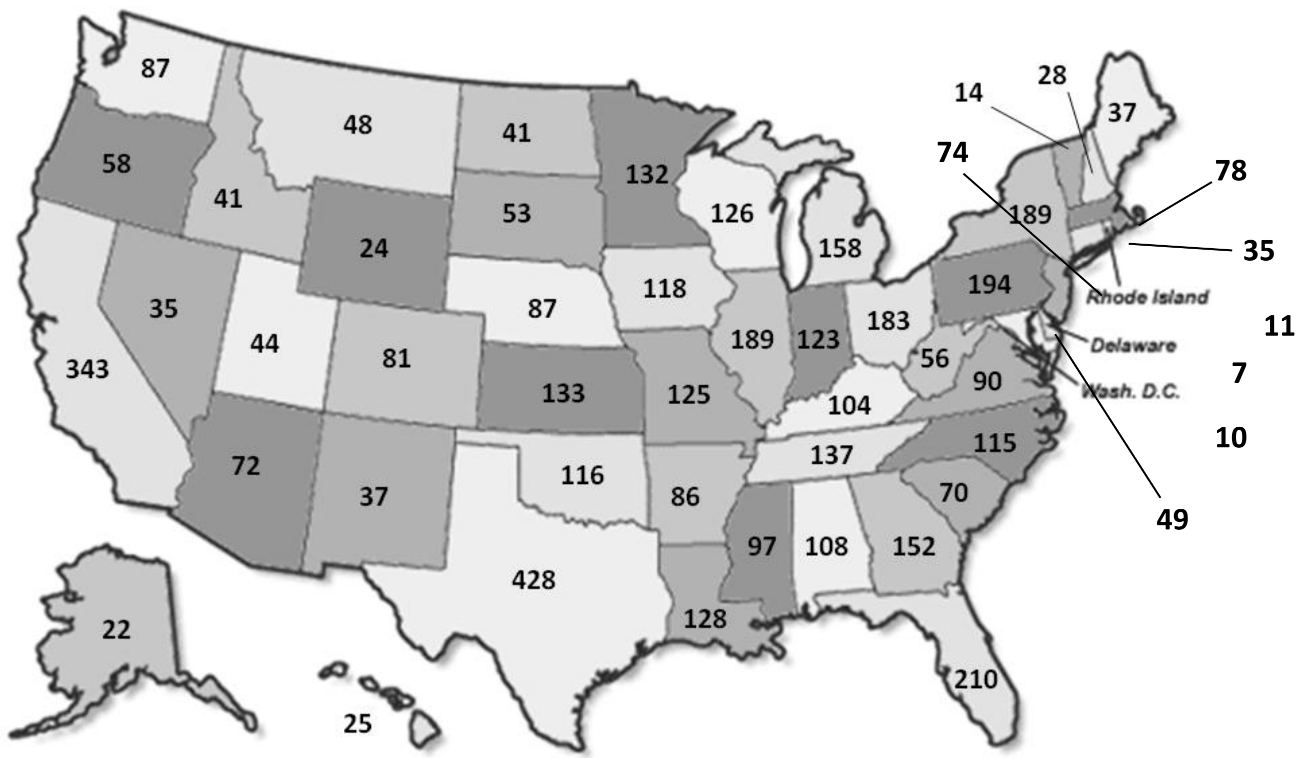

Figure 15: Number of hospitals per state (adapted from: http://www.energycodes.gov/images/us_map_colored.gif)

The 5,008 registered community hospitals in the U.S. have a total of 805,593 beds. The number of beds based on a per capita basis shows the health care delivery coverage of a nation, state, or region. The Organization for Economic Co-operation and Development (OECD 2002) states that only four countries have fewer acute care hospital beds per capita than does the U.S. The OECD average is 3.8 per 1000 citizen, while the U.S. average is 2.7 beds per 1000 citizens, while Japan, the global leader, has 8.2 beds per 1000 citizens (Oxley et al 2004). Generally speaking, a higher number means better availability of healthcare services. The American Hospital Association (AHA 2011b) reports that from 2000 to 2009, the number of hospitals in the U.S. increased by 1.9 percent, whereas the total number of beds decreased by 2.2 percent resulting in reduced health care coverage availability for U.S. citizens. The total number of hospital beds per state ranges from 1,296 in Vermont (VT) to 68,745 in California

(CA, Appendix A). The number of beds per capita differs from having 1.7 beds/1000 citizens in Oregon (OR) and Washington (WA) to having 5.8 beds/1000 citizens in the District of Columbia (DC, Appendix A).

3.3.6. Physician and nursing shortages

The number of physicians per capita allows us to make comparisons between the healthcare coverage of countries, states, and regions. According to 2002 statistics from the Organization for Economic Co-operation and Development (OECD), the global average for the OECD countries was 2.9 physicians per 1,000 citizens, the U.S. had 2.3 physicians per 1,000 citizens and ranked 52nd globally, whereas nations like France and Germany had 3.4 physicians per 1000 citizens (Siegel 2009). By 2008, the OECD average was 3.1 physicians per 1,000 citizens, while the U.S. had 2.4 physicians per 1,000 citizens (Bartlett 2009). Physicians in the U.S. are cultivated by the U.S. medical education system and receive a license to practice. Additionally, internationally trained medical graduates who have acquired medical licenses by U.S. state agencies (HHS 2012) are also employed by the U.S. health care system. Given the increasing demand of healthcare, the U.S. is facing a shortage of physicians. Sataline and Wang (2010) cite experts who warn that the demand for health care of newly insured under the Care of Education Reconciliation Act will cause a shortage of physicians and nurses. These two authors claim that given current graduation rates, the U.S. would face a shortage of about 150,000 doctors over the next 15 years. This shortage of physicians will limit access to healthcare and cause longer waiting times for the population in need. Primary-care physicians are the group with the most severe shortage, expected to number 45,000 missing physicians by 2020 (Salsberg and Grover 2006). This number is supported by an article in the Washington

Post in 2010 (Halsey 2009) stating that roughly 40,000 primary care doctors, including internal medicine, gynecology, family practice, and pediatrics, would be missing by 2020 (Halsey III 2009). This number of missing primary care doctors is based on a 52 percent drop in the number of graduates since 1997.

Shortages are also reported for nurses. The American Association of Colleges of Nurses warns about a shortage of registered nurses (Coile et al. 2002). The estimated shortage is projected to increase from 135,000 positions in 2007 to 230,000 positions by 2025 (Rosseter 2005). Other studies (Janiszewski-Goodin 2003; Greiner and Knebel 2003) show that, due to the increase in demand of healthcare services by the baby boomer generation, the shortage of registered nurses will be even more severe. Also, 40 percent of nurses in the U.S. are 50 years or older (Buerhaus et al. 2000) and will retire relatively soon. However, several possible solutions are discussed in the literature to mitigate the shortage of registered nurses (Janiszewski-Goodin 2003; Greiner and Knebel 2003). Ideas include, for example, federal grants for nursing students, technological advances to reduce the number of nurses required, and educational tools to educate nurses to be more productive (Janiszewski-Goodin 2003).

3.3.7. Chief Executive Officers (CEOs) in hospitals

According to the American College of Healthcare Executives (2011), the leadership turnover rate remains high at U.S. hospitals. In 2011, the U.S. hospital CEO turnover rate was 16 percent (Commins 2012), a rate higher than the 13 percent CEO turnover rate in fortune 100 companies (Commins 2012). Commins (2012) explains the high turnover rate with the following four possibilities: 1) the demanding nature of a hospital CEO position nowadays, where hospital CEOs have to deal with healthcare reform and a wide variety of stakeholders, besides running a business; 2) the high demand for individuals in hospital CEO positions, giving incumbents plenty of opportunities to find better positions; 3) the quick termination of low performing hospital CEOs, where, in fact, every fifth is laid off; and 4) the hospital CEOs average age (55 years, e.g., baby boomers) and thus, a high percentage of CEOs are retiring. Another alarming trend, according to Thomas C. Dolan, president and CEO of the American College of Healthcare Executives, is that most hospital CEOs (58%) have been on duty for less than 5 years and therefore might not be able to make the necessary changes stick (Commins 2012; Khaliq et al. 2006). Despite the high CEO turnover rate, the aging of CEOs in healthcare, and the limited time a CEO is in his position, most hospital organizations do not have a CEO succession plan in place. Results from a survey conducted by the American College of Healthcare Executives (2008) showed that only 20% of hospital organizations in the U.S. have a CEO succession plan. Groves (2007) and Biggs (2004) show evidence that the most successful succession plans emerge when the board of directors starts to work with the new CEO on succession planning right from the beginning. However, only a few of the U.S. hospitals or hospital chains have adapted this approach (Groves 2007; Biggs 2004). Alexander and Lee (1996) stated that a hospital's board of directors should focus on identifying successors from within the organization and if that is not possible, have an internal interim CEO until an outsider can be recruited to fill the position. Alexander and Lee's (1996) suggestion are supported by a study by Garman and Glawe (2004) that showed that hospitals that established succession planning and CEO recruiting from within the organization showed better financial returns and more stability regarding performance outcomes than hospitals without such plans. (Rothwell 2010; Garman and Glawe 2004). In fact, multiple authors (e.g. Rothwell 2010; Groves 2007; Blouin et al. 2006; Biggs 2004; Garman and Glawe 2004) argue that especially larger hospital organizations have the possibility to groom several internal candidates as successors and then select the most promising one for the CEO position. However, according to Rothwell (2010), the board of directors needs to help any CEO successor to fill the position by coaching and supporting them.

3.4. Leadership and hospital performance

Given the extensive debate about the future of health care in the U.S. (Dellit et al. 2007; Elwood 2007; Porter and Teisberg 2007) and the financial implications of health care on the future prosperity of the nation (Busse et al. 2003), extensive resources are expended to better understand the current state of health care and to search for improved solutions. One such area of interest is the link of leadership traits and hospital performance.

3.4.1. Leadership traits in healthcare

A large part of the research done in the area of leadership traits and performance has looked at the broader field of health care, of which hospitals are a subset. Limited research has focused on leadership traits and hospital performance, and most of these efforts have focused on leadership and employee motivation (Spinelli 2006; Alexander et al. 1993). However, to our knowledge, no study exists that researches the relationship of leadership traits of executives and hospital quality of care performance.

Schultz et al. (2004) debate the question of who better suits the position of a chief executive officer (CEO) of a hospital, a manager with an education in business (MBA) or an individual trained in medicine (MD). Schutlz et al.'s study compares CEOs with either background on their ability to make sound strategic decisions that maximize the quality of care and the income of a hospital. Their study concludes that no significant differences between CEOs with different backgrounds (business versus medicine) exist and that thus, a CEO candidate's educational background should not play an important role in the selection process. Ford, in 2005, describes the case of the Spartanburg Regional Healthcare System (SRHS). SRHS was trying to create a collaborative environment (a learning organization) to execute change more effectively within the organization. Ford's study used qualitative and quantitative research to depict findings of behavioral change at SRHS from May 2000 to Dec. 2003. Findings of the research study show that management behavior on an organizational level as well as the relations between the CEO and the VPs were changing towards a participative leadership style. This change also resulted in more contact to the patients, which in turn improved patient satisfaction from 50 to 90 percent. A study published in 1995 (Anon. 1995) focused on assessing the traits of a successful chief executive officer (CEO) in healthcare. Findings include that a successful CEO has to possess the following traits: responsibility, creativity, ability to deal with stress, insights, and good communication skills. Another study, conducted by Hudak et al. (1993), describes job skills, knowledge, and capabilities necessary to be a successful hospital manager. The study concluded that managers in hospitals should focus on the business aspects of a hospital, in particular financial performance, organizational restructuring, succession planning, and the development of leadership capabilities.

However, as pointed out before, the research of the relationship between leadership traits and hospital performance has received minimal attention so far. Waldman et al. (1998) assessed individuals in manufacturing and hospitals on transformational leadership activities as predictors of financial performance (Waldman et al. 1998). Nurse (2011) looked into executive leadership traits (transformational and transactional) affecting hospitals' financial performance. Nurse (2011) used a quantitative multivariate correlation research study with an existing MLQ likert-scale questionnaire (Avolio and Bass 2000) to survey selected CEOs at not-for profit hospitals in Canada and the U.S. Nurse's findings suggest that leadership traits influence financial performance of hospitals in both countries. Specifically, transactional leadership traits affected financial performance in Canada's hospitals, whereas a combination of transformational and transactional leadership traits influenced U.S. hospitals financial performance (Nurse 2011). Other studies, e.g., Marley et al. (2004) or Flynn et al. (1994) have shown that leadership, as an individual factor, has an influence on hospital performance outcomes. These studies, however, have not looked at individual leadership traits but at leadership as a group variable.

3.4.2. Hospital performance measurement

Discussion exists in the literature about the correct performance measures to evaluate hospital performance. In fact, most studies are based on either financial or quality performance indicators.

Several studies (Younis and Forgione 2005; Bazzoli et al. 2000; Watkins 2000; Zeller et al. 1997) investigated **financial performance** measures at U.S. hospitals. Younis and Forgione (2005) investigated hospital profitability by comparing return on equity (ROE) with total profit margin, accounting for inflation and other prominent factors. Findings suggested that total profit margin (TPM) is a better measure of profitability (hospital performance) than return on equity (ROE). Zeller et al. (1997) studied the effectiveness and meaningfulness of financial ratios to evaluate hospital performance over a period of 4 years. They concluded that hospital financial performance can best be measured by the following six financial characteristics: profitability, liquidity, debt coverage, capital structure, working capital, and fixed asset efficiency, as well as fixed asset age. Bazzoli et al. (2000) investigated financial performance of hospitals based on changes in net patient revenues per patient day and the ratio of cash flow to total revenues. Bazzoli et al. (2000) found that cutbacks in financial spending, due to increasing financial pressure led to poor patient outcomes. In 2000, Watkins investigated hospital performance by relying on 21 financial ratios combined with 10 non-financial factors, concluding that non-financial factors are highly significant in explaining bond ratings. All these studies (Younis and Forgione 2005; Bazzoli et al. 2000; Watkins 2000; Zeller et al. 1997) supported the notion that financial performance measures are the only means to measure hospital success, except for a study by Watkins (2000) who showed that non-financial factors are significant in describing performance of hospitals.

Various theoretical frameworks to study **health care quality** of hospitals in the U.S. have been discussed. While some researchers have employed subjective measures, such as cleanliness of patient rooms or attention of physicians to patients, (Arrow et al. 2009; Meyer and Collier 2001), others have focused solely on a set of core measures for serious health conditions that can be related to preventable medical errors (acute myocardial infarction (AMI) rate, heart failure (HF) rate, pneumonia (PN) rate, and surgical care improvement project (SCIP rate, Boyer et al. 2012; Marley et al. 2004; Flynn et al. 1994) . These core measures for serious health conditions quality measures are publicly available (CMS 2012; Porter and Teisberg 2007; Tucker et al. 2007) and make hospital comparisons across U.S. hospitals possible.

Even though some researchers have claimed that the use of quality performance measures provide a good explanation of hospital performance (Boyer et al. 2012; Singer and Shortell 2008; Marley et al. 2004), others have argued that these quality performance measures should be complemented with financial measures (Sugarman and James 2004; Watkins 2003; Kaplan and Norton 1996; Walker 1993). Yet another set of researchers argued that financial performance measures alone are the best means to explain hospital performance (Nurse 2011; Younis and Forgione 2005; Younis et al. 2003). However, while these conflicting opinions are based on sound reasoning, agreement exists that the quality of care impacts hospitals' financial performance (Alexander et al., 2006; Born and Simon 2001).

3.5. Survey research design

3.5.1. Introduction

Researchers typically use one of six methods to collect relevant data from a given population (Kent 2001; Weisberg et al. 1996). These six methods consists of focus groups, literature research, personal interviews, telephone surveys, and mail or online surveys (Creswell and Clark 2007; Fink 1995; Alreck and Settle 1995; Rea et al. 1997; Weisberg et al. 1996). Telephone, mail and online surveys are considered to be similar as they all rely on preparing a questionnaire that asks the same questions either on the phone, by mail, or online. In some cases, a similar questionnaire is also used for personal interviews (Alreck and Settle 1995; Fink 1995; Rea et al. 1997).

A survey is defined as the process of taking measurements on a population or a sample of a population to make inferences about characteristics of the population at a certain point in time (Kent 2001; Ott and Longnecker 2008; Couper et al. 2001; McConnell 2003; Rea et al. 1997). However, a colloquial definition of a survey is a questionnaire with rated or open-ended questions designed to gather data on a topic of interest (Gorchels and NetLibrary 2000; Rea et al. 1997; Dillman 2007). To make inferences about a larger population, where only a subset can be questioned, a random selection of units in the population has to be guaranteed, e.g., there shouldn't be any bias in the selection process of survey participants. The survey design is important since it is the instrument used to gather information on which the findings are based (Weisberg et al. 1996; McConnell 2003; Rea et al. 1997; Dillman 2007; Alreck and Settle 1995).

If the information gathered is accurate, the probability of having dependable results are higher, leading to better results (Fowler 1995; Fink 1995; Dillman 2007; Alreck and Settle 1995).

3.5.2. Survey research design roadmap

The survey research design usually follows an orderly and specific procedure (Fowler 1995; Alreck and Settle 1995; Rea et al. 1997). The process of survey design consists of the methodology to carry out the survey, the determination of the feasibility of the methodology, the development of the questionnaire, the selection of a sample, a pilot test, the revision of the questionnaire, the execution of the survey, the analyzing of the data, and the preparing of the report (synthesis). Figure 16 displays a graphical representation of the survey design process (Fowler 1995; Alreck and Settle 1995; Rea et al. 1997).

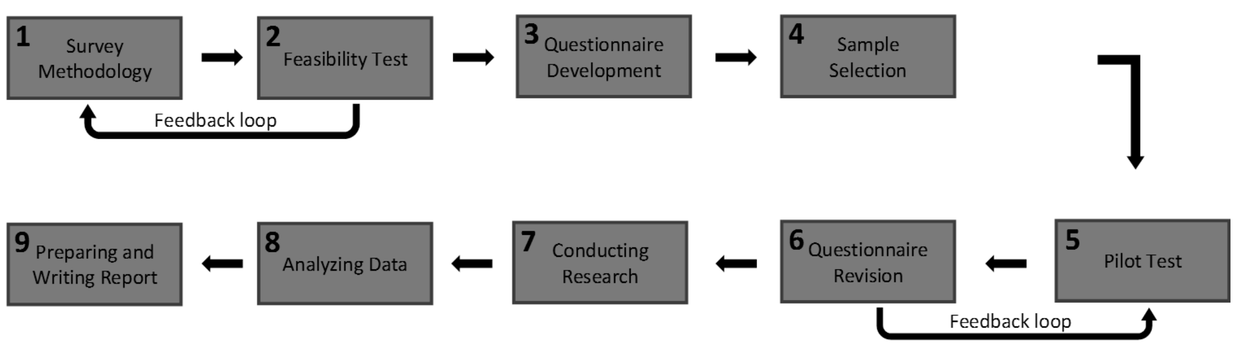

Figure 16: Survey roadmap (adapted from Fowler 1995; Alreck and Settle 1995; Rea et al. 1997)

Step 1, survey methodology, and step 2, feasibility test, are interconnected with a feedback loop to allow the researchers to undertake revisions to assure the feasibility of the study. Another feedback loop exists between step 5, conducting the pilot test, and step 6, questionnaire revision, to allow for improvement of the questionnaire to assure the quality of the responses.

3.5.3. Survey design

Research has proven that the design of questionnaires is the most critical part in conducting surveys, as the most common problems in survey analysis can be traced back to the design of questionnaires (Couper et al. 2001; Isaki and Fuller 1982; Alreck and Settle 1995). An important consideration before the development of a questionnaire is to know and to reflect on the **goals of the study**. A clear, concise statement of the goal(s) drafted prior to starting work on the questionnaire will make the design of the questionnaire considerably easier and the outcomes better (Alreck and Settle 1995; Creswell and Clark 2007). Also, the use of the data gathered and the results to be created from the survey have to be kept in mind throughout the entire surveying process. The **length of the questionnaire**, with a few exceptions, should be short and consist only of questions targeted towards the study's goal(s), as short questionnaires are likely to get more responses (Creswell and Clark 2007; Alreck and Settle 1995; Yin 2009). High response rates are the most important indicator of how much confidence can be placed in the results of the survey and are, therefore, an important criteria for the success of the research (Ott and Longnecker 2008; Fink 1995). Successful surveys have been developed in **collaboration** with researchers in conjunction with experts and relevant stakeholders, as such, expert and stakeholder input typically improves the questionnaire and the confidence that can be placed in the results (Rea et al. 1997). Furthermore, in Step 1 (survey methodology, Figure 16), a **plan for statistical analysis** has to be formulated to understand how each question will be analyzed and how missing data might affect the results.

In a mail survey, the design and **appearance of the envelope** should be unique, since this is the only way to make a good first impression to potential respondents. The best envelope designs are those that instill a desire in the recipient to want to see what is inside and are usually made from colored stock, hand addressed, and use commemorative post stamps (Gorchels and NetLibrary 2000; Rea et al. 1997; McConnell 2003). What the envelope is to the mail survey, the subject line is to the e-mail survey. A well-formulated subject line can enhance chances that the recipient will actually open the e-mail. **Well-written cover letters and e-mails** for the marketing of surveys is important and should not be underestimated since letters and e-mails give the first impression and might lead to a higher response rate if the respondent can be persuaded to respond to the survey (Dillman 2007). Two additional considerations need to be considered when designing a survey. The first is to write a **short and meaningful title** onto the questionnaire, followed by clear and concise instructions on how to complete the questionnaire. This makes the questionnaire easy to understand for the respondent. Secondly, **incentives** need to be considered when developing a survey. Incentives are used to motivate the respondent to properly complete the questionnaire. A good incentive increases a respondent's desire to complete the survey. Incentives can take the form of offering free summary reports and benchmarks, but can also have the form of attaching coupons or the handing out of giveaways (Dillman 2007; Yin 2009; Gorchels and NetLibrary 2000).

The **questionnaire** needs to be created considering the language, how to place questions, allowing space for comments, the design, and incentives. The questionnaire should always **begin with a few interesting** and **non-threatening questions**. If that is not the case, the likelihood that the respondent does not complete the survey is higher. Generally, people will make a decision whether or not to complete the survey after the first couple of questions. Thus, it is important to encourage them to continue the survey by giving them interesting questions first (Alreck and Settle 1995; Creswell and Clark 2007; Fowler 1995; Fink 1995; Rea et al. 1997; Weisberg et al. 1996). **Important questions**, however, should be placed in the **first half of the questionnaire** since respondents often send back partially answered questionnaires. Placing these questions in the first half of the questionnaire allows getting the most important questions answered (Dillman 2007; Fink 1995; Fowler 1995; Couper et al. 2001). **Good questions**, according to Fowler (1995) and Alreck and Settle (1995) are questions that evoke the truth, can accommodate all answers, asks for an answer on only one dimension, and leaves no ambiguity in the mind of the respondent (e.g., question consists of mutually exclusive options). Good questions also produce variability of responses, transitions easily from the preceding question, do not presuppose a certain state of knowledge, do not imply a certain answer, do not use unfamiliar words or abbreviations, do not ask a respondent to rank a series of more than five factors, are not dependent on previous questions, and does not use emotionally loaded or vaguely defined terms (Fowler 1995; Alreck and Settle 1995). The **wording** of **questions** is one of the most important criteria for a successful survey design; however, the effects of the wording of questions are one of the least understood in questionnaire research. Rea et al. (1997) states that the following words, especially adjectives and adverbs, should not be used: most, numerous, many, a substantial majority, and several. Other adjectives that have a shared meaning and variability and thus should be avoided are: almost all, virtually all, a majority.

Throughout the questionnaire, it is important to keep the **respondent's interest** in the survey alive. Varying the question format and the type of questions throughout the questionnaire can help maintain the interest of the respondent (Isaki and Fuller 1982; Fink 1995; Rea et al. 1997; Alreck and Settle 1995). However, as Alreck and Settle (1995) state, it is also of importance to cluster questions into **coherent clusters** so that questions flow smoothly from one to the other. The questions should be kept in simple and direct language (e.g., to the point) so that the questions are easy and clearly understandable for the respondent. Thus, uncommon words and long sentences should be avoided. Using **brief, simple, and easy to understand questions** will make the questionnaire appear to be easier to complete and will reduce misunderstandings. Misunderstanding of questions can also be reduced and eliminated through **emphasizing crucial words** by using **bold** or *italics* (Rea et al. 1997; Weisberg et al. 1996). Adequate space for the respondent to make **comments** should be given in each survey to gather valuable information that is not captured by the questions. Also, Rea et al. (1997) stress the point that space for comments and remarks make the questionnaire look more interesting and therefore increases the response rates. Finally, emphasis should be put on making the questionnaire unique, convenient, and easy to fill out. Making the **questionnaire unique** can be achieved by anything that makes the survey stand out from all the other surveys the prospective respondent receives, for example through the use of different inks and/or papers. To make responding **convenient** for the respondent, a mail survey always needs to include a self-directed postage pre-paid envelope. Research has shown that envelopes with postage stamps get better response rates than business reply envelopes (pre-addressed, specially formatted, usually bar-coded envelopes that enable a business to pay the postage for mail received from its customers). However, generally, online surveys are even more convenient than mail surveys for respondents, but the communication regarding an online survey (e.g., the invitation e-mail) can get lost in spam filters (Alreck and Settle 1995; Couper et al. 2001; Rea et al. 1997). The final test of a questionnaire is to conduct a test-run on selected representatives of the sample population to identify problems with the questionnaire. Questionnaires typically are revised after a test-run to alleviate all the problems discovered. Being present when the representatives fill out the test questionnaire to discover problems right away is the most preferred method for conducting a test survey, but might not always be feasible (Rea et al. 1997; Fowler 1995).

3.5.4. Response rate

The response rate is the most important indicator of how much confidence can be placed in the results of the survey. Fowler (1995) estimated that typical response rates for surveys sent out without **reminder post-cards and follow-up questionnaires** is somewhere between 10 and 60 percent, depending on the kind of questionnaire that was distributed. Since response rates often are too low for the intended purpose of a study, research has proven that one of the most powerful tools of increasing response rates is using follow-up questionnaires and/or reminder letters (Fowler 1995; Alreck and Settle 1995; Weisberg et al. 1996). Most typically, researchers mail another copy of the questionnaire as the follow-up. Also effective are follow-up postcards to remind prospective respondents to complete the survey. Indeed, research has shown that follow-up postcards result in an increase of response rates by about 4 percent (Rea et al. 1997; Dillman 2007). However, Dillman (2007) shows that the most successful results in increasing response rates have been achieved by using phone calls, with increases ranging from 6 to 10 percent. Response rates might also be influenced by the quality of the questionnaire, e.g., the order of the questions and the transition between questions (Alreck and Settle 1995; Weisberg et al. 1996). Dillman (2007), however, points out that the evidence for this claim is not conclusive and further research is needed.

Also, the perceived **confidentiality and anonymity** of answers might have an impact on the response rate (Creswell and Clark 2007; McConnell 2003; Couper et al. 2001). Other researchers reported that responses became more slanted when respondents felt threatened that their identities would become known (Rea and Parker 2005; Rea et al. 1997). However, other researchers found that confidentiality and anonymity does not affect response rates and responses (Dillman 2007; Weisberg et al 1996; Alreck and Settle 1995).

Another rule of thumb, claimed by some researchers but denied by others, is that the **length of the questionnaire** affects response rates, as well. Long questionnaires get fewer responses than shorter questionnaires (Alreck and Settle 1995; Rea et al. 1997). However, other studies have shown that the length of the questionnaire does not necessarily affect response rate (Dillman 2007; Weisberg et al 1996). Thus, based on the evidence available, the content of the questionnaire and the quality of the questions are more important in determining response rates than is the length of the questionnaire. Respondents are more likely to respond if they feel involved and are interested in the topic (Dillman 2007; Couper et al. 2001; Fowler 1995).

Nonmonetary **Incentives** have been proven to increase response rates only if they were enclosed with the survey. According to Dillman (2007) and Yin (2009), the average increase in response rate for monetary and nonmonetary incentives was between 9 and 20 percent, respectively (Yin 2009; Dillman 2007). These numbers are supported by other sources that have found that smaller monetary incentives do not work as well as higher monetary incentives in increasing response rates (Alreck and Settle 1995).

Sponsorship is another factor that affects response rates. In a study conducted by Dillman (1978), University sponsorship was the most effective type of sponsorship and resulted in an increase of responses by almost 10 percent. This might be explained by the benefits that university sponsors do not imply advertising and/or sales to potential respondents compared to business sponsors (Fink 1995; Fowler 1995; Gorchels and NetLibrary 2000; McConnell 2003; Alreck and Settle 1995).

Deadlines for responding have proven to be contra-productive and resulted in a slight decrease in responses (Couper et al. 2001). This might be explained by the fact that prospective respondents do not complete the questionnaire after the deadline has past (Couper et al. 2001). However, others argue that shorter times for responding do not affect the response rate in either way (Dillman 2007; Rea et al. 1997).

3.5.5. Sample

Often, the target population is difficult to define because there are options to use the whole population (census survey), the ideal population, and the negotiable maximum population (e.g. based on costs, time, and effort, Dillman 2007). Thus, the methodology to define a target population does not follow any strict rules, and the researchers must rely on self-judgment and logic (Dillman 2007). However, the target population can be framed and defined based on the objectives of a given research project (Rea and Parker 2005). Depending on the research topic, the research population in question may be small and the researcher can include the entire population in the survey, resulting in a census survey (Rea and Parker 2005). However, most often, the population in question is too large to attempt a full study and therefore requires a carefully chosen sample (e.g., a subset) that acts as a representative for the entire population. **Samples** can be classified into two categories: 1) **probability** sampling and 2) **nonprobability** sampling (Alreck and Settle 1995; Dillman 2007; Rea et al. 1997; Isaki and Fuller 1982; Couper et al. 2001; Fowler 1995). In probability samples (random, systematic, and stratified sampling), each member of the population has a known non-zero probability to be selected, whereas nonprobability sampling (snowball, judgment, convenience, or quota sampling) consists of selecting members of the sample from the population in a nonrandom manner. Advantage of the probability sample is that the sampling error (e.g., the degree to which the sample can differ from the population) can be calculated, while in nonprobability samples the degree to which the sample differs from the population remains unknown (Alreck and Settle 1995; Weisberg et al. 1996; Rea et al. 1997; Creswell and Clark 2007). Both methods, probability and nonprobability sampling, are discussed below.

3.5.5.1. Probability Samples

Stratified Sampling is superior to random sampling because it reduces the sampling error. A subset of the population that shares at least one characteristic is called a stratum. Applying stratified sampling, the researcher has to identify a stratum or strata within the population (e.g., females and males) and then use random selection of subjects of each stratum until the number of selected subjects is proportional to the population, e.g. 45 percent male to

55 percent female (Alreck and Settle 1995; Creswell and Clark 2007; Fowler 1995; Rea et al. 1997).

Systematic sampling consists of selecting every n^{th} member from a list of the entire population after the sample size has been calculated. As long as the list does not contain a hidden filter or an order, systematic sampling is as valid as random sampling and is often used because of its simplicity (Creswell and Clark 2007; Isaki and Fuller 1982).

Random sampling means that each member of the population will have an equal chance to be selected. However, with large populations it is almost impossible to identify every member and therefore the pool of candidates can become biased (Creswell and Clark 2007; Isaki and Fuller 1982). To alleviate the bias, a researcher needs to fall back on a proven and validated dataset that includes the entire population from which the researcher randomly draws a sample.

3.5.5.2. Nonprobability Samples

Snowball sampling relies on the referrals from initial sample members to gain additional subjects. Even so this technique can lower research costs, it may not allow to obtain the representation of a good cross section sample from the population and therefore introduces bias (Alreck and Settle 1995; Dillman 2007).

Convenience Sampling is often used during preliminary research efforts or to get an inexpensive estimate of the truth. Thus, the sample is selected because of convenience (Rea et al. 1997). A limitation of convenience sampling is that the researcher cannot make generalizations about the population as the sample is not representative.

Judgment sampling is another form of convenience sampling and selects a sample that is based on the judgment of the researcher. It means that the researcher has to be confident that the sample represents the population that he wants examined (Alreck and Settle 1995).

Quota sampling is a nonprobability method that is similar to stratified sampling, however, it uses convenience or judgment sampling to select the required number of subjects rather than random sampling as is used in stratified sampling (Alreck and Settle 1995; Creswell and Clark 2007; Fowler 1995; Rea et al. 1997). Thus, this sampling method using non-random sampling methods can be unreliable.

3.5.6. Time and Cost Considerations

Researchers tend to underestimate the time and money required to complete a research project (Fowler 1995; Yin 2009; Weisberg et al. 1996; Rea et al. 1997; McConnell 2003; Dillman 2007; Creswell and Clark 2007; Alreck and Settle 1995). Therefore, the timely preparation of time and cost estimates is critical.

Time estimates are usually split into hour estimates for budgeting planning and duration estimates, data that is also used to prepare a project's timeline. A project timeline includes estimates of time requirements for goal clarification, study design, sample selection, questionnaire design, cover letter or e-mail design, obtaining approval from survey review boards, pilot testing, revisions of questionnaire, locating samples, time to send out the survey (mail or email), response time, attempt to get non-respondents to answer, coding response data, data entry and verification, analyzing data, and preparing the report. All these activities might be followed by the dissemination of the results (Alreck and Settle 1995; Creswell and Clark 2007; Rea et al. 1997; Weisberg et al. 1996; Couper et al. 2001).

Cost estimates include the verification and estimation of costs for proposal writing and editing, cover letter/e-mail and questionnaire writing, survey mailing, non-respondent follow up, printing costs, incentives to participate, data entry and verification, software licenses for statistical analysis and survey tools, and the costs associated with the dissemination of results (Alreck and Settle 1995; Dillman 2007).

3.5.7. Leadership Surveys

Countless surveys on leadership traits, leadership behaviors, leadership effectiveness, and leadership and organizational performance have been conducted over the past decades. Some of the most noteworthy and most relevant surveys for this study are discussed below.

The **Blake and Mouton Leadership Grid** compares, in a matrix, the leaders' concern for people versus the concern for results (Vision Council 2010).

The **Multifactor Leadership Questionnaire (MLQ)** measures variables like trust, innovative thinking, integrity, mentorship, and the inspiration sent from leadership to subordinates (Avolio and Bass 2000).

The **Myers-Briggs Type Indicator and Campbell Leadership Index** measures the scale of personal traits, e.g., introvert/extrovert, sensing/intuition, judging/perceiving, and thinking/feeling (Myers 2003; Campbell 1991; Myers et al. 1985; Myers 1962).

The **From Manager to Leader Assessment** test measures interpersonal skills, culture building, personal power, coach/influencer, team involvement, communication, recognition, provision of direction, problem-solving/decision-making, and support/reliability (Anon. 2011).

The **4E Leadership Culture Survey** measures the leader's values and consists of envision, enable, empower, and energize measurements (Roland 2008; Krames 2005).

The **Leadership Circle Profile (LCP)**, also known as the **leadership culture survey**, measures task versus relationship and creative versus reactive. The survey investigates the following criteria of leadership: a) relating, b) self-awareness, c) authenticity, d) achieving, e) controlling, f) compliance, g) system awareness, and h) protecting (The Leadership Circle 2011; Anderson Jr. 2006).

In the **Leadership and Motivation Training** assessment, the main part of this survey is similar to the "From Manager to Leader Assessment" described above. It measures support/reliability, problem solving/decision making, the providing of direction, team involvement and communication, interpersonal skills, culture building, recognition, coach versus influencer scale, and personal power (Anon. 2011).

The **Assessment for Leadership Qualities and Skills** test evaluates personal relationship skills versus task accomplishment skills (Center for Rural Studies 2009).

The **DISC Assessment** determines the scales of dominant/decisive, inspiring/influencing, supportive/steady, and cautious/conscientious leadership traits. The test also describes the scales of outgoing versus reserved and people oriented versus task-oriented (Personality Profile

Solutions 2011). The DISC assessment survey has similarity with the “Blake and Mouton Leadership Grip (Vision Council 2010)” discussed above.

The **CIO Executive Council’s Executive Competencies Assessment Tool** evaluates team leadership, result orientation, external customer focus, commercial orientation, strategic orientation, people and organizational development, change leadership, collaboration and influence, and market knowledge (Egon Zehnder International 2011).

The **Inventory Leadership Styles (ILS)** survey determines different leadership styles such as participative, visionary, affiliative, pacesetting, coaching/mentoring, and directive (Hay Group 2011).

The **Leadership Development Needs Assessment (LEADNA)** includes questions about strategy, communication, learning, knowledge, influence, relationships, delegation, priorities, integrity, and confidence (Anon. 1997).

The **Leadership Dimension Questionnaire (LDQ)** tests 8 intellectual/cognitive and managerial competencies as well as 7 emotional/social competencies (Dulewicz and Higgs 2005; Dulewicz and Higgs 2004).

The **Conger-Kanungo Model** evaluates questions about vision and articulation, unconventional behavior, sensitivity to member needs, environmental sensitivity, personal risk, and *‘does not maintain the status quo’* (Conger and Kanungo 1998; Conger et al. 1997).

The **Personal Leadership and Organizational Leadership Template** test includes questions about empowerment and decision making, purpose, organizational learning and personal growth, recognition and feeling valued, and alignment (Laub et al. 1999).

The **University of Queensland Business School Leadership Capability Framework** addresses questions regarding teamwork, emotional intelligence, managing results, strategic thinking, complex decision making, leading with purpose, and knowledge (Anon. 2010a).

The **Leader Azimuth Check II (AZIMUTH)** test investigates supervisory skills, tactical and technical competence, self-centeredness, compulsive behavior, social maturity, ethics, political skills, communication and influence (Steele and Garven 2009; Karrasch and Halpin 1999).

The **Organizational Leadership Assessment (OLA)** survey asks questions about the leader and if the leader values people, develops people, builds communities, shares leadership, provides leadership, and displays authenticity (Laub 2003; OLA 2000).

The **GE Leadership Effectiveness Survey** consists of questions about vision, customer focus, quality focus, accountability and commitment, integrity, shared ownership, team builder and empowerment, knowledge and expertise, initiative and speed, and a global mind-set (Anon. 1993).

The **Leadership Versatility Index (LVI)** positions a leader in a matrix with the scales of forceful and enabling versus strategic and operational (Kaplan et al. 2002).

The **Achieving a Culture of Inclusion** survey, which is most commonly used in higher education, consists of questions about leadership, academic planning, faculty recruitment and retention, accountability, resource allocation and faculty rewards, as well as behaviors and beliefs (Anon. 2010b).

And finally, the **Vanderbilt Assessment of Leadership in Education (VAL-ED)** test, which is also mainly used in higher education, assesses 6 core competencies and 6 key processes. The 6 core competencies are high standards for student learning, rigorous curriculum, quality instruction, culture of learning and professional behaviors, connections to external communities and performance accountability. The 6 key processes comprise of planning, implementing, supporting, advocating, communicating, and monitoring (Murphy et al. 2007).

The plethora of surveys available makes it difficult to select the appropriate leadership assessment tool for this research. However, the “Multifactor Leadership Questionnaire (MLQ)” would fit the requirements of this project well, since it measures trust, innovative thinking, integrity, mentorship, and the inspiration sent from leaders to subordinates (Avolio and Bass 2000). Another argument for the use of the MLQ in this research is that it is a widely used and a highly validated assessment tool. The MLQ thus delivers strong results. The drawback of the MLQ is the costs for a survey that is sent to almost 5000 hospitals (Avolio and Bass 2000). However, the “Manager to Leader Assessment” tool, which has also been widely used and can be adapted easily, is publicly available and consists of questions pertaining to coaching, culture building, problem solving, decision making, recognition and support (Anon. 2011). Finally, the 4E Leadership Culture Survey measures the leader’s values and consists of envision, enable, empower, and energize measurements (Roland 2008; Krames 2005). Each of the categories has valid questions that might be of interest for this research. One downside of the 4E Leadership

Culture assessment instrument is that it was not validated in the healthcare industry (Krames 2005). However, individual factors of these three leadership assessment tools (the Multifactor Leadership Questionnaire (MLQ)**,** the Manager to Leader Assessment, and the 4E Leadership Culture Survey) can be used and adapted for the research executed in this project.

3.6. Statistical Modeling and Analysis

Statistics in the following chapter refers to the scientific study of data gathered and includes the collection, organization, analysis, as well as the interpretation of data (Dodge et al. 2006). The aim of this chapter is to identify the best statistical model for survey research that enhances validity and comparability (King et al. 2004; King et al. 2000) of the data collected for leadership traits and performance measures in hospitals. Thus, different statistical models are discussed, namely multiple linear regression techniques and structural equation modeling.

3.6.1. Variable reduction techniques

Factor analysis is a set of methods used to examine how the underlying mathematical model influences the responses (x) on the number of variables (y) measured. The two main methods to conduct **factor analysis** are the **exploratory** and the **confirmatory reduction** method (Akaike 1987; Thurstone 1947; Harman 1976; Lawley and Maxwell 1962). Both types are based on the common factor model, which proposes that each observed response is influenced partially by some underlying common factors. The strength of each link between the factors and the outcomes varies, as one factor may influence some outcomes more than others (Harman 1976; Lawley and Maxwell 1962). The factor analysis approach explained below is performed by examining the pattern of covariance (correlation) between the outcomes observed. Measures that are highly correlated (positive or negative) are likely to be influenced by different factors (Thurstone 1947; Lawley and Maxwell 1962; Harman 1976; Thompson et al. 2004).

3.6.1.1. Exploratory Factor Analysis (EFA)

Exploratory factor analysis (EFA) is used "*… To discover the nature of the constructs influencing a set of responses* (Thompson et al. 2004, p 14)." EFA includes testing the number of common factors that are influencing a set of measures as well as measuring the strength of the links between each factor and each measure observed. Exploratory factor analysis tries to identify the cluster of factors (factors that are correlated) in a questionnaire. EFA is also used to determine the factors that are most important when classifying a cluster; to generate the factor scores representing the values of the underlying constructs; and to determine the dimensionality of a measurement scale (Costello and Osborne 2005; Thompson et al. 2004; Thurstone 1947).

Performing an exploratory factor analysis consists of seven steps according to Thompson et al. (2004), which are, in particular:

1) Collection of the measurement. Attention has to be paid to measure the variables on the same experimental units.
2) Obtaining the correlation matrix. Helps in obtaining the correlations between each of the variables.
3) Selecting the number of factors for inclusion. A number of methods exist to determine the optimal number of factors by examining the data. One of the techniques used most widely is the "Kaiser Criterion," which states to use a number of factors equal to the number of the eigenvalues of the correlation matrix that are greater than one. Another technique that is used frequently is the "Scree test," which states that the number of

factors is equal to the number of eigenvalues that occur prior to the last major drop, if the correlation matrix of eigenvalues was plotted in descending order.

4) Extracting the initial set of factors. There are many different extraction methods, including a principal axis, maximum likelihood, and/or principal component extraction. According to Thompson et al. (2004), the best of the methods is the maximum likelihood extraction, unless the measures lack multivariate normality.
5) Rotating the factors to a final solution. Rotation of the factors tries to make the factors highly responsive to a small subset of the factors. There are two major categories of rotation, the oblique rotation, which produces correlated factors, and the orthogonal rotation that produces uncorrelated factors. The most widely used and reliable orthogonal rotation is Varimax, whereas for oblique rotations the most commonly used ones are the Promax, the Harris-Kaiser, and the Direct Quartimin rotation.
6) Interpreting the factor structure. All the measures are linear related to each of the factors and the strength of these relations is described in the respective factor loading, which can be interpreted as a standardized regression coefficient.
7) Constructing factor scores for further analysis. Constructing factor scores requires the construction of a factor score by a linear combination of all the measures, weighted by the corresponding factor loading.

Explanatory factor analysis (EFA) has been widely used, for example to measure cultural dimensions (Schwartz 1994; Hofstede 1984), leadership characteristics (Howell and Avolio 1993), user satisfaction measures (Igbaria and Nachman 1990), or even to explore measures and models for intellectual capital (Bontis 1998), to name just a few.

3.6.1.2. Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis (CFA) is used to "*…Test whether a specified set of constructs is influencing responses in a predicted way* (Thompson et al. 2004, p.14)." This type of analysis has strong links to structural equation modeling (Gefen et al. 2000). Performing a confirmatory factor analysis consists of six steps (Thompson et al. 2004):

1) Defining the factor model involves the selection of the number of factors as well as the definition of the nature of loadings between factors and measures.
2) When collecting measurements it is important to measure the variables on the same experimental units.
3) Obtaining the correlation matrix involves obtaining the correlations between each of the variables.
4) Adjusting the model to the data. The best model-adjusting procedure is the maximum likelihood estimation method, unless the measures lack multivariate normality.
5) Evaluating the model suitability. The factor loadings are used to minimize the discrepancy between the correlation matrix and the actual matrix observed. This discrepancy then can be used as a measure of how consistent the model is. The model adequacy can be tested with the χ^2 goodness-of–fit test, which is highly sensitive to the size of the sample. Typically, large samples will more likely lead to a rejection of the null hypothesis. However, another test of model adequacy is the Tucker-Lewis index, which does not seem to be as sensitive to the sample size as is the χ^2 goodness-of-fit test.

Research shows that CFA is more complicated to perform than it is to perform EFA (Thompson et al. 2004; Lawley and Maxwell 1962), because CFA has to account for adjustments to the model and the model's suitability.

Confirmatory factor analysis (CFA) has been widely used to validate existing models and factors. For example, CFA was successfully applied to study leadership (Dyer et al. 2005; Bass 1999; Conger and Kanungo 1998), to explain performance measures of organizations (Anderson and Gerbing 1991), to investigate end-user computing satisfaction (Doll et al. 1994), and to research the intelligence scales of children (Keith and Witta 1997), to name a few.

3.6.2. Reliability testing of data

Reliability can be expressed in terms of consistency. The most common consistency check for data is the Cronbach Coefficient Alpha test, which also is known as Cronbach's Alpha (Bland and Altman 1997b; Bland and Altman 1997a; Ott and Longnecker 2008).

3.6.2.1. Cronbach's alpha

Cronbach's alpha coefficient is an index of reliability associated with the variation of the underlying construct and its true score. The true score is the score that would be obtained if the factors were not contaminated with noise. Thus, a consistent set of factors should minimize the variation and result in a high value for Cronbach's alpha. The alpha coefficient ranges from 0 to 1, where a factor greater than 0.7 indicates an acceptable reliability coefficient (Nunnally et al. 1967; Kent 2001). However, other research studies and literature have pointed out that a lower alpha value, such as, for example, 0.6 is still acceptable (Foa et al. 1993; Bland and Altman 1997b). In contemporary statistical software, such as, for example, SPSS and SAS, the correlation analysis will produce a Cronbach's alpha for each variable as well as an overall Cronbach alpha coefficient. The software typically also shows which variable could be deleted to increase the overall Cronbach's alpha (Foa et al. 1993; Cortina 1993; Bland and Altman 1997b).

3.6.3. Multiple Linear Regression

Multiple linear regression (MLR) models the relationship between a dependent, scalar variable y (outcome) and one or more independent variables denoted as x (input) (Montgomery et al. 2001). The procedure to run multiple regression analysis is similar to simple regression and consists of the following steps (Montgomery et al. 2001; Gefen et al. 2000; Weisberg 2005):

1) Define the research hypothesis.
2) Define the null hypothesis.
3) Gather data.
4) Assess each variable if the data is normally distributed.
5) Assess the relationship of each independent variable with the dependent variable if the two variables are linearly related. Includes scatter plots and calculation of the correlation coefficient.
6) Assess the relationships between all independent variables to observe if the independent variables are too highly correlated with each other by creating a correlation matrix for all independent variables.
7) Compute the regression equation from the data.

8) Compute the appropriate measures of association and tests of significance for each coefficient.
9) Accept or reject the null hypothesis.
10) Accept or reject the research hypothesis.

    and

11) Explain the practical implications of the findings.

To run multiple linear regressions, care has to be paid so the number of independent variables does not exceed or equal the number of samples. Also, MLR tends to over–fit the model when noisy data is applied. Noisy data refers to the unexplained variation found in a data sample. Finally, if collinearity among the independent variables exists, the β-coefficients, e.g., the slope coefficients are not reliable and the model might become unstable (Weisberg 2005). Another problem with MLR is based on the variability problematic (noisy data) of the Analysis of Variance (ANOVA); in ANOVA the total variability is represented by the Total Sum of Squares (SS_T), which is defined as the squared sum of the deviations of each observation from the Grand Mean of the observations. SS_T can be further decomposed into the sum of squares due to regression (SS_{reg}) and sum of squares due to random errors (SS_e, Cook and Weisberg 1982; Weisberg 2005).

Other problems with multiple regression modeling exist. To name a few, a simple regression or multiple regressions (MLR) will not be good at explaining the relations of the dependent variables to the independent variables if the relations are not linear. Another problem is that a regression with only one dependent and one independent variable requires a minimum of 30 observations and, as a rule of thumb suggests, an additional 10 observations for each additional independent variable (Gefen et al. 2000; Weisberg 2005). If multicollinearity is present, the researcher may have to drop one of the two variables that are highly correlated or the researcher has to state that mulitcollinearity is present. The presence of multicollinearity can be detected from two main indicators. Either when by adding an additional independent variable to the equation, a radical change in either the size of the sign (+/-) or the scale of the coefficients associated with other independent variables occurs or that none of the t-ratios of the coefficients is significant, but the F-test for the equation as a whole is (Cook and Weisberg 1982; Montgomery et al. 2001).

3.6.4. Structural Equation Modeling

Structural equation modeling (SEM) was derived from multiple regression analysis and does serve the same purpose in a more powerful way (Ullman and Bentler 2003). SEM takes into consideration the modeling of interactions (path model), correlated independents, measurement errors, nonlinearities, correlated error terms, as well as multiple latent independents which all are measured by multiple indicators, and one or more latent dependents also each with multiple indicators (Anderson and Gerbing 1988; Ullman and Bentler 2003). SEM may be used as a more powerful alternative to multiple regression, path analysis, factor analysis, analysis of covariance, and, in certain cases, time series analysis (Kline 2010). Thus, Structural Equation Modeling (SEM) is an extension of the general linear model (GLM), of which multiple linear regressions are also a part. Structural Equation Modeling consists of two main parts, a structural model and a measurement model. The measurement model deals with the relationship between latent variables and measured variables, whereas the structural model deals with the relationship between latent variables only (Anderson and Gerbing 1988).

Advantages of SEM, as demonstrated in studies (Buchel and Friston 1997; Baumgartner and Homburg 1996) are that SEM includes more flexible assumptions that are tested and revised until the model fits the research purpose. SEM in particular allows the interpretation of the data even when multicollinearity is present (Kline 2010). Furthermore, SEM includes the use of confirmatory factor analysis to reduce measurement error having multiple indicators per latent variable. Other advantages of SEM are (Kline 2010; Gefen et al. 2000; Anderson and Gerbing 1988):

1) Visibility and attraction of the graphical modeling interface and path theory.
2) Desirability of testing models overall rather than coefficients individually.
3) Ability to test models with multiple dependents.
4) Ability to model mediating variables rather than be restricted to an additive model (like in OLS regression).
5) Modeling of error terms.

   and

6) Ability to manipulate and handle difficult data (non-normal data, incomplete data).

In the literature, SEM is usually seen as a confirmatory rather than an exploratory procedure and uses one of the three following methodologies and/or combinations of the three (Kline 2010):

1. **Model development approach** – Typically, researchers combine confirmatory and exploratory purposes to develop a model, and therefore the models proposed will be tested using the SEM procedures. If the proposed model is found to be deficient, an alternative model based on changes that are suggested by the SEM modification indexes

is tested (Kline 2010). This is done multiple times to verify that the model is reliably loaded and can be processed further. This post-hoc modeling approach, however, may not be stable when applied to new data since it is based on the uniqueness of the initial dataset. Research, however, shows that the problem can be mitigated by using cross-validation techniques under which the model is developed using a calibration data sample (Kline 2010; Ullman and Bentler 2003). The result then has to be confirmed using an independent validation sample.

2. **Strict confirmative test** – The first model is tested using the Structural Equation Modeling goodness-of-fit test to determine if the pattern of covariance and variance in the data set is consistent with the path model developed by the researcher (Kline 2010).
3. **Alternative models approach** – the researcher might test two, three or even more causal models to understand which has the best fit. To determine the best fit, researchers usually take several goodness-of-fit measures that reflect different considerations applied to the research purpose (Kline 2010). However, a problem with the alternative model approach is that the research might not find two or more well-developed alternative models to test (Kline 2010; Ullman and Bentler 2003).

The biggest unsolved issue with SEM in creating the best possible (confirmatory) model comes from the fact that SEM cannot itself draw causal links in models nor can it resolve causal ambiguities. Therefore, the judgment and theoretical insight of the researcher is still of extreme importance and can make or break the research outcome (Kline 2010; Ullman and Bentler 2003).

3.6.5. Regression versus Structural Equation Modeling

Structural Equation Modeling (SEM), which essentially is comparing alternative models to assess relative model-fit, is more robust than regression modeling, which is highly susceptible to error of interpretation by misspecification (Kline 2010). However, given that SEM combines the model development approach, the strict confirmative test, and the alternative models approach, SEM allows more flexible assumptions compared to multiple regressions and, therefore, weakens the reliability of the model and the outcomes (Gefen et al. 2000). Thus, regression is still a more valid and robust way upon which to make proper research conclusions. Furthermore, regression modeling is also widely known and valued in the field of Management and Leadership Science.

3.7. Summary

This chapter includes 1) a review of the evolution of lean and its use in industry, administration, and government; 2) a discussion of the existing literature on leadership theories; 3) an overview of the U.S. healthcare industry; 4) current findings on leadership in healthcare as well as hospital performance measures; 5) a synopsis of methods of survey research design; and 6) an overview of appropriate statistical modeling and analysis.

Lean evolved based on many breakthrough events throughout the history of industrial development and thus, will continue to evolve. Lean, a management philosophy, can be applied to all kinds of industries and activities (Womack 2007). Among other areas, the healthcare sector can benefit from lean by reducing waste and improving the processes to improve patient safety and hospital competitiveness. However, compared to other industries, the healthcare industry is still at the beginning of their lean journey (Jones 2006).

Leadership defined by Bass and Bass (2008, p.45) as *"… The art of motivating a group of people to act towards achieving a common goal*," describes leaders as agents of change and their acts and behaviors affects followers more then they affect them (Bass 1999; Conger and Kanungo 1998). There are multiple leadership theories, from the great man theory (trait theory) to the transformational and transactional leadership theory (Eagly et al. 2003). Despite the variety of leadership theories, trait theory re-gained interest recently as charismatic leadership and transformational leadership is more researched. Trait theory is a leadership theory that supports the idea of leaders possessing certain characteristics that make them leaders. This kind of leadership theory allows to easily compare leaders with each other and to identify differences that impact how successful they are (Zaccaro 2007; Kirkpatrick and Locke 1991).

The U.S. healthcare industry is facing challenges on three fronts: it must become more cost effective, increase its quality of care, and be able to cope with large increases in demand. Also, new legislation, a shortage of nurses and physicians, and high employee turnover rates are in need of attention by the industry. Indications exist that the U.S. healthcare industry is at the beginning of a major transition to redefine itself to improve patient safety and quality of care, and to make the entire health system more cost effective. Numerous ideas are being contemplated to achieve this goal, such as, for example, healthcare providers adapting new management systems to improve their delivery of healthcare while reducing costs (Kenney 2010).

Survey research design depicts a standard way of conducting research based on the characteristics of a population or a random sample of a population to make inferences about certain characteristics of this population. Considerations in survey research have to be given to the goals of the survey, the questionnaire design, the survey sample, the presentation and dissemination of results, and time and cost. However, the design of the questionnaire and the development of the questions is the most critical part in conducting survey research (Rea and Parker 2005).

Statistical modeling and analysis pertains to the scientific study of data gathered. Statistical modeling and analysis includes the collection, organization, analysis, as well as the interpretation of data (Dodge et al. 2006). Multiple linear regression (MLR) models are robust and offer powerful statistical outcomes, especially compared to structural equation modeling (SEM) models. However, shortcomings of MLR are that regression models have difficulties in explaining the relations of independent and dependent variables if the relation is not linear.

Leadership and Healthcare – Research about leadership traits of executives evaluating how those traits relate to hospital performance, are rare. There are a few studies that look at leadership as one factor group (not as individual traits) and compare them to performance outcomes. Nurse (2010) for example looks at transformational and transactional leadership at the CEO level and compares those leadership theories with financial outcomes. Thus, studies about hospital performance outcomes in the literature are mainly based on financial performance; however, Boyer (2012) uses the non-financial measures to identify the influence of government and state leadership on the quality of care measures. Finally, findings of the leadership and healthcare literature review show shortcomings in research on leadership traits at the executive level and linking those traits to performance based on the quality of care measures (HHS 2012).

Based on this literature review, little specific information about the relationship of Chief Executive Officer (CEO) traits (e.g., leadership traits) and hospital performance exists. Thus, this research has been designated to provide insights into the drivers of quality of care performance outcomes of hospitals and leadership traits. Also, this study will deliver insights on differences in CEO leadership traits among three categories of hospitals: 1) lean; 2) high; and 3) low performing hospitals. The following chapter “Methodology” depicts the research design used to execute this leadership traits and hospital performance study and discusses primary and secondary data collection methods, research instruments, and the data analysis and statistics.

3.8. References

Abernathy, W. J., and K. B. Clark. 1985. "Innovation: Mapping the Winds of Creative Destruction." *Research Policy* 14 (1): 3–22.

Aguayo, Rafael. 1991. *Dr. Deming: The American Who Taught the Japanese About Quality*. Touchstone.

AHA. 2011a. *AHA Guide 2011*.
———. 2011b. *AHA Hospital Statistics 2011*.

AIR, C. I.N.A.N.E. "Management by Exception."

Akaike, H. 1987. "Factor Analysis and AIC." *Psychometrika* 52 (3): 317–332.

Alexander, J. A., M. L. Fennell, and M. T. Halpern. 1993. "Leadership Instability in Hospitals: The Influence of board-CEO Relations and Organizational Growth and Decline." *Administrative Science Quarterly*: 74–99.

Alexander, J. A., and S. Y. D. Lee. 1996. "The Effects of CEO Succession and Tenure on Failure of Rural Community Hospitals." *The Journal of Applied Behavioral Science* 32 (1): 70–88.

Alexander, J. A., B. J. Weiner, and J. Griffith. 2006. "Quality Improvement and Hospital Financial Performance." *Journal of Organizational Behavior* 27 (7): 1003–1029.

Allman, Sam. 2009. "Leadership vs. Management." *Successful Meetings* 58 (11) (October): 12. doi:Article.

Alreck, P. L., and R. B. Settle. 1995. *The Survey Research Handbook*. Irwin Chicago.

Altman, S. H., and R. Blendon. 1977. "Medical Technology: The Culprit Behind Health Care Costs? Proceedings of the 1977 Sun Valley Forum on National Health."

Anderson, J. C., and D. W. Gerbing. 1988. "Structural Equation Modeling in Practice: A Review and Recommended Two-step Approach." *Psychological Bulletin* 103 (3): 411–423.
———. 1991. "Predicting the Performance of Measures in a Confirmatory Factor Analysis with a Pretest Assessment of Their Substantive Validities." *Journal of Applied Psychology* 76 (5): 732.

Anderson Jr, R. J. 2006. "The Leadership Circle Profile: Breakthrough Leadership Assessment Technology." *Industrial and Commercial Training* 38 (4): 175–184.

Andrews, A. P., J. Simon, F. Tian, and J. Zhao. 2011. "The Toyota Crisis: An Economic, Operational and Strategic Analysis of the Massive Recall." *Management Research Review* 34 (10): 1064–1077.

Annas, G. J. 2003. "HIPAA Regulations—a New Era of Medical-record Privacy?" *New England Journal of Medicine* 348 (15): 1486–1490.

Anon. 1993. "The General Electric (GE) Leadership Effectiveness Survey (LES)." http://www.e-coach.narod.ru/business_guide/crosscuttings/tests_leadership_ef_byge.html.

———. 1995. "Big Five.jpg (JPEG Image, 412 × 277 Pixels)." http://blog.lib.umn.edu/meriw007/psy_1001/Big%20Five.jpg.

———. 1997. "Leadership Development Needs Assessment (LEADNA) - Google Search." https://www.google.com/#hl=en&sclient=psy-ab&q=Leadership+Development+Needs+Assessment+(LEADNA)+&oq

———. 2010a. "University of Queensland Business School Leadership Capability Framework - Google Search." https://www.google.com/#hl=en&sclient=psy-ab&q=University+of+Queensland+Business+School+Leadership+Capability+Framework+

———. 2010b. "Achieving a Culture of Inclusion Assessment - Google Search." https://www.google.com/#hl=en&sclient=psy-ab&q=Achieving+a+Culture+of+Inclusion+assessment&oq=Achieving+a+Culture+of+Inclusion+assessment&aq.

———. 2011. "Leadership Self-Assessment: Manager to Breakthrough Leader." http://www.leadership-and-motivation-training.com/leadership-self-assessment.html.

———. "Accounting for the Cost of Health Care in the United States | McKinsey Global Institute | Americas | McKinsey & Company." http://www.mckinsey.com/Insights/MGI/Research/Americas/Accounting_for_the_Cost_of_Health_Care_in_the_United_States.

Arrow, K., A. Auerbach, J. Bertko, S. Brownlee, L. P. Casalino, J. Cooper, F. J. Crosson, et al. 2009. "Toward a 21st-century Health Care System: Recommendations for Health Care Reform." *Annals of Internal Medicine* 150 (7): 493–495.

Avolio, B. J., and M. Bernard. "Bass (2004)." *Multifactor Leadership Questionnaire: Manual and Sampler Set*.

Avolio, and Bass. 2000. "MLQ Multifactor Leadership Questionnaire . Redwood City | Mendeley." http://www.mendeley.com/research/multifactor-leadership-questionnaire-redwood-city/.

Avolio, Bruce J. 1999. *Full Leadership Development: Building the Vital Forces in Organizations*. SAGE.

Ayanian, J. Z., J. S. Weissman, E. C. Schneider, J. A. Ginsburg, and A. M. Zaslavsky. 2000. "Unmet Health Needs of Uninsured Adults in the United States." *JAMA: The Journal of the American Medical Association* 284 (16): 2061–2069.

Bahri, Dr. Sami. 2009. *Follow the Learner: The Role of a Leader in Creating a Lean Culture*. Lean Enterprise Institute, Inc.

Baker, David. 2007. *Strategic Change Management in Public Sector Organisations*. Oxford: Chandos.

Baker, L., H. Birnbaum, J. Geppert, D. Mishol, and E. Moyneur. 2003. "The Relationship Between Technology Availability and Health Care Spending." *Health Affairs-millwood Va Then Bethesda Ma-*: 3–537.

Balle, Freddy, and Michael Balle. 2005. *The Gold Mine: A Novel of Lean Turnaround*. Lean Enterprises Inst Inc.

Barnes, R. M., and R. M. Barnes. 1958. *Motion and Time Study*. Vol. 84. Wiley.

Bartlett, Bruce. 2009. "Health Care: Costs And Reform - Forbes.com." http://www.forbes.com/2009/07/02/health-care-costs-opinions-columnists-reform.html.

Bass, B. M. 1990a. "Bass & Stogdill's Handbook of Leadership." *Research and Managerial*: 21.
———. 1990b. "From Transactional to Transformational Leadership: Learning to Share the Vision." *Organizational Dynamics* 18 (3): 19–31.
———. 1998. *Transformational Leadership: Industrial, Military, and Educational Impact*. Lawrence Erlbaum.
———. 1999. "Two Decades of Research and Development in Transformational Leadership." *European Journal of Work and Organizational Psychology* 8 (1): 9–32.

Bass, B. M., and B. J. Avolio. 1990. *Transformational Leadership Development: Manual for the Multifactor Leadership Questionnaire*. Consulting Psychologists Press, Palo Alto, CA.
———. 1994. *Improving Organizational Effectiveness Through Transformational Leadership*. Sage Publications, Inc.

Bass, Bernard M. 1985. *Leadership and Performance Beyond Expectations*. New York: Free Press.

Bass, Bernard M., and Ruth Bass. 2008. *The Bass Handbook of Leadership: Theory, Research, and Managerial Applications*. Simon and Schuster.

Baumgartner, H., and C. Homburg. 1996. "Applications of Structural Equation Modeling in Marketing and Consumer Research: A Review." *International Journal of Research in Marketing* 13 (2): 139–161.

Bazzoli, G. J., B. Chan, S. M. Shortell, T. D'Aunno, and others. 2000. "The Financial Performance of Hospitals Belonging to Health Networks and Systems." *Inquiry: a Journal of Medical Care Organization, Provision and Financing* 37 (3): 234.

Bell, R. A., R. L. Kravitz, and M. S. Wilkes. 1999. "Direct-to-Consumer Prescription Drug Advertising and the Public." *Journal of General Internal Medicine* 14 (11): 651–657.

Bennis, W. G., and B. Nanus. 1986. *Leaders: The Strategies for Taking Charge; Leaders: The Strategies for Taking Charge*. Harper & Row.

Bennis, W., and R. Townsend. 1995. *Reinventing Leadership: Strategies to Empower the Organization*. William Morrow & Company.

Ben-Tovim, D. I., J. E. Bassham, D. Bolch, M. A. Martin, M. Dougherty, and M. Szwarcbord. 2007. "Lean Thinking Across a Hospital: Redesigning Care at the Flinders Medical Centre." *Aust Health Rev* 31 (1): 10–5.

Berenson, A. 2006. "As Drug Prices Climb, Democrats Find Fault with Medicare Plan." *The New York Times*.

Berk, M. L., and A. C. Monheit. 2001. "The Concentration of Health Care Expenditures, Revisited." *Health Affairs* 20 (2): 9–18.

Bhatia, N., and J. Drew. 2006. "Applying Lean Production to the Public Sector." *The McKinsey Quarterly* 3 (1): 97–98.

Biggs, E. L. 2004. "CEO Succession Planning: An Emerging Challenge for Boards of Directors." *The Academy of Management Executive (1993-2005)* 18 (1): 105–107.

Blake, R. R., and J. S. Mouton. 1968a. "The Managerial Grid." *The Progress of Management: Process, Behavior, and Operations Research. A Book of Readings*: 245.

———. 1968b. "The Managerial Grid; Key Orientations for Achieving Production Through People."

———. 1968c. "The Managerial Grid." *The Progress of Management: Process, Behavior, and Operations Research. A Book of Readings*: 245.

———. 1985. *The Managerial Grid III: A New Look at the Classic That Has Boosted Productivity and Profits for Thousands of Corporations Worldwide*. Butterworth-Heinemann.

Blanchard, K. H., P. Zigarmi, and D. Zigarmi. 1985. *Leadership and the One Minute Manager: Increasing Effectiveness Through Situational Leadership*. William Morrow.

Blanchard, O. J. 1983. *The Production and Inventory Behavior of the American Automobile Industry*. National Bureau of Economic Research Cambridge, Mass., USA.

Bland, J. M., and D. G. Altman. 1997a. "Statistics Notes: Cronbach's Alpha." *British Medical Journal* 314 (7080): 572.

Bland, J. M., and D. G. Altman. 1997b. "Cronbach's Alpha." *BMJ: British Medical Journal* 314 (7080): 572.

Blouin, A. S., K. J. McDonagh, A. M. Neistadt, and B. Helfand. 2006. "Leading Tomorrow's Healthcare Organizations: Strategies and Tactics for Effective Succession Planning." *Journal of Nursing Administration* 36 (6): 325.

Bodenheimer, T., K. Lorig, H. Holman, and K. Grumbach. 2002. "Patient Self-management of Chronic Disease in Primary Care." *JAMA: The Journal of the American Medical Association* 288 (19): 2469–2475.

Bohmer, R., and C. I. Knoop. 2007. "The Challenge Facing the US Healthcare Delivery System." *HBS Case*: 9–606.

Boies, K., and J. M. Howell. 2006. "Leader-member Exchange in Teams: An Examination of the Interaction Between Relationship Differentiation and Mean LMX in Explaining Team-level Outcomes." *The Leadership Quarterly* 17 (3): 246–257.

Bond, P., and others. 1999. "Globalization, Pharmaceutical Pricing and South African Health Policy: Managing Confrontation with US Firms and Politicians." *International Journal of Health Services* 29 (4): 765–792.

Bontis, N. 1998. "Intellectual Capital: An Exploratory Study That Develops Measures and Models." *Management Decision* 36 (2): 63–76.

Bootman, J. Lyle. 2000. "To Err Is Human." *Arch Intern Med* 160 (21) (November 27): 3189. doi:10.1001/archinte.160.21.3189.

Borgatta, E. F., R. F. Bales, and A. S. Couch. 1954. "Some Findings Relevant to the Great Man Theory of Leadership." *American Sociological Review*: 755–759.

Born, P. H., and C. J. Simon. 2001. "Patients and Profits: The Relationship Between HMO Financial Performance and Quality of Care." *Health Affairs* 20 (2): 167–174.

Bourantas, Dimitris, and Nancy Papalexandris. 1990. "Sex Differences in Leadership: Leadership Styles and Subordinate Satisfaction." *Journal of Managerial Psychology* 5 (5): 7–10. doi:10.1108/02683949010141291.

Boyer, K.K., J. Gardner, and S. Schweikhart. 2012. “Process Quality Improvement: An Examination of General vs. Outcome-specific Climate and Practices in Hospitals.” *Journal of Operations Management*.

Brewer, N. 1995. “Leadership and Supervision.” *Psychology and Policing*: 291–316.

Brown, C. 2007. *Industrial Revolution in the Upper Connecticut River Valley: An Overview*. American Precision Museum.

Browning, T. R., and R. D. Heath. 2009. “Reconceptualizing the Effects of Lean on Production Costs with Evidence from the F-22 Program.” *Journal of Operations Management* 27 (1): 23–44.

Bryman, A. 1992. *Charisma and Leadership in Organizations*. Sage London.

Buchel, C., and K. J. Friston. 1997. “Modulation of Connectivity in Visual Pathways by Attention: Cortical Interactions Evaluated with Structural Equation Modelling and fMRI.” *Cerebral Cortex* 7 (8): 768.

Buerhaus, P. I., D. O. Staiger, and D. I. Auerbach. 2000. “Policy Responses to an A Gi Ng R Egi Ste Red Nurse Wo Rk Fo Rc e.” *Nursing* 18 (6): 278.

Burns, James MacGregor. 1979. *Leadership*. Harper & Row.

Busse, R., G. Wurzburg, and M. Zappacosta. 2003. “Shaping the Societal Bill: Past and Future Trends in Education, Pensions and Healthcare Expenditure.” *Futures* 35 (1): 7–24.

Butler, J. K. 1993. “Assessing the Situations of the LEAD.” *Organization Development Journal* 11: 33–33.

Bycio, P., R. D. Hackett, and J. S. Allen. 1995. “Further Assessments of Bass’s (1985) Conceptualization of Transactional and Transformational Leadership.” *Journal of Applied Psychology* 80 (4): 468–478.

Campbell, D. P. 1991. “Manual for the Campbell Leadership Index.” *Minneapolis, MN: National Computer Systems*.

Cavé, R. 1953. *Le Contrôle Statistique Des Fabrications*. Eyrolles.

Center for Rural Studies. 2009. “CRS - NERL The Qualities of Leadership.” http://crs.uvm.edu/gopher/nerl/personal/assess/b.html.

Chernew, M. E., R. A. Hirth, and D. M. Cutler. 2003. “Increased Spending on Health Care: How Much Can the United States Afford?” *Health Affairs* 22 (4): 15–25.

Clancy, C. M. 2009. “Ten Years After to Err Is Human.” *American Journal of Medical Quality*.

CMS. 2012. “Quality Initiative.” http://www.cms.hhs.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/QualityInitiativesGenInfo/index.html?redirect=/QualityInitiativesGenInfo/.

Coile, R. C., American Hospital Association. Society for Healthcare Strategy, Market Development, and Superior Consultant Company. 2002. *Futurescan 2002: A Forecast of Healthcare Trends, 2002-2006*. Health Administration Press.

Commins, John. 2012. “High CEO Turnover, No Succession Planning Plague Hospitals - HealthLeaders Media.” http://www.healthleadersmedia.com/print/HR-277606/High-CEO-Turnover-No-Succession-Planning-Plague-Hospitals.

Conger, J. A. 1989. *The Charismatic Leader. Behind the Mystique of Exceptional Leadership.* Jossey-Bass Inc., Publishers, 350 Sansome Street, San Francisco, CA 94104 ($20.95).

Conger, J. A., and R. N. Kanungo. 1988. *Charismatic Leadership: The Elusive Factor in Organizational Effectiveness.* Jossey-Bass.
———. 1998. *Charismatic Leadership in Organizations*. Sage Publications, Inc.

Conger, J. A., R. N. Kanungo, and S. T. Menon. 2000. “Charismatic Leadership and Follower Effects.” *Journal of Organizational Behavior* 21 (7): 747–767.

Conger, J. A., R. N. Kanungo, S. T. Menon, and P. Mathur. 1997. “Measuring Charisma: Dimensionality and Validity of the Conger-Kanungo Scale of Charismatic Leadership.” *Canadian Journal of Administrative Sciences/Revue Canadienne Des Sciences De l’Administration* 14 (3): 290–301.

Conger, J. A., R. N. Kanungo, and others. 1988. *Charismatic Leadership: The Elusive Factor in Organizational Effectiveness*. Jossey-Bass San Francisco.

Connors, E. E., and L. O. Gostin. 2010. “Health Care Reform—a Historic Moment in US Social Policy.” *JAMA: The Journal of the American Medical Association* 303 (24): 2521–2522.

Conti, R., J. Angelis, C. Cooper, B. Faragher, and C. Gill. “The Effects of Lean Production on Worker Job Stress.” *International Journal of Operations & Production Management* 26, no. 9 (2006): 1013–1038.

Cook, C. R., and J. C. Graser. 2001. *Military Airframe Acquisition Costs: The Effects of Lean Manufacturing*. 1325. Rand Corp.

Cook, R. D., and S. Weisberg. 1982. *Residuals and Influence in Regression*. Vol. 223. Chapman and Hall New York.

Cooke, David J. 2007. "Leading the Way To Lean." *Business Finance* 13 (5) (May): 13–16. doi:Interview.

Cooney, S., and B. D. Yacobucci. 2007. *US Automotive Industry: Policy Overview and Recent History*. Nova Novinka.

Cooney, S., B. D. Yacobucci, and Library of Congress. Congressional Research Service. 2005. "US Automotive Industry: Policy Overview and Recent History." In .

Cooper, A. C., G. E. Willard, and C. Y. Woo. 1986. "Strategies of High Performing New and Small Firms: A Reexamination of the Niche Concept." *Journal of Business Venturing* 1 (3): 247–260.

Cortina, J. M. 1993. "What Is Coefficient Alpha? An Examination of Theory and Applications." *Journal of Applied Psychology* 78: 98–98.

Costello, A. B., and J. W. Osborne. 2005. "Best Practices in Exploratory Factor Analysis: Four Recommendations for Getting the Most from Your Analysis." *Practical Assessment, Research & Evaluation* 10 (7): 1–9.

Couper, M. P., M. W. Traugott, and M. J. Lamias. 2001. "Web Survey Design and Administration." *Public Opinion Quarterly* 65 (2): 230.

Creswell, J. W., and V. L. P. Clark. 2007. *Designing and Conducting Mixed Methods Research*. Sage Publications, Inc.

Davies, S. "A Matter of Takt-[manufacturing Takt Time]." *Engineering & Technology* 4 (9): 62–65.

Davis, K., C. Schoen, K. Stremikis, and C. Fund. 2010. *Mirror, Mirror on the Wall: How the Performance of the US Health Care System Compares Internationally: 2010 Update*. Commonwealth Fund.

Davis, Robert C. 2007. *Shipbuilders of the Venetian Arsenal: Workers and Workplace in the Preindustrial City*. JHU Press.

Dellit, T. H., R. C. Owens, J. E. McGowan, D. N. Gerding, R. A. Weinstein, J. P. Burke, W. C. Huskins, et al. 2007. "Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America Guidelines for Developing an Institutional Program to Enhance Antimicrobial Stewardship." *Clinical Infectious Diseases* 44 (2): 159–177.

Deming, W.E. 1967. “What Happened in Japan?” *Industrial Quality Control* 24 (2): 89–93.

Dennis, Pascal. 2007. *Getting the Right Things Done: A Leader’s Guide to Planning and Execution*. 1st ed. Lean Enterprise Institute.

Dienesch, R. M., and R. C. Liden. 1986. “Leader-member Exchange Model of Leadership: A Critique and Further Development.” *Academy of Management Review*: 618–634.

Dillman, D. A. 2007. *Mail and Internet Surveys: The Tailored Design Method*. John Wiley & Sons Inc.

Dinero, D. A. 2005. *Training Within Industry: The Foundation of Lean*. Productivity Pr.

Docteur, E., H. Oxley, and O. Secretariat. 2004. “Health System Reform: Lessons from Experience.” *Towards High-performing Health Systems: Policy Studies* 434: 19.

Dodge, Y., D. Cox, and D. Commenges. 2006. *The Oxford Dictionary of Statistical Terms*. Oxford University Press, USA.

Doll, W. J., W. Xia, and G. Torkzadeh. 1994. “A Confirmatory Factor Analysis of the End-user Computing Satisfaction Instrument.” *Mis Quarterly*: 453–461.

Dooley, C.R. 2001. “The Training Within Industry Report 1940-1945.” *Advances in Developing Human Resources* 3 (2): 127–289.

Doppler, Klaus, and Christoph Lauterburg. Change Management.: Den Unternehmenswandel Gestalten. Campus Verlag, 2002.

Drickhamer, D. 2012. “Using Lean Thinking to Reinvent City Government.” *2012*.

Drucker, P.F. 1990. “The Emerging Theory of Manufacturing.” *Harvard Business Review* 68 (3): 94–102.

———. 2000. “Implementing the Effective Management of Knowledge Worker Productivity: The Biggest Challenge.” *The Knowledge Management Yearbook 2000-2001*: 267.

Dulewicz, S. V., and M. J. Higgs. 2004. “Design of a New Instrument to Assess Leadership Dimensions and Styles.” *Selection and Development Review* 20 (2): 7–12.

Dulewicz, V., and M. Higgs. 2005. “Assessing Leadership Styles and Organisational Context.” *Journal of Managerial Psychology* 20 (2): 105–123.

Dvir, T., D. Eden, B. J. Avolio, and B. Shamir. 2002. "Impact of Transformational Leadership on Follower Development and Performance: A Field Experiment." *Academy of Management Journal* 45 (4): 735–744.

Dye, C. F. 2000. *Leadership in Healthcare: Values at the Top*. Health Administration Press.

Dyer, N. G., P. J. Hanges, and R. J. Hall. 2005. "Applying Multilevel Confirmatory Factor Analysis Techniques to the Study of Leadership." *The Leadership Quarterly* 16 (1): 149–167.

Eagly, A. H., M. C. Johannesen-Schmidt, and M. L. van Engen. 2003. "Transformational, Transactional, and Laissez-faire Leadership Styles: A Meta-analysis Comparing Women and Men." *Psychological Bulletin* 129 (4): 569–591.

Egon Zehnder International. 2011. "CIO Executive Council: Executive Competencies Assessment Tool." https://www.cioexecutivecouncil.com/survey/pub_csuite.html.

Elkins, T., and R. T. Keller. 2003. "Leadership in Research and Development Organizations: A Literature Review and Conceptual Framework." *The Leadership Quarterly* 14 (4-5): 587–606.

Elwood, T. W. 2007. "The Future of Health Care in the United States." *International Quarterly of Community Health Education* 26 (1): 5–21.

Emiliani, M. L. 1998. "Lean Behaviors." Management Decision 36 (9): 615.
———. 2006. "Origins of Lean Management in America." Journal of Management History 12 (2): 167.

Emiliani, Bob. 2007. *Better Thinking, Better Results*. 2nd ed. The CLBM, LLC.

Evans, M. G. 1970. "The Effects of Supervisory Behavior on the Path-goal Relationship." *Organizational Behavior and Human Performance* 5 (3): 277–298.

Falk, S. L. 1964. "Artillery for the Land Service: The Development of a System." *Military Affairs* 28 (3): 97–110.

Fiedler, F. E. 1967. *A Theory of Leadership Effectiveness*. McGraw-Hill New York.
———. 1996. "Research on Leadership Selection and Training: One View of the Future." *Administrative Science Quarterly*: 241–250.

Fink, A. 1995. *How to Ask Survey Questions*. Sage.

Flynn, B. B., R. G. Schroeder, and S. Sakakibara. 1994. "A Framework for Quality Management Research and an Associated Measurement Instrument." *Journal of Operations Management* 11 (4): 339–366.

Foa, E. B., D. S. Riggs, C. V. Dancu, and B. O. Rothbaum. 1993. "Reliability and Validity of a Brief Instrument for Assessing Post-traumatic Stress Disorder." *Journal of Traumatic Stress* 6 (4): 459–473.

Ford, H., S. Crowther, and N. Bodek. 1988. *Today and Tomorrow*. Productivity Press.

Ford, Henry. 2009. *My Life and Work - An Autobiography of Henry Ford*. BN Publishing.

Fowler, F. J. 1995. *Improving Survey Questions: Design and Evaluation*. Sage Publications, Inc.

Fujimoto, T. 1999. *The Evolution of a Manufacturing System at Toyota*. Oxford University Press, USA.

Furman, C., and R. Caplan. 2007. "Applying the Toyota Production System: Using a Patient Safety Alert System to Reduce Error." *Joint Commission Journal on Quality and Patient Safety* 33 (7): 376–386.

Furst, P. G. 2007. "Lean Six Sigma-Innovative Safety Management." In *ASSE Professional Development Conference*.

Furuya, Hiroyuki Hirano; Makoto. 2006. *Jit Is Flow*. PCS Press.

Gardner, J. W. 1993. *On Leadership*. Free Pr.

Garman, A. N., and J. Glawe. 2004. "Succession Planning." *Consulting Psychology Journal: Practice and Research* 56 (2): 119.

Garson, Arthur. "The US Healthcare System 2010: Problems, Principles, and Potential Solutions." *Circulation* 101, no. 16 (April 25, 2000): 2015–2016.

Gartman, D. 1979. "Origins of the Assembly Line and Capitalist Control of Work at Ford." *Case Studies on the Labor Process*.

Gefen, D., D. Straub, and M. C. Boudreau. 2000. "Structural Equation Modeling and Regression: Guidelines for Research Practice." *Communications of the Association for Information Systems* 4 (1): 7.

George, M. L., and J. Maxey. 2005. *The Lean Six Sigma Pocket Toolbook: A Quick Reference Guide to Nearly 100 Tools for Improving Process Quality, Speed, and Complexity*. McGraw-Hill Professional.

Gibson, James. 2008. *Organizations: Behavior, Structure, Processes*. 13th ed. McGraw-Hill/Irwin.

Gilbreth, F. B., and L. M. Gilbreth. 1919. "Applied Motion Study."

Ginsburg, P. B. 2004. "Controlling Health Care Costs." *New England Journal of Medicine* 351 (16): 1591–1593.
———. 2008. "High and Rising Health Care Costs: Demystifying US Health Care Spending." *Princeton, NJ*.

Glenday, Ian Fraser. 2005. *Breaking Through to Flow: Banish Firefighting and Produce to Customer Demand: 1*. 1st ed. Lean Enterprise Academy Ltd.

Gorchels, L., and Inc NetLibrary. 2000. *The Product Manager's Handbook: The Complete Product Management Resource*. NTC Business Books.

Gordon, A., and G. Yukl. 2004. "The Future of Leadership Research: Challenges and Opportunities." *New Perspectives on Leadership Research* 18 (3): 359.

Gorwitz, R. J., D. B. Jernigan, J. H. Powers, J. A. Jernigan, and others. 2009. "Strategies for Clinical Management of MRSA in the Community: Summary of an Experts' Meeting Convened by the Centers for Disease Control and Prevention. 2006." *Centers for Disease Control and Prevention* 11.

Graban, Mark. 2008. *Lean Hospitals: Improving Quality, Patient Safety, and Employee Satisfaction*. 1st ed. Productivity Press.

Graen, G. B., R. C. Liden, and W. Hoel. 1982. "Role of Leadership in the Employee Withdrawal Process." *Journal of Applied Psychology* 67 (6): 868–872.

Graen, G. B., and M. Uhl-Bien. 1991. "The Transformation of Professionals into Self-managing and Partially Self-designing Contributors: Toward a Theory of Leadership-making." *Management Department Faculty Publications*: 16.

Graen, G. B., J. B. Orris, and K. M. Alvares. 1971. "Contingency Model of Leadership Effectiveness: Some Experimental Results." *J. Burdeane Orris*: 12.

Gray, J. A. M. 1997. *Evidence-based Healthcare: How to Make Health Policy and Management Decisions*. Churchill Livingstone New York.

Green, C. M., and E. Whitney. 1956. "The Birth of American Technology." *Boston, Little, Brown*.

Greene, C. N. 1975. "The Reciprocal Nature of Influence Between Leader and Subordinate." *Journal of Applied Psychology* 60 (2): 187–193.

Greiner, A., and E. Knebel. 2003. *Health Professions Education: a Bridge to Quality*. Natl Academy Pr.

Groves, K. S. 2007. “Integrating Leadership Development and Succession Planning Best Practices.” *Journal of Management Development* 26 (3): 239–260.

Gryna, F. M., R. C. H. Chua, J. A. Defeo, J. A. De Feo, and J.M. Juran. 2005. *Juran’s Quality Planning and Analysis: For Enterprise Quality*. McGraw-Hill Science/Engineering/Math.

Hadley, J. 2003. “Sicker and poorer—The Consequences of Being Uninsured: A Review of the Research on the Relationship Between Health Insurance, Medical Care Use, Health, Work, and Income.” *Medical Care Research and Review* 60 (2 suppl): 3S–75S.

Hadley, J., and J. Holahan. 2003. “How Much Medical Care Do the Uninsured Use, and Who Pays for It?” *Health Affairs (Project Hope)*: W3.

Halsey III. 2009. “Primary-Care Doctor Shortage May Undermine Health Reform Efforts.” http://www.washingtonpost.com/wp-dyn/content/article/2009/06/19/AR2009061903583_pf.html.

Hammond, L. 1930. “Guns and Standardization.” *The North American Review* 230 (6): 679–686.

Hanna, J. 2007. “Bringing ‘Lean’principles to Service Industries’.” *Harvard Business School Working Knowledge*.

Harackiewicz, J. M., and G. Manderlink. 1984. “A Process Analysis of the Effects of Performance-contingent Rewards on Intrinsic Motivation.” *Journal of Experimental Social Psychology* 20 (6): 531–551.

Harman, H. H. 1976. *Modern Factor Analysis*. University of Chicago Press.

Den Hartog, D. N., R. J. House, P. J. Hanges, S. A. Ruiz-Quintanilla, P. W. Dorfman, and others. 1999. “Culture Specific and Cross-culturally Generalizable Implicit Leadership Theories: Are Attributes of Charismatic/transformational Leadership Universally Endorsed?” *Leadership Quarterly* 10: 219–256.

Den Hartog, D. N., J. J. Van Muijen, and P. L. Koopman. 1997. “Transactional Versus Transformational Leadership: An Analysis of the MLQ.” *Journal of Occupational and Organizational Psychology*.

Hater, J. J., and B. M. Bass. 1988. “Superiors’ Evaluations and Subordinates’ Perceptions of Transformational and Transactional Leadership.” *Journal of Applied Psychology* 73 (4): 695.

Hay Group. 2011. “Hay Group : Inventory of Leadership Styles (ILS).” http://www.haygroup.com/leadershipandtalentondemand/ourproducts/item_details.aspx?itemid=50&type=1.

Heller, V. L., and J. R. Darling. 2011. “Toyota in Crisis: Denial and Mismanagement.” *Journal of Business Strategy* 32 (5): 4–13.

Hersey, P., and K. H. Blanchard. 1982. “Management of Organizational Behaviour: Utilizing Human Resources; Management of Organizational Behaviour: Utiling Human Resources.”

Hersey, P., K. H. Blanchard, and D. E. Johnson. 1977. *Management of Organizational Behavior*. Prentice-Hall Englewood Cliffs, NJ.

Hesselbein, F., and A. Shrader. 2008. *Leader to Leader 2: Enduring Insights on Leadership from the Leader to Leader Institute’s Award Winning Journal*. Jossey-Bass.

HHS. 2012. “Hospital Compare.” http://www.hospitalcompare.hhs.gov/staticpages/help/hospital-how-to.aspx.

Himmelstein, D. U., E. Warren, D. Thorne, and S. Woolhandler. 2005. *Illness and Injury as Contributors to Bankruptcy*. Harvard Medical School.

Hinterhuber, H.H. 1997. “Strategic Cost Management: Preliminary Lessons from European Companies.” *International Journal of Technology Management* 13 (1): 1–14.

Hirano, Hiroyuki. 1996. *5S for Operators: 5 Pillars of the Visual Workplace*. 1st ed. Productivity Press.

Hirst, G., L. Mann, P. Bain, A. Pirola-Merlo, and A. Richver. 2004. “Learning to Lead: The Development and Testing of a Model of Leadership Learning.” *The Leadership Quarterly* 15 (3): 311–327.

Hofstede, G. 1984. “Cultural Dimensions in Management and Planning.” *Asia Pacific Journal of Management* 1 (2): 81–99.

Hogan, Brian J. 2009. “Sustaining a Lean Culture.” *Manufacturing Engineering* 143 (5) (November): 71–76. doi:Article.

Holmer, A. F. 1999. “Direct-to-consumer Prescription Drug Advertising Builds Bridges Between Patients and Physicians.” *JAMA: The Journal of the American Medical Association* 281 (4): 380–382.

Holweg, Matthias. 2007. “The Genealogy of Lean Production.” *Journal of Operations Management* 25 (2) (March): 420–437. doi:10.1016/j.jom.2006.04.001.

Howell, J. M., and B. J. Avolio. 1992. “The Ethics of Charismatic Leadership: Submission or Liberation?” *The Executive*: 43–54.

———. 1993. “Transformational Leadership, Transactional Leadership, Locus of Control, and Support for Innovation: Key Predictors of Consolidated-business-unit Performance.” *Journal of Applied Psychology* 78 (6): 891.

Hudak, R. P., P. P. Brooke Jr, K. Finstuen, and P. Riley. 1993. “Health Care Administration in the Year 2000: Practitioners’ Views of Future Issues and Job Requirements.” *Hospital & Health Services Administration* 38 (2): 181.

Igbaria, M., and S. A. Nachman. 1990. “Correlates of User Satisfaction with End User Computing: An Exploratory Study.” *Information & Management* 19 (2): 73–82.

Imai, and Masaaki. 1986. *Kaizen: The Key to Japan’s Competitive Success*. New York, NY, USA: Random House.

Inkpen, A. 1998. “Learning, Knowledge Acquisition, and Strategic Alliances.” *European Management Journal* 16 (2): 223–229.

Institute for Healthcare Improvement. 2012. “White Paper, Lean Principles, Throughput Time, Lean Thinking, Kanban, Muda, Value Stream, A Priori, Kaizen, Takt Time, Lean Management Trystorm,” http://www.ids-healthcare.com/Common/Paper/Paper_51/Going%20Lean%20in%20Health%20Care1.htm.

Isaki, C. T., and W. A. Fuller. 1982. “Survey Design Under the Regression Superpopulation Model.” *Journal of the American Statistical Association* 77 (377): 89–96.

Ishikawa, K., and D. J. Lu. 1985. *What Is Total Quality Control?: The Japanese Way*. Prentice-Hall Englewood Cliffs, NJ.

Jago, A. G., and J. W. Ragan. 1986. “The Trouble with "leader Match" Is That It Doesn’t Match Fiedler’s Contingency Model.” *Journal of Applied Psychology* 71 (4): 555.

Janiszewski-Goodin, H. 2003. “The Nursing Shortage in the United States of America: An Integrative Review of the Literature.” *Journal of Advanced Nursing* 43 (4): 335–343.

Jardim, A. 1970. *The First Henry Ford: a Study in Personality and Business Leadership*.

Jewell, K., and L. McGiffert. 2009. “To Err Is Human—to Delay Is Deadly.” *Austin, TX, Consumers Union*.

Jin, R. L, C. P Shah, and T. J Svoboda. “The Impact of Unemployment on Health: a Review of the Evidence.” *CMAJ: Canadian Medical Association Journal* 153, no. 5 (1995): 529.

Jones, Daniel T., and James P. Womack. 2002. *Seeing the Whole: Mapping the Extended Value Stream*. Lean Enterprise Institute.

Jones, Daniel T. 2006. “Leaning Healthcare.” Management Services 50 (2): 16.

Joyce, M. 2004. *The Lean Enterprise-A Management Philosophy at Lockheed Martin*. DTIC Document.

Juran, J. M. 1988. *Juran on Planning for Quality*. Free Press New York.

Kaiser EDU. 2012. “U.S. Health Care Costs: Issue Modules, Background Brief.” http://www.kaiseredu.org/issue-modules/us-health-care-costs/background-brief.aspx.

Kandebo, S. W. 1999. “Lean Thinking Spurs Culture Shift at LMAS.” *Aviation Week and Space Technology*: 56–63.

Kaplan, R. E., R. B. Kaiser, and D. Assessment-Methode. 2002. “Leadership Versatility Index®.” *Greensboro, NC: Kaplan DeVries Inc*.

Kaplan, R. S., and D. P. Norton. 1996. *The Balanced Scorecard: Translating Strategy into Action*. Harvard Business Press.

Karrasch, A. I., and S. M. Halpin. 1999. *Feedback on 360 Degree Leader AZIMUTH Check Assessment Conducted at Fort Clayton, Panama.* DTIC Document.

Keehan, S., A. Sisko, C. Truffer, S. Smith, C. Cowan, J. Poisal, M. K. Clemens, and others. 2008. “Health Spending Projections Through 2017: The Baby-boom Generation Is Coming to Medicare.” *Health Affairs* 27 (2): w145–w155.

Keith, T. Z., and E. L. Witta. 1997. “Hierarchical and Cross-age Confirmatory Factor Analysis of the WISC-III: What Does It Measure?” *School Psychology Quarterly* 12 (2): 89.

Kenney, Charles. 2010. *Transforming Health Care: Virginia Mason Medical Center’s Pursuit of the Perfect Patient Experience*. 1st ed. CRC Press.

Kent, R. A. 2001. *Data Construction and Data Analysis for Survey Research*. Palgrave Macmillan.

Khaliq, A. A., S. L. Walston, and D. M. Thompson. 2006. “The Impact of Hospital CEO Turnover in US Hospitals: Final Report.” *Chicago: American College of Healthcare Executives*.

Kimball, B., and E. H. O'Neil. 2002. *Health Care's Human Crisis: The American Nursing Shortage*. Robert Wood Johnson Foundation.

Kinder, A., and I. T. Robertson. 1994. "Do You Have the Personality to Be a Leader?" *Leadership & Organization Development Journal* 15 (1): 3–12.

King, G., C. J. L. Murray, J. A. Salomon, and A. Tandon. 2004. "Enhancing the Validity and Cross-cultural Comparability of Measurement in Survey Research." *American Political Science Review* 98 (01): 191–207.

King, G., M. Tomz, and J. Wittenberg. 2000. "Making the Most of Statistical Analyses: Improving Interpretation and Presentation." *American Journal of Political Science*: 347–361.

Kirkpatrick, S. A., and E. A. Locke. 1991. "Leadership: Do Traits Matter?" *The Executive* 5 (2): 48–60.

Kline, R. B. 2010. *Principles and Practice of Structural Equation Modeling*. The Guilford Press.

Kohn, Linda T. 2000. "To Err Is Human : Building a Safer Health System."

Kotter, John P. 1988. "The Leadership Factor." *McKinsey Quarterly* (2): 71–78. doi:Article.
———. 1996. *Leading Change*. Harvard Business Press.

Kotter, John. "Sense of Urgency." *Leadership Excellence* 25, no. 3 (March 2008): 10.

Kouzes, James M., and Barry Z. Posner. 2007. *The Leadership Challenge*. John Wiley and Sons.

Kovner, A. R., D. J. Fine, R. D'Aquila, and Association of University Programs in Health Administration. 2009. *Evidence-based Management in Healthcare*. Health Administration Press.

Krafcik, John F. 1988. "Triumph of the Lean Production System." *Sloan Management Review* 30 (1): 41–52. doi:Article.

Krames, J. A. 2005. *Jack Welch and the 4E's of Leadership: How to Put GE's Leadership Formula to Work in Your Organization*. McGraw-Hill Professional.

Krauss, E. S. 1992. "Political Economy: Policymaking and Industrial Policy in Japan." *PS: Political Science and Politics* 25 (1): 44–57.

Lander, E., and J. K. Liker. 2007. "The Toyota Production System and Art: Making Highly Customized and Creative Products the Toyota Way." *International Journal of Production Research* 45 (16): 3681–3698. doi:10.1080/00207540701223519.

Landsbergis, P. A., J. Cahill, and P. Schnall. 1999. “The Impact of Lean Production and Related New Systems of Work Organization on Worker Health.” *Journal of Occupational Health Psychology* 4 (2): 108.

Lapidus, R. S., J. A. Roberts, and L. B. Chonko. 1996. “Stressors, Leadership Substitutes, and Relations with Supervision Among Industrial Salespeople.” *Industrial Marketing Management* 25 (5): 395–409.

Laub, J. 2003. “From Paternalism to the Servant Organization: Expanding the Organizational Leadership Assessment (OLA) Model.” In *Proceedings of the Servant Leadership Research Roundtable*.

Laub, J. A., R. H. Braye, J. H. Horsman, D. A. Beazley, R. S. Thompson, D. S. Ledbetter, W. M. Freitas, and J. D. Herbst. 1999. “Assessing the Servant Organization: Development of the Servant Organizational Leadership Assessment (SOLA) Instrument.”

Lawley, D. N., and A. E. Maxwell. 1962. “Factor Analysis as a Statistical Method.” *The Statistician* 12 (3): 209–229.

Lean Advancement Initiative. 2012a. “History | History | Lean Advancement Initiative.” http://lean.mit.edu/history/history.html.
———. 2012b. “2876-lai-overview-march-2012.pdf.” http://lean.mit.edu/downloads/download-document/2876-lai-overview-march-2012.html.

Lean Enterprise Institute. 2010. “LeanTimeline.swf (application/x-shockwave-flash Object).” http://www.leaninstituut.nl/TimeLine/LeanTimeline.swf.

Lean Enterprise Institute, Lean Enterprise, John Shook, and Chet Marchwinski. 2008. *Lean Lexicon*. Lean Enterprise Institute.

Lee, P. R., C. L. Estes, and F. M. Rodriguez. 2003. *The Nation’s Health*. Jones & Bartlett Learning.

Lee, R., and J. Skinner. “Will Aging Baby Boomers Bust the Federal Budget?” *The Journal of Economic Perspectives* 13, no. 1 (1999): 117–140.

Lee, Q. 2008. “Lean Manufacturing Essentials: Lean Manufacturing Defined and Explained.” *Management Services* 52 (2): 46.

Lee-Mortimer, A. 2006. “A Lean Route to Manufacturing Survival.” *Assembly Automation* 26 (4): 265–272.

LEI. 2010. “What Is Lean.” http://www.lean.org/WhatsLean/.

Leone, G., and R. D. Rahn. 2002. *Fundamentals of Flow Manufacturing*. Flow Publishing.

Levin-Scherz, J. "What Drives High Health Care Costs—and How to Fight Back." *Pediatrics* 8 (2010): 4.

Levit, K., C. Smith, C. Cowan, H. Lazenby, A. Sensenig, and A. Catlin. 2003. "Trends in US Health Care Spending, 2001." *Health Affairs* 22 (1): 154–164.

Lewis, James. *The Project Manager's Desk Reference, 3E*. 3rd ed. McGraw-Hill, 2006.

Liden, R. C., R. T. Sparrowe, and S. J. Wayne. 1997. "Leader-member Exchange Theory: The Past and Potential for the Future."

Liker. 2003. *The Toyota Way*. 1st ed. McGraw-Hill.

Liker, J., and M. Hoseus. 2010. "Human Resource Development in Toyota Culture." *International Journal of Human Resources Development and Management* 10 (1): 34.

Liker, J. K. 2004. *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer*. McGraw-Hill Professional.

Liker, Jeffrey, and Gary L. Convis. 2011. *The Toyota Way to Lean Leadership: Achieving and Sustaining Excellence Through Leadership Development*. 1st ed. McGraw-Hill.

Liker, Jeffrey K. 2004a. *The Toyota Way*. McGraw-Hill Professional.
———. 2004b. *The Toyota Way*. McGraw-Hill Professional.

Liker, Jeffrey, and David Meier. 2005. *The Toyota Way Fieldbook*. 1st ed. McGraw-Hill.
———. 2007. *Toyota Talent: Developing Your People the Toyota Way*. 1st ed. McGraw-Hill.

Likert, R. 1961. *New Patterns of Management*. McGraw-Hill New York.

Linck, J., and D. S. Cochran. 1999. "The Importance of Takt Time in Manufacturing System Design."

Locke, E. A. 1982. "The Ideas of Frederick W. Taylor: An Evaluation." *Academy of Management Review*: 14–24.

Lord, R. G., C. L. De Vader, and G. M. Alliger. 1986. "A Meta-analysis of the Relation Between Personality Traits and Leadership Perceptions: An Application of Validity Generalization Procedures." *Journal of Applied Psychology* 71 (3): 402–410.

MacDorman, M. F., T. J. Mathews, and National Center for Health Statistics (US). 2008. "Recent Trends in Infant Mortality in the United States."

Marley, Kathryn A., David A. Collier, and Susan Meyer Goldstein. 2004. “The Role of Clinical and Process Quality in Achieving Patient Satisfaction in Hospitals.” *Decision Sciences* 35 (3) (August 1): 349–369. doi:10.1111/j.0011-7315.2004.02570.x.

Marmor, T. R. 1994. *Understanding Health Care Reform*. Yale Univ Pr.

Martin, A. B., D. Lassman, B. Washington, A. Catlin, and others. 2012. “Growth In US Health Spending Remained Slow In 2010; Health Share Of Gross Domestic Product Was Unchanged From 2009.” *Health Affairs* 31 (1): 208–219.

Mary, G., and B. George. 1995. “Relationship-based Approach to Leadership: Development of Leader-member Exchange (LMX) Theory of Leadership over 25 Years: Applying a Multi-level Multi-domain Perspective.” *The Leadership Quarterly* 6 (2): 219–247.

McCall, M. W., and M. M. Lombardo. 1983. “Off the Track: Why and How Successful Executives Get Derailed.” *Statistics*.

McConnell, J. H. 2003. *How to Design, Implement, and Interpret an Employee Survey*. AMACOM/American Management Association.

McGlynn, E. A., S. M. Asch, J. Adams, J. Keesey, J. Hicks, A. DeCristofaro, and E. A. Kerr. 2003. “The Quality of Health Care Delivered to Adults in the United States.” *New England Journal of Medicine* 348 (26): 2635–2645.

McGregor, D., and J. Cutcher-Gershenfeld. 2006. *The Human Side of Enterprise*. McGraw-Hill Companies.

McGuire, E., and S. M. Kennerly. 2006. “Nurse Managers as Transformational and Transactional Leaders.” *Nursing Economics* 24 (4): 179.

Mehri, Darius. 2006. “The Darker Side of Lean: An Insider’s Perspective on the Realities of the Toyota Production System.” *Academy of Management Perspectives* 20 (2) (May): 21–42. doi:Article.

Meyer, Susan M., and David A. Collier. 2001. “An Empirical Test of the Causal Relationships in the Baldrige Health Care Pilot Criteria.” *Journal of Operations Management* 19 (4) (July): 403–426. doi:10.1016/S0272-6963(01)00053-5.

Miller, D. 2005. “Going Lean in Health Care.” *Institute for Healthcare Improvement, Cambridge, MA*.

Miller, R. L., J. Butler, and C. J. Cosentino. 2004. "Followership Effectiveness: An Extension of Fiedler's Contingency Model." *Leadership & Organization Development Journal* 25 (4): 362–368.

Miller, W., E. R. Vigdor, and W. G. Manning. 2004. "Covering the Uninsured: What Is It Worth?" *Health Affairs-millwood Va Then Bethesda Ma-* 23 (3): 290–290.

Mirsky, J., and A. Nevins. 1952. *The World of Eli Whitney*. Macmillan.

Monden, Yasuhiro. 1998. *Toyota Production System: An Integrated Approach to Just-In-Time*. 3rd ed. Engineering & Management Press.

Montgomery, D. C., E. A. Peck, and G. G. Vining. 2001. "Introduction to Linear Regression Analysis, Student Solutions Manual."

Moore, T. A., and W. P. Goss. 1980. "The Springfield Armory." *The American Society of Mechanical Engineers*.

Moravcsik, A. 1991. "Arms and Autarky in Modern European History." *Daedalus* 120 (4): 23–45.

Morden, Tony. 2004. *Principles of Management*. Ashgate Publishing, Ltd.

Murman, E. M. 2002. *Lean Enterprise Value: Insights from MIT's Lean Aerospace Initiative*. Palgrave Macmillan.

Murphy, J. F., E. B. Goldring, X. C. Cravens, S. N. Elliott, and A. C. Porter. 2007. "The Vanderbilt Assessment of Leadership in Education: Measuring Learning-centered Leadership." *Journal of East China Normal University*.

Myers, I. B. 1962. *The Myers-briggs Type Indicator*. Consulting Psychologists Press Palo Alto, CA.

———. 2003. *MBTI Manual: A Guide to the Development and Use of the Myers-Briggs Type Indicator Instrument*. CPP.

Myers, I. B., M. H. McCaulley, and R. Most. 1985. *Manual: A Guide to the Development and Use of the Myers-Briggs Type Indicator*. Consulting Psychologists Press Palo Alto, CA.

National portrait gallery, National portrait. 1862. *Catalogue of the Pictures in the National Portrait Gallery*.

Nelson-Peterson, D. L., and C. J. Leppa. 2007. "Creating an Environment for Caring Using Lean Principles of the Virginia Mason Production System." *Journal of Nursing Administration* 37 (6): 287.

Nicholls, J. R. 1985. “A New Approach to Situational Leadership.” *Leadership & Organization Development Journal* 6 (4): 2–7.

Nolte, Ellen, and C. Martin McKee. “Measuring The Health Of Nations: Updating An Earlier Analysis.” *Health Affairs* 27, no. 1 (January 1, 2008): 58–71.

Northouse, P. G. G., and P. G. Northouse. 2009. *Leadership: Theory and Practice*. Sage Publications, Inc.

Nunnally, J. C, I. H. Bernstein, and J. M. F. Berge. 1967. *Psychometric Theory*. McGraw-Hill New York.

Nurse, E. W. 2011. “A Comparative Analysis of the Relationship Between CEOs’ Leadership Style and Healthcare Organizational Viability.” University of Phoenix.

NYTimes. 2012. “Toyota Motor Corporation (TM) News - The New York Times.” http://topics.nytimes.com/top/news/business/companies/toyota_motor_corporation/index.html.

O’Neil, E., and J. A. Seago. 2002. “Meeting the Challenge of Nursing and the Nation’s Health.” *JAMA: The Journal of the American Medical Association* 288 (16): 2040–2041.

Oberlander, J. 2002. “The US Health Care System: On a Road to Nowhere?” *Canadian Medical Association Journal* 167 (2): 163–168.

Ohno, T. 1984. “How the Toyota Production System Was Created.” *The Anatomy of Japanese Business*: 197–215.

Ohno, Taiichi. 1988. *Toyota Production System: Beyond Large-Scale Production*. 1st ed. Productivity Press.

Ohno, Taiichi, and Setsuo Mito. 1988. *Just-In-Time for Today and Tomorrow*. Productivity Press.

Ola, L. A. 2000. “Development of the Organizational Leadership Assessment (OLA) Instrument.”

Ott, R. L., and M. Longnecker. 2008. *An Introduction to Statistical Methods and Data Analysis*. Duxbury Pr.

Pawar, B. S., and K. K. Eastman. 1997. “The Nature and Implications of Contextual Influences on Transformational Leadership: A Conceptual Examination.” *Academy of Management Review* 22 (1): 80–109.

Pearce, C. L., J. A. Conger, and E. A. Locke. 2008. “Shared Leadership Theory.” *The Leadership Quarterly* 19 (5): 622–628.

Personality Profile Solutions. 2011. “What Is DiSC®? Dominance, Influence, Steadiness, Conscientiousness | DiscProfile.com, 877-344-9612.” http://discprofile.com/whatisdisc.htm.

Pius Achanga, Esam Shehab, Rajkumar Roy, and Geoff Nelder. 2006. “Critical Success Factors for Lean Implementation Within SMEs.” *Journal of Manufacturing Technology Management* 17 (4): 460.

Plunkert, L. M. 1990. “1980’s: A Decade of Job Growth and Industry Shifts, The.” *Monthly Lab. Rev.* 113: 3.

Porter, M. E. 2009. “A Strategy for Health Care Reform—toward a Value-based System.” *New England Journal of Medicine* 361 (2): 109–112.

Porter, M. E., and E. O. Teisberg. 2006. *Redefining Health Care: Creating Value-based Competition on Results*. Harvard Business Press.
———. 2007. “How Physicians Can Change the Future of Health Care.” *JAMA: The Journal of the American Medical Association* 297 (10): 1103–1111.

Press, Prod. 1998. *Just-in-Time for Operators*. 1st ed. Productivity Press.

Proctor, B. D. 2006. *Income, Poverty, and Health Insurance Coverage in the United States: 2010*. Current Population Reports, US Census Bureau.

Radford 2010. *Special Topics in Management (class Presentation).*

Radnor, Z., and R. Boaden. 2008. “Editorial: Lean in Public Services—Panacea Or Paradox?”

Radnor, Z., and P. Walley. 2008. “Learning to Walk Before We Try to Run: Adapting Lean for the Public Sector.” *Public Money and Management* 28 (1): 13–20.

Ramey, Valerie A., and Daniel J. Vine. 2005. “Declining Volatility in the U.S. Automobile Industry.” *National Bureau of Economic Research Working Paper Series* No. 11596. http://www.nber.org/papers/w11596.

Rea, L. M., R. A. Parker, and R. Allen. 1997. *Designing and Conducting Survey Research: A Comprehensive Guide*. Jossey-Bass Publishers San Francisco, CA.

Rea, Louis, and Richard A. Parker. 2005. *Designing and Conducting Survey Research : a Comprehensive Guide*. 3rd ed. San Francisco: Jossey-Bass.

REFA. *REFA Methodenlehre Der Betriebsorganisation, Datenermittlung: Bd. 2*. Fachbuchverlag Leipzig, 1997.

Reinhardt, U. E. 2003. “Does the Aging of the Population Really Drive the Demand for Health Care?” *Health Affairs* 22 (6): 27–39.

Roehr, B. 2008. “Health Care in US Ranks Lowest Among Developed Countries.” *BMJ* 337.

Rogowski, J., L. Karoly, United States. Dept. of Labor, United States. Agency for Health Care Policy, and Research. 2000. “Health Insurance and Retirement Behavior: Evidence from the Health and Retirement Survey.” *Journal of Health Economics* 19 (4): 529–540.

Roland, B. 2008. “Leadership Compendium.”

Rosseter, R. 2005. “Nursing Shortage Fact Sheet.” *American Association of Colleges of Nursing*.

Rother, Mike, and John Shook. 1999. *Learning to See: Value Stream Mapping to Add Value and Eliminate MUDA*. Lean Enterprise Institute.

Rothwell, W. J. 2010. *Effective Succession Planning: Ensuring Leadership Continuity and Building Talent from Within*. Amacom Books.

Rubenstein, J. M. 1987. “Further Changes in the American Automobile Industry.” *Geographical Review* 77 (3): 359–362.

Salsberg, E., and A. Grover. 2006. “Physician Workforce Shortages: Implications and Issues for Academic Health Centers and Policymakers.” *Academic Medicine* 81 (9): 782.

Sankowsky, D. 1995. “The Charismatic Leader as Narcissist: Understanding the Abuse of Power.” *Organizational Dynamics*.

Sashkin, M., and M. G. Sashkin. 2003. *Leadership That Matters: The Critical Factors for Making a Difference in People’s Lives and Organizations’ Success*. Berrett-Koehler Publishers.

Sataline, Suzanne, and Shirley S. Wang. “Medical Schools Can’t Keep Up.” *Wall Street Journal*, April 12, 2010, sec. Health Industry. http://online.wsj.com/article/SB10001424052702304506904575180331528424238.html.

Savary, Louis M., and Clare Crawford-Mason. 2006. *The Nun and the Bureaucrat--How They Found an Unlikely Cure for America’s Sick Hospitals*. 1st ed. CC-M Productions, Inc.

Schmenner, R. W. 2001. “Looking Ahead by Looking Back: Swift, Even Flow in the History of Manufacturing.” *Production and Operations Management* 10 (1): 87–96.

Schonberger, Richard J. 1982. *Japanese Manufacturing Techniques: Nine Hidden Lessons in Simplicity*. 1st ed. Free Press.

Schriesheim, C. A., S. L. Castro, and C. C. Cogliser. 1999. "Leader-member Exchange (LMX) Research: A Comprehensive Review of Theory, Measurement, and Data-analytic Practices." *The Leadership Quarterly* 10 (1): 63–113.

Schriesheim, C., and S. Kerr. 1974. "Psychometric Properties of the Ohio State Leadership Scales." *Psychological Bulletin* 81 (11): 756.

Schultz, Frank C., Shoma Pal, and Dennis A. Swan. "Who Should Lead a Healthcare Organization: MDs or MBAs?" *Journal of Healthcare Management* 49, no. 2 (April 2004): 103–16; discussion 116–7.

Schwartz, S. H. 1994. "Beyond Individualism/collectivism: New Cultural Dimensions of Values."

Scorsone, Eric A. 2008. "New Development: What Are the Challenges in Transferring Lean Thinking to Government?" *Public Money & Management* 28 (1): 61–64. doi:10.1111/j.1467-9302.2008.00621.x.

Shactman, D., S. H. Altman, E. Eilat, K. E. Thorpe, and M. Doonan. 2003. "The Outlook for Hospital Spending." *Health Affairs* 22 (6): 12–26.

Shamir, B., R. J. House, and M. B. Arthur. 1993. "The Motivational Effects of Charismatic Leadership: A Self-concept Based Theory." *Organization Science*: 577–594.

Shimokawa, Koichi, Takahiro Fujimoto, Brian Miller, and John Shook. 2009. *The Birth of Lean*. Lean Enterprise Institute, Inc.

Shimokawa, Koichi, and Takahiro Fujimoto, eds. 2009. *The Birth of Lean*. Trans. Brian Miller and John Shook. Lean Enterprise Institute, Inc.

Shirouzu, N., A. Toyoda, and T. City. 2010. "Inside Toyota, Executives Trade Blame Over Debacle." *Wall Street Journal*.

Shook, J. 2010. "How to Change a Culture: Lessons From NUMMI." *MIT Sloan Management Review* 51 (2): 63.

Shortell, S. M., and S. J. Singer. 2008. "Improving Patient Safety by Taking Systems Seriously." *JAMA: The Journal of the American Medical Association* 299 (4): 445–447.

Siegel, Marc. 2009. "The Doctor Drought - Forbes.com." http://www.forbes.com/2009/12/04/doctors-medical-health-reform-senate-opinions-contributors-marc-siegel.html.

Singer, S. J., D. M. Gaba, J. J. Geppert, A. D. Sinaiko, S. K. Howard, and K. C. Park. 2003. "The Culture of Safety: Results of an Organization-wide Survey in 15 California Hospitals." *Quality and Safety in Health Care* 12 (2): 112–118.

Singer, Sara J., and Stephen M. Shortell. 2008. "Improving Patient Safety by Taking Systems Seriously." *JAMA : the Journal of the American Medical Association* 299 (4) (January 30): 445–447. doi:10.1001/jama.299.4.445.

Singleton, C. J. 1992. "Auto Industry Jobs in the 1980's: a Decade of Transition." *Monthly Lab. Rev.* 115: 18.

Skocpol, T. 1997. *Boomerang: Health Care Reform and the Turn Against Government*. WW Norton & Company.

Slack, R. 1999. "The Lean Value Principle in Military Aerospace Product Development."

Smalley, Art. 2004. *Creating Level Pull: A Lean Production-System Improvement Guide for Production-Control, Operations, and Engineering Professionals*. Lean Enterprise Institute.

Spear, S., and H. K. Bowen. 1999. "Decoding the DNA of the Toyota Production System." *Harvard Business Review* 77: 96–108.

Spear, Steven J. 2004. "Learning to Lead at Toyota." *Harvard Business Review* 82 (5) (May): 78–86. doi:Article.

Spinelli, R. J. 2006. "The Applicability of Bass's Model of Transformational, Transactional, and Laissez-faire Leadership in the Hospital Administrative Environment." *Hospital Topics* 84 (2): 11–19.

Staats, B., and D. Upton. 2009. "Lean Principles, Learning, and Software Production: Evidence from Indian Software Services." *Harvard Business School Technology & Operations Mgt. Unit Working Paper No. 08-001*.

Staats, B. R., D. J. Brunner, and D. M. Upton. 2010. "Lean Principles; Learning; and Knowledge Work: Evidence from a Software Services Provider." *Journal of Operations Management*.

Staehle, W. H. 1976. "Situational Approach to Management." *Management International Review*: 59–69.

Steele, J. P., and S. Garven. 2009. *The Leader AZIMUTH Check: Factor Structure of Common Competencies*. DTIC Document.

Stewart, J. M. “The Impact of Health Status on the Duration of Unemployment Spells and the Implications for Studies of the Impact of Unemployment on Health Status.” *Journal of Health Economics* 20, no. 5 (2001): 781–796.

Stogdill, R. M. 2004. “Personal Factors Associated with Leadership; a Survey of the Literature.” *The International Library of Leadership*: 51.

Stogdill, R. M., and A. E. Coons. 1957. *Leader Behavior: Its Description and Measurement*. Ohio State University College of Administrative Science.

Stogdill, R. M., and R. Melvin. 1974. “Handbook of Leadership: A Survey of Theory and Research.”

Sugarman, P. A., and W. James. 2004. “Balancing the Scorecard: Key Performance Indicators in a Complex Healthcare Setting.” *Clinician in Management* 12 (3): 129–132.

Sugimori, Y., K. Kusunoki, F. Cho, and S. Uchikawa. 1977a. “Toyota Production System and Kanban System Materialization of Just-in-time and Respect-for-human System.” *The International Journal of Production Research* 15 (6): 553–564.
———. 1977b. “Toyota Production System and Kanban System Materialization of Just-in-time and Respect-for-human System.” *International Journal of Production Research* 15 (6) (November): 553. doi:Article.

Swank, C. K. 2003. “The Lean Service Machine.” *Harvard Business Review* 81 (10): 123–130.

Systems Support. 2009. “US Census Bureau The 2012 Statistical Abstract: Family Income.” http://www.census.gov/compendia/statab/cats/income_expenditures_poverty_wealth/family_income.html.

Takeuchi, Hirotaka, Emi Osono, and Norihiko Shimizu. 2008. “The Contradictions That Drive Toyota’s Success.” *Harvard Business Review* 86 (6) (June): 96–104. doi:Article.

Taylor, F. W. 1911a. “Scientific Management.” *New York* 191 (1).
———. 1911b. “Scientific Management.” *New York* 191 (1).

Taylor 2005. *The Principles of Scientific Management*. 1st World Library.

The Leadership Circle. 2011. “Leadership Culture Survey™ - The Leadership Circle.” http://www.theleadershipcircle.com/assessment-tools/survey.

Thompson, B., American Psychological Association, and Inc Ovid Technologies. 2004. *Exploratory and Confirmatory Factor Analysis: Understanding Concepts and Applications*. American Psychological Association Washington, DC.

Thurstone, L. L. 1947. *Multiple-factor Analysis*. The University of Chicago Press Chicago, IL.

Towill, D. R. 2007. “Exploiting the DNA of the Toyota Production System.” *International Journal of Production Research* 45 (16): 3619–3637. doi:10.1080/00207540701223436.

Tsutsui, W. M. 1996. “W. Edwards Deming and the Origins of Quality Control in Japan.” *Journal of Japanese Studies* 22 (2): 295–325.

Tucker, C. M., K. C. Herman, L. A. Ferdinand, T. R. Bailey, M. T. Lopez, C. Beato, D. Adams, and L. L. Cooper. 2007. “Providing Patient-centered Culturally Sensitive Health Care.” *The Counseling Psychologist* 35 (5): 679–705.

Tuomo, T. 2006. “How to Be an Effective Charismatic Leader: Lessons for Leadership Development.” *Development and Learning in Organizations: An International Journal* 20 (4): 19–21.

Ufkes, F. M. 1995. “Lean and Mean: US Meat-packing in an Era of Agro-industrial Restructuring.” *Environment and Planning D* 13: 683–706.

Ullman, J. B., and P. M. Bentler. 2003. “Structural Equation Modeling.”

Uninsurance, Institute of Medicine (US). Committee on the Consequences of the uninsured. 2004. *Insuring America’s Health: Principles and Recommendations*. Natl Academy Pr.

Urwick, L. F., and E. F. L. Brech. 1949. *The Making of Scientific Management*. Vol. 2. Management publications trust.

US EPA, OP. 2012. “Case Studies | Publications | Lean Government | US EPA.” http://www.epa.gov/lean/government/publications/casestudies.htm.

Vansteenkiste, M., and E. L. Deci. 2003. “Competitively Contingent Rewards and Intrinsic Motivation: Can Losers Remain Motivated?” *Motivation and Emotion* 27 (4): 273–299.

Vision Council. 2010. “Blake Mouton Leadership Grid Survey - Google Search.” https://www.google.com/#hl=en&sclient=psy-ab&q=blake+mouton+leadership+grid+survey&oq=blake+mouton+leadership+grid+survey&aq

Wagner, E. H. 2009. “Chronic Disease Management: What Will It Take to Improve Care for Chronic Illness?” *Effective Clinical Practice ECP* 1 (1): 2–4.

Wainess, F. J. 1999. “The Ways and Means of National Health Care Reform, 1974 and Beyond.” *Journal of Health Politics, Policy and Law* 24 (2): 305–333.

Waldman, D. A., T. Lituchy, M. Gopalakrishnan, K. Laframboise, B. Galperin, and Z. Kaltsounakis. 1998. “A Qualitative Analysis of Leadership and Quality Improvement.” *The Leadership Quarterly* 9 (2): 177–201.

Walker, C. L. 1993. “A Cross-sectional Analysis of Hospital Profitability.” *Journal of Hospital Marketing* 7 (2): 121–138.

Walsh, M. 1977. “Pork Packing as a Leading Edge of Midwestern Industry, 1835-1875.” *Agricultural History* 51 (4): 702–717.

Walton, M. 1986. *The Deming Management Method*. Perigee Trade.

Ward, Allen C. 2007. *Lean Product and Process Development*. Lean Enterprises Inst Inc.

Watkins, A. L. 2000. “Hospital Financial Ratio Classification Patterns Revisited: Upon Considering Nonfinancial Information.” *Journal of Accounting and Public Policy* 19 (1): 73–95.

———. 2003. “A Balanced Perspective: Using Nonfinancial Measures to Assess Financial Performance.” *Healthcare Financial Management: Journal of the Healthcare Financial Management Association* 57 (11): 76.

Weisberg, H. F., J. A. Krosnick, and B. D. Bowen. 1996. *An Introduction to Survey Research, Polling, and Data Analysis*. Sage Publications, Inc.

Weisberg, S. 2005. *Applied Linear Regression*. Wiley.

Wheatley, M. J. 1999. *Leadership and the New Science*. Berrett-Koehler San Francisco.

WHO. 2009. “WHO | World Health Statistics 2009.” *WHO*. http://www.who.int/whosis/whostat/2009/en/index.html.

———. 2011. “WHO | World Health Statistics 2011.” *WHO*. http://www.who.int/whosis/whostat/2011/en/index.html.

Wilkes, M. S., R. A. Bell, and R. L. Kravitz. 2000. “Direct-to-consumer Prescription Drug Advertising: Trends, Impact, and Implications.” *Health Affairs* 19 (2): 110–128.

Williams, K., C. Haslam, J. Williams, A. Adcroft, and S. Johal. 1993. “The Myth of the Line: Ford’s Production of the Model T at Highland Park, 1909–16.” *Business History* 35 (3): 66–87.

Wilper, A. P., S. Woolhandler, K. E. Lasser, D. McCormick, D. H. Bor, and D. U. Himmelstein. 2009. “Health Insurance and Mortality in US Adults.” *American Journal of Public Health* 99 (12): 2289.

Winkler, I. 2009. “Leader–Member Exchange Theory.” *Contemporary Leadership Theories*: 47–53.

Wofford-Vicki, L., and others. 1998. “A Field Study of a Cognitive Approach to Understanding Transformational and Transactional Leadership.” *The Leadership Quarterly* 9 (1): 55–84.

Womack, J. P. 2006. “Purpose, Process, People.” *Lean Enterprise Institute E-letter*.

Womack, J. P. 2006. “Principles of Lean Management” presented at the Lean Leadership Summit, December, Orlando, FL.

———. 2007. “Moving Beyond the Tool Age [lean Management].” *Manufacturing Engineer* 86 (1) (February): 4–5. doi:10.1049/me:20070101.

———. 2010. “Purpose, Process, People.”

Womack, J. P., and D. T Jones. 2003. *Lean Thinking: Banish Waste and Create Wealth in Your Corporation*. Free Press,.

Womack, J. P., and D. T. Jones. 1996. “Beyond Toyota: How to Root Out Waste and Pursue Perfection.” *Harvard Business Review* 74: 140–172.

———. 2004. *Lean Thinking*. Campus-Verl.

Womack, James P., and Daniel T. Jones. 2003. *Lean Thinking*. Simon and Schuster.

———. 2005. *Lean Solutions: How Companies and Customers Can Create Value and Wealth Together*. 1st ed. Free Press.

Womack, James P., Daniel T. Jones, and Daniel Roos. 1991. *The Machine That Changed the World : The Story of Lean Production*. Harper Perennial.

Womack, J. P. 2002. “Lean Thinking: Where Have We Been and Where Are We Going?” *Manufacturing Engineering* 129 (3) (September): L2–L6.

Womack, J. P , and D. T. Jones. 1996. “Beyond Toyota: How to Root Out Waste and Pursue Perfection.” *Harvard Business Review* 74 (5) (October): 140–&.

Womack, J. P., and D. T. Jones. 1994. “From Lean Production to the Lean Enterprise.” *Harvard Business Review* 72 (2) (April): 93–103.

Woodbury, R. S. 1960. “The Legend of Eli Whitney and Interchangeable Parts.” *Technology and Culture* 1 (3): 235–253.

Woolhandler, S., T. Campbell, and D. U. Himmelstein. 2003. “Costs of Health Care Administration in the United States and Canada.” *New England Journal of Medicine* 349 (8): 768–775.

Wren, D. A. 2004. *The Evolution of Management*. San Francisco: John Wiley & Sons Inc., from University of Phoenix, resource, LDR711-Transformational Leadership and Innovation Course website.

Wysocki, B. 2004. "To Fix Health Care, Hospitals Take Tips from Factory Floor." *Wall Street Journal*.

Yammarino, F. J., and A. J. Dubinsky. 1994. "Transformational Leadership Theory: Using Levels of Analysis to Determine Boundary Conditions." *Personnel Psychology* 47 (4): 787–811.

Yin, R. K. 2009. *Case Study Research: Design and Methods*. Sage Publications, Inc.

Younis, M., D. A. Forgione, M. Khan, and J. Barkoulas. 2003. "Hospital Profitability in Florida: A Revisitation." *Research in Healthcare Financial Management* 8 (1): 95–102.

Younis, M. Z., and D. A. Forgione. 2005. "Using Return on Equity and Total Profit Margin to Evaluate Hospital Performance in the US: a Piecewise Regression Analysis." *Journal of Health Care Finance* 31 (3): 82.

Yukl, G. 1999a. "An Evaluation of Conceptual Weaknesses in Transformational and Charismatic Leadership Theories." *The Leadership Quarterly* 10 (2): 285–305.

———. 1999b. "An Evaluative Essay on Current Conceptions of Effective Leadership." *European Journal of Work and Organizational Psychology* 8 (1): 33–48.

Yukl, G. A., and R. Lepsinger. 2004. *Flexible Leadership: Creating Value by Balancing Multiple Challenges and Choices*. Jossey-Bass.

Yun, S., J. Cox, and H. P. Sims Jr. 2006. "The Forgotten Follower: a Contingency Model of Leadership and Follower Self-leadership." *Journal of Managerial Psychology* 21 (4): 374–388.

Zaccaro, S. J. 2007. "Trait-based Perspectives of Leadership." *American Psychologist* 62 (1): 6–16.

Zeller, T. L., B. B. Stanko, and W. O. Cleverley. 1997. "A New Perspective on Hospital Financial Ratio Analysis." *Healthcare Financial Management: Journal of the Healthcare Financial Management Association* 51 (11): 62.

Zuckerman, S., and others. 2001. "Could Subsidizing COBRA Health Insurance Coverage Help Most Low-Income Unemployed?"

4. Methodology

4.1. Overview

The **first** objective of this research study is to empirically gauge factors that influence hospital performance. Hospital performance, in this study, is defined by quality of care measures, also known as patient safety criteria, assessed and gathered by the U.S. Center for Medicare and Medicaid Services (CMS 2011). Three factor groups, e.g., management styles, organizational traits, and leadership traits, comprised in an overall research construct (Figure 17), are tested to evaluate their influence on US hospital performance by means of primary (survey) and secondary data (CMS database 2011). Results from this study allow the assessment of organizational traits, leadership characteristics, and management practices and their influence on quality of care in U.S. hospitals.

The **second** objective of this study is to empirically evaluate differences in leadership traits of chief executive officers (CEOs) and their effects on hospital performance as measured by quality of care measures (CMS 2011) across the U.S. Results from this study allow the evaluation of differences in CEO leadership traits across three categories (lean, high, and low performing) of U.S. hospitals. The CMS (2011) secondary data was used to rank all U.S. hospitals regarding their performance (e.g., quality of care), while primary data was gathered using a second online questionnaire that was addressed to selected US hospitals.

The **third** objective of this study aims to empirically evaluate differences in process management associated with higher and lower performing hospitals across the U.S. We extracted the information necessary from our primary dataset from both surveys (first and second objectives). Results from this analysis allow us to understand performance differentials based on the performance measures (secondary data) and the process management practices (primary data).

4.2. First study objective – Data and variables

The first study objective was to investigate individual drivers of hospital performance (measured by the quality of care measures, CMS 2012a). This study answered the hypotheses whether process management, modern management, organizational traits, and/or leadership impact the quality of care measures of hospitals (Hypotheses H1, H2, H3, and H4, see chapter 2.1 Factors that influence hospitals performance). Even though most research studies of the US health care sector are evidence-based and rely on case studies as a means to describe patterns and characteristics of hospitals (e.g. Kenney 2010; Bevan 2006; Sculpher et al. 2004; Anthony et al. 2003; Leatherman et al. 2003; Shojania et al. 2001; Kitson et al. 1998; Keen and Packwood 1995; Broadbent 1992), this study uses a combination of primary survey data and secondary publicly available data to test the influence of selected characteristics on hospital performance (Figure 17).

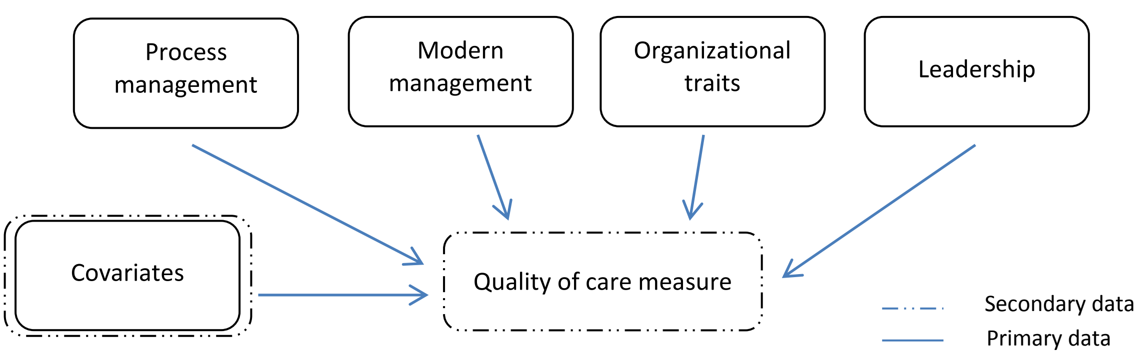

Figure 17: Study construct.

The practice of using a combination of primary and secondary data has proven to be statistically viable (e.g. Boyer et al. 2012; Marley et al. 2004).

4.2.1. Primary data

4.2.1.1. Data sources

4.2.1.1.1. Population

To study the dynamics of hospitals nationwide, the population of interest for this study consists of all hospitals on U.S. territory. According to the American Hospital Association (AHA), the total number of registered hospitals in the U.S. was 5,754 by the end of 2010, consisting of 2,904 nongovernmental, not-for-profit community hospitals, 1,013 investor-owned for-profit community hospitals, 1,068 state and local government community hospitals, 213 federal hospitals, 435 nonfederal psychiatric hospitals, 111 nonfederal long term care hospitals, and 10 hospital units of institutions (prison hospitals, college infirmaries, and others, AHA 2011b). However, according to the U.S. Center for Medicare and Medicaid Services (CMS), the total number of hospitals reporting quality of care measures was 4,697 for 2010, divided into 3,469 acute care hospitals, 20 children' hospitals, 129 acute care veteran hospitals, and 1,052 critical access hospitals (CMS 2012b). Since this study uses CMS' (HHS 2012) quality of care measures as a hospital performance indicator, the population of interest for this study are the 4,697 hospitals across the U.S. whose quality of care measures are publicly available in the CMS database (HHS 2012).

4.2.1.1.2. Mailing list

The address list used for this research consisted of information from the following sources: American Hospital Association (AHA 2011a), U.S. Department of Health and Human Services (HHS 2012), State Hospital Associations (IHA 2011; WSHA 2011), and Institute for Healthcare Improvement (IHI, 2010). The final contact list that could be matched with the CMS database (CMS 2012b; HHS 2012) consisted of 4,697 U.S. hospitals. Hospital addresses, phone numbers, fax numbers, hospital names, hospital types, and other information pertaining to each hospital was downloaded from the CMS website and incorporated into the main database. Data from AHA, IHI, and the state hospital associations were used to verify the information and to fill gaps. These efforts resulted in a dataset with a total of 4,697 addresses, which was used for this study.

4.2.1.2. Data collection

4.2.1.2.1. Online Questionnaire

An online questionnaire scripted in Qualtrics (Qualtrics 2011) was developed and was directed to quality or process improvement managers at each of the 4,697 hospitals identified. The questionnaire used three types of questions: 1) Likert scale questions, 2) open ended questions, and 3) categorical scale questions (Rea et al. 1997; Weisberg et al. 1996; Alreck and Settle 1995; Fowler 1995; Likert 1932). The final questionnaire (Appendix B) consisted of six main categories. The first category entailed six questions that describe **background information** about the respondents as well as the hospital they work for, e.g. hospital name; hospital location; type of organization and services offered; respondent's position, and his or her length of employment. The second category of questions asked six questions regarding **general hospital indicators** like the number of annual admissions, total licensed beds, and inpatient days, to name a few. The third part of the questionnaire consisted of 24 questions that were adapted from Womack (2009) and were aimed at comparing **process** with **modern management**, followed by 16 questions in the fourth part about **transactional and transformational leadership characteristics** (adapted from a variety of leadership questionnaires as explained in Chapter 4.2.3 Data analysis and statistics). This fourth part included questions about coaching and advising subordinates; personal attention, and providing hospital associates with a vision and a sense of mission, among others. The fifth part of the questionnaire, consisting of 24 questions, asked for information about **non-financial performance indicators**, such as average patient wait time, average case mix index, medication error rate, and others. Finally, the sixths part of the questionnaire consisted of ten questions regarding **financial performance measures** like gross revenues, total expenses, and expense distribution.

For the execution of this web-based survey, a website (www.hospitalleadership.org) was set up to allow easy access to the questionnaire. The questionnaire itself was hosted on a Virginia Tech server (https://virginiatech.qualtrics.com). A complete copy of the questionnaire can be found in Appendix B. Prior to executing the survey, approval from Virginia Tech's Institutional Review Board (IRB) for the questionnaire, the website, the marketing letter, the follow-up postcards, and the marketing emails was obtained on July 29, 2011 (Appendix C).

4.2.1.2.2. Questionnaire pretest

Before the pre-test, the questionnaire was reviewed by Virginia Tech faculty. Further feedback was obtained from Lean Global Network (LGN) affiliates in Brazil, the U.S., the Netherlands, South Africa, France, and the UK. Before the start of the online survey, a pretest was conducted to verify and assess the validity of the survey questionnaire and the survey statistics. A sample of 38 hospital associates from two independent hospitals in Virginia was selected to test the questionnaire for clarity, acceptability, timeliness, and comprehensiveness

(Rea et al. 1997; Alreck and Settle 1995). Thirty-three responses were received and analyzed. Based on this analysis, minor changes were incorporated into the questionnaire (Rea et al. 1997; Alreck and Settle 1995). In addition to the pre-test with two hospitals in Virginia, a randomly selected subsample of 50 hospitals from the population of 4,697 hospitals was used to investigate our overall approach to gather information required for this study. Thus, 50 marketing letters were sent out addressed to the quality or process improvement manager of each of the 50 randomly selected hospitals. The letter asked recipients to complete the survey online by visiting www.hospitalleadership.org (see appendix D). Thirteen responses were received (26 percent response rate) and analyzed and led to adjustments to the online survey tool (Qualtrics 2011) to be better able to extract data for final analysis. Queries were written to make the data extraction from the Qualtrics database to MS Excel 2010 (Microsoft 2010) and SAS 9.2 (SAS 2010) easier. Results from these 13 responses were then included in the overall response and used for final analysis.

4.2.1.2.3. Mailings, follow-ups, and data gathering

While this survey was web-based, postal mail was used for marketing purposes. Mailings alerting potential participants were issued according to the timeline shown in Figure 18. In total, two marketing letters (Appendix E) and two colored reminder postcards (Appendix F) inviting all 4,697 hospitals to participate in this research, were mailed. The timeline in Figure 18 also shows the closing date and the milestone for testing for non-response bias. The data collection took place from mid July 2011 to October 2011.

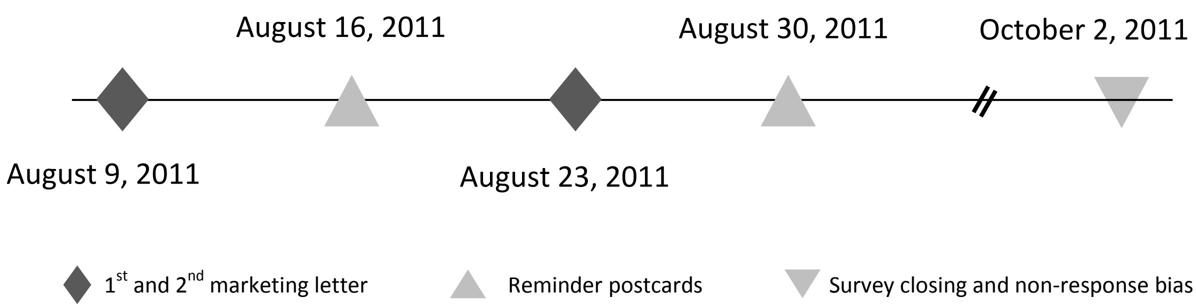

Figure 18: Survey timetable.

As scheduled, the first marketing letter was mailed to 4,697 hospitals on August 9, 2011. The letter mailed (Appendix E) was addressed to the quality or process manager of each of the hospitals targeted. All correspondence mailed included the URL of the survey website (www.hospitalleadership.org, Appendix D) for ease of access of the questionnaire online (https://virginiatech.qualtrics.com, Appendix B). A postcard (Appendix F) printed on orange paper was sent out to remind potential participants of the survey and to increase overall response rates on August 16, 2011. During the first two weeks of the survey, 21 letters were returned to sender due to wrong addresses or other reasons. Addresses and database records of hospitals with returned mail were double-checked and addresses were updated for the next mailing.

One week after the first reminder postcard, the second marketing letter (Appendix E) mailing took place. Adhering to the timeline shown in Figure 18 and having received 362 responses up to that point, another 4,335 marketing letters were sent to all non-respondents on August 23, 2011. Only 6 of those letters were returned to sender due to address changes and other issues. By the time of the mailing of the second and last colored reminder postcard (Appendix F), 478 responses were obtained and thus 4219 hospitals were addressed on August 30, 2011. Figure 19 depicts the details of execution of the survey and the frequency of responses.

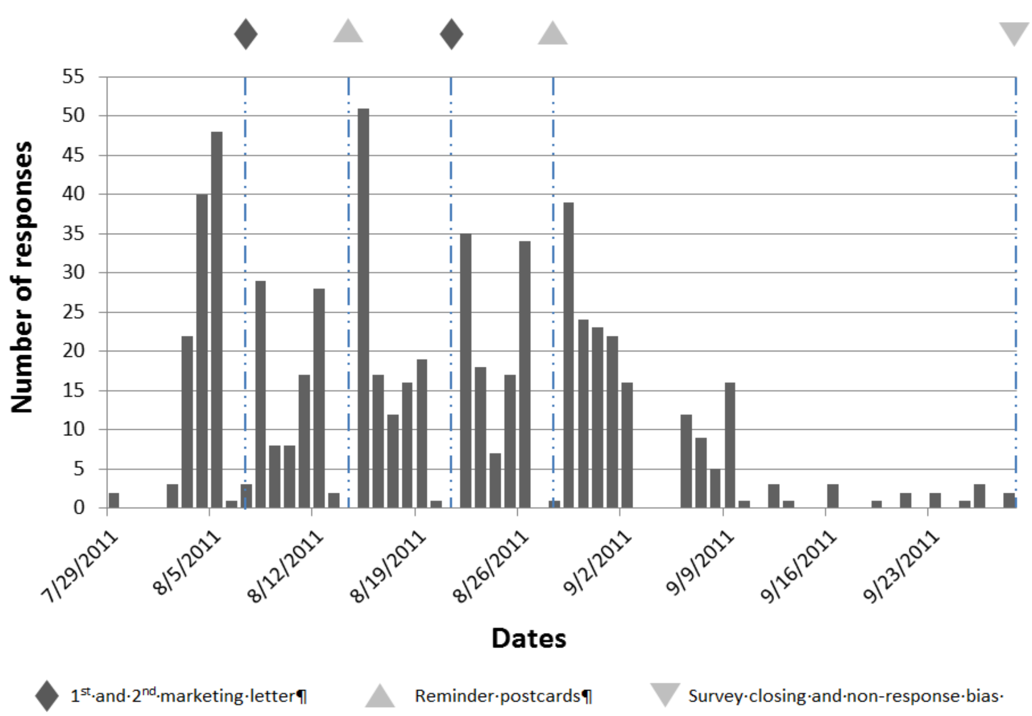

Figure 19: Response rates per day.

After closing the survey on October 2, 2011, a total of 732 responses were obtained. Of these 732 responses, 7 were returned stating that the respondents were not hospitals, 45 responses were incomplete surveys, and 83 responses were redundant entries from the same hospital. Thus, 597 usable responses were obtained for an adjusted response rate of 12.86 percent. Figure 20 depicts a map showing responses obtained by state.

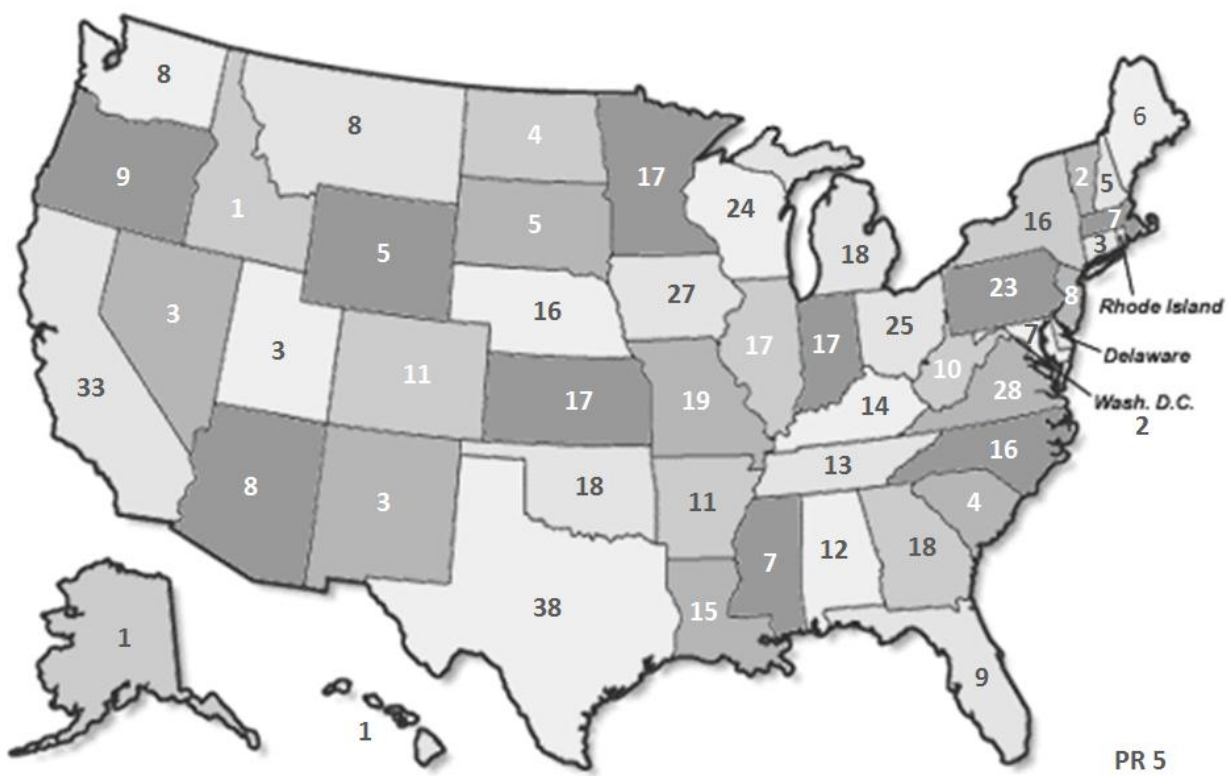

Figure 20: Response rate per state (adapted from: http://www.energycodes.gov/images/us_map_colored.gif).

Figure 20 shows that the number of responses received varied by state from one (Alaska, Hawaii, and Idaho) to thirty-eight (Texas). However, no responses were received from Rhode Island and Delaware.

After closing the survey on October 27, 2011, thirty non-respondents were contacted by phone to obtain answers to one demographic question, six organizational characteristic questions, and one question about management strategies (Appendix G). The responses from this phone survey were used to establish non-response bias (Dillman 2007; Connolly and Connolly 2005; Rea and Parker 2005; Alreck and Settle 1995).

4.2.1.2.4. Primary data preparation for further analysis

All survey responses were automatically stored, coded, and organized in Qualtrics (Qualtrics 2011). After closing the survey, the data was extracted and transferred to MS Excel 2010 (Microsoft 2010). To account for non-response bias (Dillman 2007; Connolly and Connolly 2005; Rea and Parker 2005; Alreck and Settle 1995), the thirty answers (see 4.2.2.1 Data collection) obtained from non-respondents were analyzed using Fisher's exact test (Routledge 2005; Raymond and Rousset 1995; Upton 1992). No statistically significant differences between respondents and non-respondents on any of the eight questions could be found. Detailed results are shown in Table 1.

Table 1: Non-response bias test – results.

Questions	p-value
Please indicate the ONE category that BEST describes your hospital or type of service it provides to the MAJORITY of patients	0.7964
List all process improvement methodologies your hospital is employing	0.2563
Questions about the organization:	**p-value**
Our employees like working here.	0.6785
Our organziation is more successful than our competitiors in the marketplace.	0.2378
Our organization is efficient.	0.4668
Our organization is innovative.	0.1654
Our organization is satisfying patients.	0.8753
Our organization is effective - it achieves what it is meant to.	0.3260

4.2.2. Secondary data

4.2.2.1. Data collection

A publicly available database named 'hospital compare' containing data for more than 4,697 hospitals for 2010 (January to December) was obtained and downloaded from the U.S. Department of Health and Human Services (HHS 2012). The data in the tables downloaded was combined into one MS Excel 2010 master file (Microsoft 2010). The master file includes information about hospital consumer assessment of health providers (HCAHPS), systems surveys which measures patient satisfaction at hospitals across the U.S., and quality of care measures (CMS 2012b; HHS 2012). The quality of care measures consist of four categories for serious health conditions that are related to preventable medical errors and include 1) acute myocardial infarction (AMI) rate; 2) heart failure (HF) rate; 3) pneumonia (PN) rate; and 4) surgical care improvement project (SCIP) rate. Each of the four categories is comprised of individual measures that are used to compute the overall score – AMI (10 measured factors), HF (4 measured factors), PN (6 measured factors), and SCIP (10 measured factors, CMS 2012). Details about the factors measured can be found in Appendix H and additional information about these measures can be found at the CMS website (CMS 2011), the Nassau-Suffolk Hospital Council website (NSHC 2011), and the hospital compare website (HHS 2011a).

Additional secondary data was added to the master file from the U.S. Department of Health and Human Services (HHS 2012) database and included: 1) heart attack death (mortality) rates; 2) heart attack readmission rates; 3) heart failure death (mortality) rates; 4) heart failure readmission rates; 5) pneumonia 30-day mortality rate; and 6) pneumonia readmission rates. Also, general information about each hospital was matched with the quality of care measures, readmission rates, and mortality rates, such as, for example, hospital name, provider ID, address, county, city, state, zip code, phone number, emergency service, hospital type and ownership, among others.

4.2.2.1.1. Secondary data preparation for further analysis

Hospitals that reported quality of care measures based on a sample size of 25 patients or less (HHS 2011b), were excluded from the secondary dataset to reduce the likelihood of errors in computing a valid hospital performance ranking based on the quality of care measures reported (HealthInsight 2011). This limitation was imposed since performance measures based on a sample size of 25 patients or less, lack statistical validity (HHS 2011b).

4.2.3. Data analysis and statistics

Results from the survey (primary data) and the secondary data from third parties (CMS 2012b; HHS 2012; AHA 2011a; IHA 2011) were combined to one dataset in MS Excel 2010 (Microsoft 2010). Thus, this dataset contains data from 597 hospitals, which returned usable responses. Factor groups (consisting of all factors before component analysis) were adjusted (principal component analysis) and prepared (correlation analysis) for all-subset multiple linear regression (Myers 1990; Belsley et al. 1980).

4.2.3.1. Independent variables

The original questions comprising the four factor groups in the questionnaire (Appendix B) consists of questions pertaining to: 1) **process management**, which describes and measures a management philosophy that is focused on the horizontal flow of value across a hospital and on improving those processes toward a perfect patient experience (Kenney 2010). These factors were originally developed by Womack (2009) to evaluate the transition from modern management to process management in manufacturing; 2) **modern management,** which describes a management philosophy that is used in most organizations today. An organization using modern management is described as having a strong focus on vertical functions, using managerial authority with a focus on vertical delegation, focuses on short-term and financial objectives with decisions usually made at places far from where value creation occurs (Womack 2008; Womack 2002). Modern management and process management are mutually exclusive management philosophies; 3) **organizational traits**, measuring the extent to which an organization functions effectively, efficiently, and innovatively. The organizational trait factors used in this survey were adapted from questions used in works like "Great place to work (Great Place to Work 2012)," "The Baldrige Health Care Criteria for Performance Excellence (NIST 2011)," and Womack's questionnaire (2009); and 4) **leadership traits**, describing traits of executives in hospitals. The leadership trait factors were adapted from multiple sources, including: a) the multifactor leadership questionnaire (Bass and Avolio 1994; Avolio and Bernard n.d.); b) the Baldrige Criteria for Performance Excellence (Flynn and Saladin 2001; Hutton 2000); c) the transformational leadership questionnaire (TLQ-LGV, Alban-Metcalfe and Alimo-Metcalfe 2000); and nurse managers as transformational and transactional leaders (McGuire and Kennerly 2006).

4.2.3.1.1. Principal component extraction

An exploratory factor analysis (EFA) with principal component analysis and scree test was performed to reduce the number of factors (Costello and Osborne 2005; Cattell 1966) of all four factor groups. First, the entire set of factors of each group was scree plotted and principal components with Eigenvalues greater than 1.0 were considered for further statistical analysis (Cattell 1966). Second, each of the principal components was analyzed according to the factors that loaded on them. Non-loading items were eliminated from the dataset (Thompson et al. 2004; Akaike 1987). Third, each of the components had to have at least 4 factors loading on them or they were dropped (Thompson et al. 2004). This procedure then was repeated until more than 4 factors were loaded on the principal components.

The outcomes of the principal component analysis performed on the four factor groups were as follows: **process management** factors could be reduced from 16 factors to 9 factors. The resulting 9 factors from the principal component analysis for process management are shown in Table 2.

Table 2: Process management factors.

Process Management	q10	managers are responsible for cross-functional activities, in addition to their own functional areas.
	q11	managers are evaluated according to real-time process performance, as well as, end-of-the-reporting-period results.
	q12	decisions are made at the top of the organization and refined through two-way conversations and involvement with employees.
	q13	successful managers are identified as those who both deliver results and create a learning environment to help their employees in self-discovery.
	q14	when things do not go according to plan, the manager's job is to develop corrective action in a learning environment.
	q15	managers make decisions by both analyzing the existing data and gathering first-hand information.
	q16	managers identify and solve problems both cross-functionally and within their own functions.
	q17	managers do not have to rework/revisit problems because they have determined the root cause.
	q18	we develop work standards for most activities and usually perform the work in accordance with the standards.

The process management factors from q10 to q18, were the items that loaded on the components with a greater Eigenvalue than 1.

Modern management factors could be reduced from 16 to 9 factors (Table 3). The factors q1 to q9 were also loading on the components extracted (Eigenvalue greater than 1 and at least 4 factors loading on a component).

Table 3: Modern Management.

Primary Data (Survey)		
Component	**Item no.**	**Items** [1=strongly disagree to 5=strongly agree]
		In general, in our organization ...
Modern Management	q1	managers have the authority to manage downward within functional areas, but do not feel responsible for cross-functional activities.
	q2	managers are evaluated primarily on end-of-the reporting-period results, often regardless of what methods they used to achieve results.
	q3	decisions are made at the top of the organization and communicated downward with little or no feedback from employees.
	q4	successful managers are identified as those who deliver results according to plan, even if they have not engaged their employees in a learning environment.
	q5	managers are blamed when things don't go according to plan and are expected to explain variances.
	q6	managers focus on results rather then how the work is done.
	q7	managers identify and solve problems only within their functions rather than both cross-functionally and within functions.
	q8	managers often have to revisit/rework problems because thy did not determine the root cause.
	q9	we may develop work standards for activities but rarely perform the work in accordance with the standards.

The **organizational trait** factors could not be reduced, because all 6 items did load on one and the same component that showed an Eigenvalue greater than 1. Thus, the 6 factors remained for final statistical analysis (Table 4).

Table 4: Organizational trait factors.

Component	**Item no.**	**Items** [1=strongly disagree to 5=strongly agree]
		Please indicate ...
Organizational characteristics	q19	Our Organization is efficient.
	q20	Our Organization is effective - it achieves what it is meant to.
	q21	Our Organization is satisfying patients.
	q22	Our Organization is more successful than our competitors in the marketplace.
	q23	Our Organization is innovative.
	q24	Our employees like working here.

The **leadership trait** factors, which originally consisted of 16 factors, were reduced to 12 factors based on the principal component analysis (Table 5).

Table 5: Leadership trait factors.

		Our executive team ...
Leadership (transactional and transformational)	q25	provides us with a vision and a sense of mission.
	q26	instills pride.
	q27	gains respect and trust.
	q28	communicates high expectations.
	q29	expresses important purposes in simple ways.
	q30	promotes intelligence, rationality, and careful problem solving.
	q31	gives personal attention.
	q32	treats each employee individually.
	q33	coaches and advises us.
	q34	promises rewards for good performance.
	q35	recognizes and celebrates accomplishments.
	q36	observes and searches for deviation from rules and standards and takes corrective action.

Each of the resulting four factor groups with individual dichotomous factors, were checked for internal reliability applying Cronbach's alpha (Gliem and Gliem 2003; Bland and Altman 1997). All four factor groups showed a reliability alpha greater than 0.8 and thus, showed good internal consistency (Bland and Altman 1997a).

4.2.3.2. Covariates

A covariate is an independent variable that is possibly predictive of the outcomes of a statistical test (Dodge et al. 2006). However, a covariate used in statistics, is a variable that can affect a relationship between dependent variables (e.g. performance measures in this study) and other independent variables of interest (e.g. leadership traits or management variables; Dodge et al. 2006).

As shown in Figure 17, the covariates that were controlled for in this survey consist of factors from primary and secondary data. Covariates at the hospital level included in the secondary data are the **type of hospital** and the **hospital's organizational structure**. The **type of hospital** consists of acute care hospitals, acute care – veterans' administration, and critical access hospitals. Acute care hospitals can be critical access hospitals but not vice versa (CMS 2012b). Thus, critical access hospitals (CAH) are classified by the U.S. department of health and human services (CMS 2012b) and differ from non-critical access hospitals by being located in rural areas and maintain no more than 25 inpatient beds (CMS 2012a). Another covariate established using secondary data is the **hospital's organizational structure**. The organizational structure for hospitals was divided into two groups based on whether the hospital is part of a larger organization owning multiple hospitals or if it is a self-standing organizational unit. Also, the **number of years** a respondent has been **employed by a given hospital** was controlled based on survey respondents' answers (e.g., based on primary data). Length of employment matters because evidence exists that employees perceive their organization more negatively when working for it for a longer time (Grandey 2000; Donovan et al. 1998).

4.2.3.3. Dependent variable

The dependent variable for the first study objective is hospital performance (e.g., quality of care measures, HHS 2012). The performance of hospitals is calculated by summing the numerators and denominators of all quality of care measures reported (e.g., AMI, HF, PN, and SCIP factors, HHS 2012). This score reflects the average weighted percentage of patients that received quality care, a performance metric that has been validated and checked for reliability in numerous publications (Boyer et al. 2012; Giordano et al. 2010; McGlynn et al. 2003; Marley et al. 2004). In addition, quality of care measures computed this way are widely used by ranking agencies like Thomson Reuters (Thomson Reuters 2012), HealthInsight (HealthInsight 2011), HealthGrades (HealthGrades 2011), the US Department of Health & Human Services (HHS 2012), to name just a few.

4.2.3.4. Methods to answer study hypotheses

Since the residuals and one of our factors (quality of care) tested did not show linearity, a logit transformation was undertaken (Jaeger 2008; Ashton 1972). Only responses from survey participants who answered all independent and covariate questions in the survey were used. This resulted in a dataset of 186 observations (N=186). After transformation of the dependent variable and adjustments to covariates and independent variables, an “all-subset multiple linear regression” was used to answer the hypotheses of study objective one (Myers 1990; Belsley et al. 1980). For the statistical model selection, an all-subset linear regression procedure with forward elimination was used and a nominated alpha of 0.05 was applied (Myers 1990; Hocking and Leslie 1967). To account for errors in the model selection, an 80 percent random sample of the data set (N= 147) was used. The remaining 20 percent of the data set (N=29) was applied to assess the model’s accuracy (measured as the mean absolute percent error and mean error) and the model’s bias (Hocking and Leslie 1967).

4.3. Second study objective – Data and variables

The second study objective was to compare and evaluate differences of chief executive officer's (CEO) traits among three groups of hospitals, namely 1) lean hospitals, 2) low performing hospitals, and 3) high performing hospital. To answer the research hypotheses (Hypotheses H5, H6, and H7, 2.2 Leadership traits of chief executive officers (CEOs)) of the second study objective, the following comparisons were made; differences in CEO traits between lean and low performing hospitals, CEO trait differences between lean and high performing hospitals, and CEO trait differences between low and high performing hospitals. For this purpose, secondary data collected and prepared for the first study (see 4.2.2 Secondary data) was used and new primary data was acquired by means of a 360 degree survey (CEO and follower questionnaire) addressed to different organizational levels of selected hospitals. This survey was modeled after the idea of using a 360-degree questionnaire as semi-structured interview across the hospital organization also used by Drever (1995), Foddy and Foddy (1994), and Van Dijk (1990).

4.3.1. Primary and secondary data

4.3.1.1. Data sources

4.3.1.1.1. Population and sample of interest

To study chief executive officer (CEO) leadership traits among hospitals with different performance, the MS Excel (Microsoft 2010) data set created for the research of the first study objective was used. The performance measures (e.g., quality of care measures, HHS 2012, CMS

2012a) collected for the first study objective, was now also being used to create performance rankings to answer this second study objective.

To calculate a national rank of all 4,697 U.S. hospitals in the CMS database (HHS 2012), we ranked each hospital's overall performance. The top and bottom 20th percentile of all hospitals was then matched with the 597 respondents from the first survey, resulting in 20 high and 25 low performing hospitals. Additionally, five hospitals that apply lean management principles to their organizations were selected by an expert (Helen Zak, president and chief operating officer of the Healthcare Value Leaders Network, IHI faculty member, and COO of the Lean Enterprise Institute). While the study design asked for 3 hospitals to participate in each group (lean, high, and low performing), the 5 lean, 20 high, and 25 low performing hospitals were made part of the study sample as not all entities were expected to participate in the survey.

4.3.1.1.2. Contact and email list

The same contact and email list used in the first study (see 4.2.1.1.2 Mailing list) was used. This dataset was enriched by adding each hospital's CEO name, email address, and phone number.

4.3.1.2. Data Collection

4.3.1.2.1. Online Questionnaire

Two online questionnaires, one for CEOs (Appendix I) and one for CEO followers (Appendix J) were developed and implemented online using Qualtrics (2011). The invitation to participate was directed to the hospital's CEO or any other hospital manager willing to facilitate the survey. The study design was set up to receive responses from the CEO, two senior executives, five mid-level managers, and five frontline associates (supervisors) as shown in Figure 21. However, knowing of the challenge in achieving the participation desired, the study design was set up to be able to cope with a lower participation rate. For the statistical analysis, non-parametric multiple comparisons were used to account for a low and uneven distribution of responses among followers.

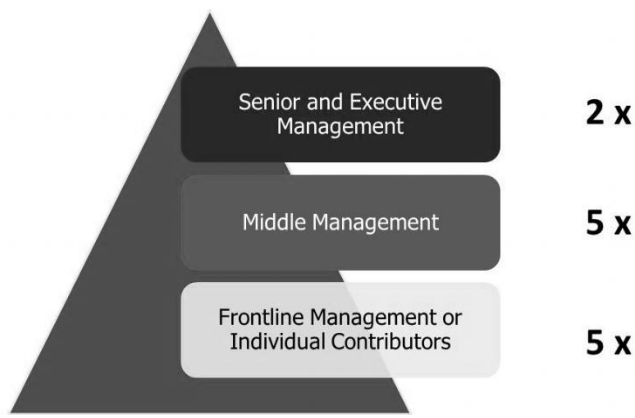

Figure 21: Requested responses from followers.

To gather the data required, three types of questions were used in this study: 1) Likert scale questions, 2) open ended questions, and 3) categorical scale questions (Alreck and Settle 1995; Rea et al. 1997; Fowler 1995; Weisberg et al. 1996; Likert 1932). The CEO (Appendix I) and follower questionnaire (Appendix J) contained four categories. The first category entailed questions for the CEO and the followers concerning their **background**, such as the respondents' daily hours, including estimates of their time spent on "firefighting," routine work, personnel issues, and improving processes. The first category of questions also asked for hospital name, respondent's position, and length of employment. The second category asked 44 questions regarding **CEOs leadership traits** and one open-ended question about three main characteristics of the CEO, in particular about setting clear directions, communicating high expectations, and acting with quiet and calm determination (Hutton 2000). The third category asked 56 questions about the organization (Flynn and Saladin 2001; Hutton 2000) and was divided into four sub-categories: 1) 10 questions about the "big picture"; 2) 14 questions about the "people"; 3) 19 questions about "process and culture"; and 4) 13 questions about "leadership." The fourth and last category of questions in the questionnaire consisted of 13 questions that were adapted from Womack (2009) comparing **process management** with **modern management.** The complete questionnaires can be found in Appendices H (CEO) and I (follower). Final approval for the survey was granted by the Virginia Tech Institutional Review Board (IRB) on February 2, 2012 (Appendix K).

4.3.1.2.2. Questionnaire pretest

The CEO and follower questionnaire was reviewed by expert faculty at Virginia Tech. Feedback was also obtained from Lean Global Network (LGN) affiliates in the Netherlands, South Africa, France, and the UK. Before the opening of the online questionnaire, a pretest was conducted to verify and statistically validate the survey. A sample of 11 hospital associates of two independent hospitals in Virginia was selected to test for clarity, acceptability, timeliness, and comprehensiveness (Rea et al. 1997; Alreck and Settle 1995). Eleven responses were received from four organizational levels (senior and executive management, middle management, and frontline associates). Responses were analyzed and minor adjustments to the questionnaires were made.

4.3.1.2.3. Mailings, follow-up, and data gathering

Starting on February 2, 2012, hospital CEOs or their assistants were contacted by email and phone to discuss the survey. Discussions included the reasons for the survey, the expected outcomes, the selection of employees, and the actual online survey. Phone calls were made to reach out to all lean, high, and low performing hospitals selected every Tuesday and Wednesday from February 2 to April 9, 2012. Also, reminder emails (Appendix L) were sent out every Monday morning to increase overall response rates (Dillman 2007; Rea and Parker 2005). Every Friday, cooperating hospitals received an update of the number of responses received from their organization (Appendix M). At the closing of the study on April 9, 2012, 10 CEO and 54 followers (15 senior executive, 22 middle manager, and 17 frontline associates) responses were obtained. Figure 22 shows the frequency of responses received by day for CEOs and followers.

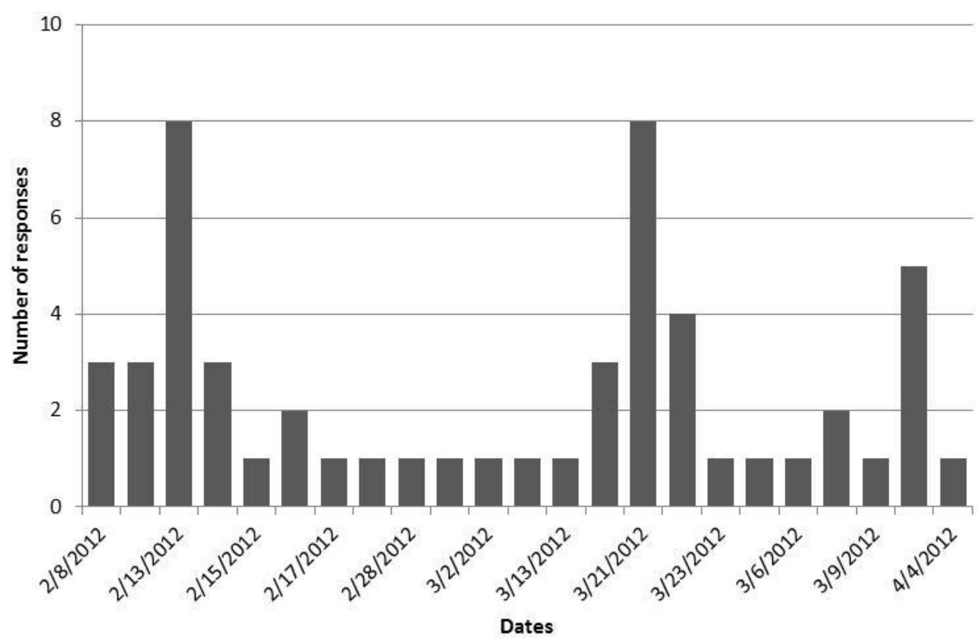

Figure 22: Response rates per day.

4.3.2. Data analysis and statistics

All survey responses (primary data) were automatically stored, coded, and organized in Qualtrics (Qualtrics 2011). Data was then transferred to MS Excel 2010 (Microsoft 2010), where the data was organized for use with SAS 9.2 statistical software (SAS 2010) for further statistical analysis.

4.3.2.1. Independent variables

CEOs' leadership traits that were compared based on responses to the online survey which consisted of a total of 44 Likert-scale factors. Fourteen of the factors were adapted from Jones (2011) presentation at the Lean Transformation summit 2011 in the UK and are shown in Table 6 (codes were randomly assigned by Qualtrics).

Table 6: Leadership trait factors (adapted from Jones 2011).

Code	Our CEO ...
1	... sets clear directions.
2	... enables staff to do their work.
3	... develops and mentors staff by asking questions rather than telling them what to do.
4	... deploys the right improvements to close performance gaps.
5	... is present/visible on a regular basis.
6	... thinks from a patient/customer point of view.
7	... establishes a learning organization (thinking and doing).
32	... follows and applies the scientific method — plan-do-study-adjust (PDSA or PDCA).
33	... creates process stability and practices frontline management (where value is created).
34	... manages by facts.
40	... trains us in responding and solving problems.
41	... holds regular stand-up meetings, uses visuals and keeps everyone on track.
42	... manages by going to the place where the work is performed and to observe what happens and asks why.
44	... focuses on the vital few things and deselects other tasks.

These 14 factors are seen as the traits that a lean leader should possess (Jones 2011). These questions and factors have so far not been scientifically validated, but have been suggested and accepted by highly respected and experienced scholars.

Another 8 leadership trait factors were adapted from Collins' 2001 book "Good to Great" and are shown in Table 7. These leadership traits have evolved from a study that was focused on identifying differences between high performing organizations ("great companies") and mediocre organizations ("good companies") based on financial performance measures (Collins 2001). Collins (2001) calls those leadership traits "level-5 leadership" and has investigated these traits in organizations and industries (Collins 2009). While these questions have been used by Collins and others, no scientific validation has been published to the knowledge of the author.

Table 7: Leadership trait factors (adapted from Collins 2001).

Code	Our CEO ...
8	... generates superb results.
9	... acts with quiet, calm determination.
10	... shows professional will and personal humility.
35	... demonstrates a compelling modesty, shuns public adulation, is humble, and is never
36	... gives credit for the organization's success to other people, external factors, and good luck; and takes full responsibility for poor results, never blaming other people, external factors, or bad luck.
37	... channels ambition into the hospital, not the self; sets up successors for even greater success in the next generation.
38	... demonstrates an unwavering resolve to do whatever must be done to produce the best long-term results, no matter how difficult.
39	... sets the standard of building an enduring great hospital; will settle for nothing less.

Fourteen leadership trait factors were adapted from multiple sources, e.g., from Bass and Avolio (1994), Alban-Metcalfe and Alimo-Metcalfe (2000), Flynn and Saladin (2001), McGuire and Kennerly (2006) and are shown in Table 8.

Table 8: Leadership trait factors (adapted from McGuire and Kennerly 2006; Flynn and Saladin 2001; Alban-Metcalfe and Alimo-Metcalfe 2000; Bass and Avolio 1994)**.**

Code	Our CEO ...
11	... abdicates responsibility and avoids making decisions.
12	... promises rewards for good performance.
13	... coaches and advises us.
14	... gives personal attention.
15	... recognizes and celebrates accomplishments.
16	... provides us with a vision and a sense of mission.
17	... has our respect and trust.
18	... communicates high expectations.
19	... observes and searches for deviations from rules and standards and takes corrective actions.
20	... expresses important purposes in simple ways.
21	... intervenes only if standards are not met.
22	... promotes intelligence, rationality, and careful problem solving.
31	... instills pride.
43	... follows up on promised rewards.

These 14 leadership trait questions in Table 8 have been selected from leadership questionnaires that have been validated (Avolio and Bernard 2004). However, the original questions have been reworded to avoid payment of royalty fees.

Finally, eight leadership trait factor questions (Table 9) were adapted from the Baldrige-Leadership behaviors (Flynn and Saladin 2001; Hutton 2000).

Table 9: Leadership trait factors (adapted from Flynn and Saladin 2001; Hutton 2000)

Code	Our CEO ...
23	... follows through on words and promises made.
24	... shows and sets a personal example of what is expected.
25	... sets achievable plans, milestones, and goals.
26	... is committed to experiments and takes risks.
27	... asks ”what can we learn?”
28	... actively listens to different points of view.
29	... treats everyone with respect and dignity.
30	... makes sure that people grow in their jobs.

The Baldrige leadership factors are publicly available for everyone who is interested in the Baldrige Award. The Baldrige Award questionnaires have been widely used and the questionnaires have been validated in research studies and are considered robust and descriptive (Meyer and Collier 2001; Flynn and Saladin 2001).

All leadership trait factors were used to compare differences in CEO leadership traits among lean, high, and low performing hospitals. While two of the leadership factor groups (lean and level 5 leadership traits) were developed by experts in their respective fields (Jones 2001 and Collins 2001 and 2009, respectively) the other two leadership trait factor groups (multiple sources and Baldrige leadership behavior) have been scientifically validated and are applied widely (Meyer and Collier 2001; Flynn and Saladin 2001). Thus, in this research, new leadership traits are investigated, but although, a wide range of leadership traits that have been used widely are investigated.

4.3.2.2. Hypotheses testing

All data obtained was assigned to lean, high, and low performing hospitals. CEO leadership traits as self-characterized by the CEOs and as indicated by the followers for each of the three performance groups (lean, high, low) were then compared using non-parametric statistical hypothesis testing (Siegel 1957; Edwards 1954; Wilcoxon 1945).

The results were evaluated using Kruskall-Wallis chi-square exact tests (Theodorsson-Norheim 1986; Breslow 1970; Kruskal and Wallis 1952) and Wilcoxon two-sample tests (Litchfield and Wilcoxon 1949; Wilcoxon 1945). The statistical model was adjusted using the Bonferroni multiple comparisons correction (corrected $\alpha = 0.01667$, Cabin and Mitchell 2000; Edwards 1954).

4.4. Third study objective

The third study objective was to compare and evaluate differences in process management used in individual hospitals grouped by: 1) lean hospitals, 2) high performing hospitals, and 3) low performing hospitals (see 4.3 Second study objective – Data and variables). In particular, hypotheses about differences in process management styles between lean and high, between lean and low, and between high and low performing hospitals were tested (Hypotheses H8, H9, and H10, 2.3 Management systems and hospital performance). For this purpose, the secondary and primary data gathered when pursuing the first and second study objectives were used (4.3.1 Primary and secondary data). The study aimed to identify differences in process management styles among a sample of 3 lean, 3 high performing, and 3 low performing hospitals.

4.4.1. Data analysis and statistics

The data contained in the MS Excel 2010 (Microsoft 2010) master database was prepared for researching study objective 3 and then uploaded to SAS 9.2 statistical software (SAS 2010) for further statistical analysis. Thus, existing primary and secondary data from the first and second study objective was used (see 4.2.3 Data analysis and statistics, 4.3.2 Data analysis and statistics).

4.4.1.1. Independent variables

The 13 Likert scale factors of process and modern management were adapted from Womack (2009) and can be seen in Table 10 and Appendix I and J.

Table 10: Process and modern management factors (adapted from Womack 2009).

Code	Our CEO ...
Q15_1	managers are responsible for cross-functional activities, in addition to their own functional areas.
Q15_2	managers are evaluated according to real-time process performance, as well as, end-of-the-reporting-period results.
Q15_3	decisions are made at the top of the organization and refined through two-way conversations and involvement with employees.
Q15_4	successful managers are identified as those who both deliver results and create a learning environment to help their employees in self-discovery.
Q15_5	when things do not go according to plan, the manager's job is to develop corrective action in a learning environment.
Q15_6	managers focus on how the work is done and assume the results will follow.
Q15_7	managers are developed primarily through formal education.
Q15_8	managers are developed primarily through in-company learning/mentoring, on-the-job training, and problem solving.
Q15_9	managers make decisions by both analyzing the existing data and gathering first-hand information.
Q15_10	managers identify and solve problems both cross-functionally and within their own functions.
Q15_11	managers do not have to rework/revisit problems because they have determined and solved the root cause.
Q15_12	we may develop work standards for activities but rarely perform the work in accordance with the standards.
Q15_13	we develop work standards for most activities and usually perform the work in accordance with the standards.

From the total thirteen factors listed in Figure 15, two factors described modern management (Q15_7 and Q15_12), while all remaining 22 factors described process management practices (Womack 2009). The independent variables were used to compare differences in management styles among lean, high, and low performing hospitals. The two factors describing modern management (Q15_7, Q15_12) are used to control for false interpretation and errors from the respondent. Specifically, the modern management factor "managers are developed primarily through formal education" is paired with the process management factor "managers are developed primarily through in-company learning/mentoring, on the job training, and problem solving." The other pair is "we may develop work standards for activities but rarely perform the work in accordance with the standards" and "we develop work standards for most activities and usually perform the work in accordance with the standards." These comparison factors allow verifying the results of the process management factors Q15_8 and Q15_13.

4.4.1.2. Hypothesis testing

As done with the second study objective (H5, H6, and H7), all data was assigned to lean, high, and low performing hospitals in SAS 9.2. Then, the management styles associated with each of these three hospital performance categories was compared based on CEO responses and the follower responses by applying non-parametric statistical hypothesis testing (Siegel 1957; Edwards 1954; Wilcoxon 1945). In particular, these results were evaluated using Kruskall-Wallis chi-square exact tests (Theodorsson-Norheim 1986; Breslow 1970; Kruskal and Wallis 1952) and Wilcoxon two-sample tests (Litchfield and Wilcoxon 1949; Wilcoxon 1945). The statistical model was adjusted using the Bonferroni multiple comparison correction, resulting in an α of 0.05 (Cabin and Mitchell 2000; Edwards 1954).

4.5. References

AHA. 2011a. *AHA Guide 2011*.
———. 2011b. *AHA Hospital Statistics 2011*.

Akaike, H. 1987. “Factor Analysis and AIC.” *Psychometrika* 52 (3): 317–332.

Alban-Metcalfe, Robert J., and Beverly Alimo-Metcalfe. 2000. “The Transformational Leadership Questionnaire (): a Convergent and Discriminant Validation Study.” *Leadership & Organization Development Journal* 21 (6) (January 9): 280–296. doi:10.1108/01437730010343077.

Alreck, P. L., and R. B. Settle. 1995. *The Survey Research Handbook*. Irwin Chicago.

Anon. “Modern Management Vs. Lean Management - Google Search.” https://www.google.com/#hl=en&sa=X&ei=BVN6T5KYEpKo8gT3rJHiBA&ved=0CCIQvwUoAQ&q=modern+management+vs.+lean+management&spell=1&bav=on.2,or.r_gc.r_pw.r_qf.,cf.osb&fp=892d95ef72c47e1e&biw=1440&bih=751.

Anthony, W., E. S. Rogers, and M. Farkas. 2003. “Research on Evidence-based Practices: Future Directions in an Era of Recovery.” *Community Mental Health Journal* 39 (2): 101–114.

Ashton, W. D. 1972. *The Logit Transformation: With Special Reference to Its Uses in Bioassay*. Griffin London.

Avolio, B. J., and M. Bernard. “Bass (2004).” *Multifactor Leadership Questionnaire: Manual and Sampler Set*.

Bass, B. M., and B. J. Avolio. 1994. *Improving Organizational Effectiveness Through Transformational Leadership*. Sage Publications, Inc.

Belsley, D. A., E. Kuh, and R. E. Welsch. 1980. *Regression Diagnostics*. Wiley Online Library.

Bevan, G. 2006. “Setting Targets for Health Care Performance Lessons from a Case Study of the English NHS.” *National Institute Economic Review* 197 (1): 67–79.

Bland, J. M., and D. G. Altman. 1997a. “Statistics Notes: Cronbach’s Alpha.” *British Medical Journal* 314 (7080): 572.

Bland, J. M., and D. G. Altman. 1997b. “Cronbach’s Alpha.” *BMJ: British Medical Journal* 314 (7080): 572.

Boyer, K. K., J. Gardner, and S. Schweikhart. 2012. “Process Quality Improvement: An Examination of General Vs. Outcome-specific Climate and Practices in Hospitals.” *Journal of Operations Management*.

Breslow, N. 1970. “A Generalized Kruskal-Wallis Test for Comparing K Samples Subject to Unequal Patterns of Censorship.” *Biometrika* 57 (3): 579–594.

Broadbent, J. 1992. “Change in Organisations: A Case Study of the Use of Accounting Information in the NHS.” *The British Accounting Review* 24 (4): 343–367.

Cabin, R. J., and R. J. Mitchell. 2000. “To Bonferroni or Not to Bonferroni: When and How Are the Questions.” *Bulletin of the Ecological Society of America* 81 (3): 246–248.

Cattell, R. B. 1966. “The Scree Test for the Number of Factors.” *Multivariate Behavioral Research* 1 (2): 245–276.

CMS. 2011. “https://www.cms.gov/HospitalQualityInits/downloads/HospitalOverviewOfSpecs200512.pdf - Google Search.” https://www.google.com/#hl=en&sclient=psy-ab&q=https:%2F%2Fwww.cms.gov%2FHospitalQualityInits%2Fdownloads%

———. 2012a. “Survey & Certification - Certification & Compliance | Center for Medicare & Medicaid Services.” zotero://attachment/1490/.

———. 2012b. “Quality Initiative.” http://www.cms.hhs.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/QualityInitiativesGenInfo/index.html?redirect=/QualityInitiativesGenInfo/.

Collins, Jim. 2009. *How The Mighty Fall: And Why Some Companies Never Give In*. 1st ed. Jim Collins.

Collins, J. C. 2001. *Good to Great: Why Some Companies Make the Leap–and Others Don’t*. Harper Business.

Connolly, P. M, and K. G. Connolly. 2005. *Employee Opinion Questionnaires: 20 Ready-to-use Surveys That Work*. Pfeiffer.

Costello, A. B., and J. W. Osborne. 2005. “Best Practices in Exploratory Factor Analysis: Four Recommendations for Getting the Most from Your Analysis.” *Practical Assessment, Research & Evaluation* 10 (7): 1–9.

Van Dijk, J. A. G. M. 1990. “Delphi Questionnaires Versus Individual and Group Interviews: A Comparison Case.” *Technological Forecasting and Social Change* 37 (3): 293–304.

Dillman, D. A. 2007. *Mail and Internet Surveys: The Tailored Design Method*. John Wiley & Sons Inc.

Dodge, Y., D. Cox, and D. Commenges. 2006. *The Oxford Dictionary of Statistical Terms*. Oxford University Press, USA.

Donovan, M. A., F. Drasgow, and L. J. Munson. 1998. “The Perceptions of Fair Interpersonal Treatment Scale: Development and Validation of a Measure of Interpersonal Treatment in the Workplace.” *Journal of Applied Psychology* 83 (5): 683.

Drever, E. 1995. *Using Semi-structured Interviews in Small-scale Research: a Teacher’s Guide*. 129. Scottish Council for Research in Education.

Edwards, A. L. 1954. “Statistical Methods for the Behavioral Sciences.”

Flynn, B. B., and B. Saladin. 2001. “Further Evidence on the Validity of the Theoretical Models Underlying the Baldrige Criteria.” *Journal of Operations Management* 19 (6): 617–652.

Foddy, W., and W. H Foddy. 1994. *Constructing Questions for Interviews and Questionnaires: Theory and Practice in Social Research*. Cambridge Univ Pr.

Fowler, F. J. 1995. *Improving Survey Questions: Design and Evaluation*. Sage Publications, Inc.

Giordano, L. A., M. N. Elliott, E. Goldstein, W. G. Lehrman, and P. A. Spencer. 2010. “Development, Implementation, and Public Reporting of the HCAHPS Survey.” *Medical Care Research and Review* 67 (1): 27–37.

Gliem, J. A., and R. R. Gliem. 2003. “Calculating, Interpreting, and Reporting Cronbach’s Alpha Reliability Coefficient for Likert-type Scales.” In *Midwest Research to Practice Conference in Adult, Continuing, and Community Education*. Vol. 88.

Grandey, A. A. 2000. “Emotional Regulation in the Workplace: A New Way to Conceptualize Emotional Labor.” *Journal of Occupational Health Psychology* 5 (1): 95.

Great Place to Work. 2012. “Great Place to Work® Institute United States.” http://www.greatplacetowork.com/.

HealthGrades. 2011. “America’s 50 Best and 100 Best Hospitals Identified by HealthGrades.” http://www.healthgrades.com/content/ratings_and_awards_2012_Americas_Best_Hospitals.aspx.

HealthInsight. 2011. “Hospital Performance Rankings.” http://www.healthinsight.org/Internal/HospitalPerformanceRankings.html.

HHS. 2011a. “http://www.hospitalcompare.hhs.gov/staticpages/for-professionals/poc/technical-appendix.aspx#HeartAttack

———. 2011b. “Http://www.hospitalcompare.hhs.gov/staticpages/help/hospital-how-to.aspx - Google Search.” https://www.google.com/search?hl=en&noj=1&q=http%3A%2F%2Fwww.hospitalcompare.hhs.gov%2Fstaticpages%2Fhelp%2Fhospital-how-to.aspx&oq

———. 2012. “Hospital Compare.” http://www.hospitalcompare.hhs.gov/staticpages/help/hospital-how-to.aspx.

Hocking, R. R., and R. N. Leslie. 1967. “Selection of the Best Subset in Regression Analysis.” *Technometrics*: 531–540.

Hutton, D. W. 2000. *From Baldrige to the Bottom Line: A Road Map for Organizational Change and Improvement*. American Society for Qualit.

IHA. 2011. “Idaho Hospital Association.” http://www.teamiha.org/AboutIHA/index.cfm.

IHI (Institute for Healthcare Improvement). 2010. *IHI Internal Hospital Statistics database 2011*

Institute for Healthcare Improvement. 2012. “White Paper, Lean Principles, Throughput Time, Lean Thinking, Kanban, Muda, Value Stream, A Priori, Kaizen, Takt Time, Lean Management Trystorm,” http://www.ids-healthcare.com/Common/Paper/Paper_51/Going%20Lean%20in%20Health%20Care1.htm.

Jaeger, T. F. 2008. “Categorical Data Analysis: Away from ANOVAs (transformation or Not) and Towards Logit Mixed Models.” *Journal of Memory and Language* 59 (4): 434–446.

Jones, D.T. 2011. "Lean leadership characteristics." *London, UK, Lean Transformation Summit*

Keen, J., and T. Packwood. 1995. “Qualitative Research: Case Study Evaluation.” *Bmj* 311 (7002): 444–446.

Kenney, Charles. 2010. *Transforming Health Care: Virginia Mason Medical Center’s Pursuit of the Perfect Patient Experience*. 1st ed. CRC Press.

Kitson, A., G. Harvey, and B. McCormack. 1998. “Enabling the Implementation of Evidence Based Practice: a Conceptual Framework.” *Quality in Health Care* 7 (3): 149–158.

Kruskal, W. H., and W. A. Wallis. 1952. “Use of Ranks in One-criterion Variance Analysis.” *Journal of the American Statistical Association*: 583–621.

Leatherman, S., D. Berwick, D. Iles, L. S. Lewin, F. Davidoff, T. Nolan, and M. Bisognano. 2003. “The Business Case for Quality: Case Studies and an Analysis.” *Health Affairs* 22 (2): 17–30.

Likert, R. 1932. “A Technique for the Measurement of Attitudes.”

Litchfield Jr, J. T., and F. Wilcoxon. 1949. “A Simplified Method of Evaluating Dose-effect Experiments.” *Journal of Pharmacology and Experimental Therapeutics* 96 (2): 99–113.

Marley, Kathryn A., David A. Collier, and Susan Meyer Goldstein. 2004. “The Role of Clinical and Process Quality in Achieving Patient Satisfaction in Hospitals.” *Decision Sciences* 35 (3) (August 1): 349–369. doi:10.1111/j.0011-7315.2004.02570.x.

McGlynn, E. A., S. M. Asch, J. Adams, J. Keesey, J. Hicks, A. DeCristofaro, and E. A. Kerr. 2003. “The Quality of Health Care Delivered to Adults in the United States.” *New England Journal of Medicine* 348 (26): 2635–2645.

McGuire, E., and S. M. Kennerly. 2006. “Nurse Managers as Transformational and Transactional Leaders.” *Nursing Economics* 24 (4): 179.

Meyer, Susan M., and David A. Collier. 2001. “An Empirical Test of the Causal Relationships in the Baldrige Health Care Pilot Criteria.” *Journal of Operations Management* 19 (4) (July): 403–426. doi:10.1016/S0272-6963(01)00053-5.

Microsoft. 2010. “Buy and Download Microsoft Excel 2010, Spreadsheet, Data Tracking Software, Numbers, Enhanced Tools - Microsoft Store Online.” http://www.microsoftstore.com/store/msstore/pd/productID.216445700?WT.mc_id=pointitsem_US_Google_5-Excel_generic_2010

Myers, R. H. 1990. *Classical and Modern Regression with Applications*. Vol. 488. Duxbury Press Belmont, California.

NIST. 2011. “Health Care Criteria for Performance Excellence.” http://www.nist.gov/baldrige/publications/hc_criteria.cfm.

NSHC. 2011. “Http://nshc.org/quality/docs/2012-02-06_quality_compendium.pdf - Google Search.” https://www.google.com/#hl=en&sclient

Qualtrics. 2011. “Qualtrics Virginia Tech - Google Search.” https://www.google.com/#hl=en&output=search&sclient=psy-ab&q=qualtrics+virginia+tech&oq=quLTRICS&aq

Raymond, M., and F. Rousset. 1995. “An Exact Test for Population Differentiation.” *Evolution* 49 (6): 1280–1283.

Rea, L. M., R. A. Parker, and R. Allen. 1997. *Designing and Conducting Survey Research: A Comprehensive Guide*. Jossey-Bass Publishers San Francisco, CA.

Rea, Louis, and Richard A. Parker. 2005. *Designing and Conducting Survey Research : a Comprehensive Guide*. 3rd ed. San Francisco: Jossey-Bass.

Routledge, R. 2005. “Fisher’s Exact Test.” *Encyclopedia of Biostatistics*.

SAS. 2010. “Products & Solutions | SAS.” http://www.sas.com/software/.

Sculpher, M. J., National Co-ordinating Centre for HTA (Great Britain), and R. NHS. 2004. “Generalisability in Economic Evaluation Studies in Healthcare: a Review and Case Studies.”

Shojania, K. G., B. W. Duncan, K. M. McDonald, R. M. Wachter, and A. J. Markowitz. 2001. *Making Health Care Safer: a Critical Analysis of Patient Safety Practices*. Agency for Healthcare Research and Quality Rockville, MD.

Siegel, S. 1957. “Nonparametric Statistics.” *The American Statistician* 11 (3): 13–19.

Theodorsson-Norheim, E. 1986. “Kruskal-Wallis Test: BASIC Computer Program to Perform Nonparametric One-way Analysis of Variance and Multiple Comparisons on Ranks of Several Independent Samples.” *Computer Methods and Programs in Biomedicine* 23 (1): 57–62.

Thompson, B., American Psychological Association, and Inc Ovid Technologies. 2004. *Exploratory and Confirmatory Factor Analysis: Understanding Concepts and Applications*. American Psychological Association Washington, DC.

Thomson Reuters. 2012. “Home – 100 Top Hospitals – Healthcare – Thomson Reuters.” http://www.100tophospitals.com/.

Upton, G. J. G. 1992. “Fisher’s Exact Test.” *Journal of the Royal Statistical Society. Series A (Statistics in Society)*: 395–402.

Weisberg, H. F., J. A. Krosnick, and B. D. Bowen. 1996. *An Introduction to Survey Research, Polling, and Data Analysis*. Sage Publications, Inc.

Wilcoxon, F. 1945. “Individual Comparisons by Ranking Methods.” *Biometrics Bulletin* 1 (6): 80–83.

Womack, James P. 2009. “Womack Modern vs. Lean Management” August 25. http://www.slideshare.net/cmarchwi/womack-modern-vs-lean-management.

Womack, James P. 2002. “Lean Thinking: Where Have We Been and Where Are We Going?” Manufacturing Engineering 129 (3) (September): L2.

Womack, J. P. 2009. “Modern vs. Lean Management Assessment questionnaire." Internal LEI document for company assessments.

Womack, J. P. 2008. *The Power of Purpose, Process and People*.

WSHA. 2011. “Washington State Hospital Association: Hospital Quality Rankings.” http://www.wsha.org/hospitalquality.cfm.

5. Management Styles and Hospital Performance

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5.1. Abstract

Hospitals, to be successful, must make sure they have the right leadership, organizational traits, and management systems factors line-up. This study systematically explored the effects of these factors as one interdependent construct related to hospital performance measures based on quality of care outcomes.

Findings indicate that the selection of factors related to the management system employed, as well as factors related to organizational traits and leadership correlates with hospital performance. However, we also found that other factors, such as, for example, the types of hospital (acute or critical care) also significantly influence hospital performance. Moreover, this study also found two factors related to the management system employed by hospitals to have a significant impact on hospital performance. One factor related to modern management practices, that "*Managers often have to revisit/rework problems because they did not determine the root cause*" was found to have a negative influence on hospital performance. We also found that one factor that "*Managers are responsible for cross functional activities in addition to their own functional areas*," which is related to process management practices, influenced hospital performance negatively.

Thus, while leadership has been widely acknowledged as an important factor in determining hospital performance, this study did not find evidence supporting this notion. In essence, this study found that the type of hospital (critical access and acute care) and management system factors determine hospital performance.

Keywords: organizational traits, process management, modern management, leadership, management styles, quality of care measure

5.2. Introduction

In 1999, the Institute of Medicine (IOM, Bootman 2000) reported that between 44,000 and 98,000 hospital patients die and almost a million patients are injured every year as a result of preventable medical errors (Bootman 2000; Kohn et al. 2001). These dramatic numbers combined with skyrocketing health care costs induced the federal government to undertake initiatives to improve patient safety and to make the entire U.S healthcare system more cost effective (Shortell and Singer 2008; Porter and Teisberg 2006; Singer et al. 2003). However, despite all these efforts, *"…The U.S. health care system remains largely the same as it was a decade ago. We have seen no convincing approach to changing the unsustainable trajectory of the system, much less to offsetting the rising costs of an aging population and new medical advances* (Porter 2009, 1)." While a safer, more cost effective US health care system proves elusive, a major initiative for a safer health care system launched by the US Center for Medicare and Medicaid Services (CMS) to reduce medical errors has raised public awareness and holds hospitals accountable (Leape and Berwick 2005; McGlynn et al. 2003). CMS embraced a set of core measures for serious health conditions that can be related to preventable medical errors including acute myocardial infarction (AMI) rate; heart failure (HF) rate; pneumonia (PN) rate; and surgical care improvement project (SCIP) rate. These quality measures, which are reported by more than 4,500 U.S. hospitals (e.g., roughly 98 percent of all eligible providers), are used to systematically gauge a given hospital's performance (HHS 2011).

Despite these efforts to improve patient safety in hospitals, the necessary improvements are not evident (Singer and Shortell 2008; Leape and Berwick 2005). Thus, supporting patient safety and quality of care performance outcomes with suitable management systems, organizational traits, and leadership still constitutes a challenge for the majority of U.S. hospitals. While hospitals are aware of the importance of such factors for hospital performance, they are struggling to select and implement the best fitting factors (Boyer et al. 2012; Proudlove et al. 2008). Indeed, this problem is an understudied phenomenon of critical importance in the drive for better patient safety and hospital performance.

The objective of this study is to identify drivers of hospital performance as measured by the quality of care (HHS 2011). In particular, this study takes a holistic view on the interrelationship of management systems (process and modern management), organizational traits, and leadership on hospital performance. While studies about various applied and theoretical practices from process management (which, in this study, is used synonymously with lean management) in healthcare, such as organizational learning, standardized processes, tools, or continuous improvement have been conducted (Boyer et al. 2012; Boyer and Pronovost 2010; de Souza 2009; Proudlove et al. 2008), little attention has been paid to the holistic system that is essential to sustain and continuously improve patient safety and hospital performance (Singer and Shortell 2008; Leape and Berwick 2005; Womack 2002). Also, past studies have proven that leadership is an important driver for hospital performance as measured by quality outcomes (Singer and Shortell 2008; Marley et al. 2004; Kohn et al. 2001; Flynn et al. 1994). Therefore, leadership has been recognized and is used by the Malcolm Baldrige National Quality Award Health Care Criteria (MBNQA) to assess hospitals (Marley et al. 2004). However, so far and despite its relevance, leadership has not been accounted for to explain patient safety.

Various theoretical frameworks to study the quality of care (e.g., performance) in hospitals have been discussed by researchers (Kane 2006; Marley et al. 2004; Sower et al. 2001; Kane et al. 1997; Cleary et al. 1988). While some researchers have employed subjective measures that are difficult to interpret (Arrow et al. 2009; Meyer and Collier 2001), others focused solely on a set of core measures for serious health conditions (e.g., data reported in the CMS database, HHS 2011) that are publicly available (Porter and Teisberg 2007; Tucker et al. 2007) without considering the interpersonal aspect of patient and provider interactions. Such interpersonal aspects are measured by the patient satisfaction score survey (HCAPS, Boyer et al. 2012; CMS 2012). Yet, the linkage between patient satisfaction and patient safety may not be as direct as previously thought and might also dilute research findings by subjective and sometimes irrational responses of the patients (Piper 2010). Moreover, some of the past research is on hospital performance centers on acute care hospitals in the U.S. (e.g. Kane 2006; Sower et al. 2001) and do not account for all four of the quality of care measures (e.g. Boyer et al. 2012). In addition, limited population sizes, such as, for example, a focus on acute care or specialized hospitals, might have led to observational bias by ignoring other hospitals that report quality of care measures (Kane 2006). Thus, such limitations are not without consequences and might hide the influence of management systems and organizational traits and leadership to the quality of care performance outcomes of hospitals. We, therefore, test for factors that belong to the four variables identified (process management, modern management, organizational traits, and leadership) using the four quality of care measures (e.g., acute myocardial infarction, heart failure, pneumonia, and surgical care improvement, HHS 2011) that are publicly available.

For this study, we use an extensive set of data of more than 4,500 hospitals in the U.S. This data set comprises the dependent variable, namely quality of care measure, which consists of four CMS (2010) factors (secondary data) and the independent variables collected from our survey (responses of 597 hospitals, primary data) to conduct our analysis. Hospital performance, in this study, is measured by a hospital's overall performance rate based on four core measures, e.g., acute myocardial infarction, heart failure, pneumonia, and surgical care improvement as reported in the Federal Government's CMS database (HHS 2011). First, we speculate that process management affects the quality of care performance of hospitals and we try to identify the underlying factors that affect the quality of care (e.g., performance) the most. Secondly, we speculate that modern management has a negative effect on hospital performance. Third, we also venture that hospitals with specific organizational traits have their performance affected. Fourth, empirical evidence shows that transformational and transactional leadership characteristics influence quality outcomes, so we test to see if leadership characteristics also influence hospital quality of care performance. An in depth description of the four variables (process management, modern management, organizational traits, and leadership) are discussed in Chapter 5.3.Theoretical context and hypotheses.

5.3. Theoretical context and hypotheses

Creating organizational traits, deploying the appropriate leadership, and choosing between a modern or process-management focused orientation, are decisions that hospitals must manage concurrently to satisfy the increasing demand for quality care, while, at the same time, maintaining and improving quality of care performance. Today, hospitals are forced to transform their processes and systems to reduce costs and to provide safer care. These requirements are driven by facts such as that Medicare and Medicaid do not cover all associated costs of running a hospital, that quality of care measures of hospitals are publicly disclosed and thus enforce competition, to cope with dramatically increasing healthcare costs, and changes associated with new healthcare legislation (Arrow et al. 2009; Porter 2009; Porter and Teisberg 2006). Given these facts, the following section examines the four components of interest in our study and discusses its influence on hospital performance as measured by the quality of care. The overall research construct consists of process management, modern management, organizational traits, and leadership, as shown in Figure 23.

5.3.1. Process management vs. modern management in hospitals

The follow-up to the 1999 Institute of Medicine (Bootman 2000) report on the quality of health care in the U.S. by Jewell and McGiffert (2009) and a publication by Wachter (2010) share evidence that patient safety in the U.S. healthcare system did not improve over the last decade. In particular, Wachter (2010) points out that to achieve improvements in patient safety, hospital leadership needs to focus on process management and workforce issues, as well as on training. However, as Singer and Shortell (2008), Tucker et al. (2006), Edmondson et al. (2001), Blendon et al. (2002), and Boyer and Pronovost (2010) revealed, there are challenges associated with the execution of process management initiatives such as, for example, that if associates feel their work being impacted by changes that they are more likely to sabotage process management initiatives (Singer and Shortell 2008). Also, hospital associates that are unfamiliar with new processes are difficult to convince to buy-in to process management (Tucker et al. 2006; Edmondson et al. 2001) and physicians are frequently the most reluctant group of hospital associates to embrace and practice process management principles (Blendon et al. 2002). Furthermore, hierarchical barriers leading to power distance increase the difficulties in adapting process management principles (Boyer and Pronovost 2010; Pronovost and Vohr 2010). Despite all those difficulties implementing process management, case studies have shown positive results on hospital performance from such efforts. Examples include the Flinders Medical Center in Adelaide, Australia (Ben-Tovim et al. 2007a); the Virginia Mason Medical Center (Institute for Healthcare Improvement 2012; Kenney 2010; Nelson-Peterson and Leppa 2007); and ThedaCare, Inc. (Institute for Healthcare Improvement 2012). Based on these observations, one can speculate that hospitals that apply process management should, on average, be performing better than hospitals that are not pursuing such process management initiatives. To test for this effect, we let our null hypothesis be:

$H1_0$ *Process Management has no impact on hospital performance.*

Modern management, according to Womack (2010), describes ideas on management that were pioneered by Alfred Sloan at General Motors (GM) and were gradually refined and adapted by, among others, General Electric (GE) during the 1980s and 1990s (LEI 2010). Womack (2010) describes modern management as a management approach that primarily focuses on vertical functions and an organization with departments with clear managerial authorities and vertical delegation. Furthermore, Womack (2010) describes modern management as a top-down management approach where managers are developed through formal education and decisions are made far from the point of value creation. Thus, Womack (2010) argues that modern management practices are not favorable to the creation of an organization that applies process management (Womack 2010). Therefore, we test for the impact of modern management on hospital performance (quality of care). Hence, our second null hypothesis is:

$H2_0$ *Modern Management has no impact on hospital performance.*

5.3.2. Organizational traits

According to Robinson and Luft (1985) and Dalton et al. (1980), firm and well-rounded organizational traits are positively correlated with better organizational effectiveness, efficiency, and innovation at hospitals. Thus, we test to see if organizational traits have an impact on hospital performance and define our third null hypothesis to be:

$H3_0$ *Organizational Traits have no impact on hospital performance.*

5.3.3. Leadership

According to leadership theory (Bass and Avolio 1994, Hutton 2000), hospital performance and quality of care is dependent on leadership, among other things (Piper 2010; Eagly et al. 2003; Meyer and Collier 2001). A few studies have focused on transformational and transactional leadership traits and have revealed that a combination of transformational and transactional leadership leads to better performance outcomes than if they were applied separately (Eagly et al. 2003; Hirst et al. 2004; Greene 1975; Pawar and Eastman 1997; Wofford-Vicki et al. 1998). Transformational leadership is widely researched and is characterized by a leadership style that places strong emphasis on followers' needs, morals, and values evolves from quality leader-follower relationships. However, critics claim that transformational theory lacks conceptual clarity, as well as that it is often interpreted as too simplistic or an either-or approach (Eagly et al. 2003; Pawar and Eastman 1997; Wofford-Vicki et al. 1998). Transactional leadership, then, is described as driven by management-by-exceptions and leading with contingent rewards (Bass and Avolio 1994). Transactional leadership also has critics that claim that this leadership style does not consider the human aspect of work, meaning, among other things, that transactional leadership is not empowering people (Bass and Avolio 1994). Despite the drawbacks inherent in both leadership styles, hospital performance employing transformational and/or transactional leadership styles should be, on average, better than the performance of hospitals that do not apply such leadership. Thus, our null hypothesis is:

$H4_0$ *The use of transformational and, or transactional leadership styles have no impact on hospital performance.*

The objective of this study was to investigate criteria that impact hospital performance and quality of care measures. Principally, the four areas of interest were: 1) modern management; 2) process management; 3) organizational traits; and 4) leadership.

5.4. Data and variables

A large part of research studies on the U.S. health care sector use case study methodology to describe characteristics of hospitals and their relationship to hospital performance (e.g. Kenney 2010; Bevan 2006; Sculpher et al. 2004; Anthony et al. 2003; Leatherman et al. 2003; Shojania et al. 2001; Kitson et al. 1998; Keen and Packwood 1995; Broadbent 1992). However, empirical research using a census survey has also been conducted using primary and secondary data (e.g. Boyer et al. 2012; Marley et al. 2004). This study, thus, uses a combination of primary and secondary data to test the construct shown in Figure 23.

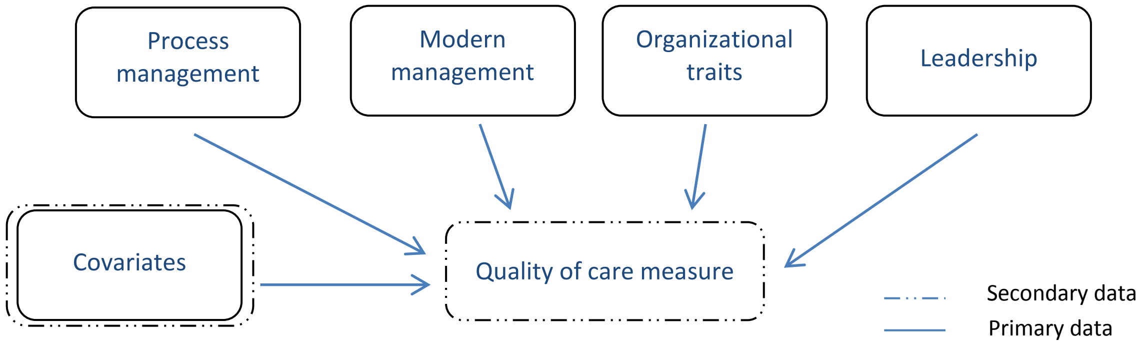

Figure 23: Study construct.

To study the performance of U.S. hospitals, we did build a secondary set of data that includes all U.S. hospitals, even though we limit our research to a sample of hospitals for which we have both primary and secondary data. However, in our secondary dataset, we excluded all hospitals that reported quality of care measures based on a sample size of 25 patients or less (HHS, 2011) to avoid outliers. Thus, while we are in possession of secondary data for 4,697 US hospitals, we explored our research questions using a database comprising of 597 hospitals from which we also have obtained primary data.

5.4.1. Primary data – independent variables

The primary data for this study was collected through an online survey. The survey measured the four components of interest in our study, namely ‘process management’, ‘modern management’, ‘organizational traits’, and ‘leadership’. To obtain the data required, three types of questions were used in the questionnaire: Likert scale questions, open ended questions, and categorical scale questions (Alreck and Settle 1995; Rea et al. 1997; Fowler 1995; Weisberg et al. 1996; Likert 1932). In addition to questions about process management, modern management, organizational traits, and leadership, the questionnaire asked participants to answer a set of selected 2010 hospital indicators (e.g., inpatient days, triage, discharge, turnover rates, apache scores), hospital background information, and improvement methodologies used, to name just a few. A draft version of the questionnaire was reviewed internally and feedback from researchers at Virginia Tech and the Lean Global Network (LGN) was obtained. Before the start of the online survey, a pre-test was conducted to verify and statistically validate the questionnaire. A sample of 38 hospital associates at two independent hospitals in Virginia was selected to test for clarity, acceptability, timeliness, and comprehensiveness (Rea et al. 1997; Alreck and Settle 1995). Thirty-three responses were received, analyzed, and minor changes were incorporated into the questionnaire to increase clarity (Rea et al. 1997; Alreck and Settle 1995).

The population of interest for this study consisted of all hospitals in the U.S., thus, we collected hospital addresses from different sources: the American Hospital Association (AHA 2011), U.S. Department of Health & Human Services website (HHS, 2011), State Hospital Associations, and the Institute for Healthcare Improvement (IHI, 2010). The final contact list consisted of 4,697 US hospitals. Data collection took place from mid-July to early October 2011 and included two physical mailings and two colored reminder postcards addressed to hospital managers (Rea and Parker 2005). After the first mailing, a reminder postcard, a letter, and another reminder postcard were sent out every week, respectively. Two weeks after closing the survey from which 597 responses from 48 States (with participation varying from one response each from Alaska, Hawaii, and Idaho to 38 responses from Texas, while no responses were received from Rhode Island and Delaware) were obtained, 30 non-respondents were contacted by phone to answer one demographic, six organizational traits questions, and one continuous improvement methodology question. Those 30 responses were used to test for non-response bias (Dillman 2007; Connolly and Connolly 2005; Rea and Parker 2005; Alreck and Settle 1995). No significant difference between survey respondents and non-response bias respondents were found (p-values ranging from 0.1654 to 0.8753).

Variables from primary data

All questions pertaining to our four factors of interest (modern management, process management, organizational traits, and leadership) in this primary data collection effort can be found in Appendix B. We evaluate the variable **process management** (e.g., lean management) using a nine-item scale, which describes and measures items of process management, e.g., a management philosophy that is focused on the horizontal flow of value across a hospital and on improving those processes towards a perfect patient experience. These items were originally developed by Womack (2009) to evaluate the transition from a modern management style to a process management style in manufacturing. The variable **modern management** also consists of nine items and describes an opposing view of the process management items we deployed. An organization using modern management is described as having a strong focus on vertical functions, using managerial authority with a focus on vertical delegation, focusing on short-term and mainly financial objectives, and making decisions far from the place of value creation (Womack 2008; Womack 2002). All items used for the inquiry about process and modern management in the questionnaire were originally developed by Womack (2009) as a paired comparison of modern versus process management. However, in this study, we are using modern and process management as separate factors and thus, used explanatory factor analysis and principal component extraction to reduce the number of items (16 each) in these two categories (Costello and Osborne 2005; Thompson et al. 2004; Akaike 1987). The variable **organizational traits** consists of 6 items to measure the extent to which an organization functions effectively, efficiently, and innovatively while patients and hospital associates are satisfied with the performance of the organization. The items are based and adapted from questionnaires such as "Great place to work (Great Place to Work 2012)," "The Baldrige Health Care Criteria for Performance Excellence (NIST 2011)," and Jim Womack's questionnaire (2009). Finally, the fourth variable **leadership** with 12 items is grounded and adapted from the multifactor leadership questionnaire (Bass and Avolio 1994; Avolio and Bernard 2004), the Baldrige Criteria for Performance Excellence (Hutton 2000), the transformational leadership questionnaire (TLQ-LGV, Alban-Metcalfe and Alimo-Metcalfe 2000), and a publication by McGuire and Kennerly (2006).

5.4.2. Secondary data – dependent variables

To explore our research questions we used data from secondary sources collected by the federal government for 2010. This data, reported as quality of care measure (our measure for hospital performance) by HHS (2011), was used as our dependent variable. Quality of care measures refer to a widely used benchmark that explains how well a hospital provides care to its patients (HHS, 2011). Quality of care measures are based on reported patient records of 4,697 hospitals and are publicly available at CMS (2010). For this study, we consider all four categories of core measures for serious health conditions that can be related to preventable medical errors, including 1) acute myocardial infarction (AMI) rate; 2) heart failure (HF) rate; 3) pneumonia (PN) rate; and 4) surgical care improvement project (SCIP) rate. Each of the four categories consists of individual items – AMI (8 items), HF (4 items), PN (7 items), and SCIP (2 items, CMS 2012). The overall score of the quality of care measures (AMI, HF, PN, and SCIP) by hospital is calculated by summing the numerators and denominators of all measures reported, e.g., the average weighted percentage of patients that received quality care. This score has been validated in numerous publications (Boyer et al. 2012; Giordano et al. 2010; McGlynn et al. 2003; Marley et al. 2004).

5.4.3. Covariates

In this study, we included covariates at the hospital level to control for the **type of hospital** (acute care hospital, acute care – veterans administration, and critical access hospital). Critical access hospitals (CAH) are classified and differ from non-critical access hospitals by being located in a rural area or an area that is treated as rural and maintains no more than 25 inpatient beds. We also controlled for a hospital's **organizational structure** (subsidiary or stand-alone entity, CMS 2012). Among the covariates external to the hospital, we accounted for the **number of years** that respondents have been employed at their hospital.

5.4.4. Methods

We used confirmatory factor analysis (Dyer et al. 2005, Thompson et al 2004) for each of the four variables (process management, modern management, organizational traits, and leadership) to account for the common variance of each set of variables. In addition, we checked for internal reliability and validity of our dichotomous items using Cronbach's alpha (Gliem and Gliem 2003; Bland and Altman 1997). All four components showed a reliability alpha greater than 0.8 indicating good internal consistency. Since our quality of care measure (our dependent variable and a number between 0 and 1) was non-linear, we used logit transformation to account for non-linearity (Jaeger 2008; Ashton 1972). To test the hypotheses pertaining to the quality of care measure, we used **all-subset multiple linear regression** (Myers 1990; Belsley 1980)**.** For the statistical model selection we applied forward elimination and a nominated alpha of 0.05. To account for errors in the model selection, we used an 80 percent sample of our dataset and used the remaining 20 percent to assess the model's accuracy (mean absolute percent error, mean error) as well as the model's bias (Hocking and Leslie 1967).

5.5. Results

Our statistical analysis relies on 186 observations (N=186), e.g., all responses received with all questions answered. We split these responses 80/20 (147/29) to create and to validate the model and check for bias and errors. Appendix N (1 to 4) shows descriptive statistics and the correlation tables of each of the four components researched (modern management, process management, organizational traits, and leadership). None of the correlations exceeded 0.47 and thus did not trigger further investigations (Thompson et al. 2004). Appendix N (3) shows the correlation table of organizational traits with the highest correlation value being 0.56 (Bland and Altman 1997). Appendix N (4) demonstrates the correlation table of leadership, where one observation displayed a high correlation value of 0.75 between two predictor variables (*q27 – Our executive team gains respect and trust* and *q33 – Our Executive team recognizes and celebrates accomplishments*). After checking the individual effects of those items separately with an absence of differences in results, we did run the best subset model creation algorithm including all items (Myers 1990; Belsley et al. 1980).

>>Insert Appendix N about here <<

Appendix O displays the four **all-subset models** (from all four components investigated) with significant items shown and ranked according to adjusted R^2, showing that the best fitting model includes covariate cv3 (e.g., type of hospital - acute care hospital, acute care – veterans administration, and critical access hospital), and two independent variables (modern management system factor q8 – "*managers often have to revisit/rework problems because they did not determine the root cause*" and a process management factor q10 – "*managers are responsible for cross functional activities in addition to their own functional areas.*")

>>Insert Appendix O about here <<

Appendix P shows the importance of covariate cv3 on the performance (quality of care) of hospitals. In fact, the classification of acute care hospitals relates positively to performance outcomes. Appendix P also shows that both independent variables, e.g., q8 – "*managers often have to revisit/rework problems because they did not determine the root cause*" and q10 – "*managers are responsible for cross functional activities in addition to their own functional areas*," relate negatively to a hospital's performance.

>>Insert Appendix P about here <<

Appendix Q shows the coefficient of determination (R^2) to be 0.167, meaning that 16.7 percent of the variation in hospital performance (quality of care) observed among hospitals can be explained by the model consisting of these three variables (cv3, q10, and q8).

>>Insert Appendix Q about here <<

In $H1_0$, we theorize that process management has an impact on hospital performance (quality of care). Appendix P shows that one of the factors, q10 – "*managers are responsible for cross* *functional activities in addition to their own functional areas*" relates negatively to hospital performance. Thus, we reject our $H1_0$ statement that "*Process Management has no impact on hospital performance*." To investigate the impact of modern management on hospital performance and to test $H2_0$, we use the same output from our all-subset multiple linear regression. Appendix P confirms that one item of modern management (q8 – "*managers often have to revisit/rework problems because they did not determine the root cause*") has a significant and negative impact on hospital performance and thus, we reject $H2_0$ stating that "*Modern Management has no impact on hospital performance.*" In $H3_0$, we hypothesize that organizational traits have an effect on hospital performance, but we could not find conclusive support for $H3_0$ (Appendix O and Appendix P). Therefore, we fail to reject $H3_0$ – "*Organizational Traits have no impact on hospital performance*." Similarly, in $H4_0$, we theorize that leadership impacts hospital performance. However, our findings do not support $H4_0$ as none of the items in our best model pertaining to leadership (Appendix O and Appendix P) was found to be significant (α of 0.05). Thus, we fail to reject hypothesis $H4_0$ – "*Leadership has no impact on hospital performance*," and we conclude that there is no evidence in support that leadership, as described in our questionnaire, has an impact on the performance of hospitals.

5.5.1. Robustness checks

Our results remain robust after a series of checks on our all-subset multiple linear regression model. First, we controlled for other hospital level covariates in our model. We tested on *hospital ownership* (proprietary, voluntary non-profit, and government), *State in which hospital is located*, and *type of organization* (investor owned and for profit, non-government and non-profit, and state and local government), but found no significant influence on performance and thus, did not include any of these covariates in our best subset model list. However, controlling for states showed that being located in VA, WA, and WI had a negative influence on hospital performance. Furthermore, on the hospital level, we checked if the quality of care measure is influenced by whether a hospital belongs to a chain or is a self-standing organization. Results showed that there is a moderate negative effect (comparing means) on hospital performance, which, however, does not influence our best model selection. We also tested some factors regarding process improvement to verify if they impact hospital performance (quality of care). We tested whether process improvements in hospitals are “owned” by a focused, one purpose process improvement department or if process improvements are handled by a department with additional tasks (like, f.e., the quality management department). We found a negative effect for situations where process improvements are handled by a department with additional tasks assigned. However, this effect was not strong enough to change our model. We also tested resource allocation (FTEs) towards process improvement initiatives for impact on hospital performance. There is a negative influence on hospital performance when having low FTEs allocated towards process improvement (0 and 0.01-0.75 FTEs). There also is a small positive effect if 0.76-4.00 FTEs are allocated towards process improvement. Overall, none of the robustness checks undertaken resulted in a change to our model that best predicts variation in hospital performance (Appendix P). Furthermore, we checked for robustness of our model using the remaining results that were originally withheld for this purpose to assess our model’s accuracy as mean absolute percent error and mean error and the model’s bias (Hocking and Leslie 1967). Thus, all of our results proved the robustness of our model and the presence of significance of determination.

5.6. Discussion

Our study tests how factors pertaining to process management, modern management, leadership, and organizational traits impact quality of care (defined as performance in this publication) outcomes of U.S. hospitals. We conducted our study in a U.S. context based on CMS data for 2010 (CMS 2011) and information that was gathered by a survey in 2011. We found that management system factors do impact hospital performance, but not to the extent we expected.

In this section, we review the hypotheses presented and discuss the results reported. We then add some thoughts about opportunities for further research. An issue of strategic importance to hospitals is that a majority of current management systems in hospitals is ineffective to manage a growing demand for care (Porter 2009; Porter and Teisberg 2007). Thus, our findings that one of the factors of modern management (a widely used management system, Womack 2009), namely that "*managers often have to revisit/rework problems because they did not determine the root cause*" has a negative impact on hospital quality of care measures, indicates that hospitals have a way to improve their performance. This finding supports Womack's (2009) claim that without the right mindset and tools to solve the root cause of problems, sustainable improvements are not possible (Womack 2008; Liker 2004; Womack 2002). In this sense, hospitals need to empower their employees to resolve the root cause of problems. A limitation of our study is that the questionnaire was only used twice before and solely applied to manufacturing environments, which may have left some questions lacking clarity in a health care services context. Further research should explore and validate the questionnaire in the hospital and in other industries to check for robustness and validity.

A related issue with the insufficiency of the modern management style for hospitals is to find a management system that resolves those shortcomings. Thus, we tested if process management, also known as lean management (based on the Toyota production system), promises better performance for hospitals. However, while we found no proof of a positive influence by process management related questions, we found one process management related question, "*managers are responsible for cross functional activities in addition to their own functional areas*," to be negatively related to hospital performance. However, our results should be interpreted with care, because our question might have led respondents to the conclusion that efficiencies increase if clear functionalities are in place, rather than that managers have to deal with both functional and cross functional activities. Interestingly, our study findings do not correspond to findings of research done previously (e.g. Boyer et al. 2012; Boyer and Pronovost 2010; Birkmeyer 2010; Pronovost and Vohr 2010). However, our results also might reflect that U.S. hospitals possess limited knowledge about process management (Boyer et al. 2012; Boyer and Pronovost 2010). Further research should conduct studies for validity and robustness of our questionnaire and, in particular, process management items.

A second challenge for hospitals is to find appropriate organizational traits, which drive performance improvements. However, our results reveal no evidence that organizational traits have an impact on hospital performance. However, one of the covariates showed a moderate negative impact on hospital performance if the process improvement initiative is owned as part of a department and not as an independent unit. Thus, our results are inconsistent with past research that organizational characteristics have significant impact on hospital performance outcomes (Aiken et al. 2002; Pronovost et al. 1999; Aiken et al. 1994; Burns and Wholey 1993; Kimberly and Evanisko 1981). Efforts should be made to further research the impact of organizational traits, such as, for example, matrix organizations, flat organizational structures, or organizational culture on hospital performance.

Another challenge for hospitals is to find leadership styles that foster change for the improvement of quality of care, while creating an environment in which associates can grow, feel appreciated, and can be trained (Buerhaus et al. 2007; Hassmiller and Cozine 2006; Buerhaus et al. 2005). Our study divulges that there is no evidence that any of our leadership traits tested has a significant impact on hospital performance outcomes. However, recent research findings (e.g. Tucker et al. 2007; Marley et al. 2004; Meyer and Collier 2001) indicate that strong leadership is the primary force in directing efforts towards better quality of care (e.g., better performance). Thus, we suggest that further research should be conducted on leadership traits before accepting our findings.

We found that covariate cv3, the type of hospital (acute care hospital, acute care – veteran's administration, and critical access hospital), has a significant impact on performance. This finding is consistent with findings by Joynt et al. (2011), who concluded that critical access hospitals (CAHs) had lower quality of care (e.g., performance) compared to acute care hospitals. These findings open questions as to what difference in respect to management systems, organizational characteristics, and leadership traits exists between acute care and critical access hospitals.

We also noted that traditional research has focused on studying individual aspects of hospital performance, but rarely are these aspects combined to an overall construct as done in our study using an all-subset multiple linear regression (Myers 1990; Belsley et al. 1980). This regression method accounts for correlations, VIF numbers, the residual sums of squares, and eliminates any influence from collinearity. Limitations of this method, however, are the over-fitting of the model and that there is the chance that the procedures select the wrong variables due to correlated proxies. Thus, results should be interpreted with care, especially since we had to use logit transformation of the performance score to achieve linearity of data.

Other limitations apply to our research. For example, we measured four factors, e.g., modern management, process management, organizational traits, and leadership using a variety of questions from multiple sources (Eagly et al. 2003; Hirst et al. 2004; Greene 1975; Pawar and Eastman 1997; Wofford-Vicki et al. 1998; Bass and Avolio 1994). Future research should validate our questions as they pertain to hospital performance. Also, all typical limitations of survey-based research apply to our study (Dillman 2007; Rea and Parker 2005). Most importantly, the reader should keep in mind that our results are constructed based on one respondent's answer from each hospital (Dillman 2007; Rea and Parker 2005). Moreover, we did not receive input from any hospitals in Alaska, Hawaii, and Idaho and participation from other states varied. Care is thus warranted when generalizing findings from this study.

This study adds to our understanding of a selected set of factors on hospital performance (e.g., quality of care) and the study highlights ongoing research in operations management, strategy, and healthcare delivery. In particular, research should continue to investigate the impact of: management systems (modern versus process); acute hospitals versus critical access hospitals; transformational and transactional leadership styles; and organizational characteristics on hospital performance. Only by gaining a better understanding of these drivers of hospital performance can we hope to come to terms with our ongoing struggle for affordable, quality health care in the U.S.

5.7. References

AHA. 2011. *AHA Guide 2010*.

Aiken, L.H., S.P. Clarke, D.M. Sloane, and others. 2002. "Hospital Staffing, Organization, and Quality of Care: Cross-national Findings." *International Journal for Quality in Health Care* 14 (1): 5–14.

Aiken, L.H., H.L. Smith, and E.T. Lake. 1994. "Lower Medicare Mortality Among a Set of Hospitals Known for Good Nursing Care." *Medical Care*: 771–787.

Akaike, H. 1987. "Factor Analysis and AIC." *Psychometrika* 52 (3): 317–332.

Alban-Metcalfe, Robert J., and Beverly Alimo-Metcalfe. 2000. "The Transformational Leadership Questionnaire (): a Convergent and Discriminant Validation Study." *Leadership & Organization Development Journal* 21 (6) (January 9): 280–296. doi:10.1108/01437730010343077.

Alreck, P. L., and R. B. Settle. 1995. *The Survey Research Handbook*. Irwin Chicago.

Anthony, W., E.S. Rogers, and M. Farkas. 2003. "Research on Evidence-based Practices: Future Directions in an Era of Recovery." *Community Mental Health Journal* 39 (2): 101–114.

Arrow, K., A. Auerbach, J. Bertko, S. Brownlee, L.P. Casalino, J. Cooper, F.J. Crosson, et al. 2009. "Toward a 21st-century Health Care System: Recommendations for Health Care Reform." *Annals of Internal Medicine* 150 (7): 493–495.

Ashton, W.D. 1972. *The Logit Transformation: With Special Reference to Its Uses in Bioassay*. Griffin London.

Avolio, B. J., and M. Bernard. "Bass (2004)." *Multifactor Leadership Questionnaire: Manual and Sampler Set*.

Bass, B. M., and B. J. Avolio. 1994. *Improving Organizational Effectiveness Through Transformational Leadership*. Sage Publications, Inc.

Belsley, D.A., E. Kuh, and R.E. Welsch. 1980. *Regression Diagnostics*. Wiley Online Library.

Ben-Tovim, D. I., J. E. Bassham, D. Bolch, M. A. Martin, M. Dougherty, and M. Szwarcbord. 2007. "Lean Thinking Across a Hospital: Redesigning Care at the Flinders Medical Centre." *Aust Health Rev* 31 (1): 10–5.

Bevan, G. 2006. "Setting Targets for Health Care Performance Lessons from a Case Study of the English NHS." *National Institute Economic Review* 197 (1): 67–79.

Birkmeyer, J.D. 2010. “Strategies for Improving Surgical Quality—checklists and Beyond.” *New England Journal of Medicine* 363 (20): 1963–1965.

Bland, J. M., and D. G. Altman. 1997. “Cronbach’s Alpha.” *BMJ: British Medical Journal* 314 (7080): 572.

Blendon, R.J., C.M. DesRoches, M. Brodie, J.M. Benson, A.B. Rosen, E. Schneider, D.E. Altman, K. Zapert, M.J. Herrmann, and A.E. Steffenson. 2002. “Views of Practicing Physicians and the Public on Medical Errors.” *New England Journal of Medicine* 347 (24): 1933–1940.

Bootman, J. Lyle. 2000. “To Err Is Human.” *Arch Intern Med* 160 (21) (November 27): 3189. doi:10.1001/archinte.160.21.3189.

Boyer, K.K., J. Gardner, and S. Schweikhart. 2012. “Process Quality Improvement: An Examination of General vs. Outcome-specific Climate and Practices in Hospitals.” *Journal of Operations Management*.

Boyer, K.K., and P. Pronovost. 2010. “What Medicine Can Teach Operations: What Operations Can Teach Medicine.” *Journal of Operations Management* 28 (5).

Broadbent, J. 1992. “Change in Organisations: A Case Study of the Use of Accounting Information in the NHS.” *The British Accounting Review* 24 (4): 343–367.

Buerhaus, P.I., K. Donelan, B.T. Ulrich, L. Norman, C. DesRoches, and R. Dittus. 2007. “Impact of the Nurse Shortage on Hospital Patient Care: Comparative Perspectives.” *Health Affairs* 26 (3): 853–862.

Buerhaus, P.I., K. Donelan, B.T. Ulrich, L. Norman, and R. Dittus. 2005. “Is the Shortage of Hospital Registered Nurses Getting Better or Worse? Findings from Two Recent National Surveys of RNs.” *Nursing Economics* 23 (2): 61–71.

Burns, L.R., and D.R. Wholey. 1993. “Adoption and Abandonment of Matrix Management Programs: Effects of Organizational Characteristics and Interorganizational Networks.” *Academy of Management Journal*: 106–138.

Cleary, P.D., B.J. McNeil, and others. 1988. “Patient Satisfaction as an Indicator of Quality Care.” *Inquiry: a Journal of Medical Care Organization, Provision and Financing* 25 (1): 25.

CMS. 2010. “https://www.cms.gov/HospitalQualityInits/downloads/HospitalOverviewOfSpecs200512.pdf - Google Search.” https://www.google.com/#hl=en&sclient=psy-ab&q=https:%2F%2Fwww.cms.gov%2FHospitalQualityInits%2Fdownloads%

———. 2012. "Quality Initiative." http://www.cms.hhs.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/QualityInitiativesGenInfo/index.html?redirect=/QualityInitiativesGenInfo/.

Connolly, P. M., and K. G. Connolly. 2005. *Employee Opinion Questionnaires: 20 Ready-to-use Surveys That Work*. Pfeiffer.

Costello, A. B., and J. W. Osborne. 2005. "Best Practices in Exploratory Factor Analysis: Four Recommendations for Getting the Most from Your Analysis." *Practical Assessment, Research & Evaluation* 10 (7): 1–9.

Dalton, D.R., W.D. Todor, M.J. Spendolini, G.J. Fielding, and L.W. Porter. 1980. "Organization Structure and Performance: A Critical Review." *Academy of Management Review*: 49–64.

Dillman, D. A. 2007. *Mail and Internet Surveys: The Tailored Design Method*. John Wiley & Sons Inc.

Dyer, N. G., P. J. Hanges, and R. J. Hall. 2005. "Applying Multilevel Confirmatory Factor Analysis Techniques to the Study of Leadership." *The Leadership Quarterly* 16 (1): 149–167.

Eagly, A. H., M. C. Johannesen-Schmidt, and M. L. van Engen. 2003. "Transformational, Transactional, and Laissez-faire Leadership Styles: A Meta-analysis Comparing Women and Men." *Psychological Bulletin* 129 (4): 569–591.

Edmondson, A.C., R.M. Bohmer, and G.P. Pisano. 2001. "Disrupted Routines: Team Learning and New Technology Implementation in Hospitals." *Administrative Science Quarterly* 46 (4): 685–716.

Flynn, B.B., R.G. Schroeder, and S. Sakakibara. 1994. "A Framework for Quality Management Research and an Associated Measurement Instrument." *Journal of Operations Management* 11 (4): 339–366.

Fowler, F. J. 1995. *Improving Survey Questions: Design and Evaluation*. Sage Publications, Inc.

Giordano, L.A., M.N. Elliott, E. Goldstein, W.G. Lehrman, and P.A. Spencer. 2010. "Development, Implementation, and Public Reporting of the HCAHPS Survey." *Medical Care Research and Review* 67 (1): 27–37.

Gliem, J.A., and R.R. Gliem. 2003. "Calculating, Interpreting, and Reporting Cronbach's Alpha Reliability Coefficient for Likert-type Scales." In *Midwest Research to Practice Conference in Adult, Continuing, and Community Education*. Vol. 88.

Great Place to Work. 2012. “Great Place to Work® Institute United States.” http://www.greatplacetowork.com/.

Greene, C. N. 1975. “The Reciprocal Nature of Influence Between Leader and Subordinate.” *Journal of Applied Psychology* 60 (2): 187–193.

Hassmiller, S.B., and M. Cozine. 2006. “Addressing the Nurse Shortage to Improve the Quality of Patient Care.” *Health Affairs* 25 (1): 268–274.

HHS. 2011. “Hospital Compare.” http://www.hospitalcompare.hhs.gov/staticpages/help/hospital-how-to.aspx.

Hirst, G., L. Mann, P. Bain, A. Pirola-Merlo, and A. Richver. 2004. “Learning to Lead: The Development and Testing of a Model of Leadership Learning.” *The Leadership Quarterly* 15 (3): 311–327.

Hocking, R. R., and R. N. Leslie. 1967. “Selection of the Best Subset in Regression Analysis.” *Technometrics*: 531–540.

Hutton, D. W. 2000. *From Baldrige to the Bottom Line: A Road Map for Organizational Change and Improvement*. American Society for Qualit.

IHI (Institute for Healthcare Improvement). 2010. *IHI Internal Hospital Statistics database 2011*

Institute for Healthcare Improvement. 2012. “White Paper, Lean Principles, Throughput Time, Lean Thinking, Kanban, Muda, Value Stream, A Priori, Kaizen, Takt Time, Lean Management Trystorm,” http://www.ids-healthcare.com/Common/Paper/Paper_51/Going%20Lean%20in%20Health%20Care1.htm.

Jaeger, T.F. 2008. “Categorical Data Analysis: Away from ANOVAs (transformation or Not) and Towards Logit Mixed Models.” *Journal of Memory and Language* 59 (4): 434–446.

Jewell, K., and L. McGiffert. 2009. “To Err Is Human—to Delay Is Deadly.” *Austin, TX, Consumers Union*.

Joynt, K.E., Y. Harris, E.J. Orav, and A.K. Jha. 2011. “Quality of Care and Patient Outcomes in Critical Access Rural Hospitals.” *JAMA: The Journal of the American Medical Association* 306 (1): 45.

Kane, R.L. 2006. *Understanding Health Care Outcomes Research*. Jones & Bartlett Learning.

Kane, R.L., M. Maciejewski, and M. Finch. 1997. “The Relationship of Patient Satisfaction with Care and Clinical Outcomes.” *Medical Care* 35 (7): 714.

Keen, J., and T. Packwood. 1995. “Qualitative Research: Case Study Evaluation.” *Bmj* 311 (7002): 444–446.

Kenney, Charles. 2010. *Transforming Health Care: Virginia Mason Medical Center’s Pursuit of the Perfect Patient Experience*. 1st ed. CRC Press.

Kimberly, J.R., and M.J. Evanisko. 1981. “Organizational Innovation: The Influence of Individual, Organizational, and Contextual Factors on Hospital Adoption of Technological and Administrative Innovations.” *Academy of Management Journal*: 689–713.

Kitson, A., G. Harvey, and B. McCormack. 1998. “Enabling the Implementation of Evidence Based Practice: a Conceptual Framework.” *Quality in Health Care* 7 (3): 149–158.

Kohn, L.T., J.M. Corrigan, and M.S. Donaldson. 2001. “Crossing the Quality Chasm: a New Health System for the 21st Century.” *Washington, DC: Committee on Quality of Health Care in America, Institute of Medicine*.

Leape, Lucian L., and Donald M. Berwick. 2005. “Five Years After To Err Is Human What Have We Learned?” *JAMA: The Journal of the American Medical Association* 293 (19) (May 18): 2384–2390. doi:10.1001/jama.293.19.2384.

Leatherman, S., D. Berwick, D. Iles, L.S. Lewin, F. Davidoff, T. Nolan, and M. Bisognano. 2003. “The Business Case for Quality: Case Studies and an Analysis.” *Health Affairs* 22 (2): 17–30.

LEI. 2010. “What Is Lean.” http://www.lean.org/WhatsLean/.

Liker, Jeffrey K. 2004. *The Toyota Way*. McGraw-Hill Professional.

Likert, R. 1932. “A Technique for the Measurement of Attitudes.”

Marley, Kathryn A., David A. Collier, and Susan Meyer Goldstein. 2004. “The Role of Clinical and Process Quality in Achieving Patient Satisfaction in Hospitals.” *Decision Sciences* 35 (3) (August 1): 349–369. doi:10.1111/j.0011-7315.2004.02570.x.

McGlynn, E.A., S.M. Asch, J. Adams, J. Keesey, J. Hicks, A. DeCristofaro, and E.A. Kerr. 2003. “The Quality of Health Care Delivered to Adults in the United States.” *New England Journal of Medicine* 348 (26): 2635–2645.

McGuire, E., and S.M. Kennerly. 2006. “Nurse Managers as Transformational and Transactional Leaders.” *Nursing Economics* 24 (4): 179.

Meyer, Susan M., and David A. Collier. 2001. "An Empirical Test of the Causal Relationships in the Baldrige Health Care Pilot Criteria." *Journal of Operations Management* 19 (4) (July): 403–426. doi:10.1016/S0272-6963(01)00053-5.

Myers, R.H. 1990. *Classical and Modern Regression with Applications*. Vol. 488. Duxbury Press Belmont, California.

Nelson-Peterson, D.L., and C.J. Leppa. 2007. "Creating an Environment for Caring Using Lean Principles of the Virginia Mason Production System." *Journal of Nursing Administration* 37 (6): 287.

NIST. 2011. "Health Care Criteria for Performance Excellence." http://www.nist.gov/baldrige/publications/hc_criteria.cfm.

Pawar, B. S., and K. K. Eastman. 1997. "The Nature and Implications of Contextual Influences on Transformational Leadership: A Conceptual Examination." *Academy of Management Review* 22 (1): 80–109.

Piper, L.E. 2010. "Patients Are Not Always Rational: The Leadership Challenge to Improve Patient Satisfaction Scores." *The Health Care Manager* 29 (3): 233.

Porter, M.E. 2009. "A Strategy for Health Care Reform—toward a Value-based System." *New England Journal of Medicine* 361 (2): 109–112.

Porter, M.E., and E.O. Teisberg. 2006. *Redefining Health Care: Creating Value-based Competition on Results*. Harvard Business Press.

———. 2007. "How Physicians Can Change the Future of Health Care." *JAMA: The Journal of the American Medical Association* 297 (10): 1103–1111.

Pronovost, P., and E. Vohr. 2010. *Safe Patients, Smart Hospitals: How One Doctor's Checklist Can Help Us Change Health Care from the Inside Out*. Hudson st Pr.

Pronovost, P.J., M.W. Jenckes, T. Dorman, E. Garrett, M.J. Breslow, B.A. Rosenfeld, P.A. Lipsett, and E. Bass. 1999. "Organizational Characteristics of Intensive Care Units Related to Outcomes of Abdominal Aortic Surgery." *JAMA: The Journal of the American Medical Association* 281 (14): 1310–1317.

Proudlove, N., C. Moxham, and R. Boaden. 2008. "Lessons for Lean in Healthcare from Using Six Sigma in the NHS." *Public Money and Management* 28 (1): 27–34.

Rea, L. M., R. A. Parker, and R. Allen. 1997. *Designing and Conducting Survey Research: A Comprehensive Guide*. Jossey-Bass Publishers San Francisco, CA.

Rea, Louis, and Richard A. Parker. 2005. *Designing and Conducting Survey Research : a Comprehensive Guide*. 3rd ed. San Francisco: Jossey-Bass.

Robinson, J.C., and H.S. Luft. 1985. “The Impact of Hospital Market Structure on Patient Volume, Average Length of Stay, and the Cost of Care.” *Journal of Health Economics* 4 (4): 333–356.

Sculpher, M.J., National Co-ordinating Centre for HTA (Great Britain), and R. NHS. 2004. “Generalisability in Economic Evaluation Studies in Healthcare: a Review and Case Studies.”

Shojania, K.G., B.W. Duncan, K.M. McDonald, R.M. Wachter, and A.J. Markowitz. 2001. *Making Health Care Safer: a Critical Analysis of Patient Safety Practices*. Agency for Healthcare Research and Quality Rockville, MD.

Shortell, S.M., and S.J. Singer. 2008. “Improving Patient Safety by Taking Systems Seriously.” *JAMA: The Journal of the American Medical Association* 299 (4): 445–447.

Singer, S.J., D.M. Gaba, J.J. Geppert, A.D. Sinaiko, S.K. Howard, and K.C. Park. 2003. “The Culture of Safety: Results of an Organization-wide Survey in 15 California Hospitals.” *Quality and Safety in Health Care* 12 (2): 112–118.

Singer, Sara J., and Stephen M. Shortell. 2008. “Improving Patient Safety by Taking Systems Seriously.” *JAMA : the Journal of the American Medical Association* 299 (4) (January 30): 445–447. doi:10.1001/jama.299.4.445.

de Souza, L.B. 2009. “Trends and Approaches in Lean Healthcare.” *Leadership in Health Services* 22 (2): 121–139.

Sower, V., J.A. Duffy, W. Kilbourne, G. Kohers, and P. Jones. 2001. “The Dimensions of Service Quality for Hospitals: Development and Use of the KQCAH Scale.” *Health Care Management Review* 26 (2): 47.

Thompson, B., American Psychological Association, and Inc Ovid Technologies. 2004. *Exploratory and Confirmatory Factor Analysis: Understanding Concepts and Applications*. American Psychological Association Washington, DC.

Tucker, A.L., I.M. Nembhard, A.C. Edmondson, and Harvard Business School. Division of Research. 2006. *Implementing New Practices: An Empirical Study of Organizational Learning in Hospital Intensive Care Units*. Citeseer.

Tucker, C.M., K.C. Herman, L.A. Ferdinand, T.R. Bailey, M.T. Lopez, C. Beato, D. Adams, and L.L. Cooper. 2007. “Providing Patient-centered Culturally Sensitive Health Care.” *The Counseling Psychologist* 35 (5): 679–705.

Wachter, R.M. 2010. “Patient Safety at Ten: Unmistakable Progress, Troubling Gaps.” *Health Affairs* 29 (1): 165–173.

Weisberg, H. F., J. A. Krosnick, and B. D. Bowen. 1996. *An Introduction to Survey Research, Polling, and Data Analysis*. Sage Publications, Inc.

Wofford-Vicki, L., and others. 1998. “A Field Study of a Cognitive Approach to Understanding Transformational and Transactional Leadership.” *The Leadership Quarterly* 9 (1): 55–84.

Womack 2002. “Lean Thinking: Where Have We Been and Where Are We Going?” *Manufacturing Engineering* 129 (3) (September): L2.

Womack, J. P. 2008. *The Power of Purpose, Process and People*.

Womack, J. P. 2009. “Modern vs. Lean Management Assessment questionnaire." Internal LEI document for company assessments.

Womack, James P. 2010. “Womack Modern vs. Lean Management” August 25. http://www.slideshare.net/cmarchwi/womack-modern-vs-lean-management.

6. Chief Executive Leadership Traits

Chapter 6 is written in manuscript form for submission to the California Management Journal.

6.1. Abstract

The effectiveness and efficiency of the chief executive officer (CEO) is of critical importance to the performance of an organization. To assess the impact of a CEO's leadership traits on hospital performance, this study surveyed leadership traits at high (e.g., top 20th percentile) and low performing (e.g., bottom 20th percentile) U.S. hospitals regarding their quality of care performance in 2010. Additionally, hospitals identified as lean organizations by an expert (Zak 2012) were also included in the study (ranked between the 40th and the 70th percentile). CEO leadership traits between these three types of hospitals were then compared.

Interestingly, this study could not detect any differences in CEO traits based on CEO self-assessment. However, findings from surveying CEO followers indicate that there are significant differences in CEOs' traits who manage lean and low performing hospitals, while the differences between high and low performing hospitals were less pronounced. However, no statistically significant difference of CEOs' traits could be found between lean and high performing hospitals. While these findings are not easy to interpret, they support the growing awareness in the healthcare industry that CEO leadership traits play an important role in U.S. hospital performance.

Keywords: chief executive officer (CEO), leadership traits, quality of care measures, patient safety, hospital performance, lean.

6.2. Introduction and theoretical context

Over the last decades, the U.S. health care delivery system has faced serious challenges. An increasing demand for services due to an aging population, unhealthy lifestyles, and an increase in chronic diseases faces a limited supply of money, physicians, and nurses, among other things (Bohmer and Knoop 2007). The financial dimension of the U.S. health care industry and the U.S. hospital industry in particular receives considerable attention at present. In fact, while financial health care support from federal and state governments is decreasing (Levit et al. 2003; McGlynn et al. 2003), an increasing number of uninsured individuals require treatment (Bohmer and Knoop 2007; Garson 2000). Also cost pressures from numerous stakeholders in the hospital industry persist (Levin-Scherz 2010; Porter 2009; Porter and Teisberg 2006). Most importantly, according to several studies (Porter 2009; Kohn 2000), the quality of care provided by U.S. hospitals is lacking. Kohn et al. (2001) and Bootman (2000) pointed out that between 44,000 to 98,000 U.S. hospital patients die and almost a million patients are injured every year as a result of preventable medical errors. In response to these alarming numbers, the U.S. federal government is undertaking initiatives to improve patient safety and to create a more cost effective health care system (Shortell and Singer 2008; Porter and Teisberg 2006; Singer et al. 2003). In 2001, the Department of Health and Human Services (HHS) and the Centers for Medicare & Medicaid Services (CMS) launched a quality initiative to assure the delivery of quality health care in hospitals through accountability and public disclosure of quality of care measures (CMS 2012).

However, despite all these efforts, "*…The U.S. health care system remains largely the same as it was a decade ago* (Porter 2009, p.1)." Thus, not only were efforts to improve the system unsuccessful, but Porter continues that "*We have seen no convincing approach to changing the unsustainable trajectory of the system, much less to offsetting the rising costs of an aging population and new medical advances* (Porter 2009, p. 1)." These findings are substantiated by the ten year anniversary report labeled "*To Err is Human – To Delay is Deadly. Ten years later, a million lives lost, billions of dollars wasted* (Jewell and McGiffert 2009),"of the original study on the quality of care in the U.S. healthcare system conducted by Kohn in 2000. Indeed, the U.S. health care system lacks when measured on a national scale, but it also compares unfavorably internationally (Nolte and McKee 2008). For example, preventable deaths declined less in the U.S. over the last 5 years than in 18 other industrialized nations (Nolte and McKee 2008).

Given the unsatisfactory state of care at U.S. hospitals, much research has been directed to identifying the drivers that determine quality of care performance outcomes (Boyer et al. 2012; Dye 2000; Kovner et al. 2009; Gray 1997). Among other things, leadership has been proven to be an important driver for hospital quality outcomes (Marley et al. 2004; Flynn et al. 1994). Indeed, the importance of leadership has been recognized and is measured in the Malcolm Baldrige National Quality Award Health Care Criteria (MBNQA, Marley et al. 2004). Also, scientific arguments in support of the importance of hospital leadership and its influence on patient safety exists (Singer and Shortell 2008; Marley et al. 2004; Kohn et al. 2001), but few investigations have addressed the potential diverging influence of specific leadership traits on organizational performance (McGuire and Kennerly 2006; Spinelli 2006; Collins 2001).

Leadership traits are holistically discussed in trait theory, a theory that is based on the idea that leadership is rooted in characteristics that certain people possess (Bass and Bass 2008; Burns 1979; Gardner 1993; Hesselbein and Shrader 2008; Northouse and Northouse 2009; Stogdill and Melvin 1974; Kirkpatrick and Locke 1991). Therefore, early research on leadership was based on a psychological focus, e.g. a focus on people with inherited traits. Emphasis was put on discovering these traits by studying successful leaders. The first well-known and well-researched theory is the 'Great Man' theory (trait theory) that states that leaders are born and that the capacity to lead is inherent (Borgatta et al. 1954). Leaders, according to the 'Great Man' theory, are described to be heroic, male, mythic, and are destined to rise in power when needed. Thus, these traits refer to trends in a person's behavior, explaining the way people behave and are influenced by the strength of each individual's traits. Stogdill and Melvin (1974) identified the following traits and skills as crucial for a successful leader. A successful leader is adaptable to different situations, is assertive, cooperative, ambitious and achievement-oriented, is alert to the social environment, is decisive, dependable, dominant, energetic, persistent, self-confident, tolerant of stress, and is willing to assume responsibility. Also, a successful leader is intelligent (clever), conceptually skilled, diplomatic and tactful, creative, fluent in speaking, organized, persuasive, socially skilled, and knowledgeable about group tasks (Stogdill and Melvin 1974). In another model, McCall and Lombardo (1983) identified four primary traits by which leaders can succeed or fail: Intellectual breadth, e.g., the leader needs to understand a wide range of topics, rather than being narrow-minded or myopic. Emotional stability and composure, e.g., the leader needs to be confident, predictable, and calm, particularly in stress situations. Good interpersonal skills e.g., the leader must be able to communicate and persuade people without using negative or coercive strategies. And, admitting faults, e.g., the leader owes mistakes publicly and is not trying to put effort into hiding them (McCall and Lombardo 1983). While claims to the importance of a leader's traits on performance have been made, this study will try to link hospital CEOs' leadership traits to hospital performance as measured by the quality of care provided (Medicare 2012).

6.3. Hypotheses

In this research, we were interested in investigating the traits of CEOs in high and low performing hospitals as measured by their quality of care outcomes (Medicare 2012). We also investigated potential differences in CEO traits of these two groups of hospitals (e.g., high and low performing) with hospitals that pursue lean management.

Thus, our first hypothesis tested for differences of CEO traits between lean and low performing hospitals in the U.S. We thus define our first null hypothesis to be:

$H5_0$ *There is no difference in CEO traits between lean and low performing U.S. hospitals.*

Following the same argument, we argue that differences between CEO traits of high and low performing hospitals exist. Hence, our second null hypothesis is:

$H6_0$ *There is no difference in CEO traits between high and low performing U.S. hospitals.*

And then, we wanted to test if there are differences between lean and high performing hospitals. To test for this, we let our null hypothesis be:

$H7_0$ *There is no difference in CEO traits between lean and high performing U.S. hospitals.*

6.4. Data and Variables

Most research studies (e.g., Lantz 2008; Burns 2001; Robbins et al. 2001) of leadership traits in healthcare do not consider the impact of such traits on hospital performance. Studies typically describe leadership traits (named also competencies) required for healthcare administration (Robbins et al. 2001), e.g., leadership traits that are necessary to deal with the complex and chaotic healthcare environment (Burns 2001) or studies investigating gender-based differences in leadership traits (Lantz 2008), to name just a few. Also, much case study based research has been conducted comparing leadership traits and hospital performance (Morales and Molero 1995), while few empirical, holistic research studies have investigated the influence of leadership traits on hospital performance (Boyer et al. 2012) based on a census sample.

This study uses a combination of primary and secondary data to compare and evaluate differences of chief executive officers' (CEO) traits among lean, high, and low performing hospitals. For this purpose, we used secondary data to identify high and low performing hospitals and an expert selection to choose lean hospitals (Zak 2012). The primary data for this study was acquired by a 360 degree questionnaire addressed to different hierarchical levels of each hospital's organization (Drever 1995; Foddy and Foddy 1994; Van Dijk 1990). The research construct involving three lean, three high performing, and three low performing hospitals to answer our Hypotheses is shown in Figure 24.

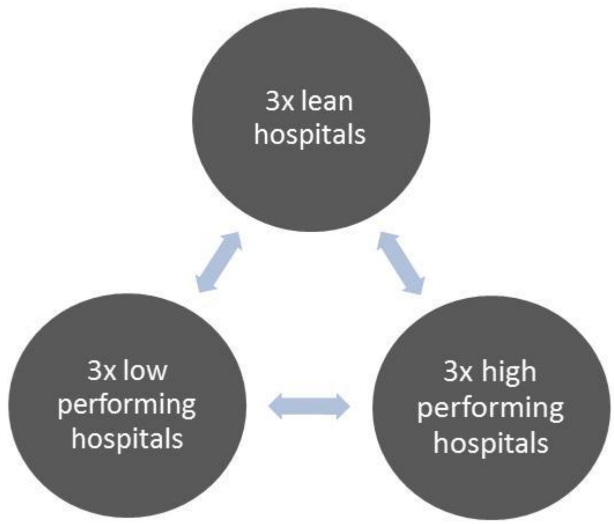

Figure 24: Research construct used.

6.4.1. Secondary data

To classify participating hospitals according to performance, we obtained public data on quality of care measures from the CMS database (2012). This database contains patient records from 4,697 U.S. hospitals (CMS 2012). For this study, we considered all four categories of core measures for serious health conditions that can be related to preventable medical errors including 1) acute myocardial infarction (AMI) rate; 2) heart failure (HF) rate; 3) pneumonia (PN) rate; and 4) surgical care improvement project (SCIP) rate (CMS 2012).

6.4.1.1. Data analysis and statistics

The CMS data (2012) was used to rank all 4,679 hospitals. Individual hospital performance was measured by the quality of care measures from CMS (2012, e.g., AMI, HF, PN, and SCIP) and was calculated by summing numerators consisting of AMI, HF, PN, and SCIP as well as summing the denominators reflecting the number of responses, resulting in the average weighted percentage of patients that received quality care (Boyer et al. 2012; Giordano et al. 2010; McGlynn et al. 2003; Marley et al. 2004). Ranking all 4,697 hospitals in the CMS (2012) database based on this quality of care measure, the top and bottom 20th percent percentile was found. We then matched these top and bottom ranked hospitals with 597 hospitals that responded to an earlier study (Schmitt et al., in review). We found matches for 20 high performing and 25 low performing hospitals, which were retained as the sample for the CEO leadership trait survey conducted in this research.

6.4.2. Primary data

The primary data for this study was collected through an online survey hosted by Virginia Tech (Qualtrics 2011). The survey measured forty-four leadership traits comprised from multiple sources (see 6.2 Introduction and theoretical context). Three types of questions were used: 1) Likert scale questions, 2) open ended questions, and 3) categorical scale questions (Alreck and Settle 1995; Rea et al. 1997; Fowler 1995; Weisberg et al. 1996; Likert 1932).

6.4.2.1. Population and sample of interest

To study leadership traits of chief executive officers (CEOs) and the relationship of these traits with hospital performance, twenty high performing and twenty-five low performing hospitals were selected as our population of interest. In addition, five hospitals that apply lean management principles to their organizations were selected and identified as lean hospitals by Helen Zak, a recognized lean expert (Zak 2012). The sample goal for this study was set to obtain answers from 3 low, 3 high, and 3 lean hospitals (Figure 24) to maintain a robust dataset for statistical analysis and to be able to employ multiple comparison techniques (Siegel 1957).

6.4.2.1.1. Contact and email list

The contact and email list for this study was derived from multiple sources, among them: American Hospital Association (AHA 2011), U.S. Department of Health & Human Services (CMS 2012), State Hospital Associations (AHA 2011), and Institute for Healthcare Improvement (IHI 2010). This contact data was assembled into a master database.

6.4.2.2. Data Collection

6.4.2.2.1. Online Questionnaire

The online questionnaire was setup as a 360 degree survey (Dillman 2007; Anon. 1993). The survey called for a self-assessment of CEOs and for an assessment of CEOs by their followers, thus offering two points of view. Two online questionnaires (Qualtrics 2011), e.g., one for CEOs (Appendix I) and one for CEO followers (senior executives, mid-level managers, and frontline associates, Appendix J), which were identical with the difference being that the questionnaire for the followers contained an additional question identifying their rank in the organization, were developed. However, the questions asked to the CEO were personal and asked how they perceive their own leadership traits, whereas the follower questions, which mirrored the questions asked to the CEO, asked how the followers perceive their CEOs' leadership traits. Then we asked CEOs or hospital managers at selected hospitals for their participation. The study design target was set to receive responses from the hospital CEO, from two senior executives, five mid-level managers, and five frontline associates.

The CEO and follower questionnaire consisted of four main parts. The first part entailed three questions for the CEO and four questions for the follower to give background information about the respondent and the hospital they work for, such as hospital name, respondent's position, and the number of years with the hospital. The second part asked 44 questions regarding the CEOs leadership traits plus one open-ended question inquiring about the three main characteristics of the CEO. The third part asked questions about the organization and was divided into four sub-categories: 1) ten questions about the "big picture" of the hospital; 2) fourteen questions about the "people" in the hospital; 3) nineteen questions about "process and culture" in the hospital; and 4) thirteen questions about "leadership" in the hospital. The third part of the questionnaire wasn't used for the compilation of the results discussed in this manuscript.

The aim of this research was to evaluate the differences in CEO leadership traits among lean, high, and low performing hospitals. The set of 44 factors about CEO leadership traits was adapted from multiple sources dealing with the subject, among them: Fourteen factors were adapted from Jones (2011) presentation at the Lean Transformation summit 2011 in the UK; eight factors were adapted from Collins (2001); fourteen factors from Bass and Avolio (1994), Alban-Metcalfe and Alimo-Metcalfe (2000), Flynn and Saladin (2001), McGuire and Kennerly (2006), and eight factors from the Baldrige-Leadership behavior (Flynn and Saladin 2001; Hutton 2000). When delivering the questionnaires to respondents, all questions were randomized to avoid response bias (Rea and Parker 2005; Alreck and Settle 1995).

6.4.2.2.2. Questionnaire pretest

The CEO and follower 360 degree questionnaires were reviewed by Virginia Tech specialists and feedback was also obtained from Lean Global Network (LGN) affiliates in the Netherlands, South Africa, France, and the UK. Before the start of the survey, a pretest was conducted to verify and statistically validate the questionnaire by checking if factors loaded sufficiently. A sample of eleven hospital associates of two independent hospitals in Virginia was selected to test for clarity, acceptability, timeliness, and comprehensiveness (Rea et al. 1997; Alreck and Settle 1995). Eleven responses were received and analyzed, and minor adjustments were made based on this feedback.

6.4.2.2.3. Mailings, follow-up, and data gathering

In February 2012, the CEOs (or their assistants) selected for this study were contacted by email and/or phone to discuss the research. Discussions included the reason for this study, the selection of employees, and the actual online questionnaire. Phone calls were made to all hospitals selected every Tuesday and Wednesday starting February 9 to April 2, 2012. Reminder emails were sent out every Monday morning over the same time frame to increase overall response rates (Dillman 2007; Rea and Parker 2005). Every Friday, cooperating hospitals received an update on the progress of the survey within their organization. At the closing of the study on April 9, 2012, 56 responses were received (10 CEO and 46 followers, divided into 11 senior executive, 19 middle manager, and 16 frontline associate). Responses from individual hospitals entailed three lean hospitals that were ranked at between the 40th and 70th performance percentile; three high performing hospitals that were ranked in the top 20th

percentile, respectively; and three low performing hospitals that were ranked at the bottom 20th percentile, respectively.

6.4.2.3. Data analysis and statistics

The data obtained was automatically stored, coded, and organized in Qualtrics (2011). After closing the survey, all data was exported to MS Excel 2010. Responses from lean, high, and low performing hospitals were clustered accordingly. The spreadsheet was then uploaded to SAS 9.2 statistical software (SAS 2010) for further analysis.

6.4.3. Covariates

The length of employment is an important measure for such studies, since perceptions about CEO traits vary depending on the length an employee has served for an organization (Schmidt and Hunter 1998). Therefore, we controlled for the number of years (length) a hospital employee has been working in the organization (Khaliq et al. 2006; Alexander et al. 1993). Furthermore, we also controlled for the CEO turnover rate. For hospitals to qualify for this research, their CEOs' tenure had to be longer than 5 years, while responding followers had to have tenure of at least one year.

6.4.4. Methods

All data received was classified into lean, high or low performing hospitals. CEO leadership traits associated with each of these three hospital performance categories were then compared by applying non-parametric statistical hypothesis testing (Siegel 1957; Edwards 1954; Wilcoxon 1945). In particular, results were evaluated using Kruskall-Wallis chi-square exact tests (Theodorsson-Norheim 1986; Breslow 1970; Kruskal and Wallis 1952) and Wilcoxon two-sample tests (Litchfield Jr and Wilcoxon 1949; Wilcoxon 1945). Statistics were adjusted using the Bonferroni correction (Cabin and Mitchell 2000; Edwards 1954) since comparisons included three groups (multiple comparisons). Thus, the nominated α of 0.05 was divided by 3 resulting in an α of 0.01667. We also checked for internal reliability of our dichotomous factors using Cronbach's α (Gliem and Gliem 2003; Bland and Altman 1997). Cronbach's α showed a reliability α greater than 0.7, indicating acceptable internal consistency (Green et al. 1996).

6.4.4.1. Limitations

As with all research, limitations apply to this study. For example, the hospital ranking in this study is based on the quality of care measures (AMI, HF, PN, and SCIP) established by CMS (2012). The quality of care measures do not reflect the entire patient care experience and is limited in scope. Also, the performance measure calculated is vulnerable to the type and number of patients a hospital treats. However, the quality of care measure used in this research has been used in numerous studies (Boyer et al. 2012; Giordano et al. 2010; McGlynn et al. 2003; Marley et al. 2004) and is an accepted yardstick for hospital performance. Furthermore, to account for the influence of small sample size, we excluded all hospitals that reported quality of care based on a sample size of 25 patients or less (HHS 2012).

Another limitation of this study is the small number of hospitals surveyed (three lean, three high, and three low performing hospitals, respectively). Thus, limitations as to the generalization of findings from this study apply. Also, unfortunately, the follower responses are not evenly distributed over all categories of hospitals (32 responses from lean, two responses from high, and 12 responses from low performing hospitals). However, our non-parametric statistical analysis accounted for this shortcoming. Also, limitations to this study exist based on responses being obtained from individuals, which may have induced personal bias into our results. Readers should also be aware that the high and low performing hospitals that participated in this study may employ lean practices. Thus, lean practices were not necessarily unique to our lean category. Hence, findings describe solely differences in CEO traits between these three categories of hospitals rather than describe mutually exclusive management systems used by individual hospitals. Furthermore, this study asked specific questions about CEO traits. It can be argued that followers knowledgeable about their CEOs are more likely to respond to the questions asked than followers that are not. However, the research team accounted for such cases and allowed the respondents to skip questions or to answer them with not applicable (N/A, Rea and Parker 2005; Alreck and Settle 1995). However, none of the responses included questions answered with N/A and only one of the follower questionnaires (46 in total) returned included unanswered questions. Thus, if bias is present, it should be small.

6.5. Results

Results from our non-parametric statistical analysis based on the CEOs' responses revealed no significant differences in traits between CEOs of any of the three categories researched (lean, high, low performing hospitals, p-values ranging from 0.100 to 1.000). However, when comparing only lean and low performing hospitals, one question, e.g., "*CEO asks what we can learn*" turned out to be statistically significantly different between lean and low performing hospital responses without Bonferroni correction ($p = 0.0286$) based on the Wilcoxon two-sample test.

The statistical analysis based on follower responses (N = 46) showed significant differences in CEO traits between lean and low and high and low performing hospitals. However, no statistically significant differences (p-values ranging from 0.0642 to 1.000) could be found between lean and high performing hospitals in respect to CEO traits perceived by followers. Table 11 shows the results of the 46 follower responses to questions adapted from Collins (2001) concerning level 5 leadership traits of CEOs.

Table 11: Level 5 leadership traits (adapted from Collins 2001).

		Kruskall-Wallis Test	Wilcoxon Two-sample Test (Bonferroni corrected 0.05/3 = 0.01667)		
Question Code	**Our CEO ...**	**Chi-Square Exact test**	**Lean vs. Low**	**High vs. Low**	**Lean vs. High**
8	... generates superb results.	0.0098	0.0090	0.2198	0.5490
9	... acts with quiet, calm determination.	<0.0001	<0.0001	0.0440	1.0000
10	... shows professional will and personal humility.	<0.0001	<0.0001	0.2088	1.0000
35	... demonstrates a compelling modesty, shuns public adulation, is humble, and is never	0.0074	0.0033	0.4945	1.0000
36	... gives credit for the organization's success to other people, external factors, and good luck; and takes full responsibility for poor results, never blaming other people, external factors, or bad luck.	0.0746	0.0317	0.9615	0.6613
37	... channels ambition into the hospital, not the self; sets up successors for even greater success in the next generation.	0.0969	0.0315	0.7473	0.6023
38	... demonstrates an unwavering resolve to do whatever must be done to produce the best long-term results, no matter how difficult.	0.0022	0.0029	0.0989	0.5294
39	... sets the standard of building an enduring great hospital; will settle for nothing less.	0.0020	0.0009	0.6703	0.3743

As shown in Table 11, lean and low performing hospitals' CEO traits show significant differences in all 8 leadership trait factors formulated based to Collins's work (2001). However, Kruskall-Wallis chi-square exact tests did not result in significant differences for 2 of the leadership traits (factors 36 and 37). Applying the Wilcoxon two-sample test (not Bonferroni corrected) to factors 36 and 37 between lean and low performing hospitals, however, produced significant results. Comparing high and low performing hospitals resulted in one leadership trait, namely "*Our CEO acts with quiet, calm determination* (question factor 9, Table 11)" to be significantly different (p-value = 0.0440), not accounting for Bonferroni correction. However, no significant differences could be detected between lean and high performing hospitals (p-values ranging from 0.3743 to 1.000, Table 11).

Factors 23 to 30 (8 factors, Table 12), which were adapted from the Baldrige leadership survey (Flynn and Saladin 2001; Hutton 2000), produced significantly different results for seven of the eight factors investigated (not accounting for Bonferroni correction). As before, the differences are most pronounced between lean and low performing hospitals. Detailed results are shown in Table 12.

Table 12: Baldrige leadership behaviors (adapted from Flynn and Saladin 2001; Hutton 2000)

		Kruskall-Wallis Test	Wilcoxon Two-sample Test (Bonferroni corrected 0.05/3 = 0.01667)		
Code	Our CEO ...	Chi-Square Exact test	Lean vs. Low	High vs. Low	Lean vs. High
23	... follows through on words and promises made.	0.0169	0.0320	0.0989	0.4920
24	... shows and sets a personal example of what is expected.	0.0004	0.0004	0.1648	1.0000
25	... sets achievable plans, milestones, and goals.	0.0043	0.0078	0.0989	0.4866
26	... is committed to experiments and takes risks.	0.1078	0.0407	0.7308	1.0000
27	... asks "what can we learn?"	0.0004	0.0004	0.1429	1.0000
28	... actively listens to different points of view.	<0.0001	<0.0001	0.0440	0.7433
29	... treats everyone with respect and dignity.	<0.0001	<0.0001	0.1868	1.0000
30	... makes sure that people grow in their jobs.	0.0268	0.0399	0.0989	0.4367

When comparing lean versus low performing hospitals' CEOs and their traits, all eight CEO traits inquired about (Table 12) are found to be significantly different (α<0.05). However, when corrected with the Bonferroni correction (Cabin and Mitchell 2000; Edwards 1954), we found seven CEO traits to be significantly different. When comparing high and low performing hospitals, statistically significant differences between CEO traits could only be found for "*Our CEO actively listens to different points of view* (factor 28, Table 12)." The comparison between lean and high performing hospital CEOs' traits did not reveal any significant differences (p-values between 0.4367 to 1.000).

Little differences between lean, high, and low performing hospital CEO traits were found when testing those CEO traits along Jones' (2011) research questions inquiring about modern versus process management. Table 13 shows, only 7 of a total of 14 factors showed significant differences between at least two categories (Kruskall-Wallis Chi-Square exact test, α = 0.05).

Table 13: Lean leadership traits (adapted from Jones 2011)

		Kruskall-Wallis Test	Wilcoxon Two-sample Test (Bonferroni corrected 0.05/3 = 0.01667)		
Code	**Our CEO …**	**Chi-Square Exact test**	**Lean vs. Low**	**High vs. Low**	**Lean vs. High**
1	... sets clear directions.	0.0441	0.0363	0.2308	0.5134
2	… enables staff to do their work.	0.1111	0.0933	0.3956	0.5900
3	... develops and mentors staff by asking questions rather than telling them what to do.	0.1318	0.1141	0.3626	0.5134
4	... deploys the right improvements to close performance gaps.	0.0036	0.0056	0.0989	0.3476
5	... is present/visible on a regular basis.	0.1255	0.1451	0.2308	0.5009
6	... thinks from a patient/customer point of view.	0.0014	0.0012	0.2418	1.0000
7	... establishes a learning organization (thinking and doing).	0.0005	0.0004	0.1667	1.0000
32	... follows and applies the scientific method — plan-do-study-adjust (PDSA or PDCA).	0.0008	0.0011	1.0000	0.0713
33	... creates process stability and practices frontline management (where value is created).	0.0512	0.0909	0.0769	0.3428
34	... manages by facts.	0.0141	0.0077	0.2527	1.0000
40	... trains us in responding and solving problems.	0.0417	0.0180	0.4359	1.0000
41	... holds regular stand-up meetings, uses visuals and keeps everyone on track.	0.3080	0.7594	0.1978	0.2228
42	... manages by going to the place where the work is performed and to observe what happens and asks why.	0.1118	0.5771	0.0549	0.1174
44	... focuses on the vital few things and deselects other tasks.	0.1264	0.0354	0.6667	0.9375

Factors 1, 4, 6, 7, 32, 34, 40, and 44 were found to be significantly different between lean and low performing hospital CEO traits (Table 13). No significance was found for factors 2, 3, 5, 33, 41, and 42, however. Also, no significant differences could be detected between hospital CEO traits in high and low performing hospitals or in lean and high performing hospitals (Table 13).

Finally, we also researched differences in CEO traits with questions adapted from Bass and Avolio (1994), Alban-Metcalfe and Alimo-Metcalfe (2000), Flynn and Saladin (2001), McGuire and Kennerly (2006). Table 14 shows that our statistical analysis (Kruskall-Wallis test, α = 0.05) found ten out of 14 factors to have at least one difference between categories (factors 13, 14, 15, 16, 17, 18, 20, 22, 31, and 43). Differences were most common, as was found throughout our observations, between lean and low performing hospitals. However, factor 13, "*Our CEO coaches and advises us,*" was not found to be significantly different between lean and low performing hospitals, but was significantly different between high and low performing hospitals (p-value of 0.0440, Table 14). The same applied to factor 19 "*Our CEO observes and searches for deviations from rules and standards and takes corrective actions,*" which was found to be significantly different between high and low performing hospitals.

Table 14: Additional CEO traits (adapted from McGuire and Kennerly 2006; Flynn and Saladin 2001; Alban-Metcalfe and Alimo-Metcalfe 2000; Bass and Avolio 1994)

		Kruskall-Wallis Test	Wilcoxon Two-sample Test (Bonferroni corrected 0.05/3 = 0.01667)		
Code	**Our CEO ...**	**Chi-Square Exact test**	**Lean vs. Low**	**High vs. Low**	**Lean vs. High**
11	... abdicates responsibility and avoids making decisions.	0.3001	1.0000	0.2821	0.1622
12	... promises rewards for good performance.	0.1791	0.0940	0.2747	0.8681
13	... coaches and advises us.	0.0182	0.0555	0.0440	0.1705
14	... gives personal attention.	0.0037	0.0089	0.0220	0.3087
15	... recognizes and celebrates accomplishments.	<0.0001	<0.0001	0.0110	0.5076
16	... provides us with a vision and a sense of mission.	0.0003	0.0003	0.1667	1.0000
17	... has our respect and trust.	<0.0001	<0.0001	0.0989	1.0000
18	... communicates high expectations.	0.0277	0.0149	0.3956	1.0000
19	... observes and searches for deviations from rules and standards and takes corrective actions.	0.143	0.5563	0.0330	0.1552
20	... expresses important purposes in simple ways.	<0.0001	<0.0001	0.0989	1.0000
21	... intervenes only if standards are not met.	0.1896	0.9483	0.1648	0.0642
22	... promotes intelligence, rationality, and careful problem solving.	0.0001	0.0001	0.0769	0.5490
31	... instills pride.	0.0001	0.0001	0.1758	1.0000
43	... follows up on promised rewards.	0.0145	0.0127	0.0641	0.6702

Four factors were found to be significantly different (α = 0.05) between high and low performing hospitals' CEO traits. In particular, the following four factors were found to be significantly different (Table 14, not accounting for Bonferroni): "*Our CEO coaches and advises us* (p = 0.0440)"; "*Our CEO gives personal attention* (p = 0.0220)"; "*Our CEO recognizes and celebrates accomplishments* (p = 0.0110)"; and "*Our CEO observes and searches for deviations from rules and standards and takes corrective actions* (p = 0.0330)." As was found throughout our survey, no statistically significant differences ($\alpha = 0.05$) were found between lean and high performing hospitals' CEO traits (p-values ranging from 0.0642 to 1.000, Table 14).

This survey compared 44 CEO traits across three categories of hospitals, e.g., lean, high, and low performing hospitals. The Kruskall-Wallis chi-square exact test across the three categories resulted in 30 out of 44 CEO traits to be significantly different ($\alpha = 0.05$). When testing the categories pairwise using the Bonferroni corrected Wilcoxon two-sample tests, 25 statistically different ($\alpha = 0.05$, 0.01667 after Bonferroni correction) factors were found for lean versus low performing, one factor (after Bonferroni correction) for high versus low performing, and none for lean versus high performing hospitals' CEO traits, respectively (Tables 11, 12, 13, 14).

Thus, based on these results, we reject $H5_0$ stating that: "*There is no difference in CEO traits between lean and low performing hospitals in the U.S.*," as we found 25 factors to be significantly different ($\alpha = 0.01667$). We also reject $H6_0$ stating that: "*There is no difference in CEO traits between high and low performing hospitals in the U.S.*," as we found one factor to be significantly different ($\alpha = 0.01667$). However, we accept $H7_0$ stating that: "*There is no difference in CEO traits between lean and high performing hospitals in the U.S.*, as we found no factors to be significantly different ($\alpha = 0.01667$) between these two categories.

6.6. Discussion and Conclusions

Our study tests if there are differences in CEO traits among lean, high, and low performing U.S. hospitals based on our national ranking of hospitals using publicly available quality of care measures. Our study was conducted in a U.S. context based on information we gathered with a 360 degree survey that entailed CEO and follower responses (two senior executives, five mid-level managers, and five frontline associates) from each participating hospital. We also used data from a secondary source, in particular the Centers for Medicare and Medicaid Services (CMS) database presenting 2010 quality of care data (Medicare 2012). We found that CEO traits differ considerably between lean and low performing hospitals and, to a lesser degree, between high and low performing hospitals, but we found no differences in CEO traits between lean and high performing hospitals. Below, we review the hypotheses presented ($H5_0$, $H6_0$, and $H7_0$) and discuss the results reported under a performance achievement perspective for hospitals using the quality of care measurements used in this study. We also provide some general thoughts and state opportunities for further research.

First, we discuss the results from the CEO self-assessment that showed only one leadership trait to be significantly different between lean and low performing hospitals, namely that the "*CEO asks what we can learn* (p-value of 0.0286)." One can speculate that CEOs of lean hospitals are more reflective and involved in continuous learning than are CEOs of low performing hospitals (Liker and Convis 2011; Miller 2011; Weber 2006). However, following this line of thought, we would have expected to find more pronounced differences in CEO traits as reported by the CEOs among lean, high, and low performing hospitals. Thus, the question remains if CEOs among all three categories of the hospitals researched indeed have similar traits or have only small, undetectable differences or if the CEOs' self-awareness does not reflect reality.

Also, observing the difference between the outcomes of the CEOs self-assessment and the follower assessment is interesting as these two assessments differ remarkably. For example, when comparing lean versus low performing hospitals, CEO responses show only one trait to be significantly different, whereas their followers perceive CEO traits to be significantly different in 33 factors (Tables 11 to 14, not considering Bonferroni). Thus, this might indicate that followers of low performing hospitals perceive their CEOs significantly different than these CEOs perceive their own leadership traits. However, this observation does not hold when comparing CEO traits between lean and high performing hospitals, as a mean comparison of responses between CEOs and followers revealed. Given these observations, we speculate that the discrepancy between CEO self-awareness and follower perception of traits is part of the dilemma of lower hospital performance (Schyns et al. 2008; Kirkpatrick and Locke 1991).

When inquiring about $H5_0$ ("*There is no difference in CEO traits between lean and low performing hospitals in the U.S*") comparing lean hospitals (ranked between the 40^{th} and 70^{th} percentile of our national quality of care ranking) to low performing hospitals (ranked in the bottom 20^{th} percentile), the results show that 33 out of 44 CEO traits researched were perceived as significantly different by followers. The traits that distinguish CEOs of lean hospitals to CEOs of low performing hospitals included all 8 factors listed by Collins (2001) describing "great" leaders (Table 11). In particular, CEOs of lean hospitals score higher on generating superb results; acting with quiet, calm determination; professional will and personal humility; demonstrating a compelling modesty, shuns public adulation, humbleness, and never boasts; gives credit for the organization's success to other people, external factors, and good luck, and takes full responsibility for poor results, never blaming other people, external factors, or bad luck; channels ambitions into the hospital, not the self, sets up successors for even greater success in the next generation; demonstrates an unwavering resolve to do whatever must be done to produce the best long-term results, no matter how difficult; and sets the standards for building an enduring great hospital and will settle for nothing less. Our results show that “level 5 leadership traits (Collins 2001)” are more present in lean hospitals than they are in low performing hospitals.

Differences in traits between CEOs of lean hospitals compared to CEOs of low performing hospitals also included all 8 factors that we adapted from the Baldrige criteria shown in Table 12 (Flynn and Saladin 2001; Hutton 2000). In particular, these 8 CEO traits are: follows through on words and promises made; shows and sets a personal example of what is expected; sets achievable plans, milestones, and goals; is committed to experiments and takes risks; asks ”what can we learn?;” actively listens to different points of view; treats everyone with respect and dignity; and makes sure that people grow in their jobs. Our findings are in-line with findings from Meyer and Collier (2001) who found that the components inquired about for the Baldrige criteria, are significantly linked with organizational performance results.

Furthermore, we found that 8 out of 14 lean leadership traits that we adapted from Jones (2011) are significantly different between lean and low performing hospitals (Table 13). Those CEO traits are: sets clear directions; deploys the right improvements to close performance gaps; thinks from a patient/customer point of view; establishes a learning organization (thinking and doing); follows and applies the scientific method – plan-do-study-adjust (PDSA or PDCA); manages by facts; trains followers in responding to and solving problems; and focuses on the vital few things. We speculate that differences between lean and low performing hospitals are less pronounced in this category than in the ones discussed previously are possibly due to the difficulties in determining to what extent an organization has adapted or believes to have adapted lean principles.

The factors concerning Leadership traits in the questionnaire that we adapted from multiple sources (McGuire and Kennerly 2006; Flynn and Saladin 2001; Alban-Metcalfe and Alimo-Metcalfe 2000; Bass and Avolio 1994) showed that 9 out of 14 CEO traits differ among lean and low performing hospitals (Table 14). These 9 CEO traits that were found to be statistically significantly different between lean and low performing hospitals are the CEOs: give personal attention; recognize and celebrate accomplishments; provide a vision and a sense of mission; have followers' respect and trust; communicate high expectations; expresses important purposes in simple ways; promote intelligence, rationality, and careful problem solving; instill pride; and follow-up on promised rewards.

To answer hypotheses two ($H6_0$, "*There is no difference in CEO traits between high and low performing U.S. hospitals*") we looked at the comparison between high performing hospitals (ranked in the top 20th percentile of our national quality of care ranking) and low performing hospitals (ranked in the bottom 20th percentile). The results (Tables 11 to 14) showed that 6 out of 44 CEO traits were found to be significantly different between high and low performing hospitals. The traits that distinguish CEOs of high performing hospitals to CEOs of low performing hospitals includes one factor of the "Level 5 leadership traits" we adapted from Collins (2001, e.g. "*acts with quiet, calm determination* (Table 11, factor 9)." However, besides this one factor, our findings do not reflect Collins' claim that high performing organizations, or as he calls them "great companies," have a CEO that embodies level 5 leadership traits (Collins 2001). According to the results from the Baldrige leadership behaviors that we tested (Table 12), the one CEO trait that is significantly different between high and low performing hospitals is that CEOs actively listens to different points of views (factor 28). In the category of lean leadership traits (Jones 2011) comparing high and low performing hospitals (Table 13), our study found no significant differences, but we found 4 out of 14 CEO traits in the CEO traits group we tested to be statistically significantly different (Table 14). These 4 CEO traits are: "*coaches and advices us*;" "*gives personal attention*;" "*recognizes and celebrates accomplishments*;" and "*observes and searches for deviations from rules and standards and takes corrective actions*."

Thus, interestingly, we only found statistically significant differences (α = 0.05) in 13.6 percent (6 of 44) of all CEO traits between high and low performing hospitals. While we were able to reject our null hypothesis and conclude that there is a difference in CEOs' traits between high and low performing hospitals in the U.S., the results were not as pronounced as one might wish to be able to offer simple advice as to what makes the difference between high and low performing hospitals. However, as discussed under "Limitations" the reader needs to be reminded that our observations are based on only two follower responses from high performing hospitals (which are sufficient to draw statistical conclusions, but do not provide much power to our statistical analysis). Thus, additional efforts need to be made to further investigate this particular area of our research.

To test hypotheses $H7_0$, we compared lean hospitals (ranked between 40th and 70th percentile of our national quality of care ranking) with high performing hospitals (ranked in the top 20th percentile). The results (Tables 11 to 14) showed that none of the 44 CEO traits were significantly different between lean and high performing hospitals. Thus, with the limitation of the low response rate for high performing hospitals in mind, it can be concluded that CEOs' traits between lean and high performing hospitals do not differ and we accept $H7_0$. CEOs' traits therefore do not explain, partially or fully, the performance gaps between lean and high performing hospitals. Support for this observation can be found in multiple studies that show that leadership is not the only factor in improving hospital performance (Schmitt et al. in review, Marley et al. 2004; Flynn et al. 1994).

When testing for our additional CEO traits adapted from McGuire and Kennerly 2006; Flynn and Saladin 2001; Alban-Metcalfe and Alimo-Metcalfe 2000; Bass and Avolio 1994, we found it interesting that two factors (factor 13, "*… coaches and advises us*," and factor 19, "*… observes and searches for deviations from rules and standards and takes corrective actions*," Table 14) were found to be significantly different between high and low performing hospitals but not between lean and low nor between lean and high performing hospitals. While we cannot present a simple explanation for this observation, we can speculate that these observations can help explain the performance differences between all three categories of hospital performance tested.

In summary, this study adds to our understanding of chief executive officer (CEO) traits and hospital performance outcomes. However, given the limitations and results of this study, we suggest that further research should be conducted to validate our findings using a larger sample of U.S. hospitals. Furthermore, basic research should be carried out to describe the current state of lean for hospitals to be better able to describe differences in practices between high and low performing hospitals and lean hospitals.

6.7. References

ACHE. 2012. "Hospital CEO Turnover Rate Holds Steady." http://www.ache.org/Pubs/Releases/2012/hospital-ceo-turnover-rate.cfm.

AHA. 2011. *AHA Hospital Statistics 2010*.

Alban-Metcalfe, Robert J., and Beverly Alimo-Metcalfe. 2000. "The Transformational Leadership Questionnaire (): a Convergent and Discriminant Validation Study." *Leadership & Organization Development Journal* 21 (6) (January 9): 280–296. doi:10.1108/01437730010343077.

Alexander, J. A., M. L. Fennell, and M. T. Halpern. 1993. "Leadership Instability in Hospitals: The Influence of board-CEO Relations and Organizational Growth and Decline." *Administrative Science Quarterly*: 74–99.

Alreck, P. L., and R. B. Settle. 1995. *The Survey Research Handbook*. Irwin Chicago.

Anon. 1993. "The General Electric (GE) Leadership Effectiveness Survey (LES)." http://www.e-coach.narod.ru/business_guide/crosscuttings/tests_leadership_ef_byge.html.

Bass, B. M., and B. J. Avolio. 1994. *Improving Organizational Effectiveness Through Transformational Leadership*. Sage Publications, Inc.

Bass, Bernard M., and Ruth Bass. 2008. *The Bass Handbook of Leadership: Theory, Research, and Managerial Applications*. Simon and Schuster.

Bland, J. M., and D. G. Altman. 1997. "Cronbach's Alpha." *BMJ: British Medical Journal* 314 (7080): 572.

Bohmer, R., and C. I. Knoop. 2007. "The Challenge Facing the US Healthcare Delivery System." *HBS Case*: 9–606.

Bootman, J. Lyle. 2000. "To Err Is Human." *Arch Intern Med* 160 (21) (November 27): 3189. doi:10.1001/archinte.160.21.3189.

Borgatta, E. F., R. F. Bales, and A. S. Couch. 1954. "Some Findings Relevant to the Great Man Theory of Leadership." *American Sociological Review*: 755–759.

Boyer, K.K., J. Gardner, and S. Schweikhart. 2012. "Process Quality Improvement: An Examination of General vs. Outcome-specific Climate and Practices in Hospitals." *Journal of Operations Management*.

Breslow, N. 1970. “A Generalized Kruskal-Wallis Test for Comparing K Samples Subject to Unequal Patterns of Censorship.” *Biometrika* 57 (3): 579–594.

Burns, J. P. 2001. “Complexity Science and Leadership in Healthcare.” *Journal of Nursing Administration* 31 (10): 474.

Burns, James MacGregor. 1979. *Leadership*. Harper & Row.

Cabin, R. J., and R. J. Mitchell. 2000. “To Bonferroni or Not to Bonferroni: When and How Are the Questions.” *Bulletin of the Ecological Society of America* 81 (3): 246–248.

CMS. 2012. “Quality Initiative.” http://www.cms.hhs.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/QualityInitiativesGenInfo/index.html?redirect=/QualityInitiativesGenInfo/.

Collins, J. C. 2001. *Good to Great: Why Some Companies Make the Leap–and Others Don’t*. Harper Business.

Van Dijk, J. A.G.M. 1990. “Delphi Questionnaires Versus Individual and Group Interviews: A Comparison Case.” *Technological Forecasting and Social Change* 37 (3): 293–304.

Dillman, D. A. 2007. *Mail and Internet Surveys: The Tailored Design Method*. John Wiley & Sons Inc.

Drever, E. 1995. *Using Semi-structured Interviews in Small-scale Research: a Teacher’s Guide*. 129. Scottish Council for Research in Education.

Dye, C. F. 2000. *Leadership in Healthcare: Values at the Top*. Health Administration Press.

Edwards, A. L. 1954. “Statistical Methods for the Behavioral Sciences.”

Flynn, B. B., and B. Saladin. 2001. “Further Evidence on the Validity of the Theoretical Models Underlying the Baldrige Criteria.” *Journal of Operations Management* 19 (6): 617–652.

Flynn, B.B., R.G. Schroeder, and S. Sakakibara. 1994. “A Framework for Quality Management Research and an Associated Measurement Instrument.” *Journal of Operations Management* 11 (4): 339–366.

Foddy, W., and W. H. Foddy. 1994. *Constructing Questions for Interviews and Questionnaires: Theory and Practice in Social Research*. Cambridge Univ Pr.

Fowler, F. J. 1995. *Improving Survey Questions: Design and Evaluation*. Sage Publications, Inc.

Gardner, J. W. 1993. *On Leadership*. Free Pr.

Garson, Arthur. 2000. "The US Healthcare System 2010: Problems, Principles, and Potential Solutions." *Circulation* 101 (16) (April 25): 2015–2016. doi:10.1161/01.CIR.101.16.2015.

Giordano, L.A., M.N. Elliott, E. Goldstein, W.G. Lehrman, and P.A. Spencer. 2010. "Development, Implementation, and Public Reporting of the HCAHPS Survey." *Medical Care Research and Review* 67 (1): 27–37.

Gliem, J.A., and R.R. Gliem. 2003. "Calculating, Interpreting, and Reporting Cronbach's Alpha Reliability Coefficient for Likert-type Scales." In *Midwest Research to Practice Conference in Adult, Continuing, and Community Education*. Vol. 88.

Gray, J. A.M. 1997. *Evidence-based Healthcare: How to Make Health Policy and Management Decisions*. Churchill Livingstone New York.

Green, S. B., N. J. Salkind, and T. M. Jones. 1996. *Using SPSS for Windows; Analyzing and Understanding Data*. Prentice Hall PTR.

Hesselbein, F., and A. Shrader. 2008. *Leader to Leader 2: Enduring Insights on Leadership from the Leader to Leader Institute's Award Winning Journal*. Jossey-Bass.

HHS. 2012. "Hospital Compare." http://www.hospitalcompare.hhs.gov/staticpages/help/hospital-how-to.aspx.

Hutton, D. W. 2000. *From Baldrige to the Bottom Line: A Road Map for Organizational Change and Improvement*. American Society for Qualit.

IHI (Institute for Healthcare Improvement). 2010. *IHI Internal Hospital Statistics database 2011*

Jewell, K., and L. McGiffert. 2009. "To Err Is Human—to Delay Is Deadly." *Austin, TX, Consumers Union*.

Jones, D. T. 2011. "Lean leadership characteristics." *London, UK, Lean Transformation Summit*

Khaliq, A. A., S. L. Walston, and D. M. Thompson. 2006. "The Impact of Hospital CEO Turnover in US Hospitals: Final Report." *Chicago: American College of Healthcare Executives*.

Kirkpatrick, S. A., and E. A. Locke. 1991. "Leadership: Do Traits Matter?" *The Executive* 5 (2): 48–60.

Kohn, Linda T. 2000. "To Err Is Human : Building a Safer Health System."

Kohn, L.T., J.M. Corrigan, and M.S. Donaldson. 2001. "Crossing the Quality Chasm: a New Health System for the 21st Century." *Washington, DC: Committee on Quality of Health Care in America, Institute of Medicine*.

Kovner, A. R., D. J. Fine, R. D'Aquila, and Association of University Programs in Health Administration. 2009. *Evidence-based Management in Healthcare*. Health Administration Press.

Kruskal, W. H., and W. A. Wallis. 1952. "Use of Ranks in One-criterion Variance Analysis." *Journal of the American Statistical Association*: 583–621.

Lantz, P. 2008. "Gender and Leadership in Healthcare Administration: 21st Century Progress and Challenges." *Journal of Healthcare Management* 53 (5): 291–301.

Levin-Scherz, J. 2010. "What Drives High Health Care Costs—and How to Fight Back." *Pediatrics* 8: 4.

Levit, K., C. Smith, C. Cowan, H. Lazenby, A. Sensenig, and A. Catlin. 2003. "Trends in US Health Care Spending, 2001." *Health Affairs* 22 (1): 154–164.

Liker, Jeffrey, and Gary L. Convis. 2011. *The Toyota Way to Lean Leadership: Achieving and Sustaining Excellence Through Leadership Development*. 1st ed. McGraw-Hill.

Likert, R. 1932. "A Technique for the Measurement of Attitudes."

Litchfield Jr, J. T., and F. Wilcoxon. 1949. "A Simplified Method of Evaluating Dose-effect Experiments." *Journal of Pharmacology and Experimental Therapeutics* 96 (2): 99–113.

Marley, Kathryn A., David A. Collier, and Susan Meyer Goldstein. 2004. "The Role of Clinical and Process Quality in Achieving Patient Satisfaction in Hospitals." *Decision Sciences* 35 (3) (August 1): 349–369. doi:10.1111/j.0011-7315.2004.02570.x.

McCall, M. W., and M. M. Lombardo. 1983. "Off the Track: Why and How Successful Executives Get Derailed." *Statistics*.

McGlynn, E. A., S. M. Asch, J. Adams, J. Keesey, J. Hicks, A. DeCristofaro, and E.A. Kerr. 2003. "The Quality of Health Care Delivered to Adults in the United States." *New England Journal of Medicine* 348 (26): 2635–2645.

McGuire, E., and S.M. Kennerly. 2006. "Nurse Managers as Transformational and Transactional Leaders." *Nursing Economics* 24 (4): 179.

Medicare. 2012. "Medicare.gov - Download Database." http://www.medicare.gov/Download/DownloadDB.asp.

Meyer, Susan M., and David A. Collier. 2001. “An Empirical Test of the Causal Relationships in the Baldrige Health Care Pilot Criteria.” *Journal of Operations Management* 19 (4) (July): 403–426. doi:10.1016/S0272-6963(01)00053-5.

Miller, Lawrence M. 2011. *Lean Culture - The Leader’s Guide*. L. M. Miller Consulting.

Morales, J., and F. Molero. 1995. “Leadership in Two Types of Healthcare Organization.” *Work and Organizational Psychology: European Contributions of the Nineties*: 209–221.

Nolte, Ellen, and C. Martin McKee. 2008. “Measuring The Health Of Nations: Updating An Earlier Analysis.” *Health Affairs* 27 (1) (January 1): 58–71. doi:10.1377/hlthaff.27.1.58.

Northouse, P. G. G., and P. G. Northouse. 2009. *Leadership: Theory and Practice*. Sage Publications, Inc.

Porter, M.E. 2009. “A Strategy for Health Care Reform—toward a Value-based System.” *New England Journal of Medicine* 361 (2): 109–112.

Porter, M.E., and E.O. Teisberg. 2006. *Redefining Health Care: Creating Value-based Competition on Results*. Harvard Business Press.

Qualtrics. 2011. “Qualtrics Virginia Tech - Google Search.” https://www.google.com/#hl=en&output=search&sclient=psy-ab&q=qualtrics+virginia+tech

Rea, L. M., R. A. Parker, and R. Allen. 1997. *Designing and Conducting Survey Research: A Comprehensive Guide*. Jossey-Bass Publishers San Francisco, CA.

Rea, Louis, and Richard A. Parker. 2005. *Designing and Conducting Survey Research : a Comprehensive Guide*. 3rd ed. San Francisco: Jossey-Bass.

Robbins, C. J., E. H. Bradley, M. Spicer, and others. 2001. “Developing Leadership in Healthcare Administration: a Competency Assessment Tool.” *Journal of Healthcare Management* 46: 188–202.

SAS. 2010. “Products & Solutions | SAS.” http://www.sas.com/software/.

Schmidt, F. L., and J. E. Hunter. 1998. “The Validity and Utility of Selection Methods in Personnel Psychology: Practical and Theoretical Implications of 85 Years of Research Findings.” *Psychological Bulletin; Psychological Bulletin* 124 (2): 262.

Schmitt and others in review. “Management Systems and Hospital Performance”.

Schyns, B., B. Kroon, and G. Moors. 2008. “Follower Characteristics and the Perception of Leader-member Exchange.” *Journal of Managerial Psychology* 23 (7): 772–788.

Shortell, S.M., and S.J. Singer. 2008. “Improving Patient Safety by Taking Systems Seriously.” *JAMA: The Journal of the American Medical Association* 299 (4): 445–447.

Siegel, S. 1957. “Nonparametric Statistics.” *The American Statistician* 11 (3): 13–19.

Singer, S. J., D. M. Gaba, J. J. Geppert, A. D. Sinaiko, S. K. Howard, and K. C. Park. 2003. “The Culture of Safety: Results of an Organization-wide Survey in 15 California Hospitals.” *Quality and Safety in Health Care* 12 (2): 112–118.

Singer, Sara J., and Stephen M. Shortell. 2008. “Improving Patient Safety by Taking Systems Seriously.” *JAMA : the Journal of the American Medical Association* 299 (4) (January 30): 445–447. doi:10.1001/jama.299.4.445.

Spinelli, R.J. 2006. “The Applicability of Bass’s Model of Transformational, Transactional, and Laissez-faire Leadership in the Hospital Administrative Environment.” *Hospital Topics* 84 (2): 11–19.

Stogdill, R. M., and R. Melvin. 1974. “Handbook of Leadership: A Survey of Theory and Research.”

Theodorsson-Norheim, E. 1986. “Kruskal-Wallis Test: BASIC Computer Program to Perform Nonparametric One-way Analysis of Variance and Multiple Comparisons on Ranks of Several Independent Samples.” *Computer Methods and Programs in Biomedicine* 23 (1): 57–62.

Weber, D. 2006. “Toyota-style Management Drives Virginia Mason.” *Physician Executive* 32 (1): 12.

Weisberg, H. F., J. A. Krosnick, and B. D. Bowen. 1996. *An Introduction to Survey Research, Polling, and Data Analysis*. Sage Publications, Inc.

Wilcoxon, F. 1945. “Individual Comparisons by Ranking Methods.” *Biometrics Bulletin* 1 (6): 80–83.

Zak, H. 2012. "Lean hospital selection for research." *phone interview Cambridge, MA*

7. Differences in Management Systems

Chapter 7 is written in manuscript form for submission to the Academy of Management Science Journal.

7.1. Abstract

Management systems are of crucial importance to any organization because of management systems' critical link to organizational performance. Thus, this research investigated differences in management system factors used between lean, high (top 20th percentile), and low performing (bottom 20th percentile) U.S. hospitals based on a national ranking of quality of care measures from 2010. The lean hospitals investigated in this research were selected by an expert. The high and low performing hospitals were derived from the national hospital ranking based on quality of care performance. Hence, this paper explores management system factors that differ between lean, high, and low performing hospitals. Findings suggest that four factors differed significantly between lean and low performing hospitals, but no evidence was found that there are differences between lean and high performing hospitals and high and low performing hospitals. Nonetheless, the evidence from this research supports the notion that management systems play an important role in transforming healthcare to achieve better hospital performance.

Keywords: management systems, quality of care measure, hospital performance, lean management, modern management, process management.

7.2. Introduction and theoretical context

During the last decades, the U.S. health care delivery system has faced serious challenges. Increasing demand for services due to an aging population, unhealthy lifestyles, growing numbers of patients with chronic diseases, and increasing numbers of uninsured individuals face a limited supply of money, physicians, and nurses, among other things (Bohmer and Knoop 2007). The financial situation of the U.S. health care industry receives considerable attention at present, particularly as the financial support for health care support from federal, state, and local governments is declining (Levit et al. 2003; McGlynn et al. 2003) and cost pressures from stakeholders in the health care industry persist (Levin-Scherz 2010; Porter 2009; Porter and Teisberg 2006). Maybe most importantly, according to several studies (Jewell and McGiffert 2009; Porter 2009; Leape and Berwick 2005; Kohn 2000), the quality of care provided by U.S. hospitals is lacking. Kohn et al. (2001) and Bootman (2000) pointed out that between 44,000 to 98,000 U.S. hospital patients die and almost a million patients are injured every year as a result of preventable medical errors. In response to these disappointing numbers, the U.S. federal government is undertaking initiatives to improve patient safety and to make healthcare more cost-effective (Shortell and Singer 2008; Porter and Teisberg 2006; Singer et al. 2003). Given the quality of care challenges of U.S. hospitals (Jewell and McGiffert 2009; Porter 2009; Leape and Berwick 2005; Kohn et al. 2001; Bootman 2000), the Department of Health and Human Services (HHS) and the Centers for Medicare and Medicaid Services (CMS), in 2001, launched a quality initiative requiring all hospitals to publicly disclose their quality of care measures (CMS 2012). Unfortunately, despite all these efforts, the U.S. healthcare system has not shown much progress in improving quality of care since 2000 (Jewell and McGiffert 2009; Leape and Berwick 2005). As Porter in 2009 stated: "*…The U.S. health care system remains largely the same as it was a decade ago. We have seen no convincing approach to changing the unsustainable trajectory of the system, much less to offsetting the rising costs of an aging population and new medical advances* (Porter 2009, p. 1)." These findings are substantiated by the ten year anniversary report of a study originally conducted by Kohn et al. in 2001, which is labeled "*To Err is Human – To Delay is Deadly. Ten years later, a million lives lost, billions of dollars wasted* (Jewell and McGiffert 2009)." The inferior quality of the U.S. health care system's outcomes is also detectable when using international comparisons, where, for example, Nolte and McKee (2008) reported that preventable deaths declined less over the last 5 years in the U.S. than in 18 other industrialized nations.

Given the unsatisfactory state of care at U.S. hospitals, much research has been directed towards identifying the drivers that determine quality of care performance outcomes (Boyer et al. 2012; Dye 2000; Kovner et al. 2009; Gray 1997). Among other things, leadership traits have been proven to be important determinants of quality of care outcomes (Marley et al. 2004; Flynn et al. 1994), as have management systems (Boyer et al. 2012; Boyer and Pronovost 2010; Meyer and Collier 2001). Indeed, scientific arguments in support of the importance of management systems and their influence on patient safety exists (Boyer and Pronovost 2010; Marley et al. 2004; Schmitt et al. in review), but few investigations have addressed the potential diverging influence of specific management system factors on hospital performance (e.g., quality of care outcomes, Institute for Healthcare Improvement 2012; Kovner et al. 2009). However, existing publications dealing with the use of management systems in the U.S. hospital industry, describe mostly case studies on individual hospitals (Aherne and Whelton 2010; Kenney 2010), yet exceptions exist (Boyer et al. 2012; Boyer and Pronovost 2010).

Quality of care (i.e., performance) of hospitals depends, among other factors, on the appropriateness and quality of the management system employed. In particular, the performance of hospitals may depend on whether the management system employed is modeled more according to modern management or process management theories (Womack 2010). Process management, also referred to as lean management (Womack 2010), has proven to be effective in transforming organizations across a variety of industries towards improved performance outcomes (Emiliani 2006; Womack and Jones 2005; Womack and Jones 2004; Allway and Corbett 2002). Womack et al. (1991) showed that auto assembly plants applying process management (e.g., lean management) principles required less human effort, half the manufacturing space, less than half the inventory, and less defects while producing a greater and ever growing variety of products and services. Based on these findings, the authors (Womack et al. 1991) conclude that lean is a management philosophy focused on maximizing customer value while minimizing waste, a claim that has been supported by numerous other authors (Womack 2010; Lander and Liker 2007; Emiliani 2005; Liker 2004; Womack et al. 1991). Opposed to process (lean) management, modern management is described by Womack (2010) as being based on management principles taught by the Alfred Sloan school of management (Womack 2010). These modern management principles are described as having a strong focus on vertical functions and departments, clear and focused managerial authorities, as well as a strong top down decision management styles (Ford 2009; Womack and Jones 2004). Managers in modern management systems are perceived as generalists that were formally and externally educated and developed (Womack 2010); individuals that make decisions far from the place where products and services are created (Shimokawa et al. 2009; Womack and Jones 2004; Emiliani 2006); and professionals that jump to solutions without having determined the root cause of problems to move faster (Womack et al. 1991).

Positive results from applying lean principles in organizations have been reported across industries, including service organizations (Hanna 2007; Ahlstrom 2004; Swank 2003), the aerospace industry (Murman 2002; Slack 1999), the public sector (Hines et al. 2008; Radnor and Walley 2008; Bhatia and Drew 2006), and hospitals (Institute for Healthcare Improvement 2012; Jones 2006). An exemplary success story in the U.S. hospital industry is Virginia Mason Medical Center, a 340 bed hospital with 400 physicians and more than 5,000 employees, located in Seattle, WA. Since 2002, the Virginia Mason Medical Center aims for zero defects while continuously improving their processes using lean principles (Institute for Healthcare Improvement 2012; Kenney 2010). Virginia Mason, by pursuing lean principles, achieved an increase in patient capacity while saving capital expenses for planned expansions. The number of full-time equivalents (FTEs, a measure that indicates the workload measured in full-time employees) to cope with the hospitals workload was decreased despite a no-layoff policy. Improving and redesigning processes to eliminate waste through conducting more than 175 rapid process improvement weeks at Virginia Mason resulted in less rework, less inventory, better quality, higher patient satisfaction, improved productivity, and cost savings of more than 10 million dollar (Institute for Healthcare Improvement 2012; Kenney 2010; Nelson-Peterson and Leppa 2007).

In any case, multiple studies have found that management systems are important drivers for hospital quality of care outcomes (Marley et al. 2004; Flynn et al. 1994). This study's goal was to gain additional insights into key factors pertaining to managements systems in respect to the quality of care performance in U.S. hospitals.

7.3. Hypotheses

The objective of this study was to determine if there is a difference in hospital performance as measured by quality of care measures (HHS 2012) based on the management system that a given hospital employs. In particular, this research was investigating if performance differences exist between U.S. hospitals employing different sets of factors pertaining to either process or modern management systems. We selected three groups of hospitals from all 4,697 U.S. hospitals for which publicly available quality of care measures (HHS 2012) are available: high performing hospitals (top 20 percentile), low performing hospitals (bottom 20 percentile), and a set of hospitals identified as lean hospitals by an expert (Zak 2012).

Thus, our first hypothesis tested among lean and low performing hospitals for factors pertaining to process and modern management systems. In particular, $H8_0$ stated:

$H8_0$ There are no differences in management system factors employed between lean and low performing U.S. hospitals.

Following the same argument, we argue that differences between management system factors of high and low performing hospitals exist. Hence, our second null hypothesis ($H9_0$) tested in this manuscript is:

H9$_0$ There are no differences in management system factors employed between high and low performing U.S. hospitals.

And third, we wanted to test if there are differences in the use of management system factors between lean and high performing hospitals. To test for this, we let our null hypothesis (H10$_0$) be:

H10$_0$ There are no differences in management system factors employed between high and lean performing U.S. hospitals.

7.4. Empirical studies

The use of management systems in U.S. hospitals is mostly described in case study form (Aherne and Whelton 2010; Kenney 2010; Weber 2006; Leatherman et al. 2003) and thus, does not consider the entire population of the U.S. hospital industry. Such case studies describe lean management applied at individual hospitals (Aherne and Whelton 2010), how lean management (process management) drives a hospital to better quality of care performance (Kenney 2010; Weber 2006), or describes the influence of quality management factors on financial performance outcomes (Leatherman et al. 2003), to name just a few. Kovner et al. (2009) conducted research comparing management systems and hospital performance as measured by financial success, while other researchers have analyzed the impact of management systems on hospital performance (e.g., quality of care) using primary and secondary data (Boyer et al. 2012; Marley et al. 2004; Meyer and Collier 2001).

Similarly to work by Boyer et al. (2012), Marley et al. (2004), and Meyer and Collier (2001), this study relies on a combination of primary and secondary data to evaluate differences in hospital performance based on management system factors employed among lean, high, and low performing hospitals. For this purpose, secondary data was used to identify high and low performing hospitals (based on quality of care measures, HHS 2012), while a lean expert selected the lean hospitals (Zak 2012). The primary data for this study was acquired by a 360 degree questionnaire addressed to different hierarchical levels of a hospital's organization (Drever 1995; Foddy and Foddy 1994; Van Dijk 1990).

7.4.1. Secondary data

Secondary data, known as quality of care measures (HHS 2012) based on reported patient records of 4,697 U.S. hospitals (CMS 2012) were used for the performance classification of all participating hospitals. In particular, for the classification, we considered all four categories of core measures for serious health conditions that can be related to preventable medical errors, including: acute myocardial infarction (AMI) rate; heart failure (HF) rate; pneumonia (PN) rate; and surgical care improvement project (SCIP) rate (CMS 2012). Using this data, we calculated hospital performance as the product of summing numerators consisting of AMI, HF, PN, and SCIP and summing denominators consisting of the number of responses and ranked hospitals according to the resulting product (Boyer et al. 2012; Giordano et al. 2010; McGlynn et al. 2003; Marley et al. 2004). Ranking all 4,697 hospitals present in the CMS (2012) database, allowed us to identify the top and bottom 20th percentile, of which 20 high performing and 25 low performing hospitals were selected based on their participation in an earlier study (Schmitt et al. in review).

7.4.2. Primary data

Primary data was collected through an online survey hosted by Virginia Tech (Qualtrics 2011). Three types of questions were used: 1) Likert scale questions, 2) open ended questions, and 3) categorical scale questions (Alreck and Settle 1995; Rea et al. 1997; Fowler 1995; Weisberg et al. 1996; Likert 1932). Besides background data, the survey measured 13 management system factors to determine which type of management system or combination of types of management systems a given U.S. hospital does use. These questions were adapted from Womack (2009) and are shown in Table 15.

7.4.2.1. Survey sample

To study management system factors among U.S. hospitals with varying performance, twenty-five low and twenty high performing hospitals were selected from our population of interest. In addition, five hospitals that apply lean management principles in their organizations were identified as lean hospitals by an expert (Zak 2012). The sample size was set at three lean, three high, and three low performing hospitals to maintain a robust dataset for multi comparison statistics (Siegel 1957).

7.4.2.1.1. Contact and email list

The following public sources were used to create the survey contact list: American Hospital Association (AHA 2011), U.S. Department of Health & Human Services (CMS 2010), State Hospital Associations (AHA 2011), and Institute for Healthcare Improvement (IHI, 2010). Additional information, such as name, phone number, and email address of senior managers, was gained from each institution's website.

7.4.2.2. Data Collection

7.4.2.2.1. Online Questionnaire

To obtain information from CEOs and CEOs' followers in U.S. hospitals, the online questionnaire was set up as a 360 degree survey (Dillman 2007; Anon. 1993). This kind of questionnaire allows researchers to obtain input about the same object from two or more points of view. One view is how CEOs perceive the management system factors applied, whereas the other view is provided by CEO followers (senior executives, mid-level managers, and frontline associates) on their experience as to how management system factors are used at their respective hospital. Thus, two online questionnaires (Qualtrics 2011), one for CEOs and one for CEO followers were deployed. CEOs and hospital managers willing to facilitate the survey in selected hospitals were asked to support data gathering in their facility. The study called for responses from the hospital's CEO, two senior executives, five mid-level managers, and five frontline associates.

The questionnaire used for CEOs and followers were identical, except that the followers had to identify their rank in the hierarchy. The CEO and follower questionnaire consisted of two parts relevant to this study with the first part entailing three questions for the CEOs and four questions for the followers to describe background information, such as hospital name, respondent's position, and the number of years employed with that particular hospital. The second part consisted of thirteen questions that were adapted from Womack (2009), containing 11 process management factors and 2 modern management factors. Table 15 lists the 13 questions asked. The survey, when taken by a participant, randomized the sequence of all questions to avoid response bias (Rea and Parker 2005; Alreck and Settle 1995).

7.4.2.2.2. Questionnaire pretest

The questionnaires were reviewed by specialists at Virginia Tech and affiliates of the Lean Global Network (LGN) in the Netherlands, South Africa, France, and the UK. Afterwards, a pretest was conducted with eleven hospital associates at two independent hospitals in Virginia to verify and statistically validate the questionnaire and to test for clarity, acceptability, timeliness, and comprehensiveness (Rea et al. 1997; Alreck and Settle 1995). Eleven responses were received and responses were analyzed and minor adjustments to the questionnaires were made.

7.4.2.2.3. Mailings, follow-up, and data gathering

In February 2012, either the CEO or their assistants at the hospitals, selected for this study were contacted by email and/or phone to discuss our study. Discussions included the reason for this study, the selection of employees, and the online questionnaire. Phone calls were made every Tuesday and Wednesday starting on February 9 until April 2, 2012. Reminder emails were sent out every Monday morning over the same time period to increase overall response rates (Dillman 2007; Rea and Parker 2005). Every Friday, cooperating hospitals received an update on the progress of the survey in their organization. At the closing of the study on April 9, 2012, 56 valid responses were received (10 CEO and 46 followers, divided into 11 senior executives, 19 middle managers, and 16 frontline associates). Responses came from three lean hospitals (ranked between the 40th and 70th percentile in our national ranking), three high performing hospitals (ranked at the top 20th percentile) and three low performing hospitals (ranked at the bottom 20th percentile).

7.4.2.3. Data analysis and statistics

The data obtained was automatically stored, coded, and organized in Qualtrics (2011). After closing the survey, all data was extracted into MS Excel 2010 (Microsoft 2010). Responses from lean, high and low performing hospitals were clustered accordingly. The spreadsheet was then uploaded to SAS 9.2 statistical software (SAS 2010) for further statistical analysis.

7.4.2.4. Independent variables

The 13 Likert scale factors relating to process and modern management were adapted from Womack (2009) and can be seen in Table 15. Respondents could indicate their level of agreement to each factor relating to process or modern management with: strongly disagree; disagree; neither agree nor disagree; agree; and strongly agree (Dillman 2007; Rea and Parker 2005). Respondents also had the possibility to check not applicable (N/A) if they were not able to answer the question.

Table 15: Process and modern management factors inquired about in the survey (adapted from Womack 2009).

Code	Our CEO ...
Q15_1	managers are responsible for cross-functional activities, in addition to their own functional areas.
Q15_2	managers are evaluated according to real-time process performance, as well as, end-of-the-reporting-period results.
Q15_3	decisions are made at the top of the organization and refined through two-way conversations and involvement with employees.
Q15_4	successful managers are identified as those who both deliver results and create a learning environment to help their employees in self-discovery.
Q15_5	when things do not go according to plan, the manager's job is to develop corrective action in a learning environment.
Q15_6	managers focus on how the work is done and assume the results will follow.
Q15_7	managers are developed primarily through formal education.
Q15_8	managers are developed primarily through in-company learning/mentoring, on-the-job training, and problem solving.
Q15_9	managers make decisions by both analyzing the existing data and gathering first-hand information.
Q15_10	managers identify and solve problems both cross-functionally and within their own functions.
Q15_11	managers do not have to rework/revisit problems because they have determined and solved the root cause.
Q15_12	we may develop work standards for activities but rarely perform the work in accordance with the standards.
Q15_13	we develop work standards for most activities and usually perform the work in accordance with the standards.

From the total thirteen factors listed in Table 15, two factors described modern management practices (Q15_7 and Q15_12); while the remaining 11 factors described process management practices (Womack 2009). These 13 independent variables were used to compare differences in management systems used among lean, high, and low performing U.S. hospitals. The two factors describing modern management (Q15_7 and Q15_12) were used to control for false interpretation and errors from the respondent. Specifically, the modern management factor "*Managers are developed primarily through formal education*" is paired with the process management factor "*Managers are developed primarily through in-company learning/mentoring, on the job training, and problem solving*." The second control pair is "*We may develop work standards for activities but rarely perform the work in accordance with the* *standards*" and "*We develop work standards for most activities and usually perform the work in accordance with the standards*."

7.4.2.5. Covariates

Since staff turnover rate is about 14% in U.S. hospitals (ACHE 2012) and since perceptions from employees vary depending on the length of their employment in a given organization, we controlled for the number of years (length) a hospital employee has been working for the organization (Khaliq et al. 2006; Schmidt and Hunter 1998; Alexander et al. 1993). Therefore, the hospitals that participated in this research were required to select employees that were with the hospital for more than 1 year and their CEOs had to have tenure of more than 5 years. Follower responses received ranged from 1 to 40 years and responses that did not meet the requirements were rejected. In such cases, our hospital contacts were asked to substitute these responses by employees with responses from somebody with tenure greater than one year.

7.4.3. Methods

In SAS 9.2, all data was classified into lean, high, and low performing hospitals. Management system factors associated with each of these three hospital performance categories were then compared based on follower and CEO responses by applying non-parametric statistical hypothesis testing (Siegel 1957; Edwards 1954; Wilcoxon 1945). In particular, these results were evaluated using Kruskall-Wallis, chi-square exact test (Theodorsson-Norheim 1986; Breslow 1970; Kruskal and Wallis 1952) and Wilcoxon two-sample test (Litchfield and Wilcoxon 1949; Wilcoxon 1945). Statistics were adjusted using the

Bonferroni correction (Cabin and Mitchell 2000; Edwards 1954), since comparisons included three groups (multiple comparisons). Thus, the nominated α of 0.05 was divided by 3, resulting in an alpha of 0.01667. We also checked for internal reliability of our dichotomous factors using Cronbach's α (Gliem and Gliem 2003; Bland and Altman 1997). It showed a reliability alpha greater than 0.7, indicating acceptable internal consistency (Green et al. 1996).

7.4.3.1. Limitations

As with all research, limitations apply to this study. For example, the hospital ranking created by us based on the quality of care measures (AMI, HF, PN, and SCIP, CMS 2012) does not reflect the entire patient care experience and might be limited in scope. The performance score is also vulnerable to type of illnesses and number of patients a hospital treats. However, this quality of care score has been used in numerous studies (Boyer et al. 2012; Giordano et al. 2010; McGlynn et al. 2003; Marley et al. 2004). Furthermore, to account for the influence of small sample sizes, we excluded all hospitals that reported quality of care measures based on 25 patients or less (HHS 2012).

Another limitation of this study is the small number of hospitals surveyed (three lean, three high, and three low performing hospitals). Thus, limitations to the generalization of findings from this study apply. Also, followers' responses obtained are not evenly distributed over all categories of hospitals (we received 32 responses from lean, two responses from high, and 12 responses from low performing hospitals). However, our non-parametric statistical analysis accounted for this shortcoming.

Also, limitations to this study exist based on responses being obtained from an individual working within a given organization, which induces personal bias. Readers should also be aware that high and low performing hospitals may employ lean practices, thus practices used at lean hospitals may not be unique. Hence, findings describe solely differences in management systems between these three categories of hospitals rather than describe mutually exclusive management systems used by individual hospitals. Also, this study asked specific questions about management systems factors. It can be argued that followers knowledgeable about management systems used at their hospital are more likely to respond accurately to the questions asked than employees that are not. However, the research team accounted for such cases and allowed the respondents to skip questions or to answer them with not applicable (N/A, Rea and Parker 2005; Alreck and Settle 1995). Answers including N/A were dropped and none of the CEO replies and only one of the follower questionnaires (46 in total) returned had to be dropped. Thus, if bias is present, it should be small.

7.5. Results

Results from our non-parametric statistical analysis based on the 10 CEO responses obtained showed no significant difference (p-values ranging from 0.236 to 1.000) in management system factors employed of either one of the comparisons; lean versus high performing hospitals, lean versus low performing hospitals, or high versus low performing hospitals.

The statistical analysis based on follower responses, however, did produce statistically significant differences in management system factors between lean and low performing hospitals (p-values between 0.0004 and 0.0275). However, no statistically significant differences (p-values 0.2424 to 1.0000, Wilcoxon two-sample test) in management system factors were found between high and low performing hospitals (p-values between 0.2424 and 1.0000), nor were there any significant differences detectable between lean and high performing hospitals (p-values between 0.2995 and 1.0000). Table 16 shows individual responses to the 13 follower questions adapted from Womack (2009).

Table 16: Follower results regarding process and modern management factors (adapted from Womack 2009).

		Kruskall-Wallis Test	Wilcoxon Two-sample Test (Bonferroni corrected 0.05/3 = 0.01667)		
Code	**Factors**	**Chi-Square Exact test**	**Lean vs. Low**	**High vs. Low**	**Lean vs. High**
Q15_1	Managers are responsible for cross-functional activities, in addition to their own functional areas.	0.2423	0.1466	0.9487	0.2995
Q15_2	Managers are evaluated according to real-time process performance, as well as, end-of-the-reporting-period results.	0.4811	0.2339	0.5000	0.9758
Q15_3	Decisions are made at the top of the organization and refined through two-way conversations and involvement with employees.	0.2301	0.0782	0.7273	0.8125
Q15_4	Successful managers are identified as those who both deliver results and create a learning environment to help their employees in self-discovery.	0.0600	0.0225	1.0000	0.5508
Q15_5	When things do not go according to plan, the manager's job is to develop corrective action in a learning environment.	0.0564	0.0223	0.4872	0.8930
Q15_6	Managers focus on how the work is done and assume the results will follow.	0.2404	0.1317	0.2424	0.8342
Q15_7	Managers are developed primarily through formal education.	0.8151	0.8719	0.7727	0.5740
Q15_8	Managers are developed primarily through in-company learning/mentoring, on-the-job training, and problem solving.	0.0506	0.0275	0.9121	0.5294
Q15_9	Managers make decisions by both analyzing the existing data and gathering first-hand information.	0.0009	0.0004	0.3956	0.5490
Q15_10	Managers identify and solve problems both cross-functionally and within their own functions.	0.2489	0.1088	0.7692	0.9358
Q15_11	Managers do not have to rework/revisit problems because they have determined and solved the root cause.	0.4539	0.4935	0.4872	0.3939
Q15_12	We may develop work standards for activities but rarely perform the work in accordance with the standards.	0.4181	0.2691	0.4872	0.7130
Q15_13	We develop work standards for most activities and usually perform the work in accordance with the standards.	0.1162	0.0575	0.7692	1.0000

Four factors were found to be significantly different ($\alpha < 0.05$) between lean and low performing hospitals. The four management system factors found to be significantly different were (Table 16): "*Successful managers are identified as those who both deliver results and create a learning environment to help their employees in self-discovery* (p = 0.0225, Q15_4)";

"*When things do not go according to plan, manager's job is to develop corrective action in a learning environment* (p = 0.0223, Q15_5)"; "*Managers are developed primarily through in-company learning/mentoring, on-the-job training, and problem solving* (p = 0.0275, Q15_8)"; and "*Managers make decisions by both analyzing the existing data and gathering first-hand information* (p = 0.0004, Q15_9)."

Thus, based on these results, $H8_0$ stating that: "*There is no difference in management system factors between lean and low performing hospitals in the U.S.*" was rejected, as 4 factors (Q15_4, Q15_5, Q15_8, and Q15_9) were found to be significantly different ($\alpha < 0.05$). However, $H9_0$ stating that: "*There is no difference in management system factors between high and low performing hospitals in the U.S.*," and $H10_0$ stating that: "*There is no difference in management system factors between lean and high performing hospitals in the U.S.*," were accepted as we found no factors to be significantly different ($\alpha < 0.05$) between these categories.

7.6. Discussion and Conclusions

This research investigated differences in management system factors among lean, high, and low performing hospitals based on our U.S. ranking of hospitals using publicly available quality of care measures from 2010 (HHS 2012). Information was gathered by a 360-degree survey that entailed responses from CEOs and CEOs' followers (senior executives, mid-level managers, and frontline associates) from each of the 9 participating hospitals. Results showed differences in management system factors between lean and low performing hospitals, but no differences in management system factors between high and low performing hospitals and lean and high performing hospitals were found. Below, we review the hypotheses presented ($H8_0$, $H9_0$, and $H10_0$) and discuss the results reported under the quality of care performance perspective for hospitals (CMS 2012). This is followed by a presentation of some general thoughts and a discussion of opportunities for further research.

First, we discuss the results from the CEO responses that showed none of the management system factors to be significantly different ($\alpha < 0.05$) over all of our categories (e.g., lean versus low, lean versus high, and high versus low performing hospitals). In the case of lean versus low performing hospitals, this assessment was not shared with the followers involved in this research. Followers from lean and low performing hospitals disagreed on four management system factors. Thus, some followers of low performing hospitals perceived their management system factors different from how their CEOs perceive them. Interestingly, this observation does not hold when comparing lean and high performing hospitals where followers and CEOs perceived management factors equally. A discussion can be built stating that this discrepancy between CEO awareness and follower perception of management system factors in low performing hospitals explains at least part of the performance differences (Schyns et al. 2008). Also, one might argue that because of the lack of CEO awareness of their management system, the sense of urgency to improve is non-existent (Kotter 2008; Kotter and Rathgeber 2006; Kotter 1996; Kotter 1995), explaining the hospital's low performance outcomes (as gaged by the quality of care measures, CMS 2012).

Second, we take a look at the follower responses and discuss our first hypotheses ($H8_0$, *"There is no difference in management system factors between lean and low performing U.S.*

hospitals") comparing lean hospitals (ranked between the 40th and 70th percentile in our national ranking) to low performing hospitals (ranked at the bottom 20 percentile). Doing this comparison, we found 4 out of 13 management system factors tested to be significantly different ($\alpha < 0.05$) based on followers' responses. In particular, lean hospitals score higher on the following management system factors: "*managers in a lean system are identified as those who both deliver results and create a learning environment to help their employees in self-discovery*;" "*managers develop corrective action in a learning environment when things do not go according to plan*;" "*managers are developed primarily through in-company learning/mentoring, on-the-job training, and problem solving*;" and "*managers take decisions by both analyzing the existing data and gathering first-hand information*." The result shows that these four lean management factors are more present in lean hospitals than they are in low performing hospitals, and therefore could explain the differences in performance that exists. Our conclusions are further strengthened by findings from other research that has shown positive effects of lean management systems on hospital performance (e.g., Institute for Healthcare Improvement 2012; Aherne and Whelton 2010; Ben-Tovim et al. 2007; Jones 2006).

To answer our second hypotheses ($H9_0$, *"There is no difference in management system factors between high and low performing U.S. hospitals.")* we looked at answers from followers of high performing hospitals (ranked at the top 20th percentile of our national quality of care ranking) and low performing hospitals (ranked at the bottom 20th percentile). The results showed that none of the answers to the 13 management system factors inquired about from high and low performing hospital followers were significantly different ($\alpha < 0.05$), thus we were unable to reject $H9_0$. Management system factors consequently do not help in explaining the performance gaps between high and low performing hospitals. Our findings do not support research on management systems and hospital performance that has found management systems to be an important factor in influencing hospital performance (Boyer et al. 2012; Aherne and Whelton 2010; Boyer and Pronovost 2010; Kenney 2010; Schmitt et al. in review).

To test our third and last hypothesis, $H10_0$ *("There is no difference in management system factors between high and lean performing U.S. hospitals")*, we compared lean hospitals (ranked between 40th and 70th percentile of our national quality of care ranking) with high performing hospitals (ranked at the top 20th percentile). Our findings did find that none of the 13 management system factors employed in lean and high performing hospitals are significantly different ($\alpha < 0.05$). Thus, we therefore accept $H10_0$. This conclusion can claim some support by some studies that show that management systems, while a factor influencing hospital performance (Boyer et al. 2012; Aherne and Whelton 2010; Boyer and Pronovost 2010; Kenney 2010; Schmitt et al. in review), are not the only factor influencing hospital performance (Schmitt et al. in review, Marley et al. 2004; Flynn et al. 1994).

In summary, this research underlines that management system factors do play a role in determining the quality of care delivered by U.S. hospitals. However, we found no evidence that management system factors explains performance differences between high and low performing hospitals, nor did we find differences between lean and high performing hospitals. Nevertheless, our findings that differences between lean and low performing hospitals exist support Jones' (2011) claim that hospitals in particular and the healthcare industry in general can greatly benefit from lean in the future. Furthermore, Jones and Filochowski (2006) expect that performance differences between lean and low performing hospitals will grow over time, as lean is not a quick fix but a long-term journey (Jones 2011; Jones and Filochowski 2006). However, given the results of this research, we encourage further research to be conducted to validate our findings using a larger sample of U.S. hospitals. Furthermore, fundamental research should be conducted to describe the current state of process management (e.g., lean management) and modern management used in the U.S. health care industry.

7.7. References

ACHE. 2012. "Hospital CEO Turnover Rate Holds Steady." http://www.ache.org/Pubs/Releases/2012/hospital-ceo-turnover-rate.cfm.

AHA. 2011. *AHA Hospital Statistics 2010*.

Aherne, J., and J. Whelton. 2010. *Applying Lean in Healthcare*. New York: CRC Press.

Aherne, J., and J. Whelton. 2010. "Applying Lean in Healthcare: a Collection of International Case Studies." *Recherche* 67: 02.

Ahlstrom, P. 2004. "Lean Service Operations: Translating Lean Production Principles to Service Operations." *International Journal of Services Technology and Management* 5 (5): 545–564.

Alexander, J. A., M. L. Fennell, and M. T. Halpern. 1993. "Leadership Instability in Hospitals: The Influence of board-CEO Relations and Organizational Growth and Decline." *Administrative Science Quarterly*: 74–99.

Allway, M., and S. Corbett. 2002. "Shifting to Lean Service: Stealing a Page from Manufacturers' Playbooks." *Journal of Organizational Excellence* 21 (2): 45–54.

Alreck, P. L., and R. B. Settle. 1995. *The Survey Research Handbook*. Irwin Chicago.

Anon. 1993. "The General Electric (GE) Leadership Effectiveness Survey (LES)." http://www.e-coach.narod.ru/business_guide/crosscuttings/tests_leadership_ef_byge.html.

Ben-Tovim, D.I., J.E. Bassham, D. Bolch, M.A. Martin, M. Dougherty, and M. Szwarcbord. 2007. "Lean Thinking Across a Hospital: Redesigning Care at the Flinders Medical Centre." *Australian Health Review* 31 (1): 10–15.

Bhatia, N., and J. Drew. 2006. "Applying Lean Production to the Public Sector." *The McKinsey Quarterly* 3 (1): 97–98.

Bland, J. M., and D. G. Altman. 1997. "Cronbach's Alpha." *BMJ: British Medical Journal* 314 (7080): 572.

Bohmer, R., and C. I. Knoop. 2007. "The Challenge Facing the US Healthcare Delivery System." *HBS Case*: 9–606.

Bootman, J. Lyle. 2000. "To Err Is Human." *Arch Intern Med* 160 (21) (November 27): 3189. doi:10.1001/archinte.160.21.3189.

Boyer, K.K., J. Gardner, and S. Schweikhart. 2012. “Process Quality Improvement: An Examination of General Vs. Outcome-specific Climate and Practices in Hospitals.” *Journal of Operations Management*.

Boyer, K.K., and P. Pronovost. 2010. “What Medicine Can Teach Operations: What Operations Can Teach Medicine.” *Journal of Operations Management* 28 (5).

Breslow, N. 1970. “A Generalized Kruskal-Wallis Test for Comparing K Samples Subject to Unequal Patterns of Censorship.” *Biometrika* 57 (3): 579–594.

Cabin, R. J., and R. J. Mitchell. 2000. “To Bonferroni or Not to Bonferroni: When and How Are the Questions.” *Bulletin of the Ecological Society of America* 81 (3): 246–248.

CMS. 2012. “Quality Initiative.” http://www.cms.hhs.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/QualityInitiativesGenInfo/index.html?redirect=/QualityInitiativesGenInfo/.

Van Dijk, J. A.G.M. 1990. “Delphi Questionnaires Versus Individual and Group Interviews: A Comparison Case.” *Technological Forecasting and Social Change* 37 (3): 293–304.

Dillman, D. A. 2007. *Mail and Internet Surveys: The Tailored Design Method*. John Wiley & Sons Inc.

Drever, E. 1995. *Using Semi-structured Interviews in Small-scale Research: a Teacher’s Guide*. 129. Scottish Council for Research in Education.

Dye, C. F. 2000. *Leadership in Healthcare: Values at the Top*. Health Administration Press.

Edwards, A. L. 1954. “Statistical Methods for the Behavioral Sciences.”

Emiliani, Bob. 2005. “Getting Lean.” *BizEd* 4 (4) (May): 56–57. doi:Article.

Emiliani, M. L. 2006. “Origins of Lean Management in America.” Journal of Management History 12 (2): 167.

Flynn, B.B., R.G. Schroeder, and S. Sakakibara. 1994. “A Framework for Quality Management Research and an Associated Measurement Instrument.” *Journal of Operations Management* 11 (4): 339–366.

Foddy, W., and W. H. Foddy. 1994. *Constructing Questions for Interviews and Questionnaires: Theory and Practice in Social Research*. Cambridge Univ Pr.

Ford, Henry. 2009. *My Life and Work - An Autobiography of Henry Ford*. BN Publishing.

Fowler, F. J. 1995. *Improving Survey Questions: Design and Evaluation*. Sage Publications, Inc.

Giordano, L.A., M.N. Elliott, E. Goldstein, W.G. Lehrman, and P.A. Spencer. 2010. "Development, Implementation, and Public Reporting of the HCAHPS Survey." *Medical Care Research and Review* 67 (1): 27–37.

Gliem, J.A., and R.R. Gliem. 2003. "Calculating, Interpreting, and Reporting Cronbach's Alpha Reliability Coefficient for Likert-type Scales." In *Midwest Research to Practice Conference in Adult, Continuing, and Community Education*. Vol. 88.

Gray, J. A.M. 1997. *Evidence-based Healthcare: How to Make Health Policy and Management Decisions*. Churchill Livingstone New York.

Green, S. B., N. J. Salkind, and T. M. Jones. 1996. *Using SPSS for Windows; Analyzing and Understanding Data*. Prentice Hall PTR.

Hanna, J. 2007. "Bringing 'Lean'principles to Service Industries'." *Harvard Business School Working Knowledge*.

HHS. 2012. "Hospital Compare." http://www.hospitalcompare.hhs.gov/staticpages/help/hospital-how-to.aspx.

Hines, P., A.L. Martins, and J. Beale. 2008. "Testing the Boundaries of Lean Thinking: Observations from the Legal Public Sector." *Public Money and Management* 28 (1): 35–40.

IHI (Institute for Healthcare Improvement). 2010. *IHI Internal Hospital Statistics database 2011*

Institute for Healthcare Improvement. 2012. "White Paper, Lean Principles, Throughput Time, Lean Thinking, Kanban, Muda, Value Stream, A Priori, Kaizen, Takt Time, Lean Management Trystorm," http://www.ids-healthcare.com/Common/Paper/Paper_51/Going%20Lean%20in%20Health%20Care1.htm.

Jewell, K., and L. McGiffert. 2009. "To Err Is Human—to Delay Is Deadly." *Austin, TX, Consumers Union*.

Jones. 2011. "Lean Leadership Characteristics" presented at the Lean Management Summit.

Jones, D. T. 2006. "Leaning Healthcare." Management Services 50 (2): 16.

Jones, D. T., and J. Filochowski. 2006. "Lean Healthcare. Think Yourself Thin." *The Health Service Journal* 116 (6000).

Kenney, Charles. 2010. *Transforming Health Care: Virginia Mason Medical Center's Pursuit of the Perfect Patient Experience*. 1st ed. CRC Press.

Khaliq, A. A., S. L. Walston, and D. M. Thompson. 2006. "The Impact of Hospital CEO Turnover in US Hospitals: Final Report." *Chicago: American College of Healthcare Executives*.

Kohn, Linda T. 2000. "To Err Is Human : Building a Safer Health System."

Kohn, L.T., J.M. Corrigan, and M.S. Donaldson. 2001. "Crossing the Quality Chasm: a New Health System for the 21st Century." *Washington, DC: Committee on Quality of Health Care in America, Institute of Medicine*.

Kotter, John. 2008. "Sense of Urgency." *Leadership Excellence* 25 (3) (March): 10. doi:Article.

Kotter, John P. 1995. "Leading Change: Why Transformation Efforts Fail. (cover Story)." *Harvard Business Review* 73 (2) (March): 59–67. doi:Article.
———. 1996. *Leading Change*. Harvard Business Press.

Kotter, John P., and Holger Rathgeber. 2006. "Our Iceberg Is Melting." *Leadership Excellence* 23 (2) (February): 11. doi:Article.

Kovner, A. R., D. J. Fine, R. D'Aquila, and Association of University Programs in Health Administration. 2009. *Evidence-based Management in Healthcare*. Health Administration Press.

Kruskal, W. H., and W. A. Wallis. 1952. "Use of Ranks in One-criterion Variance Analysis." *Journal of the American Statistical Association*: 583–621.

Lander, E., and J. K. Liker. 2007. "The Toyota Production System and Art: Making Highly Customized and Creative Products the Toyota Way." *International Journal of Production Research* 45 (16): 3681–3698. doi:10.1080/00207540701223519.

Leape, Lucian L., and Donald M. Berwick. 2005. "Five Years After To Err Is Human What Have We Learned?" *JAMA: The Journal of the American Medical Association* 293 (19) (May 18): 2384–2390. doi:10.1001/jama.293.19.2384.

Leatherman, S., D. Berwick, D. Iles, L.S. Lewin, F. Davidoff, T. Nolan, and M. Bisognano. 2003. "The Business Case for Quality: Case Studies and an Analysis." *Health Affairs* 22 (2): 17–30.

Levin-Scherz, J. 2010. "What Drives High Health Care Costs—and How to Fight Back." *Pediatrics* 8: 4.

Levit, K., C. Smith, C. Cowan, H. Lazenby, A. Sensenig, and A. Catlin. 2003. “Trends in US Health Care Spending, 2001.” *Health Affairs* 22 (1): 154–164.

Liker, Jeffrey K. 2004. *The Toyota Way*. McGraw-Hill Professional.

Likert, R. 1932. “A Technique for the Measurement of Attitudes.”

Litchfield Jr, J. T., and F. Wilcoxon. 1949. “A Simplified Method of Evaluating Dose-effect Experiments.” *Journal of Pharmacology and Experimental Therapeutics* 96 (2): 99–113.

Marley, Kathryn A., David A. Collier, and Susan Meyer Goldstein. 2004. “The Role of Clinical and Process Quality in Achieving Patient Satisfaction in Hospitals.” *Decision Sciences* 35 (3) (August 1): 349–369. doi:10.1111/j.0011-7315.2004.02570.x.

McGlynn, E.A., S.M. Asch, J. Adams, J. Keesey, J. Hicks, A. DeCristofaro, and E.A. Kerr. 2003. “The Quality of Health Care Delivered to Adults in the United States.” *New England Journal of Medicine* 348 (26): 2635–2645.

Meyer, Susan M., and David A. Collier. 2001. “An Empirical Test of the Causal Relationships in the Baldrige Health Care Pilot Criteria.” *Journal of Operations Management* 19 (4) (July): 403–426. doi:10.1016/S0272-6963(01)00053-5.

Microsoft. 2010. “Buy and Download Microsoft Excel 2010, Spreadsheet, Data Tracking Software, Numbers, Enhanced Tools - Microsoft Store Online.” http://www.microsoftstore.com/store/msstore/pd/productID

Murman, E.M. 2002. *Lean Enterprise Value: Insights from MIT’s Lean Aerospace Initiative*. Palgrave Macmillan.

Nelson-Peterson, D.L., and C.J. Leppa. 2007. “Creating an Environment for Caring Using Lean Principles of the Virginia Mason Production System.” *Journal of Nursing Administration* 37 (6): 287.

Nolte, Ellen, and C. Martin McKee. 2008. “Measuring The Health Of Nations: Updating An Earlier Analysis.” *Health Affairs* 27 (1) (January 1): 58–71. doi:10.1377/hlthaff.27.1.58.

Porter, M.E. 2009. “A Strategy for Health Care Reform—toward a Value-based System.” *New England Journal of Medicine* 361 (2): 109–112.

Porter, M.E., and E.O. Teisberg. 2006. *Redefining Health Care: Creating Value-based Competition on Results*. Harvard Business Press.

Qualtrics. 2011. “Qualtrics Virginia Tech - Google Search.” https://www.google.com/#hl=en&output=search&sclient=psy-ab&q=qualtrics+virginia+tech

Radnor, Z., and P. Walley. 2008. “Learning to Walk Before We Try to Run: Adapting Lean for the Public Sector.” *Public Money and Management* 28 (1): 13–20.

Rea, L. M., R. A. Parker, and R. Allen. 1997. *Designing and Conducting Survey Research: A Comprehensive Guide*. Jossey-Bass Publishers San Francisco, CA.

Rea, Louis, and Richard A. Parker. 2005. *Designing and Conducting Survey Research : a Comprehensive Guide*. 3rd ed. San Francisco: Jossey-Bass.

SAS. 2010. “Products & Solutions | SAS.” http://www.sas.com/software/.

Schmidt, F. L., and J. E. Hunter. 1998. “The Validity and Utility of Selection Methods in Personnel Psychology: Practical and Theoretical Implications of 85 Years of Research Findings.” *Psychological Bulletin; Psychological Bulletin* 124 (2): 262.

Schmitt and others in review. “Management Systems and Hospital Performance”.

Schyns, B., B. Kroon, and G. Moors. 2008. “Follower Characteristics and the Perception of Leader-member Exchange.” *Journal of Managerial Psychology* 23 (7): 772–788.

Shimokawa, Koichi, Takahiro Fujimoto, Brian Miller, and John Shook. 2009. *The Birth of Lean*. Lean Enterprise Institute, Inc.

Shortell, S.M., and S.J. Singer. 2008. “Improving Patient Safety by Taking Systems Seriously.” *JAMA: The Journal of the American Medical Association* 299 (4): 445–447.

Siegel, S. 1957. “Nonparametric Statistics.” *The American Statistician* 11 (3): 13–19.

Singer, S. J., D. M. Gaba, J. J. Geppert, A. D. Sinaiko, S. K. Howard, and K. C. Park. 2003. “The Culture of Safety: Results of an Organization-wide Survey in 15 California Hospitals.” *Quality and Safety in Health Care* 12 (2): 112–118.

Slack, R. 1999. “The Lean Value Principle in Military Aerospace Product Development.”

Swank, C.K. 2003. “The Lean Service Machine.” *Harvard Business Review* 81 (10): 123–130.

Theodorsson-Norheim, E. 1986. “Kruskal-Wallis Test: BASIC Computer Program to Perform Nonparametric One-way Analysis of Variance and Multiple Comparisons on Ranks of Several Independent Samples.” *Computer Methods and Programs in Biomedicine* 23 (1): 57–62.

Weber, D. 2006. “Toyota-style Management Drives Virginia Mason.” *Physician Executive* 32 (1): 12.

Weisberg, H. F., J. A. Krosnick, and B. D. Bowen. 1996. *An Introduction to Survey Research, Polling, and Data Analysis*. Sage Publications, Inc.

Wilcoxon, F. 1945. “Individual Comparisons by Ranking Methods.” *Biometrics Bulletin* 1 (6): 80–83.

Womack, J. P. 2009. “Modern vs. Lean Management Assessment questionnaire." Internal LEI document for company assessments.

Womack, J. P. 2010. “Womack Modern vs. Lean Management” August 25. http://www.slideshare.net/cmarchwi/womack-modern-vs-lean-management.

Womack, J. P., and D. T. Jones. 2004. *Lean Thinking*. Campus-Verl.

Womack, James P., and Daniel T. Jones. 2005. *Lean Solutions: How Companies and Customers Can Create Value and Wealth Together*. 1st ed. Free Press.

Womack, James P., Daniel T. Jones, and Daniel Roos. 1991. *The Machine That Changed the World : The Story of Lean Production*. Harper Perennial.

Zak, H. 2012. "Lean hospital selection for research." *phone interview Cambridge, MA*

8. General Results, Discussions, Future Research

This chapter discusses additional observations derived from this project. Furthermore, ideas for future research are presented.

8.1. Process improvement tools

The first study objective was to identify drivers of hospital performance related to management systems, organizational traits, and leadership. The first survey, sent out to 4,697 hospitals and receiving 597 responses, asked respondents about process improvement methodologies such as PDCA (plan-do-check-act), Lean Management, DMAIC (define, measure, analyze, improve, and control), Six Sigma, Total Quality Management, ISO 9000, and Business Process Reengineering, and Benchmarking. Survey participants also had the choice to check “Other” and to specify the kind of process improvement methodology the hospital employs, if not listed. Thirty-eight percent of all survey participants answered this question (N=228) by checking one or more of the process improvement methodologies they employ. Figure 25 shows the distribution of responses by process improvement methodology.

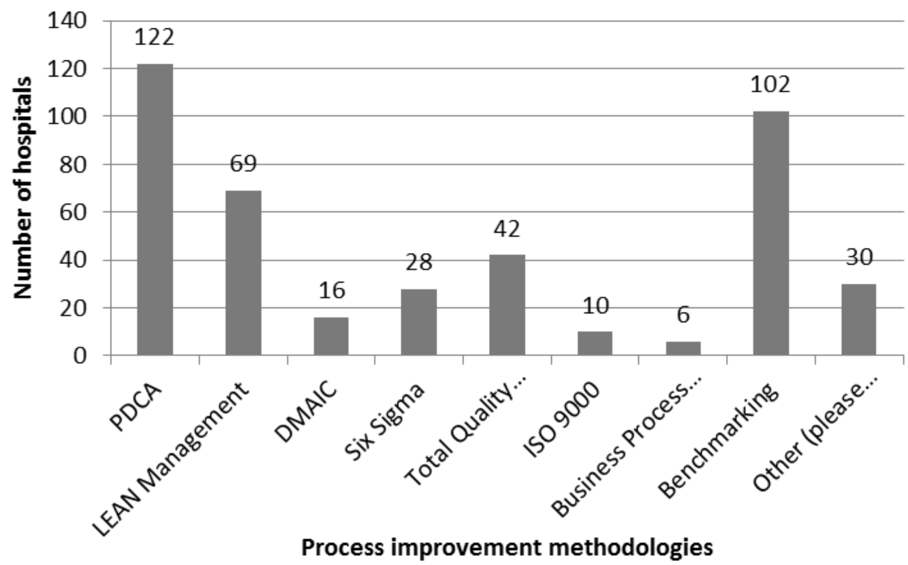

Figure 25: Overview of process improvement methodologies applied.

According to the results shown in Figure 25, the most widely employed process improvement methodology in hospitals surveyed was PDCA which was used by 54 percent of respondents. Thus, the results show that more than half of the hospitals responding to this question pursue continuous improvement. The second most widely employed methodology was Benchmarking which 45 percent of the respondents indicated as being used in their hospital. Benchmarking indicates that hospitals analyze their processes and compare them with industry averages and/or other hospitals. The third most widely employed method was lean with 30 percent of the respondents indicating that their hospital apply some lean principles. Total Quality Management ranked number 4 of the methodologies employed by hospitals with 18 percent, while Six Sigma (12 percent), DMAIC (7 percent), ISO 9000 (4 percent), and Business Process Reengineering (3 percent) were each employed by less than 15 percent of the hospitals. Thirteen percent of the respondents' hospitals indicated that they apply other process improvement methodologies, with TeamSTEPPS (N=6), SWOT analysis (N=1), and Darlene Bainbridge QI/QHi (N=1) being mentioned.

These results show that hospitals recognize the need to improve their processes and are using PDCA, Benchmarking, and other methodologies to achieve improvements in their performance. Also, lean has made its way into healthcare as a management system that can improve hospital performance. Surprisingly, TeamSTEPPS (AHRQ 2011), a teamwork process improvement system (AHRQ 2011) designed by the Agency for Healthcare Research and Quality (AHRQ) and the Department of Defense (DoD) to improve patient safety in healthcare, has not been widely adapted, yet.

8.1.1. Process improvement initiative

The major process improvement methodologies employed at U.S. hospitals, according to this research, are PDCA, Benchmarking, and Lean. Survey participants were also asked to provide information centered on the ownership of process improvement initiatives in their hospital by stating if improvement initiatives are owned either by separate process improvement departments or are part of an existing department (Appendix B). Fifty-seven percent of all survey participants answered this question (N=339) by checking one or the other category. The majority of respondents indicated that the hospital had a separate process improvement department (N=193; 57 percent), with the rest indicating that the ownership of a given hospital's process improvement initiative is part of a department with additional responsibilities (N=146; 43 percent). Figure 26 shows the titles of the departments to which the process improvement initiative has been assigned for those 43 percent of respondents.

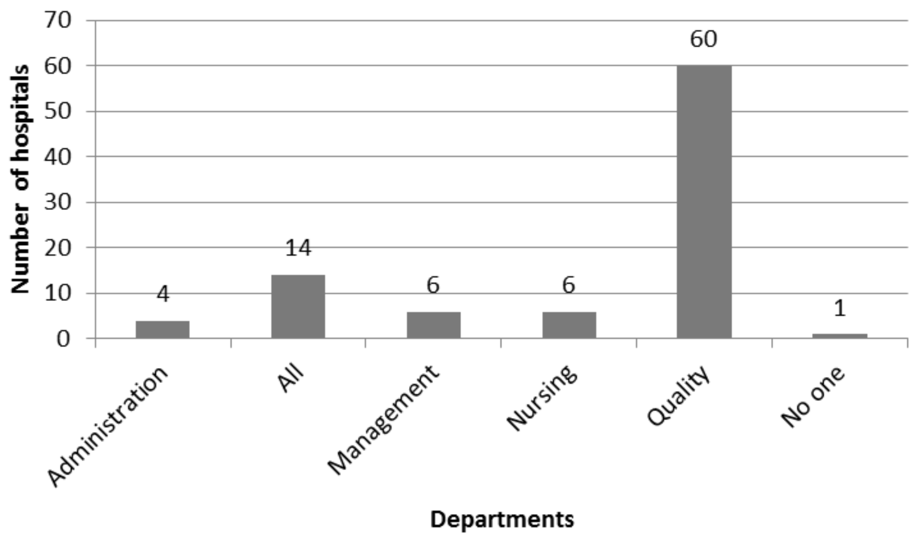

Figure 26: Process improvement initiatives owned by the respective departments when hospitals has no department focusing on process improvement.

Of the 146 hospitals that have their process improvement initiatives owned by a department with other responsibilities, only 91 respondents indicated which department had ownership (62 percent). In the majority, the process improvement initiatives were owned by the quality department (69 percent) while 15 percent of respondents reported that process improvement initiatives are owned by all departments. Others mentioned that management (8 percent), nursing (8 percent), or administration (4 percent) departments are the owner of the process improvement initiatives. Fifty-two percent of high performing hospitals (top 20th percentile) used separate process improvement departments as the owners of the initiatives, while only 43 percent of the low performing hospitals (bottom 20th percentile) did so. Thus, one can speculate that having process improvement initiatives owned by a separate process improvement department may improve a hospital's quality of care performance.

The first survey conducted also asked survey participants about their hospital's resources allocated for process improvement initiatives. In particular, we asked for the number of full-time-equivalent employees (FTEs) allocated to process improvement. Thirty-four percent of all survey participants answered this question and Figure 27 shows the distribution of answers starting with no FTEs allocated (A) to more than 4 FTEs allocated (G).

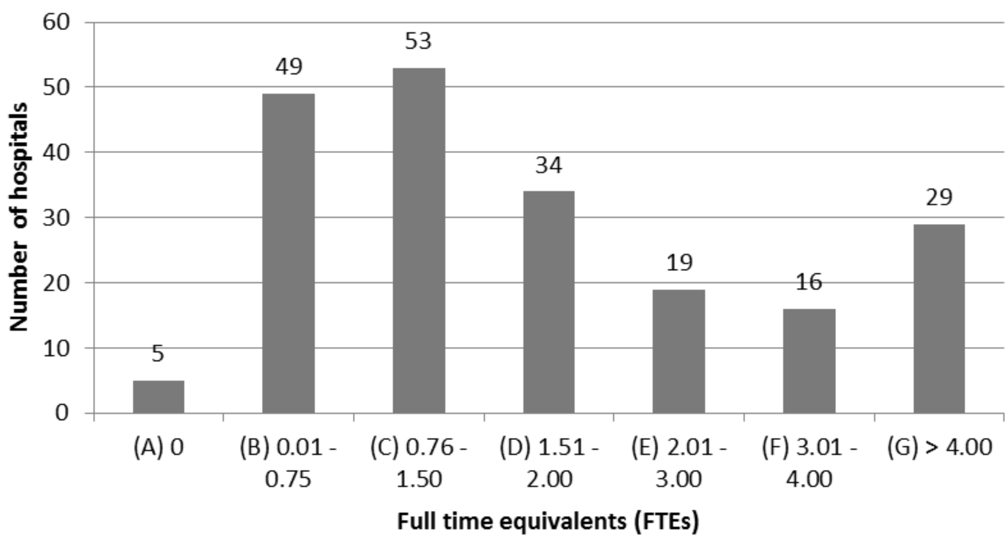

Figure 27: Resource allocation, full time equivalents for process improvement.

Fifty percent of the hospitals responding to this question allocated between 0.01 and 1.50 FTEs for process improvement, whereas 14 percent of respondents indicated that more than 4 FTEs are allocated to process improvement. Comparing FTE allocation between high performing hospitals (top 20^{th} percentile) and low performing hospitals (bottom 20^{th} percentile) showed that high performing hospitals, on average, allocate 1.51 to 2.00 FTEs for process improvement, whereas low performing hospitals allocate 0.76 to 1.50 FTEs for process improvements. Thus, higher performing hospitals, on average, assign a higher number of FTEs towards process improvement initiatives than do low performing hospitals. However, since the data presented here has not been adjusted for hospital size or any other pertinent fact, further research is needed to come to more conclusive answers.

8.1.2. Staff and nurse turnover rate

The healthcare industry is facing shortages of nurses, a problem that is expected to grow in the near future (Hassmiller and Cozine 2006; Buerhaus et al. 2005). The first survey asked respondents for information regarding “total annual staff (without nurses) turnover rate in 2010” and “total annual nurse turnover rate in 2010” to investigate the current state of staff and nurse turnover rates in U.S. hospitals. Figure 28 shows the staff (N=107 respondents) and nurse turnover rate (N=102 respondents) in 2010.

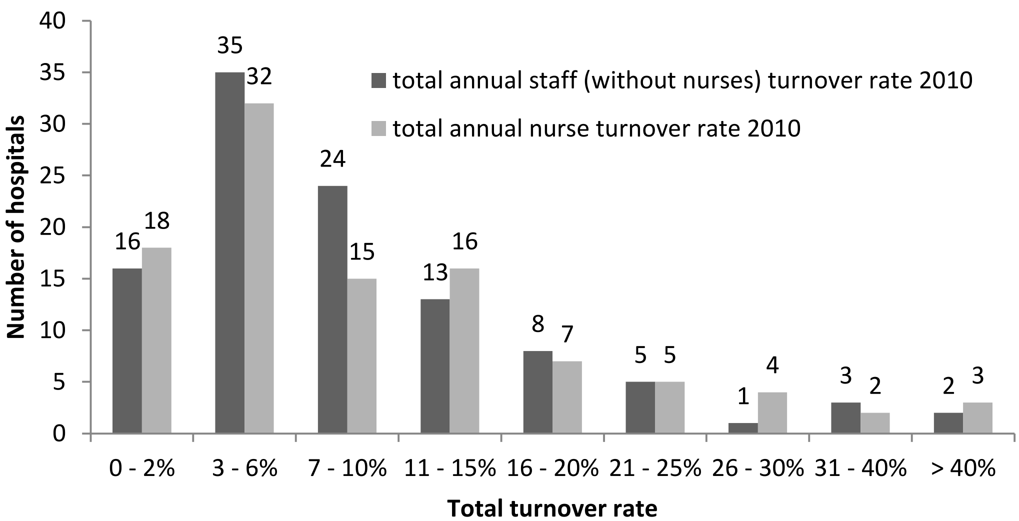

Figure 28: Total annual staff and nurse turnover rate in 2010.

Turnover rates (staff and nurse) were reported for the following categories: 0 to 2 percent (N=16 and N=18); 3 to 6 percent (N=35 and N=32); 7 to 10 percent (N=24 and N=15); and 11 to 15 percent (N=13 and N=16) to name just the four main clusters.

Based on the responses for staff and nurse turnover in U.S. hospitals, the discrepancies between staff and nurse turnover in two clusters 7 to 10 percent (N=24 and N=15 for staff and nurse turnover, respectively) and 26 to 30 percent (N=1 and N=4) could be explained by the differences in the calculated averages of staff and nurses turnover rates of 11 percent and 15.5 percent respectively. The results from this study confirm the reported annual nurse turnover rate of 15 percent in 2010 as reported by the Florida Center for Nursing (FCN 2010). The Florida Center for Nursing report also suggests that a reason for the higher nurse turnover rate observed might exist because U.S. nurses are older, on average, and thus, are eligible to retire sooner than staff. Another factor might be the competitive job market for nurses, in which nurses can switch employers easily and frequently for better paying jobs (FCN 2010).

8.1.3. Future Research

This project aspired to identify drivers of U.S. hospital performance based on publicly reported quality of care measures (HHS 2012). While this project focused on U.S. hospitals and used measures likely not available in other countries, research into the international performance of U.S. hospitals along quality of care measures (HHS 2012) would be revealing. Also, such an international comparison could shed more light on the benefits of employing different management practices and organizational and leadership traits on hospital performance. On a national basis, research should continue to investigate the impact of management systems (modern versus process), acute hospitals versus critical access hospitals, transformational and transactional leadership styles, and organizational characteristics on hospital performance to help to further improve hospital performance.

Another question of high interest to the professionals in the field of management would be to gain a better understanding as to the uniqueness of the health care industry and the hospital industry in particular in respect to process improvement efforts. Given the high stakes involved in the outcomes of the hospital process (life and death), questions about the safety of some process improvement practices, such as, for example, continuous improvement (CI), need to be carefully assessed. CI essentially implies that we accept a temporary inferior solution from which we then can further improve (a philosophy that helps us to get things started). However, such an approach may not be acceptable when the temporary outcomes may be irreversible (e.g., death).

8.2. References

AHRQ. 2011. “TeamSTEPPS Home.” http://teamstepps.ahrq.gov/.

Buerhaus, P.I., K. Donelan, B.T. Ulrich, L. Norman, and R. Dittus. 2005. “Is the Shortage of Hospital Registered Nurses Getting Better or Worse? Findings from Two Recent National Surveys of RNs.” *Nursing Economics* 23 (2): 61–71.

FCN. 2010. “Nurse Turnover Rates 2010 - Google Search.” https://www.google.com/#hl=en&output=search

Hassmiller, S.B., and M. Cozine. 2006. “Addressing the Nurse Shortage to Improve the Quality of Patient Care.” *Health Affairs* 25 (1): 268–274.

HHS. 2012. “Hospital Compare.” http://www.hospitalcompare.hhs.gov/staticpages/help/hospital-how-to.aspx.

9. Summary and Conclusions

The U.S. healthcare delivery system faces serious challenges. An increasing demand for services due to an aging population and an increasing number of individuals with chronic diseases has to be served with limited numbers of physicians, nurses, and money (Bohmer and Knoop 2007). Also, the ever rising costs of health care faces decreasing public support from federal, state, and local sources (Levit et al. 2003; McGlynn et al. 2003). However, according to Porter (2009), Kohn (2000), and others (Boyer et al. 2012; Porter and Teisberg 2006), the quality of care provided by U.S. hospitals is deficient. Several studies (Bootman 2000; Kohn 2000) have found that between 44,000 to 98,000 patients die and almost a million patients get injured annually in U.S. hospitals as a result of preventable medical errors. To counteract, the U.S. government, in 2001, started a quality offensive to improve patient safety while reducing costs (Shortell and Singer 2008; Porter and Teisberg 2006; Singer et al. 2003). In particular, the Department of Health and Human Services (HHS) and the Centers for Medicare & Medicaid Services (CMS) launched a quality initiative to assure the delivery of quality health care in all hospitals through accountability and public disclosure of quality of care measures (CMS 2012).

This study investigated differences in hospital performance (defined as quality of care measures) due to organizational factors, leadership traits, and management systems among lean, high (top 20th national percentile), and low performing (bottom 20th national percentile) hospitals in the U.S. Findings include that two management factors and the type of hospital (acute care or critical access hospital) significantly influences hospital performance. Also, most CEO leadership traits differed significantly when comparing lean and low performing hospitals

(34 out of 44 traits are significantly different, $p<0.05$) and some differed between high and low performing hospitals (6 out of 44 traits significantly different, $p<0.05$) when asking CEO followers. However, interestingly, CEOs when judging their own traits, perceive themselves as fairly similar. Only one trait was found to be significantly different between lean and low performing U.S. hospitals ($p<0.05$). This observation highlights a disparity between CEOs' self-awareness and followers' perception of CEOs' traits.

9.1. Management styles and hospital performance

This research objective tested how individual factors pertaining to management systems (modern and process) impact hospital performance (quality of care) outcomes. Findings include that some factors belonging to either modern or process management practices do impact hospital performance ($p<0.05$). Thus, hospitals need to find the best fitting management style to improve hospital performance outcomes. This finding is consistent with claims by Porter (2009) that a majority of current management systems deployed in U.S. hospitals is ineffective to manage the growing demand for care (Porter 2009; Porter and Teisberg 2007).

In particular, one of the factors of modern management, namely that "*managers often have to revisit/rework problems because they did not determine the root cause"* had a negative impact on hospital performance outcomes (significant, $p<0.05$). This finding supports Womack's (2008) claim that without the right mindset and without the proper tools to solve root causes of problems, sustainable improvements are not possible (Womack 2008; Liker 2004; Womack 2002).

Process management, also known as lean management (based on the Toyota production system, TPS), promises better performance for hospitals and is seen to resolve many of the shortcomings of the modern management style. However, this study did not yield conclusive proof that process management factors have a positive influence on quality of care outcomes of U.S. hospitals. One process management related factor, that *"managers are responsible for cross functional activities in addition to their own functional areas*," was found to be negatively related to hospital performance (significant, $p<0.05$). The result is contradictory to findings of previous research by Boyer and Pronovost (2010), showing that process management has a positive impact on hospital performance outcomes. However, Boyer and Pronovost (2010) used a different description of process management (defined by CMS 2012) than the one used in this study (where process management was used synonymously for lean management). Possibly, differences in the results from these two surveys can be explained by the fact that employees at U.S. hospitals possess limited knowledge about process management (Boyer et al. 2012; Boyer and Pronovost 2010). However, no judgment can be made about the merit of either outcome and further investigation of the issue is necessary.

Another challenge for hospitals is to find leadership that fosters change and improves quality of care, while hospitals also need leadership that creates an environment in which employees feel taken seriously (Buerhaus et al. 2007; Hassmiller and Cozine 2006; Buerhaus et al. 2005). The finding of this research showed no evidence that any of the leadership traits tested does significantly impact hospital performance, a finding that is not consistent with results by Marley et al. (2004) or Meyer and Collier (2001). These authors found indicators that there are leadership traits that are helpful in improving hospital performance. The discrepancy between this study and the studies by Marley et al. (2004) and Meyer and Collier (2001) may result from differences in the survey methodology. Both studies (Marley et al. 2004 and Meyer and Collier 2001) employed widely used, standardized questionnaires, whereas this research used questions from different sources and combined them with factors relating to management systems and organizational traits.

Hospitals also must find the appropriate organizational traits to drive hospital performance improvements. However, our research results did not produce any significant evidence of organizational traits that have a significant impact on hospital performance. Thus, our results are inconsistent with past research that showed a significant impact of organizational traits on hospital performance outcomes (Aiken et al. 2002; Pronovost et al. 1999; Aiken et al. 1994). Additional research is needed to determine the reasons for these disparities.

Interestingly, while testing factors from modern management, process management, leadership, and organizational traits and their impact on hospital performance, the type of hospital (acute care hospital or critical access hospital) turned out to be a significant determinant of hospital performance. This finding is consistent with findings by Joynt et al. (2011), who concluded that critical access hospitals (CAHs) had lower quality of care (e.g., performance) compared to acute care hospitals. These findings open questions as to what differences in respect to management systems, organizational characteristics, and leadership styles exist between acute care and critical access hospitals to explain the differences in hospital performance.

9.2. Chief executive Leadership traits in U.S. hospitals

The second research objective tested if there are differences in CEO traits among CEOs leading lean, high (top 20th percentile), and low performing (bottom 20th percentile) U.S. hospitals based on a national ranking of hospitals (HHS 2012). Findings from this part of the project were that CEO traits differ considerably between lean and low performing hospitals and, to a lesser degree, between high and low performing hospitals. However, this study found no differences in CEO traits between lean and high performing hospitals.

Interestingly, the findings showed that CEOs perceive their own leadership traits different from their followers. The comparison of CEO self-assessment of their traits among CEOs of lean and low performing hospitals showed only one factor to be significantly different ($P<0.05$) among all responding CEOs. Followers, however, perceived the CEO traits of low performing hospital CEOs to be significantly different from CEOs of lean hospitals in 34 of 44 leadership traits asked. Thus, it may be argued that the discrepancy between CEO self-awareness and follower perception of CEO traits is part of the dilemma of lower performance, as other researchers have pointed out (Schyns et al. 2008; Kirkpatrick and Locke 1991).

From the CEO self-assessment, the only factor to be found significantly different between CEO traits of lean and low performing hospitals ($p=0.0206$) was the trait "*Our CEO asks what we can learn*." In fact, this study found that CEOs of lean hospitals are more reflective and involved in continuous learning than are CEOs of low performing hospitals. This finding is consistent with findings from Liker and Convis (2011), Miller (2011), and Weber (2006) (Liker and Convis 2011; Miller 2011; Weber 2006).

Findings from comparing leadership traits of CEOs of lean and low performing hospitals from their followers' point of view showed all 8 factors of **level 5 leadership traits** (Collins 2001) to be significantly different ($p<0.05$), with level 5 leadership traits being more likely to be present in lean hospitals than in low performing hospitals. This finding is supported by Collins (2001), who stated that level 5 leadership traits have a positive impact on performance outcomes. Also, all eight leadership traits adapted from the **Baldrige criteria** (Flynn and Saladin 2001; Hutton 2000) were found to be significantly different between CEOs of lean and low performing hospitals, thus supporting findings by Meyer and Collier (2001) that the leadership traits inquired about in the Baldrige criteria are positively linked with performance results. Not all 14 **lean leadership traits** adapted from Jones (2011), were found to be significantly different between lean and low performing hospitals (8 out of 14 lean leadership traits were found to be significantly different). The eight CEO leadership traits found to be significantly different between lean and low performing hospitals were: gives personal attention ($p=0.0089$), recognizes and celebrates accomplishments ($p<0.0001$), provides followers with a vision and a sense of mission, ($p=0.0003$), has followers' respect and trust ($p<0.0001$), communicates high expectations ($p=0.0149$), expresses important purposes in simple ways ($p<0.0001$), promotes intelligence, rationality, and careful problem solving ($p=0.0001$), instills pride ($p=0.0001$), and follows up on promised rewards ($p<0.0127$).

Results from the comparison of CEO leadership traits among **high and low performing** hospitals did not completely support Collins' (2001) claim that high performing companies have a CEO that embodies all **level 5 leadership traits**. This study found only one of the 8 factors, namely "*Acts with quiet, calm determination,*" adapted from Collins' work (2001) to be significantly different ($p<0.0440$). Findings regarding the **Baldrige criteria** (Flynn and Saladin 2001; Hutton 2000) showed one factor between high and low performing hospitals to be significantly different ($p=0.0440$), namely that the "*CEO actively listens to different point of views*." This supports findings by Bass (1990) that a leader that accepts a wide range of viewpoints and out-of-the-box thinking creates superior performance (Bass 1990). However, this study did not produce any proof that any of the lean leadership traits tested in the survey was employed differently by CEOs of high and low performing hospitals.

Finally, the comparison of CEO leadership traits between **lean and high performing** hospitals did not show any CEO leadership traits that were significantly different between these two types of hospital organizations, reminding the researchers of the fact that CEO leadership traits are not the only determinant of hospital performance (Marley et al. 2004; Flynn et al. 1994). These findings open questions as to what differences in respect to management systems and organizational traits exist that describe the performance gap between lean and high performing hospitals.

9.3. Differences in management systems

The third research objective investigated differences in management systems used between lean, high (top 20th percentile), and low performing (bottom 20th percentile) U.S.

hospitals based on the national ranking of hospitals using publicly available quality of care measures (HHS 2012). Findings revealed that 4 factors differed significantly between lean and low performing hospitals, but no evidence was found that there are differences between lean and high performing hospitals and high and low performing hospitals. However, as findings of the first study objective have shown, the type of management system used in U.S. hospitals is of crucial and strategic importance to improve hospital performance (as measured by quality of care).

Findings from comparing management system factors of **lean and low performing hospitals** showed that 4 factors (process management) are significantly different. These factors are: "S*uccessful managers are identified as those who both deliver results and create a learning environment to help their employees in self-discovery* (p=0.0225)," "*When things do not go according to plan, the manager's job is to develop corrective action in a learning environment* (p=0.0223)," "*Managers are developed primarily through in-company learning/mentoring, on-the-job training, and problem solving* (p=0.0275)," and "*Managers make decisions by both analyzing the existing data and gathering first-hand information* (p=0.0004)." These results supports Jones' (2011) claim that hospitals are just at the beginning of their lean journey and leave open the possibility that the healthcare industry will benefit from lean practices in the future. Thus, it can be speculated that the performance gap between lean and low performing U.S. hospitals will grow over time.

9.4. Conclusions

Results from this study show how important management systems and leadership traits are to deliver better quality of care (e.g. performance) in U.S. hospitals. This research identified two management system factors and one hospital type as the main driver for hospital performance outcomes. These findings are supported by Porter's (2009) notion that the majority of current management systems in U.S. hospitals are ineffective and costly to manage a growing demand for care (Porter 2009; Porter and Teisberg 2007). The finding that hospital type (acute care or critical access hospital) significantly influences hospital performance is in line with a study by Joynt et al. (2011), who found that critical access hospitals deliver lower quality of care than do acute care hospitals. The research also uncovered significant differences in CEO traits among lean and low, and low and high performing hospitals. Surprisingly, this study found no evidence of differences in leadership traits among lean and high performing hospitals.

For this nation to prosper in the future, the performance of its hospitals needs to be improved and made more cost effective. This study has, hopefully, contributed a small part to finding areas where improvements do have an impact on hospital performance and has opened new questions that will support additional efforts in the future.

9.5. References

Aiken, L. H., S. P. Clarke, D. M. Sloane, and others. 2002. “Hospital Staffing, Organization, and Quality of Care: Cross-national Findings.” *International Journal for Quality in Health Care* 14 (1): 5–14.

Aiken, L. H., H. L. Smith, and E. T. Lake. 1994. “Lower Medicare Mortality Among a Set of Hospitals Known for Good Nursing Care.” *Medical Care*: 771–787.

Bass, B. M. 1990. “Bass & Stogdill’s Handbook of Leadership.” *Research and Managerial*: 21.

Bohmer, R., and C. I. Knoop. 2007. “The Challenge Facing the US Healthcare Delivery System.” *HBS Case*: 9–606.

Bootman, J. Lyle. 2000. “To Err Is Human.” *Arch Intern Med* 160 (21) (November 27): 3189. doi:10.1001/archinte.160.21.3189.

Boyer, K. K., J. Gardner, and S. Schweikhart. 2012. “Process Quality Improvement: An Examination of General vs. Outcome-specific Climate and Practices in Hospitals.” *Journal of Operations Management*.

Boyer, K. K., and P. Pronovost. 2010. “What Medicine Can Teach Operations: What Operations Can Teach Medicine.” *Journal of Operations Management* 28 (5).

Buerhaus, P. I., K. Donelan, B. T. Ulrich, L. Norman, C. DesRoches, and R. Dittus. 2007. “Impact of the Nurse Shortage on Hospital Patient Care: Comparative Perspectives.” *Health Affairs* 26 (3): 853–862.

Buerhaus, P. I., K. Donelan, B.T. Ulrich, L. Norman, and R. Dittus. 2005. “Is the Shortage of Hospital Registered Nurses Getting Better or Worse? Findings from Two Recent National Surveys of RNs.” *Nursing Economics* 23 (2): 61–71.

CMS. 2012. “Quality Initiative.” http://www.cms.hhs.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/QualityInitiativesGenInfo/index.html?redirect=/QualityInitiativesGenInfo/.

Collins, Jim. 2001. *Good to Great: Why Some Companies Make the Leap... and Others Don’t*. 1st ed. Harper Business.

Flynn, B. B., and B. Saladin. 2001. “Further Evidence on the Validity of the Theoretical Models Underlying the Baldrige Criteria.” *Journal of Operations Management* 19 (6): 617–652.

Flynn, B. B., R. G. Schroeder, and S. Sakakibara. 1994. “A Framework for Quality Management Research and an Associated Measurement Instrument.” *Journal of Operations Management* 11 (4): 339–366.

Hassmiller, S. B., and M. Cozine. 2006. “Addressing the Nurse Shortage to Improve the Quality of Patient Care.” *Health Affairs* 25 (1): 268–274.

HHS. 2012. “Hospital Compare.” http://www.hospitalcompare.hhs.gov/staticpages/help/hospital-how-to.aspx.

Hutton, D. W. 2000. *From Baldrige to the Bottom Line: A Road Map for Organizational Change and Improvement*. American Society for Qualit.

Jones. 2011. “Lean Leadership Characteristics” presented at the Lean Management Summit.

Joynt, K. E., Y. Harris, E. J. Orav, and A. K. Jha. 2011. “Quality of Care and Patient Outcomes in Critical Access Rural Hospitals.” *JAMA: The Journal of the American Medical Association* 306 (1): 45.

Kirkpatrick, S. A., and E. A. Locke. 1991. “Leadership: Do Traits Matter?” *The Executive* 5 (2): 48–60.

Kohn, Linda T. 2000. “To Err Is Human : Building a Safer Health System.”

Levit, K., C. Smith, C. Cowan, H. Lazenby, A. Sensenig, and A. Catlin. 2003. “Trends in US Health Care Spending, 2001.” *Health Affairs* 22 (1): 154–164.

Liker, Jeffrey, and Gary L. Convis. 2011. *The Toyota Way to Lean Leadership: Achieving and Sustaining Excellence Through Leadership Development*. 1st ed. McGraw-Hill.

Liker, Jeffrey K. 2004. *The Toyota Way*. McGraw-Hill Professional.

Marley, Kathryn A., David A. Collier, and Susan Meyer Goldstein. 2004. “The Role of Clinical and Process Quality in Achieving Patient Satisfaction in Hospitals.” *Decision Sciences* 35 (3) (August 1): 349–369. doi:10.1111/j.0011-7315.2004.02570.x.

McGlynn, E. A., S. M. Asch, J. Adams, J. Keesey, J. Hicks, A. DeCristofaro, and E. A. Kerr. 2003. “The Quality of Health Care Delivered to Adults in the United States.” *New England Journal of Medicine* 348 (26): 2635–2645.

Meyer, Susan M., and David A. Collier. 2001. “An Empirical Test of the Causal Relationships in the Baldrige Health Care Pilot Criteria.” *Journal of Operations Management* 19 (4) (July): 403–426. doi:10.1016/S0272-6963(01)00053-5.

Miller, Lawrence M. 2011. *Lean Culture - The Leader's Guide*. L. M. Miller Consulting.

Porter, M. E. 2009. "A Strategy for Health Care Reform—toward a Value-based System." *New England Journal of Medicine* 361 (2): 109–112.

Porter, M. E., and E. O. Teisberg. 2006. *Redefining Health Care: Creating Value-based Competition on Results*. Harvard Business Press.
———. 2007. "How Physicians Can Change the Future of Health Care." *JAMA: The Journal of the American Medical Association* 297 (10): 1103–1111.

Pronovost, P. J., M. W. Jenckes, T. Dorman, E. Garrett, M. J. Breslow, B. A. Rosenfeld, P. A. Lipsett, and E. Bass. 1999. "Organizational Characteristics of Intensive Care Units Related to Outcomes of Abdominal Aortic Surgery." *JAMA: The Journal of the American Medical Association* 281 (14): 1310–1317.

Schyns, B., B. Kroon, and G. Moors. 2008. "Follower Characteristics and the Perception of Leader-member Exchange." *Journal of Managerial Psychology* 23 (7): 772–788.

Shortell, S. M., and S. J. Singer. 2008. "Improving Patient Safety by Taking Systems Seriously." *JAMA: The Journal of the American Medical Association* 299 (4): 445–447.

Singer, S. J., D. M. Gaba, J. J. Geppert, A. D. Sinaiko, S. K. Howard, and K. C. Park. 2003. "The Culture of Safety: Results of an Organization-wide Survey in 15 California Hospitals." *Quality and Safety in Health Care* 12 (2): 112–118.

Weber, D. 2006. "Toyota-style Management Drives Virginia Mason." *Physician Executive* 32 (1): 12.

Womack, James P. 2002. "Lean Thinking: Where Have We Been and Where Are We Going?" Manufacturing Engineering 129 (3) (September): L2.

Womack, J. P. 2008. *The Power of Purpose, Process and People*.

Appendix A – Number of hospital beds and beds per capita

state		# beds	population (in thousands)	beds per 1000 citizen
Alabama	AL	15,290	4,709	3.2
Alaska	AK	1,532	698	2.2
Arizona	AZ	13,455	6,596	2.0
Arkansas	AR	9,565	2,889	3.3
California	CA	68,745	36,962	1.9
Colorado	CO	10,364	5,025	2.1
Connecticut	CT	7,935	3,518	2.3
Delaware	DE	2,125	885	2.4
District of Columbia	DC	3,452	600	5.8
Florida	FL	53,293	18,538	2.9
Georgia	GA	25,419	9,829	2.6
Hawaii	HI	2,966	1,295	2.3
Idaho	ID	3,382	1,546	2.2
Illinois	IL	33,856	12,910	2.6
Indiana	IN	17,298	6,423	2.7
Iowa	IA	10,276	3,008	3.4
Kansas	KS	10,127	2,819	3.6
Kentucky	KY	14,124	4,314	3.3
Louisiana	LA	15,857	4,492	3.5
Maine	ME	3,583	1,318	2.7
Maryland	MD	11,887	5,699	2.1
Massachusetts	MA	15,483	6,594	2.3
Michigan	MI	25,863	9,970	2.6
Minnesota	MN	15,589	5,266	3.0
Mississippi	MS	12,879	2,952	4.4
Missouri	MO	19,101	5,988	3.2
Montana	MT	3,820	975	3.9
Nebraska	NE	7,442	1,797	4.1
Nevada	NV	5,119	2,643	1.9
New Hampshire	NH	2,863	1,325	2.2
New Jersey	NJ	21,054	8,708	2.4
New Mexico	NM	3,913	2,010	1.9

New York	NY	60,400	19,541	3.1
North Carolina	NC	22,830	9,381	2.4
North Dakota	ND	3,362	647	5.2
Ohio	OH	33,994	11,543	2.9
Oklahoma	OK	11,316	3,687	3.1
Oregon	OR	6,481	3,826	1.7
Pennsylvania	PA	39,212	12,605	3.1
Rhode Island	RI	2,512	1,053	2.4
South Carolina	SC	12,483	4,561	2.7
South Dakota	SD	4,142	812	5.1
Tennessee	TN	20,959	6,296	3.3
Texas	TX	62,069	24,782	2.5
Utah	UT	4,973	2,785	1.8
Vermont	VT	1,296	622	2.1
Virginia	VA	17,538	7,883	2.2
Washington	WA	11,322	6,664	1.7
West Virginia	WV	7,408	1,820	4.1
Wisconsin	WI	13,637	5,655	2.4
Wyoming	WY	2,002	544	3.7

Appendix B – Survey questionnaire (1st study objective)

Consent Form

Informed Consent Form

Introduction

During the last decade, the U.S. health care industry has been greatly affected by new and emerging technologies, changing laws and regulations, shifts in the socio-demographic make-up of our population, and new initiatives to control health care costs, among other things. Also, hospitals strive to become more competitive through new processes and management systems.

Objectives

The objective of this study is to determine the impact of leadership practices on hospital performance.

Procedures

Filling out the questionnaire will take approximately 20 minutes or less.

Benefits

There are no direct benefits for participants. However, it is hoped that through your participation, researchers will learn more about the impact of leadership practices on hospital performance. Results from this survey will provide valuable information to the industry about best practices enhancing overall industry performance. Also, the survey helps us to provide the U.S. health care industry with educational material for improved performance. A summary of the results will be made available to all participants.

Confidentiality

All data obtained from participants will be kept confidential and will only be reported in an aggregate format (by reporting only combined results and never reporting individual ones). All questionnaires will be concealed, and no one other than then primary investigator and assistant researches listed below will have access to them. The data collected will be stored in the HIPPA-compliant, Qualtrics-secure database until it has been deleted by the primary investigator.

Participation

Participation in this research study is completely voluntary. You have the right to withdraw at anytime or refuse to participate entirely without penalty. If you desire to withdraw, please close your internet browser and notify the researcher at this email: mathias.schmitt@vt.edu. Or, if you prefer, inform the principal investigator as you leave.

Risks/ Discomforts

Risks are minimal for involvement in this study. Although we do not expect any harm to come upon any participants due to electronic malfunction of the computer, it is possible though extremely rare and uncommon.

Questions about the Research and your Rights as Research Participant

If you have any questions or concerns regarding this study, you may contact Mathias Schmitt at 540-231-9759 or email to mathias.schmitt@vt.edu. Or contact Dr. Urs Buehlmann, the principal investigator at 540-231-9759, or ubuehlm@vt.edu.

Print

Block 6

Please select the state, county, and hospital in which you currently work.

State:
County:
Hospital

If your hospital is not in the list, please provide us the information below

State:
County:
Hospital name:

Note: If you are not working in a hospital, please check the box

- I do not work or belong to a hospital - our organizations name is:

Please indicate the ONE category that BEST describes your hospital or the type of service it provides to the MAJORITY of patients:

- General medical and surgical
- Surgical
- Tuberculosis and other respiratory diseases
- Heart
- Eye, ear, nose, and throat
- Orthopedic
- Institution for the mentally retarded
- Hospital of an institution (college infirmary, prison hospital)
- Psychiatric
- Cancer
- Obstetrics and gynecology
- Rehabilitation
- Chronic disease
- Acute long term care hospital

- Alcoholism and other chemical dependency
- Other (please specify)

Please indicate ALL OTHER types of service your hospital provides to patients:

- General medical and surgical
- Surgical
- Tuberculosis and other respiratory diseases
- Heart
- Eye, ear, nose, and throat
- Orthopedic
- Institution for the mentally retarded
- Alcoholism and other chemical dependency
- Hospital of an institution (college infirmary, prison hospital)
- Psychiatric
- Cancer
- Obstetrics and gynecology
- Rehabilitation
- Chronic disease
- Acute long term care hospital
- Other (please specify)

Please indicate the TYPE OF ORGANIZATION that is responsible for establishing policy for operations at your hospital:

- Investor-owned (for profit) - Individual
- Investor-owned (for profit) - Partnership
- Investor-owned (for profit) - Corporation
- Non-government (non profit) - Not for profit corporation
- Non-government (non profit) - Church owned/operated
- Non-government (non profit) - Other not-for profit organization (please specify)
- State and Local Government - City
- State and Local Government - County
- State and Local Government - State
- State and Local Government - Hospital district
- State and Local Government - Military
- State and Local Government - Public health service
- State and Local Government - Veteran's affairs
- State and Local Government - Department of Justice
- Other (please specify)

Background Information II

Please indicate YOUR POSITION:

- Corporate or Operating Management
- Registered Nurse
- Nursing assistive personnel
- Pharmacist, licensed
- Physician and/or dentist
- Licensed practical (vocational) nurse
- Radiology technician
- Pharmacy technician

- Respiratory therapist
- Medical and dental residents/interns
- Other trainees
- Administrative staff
- Other (please specify) ______

How long have you been with the organization (in years)?

0 year(s)

Indicators for 2010:

	Total	Medicaid	Medicare
Inpatient days			
Inpatient discharges			

Indicators for 2010:

	Total
Number of Births	
Number of Admissions	
Emergency department visits	
Inpatient surgical operations	
Number of operating rooms	
Outpatient surgical operations	
Beds set up and staffed for use	
Total licensed beds	
Average daily census	

Revenues by payor - changes in sales 2008 to 2010

	-21% and less	-11% to -20%	-7% to -10%	-4% to -6%	-1% to -3%	0% to 3%	4% to 6%	7% to 10%	11% to 20%	> 21%
Government - Medicare										
Government - Medicaid										
Government - Other										

Non-government - Self-pay										
Non-government - Third-party payor										
Non-government - Other										

Is your hospital part of a group/chain of hospitals?

- Yes
- No

Please specify how many hospitals belong to this chain

- 2 - 3
- 4 - 6
- 7 - 10
- 11 - 20
- more than 20

Are your hospital employees organized in unions?

- Yes
- No
- Partially (please specify)

In general, in our organization ...

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree	N/A
... managers have the authority to manage downward within functional areas, but do not feel responsible for cross-functional activities.						
... we develop work standards for most activities and usually perform the work in accordance with the standards.						
... managers solve problems by using those who are closest to the problem rather than solving problems at an expert or staff level.						
... managers often have to revisit/rework problems because thy did not determine the root cause.						
... managers are developed primarily through formal education.						
... managers are evaluated according to real-time						

process performance, as well as, end-of-the-reporting-period results.	○	○	○	○	○	○
... when things do not go according to plan, the manager's job is to develop corrective action in a learning environment.	○	○	○	○	○	○
... managers do not have to rework/revisit problems because they have determined the root cause.	○	○	○	○	○	○
... decisions are made at the top of the organization and communicated downward with little or no feedback from employees.	○	○	○	○	○	○
... managers solve problems using staff or expert personnel rather than line-personnel or those closest to the problem.	○	○	○	○	○	○
... we may develop work standards for activities but rarely perform the work in accordance with the standards.	○	○	○	○	○	○
... managers make decisions primarily by analyzing existing data rather than gathering first-hand information.	○	○	○	○	○	○
... successful managers are identified as those who both deliver results and create a learning environment to help their employees in self-discovery.	○	○	○	○	○	○
... managers are blamed when things don't go according to plan and are expected to explain variances.	○	○	○	○	○	○
... managers are evaluated primarily on end-of-the reporting-period results, often regardless of what methods they used to achieve results.	○	○	○	○	○	○
... managers focus on how the work is done and assume the results will follow.	○	○	○	○	○	○
... managers are responsible for cross-functional activities, in addition to their own functional areas.	○	○	○	○	○	○
... managers focus on results rather then how the work is done.	○	○	○	○	○	○
... managers identify and solve problems both cross-functionally and within their own functions.	○	○	○	○	○	○
... managers make decisions by both analyzing the existing data and gathering first-hand information.	○	○	○	○	○	○
... decisions are made at the top of the organization and refined through two-way conversations and involvement with employees.	○	○	○	○	○	○
... successful managers are identified as those who deliver results according to plan, even if they have not engaged their employees in a learning environment.	○	○	○	○	○	○
... managers identify and solve problems only within their functions rather than both cross-functionally and within functions.	○	○	○	○	○	○
... managers are developed primarily through in-company learning/mentoring, on-the-job training,	○	○	○	○	○	○

and problem solving.

Is your organization undertaking a transformation/process improvement effort?

- Yes
- No

How mature do you believe the transformation/process improvement effort is?

	Very Immature	Immature	Between Mature and Immature	Mature	Very Mature
Transformation/process improvement effort					

Please indicate your level of agreement with the statements below:

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree	N/A
Our Organization is more successful than our competitors in the marketplace.						
Our Organization is efficient.						
Our Organization is satisfying patients.						
Our Organization is effective - it achieves what it is meant to.						
Our employees like working here.						
Our Organization is innovative.						

List all process improvement methodologies your hospital is employing:

- LEAN Management
- ISO 9000
- Total Quality Management
- Business Process Engineering
- Six Sigma
- PDCA
- Benchmarking
- Other (please specify)
- DMAIC

Who is responsible (e.g., who "owns") your hospital's process improvement initiative?

- Separate process improvement department
- Part of the following department (please indicate)

What is your resource allocation towards process improvement (Full time equivalent - FTE):

- 0 (FTEs)
- 0.01 - 0.75 (FTEs)
- 0.76 - 1.50 (FTEs)
- 1.51 - 2.00 (FTEs)
- 2.01 - 3.00 (FTEs)
- 3.01 - 4.00 (FTEs)
- > 4.00 (FTEs)

Leadership

Our executive team ...

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree	N/A
... uses symbols to focus efforts.						
... contracts exchange of rewards for effort.						
... coaches and advises us.						
... expresses important purposes in simple ways.						
... instills pride.						
... abdicates responsibilities and avoids making decisions.						
... communicates high expectations.						
... gains respect and trust.						
... intervenes only if standards are not met.						
... provides us with a vision and a sense of mission.						
... promotes intelligence, rationality, and careful problem solving.						
... recognizes and celebrates accomplishments.						
... gives personal attention.						
... treats each employee individually.						
... observes and searches for deviation from rules and standards and takes corrective action.						
... promises rewards for good performance.						

Please describe the main characteristics/traits of your executive team ...

Hospital performance

For 2010, please indicate the average patient wait time:

	1 - 10 minutes	11 - 20 minutes	21 - 30 minutes	31 - 40 minutes	41 - 50 minutes	51 - 60 minutes	more than 60 minutes
Admission (2010)	○	○	○	○	○	○	○
Provisional diagnosis (2010)	○	○	○	○	○	○	○
Discharge (2010)	○	○	○	○	○	○	○
Ambulance (2010)	○	○	○	○	○	○	○
Triage (2010)	○	○	○	○	○	○	○

What is the average length of stay (ALOS) in your hospital (in days)?

0 days from admission to discharge

What is your case mix adjustment?

0 is our average case mix index (CMI)

What is your patient turnover rate (2010)?

○ 0 - 10%
○ 11 - 20%
○ 21 - 30%
○ 31 - 40%
○ 41 - 50%
○ 51 - 60%
○ 61 - 70%
○ > 70%

What is your medication error rate? (this includes wrong medication, wrong dosage, wrong patient)

- 0 - 0.5%
- 0.6 - 1.5%
- 1.6 - 2.0%
- 2.1 - 3.0%
- 3.1 - 4.0%
- 4.1 - 5.0%
- 5.1 - 6.0%
- 6.1 - 7.0%
- 7.1 - 8.0%
- 8.1 - 9.0%
- 9.1 - 10.0%
- > 10%

Does your hospital have teaching affiliations?

- Yes
- No

What is your incident rate of hospital acquired conditions?
(this includes the number of patients acquiring infections, transfusions reactions, bed sores, foreign object left in a patient, pulmonary embolism, or deep vein thrombosis, post operative hematoma, etc.)

0 %

Please indicate your patient satisfaction score [HCAHPS] in 2010
(Courtesy score for staff, quality of meals, quality of physician care, quality of nursing care, etc.)

0 "Overall Hospital Rating Score"

Please indicate your hospital scores of SAPS III and/or APACHE IV

0 SAPS III (Simplified Acute Physiology Score)

0 APACHE IV (Acute Physiology Score + age point + chronic health points)

Please indicate your total annual staff (without nurses) turnover rate 2010

- 0 - 2%
- 3 - 6%
- 7 - 10%
- 11 - 15%
- 16 - 20%
- 21 - 25%
- 26 - 30%
- 31 - 40%
- > 40%

Please indicate your total annual nurses turnover rate 2010

- 0 - 2%
- 3 - 6%
- 7 - 10%
- 11 - 15%
- 16 - 20%
- 21 - 25%
- 26 - 30%
- 31 - 40%
- > 40%

Please indicate the number of current employees:

	Full time > 35 hours/week	Part time < 35 hours/week
Corporate or Operating Management		
Physician and/or dentist		
Registered Nurse		
Licensed practical (vocational) nurse		
Nursing assistive personnel		
Radiology technician		
Pharmacist, licensed		
Respiratory therapist		
Medical and dental residents/interns		
Other trainees		
Administrative staff		
Other (please specify)		

Financial performance

What are the gross revenues and expenses of your hospital in 2010
(please click and change the bars as needed)

	$ million	Not App
	0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100	
Gross Revenues		
Total Expenses (payroll +		

all non-payroll expenses)

Please indicate the payor performance in 2010

0 % of claims that are paid

Expense distribution per category

Medicare/Medicaid	0	%
Self pay (no insurance)	0	%
Third party (insurance company)	0	%
All HMO and PPO	0	%
Total	0	%

Please indicate the required amount of time for referrals to outside centers (diversion hours)

0 Diversion hours

Expense incurred by hospital - please indicate the percentage of overtime (in hours/year)

0 % overtime hours in 2010

Request - summary of results

Please indicate if you would like to receive a summary of the results

- Yes
- No

Please send the results to the following E-Mail address:

E-Mail

Appendix C – Institutional Review Board (IRB) approval letter

VirginiaTech

Office of Research Compliance
Institutional Review Board
2000 Kraft Drive, Suite 2000 (0497)
Blacksburg, Virginia 24060
540/231-4606 Fax 540/231-0959
e-mail irb@vt.edu
Website: www.irb.vt.edu

MEMORANDUM

DATE: July 29, 2011

TO: Urs Kurt Buehlmann, Mathias Schmitt

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires May 31, 2014)

PROTOCOL TITLE: Impact of Leadership Practices on Hospital Performance

IRB NUMBER: 11-643

Effective July 29, 2011, the Virginia Tech IRB Chair, Dr. David M. Moore, approved the new protocol for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at http://www.irb.vt.edu/pages/responsibilities.htm (please review before the commencement of your research).

PROTOCOL INFORMATION:
Approved as: **Expedited, under 45 CFR 46.110 category(ies) 5, 7**
Protocol Approval Date: **7/29/2011**
Protocol Expiration Date: **7/28/2012**
Continuing Review Due Date*: **7/14/2012**
*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:
Per federally regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals / work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

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An equal opportunity, affirmative action institution

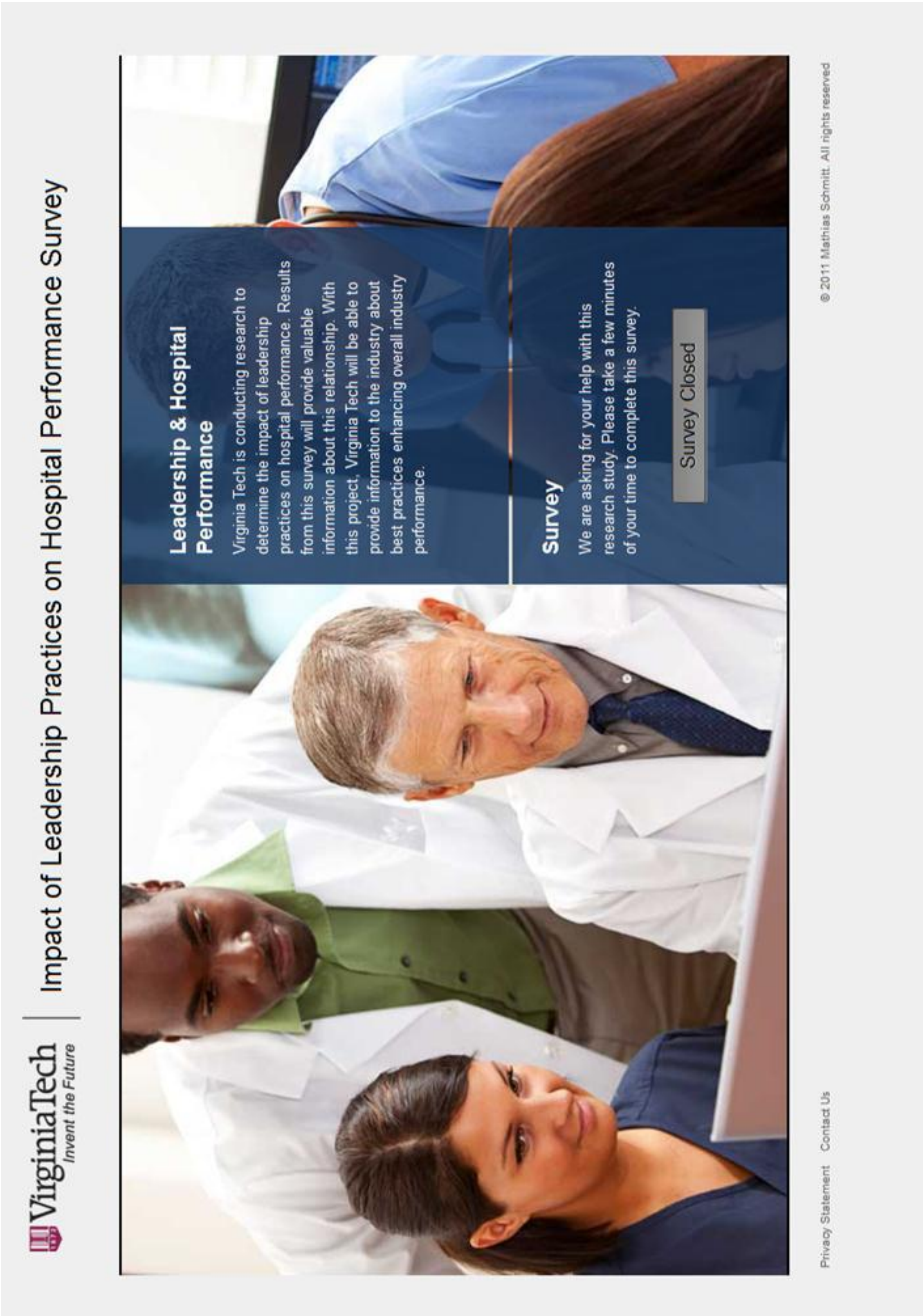
Date*	OSP Number	Sponsor	Grant Comparison Conducted?
7/25/2011	09071810	Lean Management Inst.	Not Required (not federally funded)

*Date this proposal number was compared, assessed as not requiring comparison, or comparison information was revised.

If this IRB protocol is to cover any other grant proposals, please contact the IRB office (irbadmin@vt.edu) immediately.

cc: File

Appendix D – Website to access online survey



Appendix E – Marketing letter

VirginiaTech

Brooks Center (0503), 1650 Ramble Road
Blacksburg, Virginia 24061
540-231-9759 Fax: 540-231-8868
E-mail: mathias.schmitt@vt.edu
www.hospitalleadership.org

July 22, 2011

XXXX HOSPITAL
QUALITY AND PROCESS IMPROVEMENT
LANSTIGER
YYYY, PA 99999

Dear Hospital Manager,

During the last decade, the U.S. health care industry has been greatly affected by new and emerging technologies, changing laws and regulations, shifts in the socio-demographic make-up of our population, and new initiatives to control health care costs, among other things. Also, given the intense focus on cost control, hospitals strive to become more competitive through new processes and management systems.

Virginia Tech is conducting **research to determine the impact of leadership practices on hospital performance.** Results from this survey will provide valuable information about this relationship. With this project, Virginia Tech will be able to provide information to the industry about best practices enhancing overall industry performance.

We are asking for your help with this research study by completing the online questionnaire at www.hospitalleadership.org. Participation is voluntary and you have the right to withdraw at any point without penalty. Filling out our questionnaire will take only a few minutes of your time. Please be assured that **your response will be treated with complete confidentiality** and only aggregated results will be reported. A summary of the results will be made available to all participants.

Thank you very much for your time and assistance. Should you have any questions, please contact me by phone at 540-231-9759, (fax) 540-231-8868, or (email) mathias.schmitt@vt.edu.

Sincerely,

M. Schmitt

Mathias Schmitt
Ph.D. candidate

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Appendix F – Reminder postcard

VirginiaTech

Brooks Center (0503)
Blacksburg, Virginia 24061

Invent the Future

Non-Profit Org.
U.S. Postage
PAID
Blacksburg, VA 24060
Permit No. 28

«CONTACT_NAME»
«COMPANY_NAME»
«MAILING_ADDRESS»
«CITY» «STATE» «ZIP_COMPLETE»«ZIP_ADDITIONAL»

VirginiaTech

We need your help! Recently, you were mailed a letter inviting you to help us with our research regarding Leadership in Healthcare. I am contacting you to ask your help by completing the questionnaire **online** at www.hospitalleadership.org.

If you have already completed the survey, please accept my sincere gratitude.

Your participation is sincerely appreciated. The information you provide will be kept **strictly confidential.** If you have any questions, please contact me at (540) 231-9759 (phone), (540) 231-8868 (fax) or mathias.schmitt@vt.edu.

Thank you in advance for your participation.

Sincerely,

M. Schmitt

Mathias Schmitt
Ph.D. candidate
Virginia Tech

Appendix G – Non-response bias questionnaire

Please indicate the ONE category that BEST describes your hospital or the type of service it provides to the MAJORITY of patients:

- General medical and surgical
- Surgical
- Tuberculosis and other respiratory diseases
- Heart
- Eye, ear, nose, and throat
- Orthopedic
- Institution for the mentally retarded
- Alcoholism and other chemical dependency
- Hospital of an institution (college infirmary, prison hospital)
- Psychiatric
- Cancer
- Obstetrics and gynecology
- Rehabilitation
- Chronic disease
- Acute long term care hospital
- Other (please specify)

Please indicate your level of agreement with the statements below:

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree	N/A
Our employees like working here.	○	○	○	○	○	○
Our Organization is more successful than our competitors in the marketplace.	○	○	○	○	○	○
Our Organization is efficient.	○	○	○	○	○	○
Our Organization is innovative.	○	○	○	○	○	○
Our Organization is satisfying patients.	○	○	○	○	○	○
Our Organization is effective - it achieves what it is meant to.	○	○	○	○	○	○

List all process improvement methodologies your hospital is employing:

- Total Quality Management
- Business Process Engineering
- PDCA
- Benchmarking
- LEAN Management
- Six Sigma
- Other (please specify)
- ISO 9000
- DMAIC

Appendix H – Quality of care measures

AMI factors are:

- Heart attack patients given angiotensin converting enzyme inhibitor or angiotensin receptor blocker for left ventricular systolic dysfunction
- Heart attack patients given aspirin at arrival
- Heart attack patients given aspirin at discharge
- Heart attack patients given beta blocker at discharge
- Heart attack patients given fibrinolytic medication within 30 minutes of arrival
- Heart attack patients given percutaneous coronary intervention within 90 minutes of hospital arrival
- Heart attack patients given smoking cessation advice/counseling
- Median time to fibrinolysis
- Average number of minutes before outpatients with chest pain or possible heart attack who needed specialized care were transferred to another hospital
- Average number of minutes before outpatients with chest pain or possible heart attack got an electrocardiography

HF factors are:

- Heart failure patients given discharge instructions
- Heart failure patients given an evaluation of left ventricular systolic function
- Heart failure patients given angiotensin converting enzyme inhibitor or angiotensin receptor blocker for left ventricular systolic dysfunction
- Heart failure patients given smoking cessation advice/counseling

PN factors are:

- Pneumonia patients assessed and given pneumococcal vaccination

- Pneumonia patients whose initial emergency room blood culture was performed prior to the administration of the first hospital dose of antibiotics
- Pneumonia patients given smoking cessation advice/counseling
- Pneumonia patients given initial antibiotic(s) within 6 hours after arrival
- Pneumonia patients given the most appropriate initial antibiotic(s)
- Pneumonia patients assessed and given influenza vaccination

SCIP factors are:

- Outpatients having surgery who got an antibiotic at the right time - within one hour before surgery
- Outpatients having surgery who got the right kind of antibiotic
- Surgery patients who were taking heart drugs called beta blockers before coming to the hospital, who were kept on the beta blockers during the period just before and after their surgery
- Surgery patients who were given an antibiotic at the right time (within one hour before surgery) to help prevent infection
- Surgery patients who were given the right kind of antibiotic to help prevent infection
- Surgery patients whose preventive antibiotics were stopped at the right time (within 24 hours after surgery)
- Heart surgery patients whose blood sugar (blood glucose) is kept under good control in the days right after surgery
- Surgery patients needing hair removed from the surgical area before surgery, who had hair removed using a safer method
- Surgery patients whose urinary catheters were removed on the first or second day after surgery
- Patients who got treatment at the right time (within 24 hours before or after their surgery) to help prevent blood clots after certain types of surgery

Appendix I – Survey questionnaire for CEOs (2nd study objective)

Consent Form

Informed Consent Form

Introduction

During the last decades, the U.S. health care industry has been greatly affected by new and emerging technologies, changing laws and regulations, shifts in the socio-demographic make-up of our population, and new initiatives to control health care costs, among other things. In response, hospitals strive to become more competitive through improved processes and management systems.

Objectives

The objective of this study is to determine the impact of leadership practices on hospital performance.

Procedures

Filling out the questionnaire will take approximately 20 minutes or less.

Benefits

Your participation will enable researchers to learn more about the impact of leadership practices on hospital performance. Results from this survey will provide valuable information to the industry about best practices. Also, the survey will provide the U.S. health care industry with educational material for improved performance. A summary of the results will be made available to all participants.

Confidentiality

All data obtained from participants will be kept confidential and will only be reported in an aggregate format. All questionnaires will be concealed, and no one other than the primary investigator and assistant researcher listed below will have access to the data. The data collected will be stored in the HIPPA-compliant, Qualtrics-secure database until it has been deleted by the primary investigator.

Participation

Participation in this research study is completely voluntary. You have the right to withdraw at any time or refuse to participate entirely without penalty. If you desire to withdraw, please close your Internet browser and notify the researcher at this email address: mathias.schmitt@vt.edu. Or, if you prefer, inform the principal investigator as you leave.

Risks/Discomforts

Risks are minimal for involvement in this study. Although we do not expect any harm to come upon any participants due to electronic malfunction of the computer, it is possible though extremely rare and uncommon.

Questions about the Research and your Rights as Research Participant

If you have any questions or concerns regarding this study, you may contact Mathias Schmitt at 540-231-9759 or email to mathias.schmitt@vt.edu. Or contact Dr. Urs Buehlmann, the principal investigator at 540-231-9759, or ubuehlm@vt.edu.

Background Information

Important

This survey tries to depict your hospital as it is. Therefore, please answer the questions according to your experience and observations and not according to what you envision would be a better state of things.

If you are unable to answer a question due to missing information or insights, please leave the questions blank.

1. Please select the state, county, and hospital in which you currently work.

State:
County:
Hospital

2. How long have you been working for your current employer (in years):

0 year(s)

3. Please indicate below how you spend your time at work.

(please use your cursor to set the bars as needed)

	percent of time										
	0	10	20	30	40	50	60	70	80	90	100
'fire-fighting'											
daily work											
personnel issues											
improvements											
Total:											

Questions about myself - the Chief Executive officer

4. This section consists of questions regarding yourself - Chief Executive Officer (CEO)

For your hospital, please indicate your level of agreement with the statements below.
If you are unable to answer a question due to missing information or insights, please leave it blank.

I ...

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	N/A
…set clear directions.	○	○	○	○	○	○
…enable staff to do their work.	○	○	○	○	○	○
…develop and mentor staff by asking questions						

rather than telling them what to do.

…deploy the right improvements to close performance gaps.

…am present/visible on a regular basis to my employees.

…think from a patient/customer point of view.

…try to establish a learning organization (thinking and doing).

…generate superb results.

…act with quiet, calm determination.

…show professional will and personal humility.

…abdicate responsibility and avoid making decisions.

…promise rewards for good performance.

…coach and advise my employees.

…give personal attention.

…recognize and celebrate accomplishments of others.

…provide our employees with a vision and a sense of mission.

…gained employees respect and trust.

…communicate high expectations.

…observe and search for deviations from rules and standards and take corrective actions.

…mainly express important purposes in simple ways.

…intervene only if standards are not met.

…promote intelligence, rationality, and careful problem solving.

…follow through on words and promises made.

…show and set a personal example of what is expected.

…set achievable plans, milestones, and goals.

…am committed to experiments and I take risks.

... ask "what can we learn?"	○	○	○	○	○	○
... actively listen to different points of view.	○	○	○	○	○	○
... treat everyone with respect and dignity.	○	○	○	○	○	○
... make sure that people grow in their jobs.	○	○	○	○	○	○
... instill pride.	○	○	○	○	○	○
... follow and apply the scientific method –- plan-do-study-adjust (PDSA or PDCA).	○	○	○	○	○	○

4. This section consists of questions regarding yourself - Chief Executive Officer (CEO) ... continued

For your hospital, please indicate your level of agreement with the statements below.
If you are unable to answer a question due to missing information or insights, please leave it blank.

I ...

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	N/A
... create process stability and practice front-line management (where value is created).	○	○	○	○	○	○
... manage by facts.	○	○	○	○	○	○
... demonstrate a compelling modesty, shun public adulation, am humble, and am never boastful.	○	○	○	○	○	○
... give credit for the organization's success to other people, external factors, and good luck; and take full responsibility for poor results, never blaming other people, external factors, or bad luck.	○	○	○	○	○	○
... channel ambition into the hospital, not the self; set up successors for even greater success in the next generation.	○	○	○	○	○	○
... demonstrate an unwavering resolve to do whatever must be done to produce the best long-term results, no matter how difficult.	○	○	○	○	○	○
... set the standard of building an enduring great hospital; will settle for nothing less.	○	○	○	○	○	○
... train us in responding and solving problems.	○	○	○	○	○	○
... have thought about changing my job during the past six months.	○	○	○	○	○	○
... hold regular stand-up meetings, use visuals and keep everyone on track.	○	○	○	○	○	○
... manage by going to the place where the work is performed and to observe what happens and ask why.	○	○	○	○	○	○

…follow up on promised rewards.	○	○	○	○	○	○
…focus on the vital few things and deselect other tasks.	○	○	○	○	○	○

What are the vital few things?

(please list them in the box below)

Please describe your main characteristics/ traits as a CEO

(such as, for example, innovative, selfish, intelligent, aggressive, knowledgeable, incompetent, callous, visionary, technical competent, evil, enthusiastic, emotional, tolerant, corrupt, persistent, rigid, administrative ability…)

Question about the organization

5. This section consists of questions regarding your hospital's - the big picture

For your hospital, please indicate your level of agreement with the statements below.
If you are unable to answer a question due to missing information or insights, please leave it blank.

Big Picture

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	N/A
Our employees know our hospital's vision.	○	○	○	○	○	○
Our employees know our hospital's mission.	○	○	○	○	○	○
Our senior leadership team shares information about the organization.	○	○	○	○	○	○
Our senior leadership team asks our employees for their ideas.	○	○	○	○	○	○
We encourage new ideas (innovations).	○	○	○	○	○	○
Our hospital is flexible and can make changes quickly when needed.	○	○	○	○	○	○
Our employees know how our hospital is doing as a whole.	○	○	○	○	○	○
Our employees know how well our hospital						

organization is doing financially.	○	○	○	○	○	○
Our senior leadership team shares relevant information regularly and on a timely basis.	○	○	○	○	○	○
Our senior leadership team removes things that get in the way of progress.	○	○	○	○	○	○

6. This section consists of questions regarding your hospital's - people

For your hospital, please indicate your level of agreement with the statements below.
If you are unable to answer a question due to missing information or insights, please leave it blank.

People

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	N/A
Our hospital has the right people and skills to do its work.	○	○	○	○	○	○
Our employees cooperate and work as a team.	○	○	○	○	○	○
Our senior leadership team and the hospital cares about our employees.	○	○	○	○	○	○
Our employees are committed to our hospital's success.	○	○	○	○	○	○
Our employees feel free to tell us what they think.	○	○	○	○	○	○
Our employees feel satisfied with their work.	○	○	○	○	○	○
Our senior leadership team has confidence that we practice fair management.	○	○	○	○	○	○
Our senior leadership team holds our employees accountable for their actions.	○	○	○	○	○	○
Our senior leadership team cares about our patients and our employees work.	○	○	○	○	○	○
Our senior leadership team makes sure that our employees understand what is expected of them in their work.	○	○	○	○	○	○
Our employees believe that this is a better place to work for than last year.	○	○	○	○	○	○
Our senior leadership team challenges our people to try new things and new approaches.	○	○	○	○	○	○
The jobs of our employees seem to be leading to the kind of future they want.	○	○	○	○	○	○
Our senior leadership team support and encourage decisions made by our employees.	○	○	○	○	○	○

7. This section consists of questions regarding your hospital's - process and culture

For your hospital, please indicate your level of agreement with the statements below.
If you are unable to answer a question due to missing information or insights, please leave it blank.

Process and Culture

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	N/A
Our senior leadership team creates a work environment that helps our employees doing their jobs.						
Our employees know how to measure the quality of their work.						
Our employees can get everything they need to do their job.						
Our hospital has good processes for doing its work.						
Our hospital is prepared to handle an emergency.						
For the jobs in our field of expertise, working conditions are good.						
Our employees know how well their work group is doing.						
Our hospital has only as many rules and procedures in place as necessary.						
We hold meetings only with the people necessary.						
The most knowledgeable and useful people participate in our meetings.						
Our senior leadership team gives our employees as much flexibility as they need to do their job well.						
Our senior leadership team asks if our patients are satisfied with our work.						
Our daily work processes are efficient.						
Our employees have a plan for every patient.						
Our meetings are efficient (we have an agenda, participants are prepared, tasks are assigned ...)						
Our patients know exactly what will be done with them.						
Our employees are allowed to make decisions to solve problems for their patients.						
Our employees do not solve problems proactively but they "firefight" them when they occur.						
Our employees' patients are satisfied with their work.						

Please describe the 3 main problems of your hospital below:

8. This section consists of questions regarding your hospital's - <u>leadership</u>

For your hospital, please indicate your level of agreement with the statements below.
If you are unable to answer a question due to missing information or insights, please leave it blank.

Leadership

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	N/A
Our senior leadership team has established and oversees specific system-level goals.						
Our senior leadership team commits personally to the achievement of these goals.						
Our senior leadership team establishes solid measures (e.g. hospital mortality rate, adverse drug events, re-admission, length of stay, etc.)						
Our senior leadership team develops executable strategies/plans to achieve our goals.						
Our senior leadership team oversees the execution of our strategies/plans personally.						
Patients and families are deeply involved in all improvement and redesign teams.						
Our senior executives review project teams' progress personally.						
Insurers, employers, personal care providers, and hospital staff are involved in improvement and redesign teams.						
The Chief Finance Officer (CFO) is a primary driver of quality and process improvement initiatives.						
The Chief Finance Officer (CFO) is capable of articulating all quality and process improvement initiatives.						
Physicians are appointed to project teams and process improvement initiatives						
Third party medical providers are regarded as partners in the delivery of care, not as contractors of the hospital.						
The entire senior leadership team creates the framework needed for improvement.						

Process vs. Modern Management

9. This section consists of questions regarding your hospital's - management processes

For your hospital, please indicate your level of agreement with the statements below.
If you are unable to answer a question due to missing information or insights, please leave it blank.

In general, in our organization ...

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree	N/A
... managers are developed primarily through in-company learning/mentoring, on-the-job training, and problem solving.						
... managers identify and solve problems both cross-functionally and within their own functions.						
... managers do not have to rework/revisit problems because they have determined and solved the root cause.						
... managers are evaluated according to real-time process performance, as well as, end-of-the-reporting-period results.						
... we develop work standards for most activities and usually perform the work in accordance with the standards.						
... decisions are made at the top of the organization and refined through two-way conversations and involvement with employees.						
... we may develop work standards for activities but rarely perform the work in accordance with the standards.						
... managers are responsible for cross-functional activities, in addition to their own functional areas.						
... when things do not go according to plan, the manager's job is to develop corrective action in a learning environment.						
... managers are developed primarily through formal education.						
... managers focus on how the work is done and assume the results will follow.						
... managers make decisions by both analyzing the existing data and gathering first-hand information.						
... successful managers are identified as those who both deliver results and create a learning environment to help their employees in self-discovery.						

Request summary of results

Please indicate if you would like to receive a summary of the results

- Yes
- No

Please send the results to the following E-Mail address:

E-Mail

Appendix J – Survey questionnaire for followers (2nd study objective)

Consent Form

Informed Consent Form

Introduction
During the last decades, the U.S. health care industry has been greatly affected by new and emerging technologies, changing laws and regulations, shifts in the socio-demographic make-up of our population, and new initiatives to control health care costs, among other things. In response, hospitals strive to become more competitive through improved processes and management systems.

Objectives
The objective of this study is to determine the impact of leadership practices on hospital performance.

Procedures
Filling out the questionnaire will take approximately 20 minutes or less.

Benefits
Your participation will enable researchers to learn more about the impact of leadership practices on hospital performance. Results from this survey will provide valuable information to the industry about best practices. Also, the survey will provide the U.S. health care industry with educational material for improved performance. A summary of the results will be made available to all participants.

Confidentiality
All data obtained from participants will be kept confidential and will only be reported in an aggregate format. All questionnaires will be concealed, and no one other than the primary investigator and assistant researcher listed below will have access to the data. The data collected will be stored in the HIPPA-compliant, Qualtrics-secure database until it has been deleted by the primary investigator.

Participation
Participation in this research study is completely voluntary. You have the right to withdraw at any time or refuse to participate entirely without penalty. If you desire to withdraw, please close your internet browser and notify the researcher at this email address: mathias.schmitt@vt.edu. Or, if you prefer, inform the principal investigator as you leave.

Risks/Discomforts
Risks are minimal for involvement in this study. Although we do not expect any harm to come upon any participants due to electronic malfunction of the computer, it is possible though extremely rare and uncommon.

Questions about the Research and your Rights as Research Participant
If you have any questions or concerns regarding this study, you may contact Mathias Schmitt at 540-231-9759 or email to mathias.schmitt@vt.edu. Or contact Dr. Urs Buehlmann, the principal investigator at 540-231-9759, or ubuehlm@vt.edu.

Background Information

Important

This survey tries to depict your hospital as it is. Therefore, please answer the questions according to your experience and observations and not according to what you envision would be a better state of things.

If you are unable to answer a question due to missing information or insights, please leave the questions blank.

1. Please select the state, county, and hospital in which you currently work.

State:
County:
Hospital

2. Please identify the organizational level you belong to by checking the appropriate box:

- Senior and Executive Management
- Middle Management
- Front-line Management or Individual Contributors

3. How long have you been working for your current employer (in years):

0 year(s)

4. Please indicate below how you spend your time at work.

(please use your cursor to set the bars as needed)

percent of time

	0	10	20	30	40	50	60	70	80	90	100	
'fire-fighting'												4
daily work												4
personnel issues												4
improvements												4
Total:												16

Questions about the Chief Executive officer

5. This section consists of questions regarding your hospital's - Chief Executive Officer (CEO)

For your hospital, please indicate your level of agreement with the statements below.
If you are unable to answer a question due to missing information or insights, please leave it blank.

Our CEO ...

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	N/A
... sets clear directions.						
... enables staff to do their work.						
... develops and mentors staff by asking questions rather than telling them what to do.						
... deploys the right improvements to close performance gaps.						
... is present/visible on a regular basis.						
... thinks from a patient/customer point of view.						
... establishes a learning organization (thinking and doing).						
... generates superb results.						
... acts with quiet, calm determination.						
... shows professional will and personal humility.						
... abdicates responsibility and avoids making decisions.						
... promises rewards for good performance.						
... coaches and advises us.						
... gives personal attention.						
... recognizes and celebrates accomplishments.						
... provides us with a vision and a sense of mission.						
... has our respect and trust.						
... communicates high expectations.						
... observes and searches for deviations from rules and standards and takes corrective actions.						
... expresses important purposes in simple ways.						
... intervenes only if standards are not met.						
... promotes intelligence, rationality, and careful problem solving.						
... follows through on words and promises made.						
... shows and sets a personal example of what is expected.						
... sets achievable plans, milestones, and goals.						
... is committed to experiments and takes risks.						
... asks "what can we learn?"						
... actively listens to different points of view.						
... treats everyone with respect and dignity.						
... makes sure that people grow in their jobs.						
... instills pride.						
... follows and applies the scientific method –- plan-do-study-adjust (PDSA or PDCA).						

5. This section consists of questions regarding your hospital's - <u>Chief Executive Officer (CEO)</u> ... continued

For your hospital, please indicate your level of agreement with the statements below.
If you are unable to answer a question due to missing information or insights, please leave it blank.

Our CEO ...

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	N/A
... creates process stability and practices frontline management (where value is created).						
... manages by facts.						
... demonstrates a compelling modesty, shuns public adulation, is humble, and is never boastful.						
... gives credit for the organization's success to other people, external factors, and good luck; and takes full responsibility for poor results, never blaming other people, external factors, or bad luck.						
... channels ambition into the hospital, not the self; sets up successors for even greater success in the next generation.						
... demonstrates an unwavering resolve to do whatever must be done to produce the best long-term results, no matter how difficult.						
... sets the standard of building an enduring great hospital; will settle for nothing less.						
... trains us in responding and solving problems.						
... holds regular stand-up meetings, uses visuals and keeps everyone on track.						
... manages by going to the place where the work is performed and to observe what happens and asks why.						
... follows up on promised rewards.						
... focuses on the vital few things and deselects other tasks.						

What are the vital few things?

(please list them in the box below)

Please describe the main characteristics/traits of your CEO

(such as, for example, innovative, selfish, intelligent, aggressive, knowledgeable, incompetent, callous, visionary, technical competent, evil, enthusiastic, emotional, tolerant, corrupt, persistent, rigid, administrative ability...)

Question about the organization

6. This section consists of questions regarding your hospital's - the big picture

For your hospital, please indicate your level of agreement with the statements below.
If you are unable to answer a question due to missing information or insights, please leave it blank.

Big Picture

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	N/A
I know my hospital's vision.						
I know my hospital's mission.						
The CEO shares information about the organization.						
My hospital asks for my ideas.						
My hospital encourages new ideas (innovations).						
My hospital is flexible and can make changes quickly when needed.						
I know how my hospital is doing as a whole.						
I know how well my hospital organization is doing financially.						
My hospital shares relevant information regularly and on a timely basis.						
My hospital removes things that get in the way of progress.						

7. This section consists of questions regarding your hospital's - people

For your hospital, please indicate your level of agreement with the statements below.
If you are unable to answer a question due to missing information or insights, please leave it blank.

People

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	N/A
My hospital has the right people and skills to do its work.						
The people I work with cooperate and work as a team.						
My hospital cares about me.						
I am committed to my hospital's success.						
I feel free to tell my supervisor what I think.						
My work is satisfying to me.						
I have confidence in the fairness of management.						
I am held accountable for my actions.						
I care about my patients and my work.						
I understand what is expected of me in my work.						
This is a better place to work for than last year.						
My hospital challenges me to try new things and new approaches.						
During the past six months I have thought about changing my job.						
My job seems to be leading to the kind of future I want.						
My hospital encourages me to make decisions.						

8. This section consists of questions regarding your hospital's - process and culture

For your hospital, please indicate your level of agreement with the statements below.
If you are unable to answer a question due to missing information or insights, please leave it blank.

Process and Culture

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	N/A
My senior leaders create a work environment that helps me when doing my job.	○	○	○	○	○	○
I know how to measure the quality of my work.	○	○	○	○	○	○
I can get everything I need to do my job.	○	○	○	○	○	○
We have good processes for doing our work.	○	○	○	○	○	○
We are prepared to handle an emergency.	○	○	○	○	○	○
Compared to other jobs in my field of expertise, working conditions are good.	○	○	○	○	○	○
We get good feedback as to how well our work group is doing.	○	○	○	○	○	○
There are too many rules and procedures to follow.	○	○	○	○	○	○
Our meetings have too many people participating.	○	○	○	○	○	○
The most knowledgeable and useful people participate in our meetings.	○	○	○	○	○	○
I have as much flexibility as I need to do my job well.	○	○	○	○	○	○
I ask if my patients are satisfied with my work.	○	○	○	○	○	○
Our daily work processes are efficient.	○	○	○	○	○	○
There is a plan for every patient.	○	○	○	○	○	○
Our meetings are efficient (we have an agenda, participants are prepared, tasks are assigned …)	○	○	○	○	○	○
The patient knows exactly what will be done with her/him.	○	○	○	○	○	○
I am allowed to make decisions to solve problems for my patients.	○	○	○	○	○	○
We do not solve problems proactively but we “firefight” them when they occur.	○	○	○	○	○	○
My patients are satisfied with my work.	○	○	○	○	○	○

Please describe the 3 main problems of your hospital below:

9. This section consists of questions regarding your hospital's - <u>leadership</u>

For your hospital, please indicate your level of agreement with the statements below.
If you are unable to answer a question due to missing information or insights, please leave it blank.

Leadership

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	N/A
Our senior leadership team has established and oversees specific system-level goals.	○	○	○	○	○	○
Our senior leadership team commits personally to the achievement of these goals.	○	○	○	○	○	○
Our senior leadership team establishes solid measures (e.g. hospital mortality rate, adverse drug events, re-admission, length of stay, etc.)	○	○	○	○	○	○
Our senior leadership team develops executable strategies/plans to achieve our goals.	○	○	○	○	○	○
Our senior leadership team oversees the execution of our strategies/plans personally.	○	○	○	○	○	○
Patients and families are deeply involved in all improvement and redesign teams.	○	○	○	○	○	○
Our senior executives review project teams' progress personally.	○	○	○	○	○	○
Insurers, employers, personal care providers, and hospital staff are involved in improvement and redesign teams.	○	○	○	○	○	○
The Chief Finance Officer (CFO) is a primary driver of quality and process improvement initiatives.	○	○	○	○	○	○
The Chief Finance Officer (CFO) is capable of articulating all quality and process improvement initiatives.	○	○	○	○	○	○
Physicians are appointed to project teams and process improvement initiatives	○	○	○	○	○	○
Third party medical providers are regarded as partners in the delivery of care, not as contractors of the hospital.	○	○	○	○	○	○
The entire senior leadership team creates the framework needed for improvement.	○	○	○	○	○	○

<u>Process vs. Modern Management</u>

10. This section consists of questions regarding your hospital's - <u>management processes</u>

For your hospital, please indicate your level of agreement with the statements below.
If you are unable to answer a question due to missing information or insights, please leave it blank.

In general, in our organization ...

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree	N/A
... we develop work standards for most activities and usually perform the work in accordance with the standards.	◎	◎	◎	◎	◎	◎
... managers are developed primarily through formal education.	◎	◎	◎	◎	◎	◎
... successful managers are identified as those who both deliver results and create a learning environment to help their employees in self-discovery.	◎	◎	◎	◎	◎	◎
... managers identify and solve problems both cross-functionally and within their own functions.	◎	◎	◎	◎	◎	◎
... managers make decisions by both analyzing the existing data and gathering first-hand information.	◎	◎	◎	◎	◎	◎
... we may develop work standards for activities but rarely perform the work in accordance with the standards.	◎	◎	◎	◎	◎	◎
... managers are responsible for cross-functional activities, in addition to their own functional areas.	◎	◎	◎	◎	◎	◎
... managers do not have to rework/revisit problems because they have determined and solved the root cause.	◎	◎	◎	◎	◎	◎
... managers are developed primarily through in-company learning/mentoring, on-the-job training, and problem solving.	◎	◎	◎	◎	◎	◎
... managers focus on how the work is done and assume the results will follow.	◎	◎	◎	◎	◎	◎
... managers are evaluated according to real-time process performance, as well as, end-of-the-reporting-period results.	◎	◎	◎	◎	◎	◎
... when things do not go according to plan, the manager's job is to develop corrective action in a learning environment.	◎	◎	◎	◎	◎	◎
... decisions are made at the top of the organization and refined through two-way conversations and involvement with employees.	◎	◎	◎	◎	◎	◎

Request summary of results

Please indicate if you would like to receive a summary of the results

◎ Yes

◎ No

Please send the results to the following E-Mail address:

E-Mail

Appendix K – Institutional Review Board (IRB) approval letter (2nd study objective)

VirginiaTech

Office of Research Compliance
Institutional Review Board
2000 Kraft Drive, Suite 2000 (0497)
Blacksburg, Virginia 24060
540/231-4606 Fax 540/231-0959
e-mail irb@vt.edu
Website: www.irb.vt.edu

MEMORANDUM

DATE: February 2, 2012

TO: Urs Kurt Buehlmann, Mathias Schmitt

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires May 31, 2014)

PROTOCOL TITLE: Impact of Leadership Practices on Hospital Performance

IRB NUMBER: 12-063

Effective February 1, 2012, the Virginia Tech IRB Chair, Dr. David M. Moore, approved the new protocol for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at http://www.irb.vt.edu/pages/responsibilities.htm (please review before the commencement of your research).

PROTOCOL INFORMATION:
Approved as: Exempt, under 45 CFR 46.101(b) category(ies) 2
Protocol Approval Date: 2/1/2012
Protocol Expiration Date: NA
Continuing Review Due Date*: NA
*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:
Per federally regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals / work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Invent the Future

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

An equal opportunity, affirmative action institution

Date*	OSP Number	Sponsor	Grant Comparison Conducted?
1/31/2012	09071810	Lean Management Institute	Not Required (not federally funded)

*Date this proposal number was compared, assessed as not requiring comparison, or comparison information was revised.

If this IRB protocol is to cover any other grant proposals, please contact the IRB office (irbadmin@vt.edu) immediately.

cc: File

Appendix L – Marketing email (2^{nd} study objective)

Dear …,

To do it the Lean way and knowing that you are very busy, I will keep this short. I am a PhD student at Virginia Tech and working on my thesis, titled: Leadership and the Impact on Hospital Performance. Therefore, I am looking for CEO's of high performing hospitals to fill out a brief survey. Given the limited number of hospitals identified, we heavily rely on your cooperation to make this research viable and a success. Your response is crucial, of great relevance to us and the healthcare industry, and is greatly appreciated.

I am writing to ask for your support for the following,

1. 20 minutes of your time to fill out a **CEO** survey. (can be accessed at https://virginiatech.qualtrics.com/SE/?SID=SV_8kcFo2Wb69mi256)
2. Identify 12 others in your organization to fill out a survey (**2 senior execs, 5 middle managers, 5 front line associates**) - accessible at https://virginiatech.qualtrics.com/SE/?SID=SV_cSeF5HZAdQJC2LG
3. Please let me know a contact person that if needed might facilitate the survey at your hospital and keeps in touch with me.

In return, you will receive a copy of the results compared to industry standards.

We look forward to your responses and thank you in advance for participation and contribution in this important research project. Please let me know if you have any questions.

Kind regards,

Mathias Schmitt

Virginia Tech
Brooks Center
1650 Ramble Road
Blacksburg, VA 24061
USA
phone: 540.231.9759

PS – The hospitals participation in this research is crucial and highly appreciated.

Appendix M – Update email about responses received (2nd study objective)

Dear .....,

We greatly appreciate that you and one of your middle managers have taken the survey – Thank you very much. Would it be possible to get some more responses from your hospital? Here is an update on the responses and what would be required.

Hospital – 3/3/2012

CEO:	**done**
Senior and Executive Management:	0 responses (2 responses required) – **2 missing**
Middle Management:	1 responses (5 responses required) – **4 missing**
Frontline Management or Individual Contributors:	0 responses (5 responses required) – **5 missing**

Please let me know if I can be of any help. Thank you very much for your help and collaboration.

Kind regards,

Mathias Schmitt

Virginia Tech
Brooks Center
1650 Ramble Road
Blacksburg, VA 24061
USA
phone: 540.231.9759

PS – The hospitals participation in this research is crucial and highly appreciated.

Appendix N – Correlation Matrix 1 to 4

Work.Test Pearson Correlation Matrix

	TYPE	_NAME_	q1	q2	q3	q4	q5	q6	q7	q8	q9
1	MEAN		3.1027027027	2.9513513514	2.7567567568	2.8186813187	3.0054347826	2.9297297297	2.75	3.2540540541	2.3825136612
2	STD		1.0810840188	1.0595378457	1.1657570177	1.1050273953	1.1804291273	1.0217378803	1.0926980695	1.0710099344	0.9978659749
3	N		185	185	185	182	184	185	184	185	183
4	CORR	q1	1	0.4076827927	0.3347321312	0.3760837396	0.2407813359	0.2574996153	0.4740219581	0.2355044219	0.3346119565
5	CORR	q2	0.4076827927	1	0.3775719041	0.4344150237	0.2055769084	0.3783647832	0.3283186908	0.2552050648	0.3929601095
6	CORR	q3	0.3347321312	0.3775719041	1	0.3646288692	0.3346888551	0.3323469435	0.396965547	0.4154096994	0.4730831487
7	CORR	q4	0.3760837396	0.4344150237	0.3646288692	1	0.3129364842	0.307215987	0.3276888027	0.2403577457	0.3426887629
8	CORR	q5	0.2407813359	0.2055769084	0.3346888551	0.3129364842	1	0.2994582818	0.2419885059	0.281180221	0.1971967356
9	CORR	q6	0.2574996153	0.3783647832	0.3323469435	0.307215987	0.2994582818	1	0.3326744883	0.3441908768	0.3716250335
10	CORR	q7	0.4740219581	0.3283186908	0.396965547	0.3276888027	0.2419885059	0.3326744883	1	0.3084954302	0.4543925712
11	CORR	q8	0.2355044219	0.2552050648	0.4154096994	0.2403577457	0.281180221	0.3441908768	0.3084954302	1	0.3743371624
12	CORR	q9	0.3346119565	0.3929601095	0.4730831487	0.3426887629	0.1971967356	0.3716250335	0.4543925712	0.3743371624	1

Work.Test Pearson Correlation Matrix

	TYPE	_NAME_	q10	q11	q12	q13	q14	q15	q16	q17	q18
1	MEAN		3.6195652174	3.5243243243	3.4324324324	4.0756756757	3.9945355191	3.9016393443	3.6810810811	2.6464088398	3.7826086957
2	STD		1.022612013	1.0635782011	0.9983829464	0.8996996496	0.7667346759	0.9324124099	0.9673579656	0.9468373254	0.8598651179
3	N		184	185	185	185	183	183	185	181	184
4	CORR	q10	1	0.2833597843	0.1819340032	0.3193647015	0.3542529627	0.2852532298	0.4383897242	0.2438192577	0.2281963773
5	CORR	q11	0.2833597843	1	0.3431947499	0.2479668086	0.2450471909	0.407746555	0.4433730907	0.2272998113	0.1482762004
6	CORR	q12	0.1819340032	0.3431947499	1	0.3626997776	0.2604952798	0.3064720242	0.453071339	0.3393869148	0.2783989235
7	CORR	q13	0.3193647015	0.2479668086	0.3626997776	1	0.4679984318	0.3542275346	0.3525946405	0.293548759	0.3243502074
8	CORR	q14	0.3542529627	0.2450471909	0.2604952798	0.4679984318	1	0.4232186232	0.4193391554	0.2374266855	0.3889368163
9	CORR	q15	0.2852532298	0.407746555	0.3064720242	0.3542275346	0.4232186232	1	0.3658957647	0.3371132151	0.4036849836
10	CORR	q16	0.4383897242	0.4433730907	0.453071339	0.3525946405	0.4193391554	0.3658957647	1	0.2194115961	0.2042999802
11	CORR	q17	0.2438192577	0.2272998113	0.3393869148	0.293548759	0.2374266855	0.3371132151	0.2194115961	1	0.2847590576
12	CORR	q18	0.2281963773	0.1482762004	0.2783989235	0.3243502074	0.3889368163	0.4036849836	0.2042999802	0.2847590576	1

Work.Test Pearson Correlation Matrix

	TYPE	_NAME_	q19	q20	q21	q22	q23	q24
1	MEAN		3.4756756757	3.8206521739	3.9675675676	3.5355191257	3.5675675676	4.0216216216
2	STD		1.0111888734	0.7720582163	0.9023080472	0.9593929104	1.0038117716	0.721989678
3	N		185	184	185	183	185	185
4	CORR	q19	1	0.5630605298	0.4816115179	0.4366183616	0.5517758541	0.4176003404
5	CORR	q20	0.5630605298	1	0.4609499549	0.4856539196	0.511130902	0.4469583046
6	CORR	q21	0.4816115179	0.4609499549	1	0.3611625692	0.3864536205	0.4515774183
7	CORR	q22	0.4366183616	0.4856539196	0.3611625692	1	0.4306960282	0.3039983559
8	CORR	q23	0.5517758541	0.511130902	0.3864536205	0.4306960282	1	0.3804183456
9	CORR	q24	0.4176003404	0.4469583046	0.4515774183	0.3039983559	0.3804183456	1

Work.Test Pearson Correlation Matrix

	TYPE	_NAME_	q25	q26	q27	q28	q29	q30	q31	q32	q33	q34
1	MEAN		3.8586956522	3.7868852459	3.6756756757	4.027173913	3.6557377049	3.7621621622	3.7351351351	3.7119565217	3.7135135135	3.2841530055
2	STD		0.9981570092	0.9337638729	0.9513735509	0.9019230531	0.9701916527	0.8390442775	0.9780793669	0.9799456204	0.9435600261	1.0033571223
3	N		184	183	185	184	183	185	185	184	185	183
4	CORR	q25	1	0.6134943619	0.6014621411	0.6412293801	0.5955968916	0.5799381195	0.5308244476	0.3918473682	0.5817274969	0.3179526623
5	CORR	q26	0.6134943619	1	0.781584813	0.5238332102	0.6293542853	0.7091532991	0.7197456928	0.604504905	0.7326379699	0.3811885912
6	CORR	q27	0.6014621411	0.781584813	1	0.4830688717	0.5766796405	0.7198522158	0.7307056458	0.6590848993	0.7495837059	0.3699722779
7	CORR	q28	0.6412293801	0.5238332102	0.4830688717	1	0.4243382128	0.4652631057	0.3807953235	0.2705669643	0.4921753448	0.3496139089
8	CORR	q29	0.5955968916	0.6293542853	0.5766796405	0.4243382128	1	0.6425707511	0.6402279244	0.4712939781	0.6136878961	0.3712259504
9	CORR	q30	0.5799381195	0.7091532991	0.7198522158	0.4652631057	0.6425707511	1	0.618185282	0.5391429451	0.6617294218	0.3474423451
10	CORR	q31	0.5308244476	0.7197456928	0.7307056458	0.3807953235	0.6402279244	0.618185282	1	0.7386494998	0.7300081161	0.4273288729
11	CORR	q32	0.3918473682	0.604504905	0.6590848993	0.2705669643	0.4712939781	0.5391429451	0.7386494998	1	0.635118853	0.4168435877
12	CORR	q33	0.5817274969	0.7326379699	0.7495837059	0.4921753448	0.6136878961	0.6617294218	0.7300081161	0.635118853	1	0.3202845331
13	CORR	q34	0.3179526623	0.3811885912	0.3699722779	0.3496139089	0.3712259504	0.3474423451	0.4273288729	0.4168435877	0.3202845331	1
14	CORR	q35	0.4823272663	0.5954828446	0.562407787	0.4058256967	0.53408132	0.5070770959	0.6015087749	0.4604783672	0.5522763402	0.4671421821
15	CORR	q36	0.4326871671	0.4211310812	0.5059348436	0.3698407423	0.3453980879	0.5069318177	0.335215264	0.2389593303	0.3872684995	0.2544752703

	q35	q36
1	3.9076086957	3.4945652174
2	0.9215968199	0.8683712699
3	184	184
4	0.4823272663	0.4326871671
5	0.5954828446	0.4211310812
6	0.562407787	0.5059348436
7	0.4058256967	0.3698407423
8	0.53408132	0.3453980879
9	0.5070770959	0.5069318177
10	0.6015087749	0.335215264
11	0.4604783672	0.2389593303
12	0.5522763402	0.3872684995
13	0.4671421821	0.2544752703
14	1	0.3578465546
15	0.3578465546	1

Appendix O – All subset models output

Best Models for performance_score 18:13 Thursday, March 29, 2012 10

Obs	model	rsquare	adjrsq	max_p	mape	mae	bias_ uclm	bias	bias_lclm
1	cv3 q8 q10	0.16748	0.15002	0.008559	7.52388	0.063000	0.036306	.007670259	-0.020965
4	cv3	0.10685	0.10073	0.000050	7.31010	0.060555	0.030593	.002144893	-0.026303
5	q8 q10	0.05582	0.04270	0.038777	8.09274	0.067477	0.038484	.007995823	-0.022492
6	q10	0.02730	0.02059	0.045523	8.17016	0.067718	0.035325	.004470763	-0.026383

Appendix P – All subset model p-values

Best Models for performance_score 13
18:13 Thursday, March 29, 2012

The GLM Procedure

Dependent Variable: performance_score performance_score

Parameter		Estimate	Standard Error
Intercept		0.9913095284 B	0.03524225
cv3	ACUTE CARE - VETERANS ADMINISTRATION	0.0000000000 B	.
cv3	Acute Care Hospitals	0.0559908743 B	0.01278468
cv3	Critical Access Hospitals	0.0000000000 B	.
q10		-.0164634543	0.00615886
q8		-.0160801169	0.00603145

Parameter		t Value	Pr > |t|
Intercept		28.13	<.0001
cv3	ACUTE CARE - VETERANS ADMINISTRATION	.	.
cv3	Acute Care Hospitals	4.38	<.0001
cv3	Critical Access Hospitals	.	.
q10		-2.67	0.0084
q8		-2.67	0.0086

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

Appendix Q – Coefficient of determination for all subset model

Best Models for performance_score 12
18:13 Thursday, March 29, 2012

The GLM Procedure

Dependent Variable: performance_score performance_score

Weight: weight weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.15263569	0.05087856	9.59	<.0001
Error	143	0.75872581	0.00530577		
Corrected Total	146	0.91136150			

R-Square	Coeff Var	Root MSE	performance_score Mean
0.167481	7.939152	0.072841	0.917488

Source	DF	Type I SS	Mean Square	F Value	Pr > F
cv3	1	0.09632914	0.09632914	18.16	<.0001
q10	1	0.01859424	0.01859424	3.50	0.0632
q8	1	0.03771231	0.03771231	7.11	0.0086

Source	DF	Type III SS	Mean Square	F Value	Pr > F
cv3	1	0.10176623	0.10176623	19.18	<.0001
q10	1	0.03791316	0.03791316	7.15	0.0084
q8	1	0.03771231	0.03771231	7.11	0.0086