INTEGRATING PEOPLE, PROCESS, AND TECHNOLOGY IN LEAN HEALTHCARE

by

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Dedication

To my dissertation committee, friends, colleagues from the IOE Department and work, and my family: It has been a long road to get to this point, but I have learned and grown much during this process, and I couldn't have done it without you.

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During the many years I have been working concurrently with conducting research, I have had tremendous support from a wide variety of people that I would like to acknowledge. Your support and encouragement over all of these years has been tremendous.

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Steve Hoeft, the leader of our Lean Healthcare group, has been instrumental in my maturation in gaining a deeper understanding of using lean. From my very first project working with him, I could tell that he was an expert on the practical application of lean unlike any that I had worked with before. Throughout the last four years, he has continuously supported and challenged me, which is the true mark of a lean Sensei.

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To the IOE Department

When I took my senior design course as an undergraduate in the Industrial and Operations Engineering (IOE) Department, Prof. Richard Coffee introduced me to the world of healthcare process improvement. This gave me a preview of the potential to work in this industry. His depth of experience and knowledge in the healthcare industry was a tremendous resource, and his constant encouragement was extremely helpful. When I returned from Denver Health, he recruited me to be the Graduate Student Instructor (GSI) for IOE 481, which was the senior design course that I took as an undergraduate. I served as the GSI for this course for almost four years, and it was a great experience and honor to serve as an instructor for a course that was so instrumental in my education and professional development.

Throughout my graduate studies in the IOE department, Tina Blay has been a great support and encouragement for my studies. Her support of the IOE department, and of me, has been priceless!

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Carol Husby (my mom), the Warner family, and all of the others who helped me on this long journey while I tried to meld the life of student and employee have been very helpful. Your patience and understanding during this long process was noticed and very much appreciated.

Foreword

I was first exposed to the lean philosophy and methodology through Prof. Liker, and I was immediately drawn to the potential power of the approach. I had learned a variety of different technical and managerial approaches during my many years of education in the IOE Department, but I struggled with how to change an organization in actuality. When Prof. Liker exposed me to lean, it illustrated the piece that had been missing: people. Prof. Liker's deep study of socio-technical systems, and specifically Toyota, focused on this critical aspect of organizational functioning: the technical systems and the social systems must be integrated for an organization to function and adapt. This insight was the impetus for my career and research. The approach that Toyota had developed over 60 years was a mix of what seemed to be paradoxes and very simple approaches. When examined in a vacuum, each of these could appear to be illogical or obvious. When viewed as a whole and how they affected individuals and an organization as a whole, they were deeply profound. I found this fascinating, but I found it challenging to understand how the sum was greater than the parts.

When I first started studying lean, I often felt that I understood what it was. When I would talk to Prof. Liker, he would always challenge my understanding and help me understand deeper and less obvious aspects of lean. Also, Prof. Liker encouraged me to work and "go to the gemba" in real organizations to mature my understanding of the lean philosophy and methodology. The more I worked with organizations, the more I began to realize what Prof. Liker had been alluding to all along: It wasn't about the tools, or events, or having successful projects, which was my initial understanding. It was something more. It was about thinking in a different way and becoming a teacher to help individuals and organizations think and function in a different way. I began to see that the tools and events were just the visible artifacts of something deeper.

When I decided to pursue my doctoral studies, Prof. Liker was central in both my admission to the program and support throughout. From an early stage, I was fascinated by the

potential of lean in service-industry applications. When I had an opportunity to work at Denver Health under an Agency for Healthcare Research and Quality (AHRQ) grant studying the application of lean in healthcare, Prof. Liker was very supportive. This was a great opportunity to "go to the gemba" in a unique environment. Denver Health was a safety net healthcare system, which was a strongly mission-driven organization that served the most at-risk portions of the population; it was also constrained on resources. If lean could work here, it could work anywhere.

When I began working in healthcare, I saw the tremendous potential of the socio-technical lean perspective. The healthcare system I saw was full of highly educated, skilled, and hard-working staff who had the best technology in the world, but they struggled to provide high-quality care that was affordable. Whenever I would work with teams, I was always amazed by how good a job they did despite the systems they had to work with. This was the socio-technical disconnect that lean seeks to address, and I wanted to help these individuals and organizations. Patient lives literally depended on it.

As I began working with a variety of different healthcare systems across the country, the details were different but the themes were consistent: The same breakdowns tended to occur in the same places in the hospitals. This seemed to drive an approach of traditional consultants and vendors to offer "plug and play" solutions for these common organizational maladies. Unfortunately, these solutions rarely worked. The approaches were looking at just the technical systems and neglecting the social systems.

The lean projects I worked on took a different approach: Engage the front-line staff and leaders in active problem solving and begin the long journey of "thinking in a different way." Making these changes was not easy or rapid, but when a holistic approach was followed, the changes were significant. This showed me that the gap was not in technology (or the "technical system"), but rather in the social system. Despite the difficult challenges of using lean in a different context, the benefits were significant. Staff would often get excited and want to apply lean principles to problems they had lived with and worked around for their entire careers, but now they saw a new way to solve problems and work together that they found profound. The tools and approach by themselves were simple and intuitive, so all front-line staff could use them (not just a small "special forces" team of highly trained industrial engineers working as management engineers, which is common in hospitals).

With the proper external guidance and support, these front-line efforts were aligned with leadership development, and the beginnings of true organizational change started to take place. Staff often said that they had never been asked about how to improve their work, or given the tools or support to do so. The central pillar of the Toyota House is "respect for people," and I grew in my appreciation of this central concept.

Without the ongoing challenging by Prof. Liker about what lean really is, I would not have matured beyond a mechanistic perspective of lean. His decades of deep study and reflection on socio-technical systems and Toyota helped me continue on my journey, which I plan to continue throughout my career and life. The longer I have worked with lean and healthcare under the guidance of Prof. Liker, the more I realize how deep and significant the lean approach to developing people is. I am also continuously gaining an understanding of how much more there is to learn, which can only be gained through experimentation and reflection. This incredible depth and complexity, as well as critical importance of this work, is why I will be a humble and lifelong student of lean and what Toyota has to teach me.

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Chapter 1
Introduction

The U.S. healthcare system is in a state of crisis, with increasing costs, decreasing reimbursements, limited access, and significant preventable harm done to patients. A variety of healthcare institutions in the U.S. have been using lean methods (based on the Toyota Production System) to address these challenges. While many of these cases have well-documented examples of individual project success, there has not been a high-level analysis of the applicability of lean and considerations for fit with a high-variability service industry such as healthcare. While there have been significant local successes with this approach in healthcare, the application of this approach is still in an early stage and has not gained widespread acceptance or use. This analysis explores the integration of a lean approach in various aspects of people, process, and technology in healthcare.

Challenges

The U.S. healthcare system faces a variety of different challenges, from industry challenges to shifts in patient conditions. These are explored in the following sections.

Industry

The U.S. healthcare industry represents a significant paradox. It contains the very advanced technology and capabilities, [1] but in many respects it not effective or efficient in that it delivers un-exceptional outcomes [2] despite consuming a disproportionate share of individual and government resources [3-6]. When individuals receive their bills from receiving healthcare, they assume that hospitals are making huge profits. This is not the case, as hospitals on average are making very narrow margins on the order of 3 to 4% [7, 8]. This results in hospitals vacillating between profitability and loss, which often results in short-term decision making [9]. The methods that most hospitals have for responding to these vacillations are often ineffective [10] and they struggle with basic process improvement to achieve very modest improvements [11]. Many hospitals have felt some

security in the perception that healthcare cannot be exported, but even this has been challenged recently. The phenomenon of "healthcare tourism," with patients travelling to locations such as India to receive treatment with equivalent outcomes at a fraction of the cost, is occurring with increasing frequency and some insurance companies are even covering this care [12-14]. This care can cost patients as little as 25% of the equivalent treatment in the U.S. (including travel expenses). Therefore, the inefficiencies of the U.S. healthcare delivery system seem to be driving international competition. With much of this healthcare tourism being focused on surgery, the consequences become even more severe for hospitals, with Operating Room(OR) income representing the greatest profit centers for most hospitals [15].

Economic

Compounding these challenges, a variety of different factors are aligning in a perfect storm to challenge financial the viability of U.S. healthcare organizations. The recent economic downturn has resulted in a significant reduction in the portion of the population who have health insurance as well as their financial resources to pay for their healthcare [16]. With the recent passing of healthcare reform in the U.S., estimates demonstrate that systems need to gain upward of 25% efficiency gains to maintain current levels of profitability [17]. Even before healthcare reform, reimbursements had been decreasing for healthcare providers [18]. Healthcare costs currently represent the most common cause of bankruptcy in the U.S. [19]. If costs continue to increase and if the economy does not recover quickly, the inability of many people to have access to and afford this care will most likely continue to get more severe. Compounding these economic changes is the trend of patients to avoid seeking care until their conditions become severe (due to their concerns about the costs). This delay increases the overall cost of treating their condition because treating conditions earlier tends to decrease the difficult and complexity of the illness [20].

Insurance

A trend toward high-deductible health insurance plans has reinforced patients delaying seeking care as well [21], with patients having to pay a greater amount out of their pocket.

Staffing

Staffing shortages, including nurses, physicians, and other specialties have resulted in high staff turnover and increasing staff salaries [22], which complicate all of the aforementioned challenges.

Aging Population

Patient conditions have continued to evolve as well. A greater proportion of patients suffering from chronic illnesses such as diabetes and hyper-tension [23] result in complicated co-morbidities that add significant complexity to patient treatment.

Technology

The significant increase in the number of medications and medical technologies for treating patients, which appear to have the potential to improve patient care and outcomes, add system complexity. Many studies have challenged the impact of these technologies and treatments, and have demonstrated cases where they result in negative outcomes and little or negative return on investment (ROI) [3, 4]. Studies also demonstrated that administrative healthcare costs represent as much as 25% of the total cost of healthcare [24], and these resources (if available for other uses) would be sufficient to provide care to all uninsured Americans.

Evidence-Based Best Practices

Each year significant resources are expended on medical research focused on developing evidence based best practices for patient care. Despite the clinical evidence demonstrating the impact of these practices, there is an average delay of nine years before these practices are used regularly at the patient bedside [25]. Even the impact of the Institute for Healthcare Improvement (IHI) 100k lives campaign has been challenged by several researchers, suggesting that the impact of this high-visibility initiative to deploy demonstrated and relevant evidence based patient care practices did not have a significant effect [26]. This disconnect between expected and realized outcomes reflects the high variability in patient care that is delivered, as well as the cultural norms that accept this variability [27]. This variability results in the care a patient receives depending greatly on who happens to be assigned to execute their care.

Common Approaches

With all of these challenges and opportunities, significant resources have been applied at researching care delivery models, evidence-based best practices, technologies, facilities, and a variety of other areas in an effort to improve care and efficiency. Despite these investments, outcomes appear to be largely unaffected and costs continue to climb [28]. The sustainability of many continuous improvement efforts have been minimal in most healthcare organizations with a tendency to shift from one initiative to another without fully implementing any one approach fully.[11]

PDCA/PDSA/FMEA/RCA

Given the magnitude of the challenge and the lack of a widely used and repeatable approach to address them, the need to identify, refine, and demonstrate an approach has never been greater. Almost all hospitals have a Plan-Do-Check-Act (PDCA),Plan-Do-Study-Act (PDSA) methodology for improvement, as well as Failure Modes and Effects Analysis (FMEA) and root cause analysis (RCA) techniques, however these approaches have been demonstrated to have limited effectiveness in their current form [29], especially compared with the magnitude of change that the current environment requires

Lean: From Manufacturing to Healthcare

One systems approach to improvement, commonly referred to as lean (or the Toyota Production System, also known as TPS), has demonstrated significant potential in other industries to address the types of issues that have been identified. While lean has its roots in manufacturing, it has been demonstrated to work in a variety of different areas, such as re-manufacturing [30] and product development [31], as well as in several healthcare delivery organizations [32-36]. While Toyota has been developing its production system for approximately 60 years [37-39], the first healthcare organizations in the U.S. to attempt to apply lean methods have only been doing so for approximately 10 years [34, 36], so these attempts are still in their infancy compared to Toyota [40]. A small number of healthcare organizations have undertaken a long-term and focused effort to integrate the lean/TPS methodology and philosophy into their organization, while numerous others have made minimal efforts and then abandoned the efforts after a short period of time.[11] It is common for healthcare organizations to abandon efforts after short attempts at a few

projects, and then justify this by saying that healthcare has too much variability for this approach to work.[11, 41] The lean methodology and philosophy includes a significant number of tools and approaches specifically addressing high variability environments and processes. Lean methods would seem to be applicable to healthcare if healthcare organizations apply enough resources, disciple, and long-term focus in their efforts. The four healthcare organizations that have been applying these methods for the longest time in the U.S. are Virginia Mason [34] in Seattle, ThedaCare [36] in Appleton, Wisconsin, Denver Health [42, 43], and Park Nicollet [34] near Minneapolis. They have all achieved significant improvements in efficiency, quality, and patient care. A variety of other healthcare organizations are at different stages and using different approaches to implementing this methodology, with varying degrees of success.[11] Arguably the most mature lean department in a healthcare institution is the pathology and laboratory sciences department at Henry Ford Hospital in Detroit.[30] The degree of process and cultural development in the Henry Ford example demonstrates an extreme example of the long term potential for healthcare organizations following a long term and disciplined approach to lean.

While individual examples exist of healthcare organizations or departments successfully implementing and integrating lean/TPS within their organizations, these examples are a small minority of the approximately 5,800 hospitals in the U.S. [44] (not to mention the variety of other healthcare organizations and providers). In order to be able to address the previously discussed challenges that healthcare organizations face, additional research is needed to facilitate understanding of how lean can best address some of these significant challenges.

People, Process, and Technology

Given the large scope of the problems facing the U.S. healthcare industry, three primary areas of focus are explored further due to their relevance to these challenges. These three areas are (1) People (organizational alignment using Hoshin Planning), (2) Process (Knowledge management for consistently delivering evidence-based best-practice care in a consistent fashion), and (3) Technology (selecting and deploying technology most effectively) in a lean healthcare context.

People (Hoshin Planning)

Most healthcare organizations exhibit high leadership and staff turnover [45, 46], and direct care providers are usually unaware of high-level organizational goals or strategic plans. Therefore, direct care providers often have little understanding of their role in helping to achieve these goals. For large and complicated organizations, such as hospitals, to succeed at addressing the magnitude of challenging facing them, they must be able to effectively align efforts throughout an organization. The large and complicated undertaking of aligning organizational efforts is challenging, but is essential for the long-term lean efforts of a healthcare organization. Only a handful of healthcare organizations have undertaken this type of initiative at any level. Developing an effective approach to alignment is important to developing the leadership of hospitals, which is critical for long term success with lean/TPS.[47]

A singular revelatory case of a large hospital system undertaking a system-wide hoshin initiative is explored. A practical approach and set of recommendations are provided to inform other organizations on how to use the hoshin planning approach to further their lean transformation.

Process (Knowledge Management)

Hundreds of thousands of patients die in the U.S. every year due to preventable reasons such as medical errors or hospital acquired infections [48], even though significant resources are spent to identify best care practices to prevent these deaths. It takes an average of nine years for new recommendations for care to be consistently performed in patient care.[25] Therefore, the disconnect between the existent knowledge and the hundreds of thousands of patients who die or have negative outcomes due to this knowledge not being applied demonstrate the need for a different approach to knowledge management.

The chapter on process integrates aspects of lean, knowledge management, and system complexity into a model to help understand a lean approach to knowledge management. The model is used to evaluate several case studies. Findings and practical implications for improving patient care are then provided.

Technology (Selecting and Deploying Technology)

U.S. hospitals contain some of the most advanced technology in the world, and spend significant amounts of money to acquire and update this technology. There is little correlation between these investments and patient outcomes.[28, 49-51] Technology costs have been identified as one of the primary contributors to the long-term trend of healthcare costs in the U.S. rising more quickly than inflation [28].

A model is developed to better understand a lean approach to technology in healthcare and case studies analyzed to explore the applicability of the model. Findings and practical implications for the selection and deployment of technology in healthcare will be shared.

Common Research Methods

While each paper was written to be an independent chapter, the following common approaches are relevant across the chapters. These are as follows.

Contingency Theory

Contingency theory [52] is used in all three primary chapters (Chapters 2, 3, and 4). This concept proposes that there is a need to find a fit between (a) the approach to change and (b) the state of the organization or process. A "one-size-fits-all" approach will have limited success, while an approach based on deep understanding of the challenges and careful matching of approach will prove more successful.

Case Studies

Each of the chapters uses case studies as the primary form of data. The case study methodology used is appropriate for studying longitudinal change.[53] The multiple case study approach used in this chapter adds additional depth and validity to the analysis.[53] These case studies, integrated with theoretical frameworks and analysis, provide an opportunity to extend the knowledge base of the application of lean in a healthcare context.

Participant Observer Role

The most common role for the researcher in the case studies was that of a participant observer. The researcher's primary role was that of lean facilitator for most case studies

(participant observation[53]). In one case study, the role was as a passive observer[54] with no direct influence on the process.

Anonymous Case Studies

With one exception (the Pittsburg Regional Healthcare Initiative [55-60], which is a well-documented and published case), to the organization as where the case studies occurred are not identified to maintain confidentiality of the organizations and individuals involved. The names of organizations and individuals have been removed, and other steps have been taken to maintain confidentiality.

Paired Case Studies

Most of the cases in the three primary chapters involved a lean and a non-lean approach to address the same process issue within the organization. In some case the pairing was longitudinal: a failed approach followed by a lean approach in the same case. The lean and non-lean approaches were closely linked to the researcher's role as a participant observer.[61] In most cases, either a project was requested due to an initial perceived failure or a project was conducted using a lean approach and then a subsequent non-lean intervention or approach was used. The participant observer role provided depth of insight. The multiple approaches (both lean and non-lean also increased the depth of insights with the cases.

Revelatory Cases

A revelatory case is a singular example of a phenomenon that has the potential to yield such unique insights as the non-traditional application of hoshin across a large healthcare system that is early in its lean journey.[53] Revelatory cases are included in both the People (Hoshin) and Process (Knowledge Management) chapters.

Data

Given the diverse nature of the case studies, significant variety in the performance metrics related to the success or failure of the technological interventions existed. While some of the metrics were focused on compliance, others were focused on financial or other measures. Therefore, the definition of success or failure (the most relevant measure for this

analysis) is the final measure of system performance relative to project goals for the individual case.

Unifying Research Statements

While the three primary chapters are written as stand-alone analyses, they are all seeking to address a common set of research questions. These statements are below. These statements are explored further in the conclusion in light of the three primary chapters and case studies.

Problem Statement

Current healthcare trends are unsustainable, and the common approaches to addressing that unsustainability are not sufficient. There is an increasing disconnect between people, process, and technology in healthcare.

Research Question

Can a lean approach to integrating people, process, and technology prove more effective than standard approaches?

Propositions

The following sections review unifying propositions and provide findings.

Developing People
Proposition: *A lean approach focuses on developing people and solving problems. This focus on developing people enables continuous improvement and integration with the process and technology components.*

Technology & Knowledge
Proposition: *Healthcare technology and knowledge will continue to rapidly advance. Organizations that learn how to make productive use of technology will benefit from these advances, while organizations that do not find an effective approach to using technology will find technology to have limited or negative impact.*

Variability
Proposition: *The capability of lean tools and methods to deal with variability will prove effective in a healthcare context, which is above average in variability.*

Struggles with Broad Acceptance

Proposition: *Lean process improvement requires discipline, long-term thinking, and a significant cultural shift at which only a subset of organizations will succeed. These requirements were proven in the manufacturing industry, and will likely be repeated in the healthcare industry.*

Chapter 2
Aligning Goals and Actions in Healthcare:
A Practical Method for Early Use of Policy Deployment in Immature Lean Organizations

Abstract

Hoshin kanri, also known as policy deployment, is a part of Total Quality Management [62] that Toyota [30, 47, 63, 64] and other Japanese organizations use to align goals and objectives both vertically and horizontally throughout their organizations [62, 65-68]. Hoshin kanri addresses a significant challenge within large, complicated organizations; that is, goals and objectives are not communicated effectively throughout such organizations. Even if they are communicated effectively, specific and practical approaches to achieve the goals and objectives may not reach throughout the entire organization.

While the concept of aligning everyone toward common business objectives sounds desirable to any organization, there is usually little appreciation for the discipline, time, and commitment required to coordinate such an initiative in a way that leads to the desired actions and results. Healthcare organizations are no exception to under-appreciating what it takes to succeed at this sort of initiative toward alignment, but they are drawn to the significant potential benefits. So they undertake small-scale or organization-wide implementations, and then give up once they realize what is required to succeed. Or they may conclude that it "doesn't work here."

Researchers have explored the implementation and benefits of hoshin planning in mature lean manufacturing organizations [47, 65, 68]. Less research has been done on immature lean organizations deploying hoshin across an organization. (Immature lean organizations have only been doing lean for a limited period of time, and it has not permeated the entire organization.) Since few U.S. healthcare organizations have been using lean techniques for as much as 10 years [34-36, 69-71], there are realistically no mature lean healthcare

organizations. Even fewer healthcare organizations have even attempted hoshin planning on a large scale, but there may be smaller-scale applications of hoshin in healthcare that demonstrate its potential impact.[72-76] None, however, document large scale system-wide implementation.

This chapter explores a unique (revelatory) case study of the largest full-scale implementation of hoshin planning in a large, U.S. multi-hospital and clinic system. This implementation is unique not only in looking at the organization-wide application of hoshin planning in a healthcare context, but it is also more generally within an immature lean organization. The methodology for exploration is a chronological, single-case, empirical case study analysis [53] of their hoshin planning initiative.

This chapter is organized into the following sections.

Introduction: The significance and challenges of achieving organizational alignment are discussed and used to formulate the problem statement.

Background: To further explore the problem statement, additional contextual aspects are explored, including the significance of organizational alignment and the approaches currently used. It also includes a description of hoshin planning and the healthcare context for using hoshin.

Research Questions and Propositions: Based on the problem statement and contextual background, relevant research questions and propositions are presented. An exploration of these questions and propositions helps develop a practical approach for using hoshin in immature lean organizations.

Case Study & Discussion: The research questions and propositions are explored through a singular, "revelatory" case [61]. This case is described in detail, followed by a detailed analysis. Salient observations are grouped into conceptual categories.

Findings: In this case, hoshin kanri was not used as a natural extension of extensive and long-term lean efforts, but rather as a "forcing function" to increase lean activity. To make this work in an organization that did not have a cadre highly developed people capable of participating in true hoshin kanri, additional artificial mechanisms were used to support deployment (artificial in the sense that they would not be needed in a mature lean

organization). The additional mechanisms added to the cost of using hoshin. It also revealed foundational issues that would not have been nearly as prevalent in an organization that followed a more traditional path to hoshin deployment. These foundational issues provided a critical base for future lean progress and extending lean beyond the initial pilot projects across the organization.

Practical Method: Based on the case study analysis and findings, a practical method was developed to help organizations effectively prepare for and progress along the proposed continuum. The culmination is a hoshin initiative that resembles that of a mature lean organization.

Organizational Alignment

Hoshin kanri, or policy deployment, is an approach that Toyota [30, 47, 63, 64] and other Japanese organizations (famous early examples include Komatsu and Bridgestone) [77] use to align goals and objectives both vertically and horizontally throughout their organizations [62, 65-68]. This alignment addresses a significant challenge within large, complicated organizations: communicating goals and objectives effectively through complex organizations. Even if the goals are communicated, specific and practical approaches may not reach the front-lines of the organization. While aligning goals is desirable in any organization, the challenge is to get the entire organization to embrace the goals and translate them to practical activities in addition to other daily responsibilities.

Few organizations have the discipline, time, skill, and commitment required to be successful at such an initiative. Healthcare organizations are no exception, so they may not fully appreciate what it takes to succeed. This can lead to organization-wide goals that are only loosely translated into actions and lead to disappointing results. These disappointments may lead to giving up and concluding that hoshin kanri "doesn't work here."

Researchers have explored the implementation and benefits of hoshin planning in mature lean manufacturing organizations [47, 65, 68]. Less research has been done on immature lean organizations deploying hoshin across an organization. (Immature organizations have only been practicing lean for a limited period of time, and it has not permeated the entire organization.) Since few U.S. healthcare organizations have been using lean techniques for as much as 10 years [34-36, 69-71], there are realistically no mature lean healthcare

organizations. Even fewer healthcare organizations have even attempted hoshin planning on a large scale, but there may be smaller-scale applications of hoshin that demonstrate its potential.

Problem Statement

In this chapter, we explore the role of hoshin kanri in immature lean organizations. We ask whether the benefits that outweigh costs for organization-wide deployment when the organization is not ready for true hoshin kanri. Based on a detailed case study, we present a practical method for using hoshin kanri in immature lean healthcare organizations.

Background

Striving for Alignment

To illustrate the significance of creating true organizational alignment and a sense of ownership of the highest-level objectives, an historical example is used. During a visit to the NASA Kennedy Space Center in 1962, President John F. Kennedy noticed a janitor carrying a broom. He interrupted the tour, walked over to the janitor and said, "Hi, I'm Jack Kennedy. What are you doing?" The janitor replied, "I'm helping put a man on the moon, Mr. President" [78, 79]. This example illustrates the power of creating deeply embedded alignment and ownership of goals within an organization: each staff member knows that their job has the potential to help achieve a greater goal and that their job is important.

The researcher previously worked on the Space Shuttle program as a process assurance engineer at the Kennedy Space Center. He observed first-hand the positive impact of alignment as well as the devastating consequences of individuals within a large, complicated organization losing sight of the true goals of the organization. With tens of thousands of staff working toward the goal of successfully launching and returning the Space Shuttle, a few individuals making decisions contrary to this goal (such as making schedule attainment or "normalization of risk") led to the loss of both Space Shuttles Challenger and Columbia [80-83]. While the goal for most organizations might not be as singular or grand as putting a man on the moon or launching space shuttles, it could be as important as a healthcare organization's goal of saving lives.

If the CEO of a hospital were to ask an environmental services worker cleaning a surgical operating room "What are you doing?", you would hope they would respond, "I am saving lives through preventing infections!" This would be a true statement, because the effectiveness of cleaning rooms between surgeries has a significant effect on infection rates [84-88].

Having a clear context for an activity is also critical for other aspects of organizational performance, such as standardizing work practices. If there is no context such as "saving lives," then an employee might ask why it is important to follow a standard process. If employees understand that the implications of not following the standard work might be the death or disability of a patient, this might encourage them to follow and improve standard work practices. Standard work practices would become a means to achieving a significant outcome rather than an administrative requirement. Therefore, hoshin reaches beyond goal attainment and improvement and provides critical organizational context that enables a myriad of different aspects of individual and organizational performance [47].

Most organizations, regardless of their size, employ some sort of strategic planning process to determine their near- and long-term goals and to develop quantitative and qualitative measures for achieving them [89].

Goals are usually determined at the top level of the organization, either at the C-suite level or with the board of directors. These goals often relate to financial viability, growth, social or environmental responsibility, innovation, customer satisfaction, or a variety of other measures. The goals are laudable and can create excitement but, beyond specific actions implied by them (which are usually major tactical decisions at the macro-organizational level), they are not by themselves goals that can be implemented. Unless they are achievable at the top level of the organization (by the senior executives or board of directors), these goals must be subdivided and translated for implementation by individuals further down in the organizational structure. This creates the following challenges.

- The individuals implementing the actions were not involved in creating the goals, so it may be difficult to get them to buy in to the importance of achieving the goals or even believe they are achievable.

- The farther down the organizational structure, the greater the challenge to translate the top level goals effectively to concrete actions that can be pursued and measured throughout the year. If it is a large organization, there could be 20 or more "layers," each of which requires a specific translation and alignment. If there is not an effective or reliable process for this translation, the front-lines of the organization may not have tangible goals and actions that will actually impact the higher level goals. Also, if the translation methodology is not effective, it might result in tangible goals that do not impact the highest level organizational goals.
- Another challenge is creating systems to measure the employees' progress (or lack thereof) toward a goal and limitations in how those measures are used to provide continuous feedback for corrective actions and learning.
- Alignment requires truly engaging staff in achieving the integration, which diverges from the command-and-control approach common in many western corporations [90]. A superficially similar approach used by command-and-control organizations is that of management by objective (MB0) [91-93]. This approach has limited effectiveness because it does not truly engaging all staff in the process [47].

Different Approaches

When organizations set out to create alignment, they can choose among the following options.

Passive Approach

The passive approach is the default state in most organizations. Top level goals and objectives are set each year and communicated broadly to the organization, but the goals are not translated down through the organization. Individual goals are usually created ad hoc and focus on individual development or specific projects. Therefore, there is little alignment between these goals and those of the overall organization. The annual review rarely involves discussions about the previous year's goal setting and the subsequent year's. Staff and leaders often look at this process as an administrative requirement that has little practical relevance.

Management by Objective (MBO)

A management by objectives approach [92] is a highly regimented process for translating top level goals and objectives throughout the organization. This top-down process is intended to address the shortcomings of the passive approach by applying a mechanistic deployment. Communication is often one way—top down. The MBO approach has three major limitations. (1) It does not include any tools or approaches to help staff make substantive changes or improvements. (2) Employees do not take ownership of goals under a top-down approach and may cheat to make it appear that the goals have been met. (3) The MBO approach depends on metrics or measures. Healthcare organizations lack such measures.

Charismatic Leader Approach

Non-mature lean organizations are sometimes able to align with their highest level goals and objectives. They achieve a unity of purpose, not through disciplined deployment of cascading and translated goals, but through the force of will of a visionary and charismatic leader [30]. President Kennedy and the janitor and the space race of the 1960s illustrate this approach.[78] Another example is the late Steve Jobs, co-founder of Apple Computer [94, 95]. He was a charismatic, visionary, and uncompromising leader, and this drove the culture and behavior of the entire organization [96-98].

The transformative and aligning influence of visionary and charismatic leaders is seen in a small minority of organizations [99]. Unfortunately, alignment often dissipates after the departure of the charismatic leader. For example, Steve Jobs grew Apple Computer to a significant size and success but then was forced out early in the company's history. During the next 15 years, the fortunes of Apple diminished, and the company seemed to lose its way. It was on the verge of bankruptcy several times, until Steve Jobs returned and grew it to one of the most valuable companies in the world [97].

Many companies seek to address organizational challenges and a need for unity or alignment by seeking a charismatic and visionary leader, but this often results in (at best) short-term improvements that last only while the charismatic leader stays with the organization.

Lean Approach

Organizations have been able to overcome the challenges of implementing goals and realize organizational alignment by implementing a lean approach and hoshin kanri, or policy development. Hoshin kanri was part of Total Quality Management in Japan [77]. Organizations adopting hoshin kanri had spent years developing a quality culture that included teaching basic problem solving methods throughout the organization down to the working level. Customer-driven measures were developed for quality. Hoshin kanri was then a natural evolution from a quality culture.

One of the leaders in the lean movement was Toyota Motor Company, which originally used hoshin kanri in the 1960s to deliberately improve its quality. Toyota's used the esteemed Deming Prize as a target (which it won in 1965) [30, 63]. With one exception during the recession that began in 2008, Toyota has been consistently profitable and growing for the past 60 years [100]. This was not achieved by hiring a succession of charismatic and visionary leaders but rather through developing and promoting leaders from within. Toyota refined and supported internal mechanisms for aligning organizational objectives through process discipline and problem solving [101]. The primary mechanism for supporting the alignment is that of hoshin planning, which is explored more in the following section.

Contingency Theory and Fit

Contingency theory [102, 103] is a critical concept for organizational change. It stresses the need to find a fit between the approach and the state of the organization, process, or technology. Contingency theory is especially important for this analysis because hoshin in its traditional application is a fit for mature lean organizations, and this analysis focuses on healthcare organizations, which are immature. Therefore, it is critical to develop an approach that is a fit for immature lean organizations. Without a fit, the organization is predisposed to failure. Finding a practical approach for hoshin in immature lean organizations represents significant opportunity for the vast majority of healthcare organizations in the U.S. and around the world.

Hoshin Planning

At an organization that used hoshin planning effectively, any front-line staff member could tell you what their specific goals and objectives are. These workers could tell you how their

goals aligned with their manager's goals, as well as with those of the highest level of the organization. In addition, they could describe their current activities to achieve the annual plan. They could describe how well they were performing relative to achieving those goals and their strong points and weak points. These same questions could be asked of anybody in the organization with an accompanying confident response.

Key Definitions

A few key terms used throughout this chapter are defined here.

Mature lean organization: An organization that has undertaken lean improvements and organizational change for a number of years (20+), has addressed core foundational stability issues, implemented standard work practices extensively, implemented hoshin for a multitude of years, and has spread lean processes and culture throughout their organization.

Immature lean organization: An organization that has begun to experiment with lean and has committed to along the continuum of lean maturity.

Lean journey: The path an organization takes to progress from an immaturity to a maturity. This involves changes in its people, processes, and technology.

Lean sensei: An experienced lean continuous improvement mentor who helps demonstrate projects and mentors staff and leaders in a different way of thinking and problem solving. The underlying concept is to borrow the sensei learning curve [104].

Foundational stability: This refers to the bottom of the "Toyota House Model" [37], the characteristics of operational stability needed to use more advanced lean tools and approaches. Foundational items include standard work practices, waste elimination, measuring process performance, preventive maintenance, visual management, and a variety of other different items [37, 64].

The concept of foundational stability is central to all lean systems, especially large-scale, organization-wide change initiatives. Without standard work practices, for example, it is impossible to make process improvements. The initial step in creating a foundation is

establishing standard work practices that are actively used by all employees. This creates actual common process that can be improved.

Another facet of foundational stability is variability. When patient volumes or staffing patterns are highly variable, it is difficult to balance workload or staffing, and therefore difficult to establish a foundation of operational stability. Studies have shown that upward of half of the variability in hospitals is caused by natural variation, and half is comes from artificial variation caused by internal operations separate from the patient [105]. When this variability has been stabilized, process improvement activities can begin. Preventive maintenance also presents an important opportunity for foundational stability. If equipment is unreliable, then it is difficult to develop a better process that depends on this equipment.

Therefore, if an organization has standard work practices, leveled workload, and reliable equipment and supplies, future efforts will be facilitated. If these foundational issues are not addressed, it will be difficult to develop any new processes or implement significant change. The most obvious indicator of a stable and effective foundation would be employees who consistently meet their plan each day with on time delivery of services and few quality problems.

Meaningful Discussions

The mechanism for achieving alignment is hoshin planning. At its core, hoshin planning is a series of meaningful discussions between a manager and his or her direct reports to figure out how the direct report can define achievable and measurable goals and objectives that align with the manager's goals and objectives. Meaningful, two-way discussions, often called "catchball" from the way the discussion is tossed back and forth, should take place frequently (once a year to establish goals and objectives, and numerous times throughout the year to discuss ongoing attainment toward the goal). The discussions would be familiar and not require outside facilitation. Following is an illustration of a meaningful two-way hoshin discussion between a manager and a direct report, the supervisor responsible for the logistics of the operating rooms (OR).

Manager: I just had my hoshin session with my administrator, and I need to identify
             ways to decrease our supply expenses by 20%. This seemed achievable and

will help my manager achieve his goal for the overall profitability of the OR. When the OR is doing well, the entire hospital is profitable and allows us to focus on our mission. What do you think?

Supervisor: Wow, I really don't know how we going to achieve that. I don't even know where those sorts of savings would come from. I know we throw away a lot of supplies that are "open but not used," and other supplies expire, and we seem to have too many of some things, but not enough of others, but I don't know how to address either of these or how significant they are.

Manager: Could your team start measuring this waste to see how significant it is?

Supervisor: I suppose we can divide up the tasks and do an inventory count, and we have records about what has happened to past supplies in documents someplace. We can also keep a tally during the next two weeks to see what happens to our supplies. This would give me some idea of what and how much is being wasted.

Manager: That sounds like a plan! I'll keep in touch on your progress and give you whatever support you need. In the meantime I'll arrange a two-hour after-hours meeting of the whole team where you can present the data, and we can begin to understand the causes of our material costs and possible countermeasures. Is there anything I can do to help right now?

Supervisor: If I could have a few hours off the work schedule to do some simple analysis of the data and to talk to my team members, that would be very helpful. I've been already been working a lot of overtime recently and am feeling pretty burned out. Also, can you give the team a heads-up that I will be talking to them?

Manager: That sounds great! I can definitely help you with what you need. I would trust your analysis more than the "canned reports" that I get. I don't know how reliable that data is.

Supervisor: Thank you!

Manager: So, does the goal of 20% reduction sound achievable?

Supervisor: Honestly, I don't know until I get some data and understand more clearly how much waste there is.

Manager: I'll take care of your requests, and then when we begin our meetings to analyze the data and plan possible countermeasures, it may become clearer.

Supervisor: Sounds good!

The preceding narrative illustrates the goal of hoshin, a two-way discussion that helps develop staff, improves the relationship between managers and their reports, and moves the organization toward aligned efforts and achieved goals. This discussion will improve the problem-solving ability of the supervisor and the leadership involvement of the manager. Together, they will start toward the goal of reducing waste. This discussion also illustrates the iterative nature of the hoshin process, with consensus on goals and increasingly deep understanding of the problem taking place over multiple meetings. Even if the manager knows clearly what needs to be done and how to do it, he or she asks questions (i.e., the Socratic method) to help challenge the supervisor to develop a deeper understanding of the problem and to take ownership of the solution.

Two-way discussions diverge significantly from the standard command-and-control approach most organizations use [90, 91, 93]. In the traditional approach, employees are told what they need to do and have little opportunity for input or to discuss their ability or resources to achieve the goals. There is a lot of telling and little collaborative planning. Without front-line employee input, goals may not be achievable, employees may have non-essential tasks that get in the way of achieving the goals, or the employees may not believe in the goals.

Following is an illustration of a top-down MBO discussion between a manager and her direct report (with the same manager goal as in the previous hoshin discussion):

Manager: I need you to reduce your supply expenses by 20%. Do you think you can do it by the end of next year?

Supervisor: Ummmm....I guess I can try.

Manager: How do you think you could do it?

Supervisor: I guess I could talk with Purchasing and get a quantity discount by buying in
             bulk.

Manager: Sounds great! Let me know if I can help with that.

The result of this mechanistic discussion—ordering supplies in bulk—is likely to increase inventory costs, require more storage space, increase the chance of expired inventory, and lead to related expenses that negate any per-piece purchase savings.

With both of these cases starting out with the same goal, they led to different goals for the front-line staff. The hoshin approach is likely to have a significantly positive impact on the organization and the development of the staff capabilities, while the other may decrease per piece costs, but harm relationships with suppliers, and actually increase expenses, while not developing people at all.

Two-Way Alignment

When executed correctly, hoshin results in the alignment of goals and objectives from the top to the bottom (Fig. 2.1).
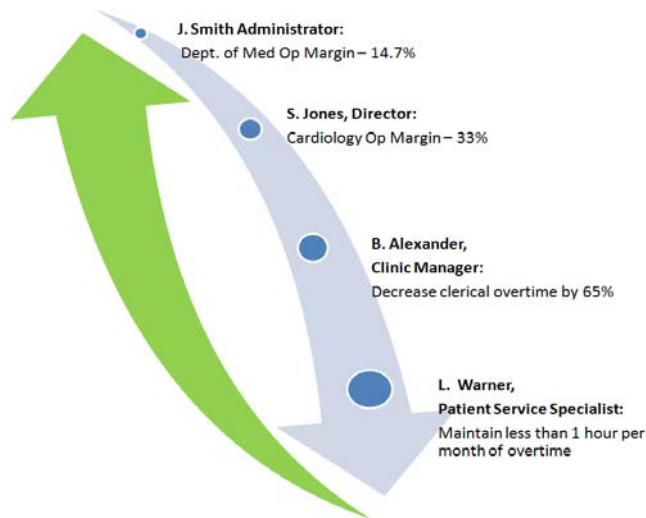
Figure 2-1:   Tactical goal of hoshin is to achieve alignment (top-down & bottom-up).

The following points illustrate the alignment in Figure 2-1 for a single goal "string" from the top of the organization to the front-line staff:

1. Top level goal (2017 System-wide Milepost): "Be better than 75% of the health care organizations in the U.S. on expense performance."

2. Dept of Medical Operation's contribution to top-level goal: "Achieve 14.7% margin."

3. Cardiology Operations Director's contribution to Department of Med Ops goal: "Achieve 33% margin."

4. Clinical Managers goal to achieve 33% margin for Cardiology's goal: "Decrease clerical overtime by 65%."

5. Patient Service Specialist's way to help the Clinical Manager achieve their goal: "Maintain less than 1 hour of overtime per month."

In the sequence of cascading goals, one of the 2017 system-wide mileposts is translated to each level of the organization in measurable and achievable ways. These resulted from meaningful two-way discussions. There were frequent negotiations using a catchball approach. The front-line staff's goal (#5) was tangible and achievable. (It also had other characteristics of Specific, Measurable, Attainable, Relevant, and Time-bound (S.M.A.R.T.) goals). As the year passes, progress toward each of these goals takes place between managers and their direct reports, and adjustments or new approaches are made.

In the definition of foundational stability discussed earlier, the metrics and staff at each of these levels would be tracked visibly and regular meetings would be held to discuss ongoing efforts to achieve the goals. This would indicate that the foundation was beginning to strengthen, which would significantly enable attaining future goals.

Artifacts

Various tools, or "artifacts," can be used to observe alignment using hoshin. One would be two-way meaningful discussions between managers and their direct reports. Another would be the forms or administrative mechanisms for recording and formalizing these aligned goals. These mechanisms would vary in format and details between different organizations, but the underlying approach would be similar. A cascaded alignment would extend from the top-level organization goals and objectives all the way to the front line of the organization. A single document could record the cascade from the top level to the

bottom of the organization and be traced back to any goal along the continuum as shown in Figure 2-1.

Another observable artifact would be the mechanisms for measuring the progress (or lack thereof) toward the goal. In some cases, all the data might be on a computer, while other organizations might have information posted for all to see and have daily huddles to review progress and plan next steps. This significant and ongoing focus on tasks and problem solving to achieve specific goals, above and beyond a singular focus on daily operations, would make the hoshin organization look different from organizations that usually have the primary focus almost exclusively on daily operations.

Deeper Significance

A deep look at a mature lean organization would reveal something deeper than just "attaining goals." A singular focus on attaining any single goal without larger organizational context can lead to disastrous results. An example of singular focus occurred with the Space Shuttle Challenger disaster. Managers became so singularly focused on meeting their schedule that they made a decision to launch in spite of the engineers' contrary recommendations. The managers achieved their goal of meeting the launch schedule, but sacrificed the lives of seven astronauts and billions of dollars of hardware [82, 83]. Focus on attaining goals must be balanced with a broader perspective of organizational mission, vision, and values that can help correct for misguided efforts.

Healthcare Context for Hoshin Kanri

What are the challenges and opportunities of using hoshin in healthcare organizations?

Mounting Challenges

As the costs of healthcare increased, and regulations, complexity, and patient conditions changed as well, the challenges facing hospitals changed significantly. Hospitals are now paid primary through a vehicle called Diagnosis Related Groups (DRGs), which are bundled packages of service payments [106]. If the total cost of care to treat a patient for a certain DRG is less than what was paid, a hospital would make a profit on that patient's care. If the cost was more than what was paid, the hospital would lose money on treating the patient.

The DRG payment method, coupled with decreasing reimbursement by government and private insurers, has driven down profit margins at many hospitals. Even before the recent economic downturn, average profit margins at hospitals were approximately three to four percent [9]. Changes expected from the Patient Protection and Affordable Care Act suggest that hospitals need to realize efficiency gains of 25% to 35% to maintain their current levels of profitability [107-109]. The ability of healthcare organizations to align their staff and organizational efforts effectively to achieve goals is paramount if they are to remain viable organizations and provide care to patients. The needed organizational changes will challenge even the most high-performing healthcare organizations.

Gaps in Capabilities

Most healthcare organizations are ill-equipped to undertake these ambitious challenges. Healthcare organizations are highly regulated and collect volumes of data for compliance; unfortunately, this data cannot be easily applied pro-actively for quality or efficiency improvement. (Both are critical for meeting the near- and long-term challenges previously described.) [107] The most usable data that hospitals collect are resource input measures (supplies, money, labor productivity, etc.). As a result, hospital administrators tend to focus on leveraging these to achieve their goals. They reduce expenses, increase targets for labor productivity, invest in technology or equipment with promises of a significant return on investment (ROI), and undertake other coercive approaches to achieve their goals [90]. These approaches rarely have the intended benefit, and more commonly decrease organizational performance [47]. A preoccupation with input measures and controlling organizations through resources, as well as a lack of core operational measures for active problem-solving for the staff, represents significant foundational barriers to initiating a hoshin planning initiative.

Research Question and Propositions

To help understand case study presented in this chapter and elicit insights for other organizations considering undertaking a similar initiative, the following research question and propositions are explored.

Research Question

What is a practical methodology for immature lean organizations to use hoshin planning effectively?

Propositions

1. **Hoshin planning is an advanced approach used by mature lean organizations, so it will be less likely to be effective with less detailed planning and focused activity in immature lean organizations.** The goal of hoshin is alignment and achievement of organizational goals and objectives through detailed planning, clear roles and responsibilities, and ongoing use of rigorous problem solving by work groups moving step by step toward common goals. At the same time, employees will increase their problem solving capability, leadership, and focus. We expect this alignment to be less effective and with more variability in the process and outcomes across the organization than in immature lean organizations.

2. **In an immature organization, the artifact level will focus on the form of the hoshin kanri process and the various documents used (this would be less important in a mature lean organization with a focus on deep dialogue, detailed planning, and ongoing learning through PDCA).**

3. **Infrastructure and foundational support needed to deploy hoshin on a large scale will be a challenge with an immature lean organization undertaking this approach.** Hoshin initiatives require infrastructure (relevant metrics to gauge progress toward goals, Human Resource systems for tracking metrics, etc.), cultural integration (PDCA thinking, long-term perspective, comfort with meaningful and honest two-way discussions between managers and direct reports, senior leadership support, etc.), and resources (time to have the initial and ongoing discussions for goal setting and attainment, as well as time to work on tasks and problem solving). With an organization that is early in its lean journey, these requirements will either not be met, be met minimally, or will need to be resourced specifically for such an initiative.

4. **Cultural challenges will become evident as hoshin in an immature lean organization drives cultural change or is inhibited by the existing culture.** The normative state in most organizations is that of a mechanistic, command and

control mentality of dictating goals and objectives to direct reports without much two-way dialogue between managers and their direct reports (such as with a Management by Objective (MBO) initiative [92]). The managers are usually not skilled problem solvers or teachers and therefore cannot provide much guidance on how best to achieve the goals. The goals are usually not specific or readily measurable, which makes attaining goals even more difficult. This clash of cultures could make the cultural gaps more visible and facilitate the awareness of the need for change, or it could inhibit the effectiveness of the hoshin efforts.

Data and Methods

The following sections describe the approach that was used for this case study analysis.

Research Methods

To study the research question and propositions and develop a practical approach for using hoshin in immature lean healthcare organizations, a case study is analyzed. A case study methodology is an effective approach for studying longitudinal change [53]. The analysis presented here is a single case study, with the single case being a revelatory [53]. A revelatory case is a singular example of a phenomenon that has the potential to yield unique insights into the non-traditional application of hoshin across a large healthcare system that is early in its lean journey. The methodology for this case study is a disguised (for confidentiality), chronological single case with a semi-embedded researcher.

The hoshin journey of this organization was followed from before they began their lean efforts to the completion of their targeted goal for the first round of hoshin planning (the completion of the initial hoshin sessions). The researcher was directly involved at multiple stages of this hoshin initiative, primarily as a hoshin session facilitator and trainer. (The researcher also served as a lean value stream manager (VSM) and A3 report facilitator on a separate project.) The researcher was a participant–observer, which yielded significant insights due to the intimate understanding of the context and activities [53].

The researcher spent approximately 150 hours observing this case, with additional time spent collecting and summarizing observations of the process. In addition to direct observation, approximately 250 hours were spent facilitating other projects not directly

related to this hoshin initiative but that provided significant organizational context (such as multiple lean facility design projects, operating room quick-turnover, and lean training courses). These observations took place over approximately 12 months. In addition to the direct observations and experiences of the researcher, periodic huddles of all of the hoshin session facilitators were used to validate the qualitative and logistical observations of the researcher.

Participant Observations

The researcher was a participant–observer in a many hoshin sessions at this healthcare system, from front-line staff to senior executives. The role of participant–observer provides an opportunity for deep observations and the ability to experiment with the process; both of these roles lead to greater understanding.[61]

Process Metrics

The process metrics for this analysis are two-fold: one is the internal metrics of the hoshin sessions, which measured the number of forms and hoshin sessions and meeting associated deadlines. The other metric for this chapter is the process measures discussed during the hoshin sessions.

Composite Cascade

A representative example of a hoshin cascade from the top level goals of the organization to the front lines is illustrated here. This example starts at the top of the organization and cascades to a front-line medical-surgical nurse, and it illustrates each of the four sections of the hoshin process. It follows the hoshin process description. This case comprises various hoshin sessions involving the facilitator and includes observed goals and struggles.

Model Predictions

Based on the discussions about the standard characteristics of organizations undertaking a large-scale hoshin initiative, Table 2-1 illustrates predictions about the characteristics of standard versus non-standard application of hoshin.

Table 2-1:   Model Predictions

	Hoshin in Mature Lean Organization	Hoshin in immature Lean organization (first attempt)
Significant Goal attainment?	Yes	No
Additional Resources required to support?	No	Yes
Hoshin creates tension with existing culture?	No	Yes
Foundational instability gets in the way of goal attainment?	No	Yes
Visual management and daily "huddles" around metrics boards throughout organization	Yes	No
Using hoshin as a forcing function	No	Yes
Focus on forms/artifacts	No	Yes
Focus on problem solving/meaningful discussions	Yes	No

The following sections provide a narrative of this case study and illustrate how the organization began the hoshin planning initiative as well as the early results and insights.

Case Study

Background on System

This case study focuses on a large regional hospital located centrally in a rural area with a few outlying clinics. It has a medical education component, with medical students and residents as well as nursing and other educational programs. While the hospital has a medical education component, it is not an academic medical center with multiple overlapping lines of authority. At this stage, the hospital was financially stable and had changed little over the recent past. The hospital administrators were not good at aligning their organizational goals and objectives, and they struggled with how to make progress toward their long-term vision of growing and prospering as a truly integrated system. Annual goals were set for managers and staff but seldom looked at until the next annual review. Achieving annual goals had no repercussions (positive or negative), and the demands of daily operations ("firefighting") took precedence over progress toward the long-term vision. Staff did not take the alignment process seriously and generally saw it as an annual administrative hurdle to complete so that they could get back to their "actual work." The annual review therefore added little value to the organization. Staff felt it was hard to set any numerical goals because they did not know how they were currently doing. As a result, many of the goals were either qualitative or numerical without a baseline.

This static situation ended when a new physician assumed the role of CEO of the system. The new CEO initiated a series of significant changes, including switching from an independent to an employed physician model. The CEO began an ambitious series of acquisitions of clinics, smaller and medium-sized hospitals, logistical and storage facilities, and other resources in their geographic region. These facilities were all in the large rural region that surrounded the main hospital. Many of these other facilities were struggling financially as individual entities and were therefore could be acquired for reasonable prices.

The CEO of the growing system saw the potential to gain efficiencies with these acquisitions by combining administrative and logistical services as well as by expanding the hospital's patient referral network to direct patients the main hospital for care that could not be delivered at the smaller facilities. In addition to acquisitions, the CEO and staff also started various construction projects to fill the gaps between the continuing needs of their communities and what could not be acquired. After this focused initiative of growth, the system became the dominant healthcare system in this region.

The system was realized the growth objective, but it soon had to face several sobering realities. The system had grown from one large hospital and a handful of clinics, to over 13 hospitals and approximately 13,000 staff. One of these realities was that rapid growth had caused a variety of unanticipated complications. When the system had a single hospital, they were able to maintain a certain unified sense of "self" because the staff all belonged to the same organization and had a shared history. After rapidly acquiring a large number of other hospitals and clinics, this sense of self was not nearly as strong. Staff at many of the hospitals still felt as if they were still independent but had just been acquired by a larger, wealthier organization, but they resented being labeled as part of the larger system.

Another challenge the new system faced related to the expected efficiencies to be gained through the expansion. In theory, the sharing and consolidation of services would provide significant savings for the system as well as for the individual hospitals and clinics. In reality, a new set of challenges appeared. So much focus and effort had been expended on the growth and expansion, that very little focus had been placed on methodically realizing the anticipated efficiencies. Many of the acquired organizations kept the internal services that were targeted for consolidation, and then linked them to the centralized function as well. Instead of realizing efficiencies, staff in a particular activity (such as human resources or

information technology) now had more steps and less efficiency than before. Therefore, instead of gaining efficiencies through consolidation, the system had lost efficiency.

A second example of the negative results of the preoccupation with growth was that staff members were sometimes hired in anticipation of recruiting a new physician. When the physician was not successfully recruited, the staff members were in place but they had no specific duties or responsibilities.

A third unanticipated complication of this focus on growth was that the challenges of goal alignment had become more severe. The complexity of the expanded organization increased dramatically in terms of hospitals, geographic size, diversity of organizations, and other factors. Leaders and staff who had found attaining goal alignment to be challenging in the original system found it even more difficult with the much larger system. This challenge was quantified clearly in an employee satisfaction/engagement survey completed before the system administrators began lean efforts. Figure 2-2 shows that managers were, on average, noticeably more satisfied and engaged according to the listed criteria than the 50th percentile for the survey, while the non-managers were well below the level of the managers. The divergence and corresponding dissatisfaction was evident across all levels of the organization, and it was especially severe in the non-manager positions (which represent the majority of the staff in the healthcare system).
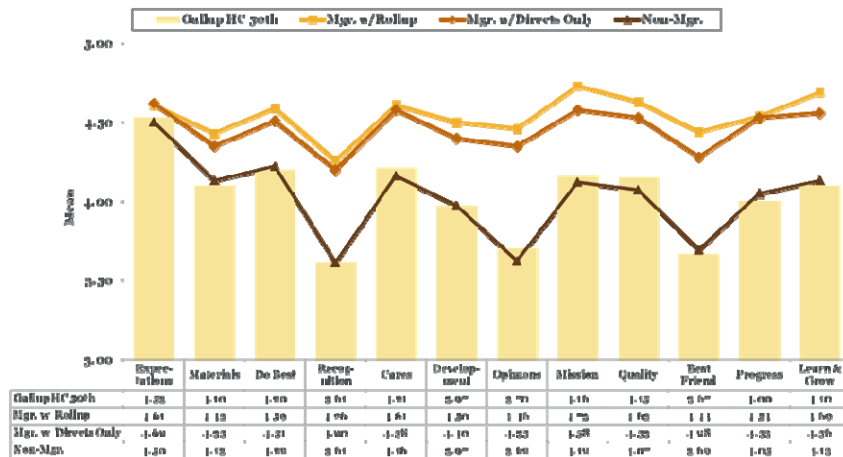
Figure 2-2: Perception divergence between leaders and front-line staff on a satisfaction/engagement survey.

With the organization experiencing growing pains from its recent expansion, one of its senior leaders heard about lean as an approach to addressing some of the critical challenges

that their system was facing. This leader attended a lean healthcare course and was excited about the potential of lean to address the challenges that their organization faced. The leader discussed with the researcher's organization the possibility of building a lean program, starting lean pilot projects, and developing their staff to build a self-sufficient lean continuous improvement program. The leader approached the CEO of the system and received approval for initiating a lean initiative. In addition to granting approval, the CEO became a visible and outspoken advocate of lean after learning more about the philosophy and methodology and observing its power in the first lean pilot projects.

Over the next two and a half years, a variety of different value stream mapping (VSM), A3 problem solving, lean facility design, and kaizen event projects were conducted. Multiple corporate-level lean coaches (fully dedicated to facilitating lean projects) and a larger number of embedded lean coaches in the operating units (focusing on facilitating lean projects part time) were developed. Efficiencies were gained, staff members were developed, successes were celebrated, failures were analyzed, and lessons were learned during these initial efforts.

The organization's experience with these initial lean efforts was positive, but there were individuals who resisted or did not want to be involved. Also, even though the leaders had been working on these projects on a rather large scale for two and a half years (a long time in most healthcare organizations), from the standpoint of lean cultural transformation, they had just begun their journey. A relatively small number of the 13,000 employees had been previously involved (either directly or indirectly) with a lean project of some sort. There were still significant challenges in terms of operational stability, standardized work practices, and a significant need to eliminate waste so staff would have sufficient time to focus on problem solving and process improvement.

As the leaders continued to measure process variability and seek waste as part of their lean initiative, they became increasingly aware of how far they still had to go. The list of potential projects grew faster than the resources to undertake the projects or foundational supports (standard work, metrics, available capacity, lean sensei, etc.). The leaders' awareness of the gaps was increasing (from the lean efforts), as well as the magnitude of these gaps (from the growth).

The senior leadership of the organization had gained greater appreciation for the increasing complexity of the organization due to its rapid growth and the growth's negative effect on their being able to achieve organizational goals and objectives. At the same time, the profitability that came with rapid acquisition and growth had slowed, and this had become apparent in the financial performance of the organization. To meet the short-term financial shortfalls, as well as to move toward their longer-term organizational goals, they decided they needed to align their organizational efforts.

The lean "sensei" consulting with the organization discussed the potential application of the hoshin planning approach to strategic alignment. The leaders were significantly interested in using this approach, and the tool's ability to address their persistent gaps seemed to have real promise. The lean "sensei" began working with them to develop a framework and an approach to deployment and facilitated some of the early, top-level goal setting sessions.

In April, a broad-level hoshin implementation plan was developed and goals were set for completing 90% of the hoshin forms and sessions by October (Fig. 2-3).

Figure 2-3: Timeline for hoshin planning implementation.

Description of Catchball

Catchball is a process used to facilitate the "meaningful two-way conversation" that is at the core of the hoshin sessions. Many organizations tend to hold one-way conversations, where the manager talks to the direct report and tells them what their goals are and how to

accomplish them [47]. In an immature organization, it is important to structure and facilitate the discussion to make it meaningful and truly a dialogue. The process in this case literally used a ball. Once the manager or direct report has discussed an aspect of the goal setting process, they toss the ball to their direct report, who then has an un-interrupted opportunity to respond and discuss the issues and goals (in essence, the two are playing catch). Only the person holding the ball is allowed to speak, so they can express their thoughts completely and without interruption. If they are interrupted, the facilitator intervenes to help reinforce the significance of this discussion rule. Catchball is essentially teaching the collaborative and respectful communication critical to the hoshin process.

Description of S.M.A.R.T. Goals

In all of the catchball sessions, the emphasis is on creating S.M.A.R.T. goals [110],[111]. Creating these goals is essential to the hoshin process to cascade goals from the top of the organization to the front-line workers. Previously, goals and objectives were vague or unattainable and rarely achieved or even tracked. S.M.A.R.T. stands for goals that have the following characteristics:

- **S**pecific: Goals should be clear and focus on what you want to happen.

- **M**easurable: Measurements should track attainment of the goal, or reasonable proxies for the measures.

- **A**ttainable: While it is important to set ambitious goals that make people "stretch," the goals should be something that can be accomplished in a predetermined timeframe.

- **R**elevant: The goals should align with their manager's goals and with those of the overall organization, and their attainment should be meaningful to their patients ("customers") and the organization.

- **T**ime-bound: The goals should have clearly defined target dates for initiating and completing projects.

Four-Phase Deployment

The following four sections elaborate on what occurred during four primary phases of this hoshin process.

Phase 1 (Early Phase) –Tool/Infrastructure Development and Organizational Goals and Pilot

During the early phases of the hoshin process, sessions were held with the senior leadership. In these sessions, the mission, vision, and values of the organization were distilled into five-year goals (from the Fiscal Year 2012 five-year Strategic Plan through 2017). These mile-posts were derived from the existing mission, vision, and values of the organization as their attainment would advance the long-term goals of the organization. From these system-wide goals, each of the C-suite (Chief Medical Officer, Chief Financial Officer, etc.) staff participated in facilitated hoshin sessions with the CEO and created goals that aligned with the 2017 mileposts.

The mission, vision, and values of the organization follow:

- **Mission**: Provide the most personalized, comprehensive, and highest quality healthcare, enhanced by medical education and research.
- **Vision**: Most trusted and most valued name in American medicine.
- **Values**: Teamwork, Patient-Centered, Innovation, Accountability, Excellence, Pride.

These were then used to drive the 2017 system-wide mileposts, which focused on such different categories as quality, efficiency, satisfaction, integration, and access:

- **QUALITY.** Be better than 90% of U.S. healthcare organizations on all publicly reported quality and patient satisfaction metrics and cause zero harm to our patients.
- **EFFICIENCY.** Be better than 75% of the health care organizations in the U.S. on expense performance.
- **SATISFACTION.** Be one of most desired places for high performers to work.
- **INTEGRATION.** Have fully integrated our information systems connecting patients, clinics, hospitals and the health plan.
- **ACCESS.** Expand our mission to care for 675,000 unique patients annually.

This top-level alignment can be seen in the upper left portion of the form in Figure 2-4

Name: Leader   **Susan Smith**   **Novell User ID:** J. Smith   **Coach:** B. Husby

Priority	Key Goals	Targets "catchball"	Action Themes	Responsibl	1
x 0 x 1	Decrease medical supply (COGS) costs.	Decrease costs from 34% of Sales to 30% of sales within the first 4 months of FY2012.	Negotiate contracted pricing with specified preferred vendor, eliminate shrinkage (loss of product).	Susan Smith	
	score.	Increase grand mean score from 3.69 to 4.00	Continue high, middle, low conversations, being clear on scoring criteria and performance gaps, follow up on action plans with timeframes (accountability).	Susan Smith	2
0 x 0 0 x 3	Operating Margin	Meet budgeted total sales for FY12.	Continue to promote OP&P service through all facilities, open additional clinics.	Susan Smith	3
0 x 0 0 x 4	Meet budgeted Contribution Margin	Increase revenue recognition to a minimum of 85% of total sales in the first 6 months of fiscal 2012.	Find the problem, get in touch with the right people (meet with RCO leadership to discuss).	Susan Smith	4
X 0 0 0 5	Patient satisfaction	Increase the Likelihood to recommend question of the Press Ganey survey by 10% or to a minimum of 50th percentile at the 2C clinic by	Assess wait times at 2C, improve by 5%. Use lean tools to address the issue.	Susan Smith	5
6					6
7					7
8					8
9					9

*Recommended number of goals is 5

Mission:
Provide the most personalized comprehensive, and highest quality healthcare, enhanced by medical

Vision:
Most Trusted and Most Valued Name in American Healthcare

Values:
Teamwork, Patient-Centered, Innovation,

Mission, Vision, & Values (Do Not Change)

The Division or Top Leader's Goals and Means to Achieve Them (already aligned with System goals)

Legend:

No Alignment	
Indirect Alignment	0
Direct Alignment	X

2017 System-wide Mileposts

1. Be better than 90% of US healthcare organizations on all
2. Be better than 75% of the health care organizations in the US
3. Be one of most desired places for high performers to work
4. Have fully integrated our information systems connecting
5. Expand our mission to care for 675,000 unique patients annually.

(See FY2012 Strategic Plan Document for Details)

5-Year Strategic Plan (Annual Change)

Name: John Doe   **Novell User ID:** J. Doe

Priority	Key Goals	Targets "catchball"	Action Themes	Responsibl	1	2	3	4	5	6	7	8	9
1	Decrease medical supply (COGS) costs.	Technically review and write reviews on top 10 products (by volume)	Comparison review of products while choosing preferred vendor	John Doe	X								
			Get staff feedback and input on										

Figure 2-4: Hoshin alignment between Mission/Vision/Values and annual Strategic Plan (top left of form).

Documenting varying degrees of alignment uses a standard hoshin kanri methodology called an X-matrix. An empty box means no alignment, while an X indicates a strong alignment and a 0 indicates an indirect alignment. For each of the top-level boxes, a key goal is created that aligns with the highest level goal (2017 mileposts), while a "targets" catchball includes more specific and measurable goals to help achieve the key goal. While filling in these targets catchball items, the actual catchball is passed back and forth between the manager and the direct report to negotiate the goals. The action themes were specific approaches to achieving the goals. Therefore, the key goals and targets are the "what" while the action themes are a high level "how" to use as a foundation for future problem solving. The final column details who is responsible for achieving this key goal.

The first round of hoshin sessions (with the top level senior leaders who report directly to the CEO) were focused on direct alignment between the 2017 System-wide mileposts and the C-suite goals. Therefore, only the top half of the forms was used for these sessions. For all of the other sessions, the top of the document (Fig. 2-5) had been filled out during the higher level session and then cascaded down to the bottom half of the form (shown later in Fig. 2-6).

Once this form had been drafted and used for top-level discussions, a pilot was conducted in a single department with one string going from the top level manager to the front-line staff member. During these departmental hoshin sessions, the form was refined and improved as issues or confusion arose. The document was also refined to facilitate collection and enter into the Human Resources (HR) annual evaluation system. During this early phase, different versions of the form were distributed as improvements were made, causing some complications. The senior leaders found the discussions differed from what they had previously had, and the facilitators for these sessions pushed the leaders hard to create the S.M.A.R.T. goals. Given that all lower-level sessions would have to align with these initial sessions, the quality of the top level hoshin sessions was critical. Achieving alignment meant spending a disproportionate amount of time on the senior leader sessions, compared with the "all-staff" sessions.

Name:	Leader		Novell User ID:		Coach:	
Susan Smith			**J. Smith**		**B. Husby**	

Priority							Key Goals	Targets "catchball"	Action Themes	Responsibl	
O	X		O	x	1		Decrease medical supply (COGS) costs.	Decrease costs from 34% of Sales to 30% of sales within the first 4 months of FY2012.	Negotiate contracted pricing with specified prefered vendor, eliminate shrinkage (loss of product).	Susan Smith	
O	O	X	O	O	2		Improve employee engagement grand mean survey score.	Increase grand mean score from 3.69 to 4.00	Continue high, middle, low conversations, being clear on scoring criteria and performance gaps, follow up on action plans with timeframes (accountability).	Susan Smith	
O	x		O	x	3		Operating Margin	Meet budgeted total sales for FY12.	Continue to promote OP&P service through all facilities, open additional clinics.	Susan Smith	
O	x	O	O	x	4		Meet budgeted Contribution Margin	Increase revenue recognition to a minimum of 85% of total sales in the first 6 months of fiscal 2012.	Find the problem, get in touch with the right people (meet with RCO leadership to discuss).	Susan Smith	
X		O	O	O	5		Patient satisfaction	Increase the Likelihood to recommend question of the Press Ganey survey by 10% or to a minimum of 50th percentile at the 2C clinic by	Assess wait times at 2C, improve by 5%. Use lean tools to address the issue.	Susan Smith	
					6						
					7						
					8						
					9						

The Division or Top Leader's Goals and Means to Achieve Them (already aligned with System goals)

Figure 2-5: Determining top-level goals that align (top half of form).

Pilot

The first pilot was conducted in a nursing department with the same top-level system wide mileposts as the rest of the hoshin initiative. This area was selected due to its representative nature, and the pilot was facilitated by the senior external facilitator. Several strings going from the top of the organization to the front-line nurses and support staff were conducted.

Most of the training was just-in-time. As a result, the staff was not prepared, did not understanding the significance of the process, or feared the process. They were anxious about the forms and ultimate goals. A variety of participants asked "What will happen if I don't meet my goals? If I set aggressive goals and miss them, will I get into trouble? Can I set modest goals that I am fairly confident that I can achieve?" These questions illustrated a cultural gap between the deeper significance of the sessions and the fear of negative repercussions that would need to be addressed. It also led to the formulation of training materials. In addition, it led to the message that senior leaders would convey to the staff about the significance and positive goals of the hoshin process. It also proved difficult to schedule time for managers and front-line nurses, as the nurses were either in meetings or providing direct patient care. The nurses' busy schedules underscored some of the challenges and the significance of making this process work. If the staff did not even have time to meet to talk about goals and alignment, how could they ever have a chance of achieving these goals?

An additional insight from these pilots was the divide between the physicians and the other staff. Many staff, especially at the front-line and departmental management level expressed statements like the following: "How can I be expected to decrease patient length of stay when the doctors won't write the discharge orders in time? You can set as many patient flow and efficiency goals as you want for me, but if I depend on the doctors to achieve this and they aren't being held accountable, how can I succeed?" Statements like this reinforced a CEO decision that had already been made to incorporate physicians and business partners fully in the goal-setting and alignment process, which had never been done before at this system. When the nurses were told this, they were surprised but still skeptical. Once the top level sessions were completed, the hoshin form developed and refined, and a pilot of the facilitation and session process completed, the next step was to

roll it out to the senior management level of the organization and begin the broader hoshin planning process in earnest.

Composite Cascade for Top Level (C-Suite to Top-Level Goals)

During full hoshin initiative, the form and process were significantly more developed than in the pilot, so it is a more representative example of the overall process. (The researcher had limited involvement in the initial pilot but was deeply involved with the full hoshin initiative following the pilot.)

Facilitators were scheduled using an "open schedule"; that is, any available facilitator coached sessions that were needed. Therefore, a single facilitator did not follow a string from the top of the organization to the front line. The four phases of the hoshin initiative are illustrated with a representative composite of a cascade from the top of the organization to the front-lines. As goals cascade through an organization, they should always tie back to the top-level, system wide mileposts. This common string is reiterated in each of these cascades through the initiative. The mileposts are referred to according to their primary focus, which are one or more of the following: quality, efficiency, satisfaction, integration, and access.

Table 2-2 illustrates the top-level alignment of the Chief Nursing Officer/Administrator to the system-wide mileposts. At this level within the organization (C-suite), the leaders have significant organizational authority and influence, and therefore were able to identify high-level goals quickly that were strongly aligned. The data they used for goal-setting was generally more available at higher levels than at lower levels because it was aggregated data across the organization. Unfortunately, aggregated data cannot be acted on by itself.

As goals were cascaded through the organization, it was difficult to find specific and data that could be acted on at the unit or individual level that would facilitate problem solving and thus help the alignment toward the top level goal. Many of the Action Themes identified included gathering data that would be used for subsequent goal setting sessions with their reports. When the Responsible column was being filled in, participants commonly identified the need to work in partnership with others in the organization.

Table 2-2:   Alignment of System-wide Mileposts to Chief Nursing Officer/Administrator Goals

Top-Level Goal (System-wide Mileposts)	Alignment	Target	Action Theme	Responsible
QUALITY. Be better than 90% of U.S. healthcare organizations on all publicly reported quality and patient satisfaction metrics and cause zero harm to our patients.	X	Decrease reportable Incidents (falls, infections, medication errors, etc.) by 25%.	Attend quality and safety meetings to review reportable incidents; integrate best practice presentations into nursing "lunch & learns"; gather data on reportable incidents and create a dashboard; visit other system hospitals to find out what they are doing with reportable incidents.	CNO (partnered with CMO for support)
EFFICIENCY. Be better than 75% of the health care organizations in the U.S. on expense performance.	X	(1) Decrease supply expenses by 20% (including linen, disposables, sterile supplies). (2) Decrease "premium" staffing expense by 10%.	(1 &2) Work with clinical managers and administers to quantify wastage, premium staffing expenses (traveler and overtime), and staff turnover expenses.	CNO (partnered with supply chain manager and HR)
SATISFACTION. Be one of most desired places for high performers to work.	X	(1) Achieve 100% of "magnet" status criteria for nursing. (2) Improve staff satisfaction to 70th percentile. (3) Decrease turnover by 20%.	(1) Work with managers to address remaining gaps in magnet status. (2) Review staff satisfaction surveys and "triage" most critical areas to address. (3) Review exit surveys for staff to identify greatest opportunities. (4) Quantify costs of turnover. Work with HR to evaluate pay equivalency with competitors.	CNO (partnered with HR)
INTEGRATION. Have fully integrated our information systems connecting patients, clinics, hospitals and the health plan.	O	Achieve 100% of "meaningful use" criteria for clinical nursing areas.	Meet with IT/compliance to check with current status of meeting criteria. Work with clinical managers to identify gaps and help to address barriers.	CNO (partnered with IT)
ACCESS. Expand our mission to care for 675,000 unique patients annually.	O	Decrease LOS to acuity-adjusted target to improve availability to accept patients (4.25 days to 3.8 days).	Take a two-fold approach to meeting LOS goal: (1) Help address barriers to meeting LOS target, and (2) ensure that appropriate acuity is being documented and reimbursed. This may raise the LOS target, but also reimbursements.	CNO (partnered with CMO)

Phase 2 – Middle Phase (Roll-out and Leader Sessions)

During the next phase of the hoshin process, the top-level goals would cascade down through the organization. This cascading was manifest in the actual document, with the manager's goals being at the top of the form (Figs. 2-4 and 2-5) and the direct reports being at the bottom of the page (as shown later in Figure 2-6). Just as the top-level, C-suite staff created goals that aligned either strongly, indirectly, or not at all with each of the top level goals, the direct reports aligned their goals with those of their manager. Therefore, each of the goals should trace back all the way up to the top level strategic goals, which then align with the Mission, Vision, and Values of the organization and 2017 mileposts.

The manager and his or her direct reports had to align with their direct manager's goals as well as to align with the strategic plan mileposts. If the goals aligned with their manager's, but not with the "mileposts" or the Mission, Vision, and Values of the organization, this indicated a breakdown in the process. It was also a form of "error-proofing"; if a goal did not align with any of their manager's goals, this would immediately indicate that it should not be undertaken as an initiative. Some of the goals would align with several of their manager's goals (either directly or indirectly), while others might only align with one.

The target was to have approximately five goals or fewer, which is indicated on the bottom of the form near the shaded and un-shaded boxes. The rationale was that individual effectiveness decreases as their efforts are divided among too many different goals [112, 113].

Composite Cascade for C-Suite to Manager

In the next phase of the cascade, we focus on the Chief of Nursing Operation's (CNO) sessions with the Medical-Surgical nursing manager. At the top level of the organization, significant organizational authority and "reach" enabled clear alignment with the top level goals. As the efforts started to move down through the organization, however, the goals of Integration and Access appeared to be system goals that would be difficult to translate to the front lines of the organization. As shown in Table 2-3, the targets and action themes to address these had only indirect alignment. The Quality, Efficiency, and Satisfaction goals readily translated to the middle level of the organization, where targets and alignments were readily identified. Given that Access and System Integration are inherently strategic and have significant breadth, individuals in the organization who have broader

organizational reach and influence will have greater alignment with these goals, while those closer to the front lines will have less direct alignment. This is a significant aspect of the hoshin process—even though the alignment decreases closer to the front lines, they would likely be completely missed if not for the hoshin process. Therefore, indirect alignment was an improvement over no alignment.

Table 2-3:   Alignment of Chief Nursing Officer/Administrator to Medical Surgical Nursing Manager Goals

Top-Level Goal (System-wide Mileposts)	Manager's Goals	Alignment	Target	Action Theme	Responsible
QUALITY. Be better than 90% of U.S. healthcare organizations on all publicly reported quality and patient satisfaction metrics and cause zero harm to our patients.	Decrease reportable Incidents (falls, infections, medication errors, etc.) by 25%.	X	Decrease falls and medication errors by 35%.	Review falls and medication error rates by unit and by shift (to help set goals). Celebrate improvements and successes.	Nursing Manager
EFFICIENCY. Be better than 75% of the health care organizations in the U.S. on expense performance.	Decrease supply expenses by 20% (including linen, disposables, sterile supplies). Decrease "premium" staffing expense by 10%.	X	Decrease linen supply expenses by 20% and sterile supplies expenses by 15%. Decrease overtime/travel expenses by 30%.	Work with Laundry and Supply to better understand usage rates and variation between departments and shifts. Work with staff to quantify wastage. Identify causes between long-term overtime/traveler expenses.	Nursing Manager (partnered with Central Supply and Linen)
SATISFACTION. Be one of most desired places for high performers to work.	Achieve 100% of magnet status criteria for nursing. Improve staff satisfaction to 70th percentile. Decrease turnover by 20%.	X	Improve staff satisfaction to 80th percentile (for units). Decrease staff overtime by 20%.	Review staff satisfaction surveys by unit and talk with unit managers.	Nursing Manager (partnered with HR)

Top-Level Goal (System-wide Mileposts)	Manager's Goals	Alignment	Target	Action Theme	Responsible
INTEGRATION. Have fully integrated our information systems connecting patients, clinics, hospitals and the health plan.	Achieve 100% of "meaningful use" criteria for clinical nursing areas.	0	Achieve 100% of "meaningful use" criteria for Medical-Surgical areas.	Meet with IT to review current status on each of the units. Spend time with nurses while interacting with Electronic Medical Record (EMR) to understand their struggles.	Nursing Manager (partnered with IT)
ACCESS. Expand our mission to care for 675,000 unique patients annually.	Decrease LOS to acuity-adjusted target to improve availability to accept patients.	0	Decrease LOS from 4.2 days to 3.6 days.	Conduct chart review with hospitalist on effectiveness of documenting accurate patient severity (to predict accurate LOS target). Work with clinical managers to collect data on discharge delay causes.	Nursing Manager (partnered with hospitalist)

Other initiatives were also discussed during these sessions. Early in each hoshin session, the direct reports were asked about all of the non-core activities that they do, such as committees, projects, initiatives, and teams. Their responses were collected in the box in the bottom left corner of the alignment form (Fig. 2-6). If these other initiatives aligned with their manager's goals, they were "moved up" on the form. As the discussions progressed and new goals and initiatives were documented, a direct report could (and was encouraged to do so) push back about their available time and resources to undertake new initiatives. This was significant, as no matter how good the goals were, if the direct reports did not have the time to work on the tasks, then they would not be achieved. When an objection might come up, the focus shifted to the other initiatives. The direct reports and their manager looked to see if the other initiatives aligned with the manager's goals or with those of the organization; if they did not, the group discussed eliminating these initiatives. They all discussed shifting time or resources from un-aligned activities to aligned activities; this helped the direct reports feel supported in achieving the goals. These discussions eliminated wasteful or un-aligned activities, which meant sometimes direct productivity or efficiency gains came from the sessions themselves.

Priority	Key Goals	Targets "catchball"	Action Themes	Responsible	1	2	3	4	5	6	7	8	9
	Name: Staff Member **John Doe**			**Novell User ID:** **J. Doe**									
1	Decrease medical supply (COGS) costs.	Technically review and write reviews on top 10 products (by volume)	Comparison review of products while choosing preferred vendor	John Doe	X								
2	Improve employee engagement grand mean survey score.	Increase grand mean score from 3.69 to 4.00	Get staff feedback and input on different products and act accordingly (help staff get engaged in product discussions and see that their frustrations and insights are acted upon).	John Doe		X							
3	Operating Margin	Meet budgeted total sales for FY12.; 100% of patient insurance checks are processed within 1 business day.	Help ease patient's mind about taking high dollar brace(s) or other products by doing insurance checks, etc,.... Transparency on cost of braces and billig process sometimes causes people to walk away. Have patient's wait and get pre-authorization/checked if	John Doe			X						
4	Meet budgeted Contribution Margin	Meet budgeted payroll expenses (re: Overtime); Keeping do-over's to 1/month or less;	Managing/controlling overtime; Minimizing mis-fits/OA.	John Doe				X					
5	Patient satisfaction	Improve response time by 10%	Improve efficiecy of radio communications to shorten wait times; Assess wait times, pilot new process, and then evaluate impact. Create "scripting" for required information for request. Earbuds for radio (pilot it and see if it helps). Click 3 times to acknowledge a response?	John Doe					X				
6													
7													
8													
9													

Aligned?

* Recommended number of goals is 5

Other Initiatives: (list)
Process letters of medical necessity
Process orders for CPM machines for an outside vendor
Offsite delivery of braces or run something to Pavillion
ESA/Dictation

The Unit or Individual's Goals and Means to Achieve Them

Figure 2-6: Direct Report alignment with supervisors'/managers' goals (bottom half of form).

Even without the other initiatives causing a resource issue, the managers were often surprised by some of the activities their direct reports were working on, and the managers wanted the direct reports to stop some of these activities because they were legacy activities or did not add value. This was another example of how the hoshin process facilitated meaningful two-way conversations. For the senior and mid-level leaders, the hoshin sessions revealed other initiatives that were not aligned with goals and that had not been fruitful in the past, despite the time spent on these initiatives. These discussions illustrate a general principle of a lean approach of "making problems visible so that they can be solved" [37]. The amount of unaligned and unproductive effort was prevalent within the organization, but the managers had not been aware of this. The cumulative nature of this unaligned work acted as organizational friction, in the sense that staff had a diminishing amount of time to work on meaningful, pro-active initiatives.

Once the unaligned activities were eliminated, the groups had additional capacity to work on aligned goals. One unaligned activity that was eliminated for a fundraiser was a variety

of standing meetings. One of these was to attend meetings of the local Chamber of Commerce as her predecessor had done. These meetings did not align with her manager's goals, and they had not raised funds for the hospital. Therefore, she was encouraged to stop going to these meetings and focus more time on the aligned activities identified during the hoshin process, such as visiting wealthy potential donors in outlying areas.

As mentioned earlier, this hoshin initiative included physicians in the annual goal-setting process for the first time. Integrating the physicians addressed a persistent gap in most healthcare organizations: the clinical and administrative functions are treated separately, despite the significant impact each of them has on the other. A staff member had stated he did not think that they could achieve his goal because of dependency on the physicians. To address this barrier, the department-level hoshin sessions paired clinical and administrative leaders in the departments and had them complete a single form (or separate forms that had coordinated goals). A discussion from one of these sessions follows: "We have worked together for years, but never really discussed in detail how to help each other achieve specific goals that help the system get where it needs to go! Without doing this, I can see how my achieving my goals could actually get in the way of you achieving yours."

The senior-leader sessions provided many important insights. The discussions differed from what most of the senior leaders had experienced, and therefore required strong outside facilitators to maintain the proper types of discussions. An insightful discussion that took place early in this process illustrates the fundamentally different nature of this approach. The researcher was facilitating multiple hoshin sessions with a manager who was tasked with organizational fundraising. As in most non-profit healthcare systems, fundraising is critical to the core mission and success of the system because many critical services that the community needs would not be cost-effective as stand-alone ventures. Also, most hospitals provide millions of dollars of uncompensated care to uninsured, homeless, or otherwise vulnerable patients. Therefore, in a healthcare context, fundraising plays a more central role than in most organizations.

Most of the fundraiser's staff members were engaged and were setting aggressive goals that they felt they could achieve. One staff member, however, was much more reserved and expressed some concern about the goals set for her. Her goals were in line with the other staff members', so from the researcher's perspective, there did not appear to be any reason

for this reservation. After the session, the researcher talked with the leader privately, and he explained what had happened. "When she interviewed for the job, she was very outspoken about her aggressive and specific goals for fundraising and her high level of confidence in achieving the goals. When she started, we had no approach to track or even hold people accountable for achieving the goals. In these hoshin sessions, she can sense that this has changed and that she will be held accountable for what she says she can achieve. Therefore, she has wanted to distance herself from the aggressive goals that helped her get her position." This illustrates the difference between setting aggressive goals without a system or ongoing discussions to methodically work toward achieving the goals, and the hoshin approach.

Leaders were also encouraged to collect relevant data to bring to the meetings, as well as to have their direct reports bring data and brainstorm ideas before the sessions. Many of the sessions had no preparation, and this decreased what could be completed in the sessions. Also, many leaders thought that this could be completed in one session. They saw the session simply as an administrative requirement. They had held similar discussions previously that had yielded little, so they were skeptical of the hoshin approach. Other leaders requested shortened, 30-minute sessions, as they thought that they did not have time for or need a full session. During the training sessions, they were informed that this process would require multiple one-hour sessions, but these individuals still thought they could complete the process in a single, 30-minutes session. The abbreviated sessions invariably led to incomplete hoshin forms and rushed discussions, which required second and third (or more) sessions.

Logistical challenges that became evident early in the process included the open approach used for scheduling hoshin session facilitators. Leaders could sign up for a session with a facilitator according to a shared calendar and a central scheduler. It was common for back-to-back sessions to be scheduled in locations far apart with no time for travel for the facilitator, or for sessions to be scheduled inefficiently for the facilitator and for the staff. The researcher experienced a scheduled series of sessions at an off-site facility where each one hour session was separated by an hour gap. The researcher assumed that this was due to the manager's schedule, and the manager assumed that it was due to the facilitator's schedule or the standard process. Early in the day, this gap was identified through informal

discussions between the manager and the facilitator and a root cause was identified. The leader had to give two options for times for the sessions, so he provided two back-to-back hour slots for each of the facilitated hoshin sessions. The scheduler then picked the earlier of each of these two options for each of the sessions, thus leading to the gaps. The manager asked the researcher if we could fit in additional sessions, and three additional sessions could be conducted in the same time period.

Challenges with form logistics also became apparent, as the earlier versions of the form were spread throughout the system and were being used by a variety of staff. A newer, unlocked version of the form allowed automated input into the HR system. Nothing on either form showed which version it was. In addition, an initial effort to make it impossible to change the form was overly restricted and did not allow coloring or highlighting of text within the form. The lack of access made it difficult to track in-process changes required between hoshin sessions, to identify areas to focus on, or note where data was missing. The version control issues created significant confusion, frustration, and re-work.

As the senior leader sessions neared completion, it was time to begin the mid-level and below sessions.

Phase 3 – Final Phase (All-Staff and Deadline)

After the main push to complete the leader forms by the August deadline, a small portion of the leaders missed the deadline; most of them completed the process by the end of October deadline for all staff. As Figure 2-7 illustrates, the rate of form completion increased dramatically as the second deadline approached. The graph also illustrates a system issue with the deployed process: How could direct reports align their goals and submit their forms if the leaders did not develop their goals methodically and thoughtfully and submit them until just before the same deadline the staff had? The leaders' delays meant the direct reports had to rush to complete their forms without sufficient time to research and align with goals hastily set by their leaders. The rush to meet a deadline approach led to completing the hoshin process as a task rather than a two-way conversation that could lead to genuinely meaningful goal alignment for the managers and organization as a whole. The missed leader deadline indicated that a certain percentage of the leaders still viewed the hoshin sessions and forms as all there was, and missed the deeper significance of moving

toward aligned efforts, developing staff, problem solving, and goal attainment throughout the entire system. Before this hoshin initiative, the annual review and goal setting was simply a bureaucratic hassle, and this perception evidently carried over to many leaders, who did not appreciate the deeper significance. This perception exemplified the cultural transition that still needed to take place.
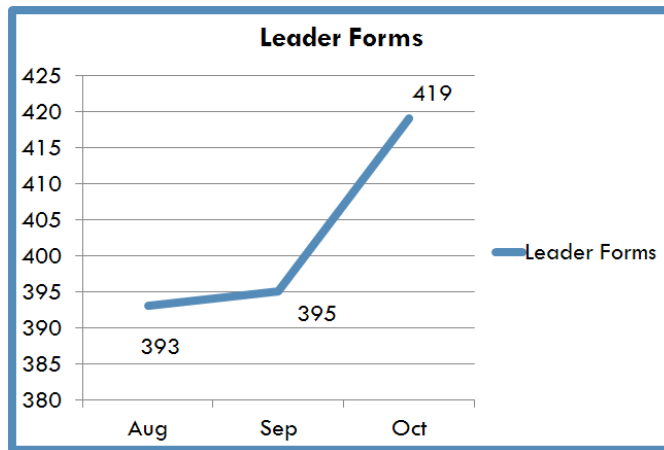
Figure 2-7: Leaders' form-completion rates increased dramatically as deadline approached.

With the substantive (approximately 93%) completion of the senior leader hoshin sessions, the focus moved toward all staff. With equal amounts of time (in terms of calendar days) allotted to the 419 leaders and the 9,056 staff members to complete the sessions and the forms, the pace would have to increase dramatically. The staff sessions that occurred prior to the September start of the staff roll-out were from the pilot areas and other self-initiated hoshin sessions (or small departments where there were very few layers between the senior leaders and the front-line staff).

Composite Cascade from Manager to Front Line

During the next part of the cascade, the nursing unit manager held a hoshin session with the staff nurses (departments varied in holding hoshin sessions with staff members individually or as a group). Some of the higher level goals of access and integration did not align strongly at the front lines, and this misalignment persisted at staff nurse level. It was also difficult to set the satisfaction goal at this level, for obvious reasons: Front-line workers usually have the highest level of turnover and the least organizational influence. Therefore, these workers were essentially the target of higher level goals. It would be equivalent to telling somebody "You need to be happier. What are you going to do to be happier?" Staff

members hesitated to put down any goals, and felt that this goal resided with their management and the organization as a whole. When discussing satisfaction, they expressed concerns that were already reflected in staff satisfaction surveys: "There is more and more paperwork every year, less time to spend with the patients, and increasing pressure to be productive," "Patients are getting sicker, and there is less and less support," "We used to have nursing assistants, transporters, and food services staff to support us, but now we are doing everything for patients, including transporting them and delivering meals to them" and similar frustrations. A few staff thought about how they could influence their workplace environment, such as attending unit social functions or mentoring new staff. For the majority of front-line staff, this sort of goal-setting was awkward and felt forced.

Table 2-4: Alignment of Unit Manager (with Medical Surgical Nursing Unit Manager) to Staff Nurse

Top-Level Goal (System-wide Mileposts)	Manager's Goals	Alignment	Target	Action Theme	Responsible
QUALITY. Be better than 90% of U.S. healthcare organizations on all publicly reported quality and patient satisfaction metrics and cause zero harm to our patients.	Decrease falls and medication errors by 35%.	X	Respond to call lights within 5 minutes (current baseline at 10 minutes) to reduce falls. Use drug library 100% of the time on IV pump for high-risk meds.	Bedside reporting. Do not bypass drug library on IV pump. Respond to call lights quickly. Work with Bed Control to place high fall risk patients near nursing station.	Unit Manager (partnered with Medical Surgical Nursing Unit Manager)
EFFICIENCY. Be better than 75% of the health care organizations in the U.S. on expense performance.	Decrease linen supply expenses by 20% and sterile supplies expenses by 15%. Decrease overtime/travel expenses by 30%.	X	Reduce linen use per patient by 10% and sterile supply wastage by 30%.	Stock fewer linens inside patient rooms (so unused linens do not have to be washed after patient discharge (D/C)).	Unit Manager (partnered with Medical Surgical Nursing Unit Manager)
SATISFACTION. Be one of most desired places for high performers to work.	Improve staff satisfaction to 80th percentile (for units). Decrease staff overtime by 20%.		N/A	N/A	N/A

Top-Level Goal (System-wide Mileposts)	Manager's Goals	Alignment	Target	Action Theme	Responsible
INTEGRATION. Have fully integrated our information systems connecting patients, clinics, hospitals and the health plan.	Achieve 100% of "meaningful use" criteria for Medical-Surgical areas.	0	Use EMR med reconciliation module 100% of the time (transition away from paper version).	Attend training for med reconciliation and begin using (rather than having D/C nurse specialist do EMR medication reconciliation).	Unit Manager (partnered with Medical Surgical Nursing Unit Manager)
ACCESS. Expand our mission to care for 675,000 unique patients annually.	Decrease LOS from 4.2 days to 3.6 days.	0	Decrease LOS for my patients by 10%.	Review D/C criteria daily. Develop better handoff process for evening and night shifts.	Unit Manager (partnered with Medical Surgical. Nursing Unit Manager)

During many of these facilitated hoshin sessions, especially as they approached the front-line workers, the goal-setting discussions often reached an impasse in terms of the staff believing that they could achieve the goals. They had not been given any new tools or approaches to address gaps that had persisted for many years. Discussions turned to how, which became a negotiating point for the catchball discussions. Some of the staff had heard about lean tools and approaches but had not been exposed to them directly or participated in training. They therefore requested guidance or support to use some of these new tools and approaches. The facilitators, who understood lean methodology, periodically suggested different approaches or ideas to help achieve the goals when an impasse was encountered. These suggestions were normally met with appreciation and curiosity, and contact information or resources were shared. These discussions were significant because they showed lean not being pushed onto staff but rather being pulled to help the staff achieve their goals. These requests affirmed the lean perspective of tools being used as countermeasures to specific problems, rather than tools being used for their own sake [30, 64].

A common difficulty for both front-line clinical and support staff related to metrics for infrequent events (such as sentinel events where harm was done, or almost done, to patients) and satisfaction. These metrics often appeared on hoshin forms, and the facilitators would then force them on workers to measure their progress throughout the year. The facilitator said to the staff (who were familiar with PDCA prior to lean), "I see how

you can do 'Plan' and 'Do,' but how can you do 'Check' and 'Act' when your only measures come once a year, or when harm is done (or almost done) to a patient?" The report responded, "I don't know….can't we just wait until the scores come out or a report tells us how we are doing?" The facilitator then asked them, "How are you planning to influence these processes to achieve the goals?" "Well, for patient satisfaction, we are going to do bedside rounds in the morning, which is shown in the literature to drive improved patient satisfaction, and we are going to respond to call lights quicker to decrease the likelihood of patient falls." The facilitator then asked, "Can you measure those and track your progress toward a goal related to those?" The report then responded, "Yes, we can, and then when the reports come out, see if it is driving the numbers in the right direction." This illustrates that many events or processes are episodic in healthcare, and this variability can make it challenging to measure certain processes outcomes directly. Standard goal-setting ends at these ill-defined and inherently delayed metrics, while the hoshin process drives toward more measurable behaviors that enable problem solving.

As the October deadline approached for completing the hoshin sessions and forms, the organization was obviously not going to have all of the forms submitted by following the standard process with requesting facilitators and holding multiple sessions. This was communicated to senior leaders with an accompanying request for an extension so the remaining hoshin sessions could be completed properly. The request was not approved as there was an intense focus on meeting the deadline (given the high visibility of this initiative within the organization), which again indicates a greater focus on the artifact than on the deeper significance of the process. This decision by senior leaders caused a sudden rush to meet the deadline, with a bias toward completion (quantity) rather than substantive and meaningful hoshin sessions (quality). Figure 2-8 reflects this rush.
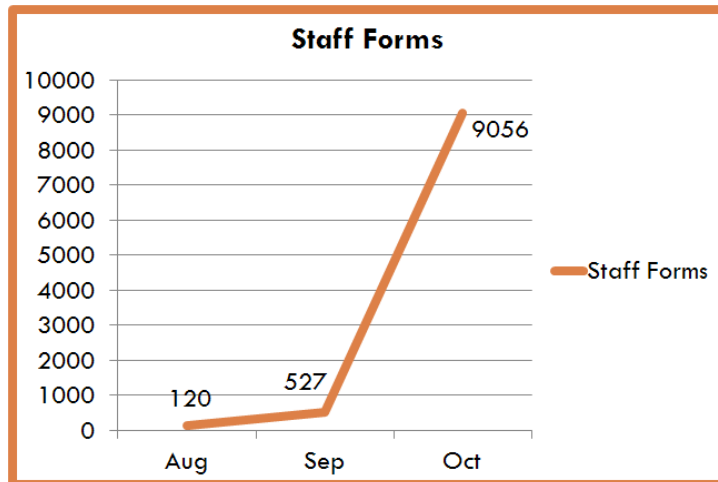
Figure 2-8: Last-minute staff rush to complete the hoshin forms.

Phase 4 – Next Steps (Groundwork for Goal Tracking)

After completing the vast majority of the hoshin forms (for leaders and staff) at the end of October, the next step of the process was to complete a more detailed plan for attaining the individual goals during the coming year. Prior to undertaking the hoshin process, the usual frequency of looking at and evaluating goals was once a year. At that point, goals were either achieved or not, or it could not be determined due to a lack of an effective measurement system. With the new approach to strategy deployment, the goals were to be looked at many times each year, with the frequency of checking more frequent at the working level. Discussions would then be held with their manager about ongoing progress and challenges. This shifted the manager or supervisor from a command-and-control role toward a lean role of mentoring, coaching, and developing their direct reports [30, 63]. As Figure 2-9 shows, the detailed plan for attaining goals includes a series of incremental goals to reach the overall goal. Beyond the annual goal-setting process, this document becomes the focal point of the ongoing work and discussions between managers and direct reports.

Figure 2-9: Creating a plan to achieve the annual goals.

An example of an in-process tracker is shown in Figure 2-10. The methodology for tracking detailed targets versus the attained performance was color coding, with green indicating that the goal was met, yellow being behind the goal but close, and red indicating that the goal was not met by a significant amount. This methodology provides quick visual clues as well as numerical measures of progress. With the previous approach to annual goal setting, the goals would only be looked at once a year, so no mid-course corrections could be made. With the hoshin approach, divergence from the plan should initiate a meaningful two-way discussion that would result in new countermeasures and active problem solving. It makes new or unforeseen issues visible so they can be solved quickly, which was not the case before committing to a hoshin approach to alignment and attainment.

Goal Alignment Target Tracker		MANAGER B NAME		MANAGERB					LEGEND
Staff Member									Met Goal
Today's Date: 2/19/12									Slightly Behind Goal
									Unable to Meet Goal

Step 4: Track

Objectives

Key Goals	Targets	Responsible	FY11 Baseline	Yr to Date Actual		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Totals
Decrease Supply Costs	Decrease Supply Costs to $87K for FY12. (Baseline: $97K for FY11)	BH, TD	$97,000	$44,297	Plan	9,000	9,000	9,000	9,000	6,375	6,375	6,375	6,375	6,375	6,375	6,375	6,375	
					Actual	8,799	9,137	11,211	8,750	6,400								
					Note													
Meet or exceed contribution margin	5% for FY12	BH, TD	4.59%	4.96%	Plan	4.60	4.65	4.70	4.75	4.80	4.85	4.90	4.95	5.00	5.05	5.10	5.10	
					Actual	4.20	4.66	4.69	4.76	4.96								
					Note													
Increase Staff Engagement	Grand Mean Score >4.02 for FY12 (baseline for Cost Center S1234 was 3.96 for FY11)	BH	3.96	3.66	Plan	3.96	3.96	3.96	3.96	3.98	3.98	3.98	4.00	4.00	4.00	4.02	4.02	
					Actual	3.95	3.96	3.96	3.99	3.97								
					Note													
Increase patient satisfaction	75th percentile on Press Ganey's "likelihood to recommend" question	TD, BH, SH, JJ, KE	62	72	Plan	62	65	75	75	75	75	75	75	75	75	75	75	
					Actual	62	67	77	78	75								
					Note													
Increase SWISS Scores	Average > 93 on all surveys FY12	BH, SH	N/A		Plan													
					Actual	77	83	88	90	93								
					Note													
Implement new ABC technology	Assemble team by 9/15/11 Complete project plan by 10/31/11 Submit RFP to potential vendors by 11/15/11 Vendor demos 1/15 - 1/20/12 Vendor selection by 2/15/12 Implementation 4/12 Testing 5/12 Roll-Out 8/12	BH, SH, TD	N/A		Plan	Team: Y	Plan: Y	RFP: Y			Demos: Y	Vendor Selected: Y	Implementation: Y	Testing: Y			Roll-out Y	
					Actual	Y	Y	N	RFP sent 12/1	Y								
					Note				Delayed									

Figure 2-10: Tracking attainment of goals throughout the year.

Detailed goal-setting was supposed to take place during the early hoshin sessions but, due to a lack of preparation and available data, it was difficult and. in a significant number of cases, it was left undone by the due-date at the end of October. If these goals were not completed by the staff outside of the official facilitated hoshin goal-setting process, the ongoing discussions and focus might not take place and goal would not be attained. During many of the hoshin sessions, metrics directly related to agreed-upon goals had no baseline measures or mechanisms to collect them. Foundational issues got in the way of the hoshin process, as core operational metrics that facilitate problem solving needed for goal attainment were not available [30]. If these were not available, it was difficult if not impossible to know if the action themes (general activities to move toward the goal) had been translated into specific activities toward the stated goal, to test the effectiveness of the interventions (or even to reflect on mistakes or errors), or to know at the end of the year if they were able to achieve the stated goal.

The lack of metrics to describe core processes became apparent during the facilitated hoshin sessions. Managers became aware that critical processes that would affect their

ability to attain their goals could not be measured readily, or else the measures that were available were aggregated or otherwise configured so they could not be used in problem solving. Managers as well as their direct reports found this a significant revelation, and it served a significant purpose. One of the primary objectives of lean is to make problems visible so that they can be solved [37, 64, 104]. The underlying assumption is that hidden problems or issues will persist indefinitely. Therefore, the lean process was manifesting one of its powerful effects through the premature use of hoshin. Hoshin was making foundational issues visible so that they could be addressed.

Composite Cascade for Phase 4

The lack of metrics was a persistent struggle throughout this first year of hoshin, as illustrated by the preliminary monthly goal-setting completed during the hoshin sessions. Without baseline measures, it was common to state a goal in terms of increasing or decreasing by a percentage. Stating goals in these terms was not a good approach because they did not know where they were starting (or even if it was a significant problem or the best use of time to address). The lack of baseline metrics also inhibited PDCA problem solving during the monthly meetings with managers. In the list of monthly goals (Table 2-5), a variety of issues are evident. The call-light response, linen usage, and LOS reduction are all important goals that a single nurse can influence, but there were no ways to measure them. With hospitals being 24/7 operations, metrics such as LOS are influenced by a variety of other individuals and not just the nurse. Drug library use and med-reconciliation could be measured for individuals (through the EMR), but these goals are basically "Doing" activities that require little or no problem solving. Therefore, for the improvements that require PDCA problem solving, there are no good mechanisms for measuring progress toward goals at the individual level.

To overcome these challenges, front-line clinical areas began to have group goal-setting sessions. In these sessions, processes could be measured at the unit level (instead of the individual level), and the improvements would require a team rather than an individual. While this represents a positive approach of team-based problem solving, it depends on a strong unit manager experienced PDCA problem solving and team facilitating—not a common occurrence in immature lean organizations.

Table 2-5:   Detailed Month-by-Month Plan throughout the Year

Goals Determined During Hoshin Process		Monthly Plan for Year											
Target	Monthly Target	1	2	3	4	5	6	7	8	9	10	11	12
Respond to call lights within 5 minutes (current baseline at 10 minutes)	Call Light Response (minutes)	10	8	7	6	5	5	5	5	5	5	5	5
Use drug library 100% of the time on IV pump for high-risk meds.	Drug Library Utilization % (excluding true emergency uses):	50	75	100	100	100	100	100	100	100	100	100	100
Reduce linen use per patient by 10% and sterile supply wastage by 30%.	Linen Use Reduction (% from baseline)	0	0	1	2	3	4	5	6	7	8	9	10
Use EMR med reconciliation module 100% of the time (transition from paper version)	% Use of EMR Med Reconciliation Module	0	0	100	100	100	100	100	100	100	100	100	100
Decrease LOS for patients by 10%	% Reduction in LOS	0	0	1	2	3	4	5	6	7	8	9	10

In a mature lean organization, the initial year-long plan would be a preliminary starting point. Throughout the year, the direct reports and their manager would review progress, reflect on what worked and what did not, set short-term goals based on small PDCA experiments, and then meet again to review the progress. This approach assumes that not enough known about the process to predict all of the interim steps correctly to achieve the goal and that this iterative experimentation is the real process of innovation and learning [114]. The interim experiments would use the metrics related to the action themes for the PDCA experimentation, and the cumulative impact (or lack thereof) of these experiments would be compared with the progress toward the goal. Without this approach, the initial activities identified are just guesses to be implemented, without the associated learning and integration of PDCA problem solving. This would likely decrease the impact significantly.

The iterative PDCA problem solving described above is prevalent in mature lean organizations, which the organization in this case study was not. The continuous and incremental leader-supported PDCA problem solving described above takes significant mentorship and experience to master, and it requires the approach to be demonstrated or facilitated, as it was with the hoshin sessions.

This organization conducted an organization-wide initiative, so there was little, if any internal capability to mentor the approximately one hundred thousand monthly meetings that should take place to review interim progress. The lack of internal mentors significantly limited the organization's initial capability to reach their goals from this initial effort, and it underscored the importance of having the foundational capabilities needed to be truly successful with organizational alignment and attainment. When the leaders review their progress after the first year, they are likely to find they can either reflect and learn from the results or assume that missed goals stem from the inapplicability of the approach.

Preliminary efforts from the hoshin efforts in organizations with previous lean experience and training appeared to use the iterative PDCA approach. One example of this was a daily huddle the researcher observed while working on a different project. A group that included an administrator, a nurse, a physician, and a technician were doing a brief huddle around metrics and progress toward their goal. They discussed issues they were encountering and new approaches to solutions. This group is likely to become a pocket of success that could be used to demonstrate successful examples.

Quotes from Staff after the First Round of Hoshin

Throughout the first round of hoshin, the Human Resources staff collected representative quotes from staff about their experiences during the process. Following are direct quotes from staff who were directly involved with the hoshin initiative. Most of these quotes were positive, which may indicate a selection bias in the quotes. While some individuals within the organization were not positive about the initiative (such as the managers who waited until the end of the second wave to complete their process), they primarily voiced their dissatisfaction indirectly with delayed or no participation. Also, with the CEO and senior leaders of the organization strongly supporting this initiative, objections may have been

discouraged. Despite this potential selection bias, these comments were unsolicited, and they aligned with the intent of hoshin.

- "I didn't realize just how critical *my* action themes are to this year's strategy."
- "I *aligned well* with my boss, but even better with the system."
- "I'm a lot *more aligned* than I thought I ever was."
- "This is just a really good overdue conversation with my boss."
- "Wow, it was hard and challenging time-wise, but I'm glad we had these conversations before the fiscal year started."

The above quotes illustrate several common themes. One of these was that the process was meaningful. Another was that the staff gained a greater appreciation of the significance of their role and their level of alignment. The final quote is probably the most significant, as it illustrated that hoshin is a challenging process that takes a commitment of thought, time, and resources.

Discussion

This case illustrated an initial attempt to deploy hoshin kanri in healthcare under challenging circumstances. The health care system was large and had grown rapidly and recently though acquisition. In addition to teaching and doing hoshin kanri, the organization was still struggling to integrate all the different cultures and systems. Since the organization was just beginning their lean journey, the lacked such foundational elements as metrics and baseline data. They also lacked understanding and experience with the lean tools, which would have helped them achieve the objectives or the problem solving method they needed to discover the root causes of problems. Because the organization chose to pilot hoshin early in their lean journey, they encountered many interesting challenges. The effects of these challenges are summarized in four categories: (1) healthcare context insights, (2) awareness, (3) resources, and (4) maturity. These categories can be the basis for a model of hoshin kanri deployment in immature lean organizations.

(1) Healthcare Context Insights
The healthcare context creates challenges for organizational alignment due to its high variability, organizational structure, and power relationships with physicians.

- *Integrate physicians into the process*. Physicians are often kept separate from alignment efforts; this divorces the most significant determinant of patient care from core processes and limits potential impact.

  Example: The normal process in the case study for physician evaluation was to illustrate their accomplishments at the end of each year, and this was used to determine bonuses. Therefore, there was no pro-active goal-setting or alignment with the system. The CEO of the system (who is a physician) clearly stated that physicians would be included in the new hoshin process. The physicians initially did not appreciate how this process was different (and they often requested "abbreviated" sessions), but then really enjoyed the discussions. Physicians are data-driven, and they appreciated the focus on data and metrics.

- *Create teams of physician leaders and administrators*. Clinical and administrative department leaders often operate autonomously and have separate goals and initiatives. Almost all processes cross administrative and clinical processes, so goal alignment cannot be effective without cross-department collaboration. The hoshin process held "paired" hoshin sessions with clinical and administrative leaders, which led to dynamic and productive goal-setting discussions. It also set up an environment for ongoing collaboration and problem solving.

  Example: The chief surgeon and the operating room administrator attended some common department meetings, but managed a variety of initiatives separately. The clinical staff often felt that administration was "getting in their way," while the administrators and non-clinical staff thought that the surgeons and other clinical staff were not supporting them and just "being difficult." During the "paired" hoshin sessions, shared goals and objectives were identified, which clarified the unity of their department and role within the larger organization. The clear divide between clinical and administrative activities diminished and ongoing collaboration and problem solving began.

- *For quality, safety, and satisfaction goals, measure behaviors and use the direct measure as an outcome*. Many of the clinical staff set goals related to quality, safety, or patient satisfaction and had readily available data, but the data were collected infrequently (quarterly or yearly) and could not be used to set

interim goals throughout the year. The infrequency of the data also made it difficult to do problem solving or relate the impact of countermeasures. The session facilitators helped to address this gap by guiding the staff toward measuring compliance with standard work or behaviors that were thought to influence the quality, safety, or satisfaction measures. The facilitators' suggestions allowed interim tracking and experimentation throughout the year that would otherwise not have been possible.

Example: Patient fall rates were determined to be an aligned goal, but they were only reported quarterly. Several countermeasures were identified to help address falls, such as setting a goal for responding to patient call lights. If a patient needed to use the toilet and had to wait a long time after pressing the call light, they were likely to go on their own, which could significantly increase their likelihood of falling.

- *High variability in workload makes goal setting difficult.* Healthcare exhibits higher variability in its workload than many other industries. This variability made goal-setting and tracking progress challenging. Seasonal variability (such as flu season) and random variability (car accidents, changes in patient volumes, staff calling in sick, etc.) add complexity to both setting goals and interpreting the effectiveness of efforts. These unpredictable events require deep thought in goal setting and ongoing discussions with managers.

  Example: An emergency department (ED) manager sets a goal with their administrator to decrease length of stay (LOS) in the ED by 15% over the next year. While setting interim goals for the upcoming year, the goals for LOS in January and February were increased due to anticipated volume shifts during flu season (with the target being lower than the seasonal average but higher than the previous month's goal). This accounted for seasonality in the goal setting. Half-way through the year, a competing hospital went out of business, increasing ED volumes by 30% and driving up the LOS. The ED manager and the administrator re-adjusted the goals, given this shift that was not known at the initial goal-setting.

- Conflicts between short-term financial pressures and long-term advantages to the organization can be an obstacle to hoshin kanri. Healthcare is experiencing decreasing reimbursement, staffing shortages, and increasing costs, all of which *discourage* investing in staff working on process improvement and problem solving.

Process improvement and problem solving, however, are critical to addressing *financial constraints*, so strong leader support is critical to maintain a long-term perspective and support *hoshin kanri*.

*Example: A medical-surgical nursing manager set goals to decrease length-of-stay for their unit, but **F**inance had set very strict productivity goals for their staff that did **no**t allow much time for non-direct-patient-care activities. One of the action themes identified was to have nurses sit on teams to plan for patient discharge at the time of admission to prevent discharge delays that would drive up LOS. Having staff on this team w**ould** cause **the nursing manager** to miss his productivity target, but **it would** result in a net improvement of patient care and improved longer-term financial performance for the hospital.*

(2) Awareness
The hoshin process made gaps or opportunities visible that were not apparent before.

- *Hoshin creates pull for lean.* Hoshin created pull for the lean process by establishing goals that had no current mechanisms or skills to accomplish them otherwise.

   Example: A staff member was charged with reducing inventory levels by 25% to meet his goals, but he did not know how to accomplish this. He did hear about a lean tool called 5S that seemed to help with this, so he request training and support to use the tool to achieve this goal.

- *Hoshin brings visibility to gaps.* Hoshin highlights gaps in capabilities required to conduct hoshin effectively (such as bandwidth, process discipline and metrics, leadership, infrastructure, and culture present in more mature lean organizations).

   Example: By conducting the hoshin initiative, resources, facilitators' availability, metrics availability, and staff time became limiting factors. Each of these was indicative of the infancy of the lean initiative and next steps to progress. Staff and leaders gained an appreciation for where they are on the lean journey, and the need to continue to focus on developing their staff and systems to truly be successful.

(3) Resources

Success when implementing hoshin early in an organization's lean journey calls for additive resources or additional considerations that would not be found in a more mature lean organization.

- *Hoshin requires strong leadership.* Implementing hoshin early in the lean journey required strong and visible senior leadership support and significant additional resources for implementation. The revelatory case had an exceptionally engaged and committed physician–CEO leader, which cannot be expected in all organizations. If a lower-level (but still senior) leader is identified as a strong and committed leader for hoshin, a smaller-scale pilot (from this leader down through their span of control) is a viable option to begin the learning process.

  Example: The CEO of the system took a strong and visible stand that "this is our new approach for organizational alignment from now on. We will support it, and we will take it seriously." He then secured resources for external sensei experienced in hoshin to facilitate and train others in the process. During the various challenges during the early lean efforts, as well as during the hoshin efforts, the leaders remained dedicated to the process and were not tempted to give up. The leaders took significant risks associating themselves with an undertaking like this, which was critical. Without this leadership, the difficulties encountered likely would have led to the initiative being labeled a "failure."

- *Logistical details are critical to hoshin.* Details of implementing hoshin in an immature lean organization were critical as the logistics became overwhelming and variability began to cause significant issues. A mature lean organization that has developed significant foundational infrastructure and culture as well as experience with many cycles of hoshin planning, the attention to detail is already integrated into the annual cycle and culture. The logistical challenges were magnified during this case due to the "system-wide" nature of the initiative. If a smaller-scale pilot was conducted (from a mid- to senior-level leader, below the CEO), the degree of logistical requirements and infrastructure would be reduced.

  Example: The first round of sessions offered "open scheduling" of the facilitators, which led to a variety of different logistical difficulties. Facilitators often had back-to-back sessions scheduled in locations that were a 30-minute drive apart, or else

they drove to a remote (1 or 1.5 hours away) location for only one session. This
made undertaking hoshin early in the lean journey even more resource intensive.
Variability in forms and integration with the HR systems also created significant
additional work and complexity.

- *Standardized hoshin processes are critical.* There were ongoing challenges with
  standardizing session facilitation among the multiple hoshin facilitators.
  Example: Managers who had a different facilitators for different hoshin sessions
  with their different direct reports noted that the facilitators had different styles and
  approaches, which sometimes affected the quality of the output. When there were
  multiple sessions with the same manager and direct reports but different facilitators,
  this affected the effectiveness of the facilitator because the facilitator was not as
  familiar with the previous discussions. It became critical to train and standardize the
  facilitators, and to use the same facilitators in a department with a manager and
  their multiple direct reports whenever possible.

(4) Maturity
Organizational struggles occurred with using hoshin in an organization that was less mature,
from a lean organization perspective.

- *Initial impact was diminished, but the process was still worthwhile in the*
  long term. While the results (in terms of achievement of goals) were less than
  would be found in a mature lean organization, the resulting focus, structure, pull for
  lean, and spread of lean was valuable. With a long-term focus being critical to a
  lean initiative's success, the benefits of these initial efforts were delayed but would
  have significant benefits in the future. While this particular case illustrated useful
  points about broad adoption of hoshin kanri by an immature lean organization,
  whatever successes they enjoyed should not be assumed for all organizations
  undertaking this sort of initiative. If the leadership had been less committed or
  involved, the process could have fallen apart and caused irreparable damage to
  both the lean and hoshin initiatives. This was a revelatory case due to the extremely
  strong leadership and the system-wide nature of the initial implementation. Other
  organizations would be advised to take a more measured approach, as there was
  significant organizational risk in the revelatory case studies. While it worked out

well for this particular organization, this path and success cannot be assumed for all organizations. Lower-risk approaches of smaller-scale piloting and gradual "ramp-up" would take longer, but it would entail less risk, fewer resources, and less uncertainty.

Example: When a goal was set to reduce Operating Room turnover times, it became immediately apparent that there was wide variability in the process and no consistent or reliable measures for turnover times. The group documented the different processes, began measuring the turnover times, and built a metrics board and began having daily huddles around it. By themselves, these foundation building steps do not improve turnover, but they enable future efforts to improve the process and instill the daily discipline critical for future success.

- *The hoshin sessions and forms are just tools to enable meaningful and productive discussions that will move toward goal alignment, problem solving, and achievement.* The highly variable nature of conducting a hoshin initiative for the first time, coupled with an immature lean organization, turned the focus to completing hoshin as opposed to internalizing the significance of the process and discussions.

  Example: Rather than allowing extra time for the remainder of the hoshin sessions to be completed once the deadline was missed, the leaders kept the deadline in place, which resulted in a rush to complete the forms regardless of the quality of the sessions or goal-setting.

- *The hoshin process requires time and deep thought and involves a different type of discussion than is common in most organizations; this process cannot be rushed*. Organizational confusion with this seemingly simple approach that was not easy; underestimating the complexity and challenges of implementing a seemingly simple conceptual framework.

  Example: Physicians and others commonly requested half sessions (30-minute sessions) instead of the multiple one-hour sessions that were part of the standard process. Despite evidence that the half sessions were not adequate, the doctors continued to request them. These requests showed that the doctors understood the importance of the sessions, as well as the difficulty of completing them. They thought these conversations were similar to what they had done annually before

but, after the first facilitated session was completed, they often realized that the discussions were much different and required more time and preparation.

- *Preparation is key to hoshin success.* A few departments prepared beforehand and took the process seriously; this made facilitating the sessions minimal, and the sessions could often be completed in a single hour-long session, or even a half-session. This level of preparation was the exception.

  Example: Certain departments were well prepared, gathered significant data, and thought deeply about their goals before the sessions. These participants demonstrated the most meaningful aspects of the hoshin sessions and initiated the meaningful two-way discussions on their own. These departments provide a glimpse of the long-term goal of cultural transformation related to hoshin and lean transformation. The difficulties encountered by the departments that underestimated the work or the thought that was required validated the importance of preparation and deep thought related to this process.

- *Hoshin requires goal setting rigor.* For many of the sessions, the discussions were qualitative, and few metrics were brought to the sessions despite clear explanations of required preparation. When the staff agreed with the leader's proposed goals, the facilitators asked how these goals could be measured. The group would see the difficulty of being able to measure a goal. Session participants seemed comfortable with this and were sometimes looking to just meet the minimum expectations of the sessions (i.e., just filling out the forms).

  Example: Leaders came to the meeting without much preparation, and were comfortable with putting down qualitative, non-numerical goals that could not be measured or that did not have baselines. Facilitators had to push hard to get them to think about goals in a way that could be measured and get them to struggle with how to set up foundational systems to measure their performance.

Foundational insights. One of the strongest themes of this initial hoshin effort was the lack of additional foundational stabilization not only to enable future hoshin efforts, but also to succeed in the lean efforts underway. Organizations tend to skip foundational efforts and focus on the more advanced lean tools. They jump to hoshin kanri because senior management tends to support the concept of aligned goals and measureable outcomes.

When foundational stabilization is skipped, organizations find it difficult to implement and sustain their efforts. Successful lean organizations normally spend significant time and energy on the foundational items before progressing to the more advanced approaches such as hoshin planning. When they run into problems one of the first questions that they ask is why, and the answer is often a foundational issue. On the one hand the implication is that hoshin kanri should not be introduced too early, leaving time for stabilization. On the other hand, this case study reveals that the early use of hoshin drives the organization to focus on the foundation and the pull in basic lean tools. This is consistent with lean philosophy and methodology [37, 63]. A specific foundational requirement for hoshin is committed and strong leadership. Even if all of the technical aspects of foundational stability are in place (such as standard work, workload balancing, visual management), lack of strong, committed, and involved senior leaders will likely lead to negative outcomes.

Findings

Rather than using hoshin as a natural extension of extensive and long-term lean efforts, it was applied as a forcing function, which required artificial, additive mechanisms to support and deploy (artificial in the sense that they would not be needed in a mature lean organization). This added to the cost of using hoshin, but it brought visibility to foundational issues that would not have been nearly as obvious in an organization that followed a more traditional path. This visibility of foundational issues will be critical for this organization making future lean progress and extending lean beyond the initial pilot projects and dispersing lean more widely within the organization.

The forcing approach required additional resources, and many of the requirements for achieving the goals (metrics, available time to work on projects, workload leveling) were still not in place by the end of the year. This organization could have minimized these additive resources and other complications with smaller-scale piloting, but they chose to take a measured risk with undertaking a large-scale implementation. A smaller-scale approach would have carried less risk, but it would have carried with it a risk of not moving beyond the pilot phase, which is a common risk in organizations. Also, because the organization accepted a large risk, they advanced more quickly than the pilot approach would have resulted in.

Nonetheless, important insights were gained and knowledge about the requirements and mechanics of hoshin were instilled in the organization. Also, additional staff members were involved and exposed to lean, and were pulling for knowledge and guidance on the use of lean tools to help achieve their goals.

Even though this organization was immature when compared with organizations that have been on the lean journey for many years, they are much more committed and have stronger leadership than other hospital systems we have observed in the U.S. Because of this, they had the organizational humility to learn the difficult lessons and identify the gaps that this process made visible and that will be invaluable in their continuing lean journey. They will likely be able to leverage the insights from the non-traditional use of the hoshin planning approach. A less mature lean organization, or one with less committed or strong leadership, would most likely conclude that hoshin does not work here or even more broadly that lean does not work here and give up without having experienced success in terms of alignment or goal achievement.

It appears that a minimum level of lean maturity and leadership strength (and risk-taking tolerance) is needed to attempt hoshin on a large scale early in the lean journey, and a willingness to accept its non-traditional, foundational insights. If an organization does not have this minimum level of maturity and leadership strength, then this early use of hoshin planning on this scale would most likely fail. An organization without this minimum level of maturity has many options in the early stages of implementing lean. Here are three possibilities: (1) work on small- and medium-sized lean projects to improve foundational stability and increase buy-in; (2) undertake smaller-scale hoshin pilots under strong and committed leaders below the CEO level; or (3) do both, setting a business strategy at the top of the company and beginning to deploy goals through the higher levels of management. If a company were to choose (3), there would, for a time, be a gap between the big changes being led at the top of the company and the smaller improvements being made at the front-line of the value-creation process. If the organization proceeds toward maturity, we should see a connection between the top-down planning process and the capability throughout the organization to use an effective problem-solving approach to develop lean processes that will deliver results.

Thousands of hospitals and systems across the U.S. need of a more effective methodology for working toward goal alignment. The pressures of decreasing reimbursement and new demands resulting from healthcare reform, as well as the need for lean and improving foundational stability, call for a practical method for using hoshin effectively in immature lean healthcare organizations. By leveraging the insights gained through this case study with traditional hoshin methodology and lean process improvement, and by following a phased approach to hoshin deployment in immature lean healthcare organizations could benefit healthcare and non-healthcare organizations.

The healthcare system could have selected a single site or chosen to use value stream mapping as a pilot project. This would have reduced resource needs and focused resources more deeply for ongoing coaching, perhaps leading to greater immediate success in the pilot. The lessons from the pilot could have been leveraged for a broader deployment. However, by taking the risk of jumping ahead to hoshin, the organization developed a stronger commitment to continuing lean processes.

Reflecting on the original problem statement, are there benefits that outweigh costs for organization-wide deployment of hoshin kanri when the organization is not ready for it? In this case study, it was clear that participants felt that it was a worthwhile process that yielded a variety of benefits to individuals and the organization in terms of awareness and helping to facilitate their lean efforts. It required significant additive resources that outweighed the immediate impact, but the organizational perspective on the initiative was long-term rather than immediate impact. The participants saw this as a first step in an ongoing approach to organizational alignment and integration with their other lean initiatives. When the participants take a long-term perspective, they recognize that the benefits significantly outweigh the short-term costs.

There are important caveats to this finding, as this organization exhibited a rare combination of senior leader support, long-term thinking, and approximately four years of continuous progressive lean efforts. Without these characteristics, it is unlikely the efforts would be as successful at first, and that the organization would only look at the lack of goal achievement in the short term and not continue. Therefore, if an organization only did one pass through the hoshin process and it was not part of a long term commitment, the costs would not outweigh the immediate benefits.

Throughout this case study, many different insights indicated a lack of foundational stability as well as cultural norms and logistical struggles that inhibited the hoshin process. The struggles were unique to an immature lean organization undertaking hoshin, but the struggles had the potential to be valuable insights for change, if the organization's leaders reflect on them and act accordingly. As a result, the following phased model for hoshin deployment was developed to find a non-traditional path to lead an immature lean organization on a journey to becoming a mature lean organization. This model is premised on bridging the gap in foundational stability between an immature and a mature lean organization, which is the primary differentiating factor in organizational maturity used in this analysis.

- Phase 1: Develop a plan that is a good fit for the current situation of the organization. Is there an organizational need for a concerted hoshin planning, and, if so, this must be led by a strong and committed hoshin champion (must be a president or CEO for full-scale initial deployment)? Is the company in a position to do "business as usual" at the top and have the patience to develop capability through smaller local change efforts? Is a blended approach more appropriate for the organization's current level of maturity and its business situation?
- Phase 2: Pilot hoshin and identify foundational issues standing in the way of achieving goals or executing hoshin.
- Phase 3: Address foundational issues standing in the way of achieving goals or executing hoshin.
- Phase 4: Attain steady-state hoshin and move beyond the foundation—achieve organizational goals and objectives.

Figure 2-11 is a graphic representation of a continuum of effort and benefit for hoshin deployment. It illustrates the journey that the organization in the case study has begun with their application of hoshin (for this case study, the organization would be at Phase 2).
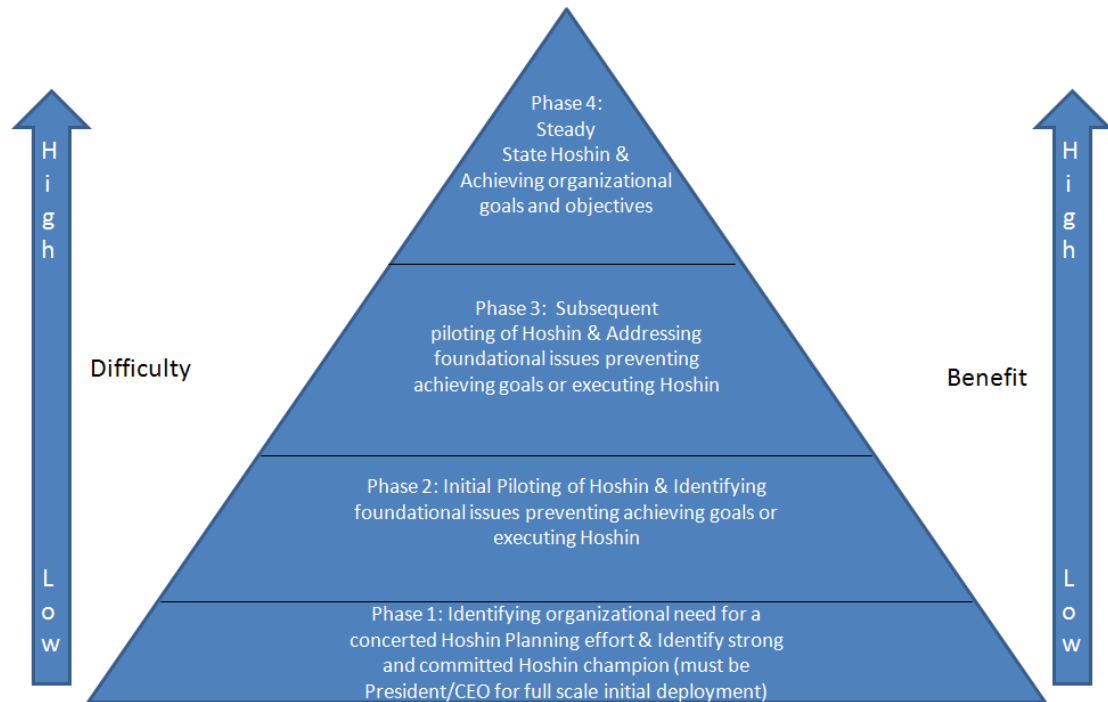
Figure 2-11: Continuum of effort and benefit for hoshin.

Practical Method for Moving Along the Continuum of Hoshin Planning

Table 2-6 captures the different parts of the model described above (in Fig. 2-11) and serves as a roadmap for organizations considering undertaking hoshin planning initiatives early in their lean journey. This approach could help temper their expectations and clearly understand that the resources, risks, challenges, and impacts they would encounter would be different from those of more mature organizations. Without this insight, the tool of hoshin planning could be used inappropriately and have negative outcomes, or it could lead to abandoning lean efforts altogether.

Phase 1 of this continuum is critical for several reasons. If the organization simply decides hoshin kanri is a good idea and undertakes an organization-wide initiative without a hoshin champion at the president/CEO level, the organization is unlikely to be successful. This approach can even set back the overall efforts toward excellence because there is a tendency to abandon efforts at the first difficulties, which are inevitable. Abandoning a

partially implemented, system-wide effort after significant investment of resources and visibility would likely damage the reputation of lean (both as an approach for organizational alignment as well as for process improvement). The result would be negative net-impact of the aborted hoshin effort. If the president/CEO is not willing or able to actively lead the deployment, then smaller-scale hoshin pilots under lower-level hoshin champions would be more advisable. These smaller-scale hoshin pilots would take place within the span of control of the leader and would progress to the front-lines.

Another approach that an organization could take would be to reach incrementally from the top of the organization to lower and lower levels of the organization with the hoshin pilots. For example, the first year might entail hoshin sessions with the CEO to the C-suite. During the next round, the hoshin sessions would reach from the CEO to the directors. The following year, it could reach to the mid-level or departmental managers. While this approach would be slower than the approach taken in the revelatory case, it would incrementally educate and develop the leaders in the hoshin approach. It would also develop their capabilities and maturity in functioning as effective hoshin champions. Given the criticality of leadership identified in this chapter, this incremental approach to leadership development would be highly beneficial. Therefore, the approach outlined in Figure 2-11 and Table 2-6 could be phased with even greater granularity. Also, the approaches identified in Figure 2-11 and Table 2-6 can take place within a sub-set of the organization within the span of control of a strong and committed hoshin champion who is below the level of president/CEO.

Therefore, interpreting Figure 2-11 and Table 2-6 as "one-size-fits-all" approaches to hoshin would be a mechanistic perspective on deploying hoshin, which would be inconsistent with the powerful insights from a contingency perspective. A fit must be found between the current state of the organization and what their leadership is ready for.

For organizations that do not have the strong and top-level hoshin champion of the revelatory case, a top-down and bottom-up approach would be a conservative, low-risk approach. Starting from the top level of the organization, hoshin could incrementally reach farther down in the organization with each round. Simultaneously, front-line problem solving and waste elimination, as well as larger projects, would be undertaken. As more staff members were exposed to these efforts and capabilities were increased, these efforts

would permeate farther up in the organization. This would then result in a meeting in the middle between the hoshin efforts (which started at the top and worked down) and the process improvement initiatives (which started at the bottom and worked up). Once the hoshin initiative met the bottom-up initiative, progressing to the front-lines with the hoshin initiative would be helped significantly by the foundational improvements and staff development that took place through the process improvement activities taking place over several years.

Table 2-6:   **Guidelines for Progressing Along Hoshin Continuum**

Phase	Maturity	Time	Discussions	Resources	Risks/ Challenges	Impact
Phase 1: Identifying organizational need for a concerted Hoshin Planning effort & Identify strong and committed Hoshin champion (must be President/CEO for full scale initial deployment).	Low	2-3 Years	Reflect on current effectiveness for alignment; talk to front-line staff about their understanding of system goals (Are current lean efforts leading to the organizational mission/vision/ goals, or are lean efforts being used to fight fires?)	Strong and visible senior leadership support. If the Hoshin champion is not at the president/CEO level, the initial hoshin deployment must be restricted to the span-of-control of the Hoshin champion. Dedicated time for senior leadership to participate in lean training, pilot projects, and reflection. Resources to develop central and embedded lean coaches and conduct training; integrating CPI staff into strategic/board meetings.	System is full of waste, which limits available time for initial efforts (continuous improvement efforts are initially additive work); shared terminology and experience with lean not in place; culture still command-and-control; leaders not prepared to mentor; visual management and huddles around metrics boards not commonplace. Overall foundation is not solid	Awareness of need to take a better approach to alignment is building; "burning platform for change" is in development.

Phase	Maturity	Time	Discussions	Resources	Risks/ Challenges	Impact
Phase 2: Pilot hoshin and identify foundational issues in the way of achieving goals or executing hoshin.	Low	1 year	Detailed department-by-department discussions of current status of foundational stability; baseline measures and how to measure going forward (Where are resources going to be found for continuous improvement and working toward goals; are metrics staff huddling around metrics boards and beginning to do continuous problem solving (PDCA) and reflection?)	Strong and visible senior leadership support. Dedicated time for senior leaders and lean facilitators to "go to the gemba" and analyze status of foundation. External lean sensei to help mentor staff and leaders. Dedicated internal staff to focus on ongoing lean efforts. Infrastructure, facilitators, administrative support, and long-term commitment to hoshin and lean.	Organizational impatience to achieve goals. Overwhelmed by foundational" findings and magnitude of the work required. Concern over resources to strengthen foundation and eliminate waste before much waste has been removed to free up resources. Change in leadership that derails efforts and takes organization in a new direction. Not using facilitators in sessions and managers falling into habits of using MBO approach. Focusing on the artifact of the form rather than the significance of the process.	Increasing leadership involvement and understanding of process. Greater staff awareness and involvement in continuous improvement. Model lines established that can be used to demonstrate power of approach in this particular organization.

Phase	Maturity	Time	Discussions	Resources	Risks/ Challenges	Impact
Phase 3: Address foundational issues in the way of achieving goals or executing hoshin.	Moderate	5 years	What is our progress on addressing foundational issues identified in phase 2? Are we developing our staff and sustaining our improvements? Are our staff and leaders starting to think and behave in a different way (PDCA, eyes-for-waste, etc,)? Extensive evidence of visible artifacts of continuous problem solving (visual management and metrics boards).	Strong and visible senior leadership support. Lean sensei for ongoing mentoring and development of staff, internal lean experts working on projects, and senior leaders on addressing foundational issues at the highest levels.	Increasing pressure to skip foundational work before it is completed. Regression of foundational improvements. Risk that senior leadership change that could "derail" efforts.	Peripheral and increasingly common movement toward goals. In most areas, increased path clarity on areas needing to be addressed. Increasing uniformity of alignment, PDCA thinking, and changes in staff and leader behavior.
Phase 4: Attain steady-state hoshin and move beyond foundation; achieve organizational goals and objectives.	High	10+ years and beyond	Are we maintaining our foundation? Are we making progress toward achieving our goals? Are we continuing to develop and support our people? Are our leaders staying intimately involved with efforts throughout the organization?	Strong and visible senior leadership support. Stable foundation, standard work practices maintained and followed, and workload balanced. Internal staff experts to mentor and develop staff and leaders throughout the organization. Promote from within is the new norm. No (or minimal) additive resources. All staff can use core lean tools to solve problems.	Senior leadership change that could derail efforts. Maintaining organizational discipline and focus. Organizational arrogance from successes. Neglecting the foundation. Increasing resource abundance derailing "burning platform."	Substantive progress toward goal attainment. Greatly outperforming competitors that have not progressed down a similar path. Improved patient care and efficiency. "Roof" being constructed on the organization's "house."

Figure 2-12 illustrates the different focus areas of using hoshin in an immature lean organization compared with a more mature one. The first three phases focus almost exclusively on the foundation, which could take up to 10 years of concerted effort. Mature lean organizations already have a foundation of operational stability and therefore focus their efforts on maintaining the foundation and the pillars. Only with a firm foundation and disciplined application of the pillars can establish a solid roof on the house, and this roof is essentially the attaining of organizational goals set during the hoshin process [37, 47].

Source: [37]
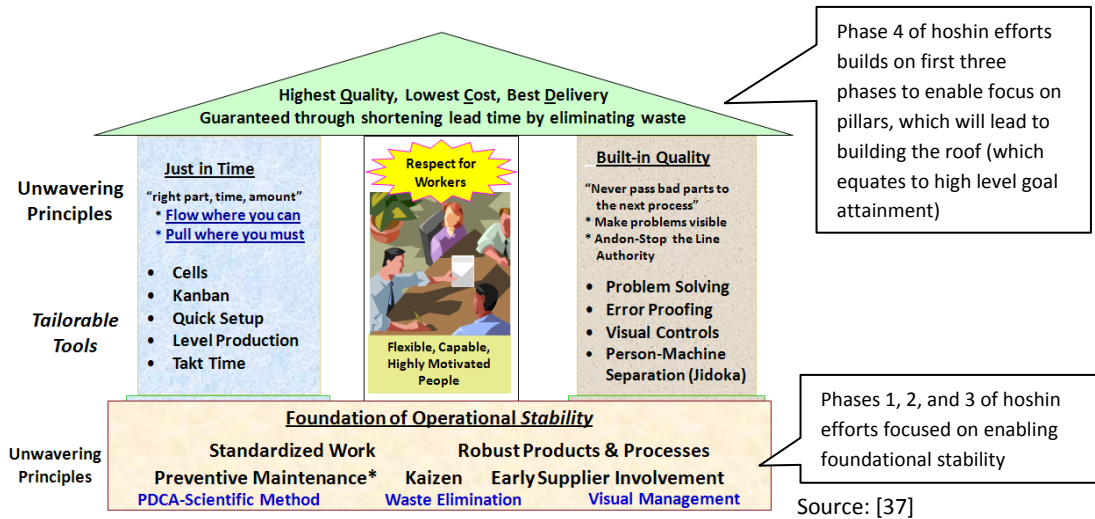
Figure 2-12: Toyota House Model.

Chapter 3
Using State of the Art Medical Knowledge in Health Care Practice: A Theoretical Analysis and Critique of Evidence-Based Best Practices with Examples

Abstract

Billions of dollars are spent in the United States every year studying the best methods for treating illnesses from diabetes to cancer [115]. In these studies, specific sequences of care and types of treatment are recommended based on careful analysis of a variety of variables. These recommendations attempt to standardize the best way (such as maximize effectiveness or minimize negative outcomes) to provide the care [116, 117]. This ongoing investment has led to an impressive body of knowledge on effective ways to treat patients, known as "evidence-based medicine" [26, 118-121].

Researchers commonly extrapolate the aggregate impact on patients if these best practices were used for patient care; the results are compelling. In addition, such organizations such the Institute for Healthcare Improvement (IHI) and the Joint Commission (formerly the Joint Commission for the Accreditation of Healthcare Organizations, or JCAHO) make recommendations or establish requirements aimed at decreasing the estimated 198,000 patients who die every year from preventable medical errors or hospital-acquired infections [48]. Retrospective analysis, however, has revealed little timely impact from these initiatives or recommendations [26]. Other analyses have shown that it takes on average nine years for principles from evidence-based medicine to come into regular practice in healthcare institutions [122], [123], [25], so there appears to be a significant gap between the accumulated body of knowledge in healthcare and what is applied at the bedside [124]. The gap is not in knowledge, but in the application of existing knowledge. In this chapter, we explore this gap through the perspective of insights and approaches from lean philosophy and methodology [37]. Principles of knowledge management are included in this investigation.

Most applications of lean principles in healthcare relate to routine work with short cycle times. These applications differ from non-routine work with the longer cycle time that evidence-based medicine targets. In this chapter, we look at the application of lean knowledge management in healthcare. The research question to be explored is: What approaches to knowledge management are effective in integrating evidence-based practices?

This paper is divided into the following four sections:

1) Introduction and Background: Independent findings illustrate the significance of exploring new approaches to knowledge management in healthcare as summarized in the problem statement. Following this is background information on the healthcare industry, and theoretical frameworks are discussed to provide a context for the problem statement. The problem statement and contextual discussions are used to develop relevant research questions and propositions.

2) Model Development: The process of knowledge management is explored, followed by discussions of different classifications and approaches to knowledge management. Relevant aspects of these frameworks are then integrated into a model that can used to evaluate the case studies. Testable hypotheses result from the model.

3) Case Studies: The primary variables of the model are explored through case studies to test the hypotheses predicted by the model, as well as the research questions and propositions.

4) Findings: Insights from the case study analysis are summarized.

The primary finding of this paper is that, where possible, processes need to be simplified (according to the Cynefin scale) to enable the use of evidence-based best practices (explicit knowledge that reflects care provided at the patient's bedside). Without this shift, explicit knowledge is implemented in a top-down manner (coercively) and does not result in timely improvements in patient care. Based on several case examples, improved effectiveness and shortened timeline for bringing evidence-based care into daily practice can be achieved through:

- Identifying repeatable process steps,

- Internalizing salient points from academic medical literature containing best practices,
- Linking these new processes to outcomes measures (linking cause and effect according to the Cynefin scale), and
- Making this new process knowledge explicit through an enabling approach.

When this process is followed, new tacit (not written down) knowledge related to PDCA problem solving is instilled in participants, which enables ongoing process improvement and integration of knowledge into practice at the patient's bedside.

Only a specific subset of processes substantially composed of tacit knowledge can be shifted to a state that is a fit for explicit evidence based practices (or a subset of a particular process with repeatable aspects). With the significant variability inherent in healthcare, a significant portion of medical knowledge remains tacit. Efforts to shift these inherently tacit forms of knowledge will not prove successful, and are likely be counterproductive. This distinction between knowledge that can be shifted and that cannot is critical, as it focuses efforts in a positive direction as well as avoids a coercive approach to force medical personnel to use standard procedures that do not fit specific situations. While this distinction exists between inherently tacit knowledge and that which can be shifted to a state that is conducive to best practices, it is important to challenge this distinction. Rarely challenged is the pervasive perspective that most knowledge is inherently tacit in healthcare. The case studies illustrate examples of the shift from tacit to explicit knowledge using a lean approach, but only with a significant effort focused on problem-solving and "organizational experimentation and struggle." Therefore, the process shifting from tacit to explicit knowledge were not mechanistic or coercive, but rather enabling.

<u>Primary Findings</u>

For knowledge that remains inherently tacit, methods for effectively transferring tacit knowledge (such as an apprenticeship model) are a natural fit. To enable the transfer of tacit knowledge, a highly effective apprenticeship model needs to be used more widely. Tacit knowledge can be most effectively taught by also developing strong problem solving skills that use the PDCA framework for learning through repeated experience.

When repeatable steps are identified, tacit problem solving knowledge (developed for dealing with knowledge which is inherently tacit) enables individuals and groups to effectively integrate relevant external evidence-based knowledge to help address problems (see Fig. 2-2). This problem solving skill set allows for the integration of the externally generated knowledge with patient care and to overcome the organizational and individual variability that is a significant barrier to the knowledge management. This problem solving capability for integration also prepares the organization for ongoing integration of new evidence-based knowledge that is continually created, leading to a more sustainable knowledge management process.

The case studies in this chapter illustrate the effectiveness of the enabling approach.

Introduction

The past 50 years have seen an unprecedented increase in the overall knowledge of how the human body functions and how to treat its maladies with new technologies and medications. Procedures that were once exotic, such as open heart surgery, are now commonplace, and achievements in healthcare border on the miraculous [125]. One might conclude that healthcare is on a path to achieve tremendous improvements. However, several bodies of evidence indicate the actual changes are less effective than expected. Approximately 198,000 patients die every year in the U.S. from preventable medical errors and hospital-acquired infections. This is approximately twice the number of deaths from automobile accidents, breast cancer, and AIDS combined, making a patient's stay in a hospital one of the most dangerous experiences they can have [48]. At the same time, costs have been rising at several-fold over inflation without a corresponding improvement in services provided or outcomes [126]. The gap between the known best practices and actual patient care provided at the bedside is increasing. Why?

Problem Statement

The following finding from The Commonwealth Fund reinforces other findings demonstrating the need to focus on the knowledge management cycle to help save lives and improve the quality of care for patients [122, 123, 127]:

> *Despite the substantial literature on evidence-based clinical care practices that have proven effective in controlled environments and trials, a major challenge for health*

care systems has been to spread these advances broadly and rapidly. The literature

suggests that it takes an average of nine years for interventions that are

recommended as evidence-based practice in systematic reviews, guidelines, or

textbooks to be fully implemented. Such a sizeable research–practice gap raises the

question of why new ideas and actions are not spread and adopted faster.

—From The Commonwealth Fund: Blueprint for the Dissemination of

Evidence-Based Practices in Health Care [127]

Why does it take nine years to pass for something demonstrated in the medical literature to be practiced at the patient's bedside? This question leads to the problem statement explored in this chapter: There is a growing gap between the increasing external healthcare knowledge base and the industry's ability to use this knowledge base to improve efficiency, quality, and safety.

Background

Scientific Method

The creation of knowledge in healthcare is based on the scientific method [128]. Clinical research, which is the primary source for knowledge creation in healthcare, is based on controlled experimentation with clearly defined inputs and outputs, evaluation of the impact of a specific intervention against a null hypothesis, and statistical analysis to evaluate its efficacy. This approach, based on the scientific method of stating hypotheses, setting up experiments, evaluating results, and then repeating this process as greater understanding of the process is gained, is essential to knowledge creation in healthcare. This approach is shared with the most common problem-solving approach in lean healthcare, that of PDCA (Plan-Do-Check-Adjust) or PDSA (Plan-Do-Study-Act) [129, 130]. In PDCA, a plan is created after deeply studying a problem (with the plan equating to a hypothesis), it is implemented (equivalent to conducting an experiment), the results are evaluated, and the process is repeated to continuously improve the process and gain a deeper understanding of the process. Therefore, both PDCA and healthcare knowledge are based in the same fundamental principles of the scientific method.

Most clinical research is formulated with clearly defined and controlled variables, and the inputs (X) and outputs (Y) are closely tied. A common reason for contesting the relevance of

clinical research is that the application of the findings from clinical research is no longer in a controlled research environment. The concern is that factors not accounted for in the academic literature negate (or decrease) the apparent relevance or effectiveness of using evidence-based insights in providing actual care to patients (or the effects are present, but not visible). The knowledge is applied in a much more dynamic and uncontrolled environment where the employees implementing the knowledge were not involved in the creation of the knowledge and therefore do not necessarily believe in its legitimacy or feel empowered to customize the knowledge and experiment to make it work in their unique context.

Mechanistic versus Socio-Technical Perspective

Evidence-based best-practice knowledge was created externally using the scientific method, and then disseminated within a healthcare organization without the "buy-in-through-involvement" that comes from a team-based approach [37]. A mechanistic view of organizations and individuals assumes that they would take direction from a policy or procedure and apply it exactly as it is described [131]. A socio-technical perspective would suggest that the social system must be integrated with the technical system (in this case, the evidence-based best practice). From the evidence on the ineffectiveness of deployment campaigns [26] and delays in the acceptance of evidence-based practices [25], something appears to be missing from the current perspective and approach. The socio-technical perspective suggests additional considerations and approaches that may be able to address the apparent gap.

If one views evidence-based best practices (external knowledge) as responses to problems that were encountered by care providers, then for the knowledge to be accepted and actively used one must be involved in the problem solving that created the knowledge. Alternatively, there must be some internalization process to embed the best-practice knowledge within an organization and facilitate their active and sustained use [132]. This process for internalization is a fundamental paradigm shift from a mechanistic view of organizations. Given that best-practice knowledge was created externally to the organization, the question becomes, "How do you involve staff in the problem solving process for research that was conducted externally?"

Variability between Organizations

Hospitals vary in many aspects of organizational structure, technology, staffing, regulations, and cultural characteristics (both between organizations and within an organization) [133, 134]. When medical literature demonstrating a best practice is shared within the healthcare industry, sharing occurs through conventional dissemination [135], leaving it to individuals within an organization to make it work. Many variables can have a significant effect on the implementation of the evidence-based medical best practices, as they are not "plug-and-play" as might be assumed in a mechanistic view of organizations and processes [136]. Without integration of best-practice knowledge with their internal processes, the staff members have little if any understanding of how the particular best practice actually affects patient outcomes. They have no training or time to experiment and figure out the best way to implement the best practice in their particular organization. This lack of implementation leads to a situation of either partial implementation, implementation without knowing its effectiveness, or an environment of coercive enforcement of seemingly arbitrary requirements [90]. Therefore, the "deployment and enforcement" approach (essentially centralized command-and-control) assumes one size fits all. This approach does not take into consideration variation between hospitals and between departments and individuals within hospitals. It also does not take into consideration the differentiation between knowledge that is inherently tacit (which cannot be shifted to explicit) and that which has potential to be shifted toward explicit.

Best Practices at the Patient's Bedside

If you were to tour a modern hospital in search of evidence-based medical best practice and view care through the mechanistic viewpoint (centralized command-and-control), you would look for the policies and procedures to be documented and checklists to be followed. Using this viewpoint, the assumption would be that the knowledge of evidence-based best practices had been successfully transferred to the organization and reflected practice, given that it was documented. Often evidence-based medicine proceeds to the point of being documented in a hospital. But the critical question is not whether it is documented or in the patient's chart. The critical question is whether the best care was provided to the patient and that this care was based on some defensible source of knowledge. Although a large amount of explicit (documented) knowledge that reflects evidence-based care in U.S.

hospitals is deceiving, variable tacit knowledge ("learned" knowledge that is not documented) seems to be the primary driver of actual care delivered to patients. Therefore, unless the documented processes reflect actual care practices, the documented knowledge is essentially irrelevant. This supports arguments that tacit knowledge is the dominant force in healthcare, and is a significant barrier to transitioning the evidence-based medical knowledge into actual care.

Variability in Care

The prevalence of tacit knowledge drives significant variability in the care that is provided. Tacit knowledge is learned and not documented, and therefore varies significantly between care providers. This leads to the care provided to patients depending on the individual practitioners that treat them. While the tacit knowledge taught through an apprentice model to care providers is effective at dealing with high variability and uncertainty, it is a barrier to the consistent practice of best practices identified as resulting in improved outcomes for patients.

"Checking the Box"

Another factor related to the relationship between tacit and explicit knowledge is the "checking the box" mentality, where checklists are completed simply out of a desire to meet bureaucratic requirements rather than to achieve the underlying aim of the checklist.

For example, the researcher observed mobility assessments for patients at multiple hospitals. When patients are in the hospital for extended periods of time, they are supposed to have their mobility assessed (through attempting to have the patient sit up, walk, stand, etc.) in order to provide proper physical or occupational therapy and make sure that their health does not degrade. When patients are not mobilized and stay in bed, their strength and fitness diminish, their balance is negatively affected, and they can develop hypotension [137]. Daily assessment is on a checklist, and the compliance with checking the box is almost a 100%. In this researcher's experience, however, the actual frequency of mobility assessments was around 25% or less. This lack of mobility assessment can lead to chronically ill or elderly patients who had been living independently before entering the hospital having to be transferred to a nursing home after their stay because their strength and health had degraded significantly during their one- or two-week stay. Therefore, the

net effect of their hospital stay may actually be negative, despite the evidence-based best practice of mobility assessments being explicit and required. The patient's decreased ability to live independently was the result of not following defensible evidence-based guidelines, not as the result of the reason they were admitted to the hospital. The artifact of the explicit knowledge did not reflect the actual care provided to the patient, despite the significant benefit to the patient from the care suggested by this best practice.

An alternative interpretation of the mobility assessment is that when the nurses are busy they may observe the patients without formally doing the assessment, and then check the box. They would not find doing the assessment to be a productive use of their time. This would be an example of a nurse using their tacit knowledge to assess the patient's mobility differently than the checklist would suggest. This adds complexity to the process, as the unofficial assessment is based on the tacit knowledge of the nurse, which is likely to be variable. If the nurse's tacit knowledge is effective at doing this unofficial assessment, then the outcomes for patient may not be negatively affective. If the nurse's tacit knowledge is not effective at this unofficial assessment, then the patient's health could be negatively affected. This demonstrates the relationship between tacit knowledge and variability in care. This example also demonstrates how workload can also lead to variability in care, with providers making care decisions based on their workload.

Based on these contextual discussions, the following research questions and propositions are explored.

Research Question and Propositions

Research Question

What approaches to knowledge management are effective in a healthcare context for achieving integration of evidence-based practices with care provided to patients?

Propositions

To explore the research question, several propositions are stated, relevant models developed, and then explored through a variety of case studies. These propositions were derived from the background issues presented in the previous section.

- **Processes exist in a complex environment, and this must be taken into consideration when considering how to deploy evidence-based healthcare knowledge (open systems perspective).** The healthcare environment is complicated and dynamic, and neglecting to integrate this consideration into the approach will be detrimental to the effectiveness [138].

- **The most effective models for teaching and deployment will depend on the type of knowledge being deployed (contingency perspective).** A one-size-fits-all approach is consistent with a mechanistic perspective of organizational function, while a contingency perspective assumes that a fit must be found between the type of knowledge and the approach. The ability of an organization to determine and support this fit will be a significant determinant in the integration of evidence-based knowledge into practice [139].

- **A "structural" mismatch frequently exists between the current state of knowledge (complex and tacit) and the current organizational approach of command and control (which corresponds to knowledge that is simple and explicit), resulting in limited effectiveness.** Complex knowledge can, in certain circumstances, be simplified so that standardization in practice becomes more likely. Complex and tacit knowledge is inherently difficult to make explicit, so it must be simplified in order to enable its transition (or partial transition) to explicit knowledge. The types of knowledge that can be shifted are the repeatable steps of a straight forward process, not the higher variability aspects of healthcare that are inherently tacit.

- **Process measures must be available and reliable to test and refine the efficacy of this knowledge and how it is applied (process measures are necessary for cause-and-effect understanding, which is essential for influencing localized standardized work).** Without measures of output or performance of a process or system, it is difficult if not impossible to determine cause-and-effect relationships. This link of measurement and testing change is also congruent with the PDCA approach of lean [30, 101, 140].

- **Government standards (centralized explicit knowledge) must be translated to localized standardized work created by each health care unit before it will become actively used.** The cause-and-effect relationships of a system cannot be clearly

understood if wide variation in the process needed to complete a task exists. More variability in a process increases the complexity of the system and the difficulty in understanding the cause-and-effect relationships. As summarized in a common phrase at Toyota: "without a standard there is no problem" [63]. That is, when something goes wrong, who is to say that an individual did something incorrectly if there is no documented process, or if the documented process is so cumbersome and obtuse that it is not in a usable form? Similarly, doing small tests of change with a process is difficult if it is not documented or stable enough to experiment with changing specific parts of the process.

Note: An important issue that must be discussed is the terminology of "best practices." A common and superficial interpretation of this term would be of a process that cannot be improved. A best practice is [for an expected aspect of care to be performed (typically based in some level of evidence)] the routine (standard) process performed that result in the expected aspect of care to be performed within the context of the specific setting. "Best" refers to comparison with the level at which the expected aspect of care is performed in other settings/institutions. However, if the level of performance is not 100%, it can still be improved in the comparatively high performing settings. Also, the contextual factors in other settings may differ significantly from those in the higher performance settings, so that the process in higher performance settings may not lead to some results in other settings. In lean terminology, this would be described as complying with (or striving to follow) a standard work practice, and using this standard work as a backdrop to strive toward achieving and removing any relevant barriers. As with all standard work in a lean organization, there is an expectation that the standard work will be improved, but divergence from the standard work requires evidence of a safer or more effective new iteration (improved version) of the standard work [64]. With most healthcare staff not following any clearly defined process, not to mention one that is based on medical literature, this would be a significant improvement in patient care. Therefore, for the purposes of this analysis, best practices will refer to following (or striving to follow) standard work practices based on the current evidence-based practices.

Model Development

What Is Knowledge Management?

At the core of the discussions about how to bring evidence based best practice knowledge into daily practice [141] is the question of the mechanisms for knowledge management that individual practitioners and healthcare organizations use. In essence, the goal of evidence based best practices is to bring externally generated best practice knowledge into care at the patient's bedside. The knowledge management equivalent of this is (1) initiated by recognition of need for knowledge related to providing patient care and then (2) satisfied through the relevant knowledge being internalized and actively used [132, 141-144]. Therefore, the goal of knowledge management and that of using evidence-based medical best practice are very similar, so a framework from the field of knowledge management are used in this analysis.

Four Steps of Knowledge Management

The active and effective use of evidence-based best practices is the flow of evidence-based, best practice findings to care at the patient's bedside, and the field of knowledge management helps to illustrate this flow. Szulanski [132, 144] developed a framework to describe this knowledge management process, and this will be linked to the previously discussed challenges of bringing evidence-based medicine to active and timely use in healthcare institutions. The primary steps of this framework are described in the following sections (in the context of how knowledge is supposed to be managed in most hospitals and accompanying examples) and illustrated in Figure 3-1.

Source: [132, 144]

Figure 3-1:   Szulanski's Four-Steps of Knowledge Management.

1. **Initiation** (recognize knowledge need and satisfy that need). A need is identified to find evidence-based best-practices that demonstrate objectively a better way to provide the care. A relevant piece of medical literature detailing the approach is then identified and copies are obtained. *Example: Central line (port) infections are found to be too high; a*

review of the medical literature results in numerous different approaches, but one (or several covering different aspects) seems more relevant or effective than the others and has well documented results. A specific sequence of steps is identified, as well as the medical supplies and equipment that are used.

2. **Implementation** (knowledge transfer take place). A method to convey the new process to the care providers is identified and executed. Steps are taken to "implement" the process formally, and training is conducted*. Example: The hospital writes new policies and procedures based on the new process for putting in central lines; "Lunch & Learns" are held for staff, and nursing managers convey new process at their huddles;*

3. **Ramp-up** (use the transferred knowledge). Initial implementation and use of the knowledge takes place. *Example: Staff members who have been trained on the new process begin changing their process from the original approach to the new best practice approach of the evidence-based medicine.*

4. **Integration** (internalize the knowledge). Staff and team members stop seeing the best practice as something new and different, and instead view it as "their" process. *Example: when staff members see a fellow staff member following a different process, they point out to that staff member that what they are doing is not the way that was identified and documented.*

This sequence of steps, if they occur as described above, is the ideal (theoretical) flow of knowledge management; that is, the evidence-based, best-practice care is delivered quickly and effectively to patients. Factors complicate this sequential flow of knowledge implementation in any organization, including healthcare organizations. If knowledge did flow according to this path, the time between initiation and integration would be less than the current nine-year delay [25]. Therefore, it is reasonable to assume that the flow of knowledge is not as direct or simple as described. This proposition is explored in the next section.

Mechanistic versus Organic View of Knowledge Management

The linear perspective of knowledge management proposed by Szulanski indicates a simplified, mechanistic view of knowledge management. This simplified and mechanistic

(linear) view of knowledge management appears to be shared with the dissemination-and-enforcement approaches widely used for integrating evidence-based medicine. As discussed earlier, wide variations are found between hospitals and within hospitals, as well as with the state of processes and knowledge (in terms of complexity as well as a tacit or explicit state). This variation would suggest a need to find a fit between the state of the knowledge or process and the approach. This fit can be described through a contingency perspective, which develops an argument that the approach for knowledge management is contingent on relevant variables such as the type of knowledge and surrounding environment [52].

Given the dynamic environment and somewhat relatively high level of complexity of most healthcare processes, contingency theory suggests a need for a more flexible and tailored approach (organic) to knowledge management than the linear perspective of Szulanski's model.

With the dynamic and unpredictable nature of the healthcare environment and the relatively high complexity of processes, an approach to knowledge management that supports an iterative and adaptive cycle would appear to be a better fit. A common model for this sort of approach is PDCA problem solving [140]. This approach is also at the core of the problem solving and knowledge management used at Toyota [30]. A conceptual illustration of the fit between the PDCA approach and the goals of knowledge management in healthcare is shown in Figure 3-2. The PDCA perspective is matched with the four-step model proposed by Szulanski, but it is modified with an iterative, significantly organic approach that is suggested as a fit from a contingency perspective and also through demonstrated successes from Toyota's knowledge management process.
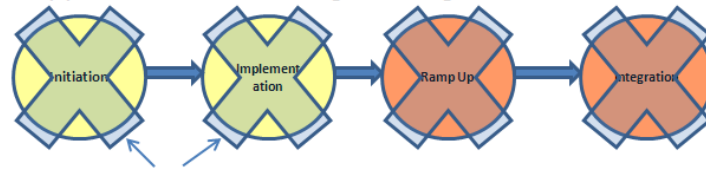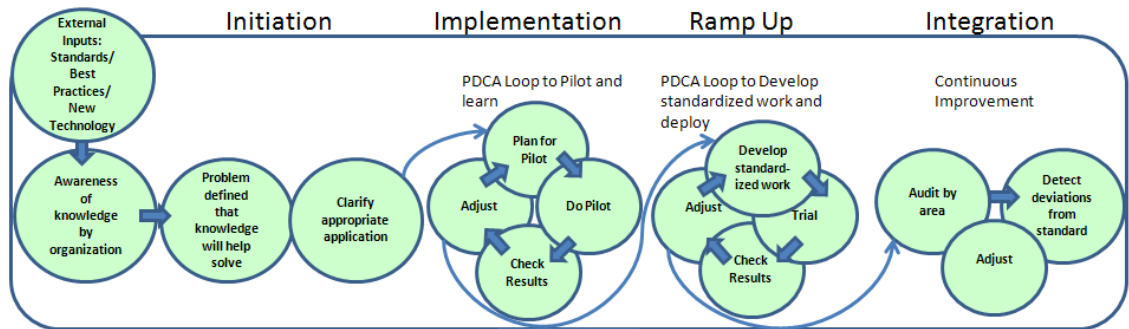
Figure 3-2: Mechanistic versus PDCA-based organic approach to knowledge management in healthcare to integrate evidence-based knowledge.

Processes vary in hospitals, whether such seemingly simple processes as sign-in or registration or such exceedingly complex processes as spine or neural surgery or chronic disease management of diabetic or auto-immune disease patients. Given a range of complexity, knowledge management is challenging. To provide a framework for analyzing this complexity, the Cynefin [142] framework for system complexity was integrated with the knowledge management cycle. This is explored in the following section.

Classification of Knowledge

System Complexity

The Cynefin framework [142, 143] categorizes process complexity into four primary areas, from simple to chaotic. For the purposes of this analysis, the primary characteristic of process complexity is understanding cause-and-effect. The four areas of complexity are based on understanding of cause-and-effect relationships, as follows.

- **Simple:** The relationship between cause and effect is obvious, and one can apply "best" practice.

- **Complicated**: The relationship between cause and effect requires analysis or some other form of investigation or the application of expert knowledge, and one can apply "good" practice.

- **Complex**: The relationship between cause and effect can only be perceived in retrospect (not in advance), and one can apply "emergent" practice.

- **Chaotic**: There is no relationship between cause and effect, and one can use "novel" practice.

  Note: For this discussion, "chaotic" systems, which according to the Cynefin framework exhibit no relationship between cause and effect, are excluded from the analysis. This includes extremely uncommon circumstances that require significant improvisation and rapid and critical problem solving that most likely would not be repeated in the future. Also, these sorts of processes would have very few, if any, repeatable components that would be a "fit" for integration of evidence-based best practices. Therefore, for this analysis, the highest level of complexity that will be explored is that of "complex." The closest form of best practice or standard work that could be applied in this sort of situation would be general heuristics or rough guidelines. Examples of this would be extremely uncommon disaster situations or trauma cases with multiple compounding co-morbidities. The most effective forms of standard work (explicit knowledge) would be rapid problem-solving approaches or "checklists" to prevent critical errors in these dynamic situations. (Chaotic situations would provide an important area of future research into knowledge management, given the significance of disaster preparedness and epidemiology.)

As shown in the preceding definitions, the less simple the relationship, the more difficult it is to apply a best practice. This relationship could be extrapolated to say that it is also farther removed from the integration phase of knowledge management, where the external knowledge is actually used consistently. Therefore, if the objective is to integrate a best practice created externally to the organization, a less-complicated process represents a more natural fit for best-practice care. If system complexity is a *constant*, then systems of greater complexity would not be amenable to best practices. If system complexity can be influenced, then the objective would be to decrease the system complexity. This decreased complexity would make more processes capable of best practice as opposed to the other

less repeatable practices, such as good, emergent, or novel. A mechanistic view of organizations would assume that all knowledge can be shifted toward a simpler state, while a socio-technical view would support the inherent complexity and human aspects of certain knowledge and the unpredictable challenges in providing care. The primary focus of this analysis is the subset of knowledge that resides in a tacit state, but which can have its complexity influenced. This subset would be the knowledge of repeatable steps that currently reside in a tacit state. The secondary focus is on the integration of inherently tacit knowledge with evidence based best practice knowledge.

While the ideal of best practice might not be achievable or realistic (given system complexity or variability), moving along the continuum to best practice (such as good practice) realizes incremental benefits of the best practice. There appears to be a strong link between establishing strong cause-and-effect understanding at individual levels to progress to the integration phase of knowledge management.

An additional complexity is that many processes in healthcare require teamwork. Therefore, it is not enough for an individual to understand and use the best practice. There should be well throughout, communicated, and rehearsed coordination between teams of people who may be in different departments using different reward systems. This need is illustrated clearly with the operating room turnover case study later in this chapter.

In healthcare organizations, as in most organizations, there may be significant variability between processes that different staff members use to accomplish the same task [145, 146]. The variability in processes adds to system complexity. There is not only variability in patient conditions, but also in the care that the same patient receives (depending on who their care provider is). Therefore, efforts to reduce variability and standardize practices decrease system complexity and increase the ability to apply best practices. Establishing documented standard work practices is essential to progressing toward the integration phase of the knowledge management cycle.

The primary variable in the Cynefin framework is the ability to elicit cause and effect from processes. To understand the cause and effect in processes, there should be stable input into the process; otherwise, each iteration of a process is a sample size of one, and the understanding of the cause-and-effect relationship would be minimal or non-existent (or

specific to one individual who follows a singular process that none of the other staff use).
The ability to understand cause-and-effect relationships is central to the PDCA problem
solving as well (and to the scientific method in a more general sense). If a process is
standardized, and the outputs are measurable and visible, then the cause and effect can be
more thoroughly understood. It is then possible to drive a process farther toward the
simple end of the Cynefin scale through iterative experimentation and stabilization of the
process. This allows the use of practices more closely resembling a best practice that
positively impacts the desired outcome.

In addition to integrating system complexity into this analysis, different characteristics of
knowledge and their relevance to the knowledge management process used to bring
evidence-based care practices into active use is explored. The primary dimensions explored
in the following section are the source of the knowledge (internal versus external) and its
state (tacit versus explicit).

Internal versus External Knowledge

Knowledge is either generated externally (outside an organization) or internally (within an
organization) [147, 148]. For this discussion, knowledge generated externally is evidence
based best practice research aimed at identifying important aspects of clinical care, such as
starting central lines (ports) [149]. This research would not be feasible for each of 6,000
hospitals in the U.S. to repeat; the work and resources required would be immense. This
would also tend to drive significant variability, as all of the hospitals would not create
consistent practices independently. In addition, some of these studies involve obscure or
rare conditions that many hospitals would not encounter [150].

Using the Cynefin framework, you could categorize clinical research studies as looking at
complex systems (where the cause-and-effect relationships can only be understood in
retrospect), because they are looking at treating conditions using different protocols and
retrospectively comparing the effectiveness of the different approaches [142, 143]. The
recommendations of evidence based best practice research are essentially documenting
cause-and-effect relationships (or correlation, depending on the understanding of the
fundamental interactions involved) gained through retrospective analysis and then making
recommendations to apply them as standards of care.

External knowledge therefore allows a greater understanding of cause-and-effect relationships than could have otherwise been achieved. It demonstrates the potential significance of knowledge transfer and integration. At the same time, as was demonstrated with the average nine-year delay before these practices come into daily use, the effective transfer and use of knowledge is not rapid, easy, or guaranteed. And the question still remains as to how to impart or transfer the belief in these relationships without users being involved in generating this knowledge themselves.

The other category of knowledge in an organization is internal knowledge. This information is generated at the organizational or individual level as a way of "making the system work." Systems can be made to work either through solving problems or as "work-arounds" to system issues.

Internal knowledge is usually generated during problem solving or when addressing an internal need [140]. Given the four steps of the knowledge management cycle, the initiation and implementation steps usually occur rather naturally, given the internally initiated nature of this knowledge management cycle. Ramp up and integration can prove more challenging, especially when trying to disseminate beyond the local area where the problem was perceived. Despite this, buy-in is more common than with the externally generated knowledge, since the need was identified internally (rather than by comparing the hospital's performance to a benchmark). Contextual similarity also supports this buy-in, because the knowledge was created within the specific context (rather than being translated from another organizational context).

An important distinction exists between internal and external knowledge. In most healthcare processes, significant variability and lack of standardization exists. Therefore, the ability of most organizations to generate knowledge internally and use this knowledge consistently for anything more than simple processes is limited. Most of the knowledge generated internally in healthcare organizations is created at the individual level and is highly variable between individuals within the organization (or between units or departments). The prevalence of these differences in knowledge may be one of the drivers of the high process variability in healthcare, which can be described in terms of the knowledge management cycle. Therefore, for organizations to apply best or even good practice in anything more than simple processes, they must perceive a need to enforce

compliance coercively, which is essentially attempting to make step 4 of the knowledge management process a "mechanistic" process [90]. This mechanistic approach tends to cause the staff to follow the process only out of compliance. The mechanistic approach divorces the practice from the deeper understanding of cause and effect and continuous improvement (such as filling out a checklist without actually performing the steps, which is commonplace). This approach was illustrated previously with the example of the compliance with daily patient mobility assessments.

For either internal or external knowledge to be used reliably, they must become internalized, and this requires that external knowledge reach the final step of the knowledge management process, which is integration. The flow of external knowledge being internalized and used consistently by care providers is the focus of this analysis: the daily use of the critical aspects of evidence-based best-practice medical research at the patient's bedside.

While a mechanistic perspective of organizations would view management flows of internal and external knowledge as being distinct, an open systems or organic perspective would view them as having significant overlap. The recommendations of evidence-based best practices are often created externally, but the organizational and individual variation in bureaucracies, technology, training, and other characteristics require the creation and integration of internally generated system knowledge to use these best practices.   The PDCA problem solving approach illustrated in Figure 3-2 is essentially the same approach used for individual (or local) problem solving and illustrates this overlap.

The mechanistic perspective does not have an effective approach for integrating internally and externally generated knowledge for an effective knowledge management process. This is due to its lack of an iterative approach to experiment and create systems that reconcile the evidence-based best practices and the individual or organizational variation. The iterative organic PDCA perspective illustrated in Figure 3-2 is based on a melding of externally generated knowledge with the iterative experimentation to make it work with the variability prevalent in healthcare. The iterative/organic perspective establishes "buy-in through involvement" that is essential and more natural with internally generated knowledge.

Explicit versus Tacit Knowledge

Another critical characteristic of knowledge is the degree to which it is explicit versus tacit. This classification relates to the "enabler" discussed earlier about standard work and standard work practices. Explicit knowledge is documented, unambiguous, and generally accepted and used, while tacit knowledge is not written down, is experiential in nature, and tends to be highly variable [141, 151, 152]. Some tacit knowledge is learned through experience and is highly situational, with the situations being too variable to list simple "if-then" relationships. In other cases the tacit knowledge could be made explicit, but simply has not been.

Physician education and training is essentially an apprentice model, where a student learns from a "master," and the processes that they follow during their career follow the approaches that they were originally taught [153]. Other healthcare staff, such as nurses, respiratory therapists, and other care providers are taught under a similar model [154]. This approach is a highly effective way to transfer complex, situational know-how that only comes through experience and feedback, but it does lead to a wide variety of different practices and variability in care [48]. An acceptance of variability in patient care has embedded itself into the culture of healthcare organizations, and it is manifested in resistance to moving from tacit to explicit knowledge [155]. This resistance to explicit knowledge is commonly referred to by staff as not wanting to do "cookbook" medicine [156-161]. This resistance is likely a response to the mechanistic efforts to implement best practices through external enforcement without thoughtful identification of fit of process or approach. This resistance shows up as delays in evidence-based practice from coming into widespread use [25, 122, 123], challenges with compliance with care pathways [162] (despite their demonstrated potential [163]), and a high number of avoidable patient deaths [48].

Classifying knowledge from evidence-based medical research as either tacit or explicit is not always clear cut and only begins to address the real problem. The real problem is ultimately what the physician believes and uses. For example, a physician may have learned a practice during residency that has become tacit knowledge even though it is contradicted by current evidence-based best practices. The physician will continue to believe their method is superior to what the scientific data suggest. Their personal experience forms a sub-

conscious (or conscious) cause-and-effect relationship, which is based on a small sample size, compared with the evidence-based best-practice research, so arguably they are wrong, but simply saying that does not solve the problem.

To transition a physician from their tacit belief or faith requires change management, not simply louder and more data-based explanations. With physicians being inherently data-driven throughout their medical education, there is a foundation for making the transition from tacit belief to evidence-based best practice, but this requires setting up mechanisms to support this transition (which will be covered later in this chapter with the discussion of coercive versus enabling approaches). It has been proven many times that people will support ideas that they experience firsthand, so a way must be found to get the physicians to try new ways. It is helpful if a group of physicians keep score so they can see tangible evidence of progress. An example of a supporting (enabling) mechanism for this transition would be metrics boards to track the relationship between different approaches to care and the corresponding outcomes.

The rationale that some healthcare providers use to justify the use of tacit knowledge and their resistance to explicit processes is that their patients are unique, that healthcare is a highly variable environment that is not conducive to standard work, that they are not allowed to change or improve their processes,[164] or that following an explicit process takes too much time and adds too much workload. While healthcare may demonstrate a higher level of variability than many other industries, specific sub-sets of other industries, including manufacturing, exhibit similar levels of variability (such as product development or research and development (R&D)). Toyota and others have successfully integrated lean principles in highly variable environments and achieved significant improvement where other organizations used the healthcare rationale of not being able to apply lean in their environment [165].

When one carefully studies the methodologies and tools of lean, it becomes clear why it works so well in highly variable environments. Many of the tools are specifically targeted at creating systems that are flexible and responsive to variation (such as kanban, Just-in-Time (JIT) inventory management, visual management, workload balancing, quick changeover, standard work, PDCA, etc.), as well as approaches to decreasing the variation [64]. Toyota has accomplished the transition from tacit to explicit knowledge more than any other

organization.[151] Given the potential impact of a similar transition taking place in healthcare, this transition is a critical part of this analysis and model development.

A correlation between highly variable environments and significant component of tacit knowledge in these environments appears to exist, but Toyota has demonstrated an ability to de-couple this relationship between environmental variability and tacit knowledge. This has especially been noticeable in product development, a knowledge-work process where Toyota engineers are deeply mentored to learn tacit know-how and also to codify explicit knowledge stored in databases by vehicle subsystem [165]. This capability legitimizes the potential application of lean principles in a highly variable healthcare context. Toyota has also been successful at sharing important aspects of best practices among its plants and engineering centers through the approach illustrated in the lower half of Figure 3-2, while encouraging kaizen (improvement) and integration with plant-to-plant variation.

In addition to the impact of using explicit knowledge instead of tacit knowledge to decrease variability and codify knowledge, the shift from tacit to explicit knowledge is important for the longer-term success of healthcare institutions. Even if all hospitals in the country began to use the current evidence-based best practices universally, without an accompanying transition to explicit knowledge, performance would eventually degrade if no effective mechanism for integrating new knowledge existed. One of the lean concepts related to explicit, standard work practices is that they form the foundation for continuous improvement. If no documented work practices exist, and a mandate to "do process improvement" is initiated, the natural question is, improve what? In addition to the development of standard work, the tacit problem solving knowledge developed in staff through the process in the lower half of Figure 3-2 would facilitate the ongoing integration of evidence based knowledge.

According to Taichi Ohno, one of the fathers of the Toyota Production System [39, 40, 166, 167] "without standards there is no Kaizen (improvement)." Therefore, a transition to explicit knowledge is essential to the ongoing integration of new, externally generated knowledge; without it, the transition to evidence-based practices will only have short-term impact and will not lead to sustainable knowledge management. Also, while this shift to evidence based best practices would be theoretically possible to transition to evidence-based best practices without a corresponding transition to explicit knowledge, the best

practices would be extraordinarily difficult to monitor and coordinate, given the thousands of individuals who would be involved. In addition, monitoring, compliance, and continuous improvement would be virtually impossible due to the lack of a documented process. Therefore, bringing evidence-based care to the patient is linked to a transition from tacit to explicit knowledge when a fit for this transition exists.

While the transition from tacit to explicit knowledge is critical to this discussion, a balanced perspective to avoid the mechanistic one-size-fits-all approach is essential. Recognition of the important role of tacit knowledge in lean and problem solving is also essential. In Figure 3-2, the proposed iterative PDCA knowledge management cycle is more broadly a different way of thinking and tacit knowledge about how to improve processes. This approach is learned through an apprentice-master model. This "different way of thinking" through mentored oversight of small problem solving projects develops new "behaviors" described as kata [114]. This tacit knowledge enables staff to effectively analyze and solve highly variable "problems" that they face, which are common in a healthcare environment. In Figure 3-2, this approach integrates external bodies of evidence based knowledge and internalizes it. This tacit knowledge about knowledge management and implementing change enables a transition of external explicit knowledge into daily practice. Therefore, tacit knowledge is essential to shift other forms of knowledge from tacit to explicit. To enable this tacit knowledge, it is critical to make knowledge about "knowledge management and implementing change" more explicit. This explicit knowledge facilitates the reliable development of tacit knowledge related to knowledge management and implementing change. To illustrate this point, imagine that you had one nurse who was very good at following standard work, but not at situational problem solving. That nurse would have difficulty addressing unusual events or long term changes in the work environment. If another nurse followed standard work related to repeatable steps of their job, but also had been developed to be very good at PDCA problem solving, this nurse would be very effective in handling routine and variable aspects of their job.

Coercive versus Enabling Approach

An additional dynamic to be considered in this analysis is the approach for incorporating evidence-based best practices into the local delivery of optimal care for patients. A mechanistic view of organizations assumes that the correct technical solution (in this case,

the right evidence-based, best-practice process) that is selected will invariably lead to a successful intervention [168]. In the context of evidence-based best practices, this would suggest that, if a gap were identified in patient care and a best practice was found to address this gap, then the new process would be adopted rapidly once it is introduced into the system. Given the average nine-year delay in implementation of best practices, this assumption does not seem to apply.

The difference between a mechanistic perspective and what appears to be taking place in actual organizations illustrates the significance of a socio-technical perspective, which assumes that technical and social systems must be integrated to achieve success [169]. The socio-technical perspective suggests that even if clinical studies identified an important new aspect of care the approach to implementing procedures to provide that care would have a significant influence on the success or failure of actually providing the care. For this analysis, the two approaches that are considered are coercive and enabling [90].

A coercive approach is one where staff are essentially told to implement the evidence-based best practice in delivering care and punitive or other measures are used (that is, the staff are being coerced to implement it by leadership or the organization, and systems are meant to force it to take place). An enabling approach, on the other hand, would be one where the leadership support the staff in figuring out practices work to deliver desired care and provide resources or system changes to support the new practices (that is, the leadership or organization support the initiative by enabling it through a variety of mechanisms). [90]

To illustrate the differences between a coercive versus an enabling approach to knowledge management, Table 3-1 proposes characteristics of each approach.

Table 3-1:   Proposed Characteristics of Coercive versus Enabling Approach to Establishing Explicit Best-Practice Knowledge in Healthcare

	Coercive	Enabling
Focus of approach	"One-size-fits-all"/universal	Targeted: repeatable steps
Benefits beyond direct process change	No	Different Way of Thinking (PDCA problem solving)
Direction of Change (Push or Pull?)	Push	Pull

	Coercive	Enabling
Cause and Effect relationship understood	Resides in health service researchers	Resides with health services researchers and at the hospital, and front-line staff at the hospital
Staff involved in creating standard work/process based on evidence-based principles	No (or minimal)	Yes, extensive
Knowledge tied to problem solving	No (problem solving occurred externally with researcher)	Yes (external knowledge is used to "seed" initial process and integrated through PDCA and internal validation)
Single or multiple iterations to figure out approach	Single	Multiple (PDCA)
Reaction to complications	Punishment (individual was the problem and did not "follow orders")	Reflection and problem solving (system was the problem)
Where internal documented knowledge resides	Policy manuals (exhaustive and legalistic)	Actively used standard work practices (concise and relevant)
Drivers to document knowledge	Regulatory requirement; reaction to sentinel event; positive or negative financial implications	Best care of patients; PDCA problem solving; enabling continuous improvement
Degree of staff buy-in and "belief" in process	Low	High
Resources for staff to participate in knowledge management for evidence-based medicine	Low	High (through investments or complementary lean initiatives that free capacity through waste elimination)
Degree that desired "best practice" is integrated with other parts of job	Low (additive)	High (complementary/waste elimination and simplification)
Leadership involvement in knowledge management/integration process	Low (enforcement, compliance, punishment, etc.)	High (providing resources and support, addressing cross-departmental issues identified by the team, continued monitoring of the system performance, layered audits, etc.)

Thus far, we have explored variables relevant to knowledge management in healthcare, including level of complexity, tacit versus explicit knowledge, source of knowledge (locally generated or health services researchers), and coercive versus enabling approaches. The following section explores how these approach characteristics correspond to a contingency perspective that seeks to find a fit among these variables and the challenges related to

bringing evidence-based knowledge into daily practice in providing care for patients. This

contingency perspective forms the foundation for the model for the approach to depend on

variables such as type of knowledge and surrounding environment, forms the foundation for

the model.

Contingency Model

Using the contingency perspective, different approaches to evidence-based best practices

are required for different types of knowledge and situations. A contingency [170]

perspective suggests a need for fit if the approach is to be effective.

The theoretical foundation for the contingency model is shown in Figure 3-3. It has been

integrated with the coercive-versus-enabling dimension described in Table 3-1, and with the

proposed default state of knowledge (tacit or explicit) discussed previously. This model

suggests a fit between approach (coercive or enabling from Table 3-1), task complexity

(simple or complex according to the Cynefin framework), and the state of knowledge (tacit

or explicit).

As illustrated in Figure 3-3, as we move from the lower left where knowledge is simple and a

coercive bureaucracy can be effective to the upper right where knowledge is so complex

that it is difficult to even consider a standardized approach, we face a serious challenge in

attempting shifting toward active use of explicit knowledge based on evidence-based best

practices. Possible solutions include focusing only on simple cases where cause and effect is

simple and easy to make explicit or finding ways to make the complex knowledge simpler

and more explicitly.
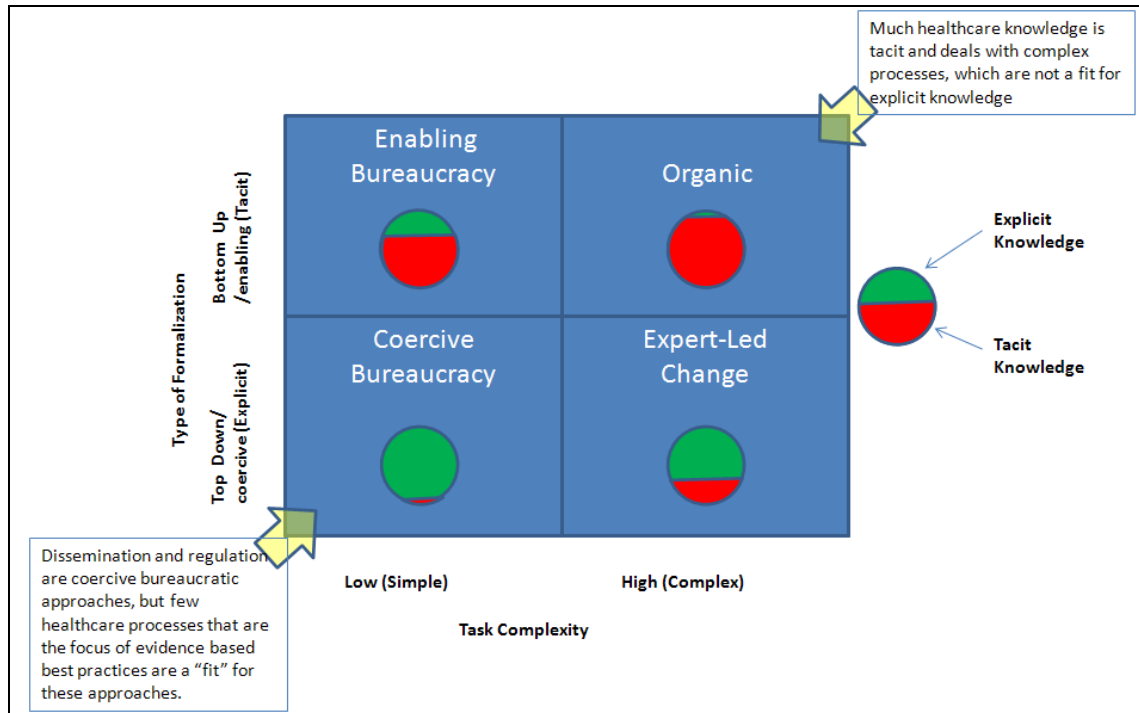
Figure 3-3:   Contingency model for knowledge management in healthcare.

To better understand the interaction of the type of knowledge (tacit versus explicit) and system complexity, a unified model is developed to explore their relationship with knowledge management in healthcare. This model is then used to evaluate three healthcare case studies that vary along the dimensions of type of knowledge (tacit versus explicit) and system complexity (simple to complex).

By integrating the Cynefin framework of system complexity on the X-axis, and then having a continuum of tacit to explicit knowledge on the Y-axis, processes can be categorized by the complexity of the processes (systems) and the form that knowledge takes in these different quadrants (tacit to explicit). An important insight from the contingency model in Figure 3-3 is that the ability to shift knowledge from tacit to explicit is contingent upon the complexity of the task. If the process has significant repeatable components, then it would be a better fit to being shifted from tacit to explicit knowledge. If the process is very high in variability, and has few if any repeatable components, then it wouldn't be a good fit to be shifted.

In Figure 3-3, each quadrant has a circle that represents the relative composition of knowledge, with red equating to tacit knowledge and green equating to explicit knowledge. To shift from the upper right hand corner to the lower left hand corner would mean an

almost total shift of all knowledge from tacit to explicit. With healthcare having such a high component of inherently tacit knowledge, this approach is not likely to be successful. A different approach would be to select specific repeatable parts of the process that are currently tacit, and shift these to explicit through an enabling approach. This would shift the process as a whole to the upper left hand quadrant, while leaving the inherently tacit knowledge in its "natural state."

Expanding the Scope of Lean Knowledge Management in Healthcare

With most lean applications currently targeting relatively simple, routine processes like room turnover and restocking supplies we must decide if there is an inherent limitation or if the boundaries of application for lean can be shifted. We may be able to shift the boundaries by teaching effective problem solving so that at least unique approaches to individual situations are managed effectively. Or we may be able to identify repeating steps even in complex situations, such as heart surgery, which can be made explicit and taught to become a routine aspect of the process. This then frees up mental effort to focus on the more complex, highly situational conditions

Because many healthcare processes or treatments fall into the complex category, they would naturally match with "emergent" or "good" practices (according to the Cynefin scale), and not "best" practices. This mismatch might explain why evidence-based best-practice medicine takes so long to appear in patient care.   The state of the process does not inherently lend itself to "best" practices without some sort novel intervention or approach, as complex processes are not a fit for best practices.

Documentation of the cause-and-effect relationships from the evidence based best practice literature is not necessarily sufficient to impart belief or understanding of the presence of these relationships. Few hospitals have pathways for collecting outcomes data or for effectively communicating these, so the ability for validating the predicted impact is difficult to achieve. If available, this validation reinforces the cause-and-effect relationship and demonstrates its effectiveness in a particular institution.

An example that illustrates the tension between explicit knowledge and care provided to patients is the use of checklists in healthcare, and in surgery in particular. A common perception is that surgery is more of an art than a science, with each surgeon learning their

trade under a master surgeon during residency (and often a specialized fellowship as well). Dr. Atul Gawande, a surgeon and author who writes [171, 172] on a variety of persistent challenges in healthcare [125] has proposed the characteristics of high-risk, highly complexity, but also relatively safe industries, such as construction and aviation. He found that a common approach in these industries is the use of checklists (or similar explicit tools). He has begun to use checklists extensively in his own surgical practice. While these checklists might not address every single step of the process, they address the potential failure points in repeating process steps. Using checklists is taking a complex process that was normally dominated by tacit knowledge and made repeatable components of this knowledge explicit, therefore simplifying core activities [142]. This approach is not shifting all knowledge related to surgery from tacit to explicit knowledge. While much of the knowledge is still inherently tacit, Dr. Gawande has identified a specific subset of repeatable and high-risk steps to shift to explicit knowledge. This allows the surgeon to focus more on the tacit aspects of the surgery rather than worrying about a mistake being made on one of the repeatable steps. Therefore, the process as a whole remains primarily tacit, but it gains an increased explicit component and decreased risk of negative outcomes. The checklist also forms a foundation for continuous improvement, as the standard checklist provides a documented foundation to improve upon.

To further explore the relevant aspects of knowledge management summarized in the contingency model in Figure 3-3, the following sections develop a model of transitioning from tacit to explicit knowledge.

Integrated Model

A model is developed in the following section to explore different approaches to knowledge management and evaluate the case studies. To develop this model, characteristics of a coercive versus enabling approach (from Table 3-1) are integrated with the contingency model from Figure 3-3. This new model explores coercive versus enabling approaches to transitioning between quadrants of Figure 3-3 for repeating process steps (which is necessary for the transition from tacit to explicit knowledge).

Two Approaches to Knowledge Management

There are the two primary approaches to knowledge management in healthcare (coercive vs. enabling), which are described in Table 3-1. Figure 3-3 illustrates that the focus of health services (operational) research mostly reside in the upper right quadrant, while the target of a coercive approach is to transition to the bottom left quadrant through dissemination and regulation. The significance of transitioning to explicit knowledge based on evidence-based knowledge has implications for patient care, so exploring how a coercive versus enabling approach is explored in the following two sections.

Current Approach (Coercive)

To understand the two current paths to trying to achieve the active use of evidence-based best practices according to this model, we first analyze the coercive approach to deploying best practices (illustrated by the knowledge management approach in the top half of Figure 3-2). When one attempts to deploy best practices, there is often little emphasis on having the care providers understand the problem better [140] [37], and there is often a loose link to the impact on outcome metrics as a result of this implementation, which would help to establish an understanding of causal relationships between care provided and patient outcomes. A typical approach to this type of implementation consists of meetings, memos to the staff, adding a step to the electronic medical record (EMR) or decision support system, and introducing a form or checklist that needs to be completed.

According to the contingency model illustrated in Figure 3-3, the current state of the much healthcare process knowledge is tacit and complicated, which would suggest a more organic approach. The approach currently used with dissemination and enforcement is not organic, and therefore represents a mismatch.   Through examining the characteristics of coercive versus enabling approaches in Table 3-1, it is clear that the current approach is that of a coercive bureaucracy.

The coercive bureaucracy is a match for simple and explicit processes, which are not characteristics of evidence-based best practices (which reside in the upper right quadrant of Figure 3-3) and suggest an organic approach. Applying a mismatched approach (mechanistic) can drive the process in an undesirable direction (increased complexity and

minimal shift to explicit). This divergence of desired transition (from tacit to explicit) versus actual transition (from tacit and complex to greater complexity) is illustrated in Figure 3-4.
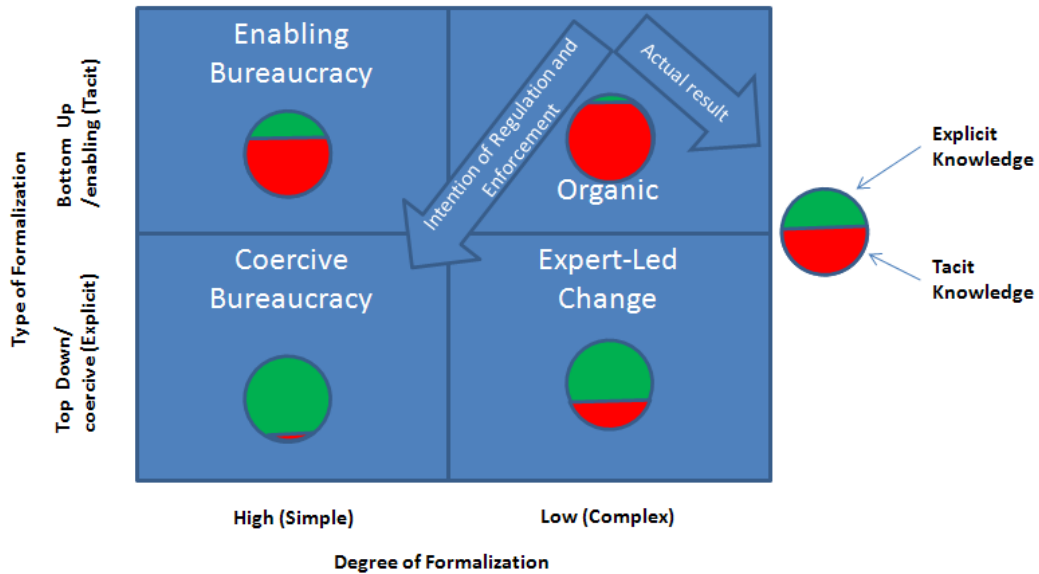
Figure 3-4:   Dissemination and deployment approach to transitioning (coercive).

The primary focus of this analysis is to find a more effective approach to shift repeatable process knowledge toward increased use of explicit, evidence-based knowledge in providing patient care. This would require a shift downward (toward explicit). Without a shift toward simplification, this transition would potentially be making a complicated and high variability process explicit, which would not reduce variability or achieve the goals of improving patient care through evidence-based best practices. This coercive approach therefore actually adds complexity (additional steps or workload), does not standardize the process unless the checklists are actually used and their corresponding compliance monitored, and does not add understanding of the cause-and-effect relationships. Therefore, according to the integrated model in Figure 3-5, the process has increased complexity, and the degree to which the knowledge is shifted down toward explicit is minimal.

An example of this would be the mobility assessment mentioned earlier.   The mobility assessment was additive to the nurses workload, with an additional form needing to be filled out. With most nurses having decreasing amounts of time for patient care due to electronic medical records and other administrative or regulatory steps, any additional steps risk affecting other steps or the steps not being completed. In the case of the mobility

assessment, the process was made explicit, but the information on the checklist does not reflect the actual care provided. Therefore, the implementation of the checklist does not result in knowledge related to the mobility assessment being shifted to explicit (because the checklist does not reflect the care provided). Due to the additional step required of the nurses to complete the checklist, the complexity of the nurse's work is increased as well.

[Note for Figures 3-5 & 3-7: A continuum of risk is overlaid from the lower left quadrant to the upper right quadrant. The slope of this line is tied to increasing process complexity and increasingly tacit knowledge. The rationale for this is that tacit knowledge tends to be more variable, and, when it is coupled with increasingly complex processes, the variability is multiplied and the risk of negative outcomes increases. The increased risk of negative outcomes (the outcome sought by the best practice is not realized) is due to an increased number of potential failure points at the interfaces of the knowledge and the process [141, 151].]
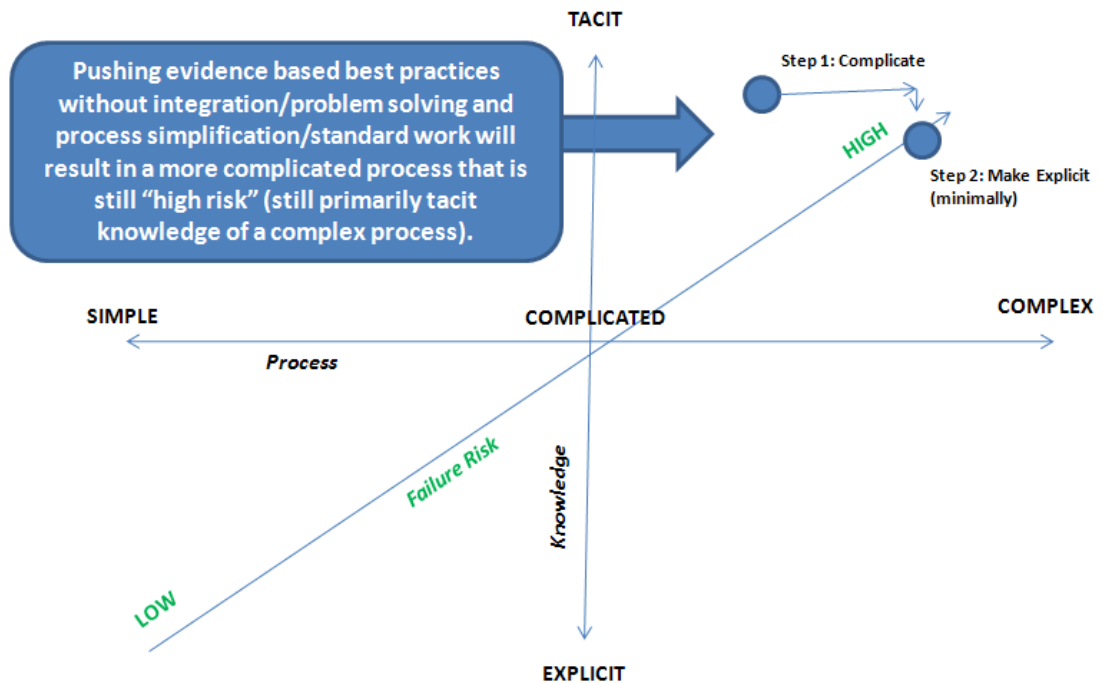
Figure 3-5:   Current state of establishing explicit processes in healthcare.

This lack of an effective approach to shifting repeatable steps from tacit to explicit knowledge has been demonstrated indirectly with the lack of improvement in patient outcomes (or even a decrease in patient safety) related to the implementation of electronic medical record (EMR) systems or other decision support systems in hospitals [49-51, 173,

174]. This breakdown in the knowledge management process has also been demonstrated through the recent analysis related to the actual impact of the IHI 100k Lives campaign, which was a nationwide effort to implement evidence-based best practices across the country [26].

These impact analyses demonstrate the need to simplify the process before attempting to shift from tacit to explicit knowledge. The coercive approach also does not address the need to increase the cause-and-effect understanding, and it is inherently based on the mechanistic paradigm of organizational function. This approach to organizational change is coercive in that it is forced on staff and does not engage them in problem solving, help them to clearly understand cause-and-effect relationships (between process steps and patient outcomes), or free resources or time to focus on the process. As you can see in Figure 3-5, first increasing the complexity inhibits making the process more explicit and also safer, which appears to be characteristic of a coercive approach to knowledge management. This coercive approach therefore does not lead to the integration of knowledge according to the knowledge management cycle [132, 144].

Alternative Approach (Enabling)

Using the contingency model in Figure 3-3, an alternative approach is explored where the presence of an enabling structure supports the professional allowing a focus on the tacit aspects of the work. This approach integrates the salient points of evidence-based best practices as a "seed" for problem solving, and, through iterative PDCA problem solving (see Figure 3-2), integrates with the unique organization and its processes.

The enabling approach also recognizes the inherent high variability of the healthcare environment, and, instead of seeking to drive toward an almost completely explicit end-state (which would be the goal of a coercive, bureaucratic approach), the goal is to drive toward the bottom of the tacit/simple quadrant, where an increased degree of knowledge would be explicit (but not all explicit). This is achieved through the integration of evidence based best practice knowledge relevant with repeatable steps of the process. This alignment of intended and actual shifting is illustrated in Figure 3-6.
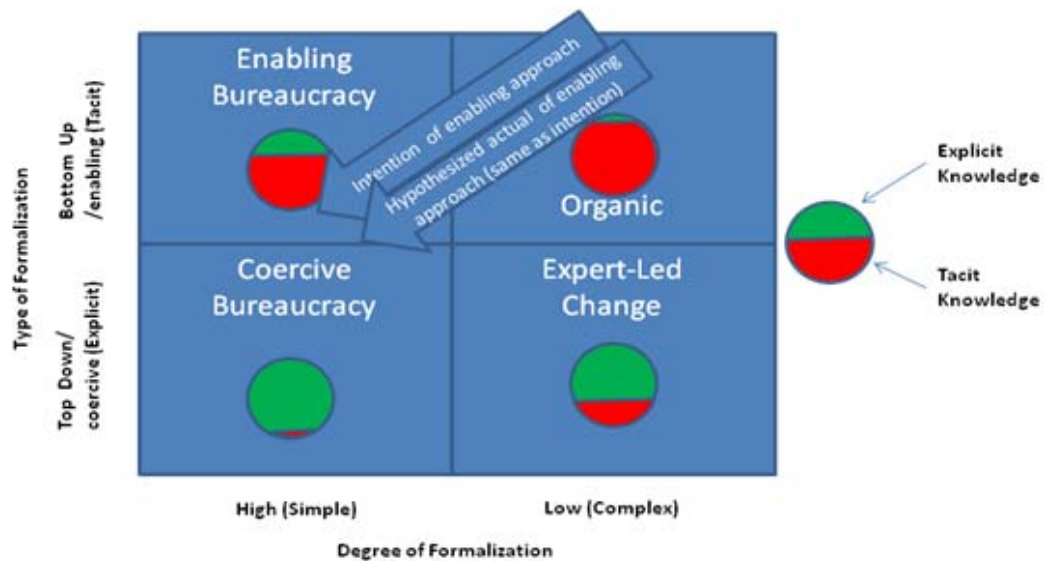
Figure 3-6: Organic/PDCA approach to transitioning (enabling).

An enabling structure approach takes the following steps:

1. Identify repeatable steps as the focus for improvement, and differentiate these steps from those that are inherently tacit.
2. Eliminate waste from the process (and peripheral or related tasks under the responsibility of the staff) to increase available time and capacity in the environment related to the process (which enables the shift toward explicit knowledge in a variety of different ways);
3. Implement measurement systems to track the effects of system changes (to enable understanding of cause-and-effect relationships); and
4. Simplify the process through standardized work practices driven by the staff identifying the critical aspects of the evidence-based best practices and subsequent iterative PDCA problem solving.

Using this approach, best practices would be closely linked to metrics for the desired outcomes based on clinical research and continuously experimenting until an effective process is found to produce those outcomes. This practice is then made explicit through standard work with an integral and ongoing understanding of cause-and-effect relationships. As with all aspects of lean, this cycle is continuous, constantly measuring results to gain better and better understanding of the relationship between the process and

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the outcomes. As Figure 3-7 shows, simplifying the process using this approach helps make the knowledge more explicit.
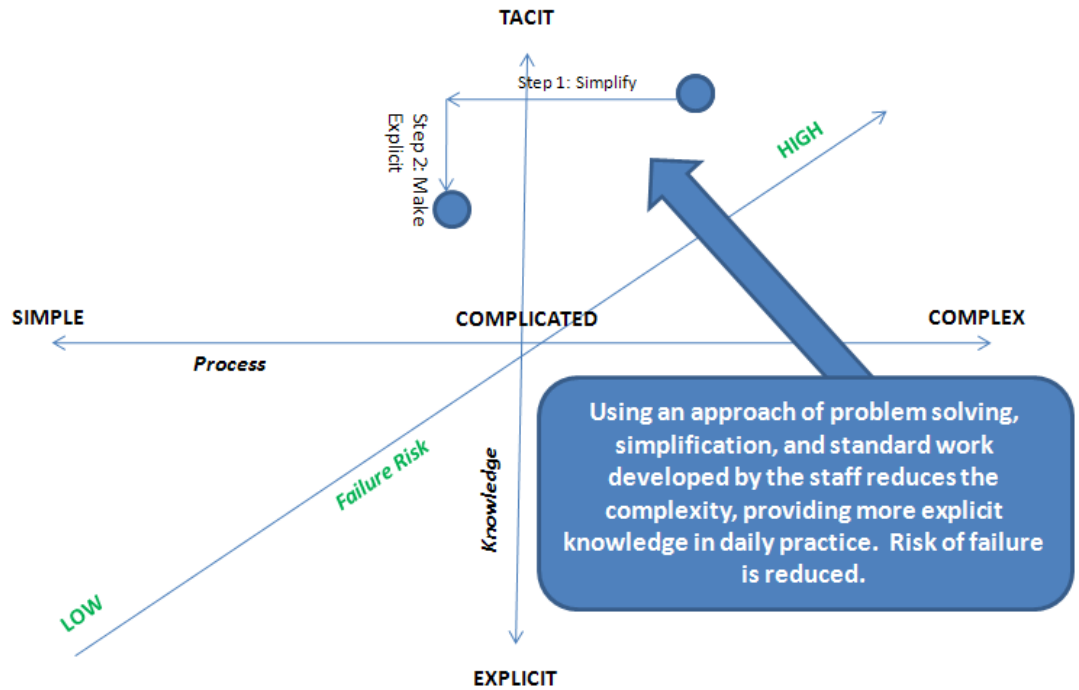
Figure 3-7:   Future state of establishing explicit processes in healthcare.

Model Predictions

Table 3-2 illustrates the predictions of the integrated models. An assumption of Table 3-2 is that the initial state of knowledge is tacit. The other assumption is that the process steps are repeatable, which make possible a transition to explicit knowledge. The most important part of these predictions addresses complex systems and knowledge, the primary focus of evidence-based best practices.

Table 3-2:   Model Predictions for Transitioning from Tacit to Explicit Knowledge

Note: Assumption of tacit state of knowledge & repeatable steps of a process		Knowledge Management Approach	
		Coercive	Enabling
System Complexity	Simple	Mixed	Success
	Complicated	Failure	Success
	Complex	Failure	Success

The following case studies test the predictions of this model as well as answer the research question and propositions stated previously.

Case Studies

The following section describes the approach, research methods, unit of analysis, and data used with the case studies. These case studies are used to explore the use of lean knowledge management in healthcare as well as address the research questions and propositions.

Approach

To study the model developed in Figures 3-5 and 3-7 and its relevance to knowledge management, case studies are used. This analysis uses multiple cases to cover the range of complexity described by the Cynefin framework, including both positive and negative examples. Each case study starts with a "before" condition in which the work is performed as if completely tacit, and then facilitators help identify opportunities for making knowledge explicit, which is integrated by the healthcare professionals into their work. Thus, each is a longitudinal study of change [175].

For each of the categories of Cynefin complexity, a representative process was selected. In addition to the specific case studies, literature was reviewed to confirm industry-wide struggles with compliance and with implementing evidence-based practices in these areas (thus the relevance of this analysis). Two of the three cases were collected through the researcher's role as a participant observer [53]; the third is a well-documented external case that is revelatory [53]. A revelatory case is a singular or unique example of a phenomenon that can yield special insights.[54] This revelatory case is the most important example along the continuum within the Cynefin framework because it is categorized as complex. Complex cases represent the greatest opportunity in healthcare for integrating best practices (where much of the medical best-practice literature exists and where best practices are not inherently applicable according to Cynefin). It is a singular example a coordinate and relatively rapid transition from tacit to explicit among multiple hospitals in a region and is therefore a revelatory case [53]. It is also helpful in counter-balancing any biases introduced from the other two cases by participant-observer. At the same time, the depth of insights from the participant-observer help balance any decreased depth that results from an externally generated, documented case.

Research Methods

To evaluate the propositions stated earlier, three case studies are evaluated using the model described previously (illustrated in Figures 3-5 and 3-7), with an X-axis of system complexity (according to Cynefin) and a Y-axis of the nature of knowledge (explicit or tacit), with a continuum of risk of failure increasing from the lower left corner to the upper right corner (Figures 3-5 and 3-7). For each of these case studies, a narrative describes the context of the case, followed by an analysis according to theoretical framework. This is followed by an alternative lean approach that describes an enabling approach.

Unit of Analysis

The unit of analysis for each of these case studies was an initiative aimed at improving quality and efficiency of processes to result in consistently providing recommended care. Each of these cases had two sequential components, as there were traditional efforts to integrate the best practice prior to the lean approach. Therefore, for each case, there was a coercive approach and enabling approach.

Data

To evaluate these cases, several pieces of data are used, depending on the case. One is specific process measures that vary from case to case; another is overall perceptions of success or failure. Analyses look at the presence or absence of the enabling characteristics (Table 3-1) previously discussed, as well as the progression of the best practice along through knowledge management (from initiation to integration) [132, 144]. Table 3-3 summarizes information on the three case studies and the role of the researcher.

Table 3-3:   Case Study Methodology Data

Case #: Title	Description	Goal	Role of Researcher	# Hours	Months of Observation
1 **Operating Room (OR) Turnover**	Multi-step cleaning process to prepare operating room for the next case. Turnover time between cases affects overall utilization of rooms, and technique/ effectiveness of cleaning has an impact on infection rates	Improve efficiency and quality related to OR room turnover. Efficiencies gained through minimizing turnover time. Quality improved through thoroughly cleaning the room in the proper sequence (back to front and top to bottom) and following specific procedures such as dwell time for antimicrobial solution	Participant Observer (Lean facilitator)	300 (4 cases, but one representative case specifically analyzed in this chapter)	12
2 **Heparin Administration Errors**	High-risk medication used to decrease blood clotting	Eliminate potentially fatal errors that occur at almost every hospital involving either incorrect dosage amount or administering the wrong type of heparin. Project was initiated in response to two "sentinel events" where harm was done (or almost done) to several pediatric patients. Included high-risk infusions (in addition to Heparin)	Participant Observer (Lean facilitators)	80	4

Case #: Title	Description	Goal	Role of Researcher	# Hours	Months of Observation
3 Central Line (port) Infections	Multi-step process to deliver potent medications directly into the bloodstream; Complexity increased due to project integration across multiple hospitals in the region	Eliminate significant opportunity for serious hospital acquired infections through the port, including MRSA or other potentially fatal pathogens	(Revelatory Case) Reviewed best practice medical research and case studies of successful implementation	40	2

Cases

The following three cases were selected to exhibit the range of complexity from simple to complex. Each of these cases includes a narrative, framework analysis, and an alternative lean approach. Each of these cases represented a process with a significant component of repeatable steps. These processes therefore involved knowledge that was potentially able to be transitioned from tacit to explicit, with explicit knowledge integrated with evidence based best practice knowledge.

Case 1: Operating Room Turnover (Simple)

Narrative. At a large academic medical center, physicians and staff had become frustrated with slow operating room (OR) turnover times between cases, as well as with unacceptable levels of patient infections following surgery. Different staff groups varied significantly on the processes they used to clean rooms, and the pressure to turn the rooms over quickly sometimes led to shortcuts being taken and steps being skipped. Staffing for turnovers was highly variable, and a perception existed that staffing levels were not sufficient. Staff often talked about how other hospitals did a better job with turnover, and supposedly had better room-turnover processes in place at this same hospital approximately 10 years earlier. Physicians were threatening to go to nearby competing hospital.

Many articles described processes for efficiently turning over rooms as well as best practices for critical aspects of processes related to infection control. The process in this case was basically undocumented (tacit knowledge), and there was little oversight or measures of compliance. The turnover time was approximately two to three times longer than the

industry best practices. With the OR being the most profitable part of the hospital, the implications for OR efficiency and physician satisfaction (and retention) were significant.

Recent efforts to improve the efficiency and quality at the hospital had minimal impact, and the researcher suggested taking a lean approach. The CEO and COO agreed due to their confidence in the process from previous lean project successes at their hospital. A team was created and began by collecting data on the process. Process variability was documented (including through video) and compliance with current infection control policies was recorded. These processed were represented on a metrics board that strengthened the case for change.

A five-day kaizen event was held (one day to map current process, one day to create a future process, and three subsequent days of PDCA experimentation). The process that was developed was piloted, and these results exceeded the goals that were set as well as the expectations of leadership. Standard work practices were developed and refined, and they integrated a variety of best practices to prevent infection, improve employee safety (such as minimizing risk for lower back injury), and improve efficiency (turn over the rooms more quickly). All of the team members were excited and proud of their accomplishments and confident in their success. They saw a positive impact for the hospital if the plan was executed. A senior hospital leader who heard about the project asked a team member whose process it was and the staff member proudly proclaimed, "That's our process!"

One of the significant requirements for making this process work was a specific staffing model, including several additional circulators and scrub techs to support the model. Despite adding these resources, the most conservative estimates of the return on investment (ROI) were 20:1, because additional cases that could be added (upward of $1M per room could be realized per year). Until the staffing model could be resourced and supported, the team continued to test and refine the process in selected rooms, and surgeons who did cases there asked, "When do we get the lean process in our rooms?" Despite the under-staffed state of the OR before this event, and the validation and high ROI for this investment to implement the turnover process across the OR, it was not acted on by leadership. Turnover continued to be high, and many of the team left to go to other hospitals within a year.

Table 3-4:   OR Quick Turnover Pilot Results

	Wheels Out to Wheels In	Wheels In to Incision	Closure to Incision	Wheels Out to Incision	Closure to Wheels Out
Baseline	0:33	0:35	1:16	1:08	0:09
Pilot Averages	0:14	0:25	0:47	0:40	0:05
Time Savings	0:18	0:09	0:28	0:27	0:03
% Improvement	55%	27%	37%	41%	36%

Framework Analysis. OR turnover is a self-contained process (in terms of time), with many discrete steps of obvious significance (removing blood and tissue, wiping, cleaning, configuring the room for the next case), thus making the process simple in terms of Cynefin. The complicating factors for this process were the number of simple steps and also the coordination of these steps among many staff members over a short time while other operations were taking place nearby. These complicating factors validated the proposition about the influence of the environment and the relevance of an open systems perspective. If these turnover steps are not followed closely, the efficiency of the turnover and infection risks can increase.

The process that the lean team used started with leadership giving the team the time and support they needed to follow the lean process. Thus the team had control. The structured process they developed was seen as flexible and enabling. The knowledge was initially simple and tacit. Therefore this approach was appropriate for and was successful in initially shifting the knowledge to being increasingly explicit. The previous approach had been that of a coercive bureaucracy, which was a mismatch for the state of the knowledge and process, and did not shift the process to explicit. The coercive approach was a mismatch because the complexity of the environment was underestimated, as well as the task complexity, which would both indicate the need for a more organic enabling approach. The variability between case types (as well as patient-to-patient variability) required dynamic PDCA problem solving to "make the process work," which is another characteristic of an enabling approach (as well as an important form of tacit knowledge for integrating evidence-based best practices).

Despite the success of the approach of an enabling bureaucracy (through a structured kaizen event), a coercive bureaucratic approach re-emerged, and the process returned to its initial state (simple/tacit). This was a failure of management to provide the leadership necessary to maintain the enabling approach. If you shift knowledge from simple/tacit (its default state) to simple/explicit (the target state), this shift cannot be maintained with a coercive bureaucratic approach (which would appear to be a fit from the new state of the knowledge). This is due to the need for an ongoing supportive organizational environment to allow for the iterative experimentation and problem solving. The drivers of this new approach (returning to a coercive approach) would seem to be lack of leadership understanding of the dynamic environment and deceptively high complexity.

Through the data gathering, metrics boards, and process observations, understanding the relationship between the current state of the process and the problems with efficiency and infection control was strengthened and made visible. Through the development of actively used (in the pilot rooms) standard work processes, the process was made explicit. Unfortunately, ongoing struggles with supporting the model in terms of resources persisted, and the model was never deployed beyond the pilot. Despite the clearly demonstrated impact (ROI and quality) and belief in the process and long-term piloting after the event, leadership would not commit to the minimal additional investments. The team members continued as zealots of the process as best they could, but eventually they could not persist in the non-supported pilot state. The same leaders who did not support the minimal investment directed the staff to not turn away any cases. This led staff members to start cases in multiple rooms simultaneously using a coercive approach to achieving increased revenue or efficiency without any of the enabling steps that the analysis suggested. This made staff rush and cut corners. Physician satisfaction decreased, and many left.

In terms of the knowledge management cycle discussed earlier, the process prior to the lean event stopped at partial implementation Through the lean event, knowledge management progressed to the point of partial integration (piloting and deep belief and understanding in a subset of the OR staff), but then regressed to implementation due to the lack of leadership and resource support. Therefore, the net impact of the event progressed from enabling implementation on a pilot basis to coercive implementation, which is not close to the progression to integration that would be necessary for success [132, 144].

Despite the ultimate failure of this particular project, the team gained tacit problem solving knowledge that persisted. Several of them participated in future teams and brought with them this tacit knowledge, which enabled future efforts. This new tacit problem-solving knowledge also helped them address daily operational issues. Specific countermeasures that resulted from the event persisted despite the overall failure, such as a two-bin system for decreasing workload and waste related to the sterile supply process. The team members continued to talk with great appreciation for the process that they experienced. Therefore, when staff progress through the organic PDCA knowledge management cycle illustrated in Figure 3-2, it has a transformative effect on those involved that persists even if the end state for a specific project reverts back to its original condition.

Alternative Lean Approach

The initial process followed was lean, but the iterative PDCA that came after the event was constrained by lack of leadership support and the project regressed to its original condition. With a more developed lean culture (especially among the senior leaders), the model would have been supported, and increased quality and efficiency would have been realized. The hospital as a whole would have benefited significantly in terms of increased revenue and profit, better patient care, and improved physician and staff satisfaction. While the process would still be viable and effective by itself (that is, the validity of the room turnover process and its demonstrated process impact), many of the staff who created it (and gained deep understanding of cause-and-effect relationships through the process) left the organization when the initiative was not supported. Therefore, to implement this exact same process now, without following a similar deliberate process that considered current factors, would be a mechanistic approach that would likely fail.

This case study demonstrates the significance of the socio-technical perspective, as much of the success of a process lies not in the artifact (what can be superficially observed) of the process step but in the process followed during the problem solving. The alternative lean approach would follow the same approach described in this case, but it would have involved significantly more leadership development and integration in the process and clear resource support by the senior leadership of the hospital prior to and following the event.

Case 2: Heparin Administration Errors (Complicated)

Narrative. Heparin overdoses result from administering either the incorrect dosage or incorrect type (adult versus pediatric) of an anti-clotting medication. The most severe mistake involves administering adult heparin to pediatric patients, because adult heparin is 1,000 times the concentration of the pediatric version of the drug. This can cause a patient to bleed to death [176-181].

With the extensive medical research on best practices related to these errors and the discrete nature of the errors, it would seem that this error could be eliminated. Unfortunately, these errors occur at almost every hospital despite the extensive literature on the risks and countermeasures to address these risks. Common countermeasures for these incidents are checklists added to the chart (which increase workload), double and triple checks (which also add workload yet do not necessarily achieve a much higher level of compliance) [182-184], and punitive actions taken against the staff who make the mistakes. When these incidents are investigated, extensive knowledge of the issues that led to the mistake often existed, but this knowledge was generally tacit (non-documented) and distributed among different staff (usually in undocumented near misses).

This case study relates to two sentinel events (both almost fatal) involving heparin overdoses (children receiving adult doses of heparin). A lean project was initiated at the direction of senior leaders, and a process like that in Case 1 was followed. During the project, a variety of high-risk issues were common knowledge among the staff but not addressed became evident. Several technical issues (related to IV pump settings) as well as storage issues (both types of heparin were stored next to each other in the Pyxis® machine with no significant physical or visual differentiation between the two types of doses) (Figure 3-8) became evident during the project. During the event, specific countermeasures (such as color-coding, error-proofing, and "distraction-free zones") were implemented to address these known issues. The countermeasures selected by the team were similar to those recommended in the medical literature. After the event, these countermeasures were sustained by the team and a decreased risk was associated with this process as long as they were sustained. Standard work practices were developed and maintained, and mechanisms for process audits were established.

Figure 3-8: Adult vs. Pediatric heparin showing subtle labeling differences and 1000X the concentration.

Due to the infrequent but severe nature of these issues, difficulties persisted to measure the direct impact of the process in terms of decreased frequencies of errors. Instead, the success of the process was measured in terms of adherence to the defined process as well as completion of discrete action items that addressed specific safety issues (such as implementing error proofing on IV pumps or in the computer systems of the pharmacy). Within 90 days of the end of the event, approximately 80% of the action items had been completed, and leaders were conducting regular process audits.

Framework Analysis. Heparin overdoses are the result of a complicated process that involves many different steps, including multiple verification steps. This process had significant potential for transition to explicit knowledge due to the repeatability of many steps. The totality of the nurses' day is much higher variability and lower in repeatability than this process and would represent an intractable undertaking to make all of their work explicit. The process becomes more complicated due to the infrequent (but extremely severe) negative outcomes of mistakes. This infrequency tends to diminish the understanding of cause-and-effect relationship and therefore increase complexity. Many hospitals have developed processes and approaches in response to sentinel events involving heparin, and they have documented these in the academic literature. Despite this documentation and available processes, these incidents still occur at almost every hospital. This demonstrates that the understanding of cause-and-effect relationships for infrequent incidents do not readily aggregate across multiple institutions.

The greatest challenge to transitioning such a process to evidence-based explicit knowledge at the bedside is figuring out how to impart cause-and-effect understanding and decrease the system complexity of the surrounding process. The ability to decrease system

complexity is exceedingly difficult. For example, the effects of an error in heparin administration are usually very severe and involve death or near-death incidents. Therefore, developing cause-and-effect knowledge through actual target effects is extremely difficult and comes at the high cost of patient harm. Unfortunately, the most common initiation of these efforts is in response to the effects of patient harm, as was the case in this example where multiple sentinel events initiated the project.

In terms of the knowledge management cycle discussed earlier, the efforts prior to the sentinel events only progressed through the initiation and implementation phases and did not get close to integration due to the long-term nature of the hidden patient safety risks [132, 144].

Alternative Lean Approach

Despite latent (non-acted upon) knowledge of the system risks and safer practices, this information was not consolidated into an explicit process until a lean project was conducted. The lean process also drove initial investigation into process variability and, during value stream mapping (VSM), the tremendous risk to the patient was made visible. Therefore, VSM increased the awareness of the cause-and-effect relationship between the lack of a standard process and the associated risk to the patient. In addition, leadership support of the team to hold the event made time and resources available (both before and afterwards). Various action items resulting from this event involved related improvements to eliminate waste and decrease workload. This was critical to allow staff to focus on such high-risk activities as drawing heparin in a non-distracting environment.

Metrics boards related to process compliance and supporting lean improvements were implemented, which helped to increase understanding of cause and effect. Therefore, the four enablers of transitioning to active use of explicit best practices were integral to the VSM (identifying repeatable steps, decreasing related workload through waste elimination, increasing cause and effect understanding, and developing standard work practices based on demonstrated best practices). Through the lean process, knowledge management progressed beyond the ramp-up phase of the knowledge management cycle and began the long path to full integration [132, 144].

Case 3: Central Line (Port) Infections (Complex)

Narrative. Central line infections are common in hospital settings, and they can result in severe and potentially fatal complications for patients [185]. While extensive literature on best medical practices focuses on how to minimize these risks [186], central line infections persist in hospitals throughout the United States. These infections are caused by variability in processes related to installing, maintaining, and removing these lines [187-189]. The discrepancy between what is known in the literature and what is seen in actual practice results in significant numbers of patients suffering and potentially dying from a seemingly preventable complication.

A group of hospitals in the Pittsburg area began a multi-hospital initiative to eliminate central line infections. The reason that this process was classified as complex was the multi-hospital aspect of this process. With patient's transitioning between multiple hospitals, the visibility of cause and effect relationships was significantly diminished in the initial state. Little transparency existed, with different organizational processes, privacy concerns, and a variety of other complicating factors. This lack of transparency resulted in what could be considered a complicated process at an individual hospital to being a complex process shared by separate hospitals. The initiative started in several intensive care units (ICUs) and then spread throughout the many hospitals [55-57, 59, 60, 190, 191]. Process improvement initiatives involved front-line staff and management as well as leadership from the president of Alcoa (as an outside facilitator with a vested interest for the care of his employees in the different hospitals). They were able to eliminate virtually all central line infections. This was accomplished through highly engaged leadership and facilitators who supported the iterative PDCA problem-solving approach used. There was a significant focus on metrics, which helped to establish strong causal relationships between process changes and outcomes (which decreases complexity according to the Cynefin scale). The result of this enabling approach was that the staff had high buy-in to the process, and also felt empowered to continuously experiment and improve the process. The enabling approach also imparted significant tacit PDCA problem solving knowledge with the staff, which had positive potential beyond this initiative. This enabling approach to take knowledge from literature on medical best practices, translate it into a usable form, experiment with

different approaches and monitor the impact, and develop a high level of process discipline resulted in a dramatic impact on the rate of central line infections (Figure 3-9).
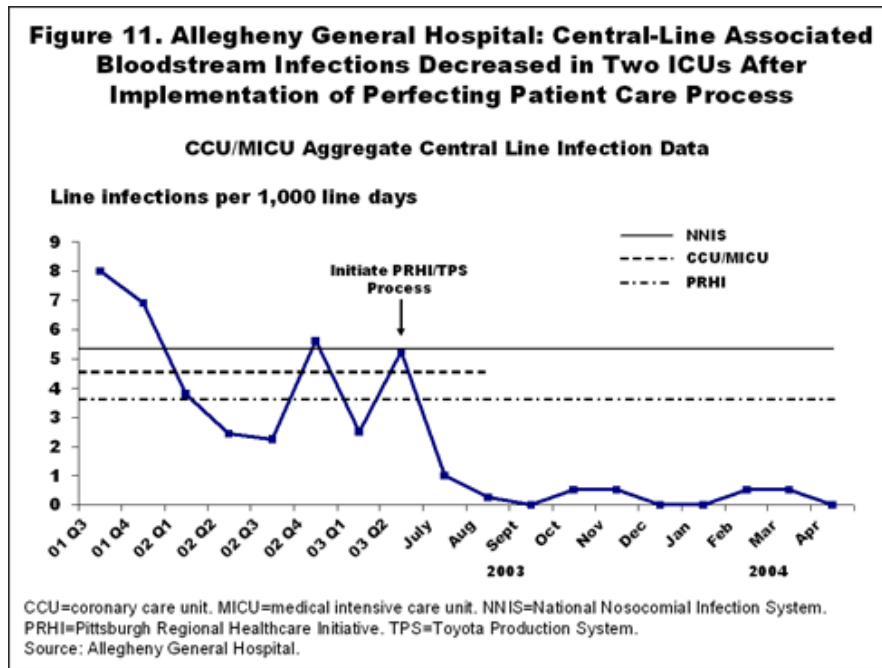
Figure 3-9:   Decreasing central line infections in PRHI interventions.

Framework Analysis. Installing a central line (also called a port) involves a variety of steps, sterile technique, skill, and patients with different co-morbidities (such as obesity, diabetes, MRSA, or others). In addition, many different approaches have generally been taught, which leads to significant variation in the approach that is used. Patients also move between hospitals in a community and can carry such illnesses as MRSA that can affect the process, so there are multi-organizational complexities that are not as significant in many other processes. Because central line infections are not always immediate or apparent, the relationship between the processes used and the outcomes are not normally clear. All of these factors drive this process into the Cynefin complex category and complicate the understanding of cause-and-effect relationships.

In most hospitals that struggle with this issue, a written protocol is implemented in a coercive way with little or no measurable impact. In this case, the hospital (and eventually a whole community of hospitals) made this problem a priority and allocated resources (staff and leadership time) to focus on it, which was an enabler for the process. These resources were in place for the initial project as well as for continued process improvement and

integration afterwards. Infection rates and related metrics were posted and continuously updated as different approaches were piloted, which increased the understanding of cause-and-effect relationships and drove down the Cynefin complexity.

A standardized process, with accompanying audits, was developed and refined. This helped codify the external knowledge from the medical literature and added the internally generated knowledge through iterative problem solving. Therefore, externally generated, best-practice insights were combined with hospital-specific operational considerations to create a process that worked effectively. This resulted in a dramatic reduction in the rate of central line infections shown in Figure 3-9 by shifting what was originally a complex, variable process based on tacit knowledge to a shared process based on collectively developed standard work practices based on externally developed best practices.

In terms of the knowledge management cycle, efforts prior to this large initiative had stopped at the implementation phase with the significant rate of patient infections remaining because the best practices had not reached the actual delivery of routine care. At the conclusion of their lean project, it was clear that the best practices had been deeply ingrained and therefore reached the integration phase of the knowledge management cycle [132, 144].

Alternative Lean Approach

The approach taken by this hospital system was based on a lean approach. All four enablers (identifying repeatable steps, decreasing related workload through waste elimination, increasing cause and effect understanding, and developing standard work practices based on research on evaluating best practices) were present in their approach, and the resulted in an impact that was more significant than their previous efforts. Therefore, the difference between this project and previous efforts was not the creation of new external knowledge, but rather taking deliberate steps to use existing best practices and effectively integrate them.

A summary of the observations from the three case studies is found in Table 3-5.

Table 3-5: Case Study Summary Analysis

	Factor	Case 1. OR Turnover		Case 2. Heparin		Case 3. Central Line Infections	
	Approach:	Enabling	Coercive	Coercive	Enabling	Coercive	Enabling
Initial State	Process complexity (initial)	Simple	Simple	Complicated	Complicated	Complex	Complex
Initial State	State of Knowledge (initial)	Tacit	Tacit/ Explicit (partial Integration)	Tacit	Tacit	Tacit	Tacit
Approach	Recommended approach (contingency perspective)	Enabling Bureaucracy	Enabling Bureaucracy/ Coercive Bureaucracy	Enabling Bureaucracy/ Organic (midpoint of continuum)	Enabling Bureaucracy/ Organic (midpoint of continuum)	Organic (less constrained than enabling bureaucracy)	Organic (less constrained than enabling bureaucracy)
Approach	Approach used	Enabling	Coercive Bureaucracy	Coercive Bureaucracy	Enabling	Coercive Bureaucracy	Enabling
Final State	Process complexity (final)	Simple	Simple	Complicated	Simple	Complex	Complicated
Final State	State of knowledge (final)	Explicit	Tacit (regression)	Tacit	Explicit	Tacit	Explicit
Outcome	Predicted outcome (from model)	Success	Mixed	Failure	Success	Failure	Success
Outcome	Actual outcome	Success	Failure	Failure	Success	Failure	Success
Enabler	Mechanisms available to measure outcomes (cause and effect)	Yes	No	No	Yes	No	Yes
Enabler	Repeatable steps	Yes	Yes	Yes	Yes	Yes	Yes
Knowledge management	Initiation	Yes	Yes (Coercive)	Yes (Coercive)	Yes	Yes (Coercive)	Yes
Knowledge management	Implementation	Yes	Yes (Coercive)	Yes (Coercive)	Yes	Yes (Coercive)	Yes
Knowledge management	Ramp Up	Yes	No	No	Yes	No	Yes
Knowledge management	Integration	Partial (pilot)	No	No	Yes	No	Yes

Discussion

Analysis of these cases using the model in Figure 3-3, as well as the perspective of the coercive-versus-enabling approach to change, yielded several insights. In each of these cases, significant bodies of academic literature on clinical best practices did not lead to achieving the predicted outcomes or aggregate impact. This challenges the commonly accepted dissemination approach. Also, the creation of explicit knowledge did not by itself lead to success, because explicit knowledge was only relevant when it was actually used. Each of the successful cases involved a team using an iterative, enabling effort to solve problems while linking these efforts to numerical results and a documented process that was subsequently monitored. Simply shifting knowledge from tacit to explicit does not lead to improved bedside practice consistently.

Tacit knowledge cannot shift to explicit knowledge by itself; this shift requires several enablers (such as identifying repeating steps, supporting cause-and-effect understanding, simplifying the process, and creating standard work). Unless practitioners focus on the enablers, the shift from tacit to explicit knowledge is simply a bureaucratic (coercive) exercise that will not lead to improvements in patient care. With much of the evidence-based research on best practices residing in the tacit/complex quadrant of the model (Fig. 3-3), simply shifting from tacit to explicit knowledge still falls outside of the types of processes that lend themselves to lean approaches to explicit knowledge (simple, and to a more limited extent complicated systems). By first focusing on the enablers of making knowledge explicit, repeatable steps of complex (as well as complicated and simple) processes can be shifted into the areas that are a good fit for lean approaches to standard work practices. Lean approaches can then be used to shift knowledge from tacit to explicit.

Bringing evidence-based best practices into active use in patient care should focus on enabling the transition to explicit knowledge rather than on the direct transition to explicit knowledge (such as creating a procedure to be enforced). Explicit knowledge created at a level of system complexity that does not match (such as creating a procedure for complex systems that do not have repeating steps) will result in an explicit process that is not followed, so the actual care remains based on tacit knowledge. Without enablers and a deliberate process, efforts to change are extremely slow and coercive.

Table 3-5 shows a clear association between decreasing process complexity, the presence of the four enablers, and the substantive achievement of integration [132, 144]. As was mentioned at the beginning of this paper, integration is the ultimate goal of bringing evidence-based best practices to patient care. Therefore, with the proper focus on the four enabling factors, as well as support for a deliberate process, evidence-based best practices can be brought into active use much more quickly [192, 193]. In addition, these efforts can seamlessly integrate with other lean continuous improvement initiatives and drive a long-term culture change.

The tacit PDCA problem solving knowledge that is imparted through the problem solving process illustrated in Figure 3-2 also develops individual's capability for dynamic problem solving in higher variability processes that do not lend themselves to explicit evidence based knowledge. This was illustrated through the effect on the staff's thought processes through exposure to a lean methodology in these case studies.

Findings

The primary finding of this paper is that, where possible, processes need to be simplified to enable the use of evidence-based best practices (explicit knowledge that reflects care actually provided to patients). Without this shift, explicit knowledge is coercively implemented and does not result in timely improvements in patient care.

Only a subset of process knowledge with a significant tacit component can be shifted into the quadrant that is appropriate (fit from the contingency theory perspective) for evidence-based best-practice practices (bottom half of Figure 3-6). With the significant variability that is inherent in healthcare, a significant portion of knowledge will remain tacit. Efforts to shift inherently tacit forms of knowledge will not prove successful, and likely be counterproductive. There is a distinction between knowledge that is inherently tacit and that which is not; however, challenging this distinction is important due to the pervasive bias that most knowledge in healthcare is inherently tacit. The case studies illustrated examples of the possibility of shifting from tacit to explicit knowledge, but only with a significant component of problem solving and organizational experimentation and struggle. This also resulted in the people involved gaining tacit knowledge related to problem solving.

The following steps were found to enable the transition from tacit to explicit knowledge.

1. Identify repeatable steps as the focus for improvement, and differentiate these steps from those that are inherently tacit.

2. Eliminate waste from the process (and from peripheral or related tasks under the responsibility of the staff) to increase available time and capacity in the environment related to the process (which enables the shift toward explicit knowledge in a variety of different ways);

3. Implement measurement systems to track the effects of system changes (to enable understanding of cause-and-effect relationships); and

4. Simplify the process through standardized work practices driven by the staff extracting the salient points of the evidence-based research on best practices and subsequent iterative PDCA problem solving.

In an organization such as Toyota, these steps (or similar steps) take place naturally as a part of their culture, processes, and work practices. In an organization that does not have this discipline or approach "in their DNA" [194, 195], an approach must be taken to enable the transition. Without this deliberate and disciplined approach to knowledge management, organizations naturally fall into the common coercive approach to transitioning from tacit to explicit knowledge. This coercive approach does not result in timely improvements in care practices [196]. The knowledge management cycle then stops at implementation rather than integration. However, with this deliberate and disciplined approach, certain knowledge can be shifted from tacit to explicit knowledge to positively impact care provided to patients.

Chapter 4
Using Technology Effectively for Lean Healthcare

Abstract

The investment in and use of technology in healthcare is a significant driver in the increasing costs of healthcare. These technologies theoretically offer significant capabilities and impressive returns on investment. However their actual impact on organizational performance is usually less than expected and they are often only partially deployed. Either of these actual outcomes can result in increased organizational complexity and cost. This chapter explores whether a lean management approach to selecting and implementing technology can enhance the actual performance outcomes and reduce costs. Case examples illustrate the lean approach.

This chapter is structured into four primary sections:

(1) **Introduction:** The chapter begins with a basic overview of the current state of technology in healthcare, as well as a long term historical perspective of the relationship between healthcare and technology. This perspective provides the context to define the drivers of technology in healthcare and identify the problem statement to be researched.

(2) **Model Development:** The second section explores theoretical models that are relevant to this analysis, including open-systems, contingency, and lean organizational frameworks. These models help to clearly define successful technology deployment. They also help elaborate the concept of fit, which is critical to the case study analysis and testing propositions. Characteristics of mismatched approaches are formulated. This section concludes with a table of testable model predictions to be evaluated in the case studies.

(3) **Case Studies:** Each of the case studies is analyzed using the model and hypotheses developed in the second section. After the individual case studies, a cross-case analysis identifies commonalities and generalizable points.

(4) **Conclusion:** The final section summarizes insights and findings of the chapter, including their implications for more effectively selecting and deploying technology within organizations.

The findings confirm the potential for a lean approach to improve the selection and deployment of technology in healthcare. The disconnect between the potential of technology in healthcare and the realized benefits has less to do with the actual technology than with the approach taken to understand the underlying issue, selecting technology appropriate to address the issue, and then deploying and supporting the technology through continuous PDCA problem solving. This approach results in integration with current processes, ownership by staff actually using the technology, and enables continuous problem solving.

This chapter begins with a contextual introduction to the current state of U.S. healthcare technology and challenges, historical context, and the potential relevance of a lean approach. Relevant propositions were created based upon this contextual background. The introduction is followed by defining success for technology in the contexts of a mechanistic versus socio-technical perspective, which are the two dominant organizational paradigms for this analysis. Open systems and contingency perspectives are used to explore different approaches to selection and deployment of healthcare, with the two primary approaches being mechanistic and organic. Case examples are then analyzed to evaluate the propositions and document findings. This is followed by a conclusion.

Introduction

Current State of U.S. Healthcare Technology

An ongoing debate about the drivers of increases in healthcare costs started in the early 1970s. Presidential candidates have included healthcare reform as a significant part of their campaign platforms, but the complexity of healthcare and disagreement on related issues have precluded any broad agreement. The passage of healthcare reform early in the Obama

administration intensified the debate. The complexity of that legislation mirrors the complexity of the problems that it was designed to solve (the reform bill was 2,700 pages).

President Obama promised to decrease healthcare costs. A centerpiece of his policy is encouraging the use of technology, such as electronic health records (EHRs, also known as electronic medical records, or EMRs) and other forms of healthcare information technology (IT). The estimated cost, including government subsidies, to implement EHR systems nation-wide over the next 10 years is close to $100 billion [197]. While it is appealing to think that digitizing all records in U.S. hospitals and investing in sophisticated hardware, facilities, and medical equipment will gain efficiencies over the current system and infrastructure, current data indicate otherwise. The United States already has the most advanced healthcare technology in the world, but spends more than any other country in terms of per-capita healthcare spending (see Fig. 4-1) as well as spending about 16% of its gross domestic product (GDP) on healthcare. This challenges the common assumption new technology has a simple and direct effect on cost reduction in health care.
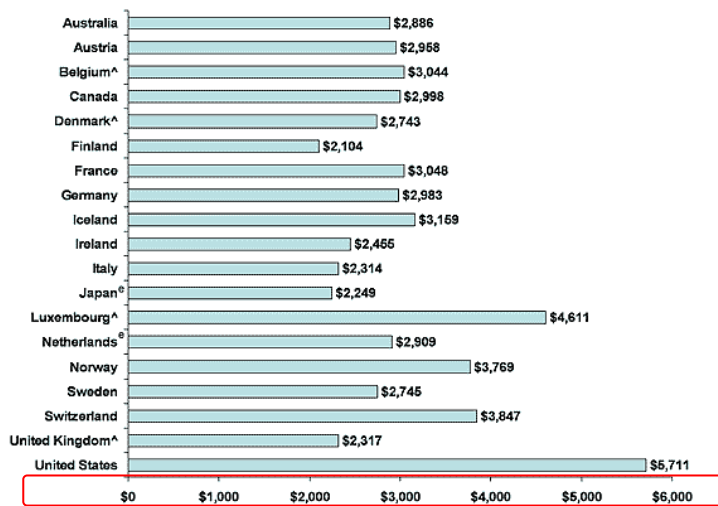
Source: [198]

Figure 4-1: Health Expenditures Per Capita, U.S. and Selected Countries, 2003.
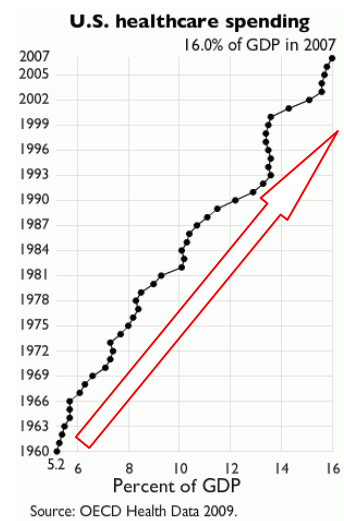
Figure 4-2: U.S. Healthcare Spending.

Data exploring this assumption are limited. Some evidence demonstrates that EHRs and other technological interventions in healthcare can produce negative returns and detrimental effects on patient care [49-51, 173, 174]. These unintended outcomes of technological investment in healthcare are echoed by findings from The Henry J Kaiser Family Foundation:

The particularly rapid increases in health insurance premiums over the last few years have focused the health policy community on the issues of cost containment and health insurance affordability. A key question from policymakers is why spending on health care consistently rises more rapidly than spending on other goods and services. Health care experts point to the development and diffusion of medical technology as primary factors in explaining the persistent difference between health spending and overall economic growth, with some arguing that new medical technology may account for about one-half or more of real long-term spending growth.

—The Henry J Kaiser Family Foundation, 2007 [28]

One possible answer is to stop investing in IT or in hardware. This action would be premature, because examples also exist of technology being effectively selected and deployed and achieving the anticipated outcomes and improving quality and safety [199]. Therefore, the proper question to ask is not whether technology in healthcare is good or bad, but rather how technology can be effectively deployed and integrated into operations [200].

The Toyota Approach to Technology

One way to explore the potential positive benefits of technology in healthcare is to examine successful cases of companies leveraging technology to achieve operational and cost improvements. A company outside of healthcare that has been highly effective at this is Toyota. This company consistently utilizes a disciplined approach to integrating the technology with its people and processes, including applications such as office, engineering, and manufacturing operations [37]. Although Toyota is a Japanese company, its unique ability to achieve discipline and results with its people, process, and technology is not due to a distinct Japanese culture. These principles are generally applicable [201], [63]. In this paper we examine how Toyota's approach can help healthcare organizations better leverage technology.

Toyota's approach for technology is primarily to use proven and reliable technology applied to well defined and understood problems, and to use the simplest solution, often on a pilot basis, before deploying more advanced technology [64]. European healthcare systems have similarly favored using technologies that are proven effective for improving clinical care or efficiency. This approach has been used in a variety of European healthcare systems and has been shown to be effective in controlling healthcare costs [202]. In these systems,

medical equipment, software, or medical supplies are evaluated for their effectiveness and cost relative to existing options, and only approved once they have demonstrated their effectiveness relative to their alternatives. In the U.S., less rigorous approaches are often used for selecting and deploying technologies. For example, the FDA compares new drug effectiveness relative to placebos, not to other drugs aimed at the same condition. Therefore, a new and expensive drug could be more effective than a placebo, but equally or less effective than a drug that has been on the market for an extended time and is available in generic form at one-tenth or less the cost per dose. Different approaches to applying more rigorous analysis of technology and medical reimbursement have been explored for the potential creation of systems for efficient allocation of resources in U.S. healthcare reform. However, these rigorous approaches are not being widely used [203].

Toyota does use new technologies. However, the process for technology selection and deployment is disciplined:

1. Have a clearly defined need/problem.
2. Think carefully about the current process and how waste can be eliminated without the technology prior to introducing new technology.
3. Consider the skills required and develop a plan for training people and involve them in the introduction.
4. Introduce the technology first on a pilot basis to prove its capability and work out the bugs of the technology and the process of introducing it.
5. In a step-by-step way, bring the technology into other locations over time with local management taking ownership of planning and leading the introduction and building on lessons learned from other sites.
6. Continuously improve the technology and the processes followed in using the technology through ideas by people who directly use it.

This approach to selecting, integrating, and using technology is the foundation for developing a lean model for technology in a healthcare context.

Background on Technology in Healthcare

Technology and healthcare have been interrelated for thousands of years. The nature of this relationship has evolved over time as technological discoveries and advancements have become available to healthcare practitioners.

Medical instruments have played an integral role in surgery, dissection, diagnosis, treatment, and other forms of medical investigation and intervention. Sets of surgical instruments have been found that date back to 50 AD [204] that closely resemble a surgeons tools used today. These instruments would be an example of a form of medical technology, in the form of tools, assisting the medical practitioner.

Another form of technology used in medicine for many millennia is information technology. Medical information technology is often thought of in the modern context of computers, but the careful collection and analysis of information related to observation of patient condition, effectiveness of different treatments, and design of new treatments dates back to the time of Hippocrates (ca. 460 BC – ca. 370 BC). Hippocrates took meticulous notes that enabled him to make numerous breakthroughs both in the understanding of the workings of the human body and in the ethics and approach to thinking that are essential to modern medical practice and investigation [205].

Comparatively little innovation took place in furthering the practice of medicine from the time of Hippocrates until the early 20th century, with developments such as the smallpox vaccine in 1901. During the 20th century, the growth of medical technology has increased continuously, with innovations such as penicillin, X-ray, PET/MRI scanning, computers, robotic surgery, radiation therapy, chemo-therapy, and many other forms of technology and treatments.

While the use of medical hardware and information technology has been essential to healthcare for thousands of years, these same tools can create difficult problems. For example, the over-use of antibiotics has caused a new form of pathogen commonly called super-bugs, such as methicillin-resistant staphylococcus aureus (MRSA) [206] and other anti-biotic resistance strains that are extremely difficult and expensive to treat. This demonstrates the double-edged sword of advances in medical technology and treatment: The advancement can create unintended consequences.

Healthcare facilities (buildings) can also be considered to be a form of technology. As with other forms of technology, physical facilities involve a mutual interaction between users of the technology and the technology. In healthcare contexts, the physical facilities are often intimately interrelated with the staff and other technology that the building contains. Often, technology is integrated into the building itself. As with other forms of technology in healthcare, organizations spend significant sums of money on their facilities. If these funds are not spent wisely, they contribute to the rising cost of healthcare and can affect the financial or operational viability of the organization. For example a study showed that new hospital beds cost between $1.5 to $2M (a "bed" in this context is a measurement of hospital capacity, and the cost is all of the associated investment required to support each incremental patient bed included in a design), so a 300-bed hospital would cost up to $600M [207]. Also, the design of a building has a significant influence on the processes it contains. The physical design of a hospital can also influence patient outcomes, so the impact of this form of technology on the patient is significant [120, 208].

Drivers of Technological Interventions in Healthcare

To understand better why hospitals invest so heavily in technology and use it as a default intervention to address perceived issues, the drivers behind technological interventions in hospitals must be understood.

A proposed model for categorizing drivers of technological interventions is based on the socio-technical systems [169] model. The two broad categories are social drivers and technical drivers. Sub-categories of technical drivers are those driven by financial or non-financial considerations. Examples of social drivers are provider preference, standardization, and industry trends. Technical drivers (financial) would include efficiency, subsidies, and marketing/growth. Technical drivers (non-financial) would include regulatory, quality, or safety considerations. These categories are illustrated in Figure 4-3.
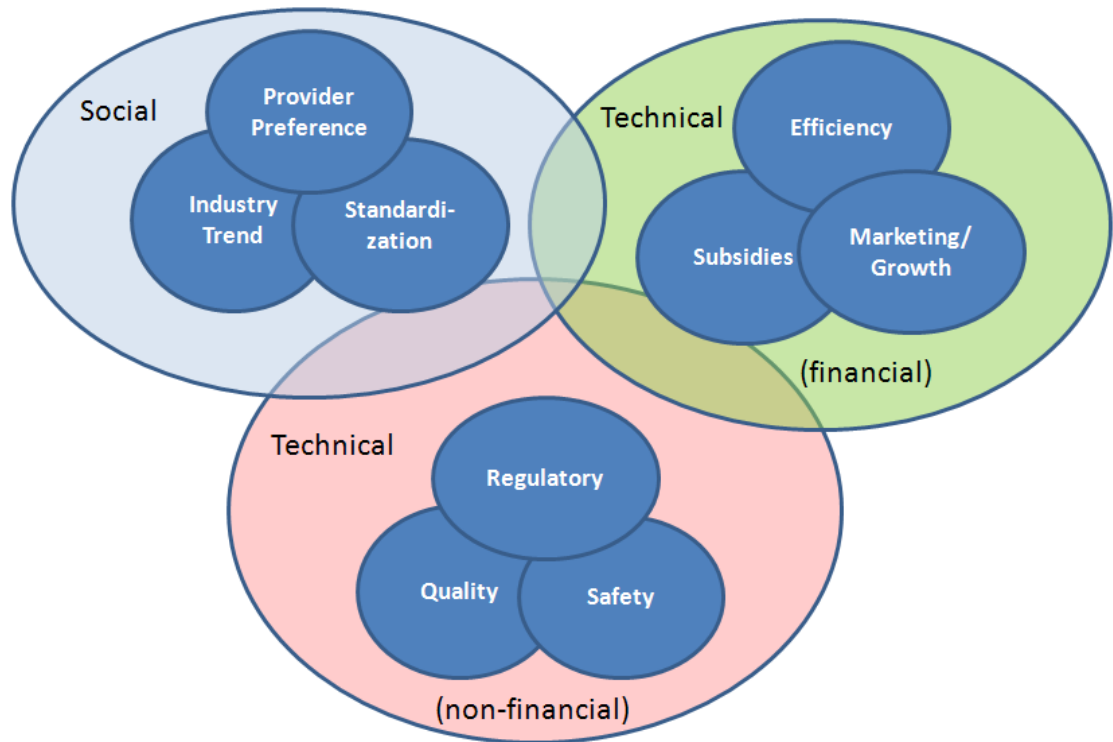
Figure 4-3: Socio-technical view of drivers of healthcare technology interventions.

The difference between financial or non-financial drivers is important for assessing the success or failure of the intervention. For example, if the primary objective of a technological intervention is financial, but the intervention only improves compliance without any clear improvement in financial performance, then the intervention could be classified as a failure.

Classifying the drivers of technological interventions as being solely technical would ignore the reality that interventions are often driven by social considerations, which is consistent with the socio-technical paradigm [169]. Examples of social drivers of technological adoption are (a) industry trends and standardization on a particular technology and (b) as physician preferences (which ultimately can become a financial driver given strategies for recruitment or retention of physicians). When a particular type of technology has started to diffuse through the healthcare industry (such as 128-slice CT scanners or DaVinci© robotic surgery systems), there is pressure to acquire this sort of technology due to the perception by physicians and patients that this is the new industry norm or tools to provide state-of-the-art care. Patients often choose (or be referred to) a particular healthcare provider based upon the technology regardless of the clinical evidence of the effectiveness of the

technology. Institutional theory predicts that bureaucracies copy each other even when there no clear rational justification exists for what they are copying [209]. Therefore, industry trends can drive patients and providers (and therefore hospital acquisition decisions) regardless of the actually efficacy of the technology.

Examples of social considerations driving the design of a physical facility would be the movement from a compartmentalized lab design to an open lab concept and movement from multiple patient rooms to single-patient rooms. While each of these shifts can be viewed through the perspective of the social paradigm (such as peer-pressure to conform to a norm), they can also be viewed as having financial or operational benefits (such as improving lab flexibility or preventing patient-to-patient infection through multiple patients in a room). These examples demonstrate the integrated nature of physical facilities for both social and technical considerations. Also, the systems or norms that existed during one's initial training or education often influence preference throughout ones career, and could be viewed as a bias in the selection and deployment of technology. For example, a decision maker may choose to design a healthcare facility to resemble what they are familiar or comfortable with, which may not necessarily be best for flow or for patients [120, 126, 208].

To classify drivers discretely in only one category would also be an over-simplification. An example of a driver reflecting more than one category is the availability of government subsidies to implement EMR systems, which is currently available in the U.S. healthcare system as a result of the federal stimulus bill and the recently passed healthcare reform act [210, 211]. While stimulus funds can be classified as a financial driver for adoption of a particular technology, federal subsidies of this technology can also be viewed as supporting an industry trend, standardizing the industry, and acting as an environmental driver to change, which are all classified as social drivers of change.

Technology Not Producing Anticipated Outcomes

With discussions of healthcare reform being at the forefront of a national debate since the early 1990s, technology's role in this future transformation has been a central topic. A wide variety of positive outcomes have been promised to result from these changes and investments, and the technological transformation of the U.S. healthcare system has

become almost synonymous with healthcare reform. Some of the more commonly discussed outcomes of technological interventions in healthcare are:

- Decrease costs
- Improve quality and safety
- Improved productivity
- Make medical information readily available
- Improve collaboration between medical providers
- Decreasing paperwork ("going paperless")

These outcomes are very similar to the desired outcomes of technological interventions in non-healthcare industries. While specific examples exist of positive outcomes of technological interventions in healthcare and estimates of potential realizable improvements in the healthcare systems from the use of these technologies [212], the actual savings and benefits from these investments have not lived up to these potential impacts on an aggregate level [49].

The actual outcomes of technological interventions in healthcare have not met the theoretical potential. The gap between potential and actual has been studied [212]. Neither the quality [173] nor efficiency [49] benefits of technological interventions in healthcare have been clearly demonstrated. Given the significant costs associated with technological interventions and the role of these interventions as one of the primary drivers in the unsustainable increases in healthcare costs [28, 213], this gap between potential and realized benefits from these technologies is at crisis level, given the unsustainable increases in healthcare costs in the U.S.

In contrast to the anticipated outcomes of technological interventions in healthcare (listed in Figure 4-3), the following examples have been reported in literature about technology in U.S. hospitals:

- Negative return on investment (ROI) for some IT in healthcare [174]
- Negative safety outcomes from some IT interventions [173]
- Driver of increasing healthcare costs is technology [28, 213]
- Staff acting as the "glue" between systems that do not interface [174]

- Complicated "hybrid" systems consisting of partial EMR systems, legacy systems, and the previous paper systems [214]
- Purchase of "off the shelf" configurations that do not integrate with current processes

A 2009 Study published in the *American Journal of Medicine* [49] found that "As currently implemented, hospital computing might modestly improve process measures of quality but does not reduce administrative or overall costs." Given the current contribution of information technology (IT) and other forms of technological interventions to the increasing costs of healthcare in the U.S., failure to generate significant quality or efficiency gains could accelerate the already dramatic increases in U.S. healthcare costs [215]. There is a distinct need to understand more clearly the drivers of these disconnects and practical approaches to rectifying them.

Given the gap between the potential and reality of technological impact in healthcare, it is critical to understand why. The following sections examine this question using relevant conceptual models.

Model Development

Mechanistic vs. Socio-Technical View of Interaction of Technology with Personnel

In this section, two competing paradigms of organizational function are explored and contrasted in relation to healthcare technology. One is a mechanistic perspective (organizations as machines) and the other is a socio-technical perspective [216]. The paradigms an organization uses significantly influence how the organization selects and deploys technology.

Organizations as Machines

To better understand the relationship between technological interventions in healthcare and their outcomes (either intended or unintended outcomes), it is helpful to look at the technology in the broader context of how organizations view their internal functioning. A common view of organizational function is one where pieces (and individuals) in an organization function in a way that is reminiscent of the internal function of a machine, with each part having a clear function and interaction with others [168]. This view of an

organization is very deterministic, presuming one change has very clear and direct causative impacts on defined outcomes.

In the context of technological interventions, if one were to look at the technology by itself through the mechanistic perspective, one can predict how it will function and interact with other systems and what its benefits will be (based on the system parameters and specifications of the IT system or other form of technology). This interaction could be viewed as the interaction of the software and hardware systems within a hospital, illustrated in Figure 4-4 below.
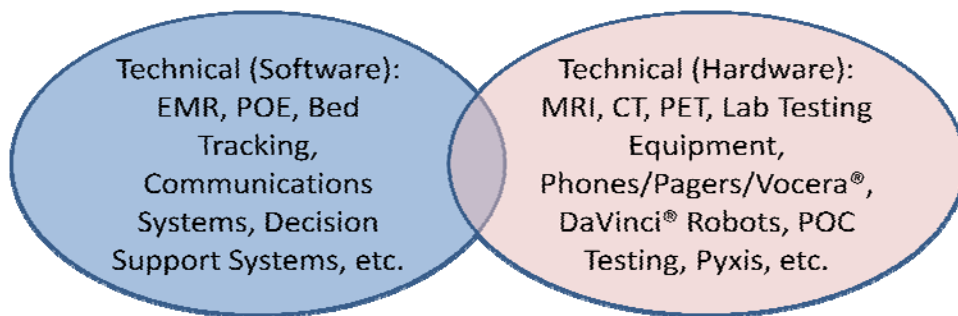
Figure 4-4:   Mechanistic view of healthcare technology.

From a mechanistic perspective, unintended consequences of the intervention are not expected, except by error of planning and execution. The underlying assumptions are of predictable interactions and deterministic and stable processes, which preclude unintended outcomes. With the mechanistic paradigm of organizations, the primary questions asked related to technological interventions in healthcare are "How much does it cost; what does it promise; and how can we integrate with our current technological infrastructure?" Hidden in these questions are several embedded assumptions, which are (1) that it will deliver what it promises, (2) that the integration with the technical infrastructure is the most important consideration beyond the capabilities of the system and (3) that no other significant considerations exist.

Socio-Technical View

A different, contrasting view is that of organizations as socio-technical systems. The social system is viewed as interacting dynamically and in complex ways with the technical system [169]. The addition of social system interaction adds a whole range of highly uncertain variables into the equation. This social perspective encompasses the role of organizational

culture in the integration and fit of the technology, the role of users in taking ownership and continually improving the process and use of the technology, as well as all of the other environmental factors that comprise the context within which the technical systems reside.

The true effectiveness of the selection and planning for introducing technology is put into a different light when a technology is viewed in this more holistic context of the organizational culture and other social considerations, other technologies that interact with it, variability in patient needs, and the staff training and practice variations. This contextual perspective was first explored by Eric Trist during and after World War II in England, where he formulated the concept of socio-technical systems theory [169]. This view of organizations puts technical systems in the context of a social system. This perspective has proven very effective at explaining problems with the technical systems that are often difficult to describe or resolve using the mechanistic view of organizations. This socio-technical view of the technical systems residing within a social context is illustrated in Figure 4-5.

Technical (Software): EMR, POE, Bed Tracking, Communications Systems, Decision Support Systems, Etc,..

Technical (Hardware): MRI, CT, PET, Lab Testing Equipment, Phones/Pagers/Voicera, DaVinci Robots, POC Testing, Pyxis, etc,...

Social: Training, integration, buy-in, work practices, problem solving, ownership of process/methods, standard work, procedures, policies, culture
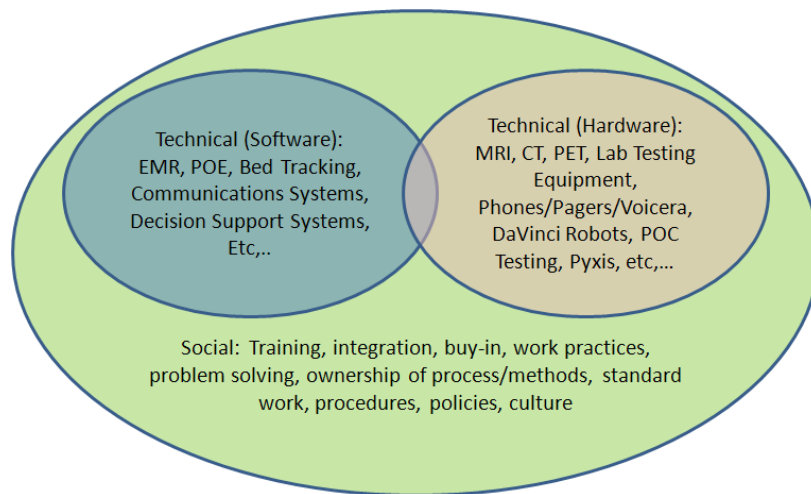
Figure 4-5:   Socio-technical view of healthcare technology.

This socio-technical view of organizations is also referred to an open systems model where the technical systems are interacting with an external environment [168]. In this model, there is a constant need to deal with the dynamic changing situations, which only people can do. These dynamic results of the interactions of the social system with the technical system are difficult, if not impossible, for the technical systems to be designed to deal with a priori, requiring constant learning and adjustment.

The competing paradigms of organizations as machines versus organizations as socio-technical systems is included in this analysis, as the tension between these different perspectives affects the selection and deployment of technology in health care.

What Is Successful Technology?

Before discussing the methods to effectively select and deploy technology effectively in healthcare, we need to define successful deployment of technology in healthcare. If a technology is deployed and achieves some direct measures of financial or technical success, such as reducing the need for employees, is it a success? Viewing this outcome from the paradigm of a mechanistic organization, it may be a success, but through the paradigm of socio-technical systems, the success would be an open question from a longer-term and broader perspective. What if through process improvements a similar increase in productivity was possible at a lower cost? What if the new technology actually reduces the quality of service? What if technology implementation is used as a quick substitute for the harder, but potentially more effective approach of developing people to continuously improve processes? What if people feel like machines only waiting to be replaced by a better technology and thus lose motivation to think and improve how they work? What if the technology isolates people instead of fostering teamwork?

Using the socio-technical systems model [169], a technology has to be successful in the broad context that the technology is applied. Therefore, the technology would need to be successful technically, socially, and in a business context. Proposed definitions of these forms of technological success are:

- **Technical Success:** Enables the users to work more efficiently, safely, and with higher quality for the benefit of the customer.

- **Social Success**: Accepted, used by, and elaborated on by staff through continuous improvement, thus enabling positive culture instead of damaging it.

- **Business Success**: Decreases costs, increases revenue/profits, and improves quality of service to customers on a continuous basis beyond the initial short-term results.

Therefore, all these aspects of success are requisite to achieve organizational success. The proposed model is as follows:

Technical * Social * Business = *Organizational success*

Without both technological and social success, as well as focusing on the right business problem, organizational success will not be achieved. Therefore, technical aspects are necessary but not sufficient for success.

This model for evaluating technological interventions in this socio-technical context is used further in this analysis to evaluate case studies of technical intervention in hospitals.

What Is Lean?

To discuss the potential relevance of lean to healthcare technology, it must be clearly defined in the context of this chapter. A wide variety of different interpretations exist for the term lean, and the following section explores specific definitions used for this analysis.

Lean production was defined as a new paradigm of production with the Toyota Production System (TPS) as its best existing model. It is often viewed in the context of the application of specific tools to eliminate waste and thus cost. This narrow definition is partly correct, but based on a mechanistic concept of organization. From the perspective of Toyota, it is a much broader concept in which the focus is on enabling people to work as teams toward common goals to constantly challenge the current state and work toward a better future state. Continuous improvement literally means every place at all levels all the time. Of course this is an ideal that can never be achieved but it defines a true north vision (a true north vision is a shared understanding of the goals and objectives of the organization).

The underlying thinking process behind continuous improvement is Plan-Do-Check-Act (PDCA), also known as the Shewhart cycle [217], [140]. Achieving a new future state that previously seemed unachievable requires innovative thinking and organizational learning through the scientific method in steps proceeding through all phases of PDCA. The defining characteristic of PDCA thinking is a careful analysis and study of the identified problem, where the context, root causes, measures, and direct observation are analyzed carefully before any countermeasures or interventions are undertaken. This leads to testing countermeasures, checking the results, and further action based on what is learned [140]. The PDCA definition is useful for lean management: thoroughly understanding the purpose of the technology, the problem being solved, the current state of the process, the desired

future state, and the root cause of obstacles. Achieving the future state involves making final decisions on the technology and implementation should be viewed as a process of learning.

In Figure 4-6, common preliminary questions describing PDCA thinking are shown, with their healthcare-context equivalents shown on the right to provide a clearer understanding of how this PDCA thinking applies in a healthcare context, and more specifically to the context of technology in healthcare. These questions are preliminary because they represent only the "Plan" of Plan-Do-Check-Act. At the same time, the answers to these questions (such as "How will we continue to adapt and improve the execution of the technology?") are requisite for the "Do-Check-Act" phases. Following through on the initial answers through the PDCA process produces the iterative experimentation and problem solving that is the goal of PDCA.

PDCA Thinking:

- (1)What is the problem we are trying to solve?
- (2)What are the root causes of the problem?

- (3)What are potential countermeasures to address the problem? How will you choose which countermeasure to propose?

- (4)Who owns the problem?

- (5)How will you get consensus from everyone involved?
- (6)What is the implementation plan and schedule?

- (7)What problems are likely to occur during implementation?
- (8)How will you know if your plan is working?
- (9)How will you continuously improve this process?

PDCA Thinking applied to technology in Healthcare:

- (1)Why are we considering this technology?
- (2)Why is the problem occurring? Is this a foundational stability or process discipline issue?
- (3)What alternative solutions could we use? Have we tried the simplest solutions first?
- (4)Who is responsible for using and maintaining the technology?
- (5)How will consensus be achieved for the technology that is chosen?
- (6)What implementation plan and schedule will account for likely unintended complications encountered? Is there a way to conduct iterative small-scale tests of the technology?
- (7)What other problems could this cause?
- (8) How will we evaluate if the technology is working?
- (9)How will we continue to adapt and improve the execution of the technology?

Source [140]

Figure 4-6:   Adaptation of PDCA thinking to healthcare technology.

Research Questions and Propositions

Given the significant demonstrated impact of lean thinking in manufacturing and other industries, and the initial impact of lean to positively impact quality, safety, and efficiency in

healthcare [32, 71], the potential of lean to impact positively the effectiveness of technological interventions in healthcare are explored through the following research questions and propositions.

Research Questions

Question 1: **Can lean thinking increase the effective use of technology in healthcare?** In this higher-level analysis, the capabilities of a lean approach to address the previously discussed disconnect between the promises and realized outcomes of technological interventions are explored.

Question 2: **What approaches to lean thinking are successful for different types of technologies and processes**? Two sub-questions are explored, and these relate to the selection of technology and the deployment of the technology. These are distinct but closely related aspects. The simplified model that is used to analyze these questions is that:

(Step 1) The problem or need is clearly defined.

(Step 2) Carefully evaluate process and eliminate waste before any new technology introduced.

(Step 3) Consider the skills required and develop a plan for training and involving them in the introduction of technology.

(Step 4) Introduce the technology first on a pilot basis to prove its capability and work out the bugs and the process of introducing it.

(Step 5) Introduce the technology into other locations in a stepwise fashion, with local management taking ownership and leading the spread.

(Step 6) Continuously improve the technology and process by the people who use it.
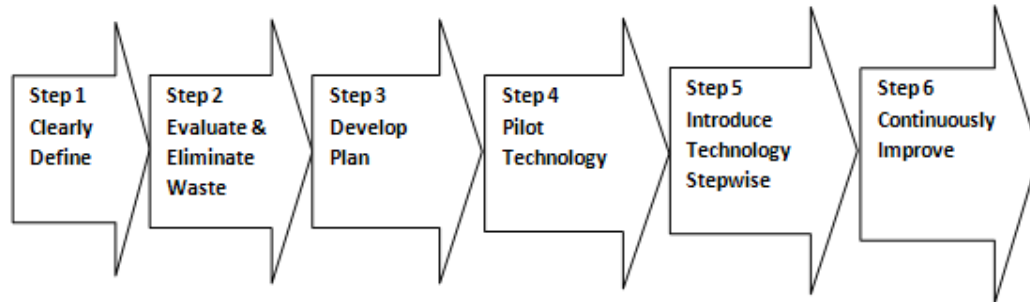
(Selection) How is the need for technology identified and particular technology selected given different conditions?

(Step 1) What approach is used for the identification of the problem, including the quantification of the need and other criteria used to justify the intervention?

Proposition: The lack of process discipline or operational stability can be misinterpreted as a need for a technological intervention. Also, unnecessary waste and complexity in the system can cloud the understanding of the core need, and even generate the perception of a need that does not exist.

(Steps 2 & 3) What approach is used for selecting the technology given the perceived need? What socio-technical factors are used in selecting the technology? What criteria are used to select among a variety of options? How is the cost (both initial and lifecycle costs) integrated into the decision making process?

Proposition: The determination of need has a significant influence on the selection of a particular type of technology, which then drives the appropriate type of deployment approach. PDCA thinking (socio-technical view) tends to define need more broadly than a traditional view (mechanistic), and therefore can result in a different type of technology being selected (e.g., focus on technology to enable problem solving rather than simply capability and return-on-investment).

(Deployment) Once technology has been selected, what approaches to lean are most effective in different conditions?

(Steps 4, 5, & 6) Is the complexity of the process taken into consideration in the deployment approach? Are various socio-technical factors considered in the deployment? Is a

mechanistic or organic approach taken? A contingency framework [218], discussed in the next section, suggests that the complexity of the problem being solved will determine the complexity of the process used for technology selection and deployment.

Proposition: The need for an organic PDCA approach to healthcare technology selection and deployment increases with process complexity, but requires employees who are capable of this sort of dynamic problem solving.

Are there mechanisms to measure the effectiveness of the technology once it has been deployed? If there are, how is this information used? Is continuous improvement and integration of the technology done after the initial implementation?

Proposition: As the complexity of the technology increases, the likelihood of initial failures will increase (due to the more unpredictable nature of complex, as opposed to simple, systems), as will the need for systems to measure their effectiveness. If these systems are not in place, then failed systems are more likely to persist and not consistently improved upon or maintained. Without the systems or staff capability to continue the PDCA problem solving, the integration of these systems will not succeed or be maintained.

Proposed Contingency Framework for Technological Effectiveness

The systems concept of fit helps characterize how different categories of technology fit with different social system characteristics.

A powerful framework for classifying technology was provided by Perrow [219]. The two dimensions in his model are analyzability and variety [220, 221].

Analyzability

Analyzability refers to the ability to study the process and make the knowledge explicit and teachable (as in a cooking recipe). Analyzability depends on the predictability of the task or process (for example, are most of the conditions patients have similar, or are there significant differences and co-morbidities that affect the process), and more precisely to the number of exceptions that are likely to be encountered while doing the task. For example, changing a bed pan would be a highly analyzable and teachable process, while performing trauma surgery would be extremely low on analyzability (even though components of the process may be analyzable).

Variety

Variety refers not just to how many different tasks a person performs, but whether those tasks differ in skill requirements. One could follow a nurse on rounds and observe a wide variety of different tasks with highly variable skill requirements.

Tasks that are both high in analyzability and low in variety are considered routine and can be taught and viewed in a fairly mechanistic way—in this case the mechanistic paradigm is not a bad approximation [90]. Tasks that are both low in analyzability and high in variety are considered non-routine and must be viewed through an organic perspective recognizing the complexity and the need for constant adjustment to new situations by the people in the system. These jobs include a great deal of tacit knowledge which must be learned on the job through experience with the guidance of a mentor.

From general observation it would appear that, compared with traditional high-volume manufacturing operations, typical healthcare processes/tasks are higher variability. Their analyzability is generally lower due the high degree of variation introduced by variability in patient characteristics, the unknowns of diseases, the uncertainty of when patients will come in and what their problems will be, and all the variables that must be controlled to maintain a safe and stable environment for the patients. Yet, there is a range of tasks within healthcare from relatively routine to highly uncertain. For the purposes of this analysis, healthcare processes are evaluated to differentiate them for analysis. An illustration of Perrow's model, with accompanying healthcare examples is shown in Figure 4-8.
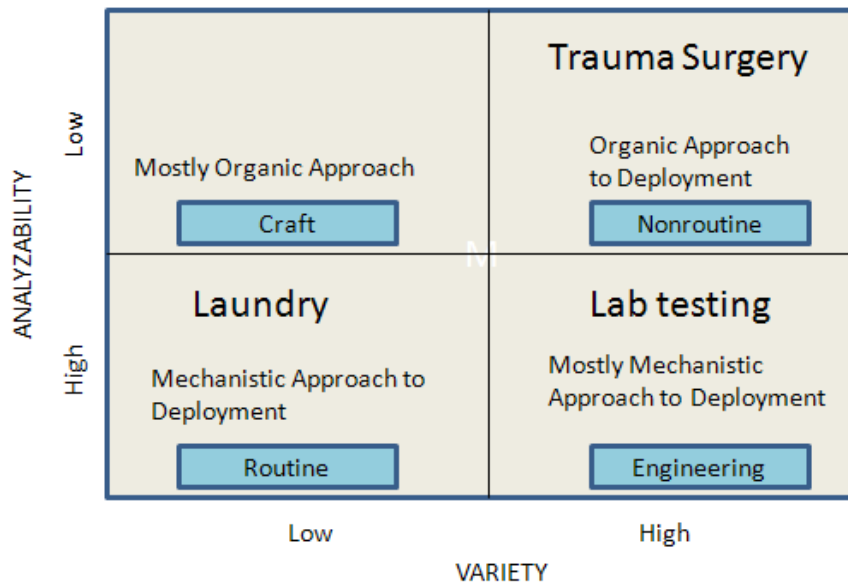
Figure 4-8: Examples of departmental technologies in healthcare according to Perrow model.

Technology Deployment

The contingency perspective on fit between an organization and a technology extends beyond the proper selection of technology. Figure 4-8 illustrates that there must also be a fit with the deployment approach selected for the technology and the nature of the technology, which is explored in this section.

Once a need has been identified (either correctly or incorrectly), and a technology has been selected to meet these perceived needs, the next step is to deploy the technology. A variety of different approaches to deployment exist. The two primary categories are mechanistic (routine) and organic (non-routine) [170], but there is a continuum of deployment in between including mostly mechanistic (engineering) and mostly organic (craft). A mechanistic approach assumes deterministic and predictable behavior of systems, while an organic (socio-technical) approach assumes that flexibility will be required, unexpected problems will be encountered, and that the path necessary for successful implementation will not be known at the beginning of the undertaking (requiring a dynamic approach). For the categories of craft and engineering, deployment requires a mix of mechanistic and organic deployment. As can be seen in Figure 4-8, Perrow's framework [219] builds on the Contingency Theory perspective of technology, introduced by Burns and Stalker [222], to integrate the departmental technology perspective. This integrated model (Figure 4-8) illustrates how the complexity of the technology being deployed influences the more

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effective approach to deploy it. That is, the approach to deployment is contingent upon the complexity of the technology being deployed.

This concept is at odds with the paradigm of technological deployment frequently used in healthcare, which assumes all technologies and organizations are low variety and highly analyzable (because of the strong bias to deploy technology mechanistically). Thus, the mechanistic approach (regardless of the complexity of the technology) is to plan out the entire implementation in a Gantt chart [223] at the very beginning of the project and use a command-and-control perspective to force implementation to go according to plan. The basic assumption of certainty and predictability of this approach is contradicted by the common experience that IT projects always take twice as long and cost twice as much as originally expected [224]. Despite the predictable symptoms of this mismatch, the approach is generally not adjusted, as the perception of a command-and-control being necessary to deploy complicated technology in such a dynamic environment is very comforting to those implementing the technology. In the facility design and build process, architects use a very similar command-and-control approach, and the design-build process generally takes longer and results in cost over-runs similar to those with the deployment of IT.

To further explore this need for fit between the complexity of the technology and the deployment approach, it is useful to examine and propose a categorization of the characteristics of a mechanistic versus an organic deployment of technology. In the Contingency model (Fig. 4-8) processes fall into four categories (craft, routine, non-routine, and engineering). To evaluate the case studies using this framework, identifiable characteristics of a mechanistic selection and deployment and of organic selection and deployment must be specified. These characteristics are listed in Table 4-1. As noted earlier, in reality a continuum exists between these two extremes.

Table 4-1:   Characteristics of Mechanistic vs. Organic Selection and Deployment of Technology

	Mechanistic Selection & deployment of Technology	Organic Selection & Deployment of Technology
Who implements the technology	Technical specialist on loan	Cross functional Team with strong program leader
Responsibility for success	Technology specialist/Subject Matter Expert	Line/Unit Management
Focus of technical selection	Technical need and cost; control behavior	Socio-technical fit; facilitates problem solving
Need for fit with process	Little process redesign	High process redesign
Perception of needs	Realization of technical capabilities	Ability to facilitate operational stability and problem solving
Reaction to complications	Reactive short term fix	Adapt/Evolve/Learn
Tendency to Pilot/Experiment	Low	High
Timeline	Fixed	Flexible

As can be seen in Figure 4-9, the roles of subject matter expert (SME) and project manager (PM) are often combined in a traditional mechanistic technology deployment, and at the completion of the project this individual leaves the process. The line management struggles to continue to keep users engaged with the technology and to solve the problems likely to occur without the technical knowledge necessary. Hirschhorn and Mokray demonstrated that competence is a function of skills and roles, which in this context illustrates the importance of the line management being closely involved to develop sufficient technical knowledge to be competent in the iterative PDCA problem solving that they need to undertake once the PM and SME leave (Figure 4-10) [225]. When they are significantly divorced from the SME and PM during the initial implementation and don't acquire this knowledge (Figure 4-9), they do not have the requisite technical knowledge to fulfill their role, and are therefore not competent in the context of this technology deployment. Therefore, a critical factor for deployment of technology is the roles and responsibilities of those involved in the context of the ongoing PDCA cycle involved with the technology and how they are prepared for their roles.

SME & PM combined or external and when they leave. Line Management is not integrated or does not have ownership.

Technical knowledge

Subject Matter Expert (SME)

Implementation/ Logistics/ People/ Acceptance/ initial sustainment

Running Operations/ Process Discipline/ Ongoing Problem Solving

Roles & Responsibilities

Combined

Line Management

Project Manager (PM)

Figure 4-9:   Disconnect between line management and PM/SME roles.

Technical knowledge

Subject Matter Expert

Implementation / Logistics/ People/ Acceptance/ initial sustainment

Running Operations/ Process Discipline/ Ongoing Problem Solving

Roles & Responsibilities

Line Management

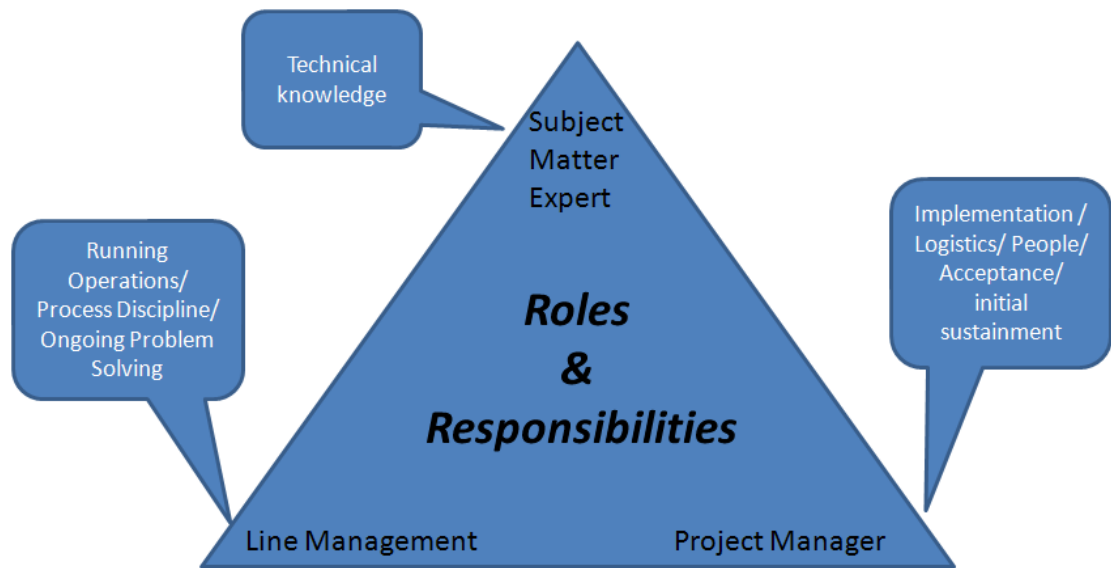Project Manager

Figure 4-10:   Balanced roles and responsibilities.

In the researcher's experience, most processes or technologies fall within the continuum between simple and complex, and not at one of the extremes. Therefore, the best deployment approach falls along the continuum between these two extremes and depends on the variety and analyzability of the process [222].
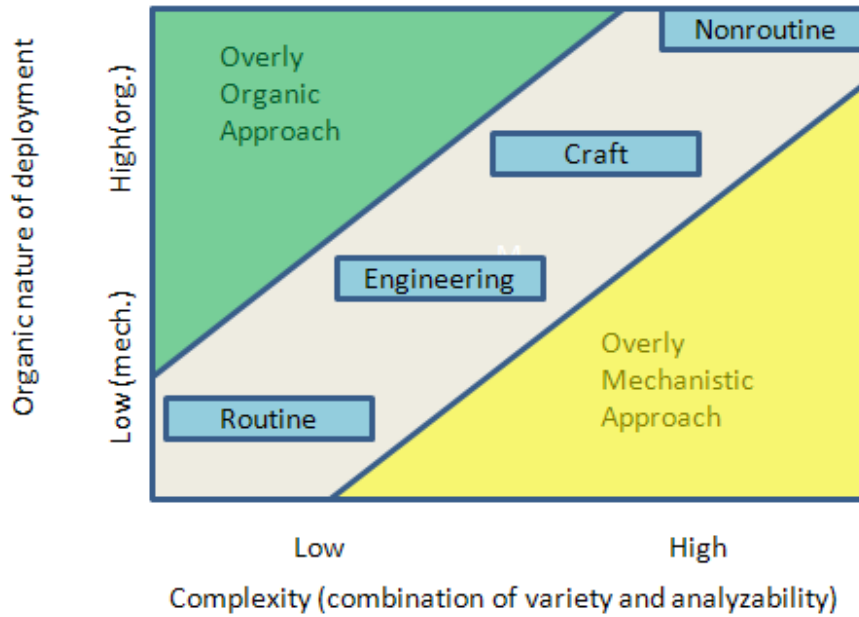
Figure 4-11: Continuum of effective deployment approach according to complexity (Perrow).

When the deployment approach does not match the process or technology, risks and timeline/integration issues occur. Characteristics of potential mismatches are listed below in Table 4-2. Along with the characteristics of mechanistic vs. organic approaches described in Table 4-1, these characteristics of a mismatched approach are helpful in the evaluation of the case studies.

Table 4-2: Characteristics of Mismatched Approach to Technological Deployment

	Overly Organic Approach	Overly Mechanistic Approach
Risks	Approach gets in the way of making rapid progress. Mismatch can give Lean a negative reputation as slowing a process that doesn't require an organic approach	Sufficient flexibility isn't in place to problem solve and integrate; Staff don't feel empowered or have ownership
Time	Execution takes longer than expected; Team doesn't feel time is being well used	Mechanistic approach "bookends" time and doesn't allow necessary flexibility and can result in partial deployment and/or integration
Integration with peripheral/linked processes	High	Low

Model Predictions

In the previous discussions, characteristics of a coercive and enabling bureaucracy were proposed in relation to the selection and deployment of technology in healthcare. Perrow's

model expanded on this by introducing the contingency framework, which suggested that a fit of approach and technology was needed for success. A lean approach was described as an iterative PDCA problem solving approach that is a reasonable surrogate to represent an organic approach for this analysis (and is present in the case studies). A mechanistic approach, as described earlier, is based on a command-and-control approach for the purposes of this analysis. With the mechanistic and organic approaches identified, and characteristics of a mismatched approach identified in Table 4-2, we can make predictions about the potential success of technological deployment, which are evaluated in the case studies. These predictions are documented in Table 4-1.

Table 4-3:   Model Predictions for Outcomes

		Approach	
		Mechanistic	**Organic**
State of Technology	*Non-Routine*	Negative	Positive
	Craft	Negative	Positive
	Engineering	Mixed	Mixed
	Routine	Positive	Negative

Case Studies

Data and Methods

This section uses a comparative case study design to explore different approaches to the selection and deployment of technology in healthcare. With a PDCA problem solving perspective integrated with the Perrow framework (Table 4-2), the relevance of a lean approach to technology in healthcare are explored. An interpretive analysis is used to identify factors that drove success or failure of these initiatives in a variety of different healthcare systems.

Research Methods

The comparative case study design was chosen to compare a variety of different technology deployment cases from different healthcare organizations. The case study methodology used is appropriate for studying longitudinal change,[53] and the multiple case study approach used in this chapter adds additional depth and validity to the analysis [53]. These cases were chosen to vary across the four primary categories of the Perrow model, as well as along the dimension of success or failure. Each of these is a case where a mechanistic

approach was used for initial deployment and a perceived failure, and this resulted in a request for a facilitated lean projected to help "fix" the situation. Therefore, these cases represent paired cases of mechanistic and socio-technical approaches to deploying the same technology. The exception to this sequence is the pneumonia vaccine protocol case, where the initial project followed a socio-technical approach and was then followed by a mechanistic one. The unit of analysis for this is the selection, deployment, and peripheral activity for departmental technology in a healthcare context. Findings from these cases are validated with embedded researcher observation, discussions with staff, and quantitative measures of related system performance.

Participant and Direct Observation

The researcher's primary role was that of lean facilitator for most of projects (participant observation [53]), but also included one case in a more passive role as a direct observer [54] that had no direct influence on the process. The specific role of lean facilitator was in all cases (except for the pneumonia vaccine case) after the technology was deployed and there was evidence it was failing to meet the intended goals, thus a recovery role. The participant observation allowed for a greater depth of contextual understanding, while the direct observation allowed for collecting cases that could serve a role of impartial validation where the outcome could not have been biased by the researcher's role in the project [61].

The following table summarizes the technology and the involvement of the researcher in the five case studies. (Organization names were removed to maintain confidentiality.)

Table 4-4:   Case Study Observations

Organization (blinded)	Classification according to Perrow model	Description	Focus of Technology	Role of researcher	# Hours Observed	Duration of observation
Laundry	Routine	Large academic medical center in regional hospital system	Operational effectiveness and efficiencies of scale	Embedded researcher; Facilitated lean project	180	6 Months

Organization (blinded)	Classification according to Perrow model	Description	Focus of Technology	Role of researcher	# Hours Observed	Duration of observation
Med Reconciliation	Craft	Large academic medical center in regional hospital system	Ensuring that patients don't have redundant medications when leaving the hospital	Embedded researcher; Facilitated lean project	24	1 Month
Pneumonia Vaccine Protocol	Engineering	Large academic medical center in regional hospital system	Evidence based vaccine compliance	Outside Observer	24	1 Month
Lean Clinic Design	Non-Routine	New mid-size clinic in a rural setting	Design facility that works for patients and staff	Embedded researcher; Facilitated lean project	100	1 Months
Lean ED/OR Design	Non-Routine	Remodeling of small hospital ED and new construction of OR	Design facility that works for patients and staff	Embedded researcher; Facilitated lean project	120	2 Months

Data

Given the diverse nature of the different case studies there was significant variety in the performance metrics related to the success or failure of the technological interventions. While some of them were focused on compliance, others were focused on financial or other measures. Therefore, to normalize this, the definition of success or failure (the most relevant measure for this analysis) is the final system performance relative to the definition of success of the individual case. While the primary measure of success is based on metrics, this only represents two of the three aspects of technological success mentioned earlier (Technical * Social * Business Success = Technological Success), which are technical and business success. The social aspect is critical, especially given the significance of the socio-technical perspective discussed earlier (Fig. 4-5). To measure this, qualitative observations of staff acceptance or rejection of the processes are used.

For each of the cases, a narrative describes the events before the lean intervention and then the lean intervention for damage control. This is then followed by a theoretical analysis

using Perrow's framework. If applicable, a final discussion for the cases describe what the lean approach would have been if it had been undertaken from the beginning (alternative proactive lean approach).

Case Studies

Case 1: Centralized Industrial Laundry for Hospital System (Routine)

Narrative

Most hospitals in a large non-profit system had on-site laundry facilities, which were aging and in need of replacement. Instead of further investments in these individual hospital laundry facilities, system leaders saw an opportunity to gain efficiencies through centralizing laundry services in a large off-site industrial laundry facility (and eventually offering services to hospitals and clinics outside of their system). A total of 10 million dollars was invested in a state-of-the-art facility. Therefore, the technology was state-of-the-art and no expense was spared. From the initial launch of the laundry, shortages of operating room (OR) towels and scrubs were threatening to shut down the OR at the main hospital (the financial engine of most hospitals), and the offsite (laundry processing) and onsite (laundry distribution) managers were not on speaking terms due to animosity and finger pointing resulting from this poor system performance.

A fixed daily order for laundry was in place, with no system to react to variation in demand other than expedited orders or stealing from other departments. The Chief Operating Officer (COO) of the hospital was getting 44 calls per day from angry department administrators, and most hospitals in the system were frustrated with the new process and wanted a return to the previous system.

The $10M investment (business failure), poor performance (technical failure), and low customer satisfaction (social failure) resulted in a request for the researcher to facilitate a project to address these issues using a lean approach.

Observations and interviews were conducted to better understand the problem, a cross-functional team was created, the current state of the process was mapped, and then the team came up with a shared future state vision and accompanying action plan to bring it into reality. The team consisted of the onsite and off-site laundry managers, front-line staff, industrial laundry technical staff, truck drivers, and several internal customers. The

researcher facilitated the problem solving process, but team members developed, implemented, and refined the process. As the project progressed, the internal capacity of the team increased as they became more familiar with the approach and began focusing on the process metrics (that were not available at the beginning of the project). An example of this was that the action plan was continually added to and revised, which was the result of increasing system knowledge and ownership of the process. After completing 98% of the 150 action items (147), the process was working smoothly with no outages or calls to the COO. Also, efficiencies were achieved that reduced the workload per cart and other measures of efficiency. Front-line staff who had never been engaged in creating their processes created a system of visual kanban replenishment (a pull system) [226] to adjust orders to actual usage. Core process measurements were established and actively used for ongoing problem solving. The offsite and onsite laundry managers, who were not on speaking terms initially, were now friends and communicating multiple times per day to dynamically coordinate the flow of laundry.

An example of one of the improvements was shifting where the soiled linen was temporarily stored from the third floor to the basement. Before this change, the laundry staff had to take a heavily used elevator to the third floor that only carried two carts, which increased the number of trips and resulted in significant wait time for an available elevator. With the dirty laundry stored in the basement, a large freight elevator located at the loading dock could be used (which also greatly decreased the distance to be traveled to get to the elevator), which had a capacity for six or more carts and was only one level away from the basement storage room. This had a significant and immediate effect on the newly established metric of Average Time per Cart (Fig. 4-12).
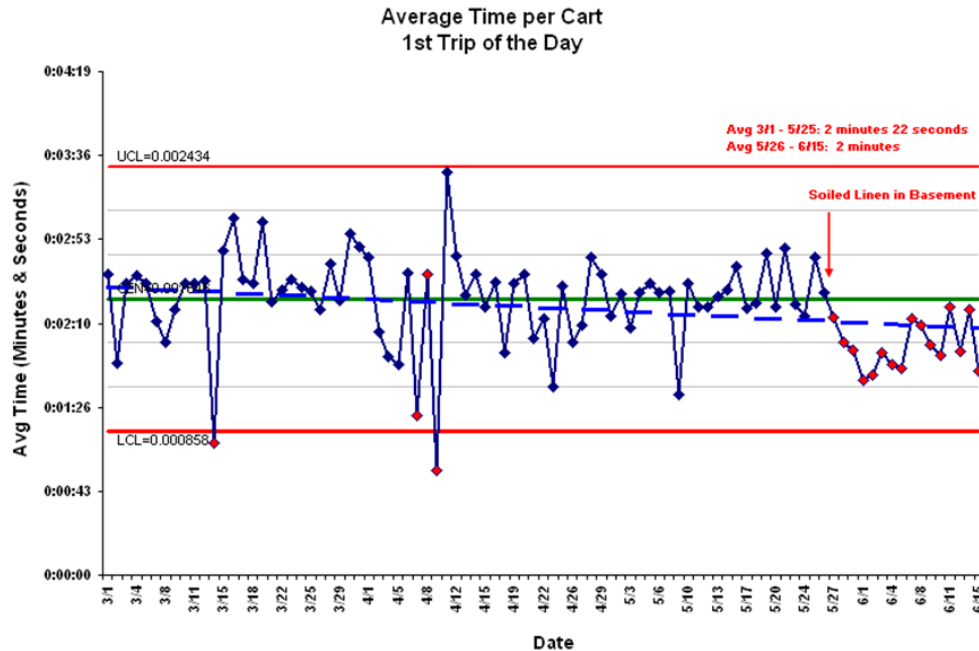
Figure 4-12: Centralized Laundry lean project graph of impact of single process change on cycle time per laundry cart.

By the end of the project, additional efficiencies were gained and outages were not threatening the hospital, and therefore the $10M investment was not being questioned (and therefore could be classified as a business success). The process was easier for the staff and they felt ownership to improve the process, so it was a technical and social success as well.

Analysis

In terms of the obvious characteristics of the laundry process, it is routine (high analyzability and low variety), and a mechanistic deployment would superficially appear to be a fit. The reason for the failure was the scope of the routine technology and the rapidity that it was implemented, as many details were overlooked and these loose ends resulting in a process that became higher variety, thus driving it to engineering from routine. Also, while the technology itself was routine, the processes needed to make the technology work were less routine and had many unidentified interdependencies. The primary focus was on the processing of the laundry, instead of the myriad of details and the interactions of this process with dependent processes in the hospital. Once it was in the engineering quadrant, it required a mostly organic approach for which the organization didn't have the internal capability.

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A fresh approach based on a lean perspective treated deployment more organically (which matched the new reality of the process caused by the poor planning and implementation) and was able to bring the system back to a state of reliability and effectiveness. While the organization's only stated objective for the project was in pure business terms, it was the combination of social and technical success through an effective deployment process that led to the business success. This demonstrates the significance of the socio-technical perspective.

Alternative Proactive Lean Approach

If a lean approach had been undertaken from an earlier stage (before the laundry facility had been purchased and built), a different series of steps would have been taken that was consistent with the lean selection and deployment framework presented. The need that was used to justify this project was to "save money (or even make money by selling services externally) with laundry services." Since the laundry equipment was aging, they thought they would have to buy new laundry equipment at individual hospitals and decided to consolidate their services into an industrial laundry system. From a lean perspective, this need would have been questioned and instead the broader purpose would have been considered. The purpose was to effectively clean laundry in a cost effective way. This might have been met through other means than centralizing laundry services (which was the most expensive and sophisticated technology).

The lean approach is to always start by understanding the current process, where there is waste, and where there are opportunities for process improvement. By improving the process they might have met their goals with simpler, less expensive, most proven technology [37]. The decision to immediately consolidate all laundry services into a state-of-the-art $10M facility was not taking this stepwise approach. Simpler, inexpensive process improvements would have been investigated with a team, and small scale experimentation done (such as improving efficiencies in the process at individual hospitals). If the centralized laundry was determined to be the best fit (in terms of capabilities) for the needs (after exhausting the simpler, less expensive process improvements), a team-based approach would have been used to develop the process for integrating the offsite laundry with the hospitals, and then use this to drive the location, capabilities, processes, training, etc. Moreover, it would have been recognized that while the act of doing the laundry was

mechanistic, the logistics of getting the right laundry worked on and delivered in the right amount at the right time is relatively organic. Still, the process itself would be classified as primarily mechanistic, and thus treated as such involving a thorough review and analysis of all of the details, and then methodically implementing the different parts. This would have resulted in a disciplined and methodical mechanistic approach to deployment. While the primary process when running smoothly would be mechanistic, as complications arose, focused PDCA (organic) problem solving would be used as needed.

Case 2: Med Reconciliation (Craft)

Narrative

During an electronic medical record (EMR) implementation, the medication reconciliation module had not yet been implemented. Technical training was done on the new module, and it was then implemented. The intention of this implementation was to improve patient safety and quality related to the medication reconciliation process. In addition, the intention was to meet federal regulations and decrease vulnerability to malpractice law suits. This process was deployed mechanistically, with very little input from the staff. Shortly after implementation, there was a sudden drop in inpatient satisfaction related to the discharge process (Fig. 4-13). Staff members were very unhappy with the process, and found the medication reconciliation process to be cumbersome and time-consuming, and thought the previous process was more effective and efficient. Patients were unhappy with the lengthy process that delayed their going home.

The researcher was asked to investigate this. After going to several nursing units experiencing this drop in satisfaction and meeting with staff, data showed that the process time to complete medication reconciliation had increased two to three times above the previous process, and with no accompanying staffing model changes (used for maintaining patient to staff ratios). This resulted in nurses being pulled away from the patient's bedside at the time of discharge (a critical time for closure in the relationship with the patient and a significant driver of patient satisfaction).

**Inpatient Satisfaction
Overall Percentile Ranking**

UCL=0.9395

CEN=0.402

EMR Installed
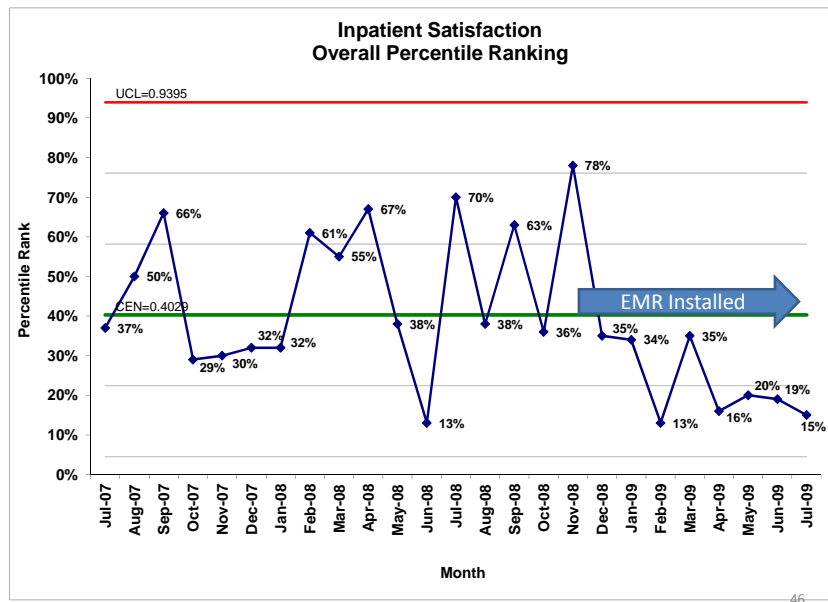
Figure 4-13: Inpatient satisfaction with discharge process.

Analysis

The perceived need for technology was to have a way to ensure that patients were going home on the correct medications, and that any new medications that they had been given in the hospital (or that had been removed) are to be reconciled with their medications that they were taking at home. Before the electronic medical record (EMR), this need was met by a paper process. When the EMR was installed, a new need was created to have an electronic version of the process to interface and use data in the electronic system, which had potential safety and regulatory benefits. Therefore, the capabilities of the electronic medication reconciliation seemed to be an obvious fit. The paper version of the process had been developed over a number of years and the staff had deep understanding of the process, but the electronic version was significantly different with little resemblance in form or logic. There was minimal consideration for customizing this module to mirror the current process or to better understand the interaction with the nurses. There was no pilot for learning and little training of the nurses.

Therefore, they viewed the technology as routine and standalone with no regard for how it affects jobs or the accompanying social system. In reality it had many complex interactions with the way the nurses did their job (especially during the time of patient discharge). The

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nurse's job is highly complex and dynamic, and entering data is a very minor part, yet the technology made this a disproportionately time consuming job. This seemingly routine technology was then driven to craft according to the Perrow's model due to the unpredictable nature of the process and its interaction (primarily increased workload and distraction) with the rest of the nurse's work. Using this technology itself should have been mostly analyzable if it had been simple to use and training had been done well (as had evolved over time with the paper version of the process) and wouldn't have affected patient satisfaction. It turned out to be more complex than necessary and added considerable variety, primarily in terms of distracting the nurse and pulling them away from the patient. Therefore, it is moderate in uncertainty as implemented and required a more organic approach which ironically could have made it a more routine part of the job. As a result of the approach taken to selection and deployment, it wasn't accepted by the staff (a social failure), it inhibited workflow and patient care (a technical failure), and threatened patients returning to the hospital due to dissatisfaction (a business failure).

Alternative Proactive Lean Approach

If a lean approach had been taken, more time would have been spent on understanding the current process prior to selecting the technology. The perspective that was used by those implementing the technology narrowly defined the need and only saw it in terms of the specific medication reconciliation regulatory and process requirements. An additional need that was neglected was that of integration with the nurse's current process and total workload. Better planning and experimentation in a pilot could have led to integrating the technology with the nursing process proactively, as opposed to re-actively in response to unintended consequences.

Case 3: Pneumonia Vaccine Protocol (Engineering)

Narrative

A team from the quality department at a large academic medical center saw an issue with low compliance with the Pneumonia vaccine administration process (a clearly defined problem). This process involves the identification of patients who meet criteria for receiving the pneumonia vaccine, which has been shown to decrease their risk of acquiring pneumonia either inside or outside of the hospital. For patients that meet these criteria

(such as elderly patients or those with certain co-morbidities), this can be a lifesaving preventative measure. They created a team, met with a wide variety of staff, and developed a simple protocol to pilot that they hypothesized would address the compliance issue. After piloting the process, gathering feedback and metrics, refining the process, and re-piloting several times (iterative PDCA), they were able to achieve almost 100% compliance with the requirement, as well as have the accompanying acceptance and ownership of the process. This process was a simple paper form in the patient chart. This was a significant accomplishment, and the team was planning to present on this project at conferences to share the success with others. Concurrently, a hospital-wide EMR was being deployed, and all protocols such as this needed to be integrated into the electronic system. The team had been promised that their simple protocol that had been proven effective would be integrated into the EMR through customization of the standard module (rather than the default protocol included in the EMR). As the mechanistic deployment of the EMR continued, the implementation fell behind schedule, and the deployment team decided to implement the default Pneumonia protocol instead of what the team had developed. This eliminated the staff's process and replaced it with an externally created generic process (essentially, it was overwritten). The compliance with the requirements immediately deteriorated, as can be seen in Figure 4-14.
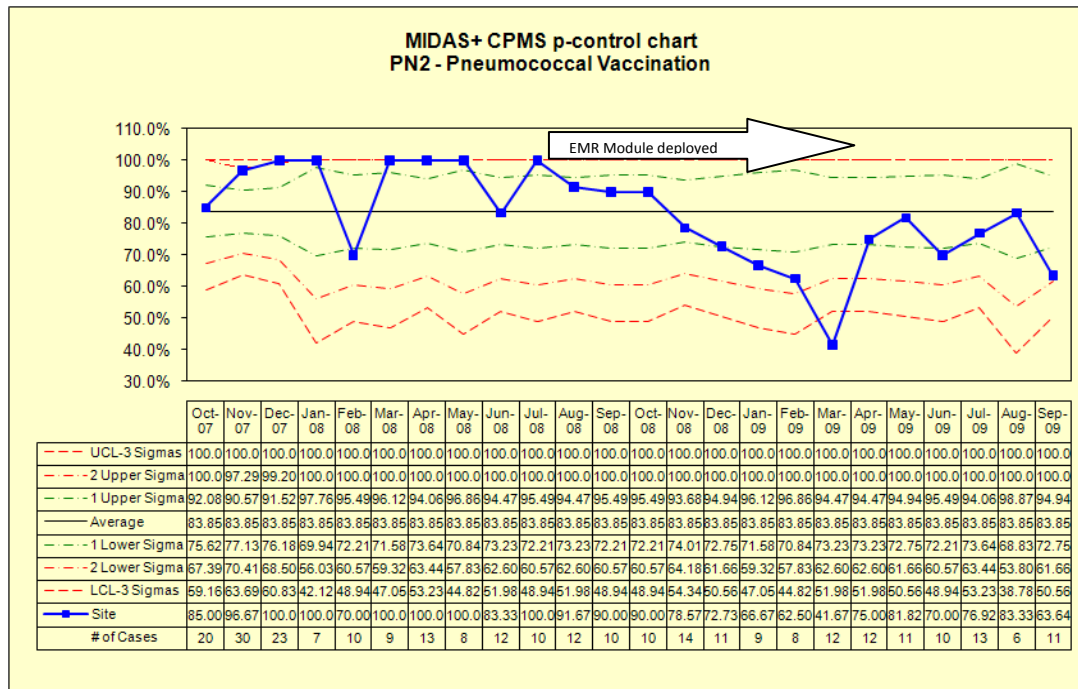
Figure 4-14: Relationship of pneumonia vaccine compliance with implementation of EMR.

Analysis

From Perrow's perspective, the protocol was a rather simple technology (essentially a checklist) that existed in a very complicated environment of highly variable patient conditions as well as highly variable staff processes related to its administration. The initial analyzability was low due to the lack of available data and process visibility (with it being intertwined so closely with the highly variable core work of the nurses), and the variety was high due to patient condition variability as well as a lack of a standardized work practices for the staff to administer it. The team worked closely with staff to pilot and refine a standardized process and to tie these experiments to the compliance data (PDCA), and they were able to standardize the process and achieve high compliance. Therefore, through this standardization and metrics infrastructure development, they drove the complexity toward simple, which would have enabled a mechanistic approach to deployment if the EMR module had integrated their process (which was originally promised).

When the process was overwritten by the default EMR module for medication reconciliation, the standardization was lost and the mechanisms for measuring and adjusting the process according to compliance were lost as well. Therefore, the analyzability decreased and the variety increased, thus increasing the complexity and necessitating a

more organic approach. Rather than using an organic approach, the module was deployed mechanistically (command and control). As was the case in Case 1, the non-lean approach increased the need for an organic deployment approach, but instead a very mechanistic deployment was used. The original process the team had created had set the groundwork for a mechanistic deployment of the electronic version of what the team had developed (by transitioning it from a more complicated technology to a rather simple one), but the approach taken resulted in the need for an organic approach that was not subsequently taken. The approach that would have been needed to make the new process work would have required an extensive evaluation and adjustment of all of the work practices and staffing model, which would have required extensive analysis and experimentation (that is, a very organic approach).

Alternative Proactive Lean Approach

If a lean approach had been followed before the EMR implementation, the initial fit between needs and capabilities of the current process (on paper) and the high staff level of following the process and protocol compliance, would have indicated a very good process that should be learned from and leveraged. The team had already set the groundwork for a mechanistic deployment of this module due to their efforts at standardizing the process and iteratively understanding the process through measurement. The staff from the team (and representatives from different areas) could have been involved in translating their process to the EMR form, and then conducting training and education with the staff. All of the mechanisms that the team had previously used to develop the stable paper process could have been leveraged (including trust of the staff) to mechanistically implement the technology quickly and without reducing compliance.

Case 4: Moderate Size Clinic Lean Design (Non-routine)

Narrative

A large hospital system was planning on building a new multi-specialty clinic in a rural setting in anticipation of future patient demand in the region. Apart from one nurse and one doctor, no other staff members who would work in the new clinic were available to be on the team because the facility was still more than a year from construction. Because of this long lead time (with more flexibility in the architectural design process with deadlines

farther off), it was possible to move departments throughout the clinic, but with the constraint of working within the original footprint of the Draft 0 design from the architects. The long lead-time also allowed significant integration of the architects into the process. A team composed of senior leaders, physicians, mid-level managers, and front-line staff was brought together for an intensive two-day event to analyze the Draft 0 of the architects design using the core healthcare flows (such as staff, patients, physicians, information, instruments and supplies, etc.), and design and evaluate multiple alternative designs for the future state. Several of the team members were also brought from a previous lean clinic design project. The team worked intensively and in close cooperation with the architects and other stakeholders. As can be seen in Figure 4-15, significant positive impact was achieved in a very short period of time. This revised design was better for staff, physicians, and patients, and was also significantly more cost effective. From a business perspective, it was a success, as it saved the organization money in the original construction and also in ongoing costs. It was a technical success as well, as it was going to facilitate the flow of staff and patients through its design. Finally, it was a social success, as the staff members involved were deeply engaged in the process and felt significant ownership in the design and confidence in its future outcome.
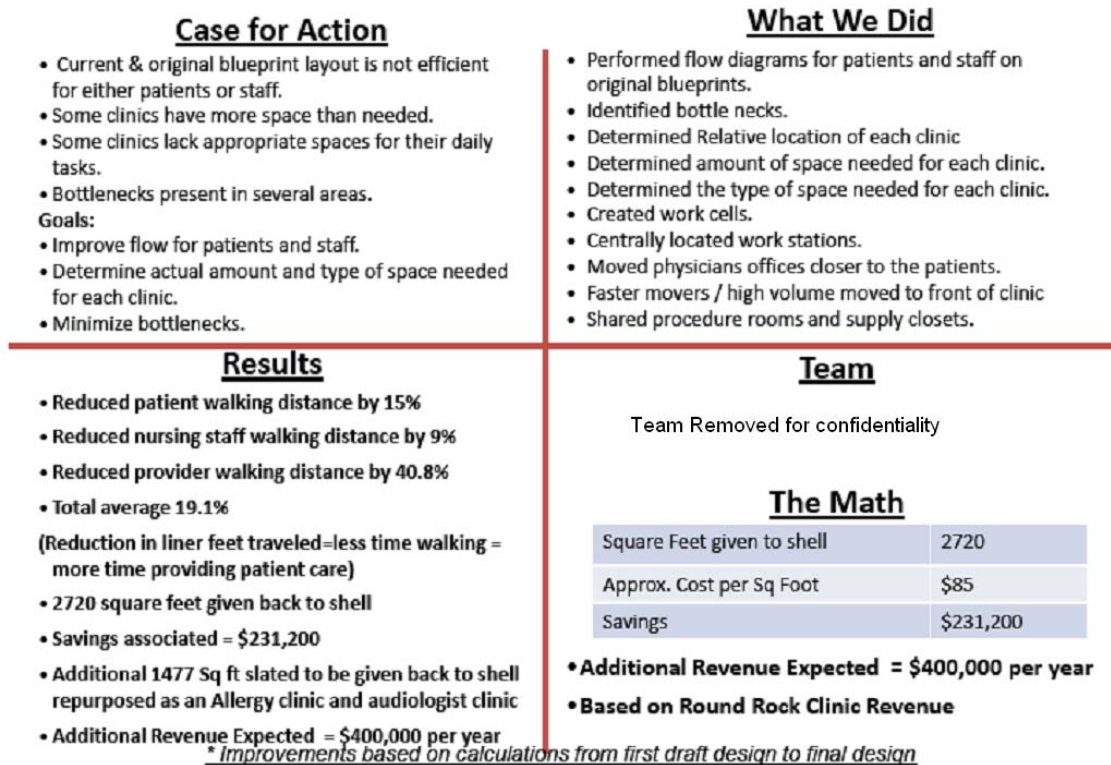
Case for Action

- Current & original blueprint layout is not efficient for either patients or staff.
- Some clinics have more space than needed.
- Some clinics lack appropriate spaces for their daily tasks.
- Bottlenecks present in several areas.

Goals:
- Improve flow for patients and staff.
- Determine actual amount and type of space needed for each clinic.
- Minimize bottlenecks.

What We Did

- Performed flow diagrams for patients and staff on original blueprints.
- Identified bottle necks.
- Determined Relative location of each clinic
- Determined amount of space needed for each clinic.
- Determined the type of space needed for each clinic.
- Created work cells.
- Centrally located work stations.
- Moved physicians offices closer to the patients.
- Faster movers / high volume moved to front of clinic
- Shared procedure rooms and supply closets.

Results

- Reduced patient walking distance by 15%
- Reduced nursing staff walking distance by 9%
- Reduced provider walking distance by 40.8%
- Total average 19.1%

(Reduction in liner feet traveled=less time walking = more time providing patient care)

- 2720 square feet given back to shell
- Savings associated = $231,200
- Additional 1477 Sq ft slated to be given back to shell repurposed as an Allergy clinic and audiologist clinic
- Additional Revenue Expected = $400,000 per year

Team

Team Removed for confidentiality

The Math

Square Feet given to shell	2720
Approx. Cost per Sq Foot	$85
Savings	$231,200

- Additional Revenue Expected = $400,000 per year
- Based on Round Rock Clinic Revenue

Improvements based on calculations from first draft design to final design

Figure 4-15: Quad chart summarizing lean design project on moderate-sized clinic.

Analysis

In this particularly case the lean approach was used proactively and did not have to be used after the fact to save the implementation. From the perspective of Perrow's framework, the question of the complexity of the technology of a clinic facility requires some discussion. Is the complexity of the technology in the physical structure itself? In that sense, it could be considered simple. Is it the interaction of the physical structure with the processes it contains? In that sense, it would be complex, as the number of different processes, staff, and patient would be very large and their interaction with the building would be highly dynamic. Given that the success or failure of the architectural design depended on its interaction with its occupants and accompanying processes, the latter is used for this analysis.

With the design being provided by the architects using their standard process (Draft 0 design), the lean process that took place recognized that this design did not take into account the myriad of complex interactions of what the building would contain. The analyzability was moderate to low, as there was no current structure or even staff to

observe, but some surrogates could be used to analyze flow. The variety of activities that would take place in the facility would be high, including needing to design the facility for future growth, expansion, and unanticipated changes. This therefore resulted in it being classified as non-routine according to Perrow's framework. Therefore, the deployment of the design (the Draft 0 with the rough matching of needs and capabilities) needed to be organic, which it was in the lean approach that was taken. Essentially, the deployment of the design was a lean approach to integrate the complexities of the interactions to transform the design into something usable from a process and staff integration standpoint (socio-technical integration). Therefore, in this case, the design took place in two phases, with the first phase being the gross matching of needs to capabilities (which was done mechanistically by the architects) and the second phase being the integration of the people, processes, and other complexities that the standard architectural design process would not have considered. In a sense, the gross matching of needs to capabilities is done by the architects in the design (the technical half of the socio-technical perspective), with the refinement of the technical perspective and the integration of the social aspect being integrated in the deployment through the lean process. Also, the iterative PDCA process was integrated closely into the process, as the team created multiple different options, evaluated their effectiveness against a myriad of criteria, and then refined the design using a paper kaizen approach.

The standard architectural design process begins and ends with the technical design of the model without taking significant consideration of the true complexity of the building and what it will contain. The lean approach directly addressed this complexity through an organic approach that resulted in a simpler technology that had already been analyzed extensively and built in mechanisms for minimizing variety once built. With the lean approach, the discovery phase of the facility primarily took place during the refinement of the design, while in the traditional architectural design process this takes place at "go live" when the facility is first being occupied (and when any structural changes to correct these problems are financially prohibitive, which limits the impact that future PDCA related to the design can have).

Narrative

A small, critical access hospital was only a few weeks away from architectural "sign off" on a $10M design for a remodeled emergency department (ED) and a new Operating Room (OR). Ever since this project was proposed, the physicians and staff had been promised that they would have significant involvement in the design process. With only a few weeks from design sign off, most of the physicians had not even seen the design and only a few middle-managers had met with the architects in highly structured and controlled meetings to review designs. The designs usually were not available beforehand, so staff had little time to review them or to think deeply about the facility implications for their future process flows. The CEO enlisted the help of the researcher to facilitate an Emergency Department lean design project just before the design sign off. The architects briefly suspended their work, and allowed the lean project to proceed. The architects were hesitant to even share the computer-aided design (CAD) designs of the buildings for the lean team to use.

Basic lean training was provided to the staff in the two departments, and two different teams were created (one for the ED and one for the OR). When the teams started analyzing the current versions of the designs using their own experience, as well as the lean perspectives from the training, significant issues with the current design became apparent. Both teams were concerned about the shared waiting room for OR and ED staff, as mixing these two patient populations was known to create patient satisfaction issues. The OR design did not support line-of-sight monitoring of patients or individual operating rooms, which was critical to patient safety and facilitating OR flow. Also, there were issues with the flows of contaminated equipment and supplies in the OR crossing "clean" areas, which represented a potential contamination risk.

The ED team identified that the central core was not nearly wide enough for moving patients on stretchers, and the storage rooms were located a significant distance away from their core work areas (which was a major frustration for the staff with their current design). In addition to these issues, there were a variety of other design issues with the current version of the design that had not been identified through the standard architectural design process. The OR team was more structured, as the team could meet after the OR closed around 3 PM. daily. The ED was a 24/7 operation, so the only way to engage this group was

to spend time periodically in the nursing station and get feedback from the staff as they had spare moments.

The ED staff slowly started to trust the researcher, and the quality and quantity of the feedback increased significantly. The OR team had strong leadership, including a nursing manager and an anesthesiologist, who found the approach new and exciting compared with what had taken place up to that point. By the end of the project, there were two designs (one for the ED and one for the OR) that were still within the original design footprint, but with significantly improved flow for patients and staff, and buy-in from the staff was high.

The issues identified with the original design were addressed by the team. The degree of the re-design can be seen in the design overlay in Figure 4-16 (the lean team's design on top of the original architect's design). At the beginning of the process, there was no social success or task success (the staff did not accept the design and it was evident that it did not integrate well with their processes/tasks), and the business success was not clear. The standard mechanistic approach used in the architectural design process was in stark contrast to the organic approach used by the researcher, which had the potential to result in social and task success (the staff members owned the new design, and flow analysis showed improved workflow and decreased process waste), as well as business success. Due to the rushed nature of the process (with strict timelines) and the adversarial relationship with the architects and their conflicting mechanistic process, the positive impact of the lean approach was diluted.
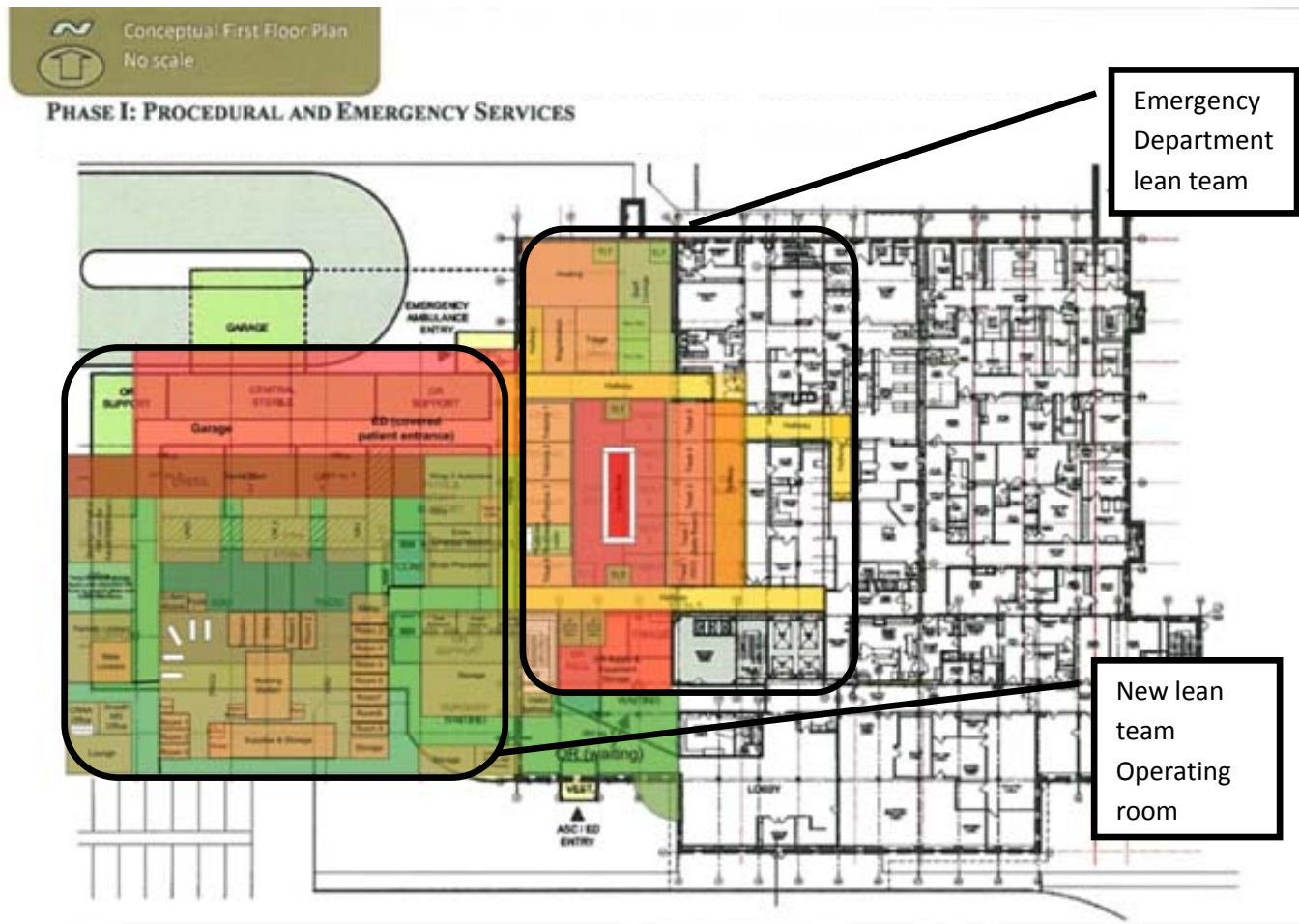
(Colored area represents significant changes to the original design, with essentially 100% of the design changed by the team; the West side of the building was the focus of the design effort, with the East side of the building left substantially unchanged.)

Figure 4-16:   Critical Access Hospital Lean ED/OR Design project.

Analysis

The technology discussed in this case was very similar to Case 4 (non-routine) and would therefore need an organic approach according to the Perrow model. In this case, the timeline was much more restrictive and the in-process mechanistic approach of the architects inhibited the parallel lean initiative that would have used the appropriate organic approach. These parallel and competing approaches caused significant conflict and ultimately diluted the impact of the organic lean effort. With this technology falling under the non-routine category of Perrow, this diluting of the organic approach by the parallel mechanistic approach would negatively affect the proper matching of technology and deployment, which was illustrated in this case.

Alternative Proactive Lean Approach

The approach that should have been taken would have mirrored that of Case 4, with an organic lean approach (recommended by the Perrow model) taken much earlier and integrated in a non-adversarial way with the architects. This would have enabled an organic approach that could have resulted in similar impact to that demonstrated in Case 4 (see Figure 4-14). The overly mechanistic approach led to the anticipated issues related to an overly mechanistic approach (see Figure 4-11 and Table 4-2) in that the final design was not integrated well with the processes and there was insufficient time and flexibility for organic PDCA problem solving.

Discussion

These five cases were analyzed according to the model predictions related to finding a match of approach, which were summarized in the Table 4-1. Relevant characteristics of the technology and deployment for each case (described in the model section of this chapter) are also included. These are summarized in Table 4-5.

Case #: Title	1. Laundry (Mechanistic)	1. Laundry (Organic)	2: Med Reconciliation	3. Vaccine protocol (Organic)	3. Vaccine protocol (Mechanistic)	4. Lean Clinic Design	5. Lean ED/OR Design
Perrow Model Classification	Routine	Engineering	Craft	Engineering	Engineering	Non-Routine	Non-Routine
Mode of Deployment:	Highly Mechanistic	Highly Organic	Highly Mechanistic	Organic	Highly Mechanistic	Organic	Mechanistic
Recommended mode of deployment (Perrow)	Mechanistic	Mostly Mechanistic	Mostly Organic	Mostly mechanistic	Mostly Mechanistic	Organic	Organic
Deployment compared to Perrow	Match* (*the mechanistic approach was poorly managed and resulted in a sudden increase in complexity)	Overly Organic	Overly Mechanistic	Overly Organic	Overly Mechanistic	Match	Mismatch* (*Competing approaches)
Predicted Outcome	Positive	Positive	Negative	Mixed	Mixed	Positive	Negative
Outcome (final):	Negative	Positive	Negative	Positive	Negative	Positive	Negative
Technology:	Consolidated industrial laundry facility		EMR Module	Paper form or Spreadsheet	EMR module	Facility/Building design	
Business Need:	Consolidation and efficiency	Make $10m investment a success after initial failure	Liability/Compliance	Liability/Compliance		Improve Flow/Decrease Waste/Decrease size (cost savings)	
Social Need:	Trust Laundry system to deliver for needs and on-site and off-site staff working together collaboratively		Integrate with other work processes and accepted by staff	Integrate with other work processes and accepted by staff		Staff Buy-in for design and acceptance by staff once built	
Task Need:	Reliability and adaptability		Patient Safety/Quality	Patient Safety/Quality		Physical Design conducive to staff/patient flow	

As can be seen in Table 4-5, there was a close correlation between following the mode of technological deployment recommended by Perrow and the successful integration of the technology. In the case of the laundry, the mismanagement of the scope of the details required for project success increased the system complexity dramatically, which necessitated an overly organic approach to bring the system back into a state of stability. This was likely due to the processes that were needed to make the technology work were less routine than the core technology, and required a more dynamic approach.

Another insight from these cases is that an overly mechanistic approach usually resulted in failure, while an overly organic approach resulted in a success (which was illustrated in Figure 4-11 and Table 4-2 earlier in this chapter, with the implications of the overly organic approach less detrimental than an overly mechanistic approach). Therefore, assuming that it is difficult to exactly match the deployment approach, a bias toward an organic approach is recommended to increase the likelihood of success. As previously noted, healthcare is a complex service industry that involves a higher degree of variability than many other industries Healthcare processes are likely to be complicated or complex, and therefore have a greater risk of an overly mechanistic approach is taken (see Fig. 4-11). The greater risk of

an overly mechanistic approach is important to recognize in high variability industries such as healthcare. Given the generally higher level of variability and complexity in healthcare, Figure 4-11 can be "normalized" to represent more accurately the relative risk of an overly mechanistic or organic approach relative to the perceived state of the technology. This is illustrated in Figure 4-17.
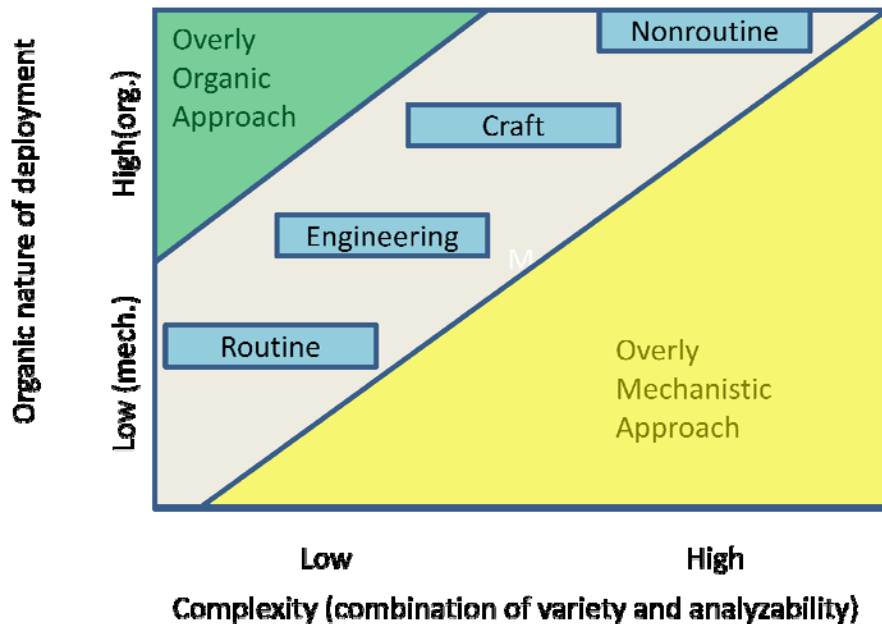
Figure 4-17: "Normalized" risk of mismatched approach.

From these cases, the Perrow model yielded a variety of insights.

- An often neglected organizational need is the integration with broader activities that make up the jobs of those who would be using the technology. Therefore, needs tend to be too narrowly focused on only direct interactions of the technology instead of the larger context and processes that the staff work within.

- The requisite capabilities of the technology is too narrowly defined in terms of the obvious technical aspects, but neglected the necessary capabilities of the staff to successfully deploy and maintain the technology (such as problem solving capability, culture, leadership support, etc.).

These overly narrow needs and capability definitions lead to an over-simplified understanding of the technology, which biases the deployment toward a mechanistic

approach and the accompanying problems that came with an overly mechanistic approach (see Table 4-2).

This overly mechanistic approach results in a lack of integration driven by an overly rigid timeframe and inflexibility that didn't allow for iterative PDCA problem solving. When these technologies are applied overly mechanistically, they encounter surprising complexity and unanticipated interactions with the broader environment of the technology, resulting in a "crisis" and uncertainty about how to proceed. When this crisis occurs, organic PDCA problem solving is needed, which is driven by staff. If this capability to facilitate organic PDCA problem-solving approach is not in place, an outside resource is required to facilitate having the staff members solve the problems (rather than doing the thinking for them as would be the normal mechanistic approach with external experts developing and delivering recommendations). The application of deceptively complicated technology in an overly mechanistic way results in increased complexity. A more organic approach is required to untangle the complexity created by an overly mechanistic deployment.

As was discussed earlier, the relationship between the model that was developed to understand the selection and deployment of technology in healthcare was closely linked to PDCA thinking, which was illustrated in Figure 4-6 earlier in the chapter. The alignment of needs and capabilities is an emergent behavior of the PDCA thinking process. This emergent behavior is also evident when following the PDCA process regarding the deployment of the technology. When the PDCA thinking questions (Fig. 4-6) are asked, investigated, implemented, and reflected upon, the benefits of properly selecting and deploying the technology are realized.

Conclusion

One of the main differences from the common mechanistic approach is doing rigorous preliminary assessment in an extended planning phase. This includes use of a pilot, starting with the most simple and robust interventions first and then considering more advanced or complicated interventions if the simpler ones do not suffice. More rigorous preliminary assessment results in incremental experimentation, which facilitates deep understanding of the interdependencies of the technology that is critical for success if more complicated technology is eventually used. The lean approach takes a broader perspective of needs,

with an inclusion of the social systems and the other activities the staff are doing outside of the specific focus on the technology in question. Without rigorous preliminary assessment an intervention may be selected that addresses a problem that is not well defined or understood. Sub-optimal outcomes from this sort of approach are not surprising. If the problem is not well understood, then a simple technology might not suffice to address a complicated problem, or a simple problem might be made more complex with complicated technology. Either scenario will not result in a positive outcome, as either disconnect will not address the underlying problem and may result in unintended outcomes.

The other main difference from the common mechanistic approach is the planning of deployment once a particular technological intervention has been selected. The "standard approach" considers only the technology in a mechanistic was and deals with social consequences after the fact. As was demonstrated in the case studies, with the right planning, philosophy, and involvement of those using the technology, a mechanistic approach to deployment can often be effective.

In conclusion, the disconnect between the potential benefits of technology in healthcare and the actual benefits has very little to do with the actual technology, and more to do with the approach that is taken to understand the underlying issue, select technology that is appropriate to address the issue, and then deploy and support the technology (through continuous PDCA problem solving) in a manner that results in integration with current processes, ownership of the staff actually using the technology, and that enables continuous problem solving. While many forms of technology available to healthcare organizations offer greater potential performance than existing technology, this increased potential can only be realized through an effective approach to the selection and deployment of technology—an approach that focuses strongly on organizational fit between the social and technical aspects of the organization. Given the complexity of modern healthcare organizations, this fit can only be obtained through skilled staff who are adept at PDCA problem solving and leadership that supports them.

Chapter 5
Conclusion

Summary of Primary Chapters

In the three previous chapters, various aspects of integrating People, Process, and Technology in a lean Healthcare context were explored. The intention of these chapters was to better understand the critical aspects of using lean in U.S. healthcare organizations in a sustainable way in order to address the many challenges that they face.

This chapter summarizes the main findings of each of the three primary chapters. Following the summary, the integrating research propositions from the introduction are considered in light of the main findings. These findings are distilled into cross-chapter findings. Finally, potential future research topics are suggested.

People (Hoshin Planning)

Organizations need to align their efforts both vertically (from direct care providers to senior leaders) and horizontally (across direct care providers, mid managers, and senior leaders) in order to achieve their long-term goals. The lean approach of hoshin planning/strategic deployment has the potential to facilitate this alignment. While hoshin is a powerful approach, it requires significant organizational capabilities and organization to implement, which are often lacking in organizations just starting their lean transformation.

The resources, discipline, and infrastructure required to implement hoshin are significant and would keep many organizations from attempting hoshin. However, the large hospital system studied in this chapter implemented a rudimentary version of hoshin planning after only a few years of their lean initiative. The results of the hoshin initiative in this case were not equivalent to those of a mature lean organization, yet they yielded significant benefits to the organization. The hoshin initiative also inspired the organization to continue using

this approach with their annual strategic planning and employee evaluation and development process.

Many of the staff found the two-way discussions with their managers to be the most meaningful they had ever had. Staff and leaders also felt greater integration with the organization through a deeper understanding of their role in helping the organization achieve its goals and objectives. With the organization just beginning its lean journey, many of the staff had heard of lean projects but had not been involved with them yet. During the hoshin process, many of them were tasked with solving problems or improving processes, but they did not know how to approach addressing them. With their tangential or indirect awareness of lean, they knew enough to know that lean could help them meet the goals identified during the hoshin process. They often requested a lean project or training to help them meet their goals. Hoshin therefore helped to create pull for lean.

This hoshin approach demonstrated significant potential to help organizations align efforts both vertically and horizontally. Despite this potential, the organization had many challenges to overcome. Any organization that undertakes this initiative at a similar stage in their lean transformation will also have to address these challenges. The primary struggles they encountered involved logistical challenges, limited resources for facilitation, and cultural struggles.

Chapter 2 developed a practical approach for immature lean organizations to undertake a hoshin initiative successfully. A significant insight from this chapter was the increased visibility of foundational issues (such as lack of standard work practices, workload variability, lack of visual management, etc.) that needed to be addressed in order to progress to the traditional application of hoshin. This foundational insight was summarized in Figure 5-1, which demonstrates the sequential nature of initially identifying the need for hoshin, identifying core foundational issues, addressing core foundational issues, and finally achieving organizational goals and objectives. Understanding that an organization does not attempt to shortcut this process is critical, as the foundational issues that would persist would inhibit any efforts. The progression from the bottom to the top of the pyramid requires discipline, commitment, leadership support, and long-term cultural change. Without this long term perspective and consistent support, an organization would not progress through the different phases.

Figure 5-1: **Phased approach to hoshin planning in immature lean organization.**

Process (Knowledge management)

The knowledge management chapter (Chapter 3) identified a significant gap between the ever-increasing accumulation of evidence-based best practice knowledge and the care was actually provided to patients. The current approach is commonly one of deployment, dissemination, and enforcement. This common approach is often mechanistic and exhibits many characteristics of a coercive approach to knowledge management. With the average nine-year delay in new recommendations for care being routinely provided to patients, this approach does not appear to match what is needed. A lean approach to knowledge management was explored that exhibited characteristics of an enabling approach. The case studies explored demonstrated that this approach was generally more effective than the more common coercive approach.

While the analysis demonstrated the ability to shift certain repeatable steps from tacit to explicit knowledge, much of the knowledge in healthcare remains inherently tacit. Efforts to shift inherently tacit knowledge to an explicit state will prove unsuccessful. While it is important to find a mechanism for shifting repeatable steps from tacit to explicit knowledge, it is critical to recognize the importance of tacit knowledge in high variability environments such as healthcare. The accepted approach for transferring this tacit knowledge in healthcare is that of the traditional master-apprentice model from the craft production era, which is highly effective at transferring situational or high variability decision making

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knowledge. This same model can also be used to develop staff and leaders in using a PDCA problem solving approach. The PDCA approach is effective in the high-variability healthcare environment where knowledge is inherently tacit and situation, and can integrate evidence based knowledge for repeating tasks.

The proposed model was based on task complexity along the X-axis and the state of knowledge (either tacit or explicit) along the Y-axis. With much of the knowledge targeted by evidence based medicine located in the complex/tacit quadrant, the intention is to shift repeatable steps downwards toward explicit (Fig. 5-2). The coercive approach to knowledge management added administrative or other workload to enforce this transition, and this inhibited or negated the shift toward explicit knowledge. This could explain long delays in the use of evidence-based medicine at the patient's bedside.
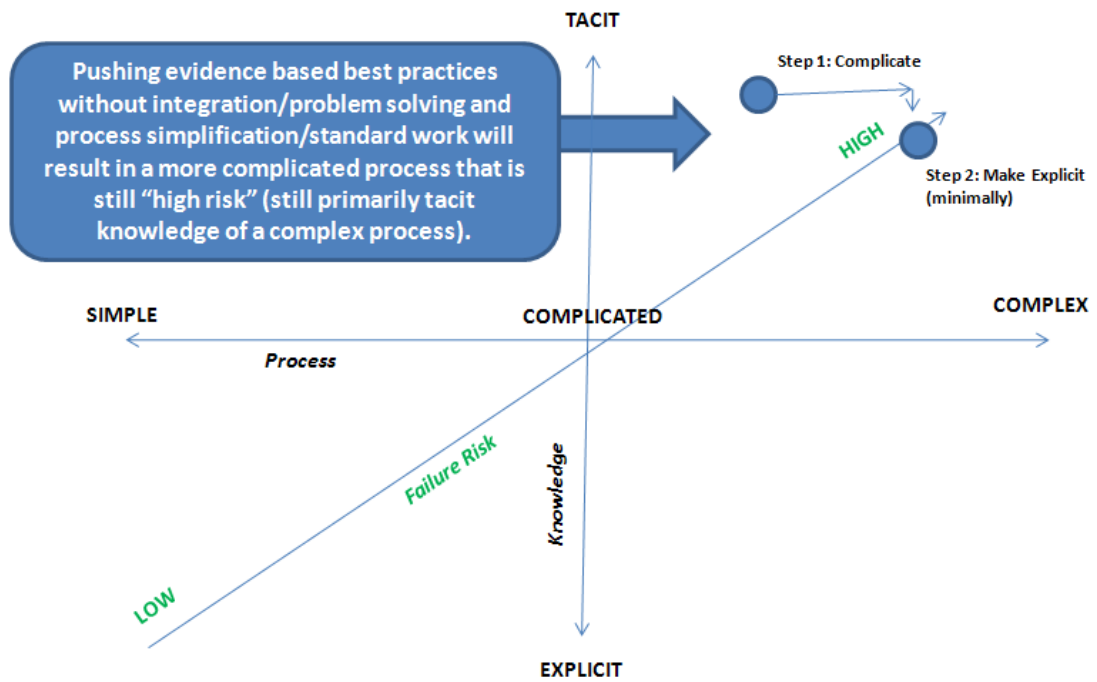

Figure 5-2: **Coercive approach to knowledge management leads to increased complexity and minimal shift to explicit knowledge.**

The lean approach to knowledge management exhibited characteristics of an enabling approach, and instead of initially complicating the process (which inhibited a shift to explicit knowledge), it simplified the process (for repeatable steps). This simplification enabled a transition to explicit knowledge (Fig. 5-3).
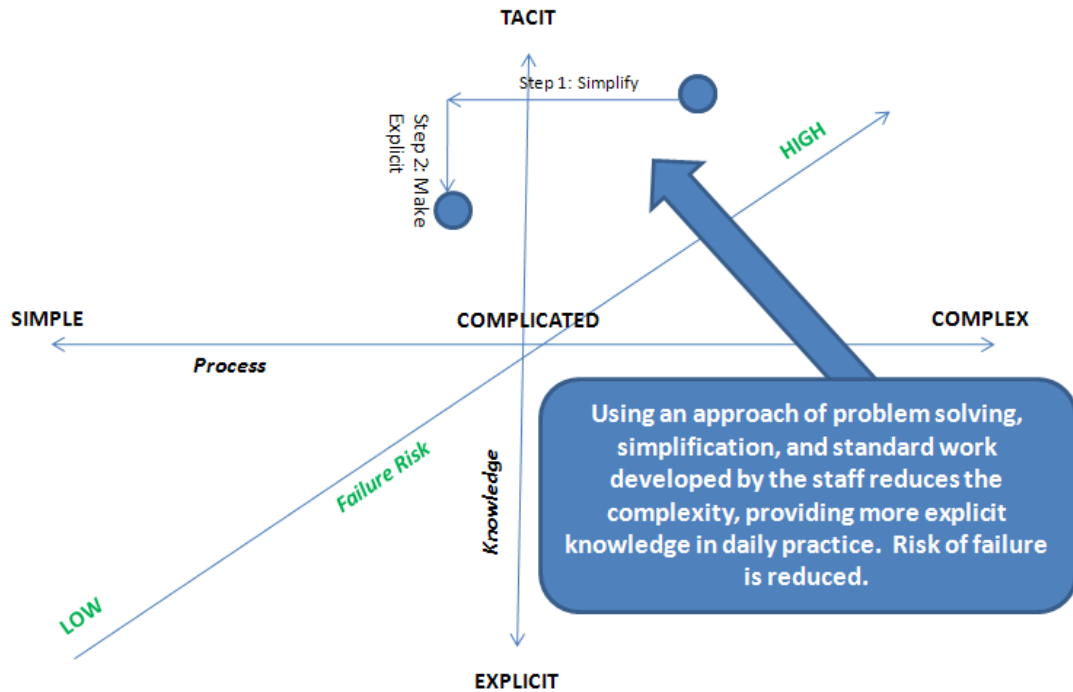
185

Figure 5-3: Enabling approach to knowledge management leads to simplification and increased explicit knowledge.

While the contingency perspective would suggest a need to find a fit between approach and knowledge, this chapter presents a unique challenge. The question is not to find a fit between the current state of the knowledge and approach, but rather to find a fit between the approach and the desired transition (from tacit to explicit knowledge for repeating steps of a process). The coercive approach is only targeting the shift downwards (toward explicit), which has an unintended outcome of increasing complexity (which then inhibits the transition to explicit). The enabling approach focuses on simplification first, which then enables a transition to explicit. Therefore, the proposed fit for transitioning from complex/tacit knowledge to simplified knowledge with a greater component of explicit knowledge is that of an enabling approach to knowledge management. The lean PDCA approach to knowledge management was the enabling approach used in this analysis and that which most closely mirrors the characteristics of an enabling approach to knowledge management.

As mentioned earlier, the knowledge that can be shifted to a simpler and more explicit state is made up of the repeatable components of processes. Trying to shift all knowledge from tacit to explicit is a mechanistic/coercive approach that will not be successful. The approach

of developing leaders and staff with an organic PDCA approach enables the transition toward increased simplicity and explicit knowledge, as well as the broader organization challenges that staff face in a high variability environment. Therefore, this tacit form of PDCA thinking is a fit for the high-variability healthcare environment.

Technology

The primary insight from Chapter 4 was the critical need to find a fit between the technology and deployment approach, as well as carefully taking into consideration the environment that exists around the technology in question. The most common approach in healthcare for introducing new technology, as in the case of evidence-based medicine, appears to be a mechanistic (command-and-control) approach, which is likely a reaction to controlling the high variability environment. This approach has limited effectiveness, as the high variability of the surrounding environment often overwhelmed the mechanistic approach's ability to adapt to a dynamic environment and uncertainty. The lean approach was able to adapt readily and use the creativity and insights of the staff to solve problems and make the systems work, while simultaneously achieving buy-in through involvement during this process. The contingency perspective suggests that the approach should not be fighting the environment, but rather fitting it. A high variability environment suggests the need for an organic approach, which appears to be a fit many healthcare processes and technologies. The lean approach appeared to be an effective approach—a fit—to help the technology in the case studies achieve success.

There is a continuum of complexity requiring approaches ranging from mechanistic to organic. There are also different degrees of risk of a mismatched approach, which are illustrated in Figure 5-4.
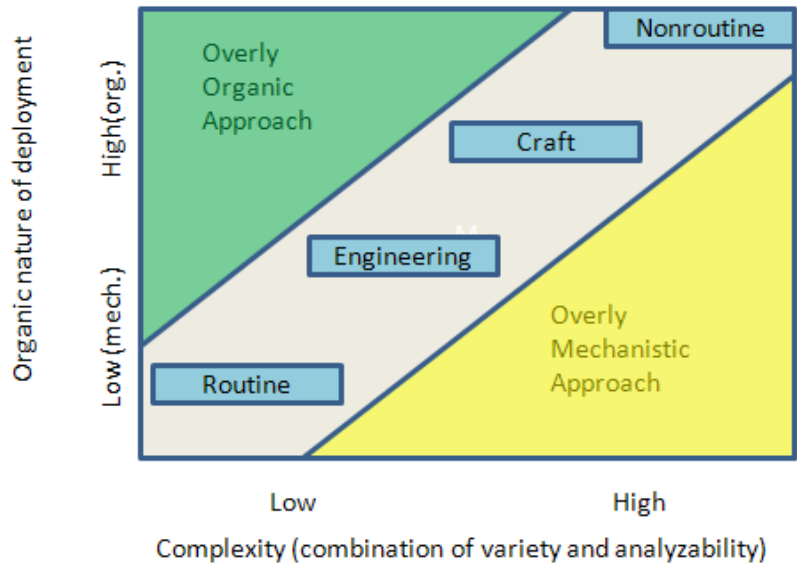
Figure 5-4: Continuum of effective deployment approach according to complexity (Perrow).

Throughout the case studies, there appeared to be a common fit between an organic approach and most of the healthcare cases that were studied in the sense that this approach led to successful outcomes. Based on a superficial analysis of this common fit, a conclusion could be drawn for the validity of a one-size-fits-all approach. On deeper analysis, the greater overall variability in healthcare would drive a bias toward an organic approach. If one stopped comparing healthcare processes to other healthcare processes (to normalize the analysis) and instead to a more absolute classification, then most healthcare processes would require at least some degree of an organic approach given the generally high variability. Therefore, Figure 5-4 did not accurately represent the relative risks of a mismatched approach (which was equal for an overly mechanistic or organic approach, with equal area above or below the continuum). If one were to shift the continuum "upward," which increases the risks of an overly mechanistic approach (equivalent to the surface area), then this figure more accurately represents what was observed in the case studies (Fig. 5-5). The insight is that, in a healthcare environment, a seemingly routine technology exists in a complicated and dynamic environment (an open-systems perspective) and therefore would suggest the need for a partially organic approach.
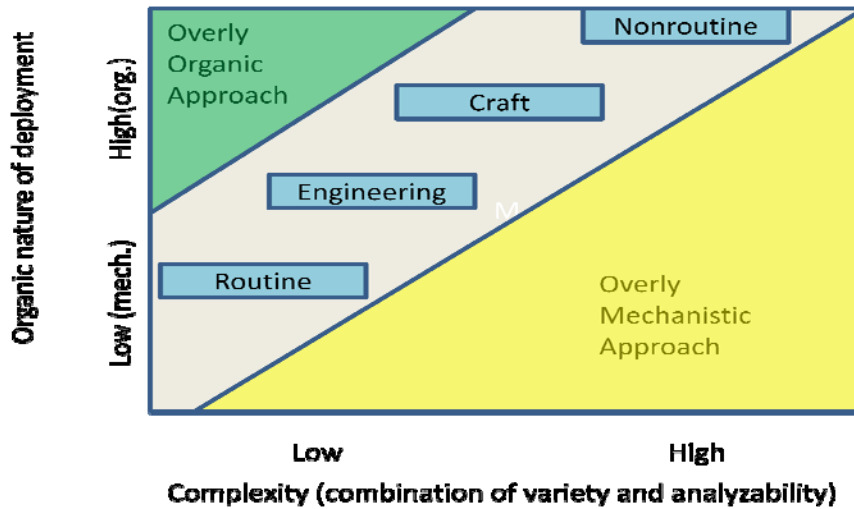
Figure 5-5: "Normalized" risk of mismatched approach (increased variability in healthcare shifts curve up).

Given the disproportionately high risk of an overly mechanistic approach, the ability of an organic PDCA approach to integrate technology both pro-actively and re-actively and make it successful would appear to be a fit. This shifted risk profile would therefore be a reasonable starting point for most healthcare technology projects. Based on the particular characteristics of the technology and the capabilities of the staff, it could be shifted toward a more mechanistic approach if the low complexity of the technology and surrounding processes could be confirmed. Given the high variability nature of healthcare, this shift should be taken carefully and only after careful analysis of the environment and capabilities of the staff.

Summary of Findings to Address Propositions from Introduction

In this section we look at insights that were gained through identification of common threads or characteristics and relate these to the statements and propositions in the introductory chapter.

Propositions

The following sections review unifying propositions and provide findings.

Developing People

A lean approach focuses on developing people and solving problems. This focus on developing people enables continuous improvement and integration with the process and technology components.

Finding: A common finding of the main content chapters was the critical importance of investing in and developing people within an organization, which is consistent with lean philosophy (the central pillar of the Toyota house) [36]. In each of the three primary chapters, organizational errors or missteps could be corrected by staff members who were properly developed and supported. This development of people manifested its power at the individual, project, and organizational levels.

Technology & Knowledge

Proposition: **Healthcare technology and knowledge will continue to advance rapidly. Organizations that learn how to make productive use of technology will benefit from these advances, while organizations that do not find an effective approach to using technology will find technology to have limited or negative impact.**

Finding: In the knowledge management and technology chapters, the most common approach was mechanistic and one-size-fits-all, without integrating the social considerations of the organizations. This mechanistic perspective of organizational function did not typically lead to integration or success of the evidence-based best practices or technology that the organizations were trying to deploy. When the organizations took a more organic (dynamic and flexible) lean approach to the deployment and integration, they were able to address their previous missteps and make the best practice or technology work.

Both of these chapters present many examples of seemingly good best practices or technology that did not work. However, with properly trained and empowered staff, the cases showed significant project successes. Therefore, good technology or best practices were necessary but not sufficient for success. Given the complexity and people-based nature of healthcare, the development of people was essential for the integration of these organizational components. When organizations focused on developing the tacit PDCA problem solving knowledge of their staff, the gap decreased between increasing knowledge or technological capabilities and what was realized in organizations. Without the focus on

developing people, the gap between capabilities and realized performance manifested itself in investments in technology or training that did not provide organizational benefit (or that decreased organizational performance).

Variability

Proposition: **The capability of lean tools and methods to deal with variability will prove effective in a healthcare context, which is above average in variability.**

Finding: Healthcare organizations demonstrate a higher overall level of variability than many other industries, which is likely a result of the wide variability in patient conditions, training and education of staff, and a variety of historical factors. This higher level of variability appeared to result in a strong bias toward an organic approach being an organization fit. This high level of variability would suggest a need to focus efforts on establishing a foundation of operational stability, which is a fundamental enabler of a lean approach. Once the foundation of a healthcare organization has been solidified to the point that variability is at a manageable level, then the variety of different approaches suggested by contingency theory could be deployed on appropriate projects and achieving success while doing so. For most healthcare processes and organizations with such a high degree of variability, using a simple mechanistic approach will cause challenges for improvement and sustainability.

Struggles with Broad Acceptance

Proposition: **Lean process improvement requires discipline, long-term thinking, and a significant cultural shift that only a subset of organizations will achieve. These requirements were proven in the manufacturing industry and will likely be repeated in the healthcare industry.**

Finding: For the organizations in these chapters, significant struggles occurred with both the tactical (front-line staff) and strategic (leadership) aspects of transitioning to a lean approach. In addition to the transition of approach from coercive to enabling, the requisite characteristics of process discipline and problem-solving capabilities were also proving challenging. High staff and physician turnover was a near-universal challenge with sustained organizational change. Despite these struggles, when organizations had strong and

committed senior leadership, as well as champions piloting and spreading projects through the organizations, incremental progress was maintained. These change-management challenges are not unique to healthcare, and they generally inhibit broad and sweeping acceptance of lean. Therefore, these struggles with change and acceptance are likely to persist in healthcare. Specific hospitals or systems that commit to a long-term perspective and invest in developing their staff will achieve substantial improvements in financial viability and patient care.

Cross-chapter Findings

Given the significant role of technology in driving increasing healthcare costs and constrained impact that these investments are having, finding a different approach to selecting and deploying technology is critical. A similar situation was found for bringing evidence-based best practices into daily use at the patient's bedside, with a growing divide between capabilities and what is being realized. The cases in both the technology and knowledge management chapters illustrated how a lean approach of developing and engaging front-line staff and leadership in the integration process was significantly more successful than the more common coercive approaches. Therefore, it would seem reasonable to shift a significant portion of the resources that are currently being spent on technology and best-practice research into developing staff and leaders to become better problem solvers. If one makes the reasonable assumption that new technology has greater inherent capabilities than current technologies, then the greater capabilities could be realized if an effective approach to their adoption is used. The technology chapter demonstrated the ability of staff to make new technology work if a PDCA approach was taken to integrating the technology (and more importantly developing the staff in becoming better PDCA problem solvers). Therefore, the greater potential of modern technology can be realized if an enabling PDCA approach is followed. Without this approach, the greater capabilities of modern technology are unlikely to be realized (and thus increase costs and complexity).

Integrating a hoshin kanri planning approach would further leverage these investments further and help align organizational efforts and address foundational issues. Investments in developing people would enable future investments in technology and implementing evidence based best-practices, as a well as local process improvement. While the use of

lean in these applications demonstrated the potential significance, the organizational challenges (such as organizational discipline, long-term thinking, and foundational stability) to make and sustain these improvements were also clear.

A common aspect of the three primary chapters was the critical role of engaged and supportive leadership. The enabling approaches necessary for successful integration of a hoshin initiative, evidence-based best-practice, or technology all required engaged and supportive leadership. This was clearly demonstrated in Chapter 2 (People) that discussed using hoshin in an immature lean organization. Engaged and supportive leadership were essentially foundational requirements for the lean projects.

Both the knowledge management and technology chapters argued for a contingency approach, which states that the approach must be a fit for the context. The almost universal finding of needing to invest significantly in staff and leadership development focused on an organic lean problem-solving (PDCA) approach would suggest a one-size-fits-all approach, which is contrary to a contingency perspective. On deeper reflection, however, this seeming contradiction is not a contradiction at all, but rather a fit with the dominant environment of healthcare. I

n the technology chapter, the risks of an overly organic or overly mechanistic approach needed to be adjusted for the higher variability environment of healthcare, where an organic approach is more effective for most applications. The knowledge management chapter supported this perspective as well, since the highly dynamic and variable healthcare environment required a highly flexible (organic PDCA) approach for organizations to figure out how to integrate externally generated knowledge and integrated it with their systems. Compounding the fundamentally high variability nature of healthcare is the prevalence the foundational issues, which were illustrated in the hoshin chapter. Therefore, between the high variability nature of healthcare and the foundational issues (such as lack of standard work practices and variable workload), there is a strong fit between an organic PDCA approach and the current state of healthcare. Conversely, there is a fundamental mismatch between the dominant mechanistic approach and the current state of healthcare, with this mismatch driving the growing crisis and inability to adapt to the fundamental challenges that are facing the industry.

The need to experiment was clearly demonstrated in all three of the primary chapters, including the revelatory hoshin case. With the high complexity and variability inherent with a dynamic social system interacting with a highly interconnected and complicated technical system in a modern hospital [227], the uncertainty of outcomes and the associated need to experiment was demonstrated (that is, outcomes could not be readily predicted). Without experimentation and developing the tacit PDCA problem solving knowledge (illustrated in Chapter 2, People), the requisite integration is not likely to be achieved and to result in partial-implementation or a system that is full of "work-arounds."

Figure 5-6 summarizes the key insights from each of the primary chapters, and provides a high-level perspective on how to integrate people, process, and technology in lean healthcare. Figure 5-6 illustrates the integrated nature of people, processes, and technology, as each of them enables the others and all three are required to begin a successful lean transformation in healthcare.
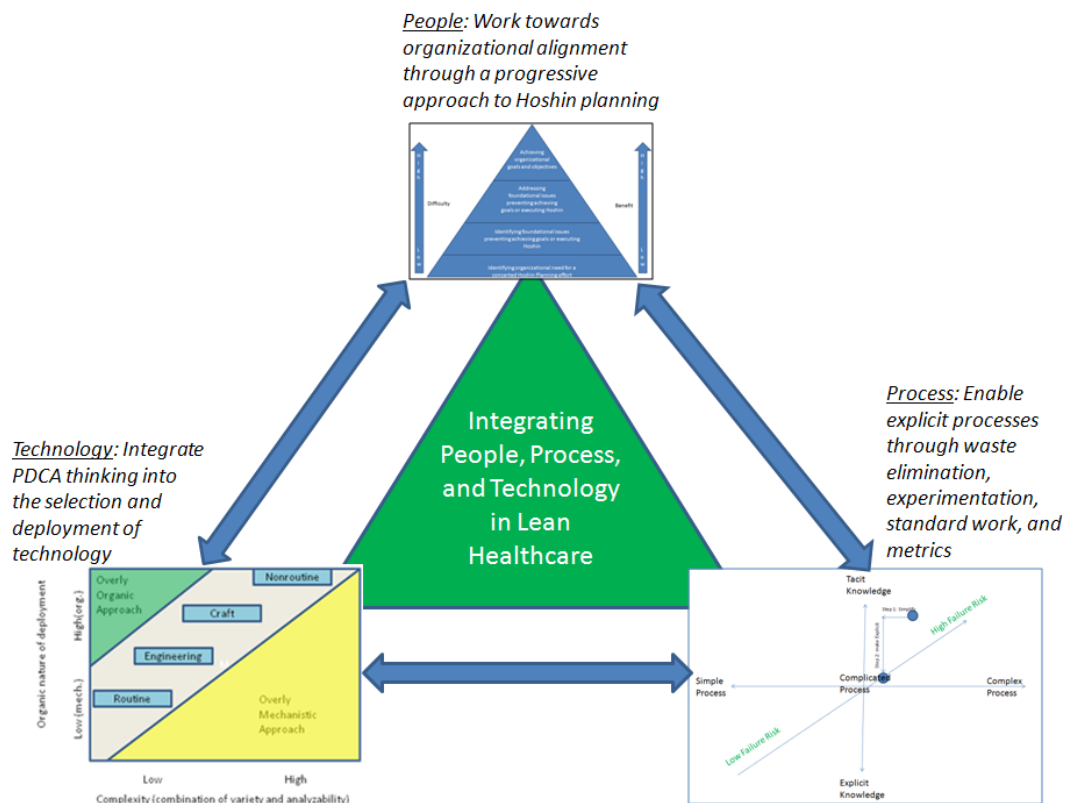

Figure 5-6:   **Integrated model for integrating People, Process, and Technology in Lean Healthcare**

Future Research Topics

Throughout this dissertation, numerous illustrations of the potential impact of lean in a healthcare context were explored. Each of the successes required thoughtful analysis, PDCA problem solving, and reflection on both successes and failures. Therefore, no "silver bullet" approach was found for applying lean in a mechanistic way to all situations. This dissertation targeted three of the largest areas of opportunity for the broad application of lean principles in a healthcare context.

With the healthcare industry being expansive and complicated, a variety of areas offer prime opportunities for leveraging a lean approach to improve quality, safety, and delivery in healthcare. Specific topics of future research are detailed below.

Lean Emergency Preparedness

Emergency preparedness deals with rapid, cross-organization and cross-departmental reaction to catastrophic events. The potential of lean principles of disciplined problem solving, standard work, and process discipline would appear to be critical for successful emergency preparedness. In the knowledge management chapter, the highest level of complexity was "chaos," with little understanding of cause-and-effect relationships according to the Cynefin scale [141, 142]. This type of system complexity was out of the scope for this analysis in the knowledge management chapter, but it would represent an integral part of using lean in emergency preparedness. Toyota has demonstrated the ability to respond rapidly after emergencies. For example, even in the lingering context of the great recession, after the 2011 tsunami in Japan and the worst flooding in Thailand's history severely disrupted production, they were able to recover within months. They recognized new opportunities to reduce the vulnerability to similar catastrophic disasters. With hospitals representing the "front-line" response to a variety of disasters from natural disasters to bio-terrorism, this sort of responses would be significantly improved with a lean approach.

Integrating Lean in Healthcare Professional Education

Many medical education programs are beginning to require process improvement as part of their curriculum. These requirements include both classroom training as well as participation in projects. Researching approaches that combine standardization with

effective models of master–apprentice learning would be significant, as it would facilitate a common set of concepts and approaches for continuous improvement for new healthcare providers.

In addition to a direct focus on continuous improvement to prepare practitioners for their upcoming careers, cross-institutional collaboration on directly applying these approaches to shared processes would be significant (such as separate hospitals that had rotations of the same students). The knowledge management chapter discussed how to bring evidence-based, best-practice medicine to the patient's bedside, but this was essentially a countermeasure resulted in (at least partially) from the high level of variability in medical education coming out of different institutions. If the process of medical education programs found collaborative approaches to identifying and teaching evidence-based, best-practice care, then a higher level of consistency of medical practice would result from these programs.

If medical education programs provided a consistent curriculum of lean, continuous-improvement education as well as consistent and dynamic education of evidence-based medical practice, this consistency would be a significant advancement for improving the long-term viability of the industry and improving patient care. With medical practitioners at hospitals coming from a wide variety of different medical education programs, this consistent background would improve the operational stability of hospitals.

Extending Lean beyond a Single Hospital: Community-based Integrated Healthcare Delivery

The Pittsburg Regional Healthcare Initiative [55, 56, 58, 59] demonstrated the power of integrating improvement efforts beyond a single hospital, but this example was focused on a single process. With most hospitals competing with each other, disincentives to collaboration are common. These can result in risks to delivering patient care and realizing efficiencies. The lack of collaboration can lead to over-building and over-purchasing of capacity, which proves detrimental to all hospitals and healthcare facilities in the area. With patients transferring between different hospitals, breakdowns in information sharing or common practices can lead to infection control risks or wasteful processes. Lean philosophy would suggest benefits to extending the value stream to other partners and suppliers, and

these benefits can prove profit all of the organizations. With the entire country facing a significant shift in payer systems and individual's ability to pay for their care, novel approaches to gaining efficiencies and improvements in care (such as extending the value stream beyond a single hospital) would seem to have significant potential. Support for this perspective has been demonstrated with the establishment of systems for accountable care organizations (ACOs) [228]. Hospital systems have tried to achieve this integration through direct acquisitions instead of collaborations, and many of them have not realized the efficiencies that they expected. Therefore, a more disciplined approach is needed to achieve this integration. The lean approach to working with partners and suppliers would have significant potential relevance.

Error-proofing in Healthcare: An Alternative Approach to Addressing Sentinel Events

One of the significant barriers to improving patient safety is the lack of a safety culture where staff members are encouraged and feel safe to report sentinel events and near misses. Staff members often feel that they will be looked at negatively for reporting these events, will have to spend a significant amount of time just to report the incident. In addition the primary outcome from the Failure Modes and Effects Analysis (FMEA)/Root Cause Analysis often adds significant workload to the patient chart in terms of checklists or other administrative requirements. Evidence suggests that many administrative measures are reactionary and have limited impact on underlying issues. Lean suggests that it is difficult to make improvements if problems are not made visible so that they can be solved. Therefore, there appears to be a need for both a cultural shift to enabling reporting of near misses and sentinel events as well as a more effective mechanism for addressing issues that arise to improve patient safety. A shift to a lean culture, where not detecting a problem would be a problem (that is, "'no problem' is a problem") would address the first issue, but this shift is not trivial. A cross-case analysis of Toyota and the Veterans Affairs hospital system would provide insights into this transition.

A second aspect of the shift to a safety culture, and an aspect that addresses the latent areas of patient safety risk in a more effective manner that does not add workload, is in the second part of this analysis. The lean tool of error proofing/built in quality would be a

powerful approach to addressing the process issues as it has the potential to prevent lapses of decision making or errors more effectively than do administrative controls.

Lean Healthcare Facility Design: Creating a Fully Integrated Value Stream of Hospital Design

When lean healthcare facilitators conduct an event or work with staff to study the layout of a facility, it often becomes clear that the design of the facility is not conducive to flow or flexibly changing layout. In existing facilities, potential changes to the facility are limited and expensive (and therefore rarely undertaken). Therefore, when a new healthcare facility is being designed, it represents a significant opportunity to design the building to facilitate flow and ongoing problem solving (re-configurable, open-office design, etc.) during the 50- to even 100-year lifespan of the building. Unfortunately, the standard architectural design process does not facilitate the high level of staff engagement and greatly improved flow and efficiency that a lean approach does. In the technology chapter, case studies illustrated the potential impact of this approach. Efforts to use lean in hospital facility design are in their infancy, and they would benefit significantly from an in-depth, contingency-theory based approach that is closely integrated with the architectural design process. In-depth case studies of a wide variety of lean and non-lean healthcare facility design initiatives, as well as different approaches to lean facility design, would help advance the field of lean facility design. This would be a significant advance for the healthcare industry, and the lifecycle savings for hospitals using this approach would meet or exceed those of the cases described in this dissertation. If this approach was used nation-wide, then the aggregate impact would be significant.

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