

# Large System Transformation within Healthcare Organizations utilizing Lean Deployment Strategies

by

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## **Abstract**

Multiple U.S. healthcare organizations have been recognized as successful in enterprise-level transformation to create healthcare delivery systems that are safe, effective, patient-centered, timely, efficient and equitable. Many of these organizations have specifically cited the development, deployment and integration of enterprise-level deployment of Lean Management Systems as key to their transformational efforts. Given the intense national interest in improving quality, efficiency and efficacy of healthcare delivery systems, a greater understanding of the strategies utilized by these organizations was required in order to provide an understanding of the mechanisms that drive successful, sustained, enterprise-level transformation.

We conducted a realist review of large system transformation utilizing enterprise-level Lean Deployment methods within healthcare organizations. Synthesis and analysis of the results from this review indicate that there are five primary strategies associated with successful healthcare-based Lean deployments: Respect for People; Strategic Alignment; Strategic Deployment; Large Scale System Improvement Efforts; and Small-Scale, Local Improvement Efforts. Additional findings from this review indicate that the applications of the specific mechanisms with these strategies are emergent within multiple transitional phases spanning 6-8 years. To supplement the findings from the realist review, a series of dynamic hypotheses and system dynamics model was created in order to explore how the mechanisms and context interact to drive phase transitions within healthcare-based enterprise-level Lean deployments. The results from this model indicate that no steady state initial conditions exist that support sustained enterprise-level transformation and that the emergent nature of these deployments is necessary to overcome constraints related to the organizational capacity and capability. Additionally, we investigate the design and deployment of enterprise-level Lean programs in order to increase rate of success and decrease deployment cycles.

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# Dissertation Introduction

## Introduction

The U.S. healthcare system experiences wide variations in practice, unacceptably high rates of medical errors, major gaps between evidence and practice, suboptimal quality and relatively low operating efficiency. The impact of this is high - estimates indicate that over 100,000 patients are killed and over 5 million patients seriously injured annually by avoidable medical errors. The US spends more per capita for healthcare than any other country in the developed world (Kane, 2012). In its landmark report, “Crossing the Quality Chasm: A New Health System for the 21st Century” (Committee on Quality of Health Care in America, 2001), the Institute of Medicine (IOM) provided a framework for the development of an improved healthcare delivery system in the U.S. This framework was based on providing healthcare services that are safe, effective, patient-centered, timely, efficient and equitable.

In the 13+ years since the IOM report, the enterprise-level deployment of the U.S. translation of the Toyota Production System – widely known as *Lean Enterprise Transformation*- has been promoted to transform healthcare organizations to improve delivery of healthcare services (Toussaint, 2013) (Johnson, 2012) (Graban & Swartz, 2013) (IHI, 2005). Much of this movement is a direct result of the success of Lean Transformation efforts within manufacturing companies (Toyota, Ford, Dell) and the highly publicized application of these methods within key healthcare organizations (Theadacare, Virginia Mason, Denver Health). However, the implementation of Lean enterprise methods within healthcare systems often fails to result in long term, sustained organizational transformation. Several studies, including Radnor (2012) and Mazzacato et al (2010), have described failed healthcare-based Lean deployments due to a focus only on the isolated implementation of Lean tools and methods with little or no emphasis on the cultural transformation necessary to sustain results over time. While comprehensive Lean Enterprise Deployments frameworks that include cultural transformation do exist within the manufacturing literature (Nightingale, 2009) (Koenigsaecker, 2013), distinct differences in healthcare organizations may limit the direct translation of strategies, impacting program sustainability as well as diffusion and dissemination throughout healthcare systems (Radnor, Holweg, & Waring, 2012).

In consideration of these challenges, it becomes clear that the large-scale deployment of Lean enterprise strategies requires the translation of the existing deployment evidence base into models that are *healthcare-based* as well as facilitate understanding and testing of successful deployment strategies.

The overarching objective of this research is to develop and test a framework by which systems approaches are applied in order to facilitate translation of the evidence for healthcare-based enterprise-level Lean Deployment strategies into management practice. This will be done through identifying specific strategies utilized as part of Lean Enterprise Deployment, understanding how those strategies interact to insure successful, sustained transformation efforts and investigating how current Lean Enterprise deployment strategies can be improved to improve success rates and reduce deployment timelines. The scope of this work is limited to the development, initial application and testing of deployment strategies utilizing systems approaches.

The motivation for this work comes from my current role as the Chief of Systems Redesign at the Roudebush VA Medical Center and the Director for the VA Center for Applied Systems Engineering as well as my prior position as an Assistant Professor of Industrial Engineering Technology at the School of Engineering and Technology at Purdue. Within these roles, I have witnessed multiple healthcare organizations struggle and fail to deploy and sustain Lean programs. In fact, it seems that failure is much more likely than success, as estimates for successful Lean Enterprise Transformations within healthcare come in at ~10% (American Society for Quality, 2009). And yet – there are healthcare organizations that have been successful in Lean Enterprise Transformations. My experiences with these failed organizations led me to question - “Why isn’t the evidence from these successful organizations (i.e. what works, for whom and under what conditions)....being better utilized in order to facilitate success in other organizations?”

The introduction to this thesis is organized in order to present an overview of the research approach and results as well as to clearly articulate the contributions of this work. We will begin by providing an overview of the overarching framework that was developed and used in application of systems approaches to develop and translate the evidence base into management practice. We will then briefly discuss the analysis and results from the research work as well as the contributions of this work to the areas of Lean Management, Evidence Based Management and Health Services Research. Finally, we will describe the overall organization and structure of the dissertation.

## **Methods**

The research discipline that best frames this translation of the research evidence base into management practice is known as *Evidence Based Management (EBMgt)*. EBMgt is based on the clinical Evidence Based Practice (EBP) movement first initiated in the 1990s to support translation of clinical evidence into

medical practice (Walshe, 2001), and, as a result, is well suited for application within healthcare management. Multiple frameworks exist that describe the requirements for translation of the research evidence base into actionable management decisions, including those outlined by Pfeffier & Sutton (2006), Bowen & Zwi (2005) and Walshe & Rundall (2001). These requirements include the sourcing and building of the evidence base from the management literature in a manner that is reproducible and transparent, application of the methods and strategies supported by the evidence within a context that allows for testing, experimentation and eventual adaptation in consideration of the organizational context and intentional integration of the revised strategies into future decision making.

As outlined by Shortell (2007) and Briner et al. (2009), the primary challenge of successfully integrating EBMgt into everyday management practice is the lack of relevant approaches that can be applied in order to navigate these requirements with the precision required to create technically valid, relevant body of work, capable of wide dissemination. For example, all EBMgt frameworks require the sourcing and building of the evidence base in a manner that is rigorous enough to withstand a high order of scrutiny. However, traditional Conchrane-style systematic review techniques entail a level of rigor with respect to the exclusive use of peer-reviewed literature that we knew would not be possible within the popular management literature related to Lean Implementation. In response to these limitations, we identified more flexible, yet still well-respected approaches to literature review, and tested those within the context of the available literature. This led us to understand that the Realist Review techniques outlined by Pawson & Tilley (1997), coupled with traditional thematic analysis methods, would meet our needs for flexibility, while still allowing for enough academic rigor to meet the requirements for reproducibility and transparency.

Why use systems approaches within a framework for translation of the evidence base into management practice? Systems approaches are often cited as integrating both the “analytic and the synthetic method, encompassing both holism and reductionism” (Heylighen, 1998). Utilizing these approaches, the constituent parts of a system can be studied within the context of interactions with each other and with other systems, rather than independently or in isolation, significantly increasing the potential relevance of the translation. Systems approaches, such as System Dynamics modeling, are often recommended to supplement mental models for organizational operations and have been previously utilized to inform strategic and policy considerations (Ghaffarzadegan, Lyneis, & Richardson, 2011) and have previously been used to model quality improvement programs within manufacturing organizations (Keating, Oliva, Repenning, Rockart, & Sterman, 1999). We chose the systems approaches of dynamic

hypotheses and system dynamics modeling specifically as these approaches allow for a collaborative approach to development of theoretical dynamic hypotheses, the translation of theoretical evidence into key operational parameters and the testing, experimentation and adaptation of deployment approaches in order to assess how management decisions impact on deployment diffusion and sustainability. Additionally, interactive system dynamics models have been recommended as effective dissemination mechanisms for complex strategic and policy considerations (Best & Holmes, 2010).

A primary challenge in this research was the translation of the evidence base from the operational evidence noted within the literature, into general mechanisms that could be compared, contrasted and synthesized into high level strategies and then the translation of these strategies into key operational parameters and systems structure necessary for the development of the system dynamics model. This challenge was overcome through the use of an expert panel to create dynamic hypotheses to catalog the relationships and interactions between strategy components. These dynamic hypotheses were then used to inform the key operational parameters and systems structure for the system dynamics model building.

Our adapted EBMgt framework, integrating the realist review and the systems approaches as well as incorporating this cross-level translation (operational evidence → high-level theoretical constructs → mid-level theoretical construct → key operational parameters and system structure) is outlined below:

1. **Extraction of Operational Evidence:** Realist review and thematic coding techniques were used to extract key operational evidence noted within prior successful healthcare-based enterprise-level Lean deployments.
2. **Synthesis into High-level Theoretical Construct:** Cross-case analysis methods were used to compare, contrast and synthesize the evidence base from the Realist Review into high level deployment strategies and primary outcomes
3. **Development of Mid-level Theoretical Construct:** Translation of the synthesized evidence base into mid-level theoretical dynamic hypotheses was conducted by an expert panel.
4. **Translation into Operational Model:** The key parameters and model structure from the theoretical dynamic hypotheses were translated into an interactive System Dynamics model to enable evaluation of deployment strategies, development of an understanding of deployment strategy constraints, and recommendations for improved deployment strategies.

An overview of this approach is shown in Table 1.

Table 1. Outline of Adapted EBMgt Framework

<b>Enterprise Transformation Integrative Models</b>		
<b>Model Types</b>	<b>References</b>	<b>Transformational Strategies</b>
<b>General Enterprise Transformation Models</b>	<b>Kotter "Leading Change" (1995)</b>	<ul style="list-style-type: none"> <li>- Establishing a Sense of Urgency</li> <li>- Form a Powerful Guiding Coalition</li> <li>- Create a Vision</li> <li>- Communicate the Vision</li> <li>- Empowering Others to Act on the Vision</li> <li>- Planning for and Creating Short-Term Wins</li> <li>- Consolidating Improvements and Producing Still More Change</li> <li>- Institutionalizing New Approaches</li> </ul>
	<b>Kotnour "Emerging Theory of Enterprise Transformations" (2011)</b>	<ul style="list-style-type: none"> <li>- Leadership Driven</li> <li>- Strategy Driven</li> <li>- Project Managed</li> <li>- Continuous Learning</li> <li>- Systematic Change Process</li> </ul>
<b>Lean Specific Enterprise Transformation Models</b>	<b>Nightingale "Principles of Enterprise Systems" (2007)</b>	<ul style="list-style-type: none"> <li>- Adopt a Holistic Approach</li> <li>- Identify Value Propositions for Relevant Stakeholders</li> <li>- Focus on Effectiveness before Efficiency</li> <li>- Address Internal and External interdependencies</li> <li>- Ensure Stability and Flow</li> <li>- Cultivate Leadership to Support and Drive Behaviors</li> <li>- Emphasize Organizational Learning</li> </ul>
	<b>Koenigsaecker, "Leading the Lean Enterprise Transformation" (2013)</b>	<ul style="list-style-type: none"> <li>- Serve the Customer</li> <li>- Seek What's Right, Regardless</li> <li>- Decide Carefully, Implement Quickly</li> <li>- Candidly Admit Imperfections</li> <li>- Speak Honestly and with Deep Respect</li> <li>- Go, See and Listen to Learn</li> <li>- Deliver on Meaningful Challenges</li> <li>- Be a Mentor and a Role Model</li> </ul>
<b>Healthcare Specific Enterprise Transformation Models</b>	<b>Lukas/Charns Organizational Model for Transformational Change (2007)</b>	<ul style="list-style-type: none"> <li>- Sense of Urgency</li> <li>- Leadership Drives and Facilitates Change</li> <li>- Improvement Initiatives Engage Multi-disciplinary Staff in Meaningful Improvement</li> <li>- Organizational Alignment</li> <li>- Organizational Integration</li> </ul>
	<b>Best/Greenhalgh Transformation "Simple Rules" (2012)</b>	<ul style="list-style-type: none"> <li>- Engage individuals at all levels in leading the change efforts</li> <li>- Establish Feedback Loops</li> <li>- Attend to History</li> <li>- Engage Physicians</li> <li>- Involve patients and families</li> </ul>

## **Analysis/Results:**

### **1. Extraction of Operational Evidence**

The vast array of peer-reviewed and grey literature with a primary topic of healthcare-based Lean deployment was iteratively reviewed in order to identify organizations that had utilized Lean Enterprise Transformation approaches and met the Best/Greenhalgh definition for healthcare-based Large System Transformation (LST) - "...coordinated, system-wide change affecting multiple organizations and care providers, with the goals of significant improvements in the efficiency of healthcare delivery, quality of patient care and population-level patient outcomes...". A secondary review was conducted to insure that ample evidence was presented within the selected literature to inform a comprehensive synthesis.

As a result of these reviews, six healthcare organizations were selected for inclusion in this review: 1) Virginia Mason Healthcare System, 2) Denver Health System, 3) Seattle Children's Healthcare System, 4) New York Health and Hospital System, 5) Thedacare and 6) University of Michigan Healthcare System. Realist review (Pawson & Tilley, 1997) and thematic coding techniques (Thomas & Harden, 2008) were then used to extract key operational evidence from peer-reviewed and grey literature sourced from the included organizations.

### **2. Synthesis into High-level Theoretical Construct**

Cross-case analysis methods were used to compare, contrast and synthesize the evidence base from the Realist Review into high level deployment strategies and primary outcomes. This evidence was then aligned with Lean deployment strategies in order to identify common themes. In all, although specific mechanisms varied from organization to organization, five deployment strategies were identified as being utilized within all organizations that had been successful in Lean Enterprise Transformation: 1) Respect for People, 2) Strategic Alignment of transformation efforts, 3) Large-Scale, system-level improvement, 4) Small-Scale, unit-level improvement efforts and 5) Lean Management System (also known as Strategic Deployment). This analysis led to the development of the initial high-level theoretical construct (initial hypothesis) for enterprise-level Lean Deployment.

A dynamic cross-case analysis was conducted by aligning the mechanisms and strategies utilized within each of the organizations with respect to emergence within the Lean deployment timeline. This analysis showed that all organizations studied exhibited transitional phases within their deployment

timelines. These transitional phases were similar across these organizations and were triggered by Executive Management identification and eventual resolution of significant gaps in program outcomes.

- **Phase 1 (typically Year 1-2)** – Organizational focus on creating "pockets" of Lean implementation in early adopter areas of the organizations. The program gap that drives the next deployment phase originates from lack of impact to primary organizational goals.
- **Phase II (typically Years 2-6) – Strategic Alignment:** Organizational focus on integration of Lean into clinical and operational practices within the organization. The program gap that drives the next deployment phase is poor sustainability and diffusion of initiatives.
- **Phase III (typically Years 6+) - Strategic Deployment:** Organizational focus on integration of Lean into management practices within the organization (Lean Management System).

This analysis led to the development of a modified high-level theoretical construct (revised hypothesis) for enterprise-level Lean Deployment. Within this theoretical construct, a sixth deployment strategy was identified as being the key driver for the success of the Lean Enterprise Transformation program—the creation of organization engagement for the transformation efforts – or “pull”. The dynamic cross-case analysis identified that the *emergent* deployment strategies utilized by these organizations were necessary in order to consistently maintain organizational engagement (“pull”) at the highest level.

### **3. Development of Mid-level Theoretical Construct**

The cross-case analysis and the high-level theoretical construct (revised hypothesis) were each reviewed by an expert panel. This panel consisted of two healthcare administrators that had significant prior experience in Lean Enterprise Transformation within large, multi-system healthcare organizations, two healthcare consultants with extensive experience in advising large healthcare systems in Lean Enterprise Transformation, including one consultant with direct experience in two of the hospitals included within the realist review and one health services researcher with expertise and on-going research in the evaluation of healthcare transformational models.

This expert panel was then tasked with identifying key reference modes related to enterprise-level Lean Deployment initiatives as well as to map the five deployment strategies to the goal of creating “pull” for the transformational initiative within the organization. Feedback from this group was utilized to map relationships between key strategies/mechanisms and contextual elements as well as to identify potential endogenous vs. exogenous elements.

The results from this effort were mapped to the Reference Modes, Model Boundaries/Sub-System Diagram, and eventually the Dynamic Hypotheses presented in the subsequent chapters. These dynamic hypotheses were critical as they provided the mid-level translation of the higher-order constructs. This mid-level translation assisted our team in “bridging the gap” between the higher-level theoretical constructs and an operational model for enterprise-level Lean deployment that could be disseminated and used in the field.

#### **4. Translation into Operational Model**

The next step in this process was to translate the key parameters and model structure from the mid-level theoretical dynamic hypotheses into an interactive, operations-based System Dynamics model. The overall objective for this model was to utilize a minimalistic approach to incorporate only the key operational parameters and model structure, while still allowing for the endogenous derivation of factors linked to critical deployment strategies, such as leadership capability and staff capacity.

Additionally, we envisioned an interactive user interface that would support sensitivity analysis for exogenous variables, such as the initial level of facilitator capacity and the ratio of small-scale vs large-scale Lean projects. This would enable real-time testing and evaluation of deployment strategies, and assist in development of an understanding of deployment strategy constraints as well as recommendations for optimized deployment strategies.

The final model is shown in Appendix B. The model consists of six primary process frames mapped to each of the dynamic hypotheses. Each process frame contains stocks, flows and parameters that represent the operational translation of the dynamic hypothesis into key parameters and model structure. Exogenous variables were either derived from the evidence base identified in the realist review or estimated by the expert panel.



The SD model sensitivity analysis conducted using the System Dynamics model clearly supports the importance of dynamic deployment strategies in creating successful, sustained enterprise-wide Lean programs. In contrast to the popular perception by many healthcare executives, the results from this analysis indicate that initial conditions do not exist that would create sustained program results, even at very high staff and facilitator resource levels and with well-balanced initiative portfolios.

Furthermore, the transformational phases identified during the dynamic cross-case analysis are confirmed to be the emergent responses of highly experienced leadership teams attempting to mitigate/eliminate identified gaps within their Lean transformation program performance. Hence, the applications of these strategies would require a highly skilled, engaged and informed leadership team with a clear line of sight to program performance throughout the organization.

One concern highlighted from the findings from this is that the majority of leadership teams may not have the experience necessary to effectively navigate these transitional phases. An additional concern is whether compressing the deployment timeline is possible if leadership development/expertise is a primary constraint.

Potential options for overcoming this barrier include creating a roadmap for Lean deployment that integrates the transitional phases and dynamic nature of these deployments without overwhelming the less experienced leadership teams, as well as exploring/developing alternative deployment strategies that do not rely on leadership as the primary control. Additionally, it is our hope that through developing the operations-based SD model, we would be able to use this model to train healthcare leadership teams to think in a more strategic way about dynamic deployment approaches for Lean Enterprise Transformation.

## Contributions:

This research presents a body of work that describes an innovative framework for extracting, synthesizing and operationalizing the evidence base related to successful Lean Enterprise Transformation efforts within healthcare organizations. The focus of this work has been to critically review and synthesize the mechanisms that successful healthcare organizations have utilized with their Lean Enterprise Transformation programs, link these mechanisms to specific deployment strategies and utilizing dynamic cross-case analysis techniques, develop high-level theoretical hypotheses describing the dynamic nature of these deployment strategies. We then utilized systems approaches to translate the high-level theoretical hypotheses into mid-level dynamic hypotheses and an operations-based System Dynamics model. These efforts have resulted in a level of understanding of the key limitations and constraints for Lean Enterprise Transformation deployment methods that both align with and directly contrast current thinking for healthcare-based Lean Enterprise Transformation frameworks. For example, while current Lean deployment frameworks indicate requirements for initial program setup to enable long-standing, sustained transformational efforts, our work has clearly indicated that no initial conditions exist that would provide this outcome. Additionally, although leadership support and engagement is found to be a primary constraint (in support of prior work); our work has shown that role of leadership is the *continuous facilitation of a dynamic process of transformation*. The primary contributions from this work can be aligned within the disciplines of Evidence Based Management, Health Services Research and Lean Management.

The primary contribution to the body of research supporting *Evidence Based Management* is the integration of realist review and systems approaches, such as dynamic hypotheses building and system dynamics modeling, within evidence based management framework. This work is the first, to our knowledge, to explicitly integrate these strategies in such a way as to maintain the academic rigor necessary to support the validity of the literature review, while linking the information provided from that review to a systems-based interactive model in order to facilitate dissemination and application of the review findings directly into management practice.

The primary contribution to *Health Services Research* is the application of realist review and dynamic cross-case analysis to synthesize healthcare-based enterprise-level management strategies. To our knowledge, we are the first to apply realist review to an evaluation of enterprise-level healthcare management strategies as well as the first to utilize this approach to inform the creation of mid-level theory-based dynamic hypotheses.

Within *Lean Management* research, the primary contribution of this work is the synthesis of the operational evidence supporting successful healthcare-based Lean Enterprise Transformation to high level deployment strategies, mid-level theoretical dynamic hypotheses and key parameters and systems structure. This synthesis and translation has provided the first objective articulation of the dynamic nature of healthcare-based Lean Transformation efforts as well as the emergent transitional phases present within these efforts. Additionally, this work is the initial application of system dynamics to create healthcare- based operational model to develop and test the limitations and constraints of enterprise level Lean deployment strategies. Follow-on work would include the use of the interactive systems dynamic model to inform strategic thinking about enterprise-level Lean deployments within healthcare organizations.

## **Dissertation Structure**

This dissertation is divided into three chapters – each with focus on a specific set of research questions related to the application of systems approaches to build the evidence base necessary in order to understand and refine Lean Deployment strategies within healthcare.

**Chapter 1: Lean Healthcare Enterprise Deployment - A Realist Review** Realist review techniques are utilized to compare and contrast the context, mechanisms and outcomes related to successful enterprise-level Lean deployment in order to better understand the role and interaction of transformational strategies. Additionally, this chapter seeks to identify what transformational phases exist, if any, within enterprise-level Lean deployments.

**Chapter 2: Creating Organizational Pull for Transformational Programs utilizing Lean Deployment Strategies** The focus of this chapter is the development and analysis of mid-level theoretical constructs

utilizing dynamic hypotheses in an effort to improve the understanding related to the interaction of strategies and mechanisms to drive organizational “pull” within healthcare-based enterprise-level Lean deployments.

**Chapter 3: Improving Lean Healthcare Enterprise Transformation Deployment Programs utilizing System Dynamics Modeling** Within this chapter, an operational System Dynamics model is developed and utilized in order to explore the dynamics of healthcare-based, enterprise-level Lean deployment programs to increase transformational program outcomes and decrease deployment cycle timelines.

# **Chapter 1:**

## **Lean Healthcare Enterprise Deployment: A Realist Review**

## **Background/Introduction**

Multiple U.S. healthcare organizations have been recognized as successful in enterprise-level transformation to support improved healthcare delivery. Many of these organizations have specifically cited the development, deployment and integration of enterprise-level Lean Management Systems (Toussaint & Gerard, 2010) (Gabow & Mehler, 2011) (Kenney, 2011) as key to their transformational efforts. Given the intense national interest in improving quality, efficiency and efficacy of healthcare delivery systems, a formal review of the strategies utilized by these organizations can provide important information needed to understand the mechanisms that drive successful, sustained, enterprise-level transformation.

Lean is the term utilized to describe the translation of the Toyota Production System (TPS) into U.S. industries. The basic tenet of Lean is a singular focus on creating value to the customer through identifying and removing waste within processes and systems. Lean methods and tools have been used extensively throughout U.S. manufacturing industries. In comparison, translation of Lean/TPS into healthcare delivery systems is relatively new, with initial applications referred to in published literature starting in 2002.

A primary challenge posed by the existing literature of Lean applications within healthcare is that the majority of peer-reviewed, published research on interventions have studied small-scale, localized improvements (Mazzacato, Savage, Brommels, Aronsson, & Thor, 2010) rather than enterprise-level transformations. This is due, in part, to the limited number of healthcare organizations that have successfully achieved large-scale transformation. A 2009 study by the American Society for Quality found that over 50% (n=38) of responding healthcare institutions reported some level of small-scale application of quality improvement tools and methods but only 4% of these reporting organizations (n=3) reported full-scale, enterprise-level deployment efforts (American Society for Quality, 2009)

### **Integrative Enterprise Transformation Models**

Enterprise deployment models are often developed in order to provide a path for organizations through an enterprise transformation. Within the consulting grey literature, there are many models for enterprise transformation, mostly untested and utilized to promote a specific product or service. However, multiple researchers have taken on the challenge of aggregating information from organizations that have been successful in enterprise transformation to create *integrative models of*

*enterprise transformations*. These models often include a description of specific characteristics associated with successful enterprise transformation as well as stages or cycles of transformation. As shown in Table 1, these integrative models range from general enterprise transformation (Kotter, 1995) (Kotnour, 2011) to those describing a particular deployment strategy such as Lean (Koenigsaecker, 2013) (Nightingale, 2009) to those specific to an industry such as healthcare (Lukas et al., 2007) (Best & Greenhalgh et al., 2012).

**General Enterprise Transformation Models** The earliest of the general transformation models was proposed by John Kotter (1995) in a case study comparison of why transformation efforts fail. Within this comparison, Kotter identifies eight key steps for organizational transformation to counteract the common mistakes that cause failure in transformation efforts, including: establishing a sense of urgency; forming a powerful guiding coalition; creating a vision; communicating the vision; empowering others to act on the vision; planning for and creating short-term wins; consolidating improvements; producing still more change and institutionalizing new approaches.

Another, more recent model is proposed by Kotnour (2011). Within this model, Kotnour posits that successful enterprise transformation must be leadership driven, strategy driven, project-managed, as well as involve continuous learning and a systematic change process. Kotnour describes that these characteristics are often implemented in four cycles: Executing the Business; Continuously Set Strategy; Making the Strategy Real through a Systematic Change Process; and Enabling the Transformation through Leadership, Project Management and Learning. Kotnour's overall hypothesis is that higher alignment of the enterprise transformation approach with the transformation need, internal context and transformation challenges will lead to a higher overall performance of the transformation.

**Lean Specific Transformation Models** Multiple Lean specific enterprise roadmap models exist within the literature. These Lean-specific models are often based upon review/aggregation of case studies across multiple organizations successful in the implementation of Lean enterprise transformations. The most prominent models are those published by the Lean Advancement Institute (LAI) and George Koenigsaecker.

In 2008, the Lean Advancement Institute (LAI) research team developed an Enterprise Transformation Roadmap based on the aggregation of Lean enterprise across nine organizations spanning multiple industries – Aerospace, Healthcare (Mental Healthcare hospital, Emergency Department, Medical Device

Manufacturer), Services, Automotive and Government. The LAI model includes three progressive cycles. The Strategic Cycle includes developing the business case and engaging leaders in transformational efforts. The Planning Cycle includes understanding the current state, developing the vision and design for the future state of the enterprise and aligning infrastructure to meet that vision through the transformation plan. The Execution Cycle includes implementation, coordination and monitoring of the deployment strategy, with gaps within the program results feeding into additional strategic and planning cycles (Nightingale, 2009).

George Koenigsaecker is widely considered to be the foremost expert in enterprise deployment of Lean/TPS within the U.S. having led (as president) 11 corporations in successful enterprise-level deployment of Lean. Koenigsaecker describes the building blocks of establishing a Lean Culture as including serving the customer; “deciding carefully, but implementing quickly”; and “Go See, and Listen to Learn”. Koenigsaecker also describes a transformation continuum of committing to a new system of management, accelerating capability and performance and leveraging cultural transformation (Koenigsaecker, 2013).

**Healthcare Specific Transformation Models** The term *large-system transformation* has been defined within healthcare to describe the “...coordinated, system-wide change affecting multiple organizations and care providers, with the goals of significant improvements in the efficiency of healthcare delivery, quality of patient care and population-level patient outcomes...” (Best & Greenhalgh et al., 2012). A review of recommendations for organizational transformation (Best & Greenhalgh et al., 2012) (Lukas et al., 2007) lists key elements required to drive large-system transformation within healthcare institutions. These elements include leadership engagement at all levels of the organization; strategic alignment of transformation initiatives; front-line staff utilization of improvement methods as part of daily work (continuous quality improvement); and engagement of physicians and families in transformation efforts.

Many common themes emerge from within these integrative transformation models, including a focus on the customer, the need for active and engaging leadership, the balance of short term and long term gains, the use of a structured, project managed approach to transformation as well as staff engagement in transformation efforts. Additionally, the lean specific transformation models (Nightingale, Koenigsaecker), in contrast to the other general and healthcare specific transformational models, primarily focus on leadership action.



Less apparent from the current literature on these integrative models is *how* to develop these key transformational elements and put them into place. For example, if leadership engagement throughout the organization is critical to organizational transformation, what interventions effectively develop engaged leaders? Are interventions different for executive versus mid-level leaders within healthcare organizations? How are interventions typically modified to take organizational context into account?

Additionally, several of these models (Kotnour, LAI, Koenigsaecker) note that transformation occurs in multiple stages or cycles. However, no current model identifies the primary drivers of phase transitions nor discusses how these phase transitions interact with organizational culture and environment.

The purpose of this review is to attempt to close the gaps present in the current research literature in the enterprise deployment of Lean transformation efforts within healthcare delivery.

Specifically, the work presented in this chapter seeks to:

- 1) Compare and contrast the context, mechanisms and outcomes related to successful enterprise-level Lean deployment strategies in order to better understand the role and interaction of specific transformational strategies.
- 2) Identify evidence-based transformational phases (if they exist) within enterprise-level Lean deployments and explore how mechanisms and contexts interact to drive phase transitions.

Table 2. Enterprise Transformation Integrative Models

<b>Enterprise Transformation Integrative Models</b>		
<b>Model Types</b>	<b>References</b>	<b>Transformational Strategies</b>
<b>General Enterprise Transformation Models</b>	<b>Kotter "Leading Change" (1995)</b>	<ul style="list-style-type: none"> <li>- Establishing a Sense of Urgency</li> <li>- Form a Powerful Guiding Coalition</li> <li>- Create a Vision</li> <li>- Communicate the Vision</li> <li>- Empowering Others to Act on the Vision</li> <li>- Planning for and Creating Short-Term Wins</li> <li>- Consolidating Improvements and Producing Still More Change</li> <li>- Institutionalizing New Approaches</li> </ul>
	<b>Kotnour "Emerging Theory of Enterprise Transformations" (2011)</b>	<ul style="list-style-type: none"> <li>- Leadership Driven</li> <li>- Strategy Driven</li> <li>- Project Managed</li> <li>- Continuous Learning</li> <li>- Systematic Change Process</li> </ul>
<b>Lean Specific Enterprise Transformation Models</b>	<b>Nightingale "Principles of Enterprise Systems" (2007)</b>	<ul style="list-style-type: none"> <li>- Adopt a Holistic Approach</li> <li>- Identify Value Propositions for Relevant Stakeholders</li> <li>- Focus on effectiveness before efficiency</li> <li>- Address internal and external interdependencies</li> <li>- Ensure stability and flow</li> <li>- Cultivate leadership to support and drive behaviors</li> <li>- Emphasize Organizational Learning</li> </ul>
	<b>Koenigsaecker, "Leading the Lean Enterprise Transformation" (2013)</b>	<ul style="list-style-type: none"> <li>- Serve the Customer</li> <li>- Seek What's Right, Regardless</li> <li>- Decide Carefully, Implement Quickly</li> <li>- Candidly Admit Imperfections</li> <li>- Speak Honestly and with Deep Respect</li> <li>- Go, See and Listen to Learn</li> <li>- Deliver on Meaningful Challenges</li> <li>- Be and Mentor and a Role Model</li> </ul>
<b>Healthcare Specific Enterprise Transformation Models</b>	<b>Lukas/Charns Organizational Model for Transformational Change (2007)</b>	<ul style="list-style-type: none"> <li>- Sense of Urgency</li> <li>- Leadership drives and facilitates change</li> <li>- Improvement initiatives engage multi-disciplinary staff in meaningful Improvement</li> <li>- Organizational Alignment</li> <li>- Organizational Integration</li> </ul>
	<b>Best/Greenhalgh Transformation "Simple Rules" (2012)</b>	<ul style="list-style-type: none"> <li>- Engage individuals at all levels in leading the change efforts</li> <li>- Establish Feedback Loops</li> <li>- Attend to history</li> <li>- Engage physicians</li> <li>- Involve patients and families</li> </ul>

## Methods

### Realist Review

The realist review technique is a viable alternative to Cochrane-style systematic reviews and meta-analyses when the amount of published literature is limited, as is the case for healthcare-based quality improvement and large-system transformation initiatives (Best & Greenhalgh et al., 2012).

As defined by realist review methods (Pawson & Tilley, 1997), the term *mechanism* is used to describe specific interventions that are implemented in order to 'bring about' effects. *Strategies* are groups of mechanisms often applied to achieve similar effects. The term *context* describes features of the conditions in which the strategies are introduced. *Outcomes* describes the consequences (intended or unintended) that result from application of specific *strategies* and *mechanisms* within varying *contexts*.

Within a realist review, cross-case comparisons help to identify interactions between specific change mechanisms and specific contexts in order to develop theoretical hypothesis (program theory) of how interventions are able to activate specific outcomes. These theories are then iteratively tested and refined to identify "...what works for whom, how and under what conditions.." (Pawson & Tilley, 1997).

### Identification of Relevant Organizations

Realist review methods were used to identify published literature from healthcare organizations with success in enterprise-level Lean/Toyota Production Systems methods. Initial searches conducted within PubMed included terms such as Lean Enterprise, Lean Strategic Deployment, Toyota Production System and Lean Management System. Each resulting paper was reviewed to determine if the content of the paper met the Best/Greenhalgh definition for healthcare-based Large System Transformation (LST) - "...coordinated, system-wide change affecting multiple organizations and care providers, with the goals of significant improvements in the efficiency of healthcare delivery, quality of patient care and population-level patient outcomes..." utilizing the Lean/TPS approaches.

Publications meeting the LST and Lean/TPS criteria were then further reviewed and iterative searches were conducted and refined based on content in order to identify additional published literature related to specific LST initiatives. For example, initial PubMed searches identified a Lean Enterprise Deployment initiative within Virginia Mason Medical Center in Seattle, Washington. A review of these papers

identified additional terms used to describe the Virginia Mason Lean initiatives (Virginia Mason Production System, VMPS) and these terms were then used as key search terms to identify additional relevant publications.

Due to the limited number of peer-reviewed publications, additional searches were also conducted within the grey literature to identify published narrative accounts of enterprise-level Lean Deployment Initiatives such as books, book chapters, periodical articles and conference presentations.

This protocol used is outlined in Figure 1. In total, eleven organizations were identified with associated published sources that met LST criteria utilizing a Lean Deployment Transformation approach. Table 3 presents the summary of these results.

Figure 1. Realist Review Search Protocol

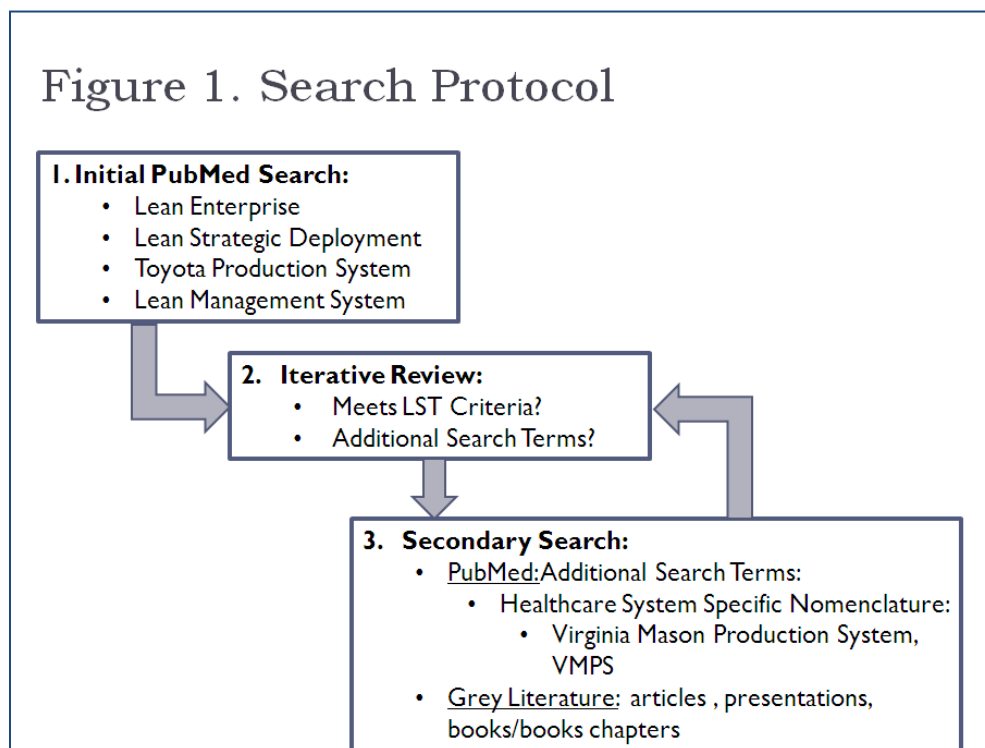


Table 3. Summary of Realist Review Search Results

Healthcare Organizations	# of peer-reviewed publications returned in PubMed	# of peer-reviewed publications meeting LST criteria	Grey Literature meeting LST criteria		
			Articles	Presentations	Books/ Book Chapter
Denver Health	6	3	2	2	1
Virginia Mason	7	3	2	2	1
Seattle Children's Hospital	9	1	2		1
ThedaCare	3	3	1	1	1
University of Michigan - Ann Arbor	7	4	1	1	
New York City Health and Hospitals Corporation	5	3		2	1
Pittsburgh Regional Health Initiative (PRHI)	1	1			1
Henry Ford Health System	2	2	1	1	1
Intermountain Health	4	2			
Northeast Health	1	1			
Harvard Vanguard	1	1			

A secondary review was conducted to determine each organization’s inclusion within the coding and cross-case analysis. The criteria for the secondary analysis included:

1. Does the information presented within the sources support that the organization did undertake an enterprise-level Large System Transformation (LST) effort utilizing Lean/TPS?
2. Does the information within the sources provide detailed information related to the Large System Transformation (LST) and Lean/TPS efforts, including detailed information related to specific mechanisms utilized within the LST deployment efforts and the timing of application of these mechanisms?
3. Does the information within the sources provide ample evidence related to outcomes directly resulting from their transformational initiatives, such as quality of care, employee satisfaction and patient satisfaction?
4. Do multiple peer-reviewed and grey literature sources exist that report consistent information related to mechanisms and outcomes associated with the transformational initiatives?

Based on this review, six organizations reporting enterprise-level Lean deployments were selected for follow-on thematic analyses: Denver Health, Virginia Mason, Seattle Children’s Hospital, ThedaCare, the University of Michigan Health System and the New York City Health and Hospital Corporation. The Henry Ford Health System was excluded due to not meeting criteria supporting an enterprise-level Large System Transformation effort (criteria #1). The peer-reviewed sources identified for the Henry

Ford Health System described application of Lean/TPS within one section of the organization (Laboratory), which although meeting the criteria for Large System Transformation, did not meet the enterprise-level deployment requirements. Other organizations were excluded due to insufficient information related to specific mechanisms (criteria #2) and/or the availability of multiple sources (criteria #4). Note that the reliance on an edited, but 'purposeful', rather than a broad sample of organizations, can be justified as the purpose of the follow-on analysis is "interpretive explanation rather than prediction" (Doyle, Tsymbal, & Cunningham, 2003).

A brief summary of the organizations included in the follow-on analysis is shown below:

- **Denver Health** is a large public, integrated healthcare system located in the Western U.S. This system has published extensively about the enterprise-wide Lean Deployment efforts initiated in 2005.
- **Seattle Children's Hospital** is a medium-sized pediatric teaching hospital located in the West Coast of the U.S. This organization (along with Virginia Mason) is widely recognized as one of the earliest in translation of Lean/TPS within healthcare delivery systems with the program initiation in 2002.
- **ThedaCare** is a large 5 hospital system located in the North Central U.S. Thedacare has also published extensively about the Lean Transformation efforts and is seen as a national leader in this work. Their program initiation occurred in 2002.
- The **University of Michigan Health System** is a large academic multi-hospital system located in the Northern U.S. This system reports initiating their Lean Enterprise Deployment efforts in 2005.
- **Virginia Mason** is a medium-sized teaching healthcare system located in the West Coast of the U.S. This system is widely recognized as being on the forefront of Lean Enterprise Deployment within healthcare and has also published extensively about transformation program efforts.

- The **New York City Health and Hospital Corporation** (NYCHHC) is a large, multi-facility healthcare system located in the Eastern U.S. This system initiated an external consultant-supported Enterprise Lean Deployment in 2007.

### **Coding/Synthesis**

Initial coding was conducted manually utilizing thematic analysis methods (Thomas & Harden, 2008). Line by line review was used to identify and synthesize information related to the Context, Mechanisms/Strategies and Outcomes across all organizations. An example of the coding matrix for mechanisms is shown in Table 4. The initial coding matrix was modified during iterative cycles with additional search terms. The initial synthesis was conducted in two stages – 1) coding of specific terms into common themes and the timing associated with application of these mechanisms 2) coding of these mechanisms into overall strategies (analytical synthesis).

For example, in the source “Transformation Health Care: Virginia Mason Medical Center’s Pursuit of the Perfect Patient Experience” (Kenney, 2011) page 17 reads “By the time the team was airborne over the Pacific on June 19, 2002...” describing the first site visit of the Virginia Mason Executive Team to Toyota in Japan. These lines were initially coded “experiential site visit, 2002” and during the secondary synthesis linked to the overall strategy “Respect for People”.

For the purposes of this study, only content specific to the Lean enterprise deployment was included in the line by line coding. For example, the grey literature book sources included detailed information related to specific Lean/TPS projects as well as information related to enterprise deployment strategies. Content related to project-based application of Lean/TPS was excluded from the line by line coding.

Several challenges were identified in synthesizing this information from the sources. Primary literature sources were not exclusively peer-reviewed, but also included published grey literature, such as narrative accounts of the deployment strategies. Even with the use of a common deployment approach and strategy, different organizations used different nomenclature. Although initial coding was conducted manually, secondary coding was conducted within QSR NVivo to confirm manual results.

Table 4. Coding Reference Table – Initial Hypothesis (Mechanisms)

Strategies	Mechanisms	Other Terms/Concepts Used Coded to this Mechanism
Respect for People	Executive and Management Development	Manager as Coaches/Facilitators, Employees as Problem Solvers, Middle Management Training, Executive Sensei Support
	Experiential Site Visit	Site Visit, Gemba Visit, Toyota visit, Japan Visit
	External Consulting/Sensei Support	Executive Sensei, Consultants, Sensei
	Dedicated Lean Coaching and Facilitation Staff	Coaches, Facilitators, Green Belts, Black Belts, Improvement Professionals, Silver Belts, Gold Belts
Strategic Alignment	Hoshin Planning	Strategic Planning
	Transformational Plan of Care (TPOC)	Transformational Value Stream (TVSA), Strategic A3
	Key Goals/Metrics	True North Drivers, Key Drivers
	A3 Problem Solving/A3 Thinking	9-box A3, 7-box A3, Lean Thinking, PDSA
Large-Scale Improvement Efforts	Value Stream Analysis	VSA, Value Stream
	Rapid Improvement Events	RIEs, Rapid Process Improvement Workshops (RPIWs), Rapid Projects, Rapid Events
Small-Scale (Continuous) Improvement Efforts	Continuous Daily Improvement	CDI, Managing for Daily Improvement, MDI, Everyday Lean Idea, Daily Engagement System, Daily Management System
	Daily Stand-up Meetings	Huddle Meetings, Daily Work Meetings
	Area Huddle Boards/Improvement Centers	Visual Management Boards
	Area (Unit) Scorecards	Unit Dashboards
	Standard Work	Standard Work Audits
Strategic Deployment	Lean Management System	Lean Business System, LMS, Business Performance System™, World Class Management, Standard Work for Leaders, Cross Functional Management, Leader Daily Management
	Management Daily Status Sheets	Status Sheets, Leader Standard Work
	Visual Management	War Room, Strategic Planning Room, Visual Boards
	Performance Review Meetings	Catchball, Management Meetings
	Gemba Walks	Genba Walks



## Cross-case Analyses

An initial cross-case analysis was performed in order to extract and compile common information related to specific contextual elements, strategies/mechanisms and outcomes from each of the organizations. This information was utilized to develop an initial hypothesis for enterprise-level Lean Deployment. The matrix table for the initial cross-case analysis is shown in Table 5.

Additionally, a secondary analysis was conducted to inform a more dynamic hypothesis inclusive of any deployment transitional phases. Within this analysis, specific mechanisms were sorted with respect to the timing that the application of the mechanism was initiated. For example, the terms related to rapid improvement projects - Rapid Improvement Events, Rapid Process Improvement Workshop, RIE, RPIW - were found in the reviewed literature for all organizations that were studied. For each of the organizations, the timeframe that the use of this tool was initiated within that deployment strategy was noted and linked to the overall deployment timeline for that organization.

Table 5. Cross-case Analysis

<b>Context</b>	Phases/Years	Years enterprise deployment was cited as active as well as any deployment milestones
	Consultant used? Costs?	What consultant groups were cited as being used? What costs were cited as associated with the consulting engagements?
	Strategic Imperative? Y/N What?	Was a strategic imperative specifically cited as key to initiation of the deployment? Y/N If so, what was the strategic imperative?
	Executive Leadership? Who?	Who was most frequently cited as the primary Executive Leadership Sponsor(s) of the initiative?
<b>Strategies/ Mechanisms</b>	Exp Site Visit (When/Where)	Did the organizations conduct experiential site visits with outside organizations? If so, when and where did the visits occur?
	Initiative Title	Did the organization brand the Lean Deployment under an organizational specific title? If so, what title was used?
	Initial Success (Model Cell)	Were any specific areas of initial deployment success (i.e. Model Cells) noted? If so, which areas?
	Tools/ Methods Used	What tools and methods are mentioned as key to the enterprise deployment? What deployment year were the tools and methods first noted?
	Pace (# of events/year)	What number of rapid improvement events were conducted each year?
	# of facilitators/ experts	What number of external and internal facilitators were used during the deployment?
	% staff engagement	What percentage of staff were annually engaged in the deployment efforts?
<b>Outcomes</b>	Results	What enterprise level results were cited as directly resulting from the deployment?
	Deployment Gaps? When?	What gaps in the deployment process were cited? When did these gaps occur? What response(s) were initiated in response to the gaps

## Results/Discussion

The complete summary of the cross-case analysis results are shown in Table 6. A summary of the findings resulting from the cross case analysis as aligned within the context, mechanism and outcomes in the following sections.

### Context

The six organizations studied shared multiple common contextual features. All organizations represented large- to mid-size integrated healthcare systems, located within moderate- to highly-populated urban areas. However, three of the systems are recognized as large academic institutes (Seattle Children's, University of Michigan Health System, NYCHHS). The health systems studied varied from a single hospital to multi-facility (up to 11 hospitals).

Three of the five organizations initiated transformational efforts in 2001-2002, with the remaining efforts starting in 2005-2007. As such, the majority of these organizations are considered to be the "starting point" for application of Lean methods within healthcare organizations, with the outlier the NYCHHS organization, which initiated their transformative efforts later in 2007. Each organization clearly articulated a strategic imperative related to the short-term (3-5 year) viability of the organization. However, the imperative identified as the primary drivers for the transformational programs varied from improving quality of care and patient safety (Seattle Children's, Virginia Mason, Denver Health) to improving the fiscal health of the organization (Denver Health, ThedaCare, NYCHHC, University of Michigan Health System). In most organizations the Executive Sponsor for enterprise deployments for the organizations was the Healthcare System CEO. In the majority of published and grey literature, the healthcare system CEO was either lead author or a co-author.

The term Lean was consistently used to describe the tools/methods generally associated with the Toyota Production System (TPS) to drive system and process improvement efforts. However, all six of the organizations later re-branded the terms 'Lean' TPS using internal nomenclature: ThedaCare developed the ThedaCare Improvement System (TIS); Seattle Children's Hospital launched Continuous Process Improvement (CPI); Virginia Mason created the Virginia Mason Production System (VMPS); University of Michigan Health System established the Michigan Quality System (MQS); and NYCHHS termed their program "Breakthrough: The HHC Enterprise wide Improvement System".

Table 6. Summary of Cross Case Analysis Results

Organization	Context				Mechanisms/Interventions							Outcomes	
	Phases/Years	Consultant used? Costs?	Strategic Imperative? Y/N What?	Executive Leadership? Who?	Exp Site Visit (When/Where)	Initiative Title	Initial Success (Model Cell)	Tools/ Methods Used	Pace (# of events/year)	# of facilitators/ experts	% staff engagement	Results	Deployment Gaps? When?
ThedaCare	2003 - First VSMS Mapped (Strategic Alignment) 2008 - "Business Performance Systems" Developed/Integrated	Simpler	Y, Cost-Reduction	CEO (John Toussaint)	Ariens - 2003	ThedaCare Improvement System, Business Process System (BPS)	Surgical Site Infections, ED Throughput, Sr. Resident Work, IRB,	2003-2008 - TVSA, VSA, RIE, A3 2008-present: Stat Sheets, Daily performance huddles, standard work, PDSA/A3 mgmt and thinking, visual tracking	2004 - 10/month 2005 - 20/month	30 internal facilitators	2004 - 714 staff 2008 - 5500 employees total, 59 locations 2011 - 3600/6300	- productivity increase 12%, \$27M savings [2004-2009] - 3663 unit improvements (2010)	Yes, 2008 - Sustainability, missed goal of increasing productivity 10% annually Management system to support CDI
Virginia Mason	2002 - project based (tools/methods approach) 2005 - Strategic Alignment to address sustainability issues, Evolution of PSA system, externally facing VSAs 2008 - "World Class integrated (CDI, MBP, x-fxn mgmt)	John Black	Y, Change or Die, lost \$\$ for 2 prior years	CEO (Gary Kaplan)	Multiple (Boeing, Wiremold, Toyota)	Virginia Mason Production System (VMPS)	Cancer Center	2002: VSA, RPIW, 3P, PSAs, Standard Work 2008: "World Class Management" - Tuesday stand-up, Friday Report-outs, Standard Work for Leaders	-2002-2005 275 RPIWs -2006-2008 50 RPIWs + 50 1-3 days Kaizen/year - 2009 50 RPIWs + 120 1-3 day/Kaizen	2008-2009: 110 Certified RPIW Leaders, 100s of VMPS-trained managers 2012: 1-5% of VMVC as KPO	2012: 5500 Staff Members (~100%)	\$11M saved in capital investment Reduced Premiums for liability insurance by 56% 2007-2010: 68-73% Staff Satisfaction 2007-2010: 83-87% Inpatient Satisfaction 2007-2010: 87-90% Outpatient Satisfaction	Yes - 2005 Sustainability, low levels of engagement, mgmt system
Denver Health	2005: Strategic Alignment through VSM/RIEs 2007: First internal BBs (Everyday Lean)	Simpler, \$1M/year in deployment costs Simpler + internal	Y, Cost Reduction, Outcomes Improvement	CEO (Patricia Gabow)	Multiple (manufacturing and service companies in US and Denmark)	Lean; "Getting it Right: Perfecting the Patient Experience"	Westside Family Health Center, Medical Critical Care Group, RMPDC	VSA, RIE, Continuous Daily Improvement (CDI), Standard Work	- 2005-2012 16 VSAs, 300+ RPIWs; "100 RIEs/year - 16 VSS	2007: 50 BBs, 5 VSAs, 5 RIEs/month; 2011: 8 Facilitators, 225 Service level "Black Belts"; 2012 250 BBs, 36 MBBs;	2005-2012: 2055 Staff participated in RIEs, 30% of staff April 2011	- \$135M total savings from Lean Projects [2005-2012], 60% reduction in observed to expected mortality	None noted
Seattle Children's	2002 - Project (Tools/Methods) Based Approaches 2006 - Strategic Alignment through VSMS 2010 - Integrated strategy deployment, CDI	Joan Wellman and Associates	Y, Outcomes/ Quality of Care	President (Patrick Hagan)	Boeing, Japan (2007)	Continuous Performance Improvement (CPI)	Surgical Site Infections, ED Throughput, Sr. Resident Work, IRB,	2002-2005: RPIWs 2006: VSA, Standard Work, P3, 5S 2010: Leader Standard Work, Daily Management Systems	2005-2009 200+ RIEs 2006: 6 VSAs	2011: 30 people in KPO	- Cost per patient 6% reduction 2008-2009 - \$20M in cost avoidance from capital construction costs	Yes - 2006: Strategic Alignment 2009: Integration with management systems	
University of Michigan Health System	2005: Initial Lean Projects/VSMS 2009: Strategic Alignment 2011: Work group learning (LITs)/Lean Management System	Several: GM, Lean Enterprise Institute	Y, Quality, Safety, Efficiency, Appropriateness, Service	Associate Vice President for Medical Affairs (John Billi)		Michigan Quality System (MQS)	Radiation Therapy	2005: VSAs, Lean Tools/Methods, 5S, Standard Work 2009: Strategic Alignment 2011: A3 Problem Solving, Strategic Deployment, Continuous Improvement, Daily Management, Visual Management	2005-2009: 2300 staff participated in Lean education session 70 projects	2009: 8 dedicated facilitators; 25 embedded facilitators	2009: ~10% (2300/20000 employees)	- Decreased readmissions by 33%; 72h ER returns by 81% - 1 day decrease in LOS for neurosurgery inpatients - 2 day decrease in LOS for Cardiac Surgery patients	2009: Strategic Alignment 2011: Strategic Deployment (Lean Management System)
New York Health and Hospitals Corporation	2007: Initiation of Lean Program (VSM/RIE Approach) 2008-2010: Spread of VSM Approach to facilities, begin formal Hoshin Kanri 2011-12: Initiate Daily Management System (CDI)	Simpler; \$20M 2007-2013	Y, Cost, Quality of Care	CEO Alan D. Aviles		Breakthrough	ED/OR	2007-2010: VSM, RIE, Lean, 5S, Visual Management 2008: Strategic Alignment (Hoshin Kanri) 2013: Continuous Daily Improvement (CDI), Daily Management, Visual Management	2007: 17 events 2008: 165 events 2009: 276 events 2010: 295 events 2011: 316 events 2012: 274 events	2007: 3 FTEE 2008: 20 FTEE 2009: 29 FTEE 2010 38.5 FTEE 2011 57.5 FTEE 2012 77 FTEE	2008: 221 2009: 1131 2010: 1569 2011: 1227 2012: 1641 2013: 1827 Total: 7616	- Cost Savings ~\$17.9 per \$1 invested; Combined \$317M revenue and cost savings	2008: Strategic Alignment 2011: Strategic Deployment

## **Mechanisms/Strategies:**

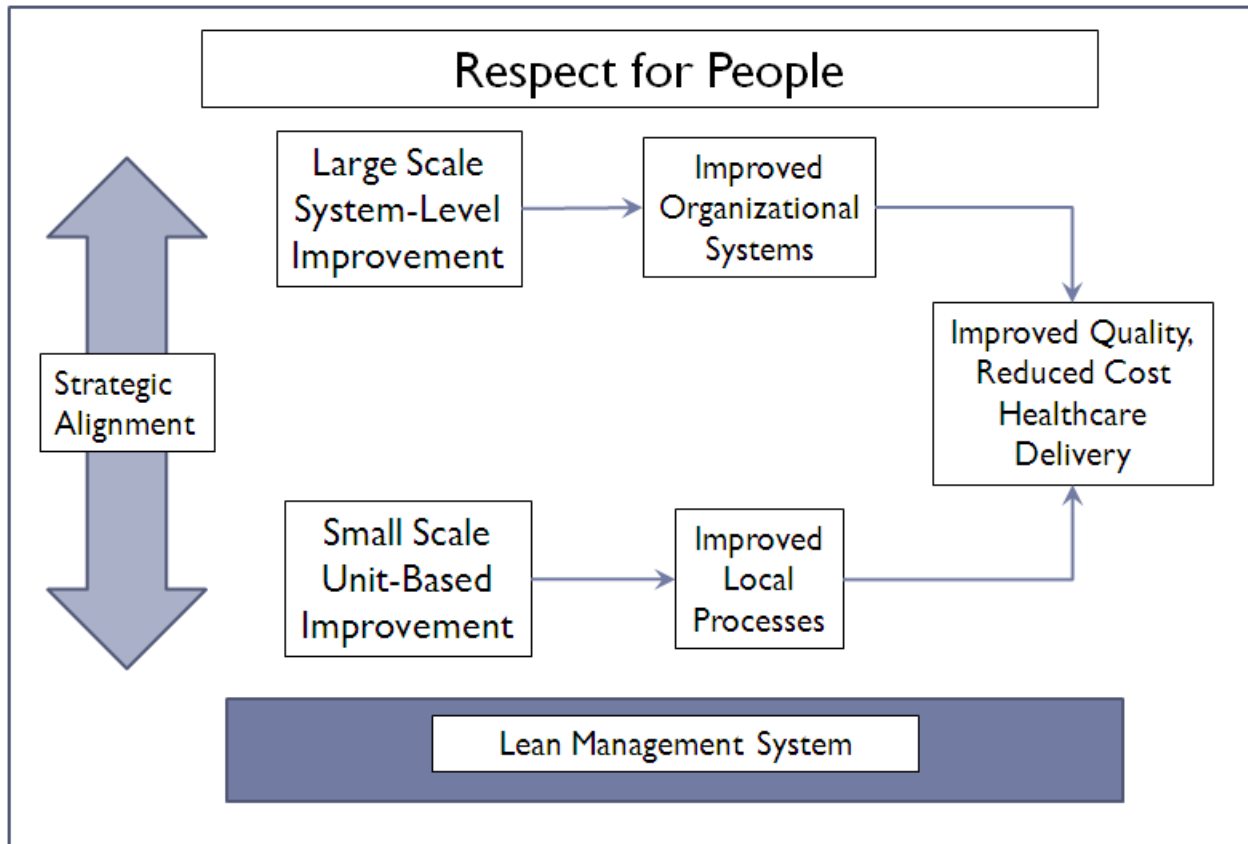
Similarities in transformation strategies and mechanisms were also present across all organizations.

Within each of the Lean improvement programs, Lean-based quality improvement tools/methods were applied to multiple initiatives and multiple levels within an organization. However, coding results indicated that all organizations referred to mechanisms that mapped to five specific strategies as key to the success of transformation efforts:

- **Respect for People:** the development of front-line staff members as the primary problem-solvers within the organization
- **Strategic Alignment of transformation efforts:** the alignment of organizational goals and the metrics associated with those goals to the transformational efforts across the organization
- **Large-Scale, system-level improvement efforts:** system-level initiatives spanning the continuum of patient care
- **Small-Scale, unit-level improvement efforts:** initiatives generally implemented within one healthcare unit or department by staff members to address specific local needs
- **Lean Management System (Strategic Deployment):** the tools and methods used to create the management systems and structure necessary to diffuse transformation efforts throughout the organization

These findings led to the development of an initial cross-case hypothesis regarding how specific strategies interrelate in effective enterprise-level transformation utilizing Lean Deployment Strategies. Figure 2 shows this model, followed by a detailed description of each of the mechanisms and strategies.

Figure 2: Model of Initial Hypothesis



### Respect for People

“Respect for People” was mentioned as a fundamental strategy of Lean deployments in the majority of organizations that were studied. The basic tenants included within the “Respect for People” strategy included respect for customers through reduction and elimination of waste within processes and respect for employees and staff members through their development as the primary problem solvers within the organization.

Peter Senge (2006) identifies the learning organization as ...“organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together”. He describes that in situations of rapid change, only organizations that are flexible, adaptive and productive will excel. For this to happen, Senge argues, organizations need to “discover how to tap people’s commitment and capacity to learn at all levels”. The outcomes from this

strategy include an empowered workforce that is able to apply continuous improvement tools autonomously as part of their daily work.

**Executive and Management Development:** These six organizations consistently highlighted that effective Lean integration at the enterprise level required a fundamental shift *away* from management (executive and mid-level) and *towards* the front-line staff as the primary problem solvers within the organization. According to Barnas (2011) “managing in a Lean environment requires an almost completely different approach to day-to-day and hour-to-hour management.” To develop this new set of skills in executive and mid-level management, nearly all of the organizations referenced the use of experiential site visits to other Lean organizations and the use of external consultants acting in a ‘Lean Sensei’ role.

- **Experiential Site Visit:** The majority of organizations reported Executive/Management visits to other lean organizations early in their transformation efforts. These visits were typically not to Lean healthcare organizations, as there were few Lean Healthcare LST efforts underway during the timeframes of the organizations deployment initiatives. For example, ThedaCare visited the Arians Corporation and Denver Health reported visiting multiple manufacturing organizations early in the transformation efforts. Two organizations (Virginia Mason and Seattle Children’s) reported multiple trips to Japan over several years. Organizations participating in these visits reported that the experiential site visits were very impactful for creating a shared vision to the “Future State” of transformation efforts among executive and management teams. Gary Kaplan (from Virginia Mason) noted that based on their visit to Toyota Japan, their team discovered that “not a single principle utilized to produce the highest quality automobiles could not be applied to healthcare and to our processes at Virginia Mason”.
- **External Consulting/Sensei Support:** Organizations reported a two-fold role for external consultants: 1) providing real-time mentoring and assistance to the leadership/management teams with respect to the leadership/management engagement with staff through transfer of knowledge and learning (in contrast to traditional didactic instructional methods) and 2) providing "feed-forward" guidance to organizational leaders with respect to deployment efforts. Both Virginia Mason and Seattle Children’s noted that experienced consultants had personally

experienced many of the hurdles and barriers that teams, process owners, executive sponsors, executive leaders faced during their own lean enterprise implementation efforts.

The degree and timing of Lean Sensei engagement varied greatly across these organizations. For example, ThedaCare, Denver Health and New York City Health and Hospital Corporation engaged immediately with consulting firms prior to initiation of transformational efforts, and relied on external consultants throughout the transformation deployment, up to and including present day. University of Michigan - Ann Arbor reported delaying engagement until deficiencies (sustainability, strategic alignment) in initial transformational approaches triggered a perceived need for external guidance. In all cases use of external consultants was based on perceived need at the executive level within the organization. This link may be potentially explained by the significant cost (>\$1M/year) of engaging external consultants as well as the higher likelihood of highly engaged executive teams to recognize the need for changes to management approaches as part of transformational efforts.

**Dedicated Internal Lean Coaching and Facilitation Staff:** The organizations studied dedicated internal resources to support coaching and the facilitation of both large-scale and small-scale system improvement initiatives. The role of the dedicated staff in these organizations was to add capacity and expertise to support transformational efforts. The level of resources reported ranged from 30 dedicated facilitation staff (ThedaCare/Virginia Mason) to 9 dedicated facilitators and 250 partially allocated "Black Belts" (Denver Health). Dedicated staff was frequently aligned within separate departments within the organization, answering directly to executive leadership, often including the sponsoring CEO.

- **Coaching/Facilitation Development:** Staff typically received initial training through external consultants and developed progressive levels of competence and skills over time. All organizations reported training internal staff in an effort to reduce reliance on external consultants. Competency and skills required were often linked to corresponding "Belt" levels. For example, Silver or Green Belts were cited as competent to train/facilitate smaller-scale improvement efforts. Gold or Black Belt certified individuals were cited as supporting large-scale, system initiatives. None of these organizations relied on external certification agencies for Belt certifications, but rather used internal certification processes.

- **Link to Promotion Potential:** All organizations cited the ability to "promote" internal staff through certification levels as an initial incentive for participation within the deployment initiative. Eventually, this also provided a mechanism to hold staff and management accountable to specific performance standards related to initiative engagement. For example, 2 organizations (Denver Health, ThedaCare) specifically cited management requirements to a "Black Belt" certification level as a contingency for promotion within the organization.
- **Dedicated vs Distributed Coaching/Facilitation Support:** Denver Health specifically reported developing dedicated coaches/facilitators followed by additional staff distributed throughout the organization with fractional time allocated to transformation efforts (referred to as "Black Belts"). Often the distributed staffs were managers and supervisors within the organization.

All of these organizations have developed consulting and training in Lean transformation efforts to outside institutions. Several of the organizations (University of Michigan Health System, Seattle Children's, ThedaCare, Virginia Mason) currently operate non-profit entities with a mission to expand the use of Lean within transformational deployments. This may represent a bias in our study sample, as organizations with a strong incentive for external focus would presumably be more likely to publish information about transformational efforts.



## Strategic Alignment

All organizations cited the use of a systematic approach to strategic alignment as integral to the success of the enterprise deployment initiatives. Strategic alignment focused on effective communication of mission, vision, objectives and results throughout the organization. Vital to this approach was a clear path of communication throughout the organization that includes the translation of transformational goals and objectives into specific initiatives and interventions, as well as reporting and aggregation of initiative results up through to the executive level.

Although all organizations used strategic alignment approaches, the timing varied considerably as to when strategic alignment was introduced within transformation efforts, as did the nomenclature employed to describe these approaches.

Approaches referenced within the reviewed literature included Hoshin Planning, Transformation Value Stream (TVSA), and Transformation Plan of Care (TPOC), with the majority of organizations adopting an integrated approach.

- **Hoshin Planning:** An overarching term used to describe policy deployment that includes a focus on shared goals, clear two-way communication pathways (that allow goals to be translated into initiatives through the organization), and accountability towards achieving those goals throughout the organization.
- **Transformational Value Stream (TVSA)/ Transformational Plan of Care (TPOC):** TVSA/TPOC was a frequently cited as utilized for annual Lean Enterprise Transformation strategic planning efforts. This approach was used to create the vision, goals, and high-level implementation plan for the upcoming lean year and create the document by which the vision and goals were evaluated for success. During a TVSA/TPOC event, participants identified specific patient care processes (Value Streams) that would be a focus of large-scale improvement efforts within the next 12 months, as well as specific areas of the organization that may implement small-scale, continuous daily improvement strategies.
- **Key Goals/Metrics:** Often referred to as "True North" Drivers, all organizations reported streamlining organizational objectives into fewer, critical goals, often aligned with desired outcomes from the enterprise-level transformation. The reduction in the number of goals to the "key few" was often referenced as the primary mechanism to focus and align transformation efforts throughout the organization. These drivers primarily included quality of care, financial (cost/revenue), patient satisfaction and employee satisfaction, with corresponding high-level

metrics developed and translated throughout the organization. Virginia Mason, however, was the one organization that reduced the primary metrics to one – Patient Safety – following a significant safety incident resulting in the death of a patient.

- **A3 Problem Solving/A3 Thinking:** A3 Problem Solving is a standardized approach to process improvement based on Toyota/TPS methods. Although each organization tailored their application of A3 Problem Solving from the traditional Toyota/TPS approaches, the application was standardized at all levels *within* each organization. This standardization served to provide a common language for improvement within the organization.

Organizations closely aligned with external consultants at the earliest stages of enterprise deployments introduced strategic alignment in the initiation of transformation efforts (ThedaCare, Denver Health, Virginia Mason). Several of the other organizations (Seattle Children's, University of Michigan, NYCHHC) reported delayed introduction until deficiencies in meeting transformational objectives indicated issues with clear pathways of communication throughout the organization. The use of TVSA/TPOC, development of the "key few" standard goals and metrics as well as the use of A3 Problem Solving throughout the organization were heavily linked to the progression from limited project-based tools/methods applications to diffusion of transformational efforts within organizations.

Many of these organizations cited Strategic Alignment strategies as the most significant mechanisms enabling organizational transformation.

### **Large Scale, System-Level Improvement**

Organizations widely reported the use of Value Stream Analysis and Rapid Improvement Events to translate the organizational goals and direction for the year into the highest-priority improvement areas within a specific patient care pathway (continuum of care).

- **Value Stream Analysis (VSA)** was cited as strengthening the gains achieved by these organizations by providing an overall vision plus specific plans that connected all improvement activities along a continuum of care. Outcomes from a VSA include a completed Value Stream Analysis, implementation plan (Projects, Rapid Improvement Events, and Just Do-Its) and

completed project charters for follow-on improvement events (RPIWs/RIEs), all aimed at achieving the desired outcomes identified by the overarching strategic goals.

- Following the Value Stream Analysis events, **Rapid Improvement Events (RIEs)/Rapid Process Improvement Workshops (RPIWs)** were used to apply a problem-solving approach (A3) to provide rapid application of the Lean Tools/Methods. The problem-solving typically occurred during an intense 2-5 day event, where sustainment of the target/goals was achieved over a period of 60-90 days immediately following the event. During the RIEs, the improvement teams applied Lean concepts and tools following the A3 improvement model to improve the specific area identified by the Project Charter. Outcomes from the Rapid Improvement Events included optimized care delivery processes as well as plan for continued monitoring and refinement of processes.

Rapid improvement events were often mentioned as occurring following a “cadence” or pace for event timing and frequency. For example, RIEs for multiple organizations (ThedaCare, Denver Health, NYCHHC) were cited as occurring on a monthly cadence. Examples of care delivery processes commonly cited as improved through a series of sequential RIEs included Emergency Department care delivery processes (ThedaCare, Seattle Children’s), Primary Care delivery processes (Denver Health), Cancer care delivery processes (Virginia Mason, University of Michigan), as well as Inpatient Care Coordination processes (ThedaCare).

VSA/RIE/RPIW methods were, by far, the most common mechanism used during the initial phases of transformation deployments. All organizations initiated the use of RIE/RPIW approaches very early in transformation efforts (often as the first "Lean" methods used) and reported continuing to use these techniques into present day. However, the primary motivation (and consequently, the frequency of use of VSAs and RIE/RPIWs) shifted throughout the phases of deployment efforts. During initial phases of deployment efforts, VSA/RIE/RPIWs were utilized as "proof of concept," providing short-term validation that Lean tools/methods could be effective in order to improve healthcare processes and systems. During mid- to later phases of transformation efforts, the pace or "cadence" of events increased significantly, providing a primary avenue for engagement for staff and employees interested in building competency in Lean applications. These organizations reported conducting up to 16 Value Streams

events and 100+ Rapid Improvement Events on an annual basis, involving up to 1000+ staff annually in system-level transformational efforts.

### **Small-Scale, Unit-Level Improvement**

Continuous Daily Improvement (CDI) was used to engage and empower the front-line staff in problem-solving efforts at the unit-level on a regular (daily) basis. CDI is most closely aligned with the ideal future state of the "culturally transformed" organization as outlined by Peter Senge: front-line staff, at the point that patient care is delivered, working to improve the systems and processes around them on a continuous basis.

Mechanisms that enabled CDI served dual purposes: providing an environment that supported identification of process and system break-downs, while linking resolution to structured problem solving approaches (A3) and alignment to transformational strategic goals.

Although the nomenclature used to describe the implementation varied widely (Denver Health: Managing for Daily Improvement, Virginia Mason: Everyday Lean Idea, Seattle Children's: Daily Engagement System, HYCHHC: Daily Management System), the actual mechanisms driving CDI implementation in these organizations was very consistent and heavily based on models translated from manufacturing industries. Example of CDI methods cited in the studied organizations included:

- Area (Daily) Stand-up Meetings (Unit-Level): Regular (daily) staff-led huddles supported by visual management boards in order to solicit improvement ideas directly from the staff as well as the direct involvement of staff in the development of solution ideas and the testing of those ideas using a Plan-Do-Study-Act (PDSA) or A3 approach.
- Area Huddle Boards/Improvement Centers (Unit-Level): Visual management boards or wall areas used to post problem areas or improvement opportunities identified by front-line staff members.
- Area Scorecards (Unit-Level): Data dashboard outlining the translation of strategic goals into unit level metrics. CDI efforts were regularly referenced as being tied to improvement goals for the unit, ensuring support for the primary strategic goals of the organization.
- Standard Work: The identification and documentation of the content, timing, sequence and outcome required to perform a set of discrete tasks. Standard work was mentioned as the key result from System-Level improvement efforts (RPIWs/RIEs) and provided the basis for continuous improvement efforts through establishing consistent process requirements that can

be assessed on a periodic basis through standard work audits. Deviation from these process requirements identified during the audits informs follow-on improvement efforts.

The major benefits from CDI observed by the organizations can be categorized following the nomenclature of Graban & Jacobson (2011) and Tonkin & Bremer (2099):

- Decreased “fire-fighting.” By having the staff members focus on the things that give them the biggest headaches, much of the daily “fire-fighting” that occurs from problems, barriers, work-arounds are addressed.
- Improved morale: Although initially skeptical, staff quickly begin to see that their voice is being heard through this process, that they are valued for their knowledge/experience/insights in the organization, that problems they face are being solved, and that they are the ones actually doing the problem-solving.
- Improved communication: The structure and format of the huddles is an effective communication vehicle and many areas that use CDI properly have indicated that they have a reduced need for staff meetings, in-services, or other mass-communication efforts.
- Widespread improvement: As CDI solution ideas begin to engage supporting services (such as engineering, supplies, IT, etc.) executive leadership is involved in addressing how to spread improvement ideas across the entire organization.

Continuous Daily Improvement (CDI) efforts were introduced during later stages of transformational efforts by all organizations, often in conjunction with Strategy Deployment and Lean Management System efforts. The introduction of CDI initiatives was most closely linked to gaps within sustainability and diffusion of transformation efforts throughout the organization. The number of improvements implemented by the area and the progress toward the improvement goals were tracked as part of the CDI process with organizations evaluated within this study reporting 1000+ CDI initiatives annually.

### **Lean Management System**

Within these organizations, the terms “Lean Business System”, “Lean Management System”, “Business Performance System™” and “World Class Management” were used to describe the integration of Lean methods beyond the application of tools/methods within the initial stages of deployment, such as standard work and daily management integration within administrative and management practices. Within Lean deployment literature - this approach is also referred to as “Strategic Deployment”. This

integration was often referred to within the reviewed literature as “standard work for leaders” (Wellman, Hagan, & Jeffries, 2011) and its intent is to “...get leaders involved directly in the daily work of steady incremental improvement..” (Kenney, 2011). Accordingly, these management systems are often referred to as “Leader Standard Work.”

If not initially integrated within the transformation deployment strategies, the driving force for implementation of an integrated Management System most often cited was the failure of prior transformation efforts to reach their full potential due to lack of integration with pre-transformation management and administrative systems. As stated by Kim Barnas in reference to ThedaCare’s transformation journey “..we did not meet our goals..” and “...after initial successes, improvements seem to plateau...Our question, then centered on the work of managers...” (Barnas, 2011) .

Although the intent and purpose for these Management Systems was consistent across all organizations, mechanisms and nomenclature varied widely. The limited amount of information available related to this topic, may indicate that these approaches were still under active development. In general, Lean Management Systems deployed during transformation efforts included references to Leader Daily Management, Cross Functional Management and Strategy Deployment/Alignment. Transformational mechanisms included:

- Management Daily Status Sheets: Management communication tool for periodic (daily, weekly) review of unit-level status with respect to critical quality and efficiency dimensions
- Visual Management: The use of visual boards, displays or other visual cues to indicate the status of the process. Visual management was mentioned as often facilitating other Lean Management mechanisms – such as the Daily Stand-up meeting and Gemba Walks.
- Performance Review Meetings: Periodic (weekly, monthly) management meeting to review unit-level Scorecards. "Catchball" (open, transparent negotiations between mid-managers and upper levels of management) were often cited as occurring during these meetings.
- Gemba Walks: Gemba (genba) were defined as the areas of the organization where the actual patient interaction occurs. Multiple organizations cited Gemba walks as key to “providing the support to your workers..” in delivering the highest quality healthcare by “being right there with them and understand what their challenges were..” (Kenney, 2011).

Many of these change mechanisms interacted with one another. For example, Senseis appeared to influence executive/management (and therefore the Management Systems) through role-modeling

behaviors related to management development. During Gemba walks, executives/managers were often unsure how to engage with front line staff productively and relied on Senseis to role-model appropriate behaviors. Additionally, the Gemba walks and use of daily status sheets were linked to the presence of Continuous Daily Improvement (CDI) mechanisms such as Daily Huddles, Visual Boards and Standard Work.

## **Outcomes**

Organizations included in this study reported significant enterprise level aggregated cost savings and revenue impacts from Lean transformational program deployment. Cost savings ranged from \$5M (University of Michigan Health System) to \$317M (New York City Health and Hospitals Corporation), with the average savings and revenue impact at \$85M or approximately \$14M/year during the deployment. Several of the organizations (ThedaCare, Virginia Mason) reported improvements in staff and patient satisfaction. Only one organization (Denver Health) reported improvement in patient outcomes with a 60% reduction in mortality rates. Other organizations did not report on system-side improvements in patient outcomes.

The majority of organizations reported 'gaps' in the deployment approximately 2 years and 5+ years into the transformation. In cases where deployment gaps were indicated, the initial (2 year) gap included issues with sustainability and alignment of initiatives throughout the organization (Strategic Alignment). The 5+ year gaps were in diffusion of Lean as an approach for improvement at the front line staff level (Strategic Deployment). Only one system – Denver Health, did not report gaps in the deployment as of this review in early 2013. However, Denver Health did note a transition to Continuous Daily Improvement and development of unit based Black Belt facilitators at year 2 of the deployment.

## **Dynamic Cross-Case Analysis**

A critical review of the timing of application of key mechanisms cited by the organizations revealed that the static view of an enterprise-level transformation (represented in Figure 2) did not capture the complexity and nuances of Lean enterprise deployment. Table 7 summarizes the deployment timelines by organization from the coded information. Each organization reported significant challenges with sustainability of strategic deployment and diffusion of continuous daily improvement activities

throughout the deployment cycle. Identification of these challenges often led to adjustment in timing and sequencing in relation to strategic deployment versus continuous daily improvement activities, driving the next stage in the deployment cycle. This analysis indicated that Lean enterprise deployments across these organizations followed a similar trend – the use of specific mechanisms was *emergent* in an attempt to resolve perceived gaps within the transformational strategies. This appeared in specific phases during the transformation timeline.

For each organization, in the initial phase, lean tools and methods (5S, A3 Problem Solving, PDSA) were introduced within the context of project-based rapid improvement mechanisms (RIEs/RPIWs). As systems improvements were implemented across the initial project focus areas, local level “point improvements” were made with some impact to lower level process level metrics. However, the anticipated significant improvement in key financial and quality metrics was not realized. This gap in achieving expected outcomes led organization leaders to recognize that initiatives were not effectively aligned with these key metrics – resulting in introduction and utilization of the strategic alignment mechanisms (Key Metrics, Value Stream Analysis, Transformational Plan of Care, A3 Problem Solving). Following improvement in the strategic alignment, issues with sustainability of initiatives and lack of diffusion of transformation efforts throughout the organization often became more apparent. These issues often triggered the integration of Lean into formal management systems (Lean Management System, Leader Standard Work) and deliberate integration of daily continuous improvement through visual boards and daily management.

This measured introduction of specific mechanisms to meet the emerging needs of the organization can be seen as corresponding to a basic tenet of Lean/TPS – the pull system. Within a pull system, goods or services are introduced only as they are required by, and at the request of, the customer or downstream operation.

This analysis led to the detection of an underlying sixth transformational strategy – creating pull for transformation initiatives. By reframing the other transformational strategies in consideration of creating pull - it becomes clear that the Lean transformational strategies must be applied in such a way as to build momentum, create internal capacity and capability for transformation efforts, as well as to provide transparency throughout the organization in such a way that leaders are able to ‘see’ the gaps in the transformational program and course-correct as appropriate. This pull strategy essentially moves the philosophy of continuous improvement beyond specific process and tasks and into the actual implementation of transformational programs.



Table 7. Deployment Timeline by Organization

Health Care System	Lean Deployment Year								
	YR1	YR2	YR3	YR4	YR5	YR6	YR7	YR8	YR9
	2002	2003	2004	2005	2006	2007	2008	2009	2010
ThedaCare	External Consultant	60 RIEs/Year	240 RIE/year	288-480 RIEs/Year	288-480 RIEs/Year	288-480 RIEs/Year	Lean Management System		Unit Level VSMs
	Site Visit - Ariens		30 Facilitators				Leader Standard Work		Process Observation Calendaring
	VSM						Visual Management		
	True North Metrics						Leadership Development		
	A3 Problem Solving						Structured CDI		
	TPOC						Daily Stat Sheets		
	PDSA						Daily Huddles		
							Monthly Perf Review Meetings		
						A3 Management			
						Gemba Walks			
	2001	2002	2003	2004	2005	2006	2007	2008	2009
Virginia Mason	External Consultant	50 RPIWs/year	110 RPIWs/year	110 RPIWs/year	50 RPIWs/year	50 RIEs/50 RPIWs	60 RIEs/50 RPIWs	60 RIEs/50 RPIWs	110 RIEs/50 RPIWs
	Site Visit - Boeing	PSA	Standard Work		PSA Expansion			Lean Management System	
	Site Visit - Japan	VSA			External VSA			Leader Standard Work	
	RIEs				Weekly Report Outs			Daily Management	
	PDSA							Visual Boards	
	A3 Problem Solving							Leadership Development	
Respect for People									
	2005	2006	2007	2008	2009	2010	2011		
Denver Health	VSA	50 RPIWs/year	50 RPIWs/year	100 RPIWs/year	100 RPIWs/year	100 RPIWs/year	100 RPIWs/year		
	RIEs		CDI - Black Belts						
	Respect for People		Visual Management Boards						
	Site Visit								
	Standard Work								
	Strategic Alignment								
	TPOC								
5S									
True North Metrics									

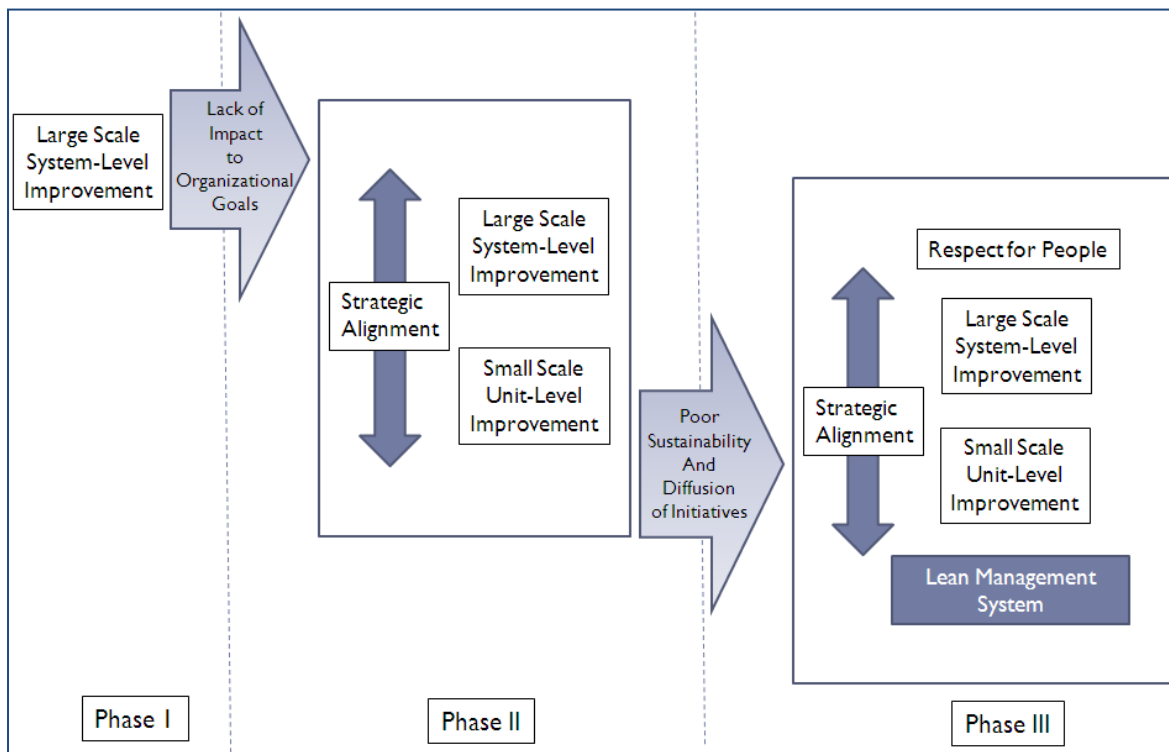
Table 7 (con't) Deployment Timeline by Organization

Health Care System	Lean Deployment Year								
	YR1	YR2	YR3	YR4	YR5	YR6	YR7	YR8	YR9
	2002	2003	2004	2005	2006	2007	2008	2009	2010
Seattle Children's	RIEs			50 CPI Events/Year	50 CPI Events/Year	50 CPI Events/Year	50 CPI Events/Year	Strategy Deployment	
	5S			Standard Work	VSA	Site Visit - Japan		Lean Management System	
	PDSA				Strategic Alignment			Leader Standard Work	
	A3 Problem Solving							Daily Management	
								Leadership Development	
								Visual Boards	
	2005	2006	2007	2008	2009	2010	2011		
University of Michigan Health System	VSA				15 projects/year		Strategy Deployment		
	5S				Strategic Alignment		Lean Management System		
	Lean Thinking				8 dedicated facilitators		Leader Standard Work		
	Standard Work				25 embedded coaches		Daily Management		
							Leadership Development		
							Visual Boards		
	2007	2008	2009	2010	2011	2012	2013		
New York City Health and Hospital Corporation (NYCHHC)	VSA	165 events (30 per active site)	276 events (23 /active site)	295 events (~20/active site)	316 events (23/active site)	Strategy Deployment			
	RIEs			Strategic Alignment (Hoshin Kanri)		Lean Management System			
	Lean Thinking	20 facilitators	29 facilitators	38.5 facilitators	57.5 facilitators	Leader Standard Work			
	Standard Work					Daily Management			
	5S					Leadership Development			
	2P					Visual Boards			
		Phase I - Tools/Methods Based Approach							
		Phase II - Strategic Alignment							
		Phase III - Lean Management							

## Revised Enterprise Deployment Strategy

Based on this analysis, it is possible to revise the static deployment strategy represented within Figure 2 to include timing and sequencing through the 3 transitional phases:

Figure 3 Lean Enterprise Deployment Strategy (Revised Hypothesis)



Aggregating across organizations, this analysis led to the identification of three qualitatively different Implementation Phases as shown in Figure 3.

- **Phase 1 (typically Year 1-2) – Project (Tools/Methods) Based Approach:** Organizational focus on creating "pockets" of Lean implementation in early adopter areas of the organizations. "External" Change Agents drive application of Lean tools and robust implementation.
  - **% of staff engaged/involved in Lean initiatives:** <5%
  - **Primary gap that drives next deployment phase:** lack of impact on primary organizational goals

- **Phase II (typically Years 2-6) – Strategic Alignment:** Organizational focus on integration of Lean into clinical and operational practices within the organization. Executive Leadership ensures that Lean is fully integrated with strategic and tactical planning.
  - **% of staff engaged/involved in Lean initiatives:** 15-20%
  - **Primary gap that drives next deployment phase:** lack of integration with current management practices results in low cultural acceptance/conflict between early and late adopter groups, poor sustainability and diffusion of initiatives
  
- **Phase III (typically Years 6+) - Strategic Deployment:** Organizational focus on integration of Lean into management practices within the organization (Lean Management System). Executives ensure that Lean is fully integrated with strategic and tactical planning and unit level tactical goals, with management practices, and the primary driver for clinical/business practices.
  - **% of staff engaged/involved in Lean initiatives:** 30-40%+

Note that these transitional phases appear to be “evolutionary” versus “revolutionary” within the transformation process, indicating that phase transitions are prompted by the organization responding to gaps within the deployment strategy. This finding corresponds to the (non-healthcare) integrative deployment models proposed by Kotnour and Koenigsaecker.

## Conclusions

Our review has shown that multiple healthcare organizations have been successful in application of enterprise-level Lean deployment strategies as part of organizational transformation efforts. Transformational approaches utilized consistent mechanisms that align with six strategies: Large-Scale, System-level improvement efforts; Small-scale, unit-level improvement efforts; Strategic Alignment; Strategic Deployment (Lean Management System); a culture that supports “Respect for People” throughout the organization; and an implementation strategy that intuitively creates a “pull” for transformation efforts.

Additionally, we have established that transformation for these organizations was not an end-state, but a dynamic journey of continuous integration at all levels of the organization, including the design and implementation of the transformation initiatives. This finding matches earlier work in development of non-healthcare integrative deployment models (Kotnour, Koenigsaecker).

A limitation of this study is that all reviewed literature related to the Lean deployments within these organizations reported favorable results. Additionally, the scope of this work was enterprise-level deployments that included Lean/Toyota Production System approaches. No attempt was made to consider failed deployments utilizing similar or different transformational deployment approaches.

Opportunities for continued and expanded research in this area include the development of management models that could be utilized to better understand the impact and interaction of specific mechanism throughout the transformational phases.

## Chapter 2:

# Creating Organizational Pull for Transformational Programs utilizing Lean Deployment Strategies<sup>1</sup>

1 Portions reprinted, with permission, from Woodward-Hagg, H., & Bar-On, I., 2013, "Large System Transformation within Healthcare Organizations utilizing Lean Deployment Strategies," Proceedings from the 31<sup>st</sup> *International Conference of the System Dynamics Society*, Cambridge, MA.

## Background/Introduction

The challenges of deploying and sustaining enterprise-level Quality Improvement (QI) programs within healthcare organizations are well documented. Numerous reasons for failed initiatives are cited within the literature, including lack of leadership support and engagement, failure to engage middle management in initiatives (Lukas et al., 2007), and inadequate development of the clinical microsystem (Godfrey et al, 2003), (Kosnik et al, 2003).

However, multiple healthcare organizations have been recognized as successful in sustained, enterprise-wide transformation utilizing Lean deployment methods. A realist review of large system transformation utilizing enterprise-level Lean deployment methods within healthcare organizations was conducted and summarized in Chapter 1. Synthesis and analysis of the results from this review indicate that there are five primary strategies associated with successful healthcare-based Lean deployments – Respect for People, Strategic Alignment, Large-scale improvement efforts, Small-scale improvement efforts and Strategic Deployment.

Additional findings from this review indicate that the applications of specific mechanisms are emergent within multiple transitional phases spanning 6-8 years. The fundamental purpose of these five strategies was found to be creation of sustained momentum for the transformational efforts within the organization across the transitional phases. This sustained momentum is often referred to as “pull.” “Pull” was found to be the key to integration of continuous improvement into the overall management of transformational programs within the organizations studied within the review.

In order to better understand the emergent nature of enterprise-level Lean deployment strategies, a more robust understanding of the interaction of the five primary strategies resulting in these transitional phases is needed. Specifically, the primary research question includes: How do strategies and mechanisms interact to drive organizational “pull” within healthcare-based enterprise-level Lean deployments?

Prior work by Keating, et al (1999) includes an extensive four-year study of QI deployments within manufacturing organizations. This work included 5 partner firms: Analog Devices, AT&T, Ford Motor, Harley Davidson, and Lucent. The primary findings from this study supported the need for effective initiation and sustained employee commitment to improvement (or “pull”). Firms unable to manage improvement programs as a dynamic (rather than static) process would eventually fail to sustain program efforts.

However, there are key differences between healthcare and manufacturing organizations (Radnor, Holweg, & Waring, 2012) that must be considered in translation of this earlier work, including:

- **Higher Order System Complexity:** Unlike manufacturing, the end user (patient) is one of multiple customers within a healthcare system. Other customers include insurers/payers for health services, physicians/providers receiving patients from the health system, as well as the local community and society at large. These customer groups often have conflicting value propositions, adding significant complexity to attempts to optimize quality and cost of healthcare received. Furthermore, due to the primary use of human to human interfaces (as compared to machine to human interfaces) to drive processes, even small-scale improvement initiatives may require more sophisticated improvement tools/methods in order achieve highly reliable processes. Additionally, outcomes from initiatives may often lack a direct, tangible connection to improving the quality or safety of patient care, limiting staff engagement.
- **Capacity- vs. Demand-Driven Revenue Cycle:** Revenue cycles within healthcare processes are often based on charge capture of specific events or encounters, rather than a single charge for an overall treatment or procedure. The primary result of this phenomenon is that improvement in efficiencies through reduction of processing steps (a fundamental concept within Lean) often reduces (rather than increases) revenue, necessitating alternative strategies beyond cost reduction for engaging management/leadership. Additionally, capacity generated during improvement events can often not be reallocated, presenting challenges with respect to generating support for Lean improvement efforts. For example, healthcare organizations are often compensated on a per procedure basis for radiology procedures. A Lean initiative to reduce over-utilization of radiological services would result in a direct reduction in revenue generated in most healthcare organizations. Furthermore, any staff capacity realized through reduction of radiological services could likely not be reallocated to other clinical processes or even radiological processes, as radiological techs are often specialized within a specific radiological modality.

A primary challenge in this research was the translation of the operational evidence base synthesized using Realist Review techniques (as described in Chapter 1), into general and key operational parameters and systems structure necessary for the development of the system dynamics model. This challenge was overcome through the use of dynamic hypotheses to catalog the relationships and interactions between strategy components to create a mid-level theoretical construct. This mid-level construct was then utilized to inform the key operational parameters and systems structure for the system dynamics model building outlined in Chapter 3.



Why use dynamic hypotheses to develop the mid-level theoretical construct? Dynamic hypotheses describe the causal relationship between system parameters and specific system outputs, essentially establishing the “causal equivalence between structure and behavior, where the system behavior is a function of time.” (Keloharju, 1981). With respect to the application described in this work, dynamic hypotheses allowed the individual Lean Enterprise Transformation deployment strategies (*Strategic Alignment, Strategic Deployment and Respect for People*) to be studied within the context of the organizational system - including interactions within and between strategies as well as with other parts of the organizational system, rather than independently or in isolation. We chose the systems approaches of dynamic hypotheses and system dynamics modeling for this translation from the high-level strategies into the operation models, specifically as these approaches allow for a collaborative approach to development of theoretical dynamic hypotheses, the translation of theoretical evidence into key operational parameters and the testing, experimentation and adaptation of deployment approaches.

## **Methodology**

An expert panel in Lean deployment initiatives was engaged in discussion of the realist review of enterprise Lean deployments as outlined in Chapter 1. This panel consisted of two healthcare administrators that had significant prior experience in Lean Enterprise Transformation within large, multi-system healthcare organizations, two healthcare consultants with extensive experience in advising large healthcare systems in Lean Enterprise Transformation, including one consultant with direct experience in two of the hospitals included within the realist review and one health services researcher with an expertise and on-going research in the evaluation of healthcare transformational models.

The panel was then asked to identify key reference modes related to enterprise-level Lean Deployment initiatives as well as to map the five deployment strategies to the goal of creating “pull” for the transformational initiative within the organization. Responses were then utilized to map relationships between key strategies/mechanisms and contextual elements as well as to identify potential endogenous vs. exogenous parameters within each of the strategies. For example, the strategy *Respect for People*, which (as described in Chapter 1) included mechanisms such leadership, middle management and staff development, was assessed by the expert panel as having a direct mapping to

the high level strategies *Strategic Alignment* (due to the requirement of a high level of leadership expertise to implement Strategic Alignment mechanisms) as well as *Strategic Deployment* (due to the requirement of a high level of middle manager engagement to implement Strategic Deployment mechanisms). Additionally, the strategy *Respect for People* was assessed to have endogenously derived parameters related to leadership, middle management and staff development, as well as exogenous parameters representing the levels of external consultant support, initial internal facilitation resources available and initial leadership engagement.

The results from this effort were mapped to the Reference Modes, Model Boundaries/Sub-System Diagram, and Dynamic Hypothesis presented in the following documentation.

### **Reference Modes:**

*Transformation Program Results* were identified as representing a primary outcome of Lean Enterprise Transformation efforts. As described in Chapter 1, program results for the successful Lean Enterprise Transformation organizations were often represented as the employee engagement within the program, annual or cumulative successful initiatives, as well as the cumulative financial benefit obtained from the program. To most closely match the findings from the evidence base, similar parameters representing the transformation program results (employee engagement, number of annual successful initiatives, financial benefit) were used as the basis for the mid-level theory development and subsequent analysis and assessment of the Lean Enterprise Transformation Deployment strategies within the system dynamics model.

The reference modes represented in Figure 4 (below) indicate the expected annual transformation program results for Lean Deployment efforts within three types of representative organizations with respect to Lean Enterprise Transformation efforts:

1. **Robust Organization** – An organization sustaining program results over 8+ years. This organization most closely matches those studied within the realist review in Chapter 1. Program results within these organizations were found to increase initially and then plateau, triggering a response and adjustment to deployment strategies resulting in improved program performance and subsequent cycles of adjustment to deployment strategies.
2. **Average Performing Organization** – An organization exhibiting strong initial results, however those results are not sustained beyond 5 years.
3. **Low Performing Organization** – An organization exhibiting early (Year 1-2) moderately positive results, with a sharp decrease in results and the program ending after Year 3.

Figure 4. Reference Mode for Transformation Program Results

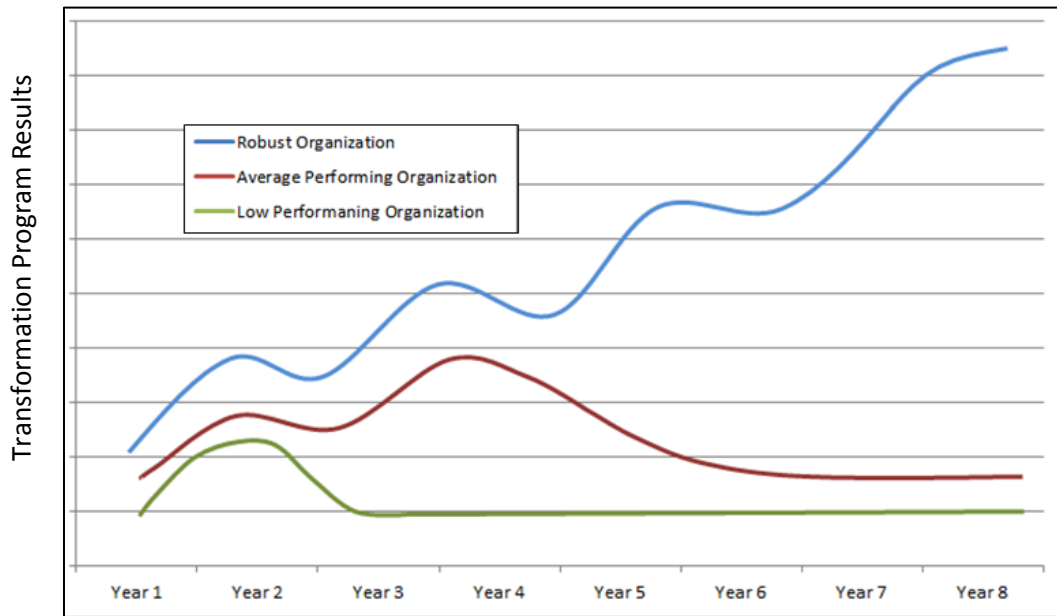
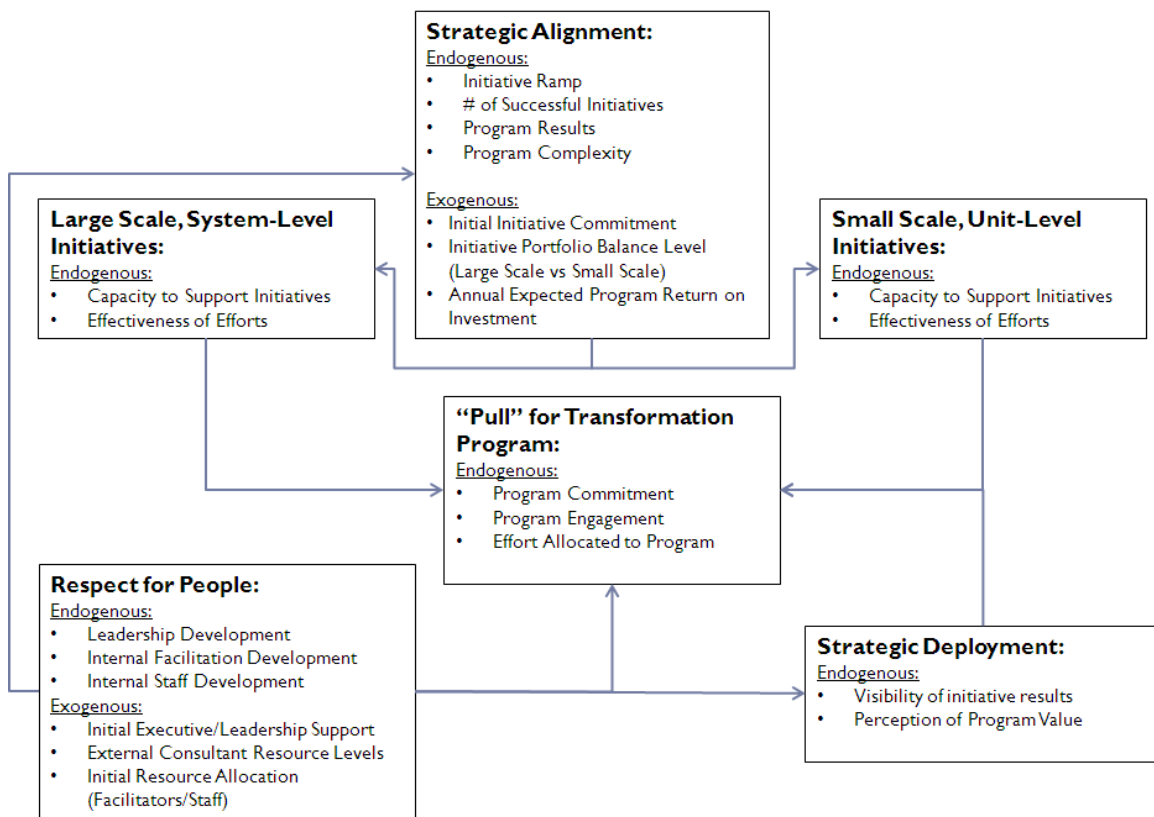


Figure 5. Model Boundaries/Sub-System Diagram



### **Model Boundaries/Sub-System Diagram:**

The five primary strategies identified within the successful transformational initiatives were mapped to the higher order strategy of creating “pull” for the enterprise-level Lean Deployment Program within the organization, as shown in Figure 5.

- *Strategic Alignment* determines alignment of initiatives to organizational goals as well as the ‘mix’ of initiatives within the transformational efforts (*large-scale vs small-scale initiatives*). Strategic alignment is often achieved through the use of strategic planning methods (Hoshin Kanri, Transformational Value Stream Analysis (TVSA)) closely aligned with departmental and unit based improvement initiatives.
- *Respect for People* provides the level of Executive and Management commitment for transformation efforts as well as the management-level commitment and capability to lead and effectively direct transformational activities (Strategic Alignment) and as well as implement management systems that facilitate diffusion/spread of initiatives throughout the organization (Strategic Deployment).
- *Strategic Deployment* efforts impact the overall perception of the transformational program value through translation of program results into relevant and visible accomplishments clearly linked to the local and organizational goals. Strategic Deployment is accomplished through the implementation of the components of the Lean Management System. For example, daily improvement huddles, area (unit level) improvement visual displays as well as management and executive level standard work.

Additionally, based on the work by Keating, et al, the three primary outcomes related to the organizational “pull” for the transformation program were identified:

- *Transformation Program Complexity* describes the extent to which the program is focused on improvement efforts that involve a high level of technical complexity (level of difficulty in designing, conducting and interpreting improvement initiatives) and/or organizational complexity (scope and extent of personnel and organizational functions required for the improvement initiative)

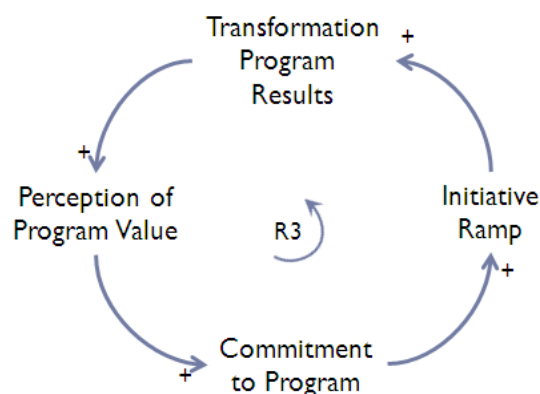
- *Transformation Program Results* describes the tangible benefits associated with the program. These benefits are often represented in financial benefit, the number of initiatives resulting in improved process performance and/or impact to metrics assessing reliability and availability of clinical care processes.
- *Program Commitment* describes the extent of the financial, resource or cultural support that the organization is willing to provide to the transformational program. For example, an organization exhibiting a higher level of Program Commitment may allocate a higher level of staffing or facilitators to support improvement efforts as compared to an organization with a lower level of program commitment.

## Analysis/Results

Dynamic hypotheses are used to provide a visual depiction of the relationship between structural parameters and observed or anticipated behavior in non-linear systems. This method allows for identification of interactions and dependencies between and within systems structures. The use of dynamic hypotheses within our research was initiated by the discovery of prior relevant work (Keating, Oliva, Repenning, Rockart, & Sterman, 1999) using dynamic hypotheses and system dynamics modeling to explore sustainability of quality improvement (QI) efforts within manufacturing industries.

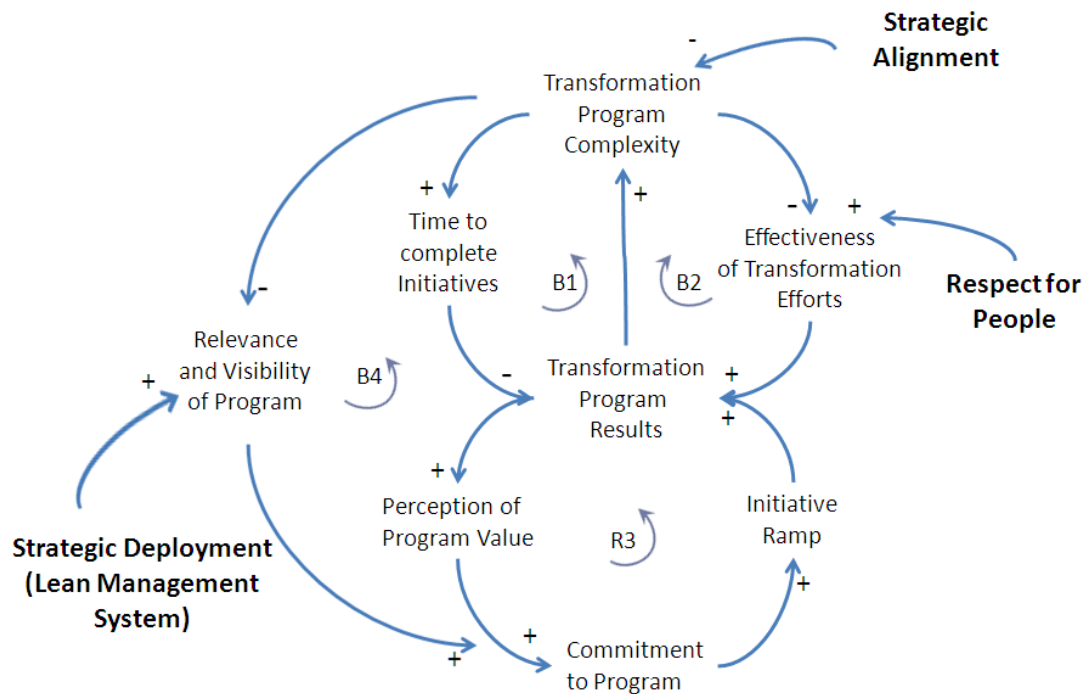
Keating described that as the results from the transformation program are aggregated, the perception of the program value to the organization increases, also increasing the amount of resources and cultural acceptance of the initiative (commitment to program) to the organization. This relationship between the organizational parameters and the program outcomes, adapted from Keating, is shown in form of a dynamic hypothesis in Figure 6a below (Loop #R3). This results in a greater number of transformational initiatives being initiated (increased Initiative Ramp), which then, in-turn, increases the number and quality of successful outcomes (program results). Thus, Loop #R3, can be described as representing a reinforcing loop creating “pull” for the transformational efforts within the organization.

Figure 6a. Dynamic hypothesis adapted from Keating (1999)



## Initial Dynamic Hypothesis:

Figure 6b. Initial Dynamic Hypothesis – Creating Pull for Transformation



Within our work dynamic hypotheses aligned with each of the higher order strategies (Strategic Alignment, Respect for People, Strategic Deployment) were created utilizing a base model (initial dynamic hypothesis- Figure 6b). These dynamic hypotheses allowed investigation of the impact and interaction of each strategy on the key outcomes most closely aligned with creating and maintaining the “pull” of the transformation efforts within the organization (Program Complexity, Program Results and Commitment).

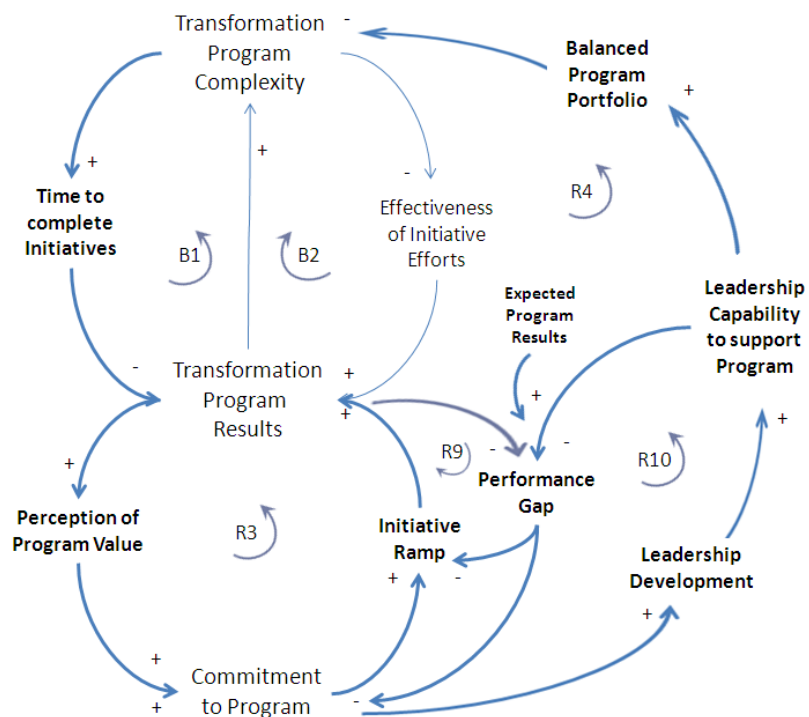
Loops #B1/B2 are the balancing loops representing the two primary constraints to continued increase in the Lean deployment “pull”: the number of required resources to support the program (capacity) and the expertise level of program resources (capability). As outlined by Keating, as the program results from the transformation efforts continue to expand, new initiatives will have higher complexity as low-hanging fruit issues are resolved, resulting in longer time to complete and higher-level QI tools/methods to effectively resolve issues due to lag in assigning resources (capacity) or developing resources (capability). This higher order of program complexity slows the pace of improvement, reducing program results.

Referencing Loop #B4, as the program complexity increases, the relevance and visibility of the program initiatives to the day-to-day work within the organization decreases, resulting in a decrease in the organizational commitment to the program, reduced initiative ramp and decreased program results. Therefore, Loop #B4 can be considered to represent a balancing loop representing the direct impact that the program complexity has on the commitment.

**Expanded Dynamic Hypothesis:**

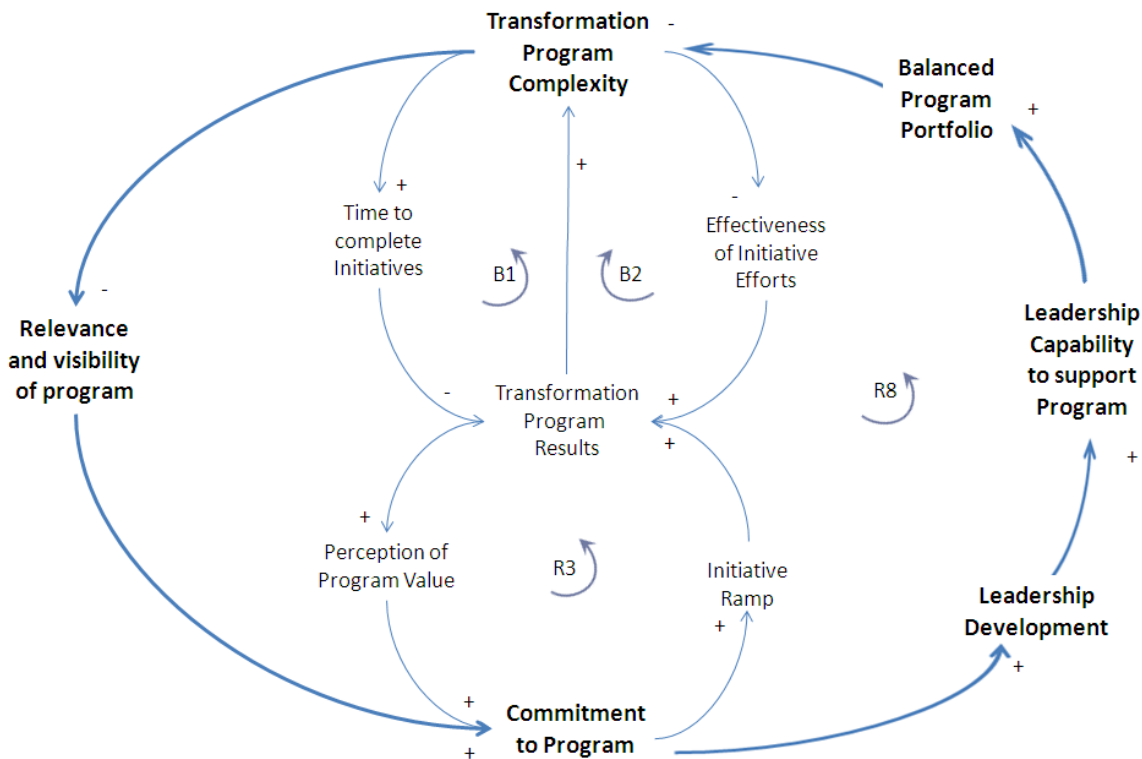
The initial dynamic hypothesis was expanded to integrate mechanisms associated with the five strategies utilized by successful healthcare organizations in enterprise-level Lean transformational programs. This integration was conducted in order to create a mid-level theoretical construct facilitating a greater understanding of structural components present within each transformational strategy as well as the interactions between strategies. A summary of the findings from this integration are summarized in the following sections.

Figure 7. Expanded Dynamic Hypothesis Representing the Strategic Alignment Integration with the Base Model



**Strategic Alignment (Loop #R4/R9/R10, Figure 7):** *Large Scale, System-Level Improvements* will have higher complexity, resulting in longer time to complete and slower pace of improvement, reducing program results. However, although *Small Scale, Unit-level Improvements*, can be completed with a faster timeline, these initiatives will have less of an impact on the overall transformational effectiveness and therefore, on the overall program results. Strategic Alignment mechanisms enable a balance between Large-scale and Small-scale program portfolios as well as the number of efforts initiated (Initiative Ramp). This is accomplished through the capability of the leadership to 1) appropriately align organizational goals/metrics (Loop #R9); 2) measure and assess performance gaps in the Lean deployment program (Loop #R10); and 3) appropriately balance the program portfolio and initiative ramps to ensure growth in program results without increasing the complexity of the overall program beyond organizational capabilities (Loop #R4).

Figure 8. Expanded Dynamic Hypothesis Representing the Strategic Deployment Integration with the Base Model

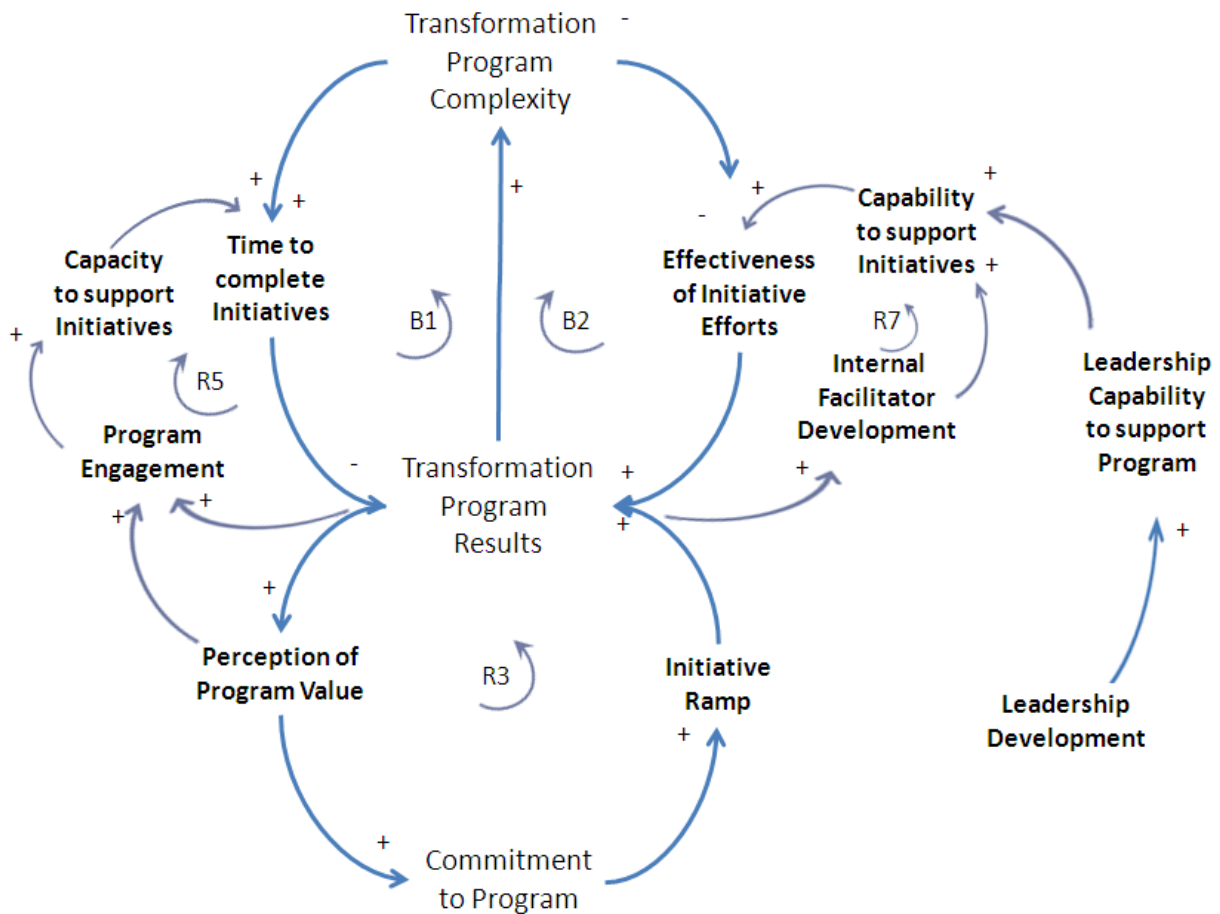


**Strategic Deployment Integration (Loop #R8, Figure 8):** Multiple organizations cited that system level, high complexity initiatives did not translate as well throughout the organization, reducing the ability to



increase commitment to the Lean transformation program. *Strategic Deployment* mechanisms including Lean Management System and Continuous Daily Improvement (CDI) are achieved through balancing the overall program portfolio – e.g. the ratio of small-scale vs. large scale initiatives (*Strategic Alignment*). These mechanisms allow the organization to better manage the overall program complexity, ensuring that program results and impact are highly visible and relevant throughout the organization, increasing the commitment to the program. However, the implementation of *Strategic Deployment* mechanisms often require advanced leadership and management strategies that can only be realized through intensive leadership and management development.

Figure 9. Expanded Dynamic Hypothesis Representing the Respect for People integration with the Base Model



**Respect for People (Loop #R5/R7, Figure 9):** These loops represent the capacity and capability to support initiatives. For example, capacity represents the level of staff engagement within

transformational program efforts, either through training or direct experience in these efforts. In contrast, capability describes the level of expertise of program resources, such as initiative facilitators. As the Transformation Program results are aggregated, the overall program complexity increases as prior initiatives must be sustained over time and methods and tools to sustain may be more complex than needed for the initial transformation initiatives. Capacity to support initiatives is provided by engaged staff members. Engagement occurs as a function of the perception of program value and participation in successful transformational initiatives (Loop #R5). The capability of internal coaches and facilitators, as well as the organizational leadership to appropriately support initiatives ensures the effectiveness of Lean transformation efforts (Loop #R7).

## Discussion

The dynamic hypotheses indicate that these strategies integrate to generate sustained momentum for the transformation efforts, or “pull.” An organizational culture supporting *Respect for People* ensures that internal capacity and capability is developed at the staff, coaching/facilitation and leadership levels. *Strategic Alignment* methods provide transparency throughout the organization with respect to organizational goals and metrics, as well as the transformation program results in meeting those goals. A balanced portfolio between Large-Scale, system-level and Small-Scale, local-level initiatives ensures that program results sustain without significantly increased complexity within the Lean deployment program. *Strategic deployment* mechanisms ensure that the transformational initiatives are tangible and relevant to the front-line staff members.

A summary of the impact of each Lean Deployment Strategy – Strategic Alignment, Respect for People and Strategic Deployment - on the primary program outcomes driving “pull” is shown in Table 8 (below). As described in this table, the absence or incomplete deployment of these strategies would result in a decrease in program commitment, initiating a reinforcing feedback loop resulting in a reduction organizational pull for transformation efforts. Unless this impact is identified and mitigated in a timely manner, this reduction would result in the eventual elimination of any positive program results, negatively impacting the overall viability of the transformational program. Successful organizations must, therefore, insure that issues with transformational program outcomes are readily recognized and resolved. This supports the existence of transitional phases indicated by organizations reviewed within Chapter 1.

Additionally, the impact of leadership involvement/engagement is also shown to be a key factor. Each dynamic hypothesis indicates that leadership development and subsequent leadership capability is

necessary to drive integration of these program strategies. Leadership capability insures *Strategic Alignment* of initiatives to meet performance expectations. Within Strategic Deployment, leadership drives the appropriate portfolio balance to manage complexity, insuring the relevance and visibility of the transformational program. Additionally, leadership drives the elements of Respect for People through insuring facilitator development to meet program capability requirements.

Table 8. Impact of Lean Deployment Strategies on Transformational Program Outcomes

Lean Deployment Strategies			Transformational Program Outcomes		
Strategic Alignment	Respect for People	Strategic Deployment	Complexity	Commitment	Results
+	-	-	Program complexity is reduced/managed through appropriate portfolio balance. Projects and initiatives are clearly aligned to meet performance expectations.	Program commitment initially increases due to impact on performance expectations, however, cannot be sustained due to lack of leadership development/staff engagement. Program lacks visibility and relevance to front line staff, resulting in decreased commitment to the program.	Program results initially increase due to impact on performance expectations. However, initial results cannot be sustained as commitment decreases, resulting in a reduction in the initiative ramp and eventual decline in program results.
-	+	-	Program complexity is not managed to reduce complexity. Projects and initiatives are not aligned to meet performance expectations.	Program commitment is initially high due to leadership development and staff engagement. However, increasing complexity of initiatives reduces the relevance and visibility of the program, negatively impacting the commitment throughout the organization.	Program results initially increase due to highly developed leadership and high staff engagement. However, the reduction in perceived value of the program as well as the lack of impact to performance expectations results in a reduction in the initial ramp and decline in program results.
-	-	+	Program complexity is not managed to reduce complexity. Projects and initiatives are not aligned to meet performance expectations.	Program commitment is initially high due to the relevance and visibility of the initiatives throughout the organization. However, this cannot be sustained due a decrease in perceived value as the program results decrease.	Program results initially increase due to the relevance and visibility of the initiatives throughout the organization. However, this cannot be sustained due to the lack of leadership development/staff engagement to effectively manage the increasing program complexity, resulting in eventual decrease in program results.
+ Transformational Strategy is utilized					
- Transformational Strategy is not utilized					

## Conclusion

In order to better understand the interaction of enterprise-level Lean deployment strategies within healthcare organizations, we have developed dynamic hypotheses that integrate the strategies for sustained, enterprise-wide transformation utilizing Lean Enterprise deployment methods.

The use of dynamic hypotheses was necessary in order to translate the high level theoretical construct for Lean Enterprise Transformation developed in Chapter 1 into a mid-level theoretical construct that could be used as the basis for the operational systems dynamics model outlined in Chapter 3. This mid-level construct describes the interrelationships between key factors in the deployment strategies as well as provides a catalog of the relationships and interactions between strategy components, informing the key operational parameters and systems structure for the system dynamics model building.

These hypotheses indicate that the Lean Deployment strategies work together to generate sustained momentum for the transformation efforts, or “pull.” An organizational culture supporting *Respect for People* ensures that internal capacity and capability is developed at the staff, coaching/facilitation and leadership levels. *Strategic Alignment* methods provide transparency throughout the organization with respect to organizational goals and metrics, as well as the transformation program results in meeting those goals. A balanced portfolio between Large-Scale, system level and Small-Scale, local level initiatives ensures that program results sustain without significantly increased complexity within the Lean program. *Strategic deployment* mechanisms ensure that the transformational initiatives are tangible and relevant to the front-line staff members. Additionally, the capability of leadership to deploy and monitor these strategies is shown to be key to creating sustained “pull” for transformational efforts. These dynamic hypotheses suggest that transitional phases within transformation efforts are indicative of successful organizations identifying and resolving issues with program outcomes in order to maintain “pull”.

## **Chapter 3:**

# **Improving Lean Healthcare Enterprise Transformation Deployment Programs utilizing System Dynamics Modeling**

## Background/Introduction

As shown in prior work (Chapter 1), three primary strategies are utilized (Strategic Alignment, Respect for People and Strategic Deployment) in successful deployment of enterprise-level Lean programs within healthcare organizations. As outlined by the analysis of the dynamic hypotheses in Chapter 2, these strategies interact to create an increased organizational commitment to the transformational program, resulting in an internally-driven sustained momentum or “pull” for the program. This “pull” is a result of the link between the increase in program results, organizational perception of the program value, and organizational commitment driving an increase in transformational activity (initiative ramp), which in turn leads to increased transformational program results.

Unfortunately, the deployment cycles from successful organizations outlined during the realist review in Chapter 1 were reported to extend from 6-12+ years. Additionally, the presence of three emergent transitional phases during the deployment cycle as well as the primary dependence on leadership capability outlined in Chapter 2 indicates that the current deployment strategies may result in impediments to sustaining the transformation program, such as decreased sustainability of initiatives, or mid-management disengagement, that all but the most sophisticated of organizations may be challenged to navigate.

In order to better understand the emergent nature of enterprise-level Lean deployment strategies, a more robust understanding of the interaction of these primary strategies and the impact of these strategies on the transitional phases within Lean Deployments is needed. Specifically, the primary research focus of this work would include investigating how to identify leverage points for successful transformations in order to improve transformational program outcomes and decrease deployment cycle timelines for healthcare-based, enterprise-level Lean deployment programs.

## Methods

The high and mid-level theoretical constructs reinforced initial theories that transformational phases identified during the dynamic cross-case analysis were the *emergent* responses of leadership teams attempting to mitigate/eliminate identified gaps within their Lean transformation program performance. Hence, successful applications of this deployment strategy require highly skilled, engaged and informed leadership teams with clear lines of sight to program performance throughout their organizations. One concern highlighted from this finding is that the majority of healthcare executive leadership teams do not have the experience necessary to effectively navigate these transitional phases. Additionally, it might not be possible to compress the deployment timeline if leadership development/expertise is a primary constraint. Given these new insights into potential failure modes within the deployment strategy, we needed to test potential modifications to traditional enterprise-level Lean deployments. As outlined in this chapter, utilizing the dynamic hypotheses development within the mid-level construct (Chapter 2), we were able to develop an operations-based Systems Dynamic (SD) Model that could be used to test deployment approaches for Lean Enterprise Transformation.

### Model Development

An SD model was developed within iThink representing the dynamic hypotheses discussed in Chapter 2. The primary sectors were created to mimic the six primary loops present within these hypotheses. The description of each sector, as well as the primary stocks associated with each sector, are listed below. The complete model is shown in Appendix B.

- **Transformation Program Complexity Sector:** *Transformation Program Complexity* describes the fraction of program initiatives that are system-level or large-scale (LS) as compared to those that are unit or department based (small-scale). A higher fraction of large-scale initiatives increase the overall complexity of the program, which is represented by the program complexity factor. The primary stock in this section is the *Program Large-Scale (LS) Initiatives*, representing the cumulative number of successful large-scale initiatives.
- **Transformation Program Results Sector:** Within this sector, the transformation program results, such as the fiscal benefit realized by the program and number of successful initiatives are determined. The *Fiscal Benefit* stock represents the accumulated fiscal result as impacted by the in-flow of annual fiscal results from the new and sustained program initiatives and the out-flow of annual program costs. The *Successful Initiatives* stock represents the accumulated level of successful initiatives as impacted by the in-flow of the number of annual initiatives started and the out-flow of the number of annual initiatives that fail. The number of annual initiatives started is limited by the organizational commitment to the deployment program (Program Commitment Factor) as well as amount

of resources committed to the program, which is represented by the *Resource Commitment* stock. The *Resource Commitment* rate is a function of the program visibility, and the fraction of annual fiscal benefit that is made available to re-invest in the transformation program.

- **Commitment to Program Sector:** The organizational commitment to the transformation program is determined through assessing the ratio between expected and actual program results. This ratio is translated through a linear graphical function to a program commitment factor between .30 (representing a low level of organizational commitment) and 1.0 (representing the highest level of organizational commitment).
- **Capacity to Support Initiatives Sector:** This sector represents the transition of available employees not currently engaged in the transformational program into employees that are engaged within the program (the stock *Engaged Employees*). The *Engaged Employees* stock represents the accumulated number of employees engaged in the program as impacted by the in-flow of the number of annual employees that participate in both new and sustained initiatives and the out-flow of the number of employees that disengage in the transformation program due to participation in failed initiatives.
- **Capability to Support Initiatives Sector:** This sector represents the transition of potential facilitators not currently trained in the transformational program methods into facilitators that are capable of effectively supporting initiatives within the program (the stock *Internal Facilitators to support New Initiatives*). The *Internal Facilitators to support New Initiatives* stock represents the accumulated number of fully developed facilitators as impacted by the in-flow of annual internal facilitators that are developed through participation in initiatives and out-flow of the number of facilitators that are lost to the transformation program.
- **Leadership Development Sector:** This sector represents the transition of potential leaders and mid-managers not currently engaged in the transformational program methods into senior leaders and middle managers that are capable of effectively engaging within the transformational program (stocks *Experienced Leaders* and *Experienced MidManagers*). Both of the *Experienced Leaders* and *Experienced MidManagers* stocks represent the accumulated number of fully developed leaders and managers as impacted by the in-flows of leadership and middle-manager development that are developed through participation in initiatives and out-flows representing the number of leaders and middle managers that are lost to the transformation program.

The process frame showing the sectors and relationship between sectors is shown below in Figure 10. Model constants were pulled from the organizational review conducted in Chapter 1 or estimated by the expert panel as indicated in Appendix C.

Additionally, a scenario testing panel (Figure 11) was created to allow the user to test, compare and contrast different scenarios associated with implementation of Lean Deployment strategies.



Figure 10. Process Frames indicating the sectors and relationship between sectors within the SD model

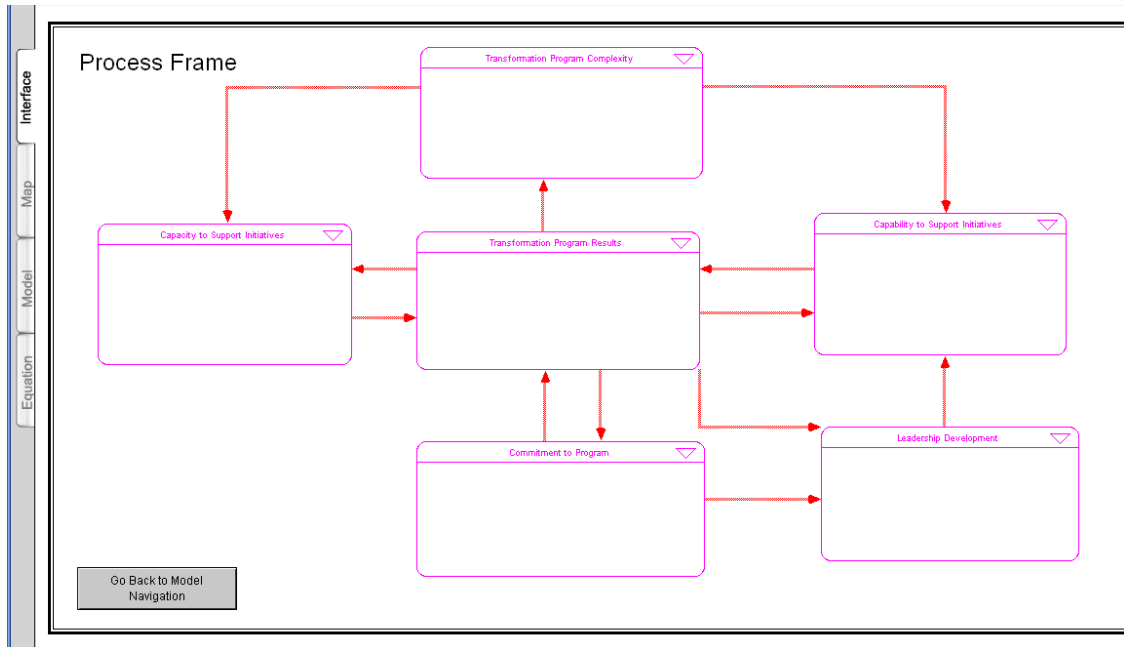
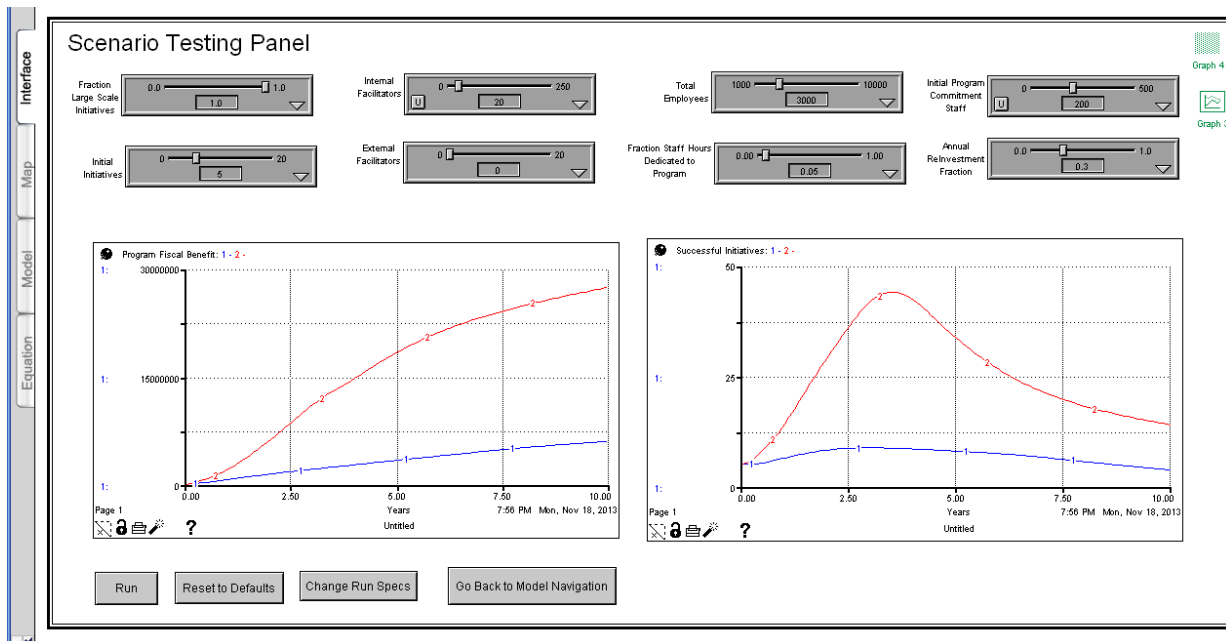


Figure 11. Scenario Testing Panel



## Graphical Functions

Four graphical functions were used to represent non-linear relationships between model variables as shown in Figures 12-15. Note that very limited evidence is available relating to the relationships between model variables and that in the absence of evidence the expert panel input was utilized to create very basic non-linear relationships (as indicated in the graphs).

The Capability Failure Fraction (Figure 11) is utilized within the model to represent the fraction of failed large scale initiatives due to lack of facilitator capability. For example, a higher level of cumulative facilitator expertise, would result in a higher fraction of large scale initiatives that meet program success criteria (successful initiatives) as compared to those that would not meet program success criteria (failed initiatives). The upper and lower bound for this fraction is based on published initiative failure rates indicating a range of initiative success from 20-80% within improvement programs. Expert panel input suggested that the maximum value would occur at a cumulative facilitator ratio of 1:1 per initiative with a significant reduction in success rate at a ratio of facilitators to initiatives at a range of .4 to .6 with a leveling-off of the facilitator capability effect at a ratio of less than .4.

The Program Commitment Factor (Figure 12) represents the fractional reduction of the program commitment as a function of the ratio of the actual to expected program performance results (fiscal benefit), as indicated by hours committed. This graph was derived from expert panel input that indicated that program commitment does not decrease significantly until the ratio of actual to expected performance results is less than .40 and at less than .40, would reduce at a rapid rate.

The Program Visibility Factor (Figure 13) and Program Complexity Factor (Figure 14) were both derived from the expert panel feedback that program complexity is increased and program visibility reduced at portfolio mix levels of greater than 50% large scale, system-wide initiatives. This follows from the review of successful enterprise-level Lean Deployment organizations in Chapter 1, where the majority of organizations noted a 50/50 ratio of large scale to small scale initiatives. Note that these functions represent a very limited understanding of the relationship between the fraction of the successful initiatives that are large scale, system-wide initiatives and the overall program complexity and visibility.

Figure 12. Capability Failure Fraction Graphical Function

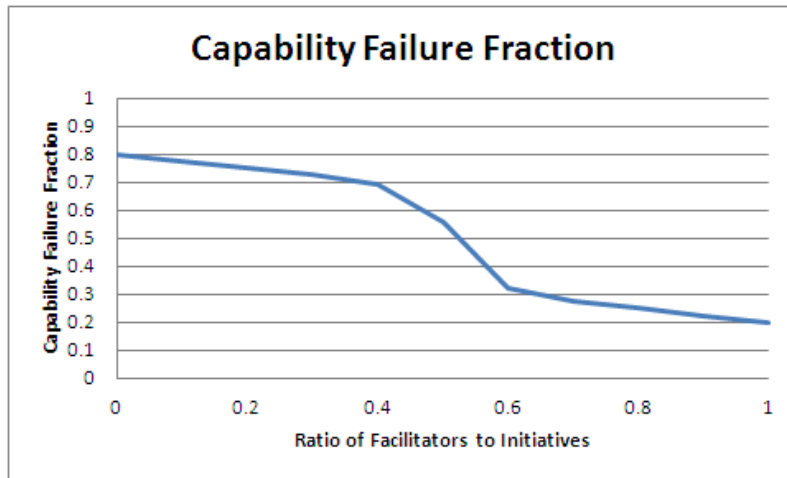


Figure 13. Program Commitment Factor Graphical Function

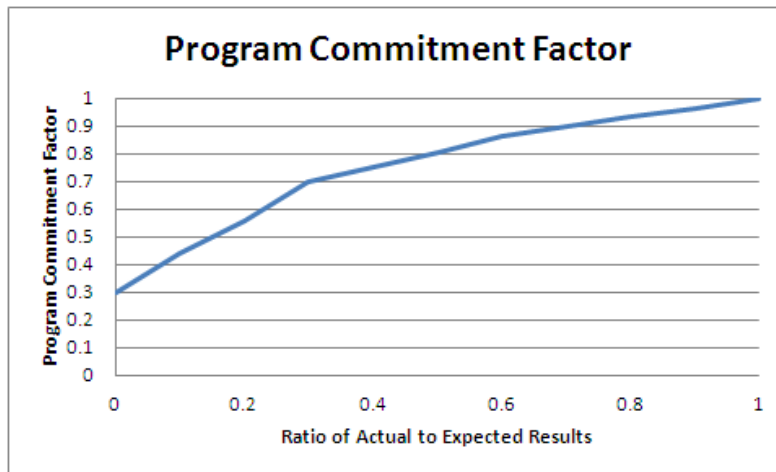


Figure 14. Program Visibility Factor Graphical Function

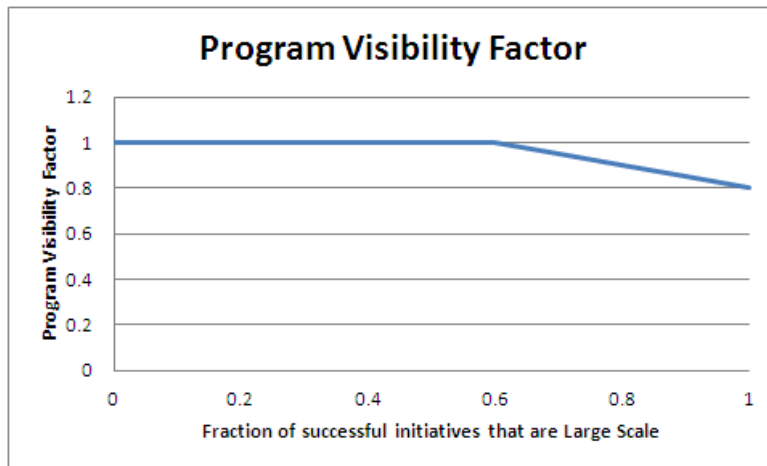
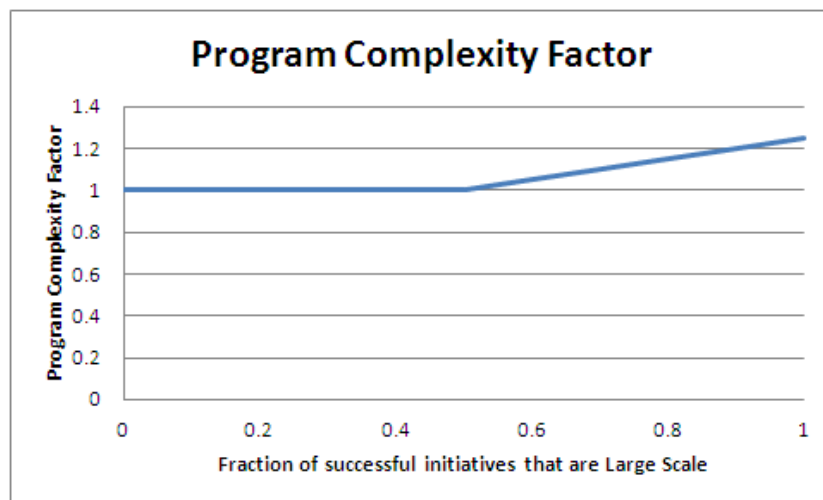


Figure 15. Program Complexity Factor Graphical Function



## Analysis

### Model Validation

The System Dynamics Model was validated against published results for Lean Enterprise Deployment for three (3) separate Large Health Systems. In all cases, systems reported implementing deployment interventions associated with strategic alignment in years 2-3 and strategic deployment in years 4-8. These interventions were input as exogenous model parameters during model validation.

**Health System #1** is a large public, integrated healthcare system located in the Midwest US. This system has published extensively about the Lean Enterprise Deployment that was initiated in 2005. This system reported an initial deployment strategy supported by external consultants with a focus on Large Scale, system-level initiatives. In year 2 of the deployment, this system reported a shift to a more balanced (large scale vs. small scale initiatives) approach with the training of over 250 additional facilitators and integration with unit-level management strategies. This system reports a completion of 416 initiatives since 2005, with over \$160M in financial benefit (Goodman, 2012). Model validation against the financial performance for this system is shown in Figure 7.

**Health System #2** is a medium teaching healthcare system located in the Western US. This system is widely recognized as being on the forefront of Lean Enterprise Deployment within healthcare and has also published extensively about transformation program efforts. This system has reported three transitions in the deployment strategy: reduction in efforts in Year 5 to allow for a “months long reflection period” where prior initiatives were re-measured and evaluated in order to address initiative sustainability issues. The outcome of this period was a revised deployment beginning in 2006 with additional resource allocation (facilitation and staff) and a balanced initiative portfolio (large scale vs. small scale initiatives). This system has not published on the program-level financial benefit of the Lean Deployment. As a result, model validation was conducted utilizing the reported Kaizen Activity (Kenney, 2011) as shown in Figure 8.

**Health System #3** is a large, multi-facility healthcare system located in the Eastern US. This system initiated an external consultant-supported Enterprise Lean Deployment in 2007 and to-date has not published on their Enterprise Lean Deployment, but shared information related to their deployment efforts and outcomes (HHC, June 11, 2013). This system has reported initiating strategic alignment (Hoshin Kanri) efforts in 2010 and strategic deployment (Daily Management System) efforts in 2012, resulting in completion of over 1300 Lean initiatives, with staff participation at over 7500 employees. The financial benefit of this program has been reported to be over \$300M. Model validation against the initiative starts, staff participation levels, and annual financial benefit is shown in Figure 9.

Figure 16. Model Validation – Health System 1

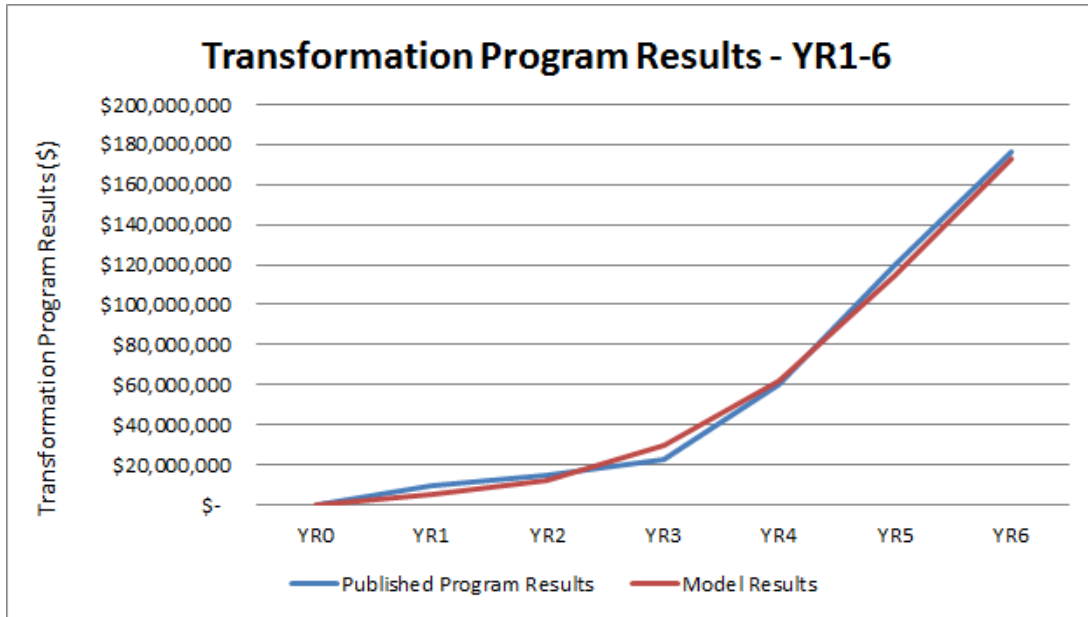


Figure 17. Model Validation – Health System 2

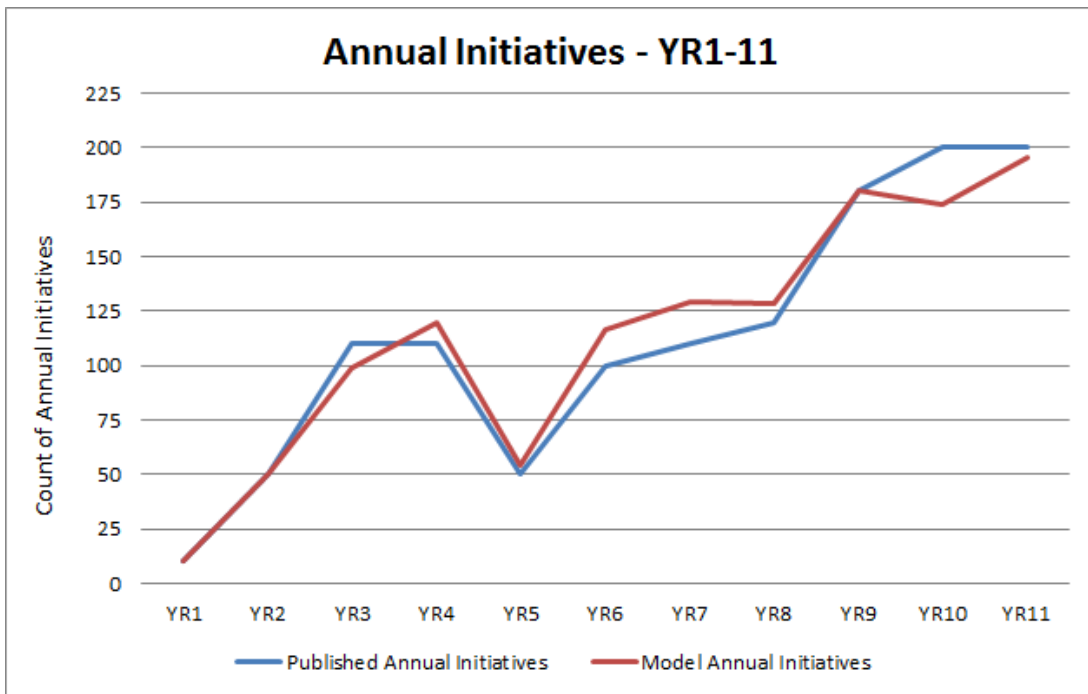
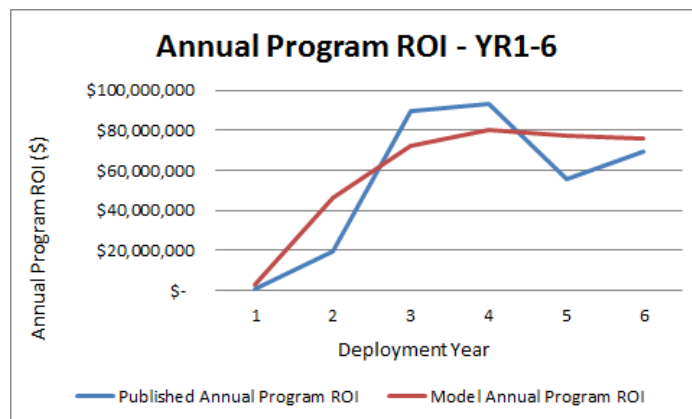
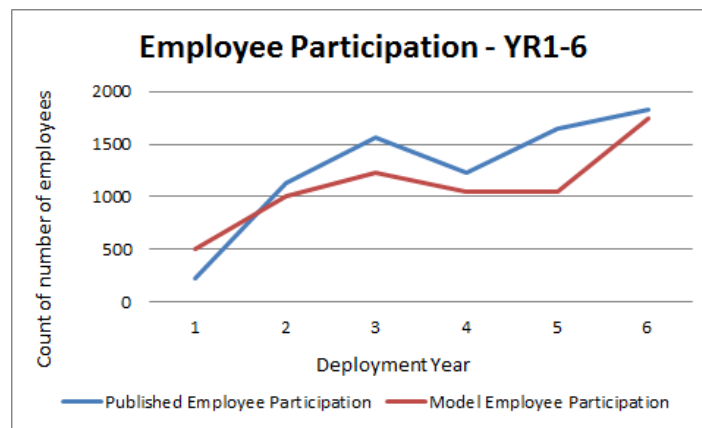
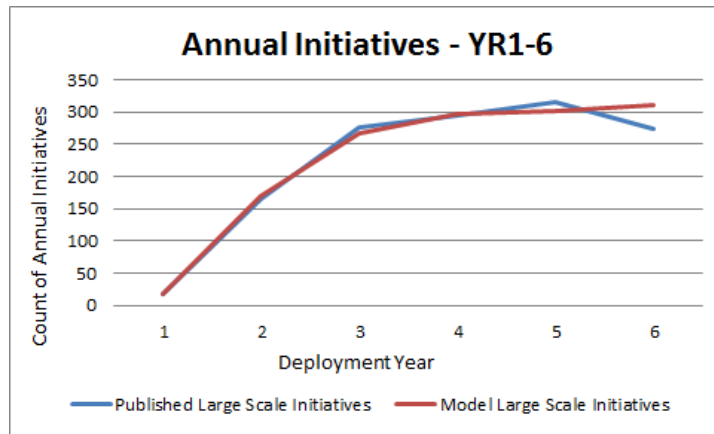


Figure 18. Model Validation – Health System 3



## Results

Multiple scenarios were run utilizing the SD model in order to evaluate specific program strategies with respect to the program results in comparison with baseline performance. In each case, baseline performance results were obtained by utilizing initial program setpoints typical of underperforming organizations: minimal initial staff/facilitator support for improvement efforts, low levels of external facilitation support, and a portfolio balance level of 100% Large Scale Initiatives. Additional scenarios were explored utilizing set point and ranges typical of Lean Transformation Deployments as outlined in the review presented in Chapter 1.

Table 9 (below) outlines the exogenous variable ranges and set points explored in the results section of this paper. Additional variable listings are presented in Appendix B.

Table 9. Exogenous Variable Ranges and Set Points for Scenarios 1-4.

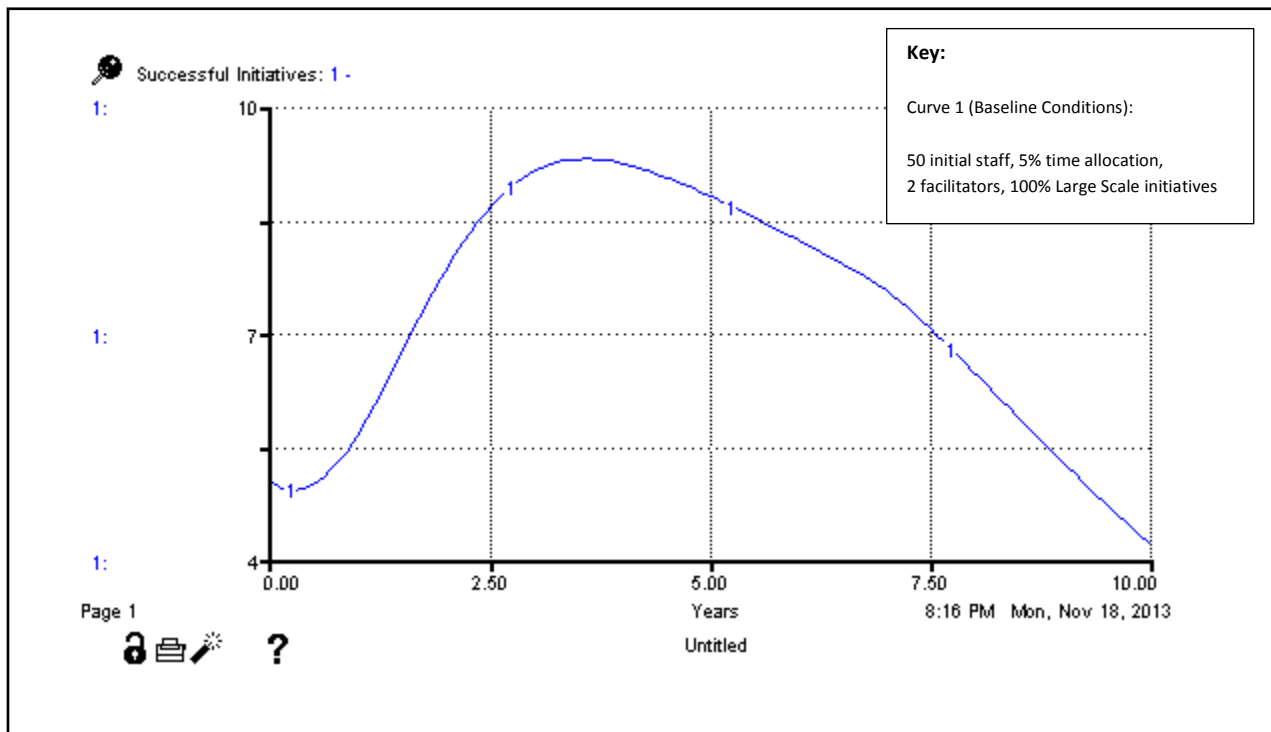
User Input Variables:	Variable Range	Low Performing Organizations	Moderate Performing Organizations	Moderate Performing Organizations	Robust Organizations (Dynamic Deployment Strategy)			
		YR1-10	YR1-10	YR1-10	YR1-2	YR3-5	YR5-9	YR9+
Initial Program Commitment (number of staff engaged in initiatives)	0-500	50-200	100-200	200	200	200	200	200
Initial Initiatives (count of initiatives during YR1)	0-20	5	5	5	10	10	10	10
Initial External Facilitators (count of external facilitators in YR1)	0-20	0	2	2	2	2	2	2
Pool of Potential Facilitators (count of staff that area available to be trained as facilitators)	0-250	10	10-40	40	10	30	50	50
Total Employees and Staff (count of the total number of employees within the organization)	1000-10000	3000	3000	3000	3000	3000	3000	3000
Fraction of Employee and Staff Hours Allocated to Program (fraction of work hours allocated to transformation program)	0-1.0	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Annual Investment Fraction (fraction of fiscal benefit invested in subsequent year program)	0-1.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Portfolio Balance Level (Fraction Large Scale vs Small Scale Initiatives)	0-1.0	1	1	1-50	1	0.8	0.5	0.2



Program Performance under baseline conditions:

As shown in Figure 19 (below), in underperforming organizations, the number of successful initiatives peaks in Year 2-3. After further examination of the interaction between model parameters, two primary constraints are identified: 1) insufficient staff capacity limits the number of initiatives started each year and 2) lack of facilitator capability results in a high initiative failure rate. These two constraints, limit the program results (note that the maximum number of successful initiatives peaks at less than 10), eventually reducing organizational commitment to the program, reducing program results in subsequent years. This phenomenon is well known in the literature and is commonly referred to as the “flavor of the month”. New organizational programs are introduced with great enthusiasm, but insufficiently resourced at the staff and expert level, resulting in poor program performance and dissolution of the program.

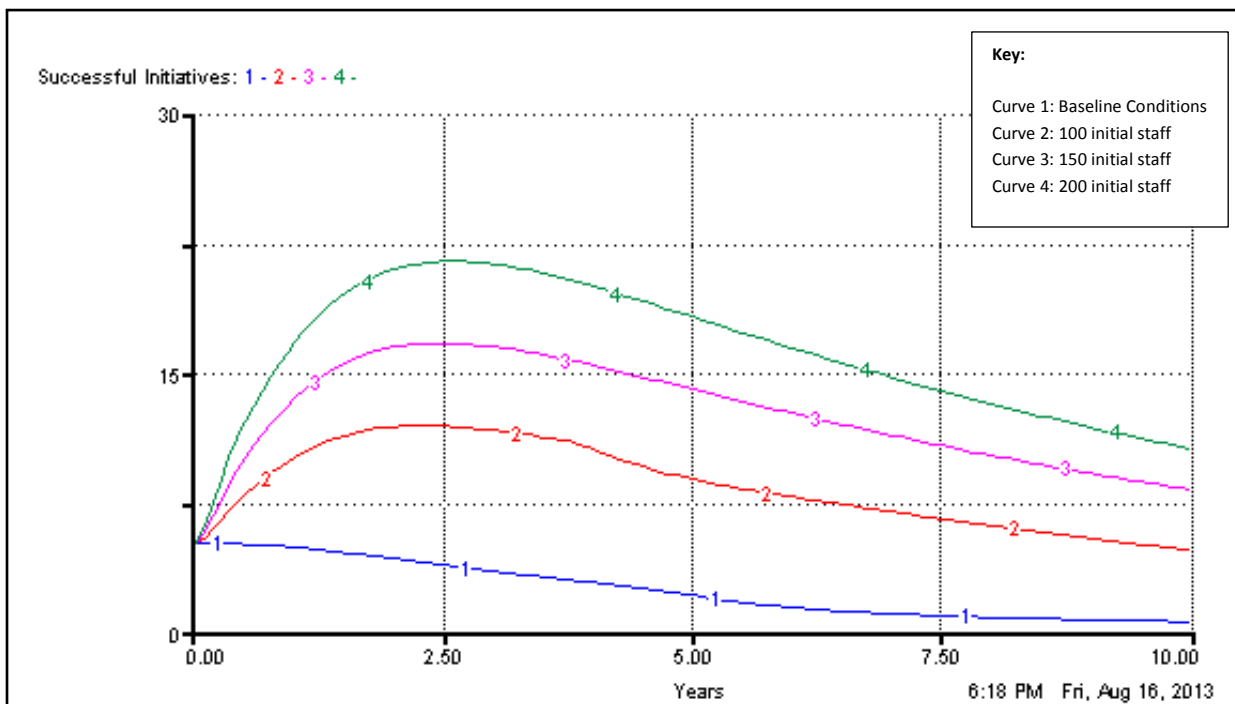
Figure 19. Count of Successful Initiatives by Year – Baseline Conditions



Scenario 1 – Low Performing Organization:

This scenario provides an evaluation of a deployment approach often used by low performing organizations – providing higher level of initial staffing levels in support of initiatives without providing any additional facilitator or expert capability. Curve 1 represents baseline at an initial staff commitment of 50 staff at 5% time allocation. Subsequent curves represent increases to 100, 150 and 200 initial staff commitment. Note that higher staff levels enable an increase in initiative ramp over time, improving the number of successful initiatives in the first 2-3 years. However, this positive impact is eventually negated by a lack of facilitator capacity, reducing the effectiveness of program efforts and resulting in higher initiative failure rates. This eventually leads to reduced perception of program value, program commitment and staff engagement, resulting in the eventual significant reduction in the number of new initiatives and subsequent program results.

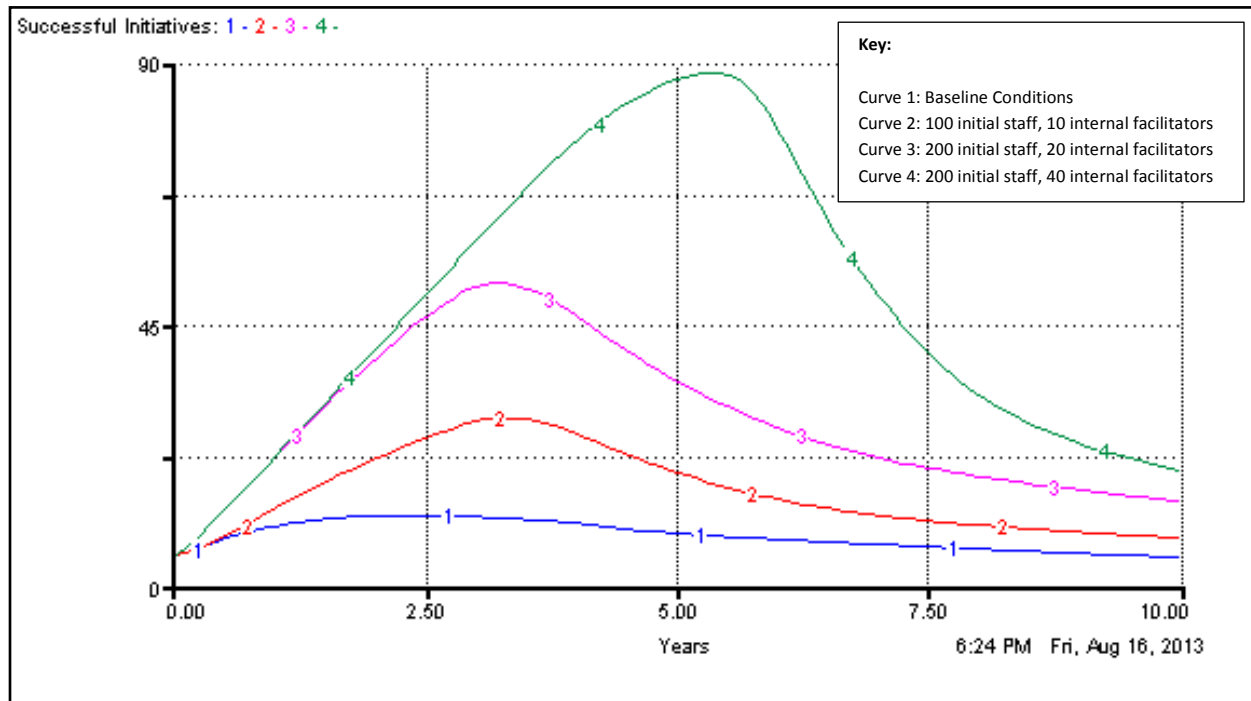
Figure 20. Count of Successful Initiatives by Year –  
Low Performing Organizations, Varying Staff Allocation



Scenario 2 – Moderate Performing Organization:

In an attempt to overcome initial staff and facilitator constraints highlighted in Scenario 1, organizations often attempt to increase staff capacity and facilitator capability as well as bring in external facilitator expertise to ‘jump-start’ the transformational program. Curve 1 represents the baseline results. Curve 2 represents an increase in facilitator capability from 2 to 10 internal facilitators initially available. Curve 3 represents an increase in facilitator capability from 2 to 10 internal facilitators initially available. Curve 3 represents an increase in staff (200) and facilitator support (20). Curve 4 represents an increase in staff (200) and the number of facilitators (40). Note that in curve 3 and curve 4 the increase in initial staff capacity and internal facilitators results in a significant increase in initiative ramp over the 1<sup>st</sup> 3 years (curve 3) and 5 years (curve 4). However, this increase eventually also increases the complexity of the overall program (due to the portfolio balance of 100% Large Scale initiatives). This increase in complexity results in a decreased initiative effectiveness and lower program commitment, eventually significantly reducing the program results.

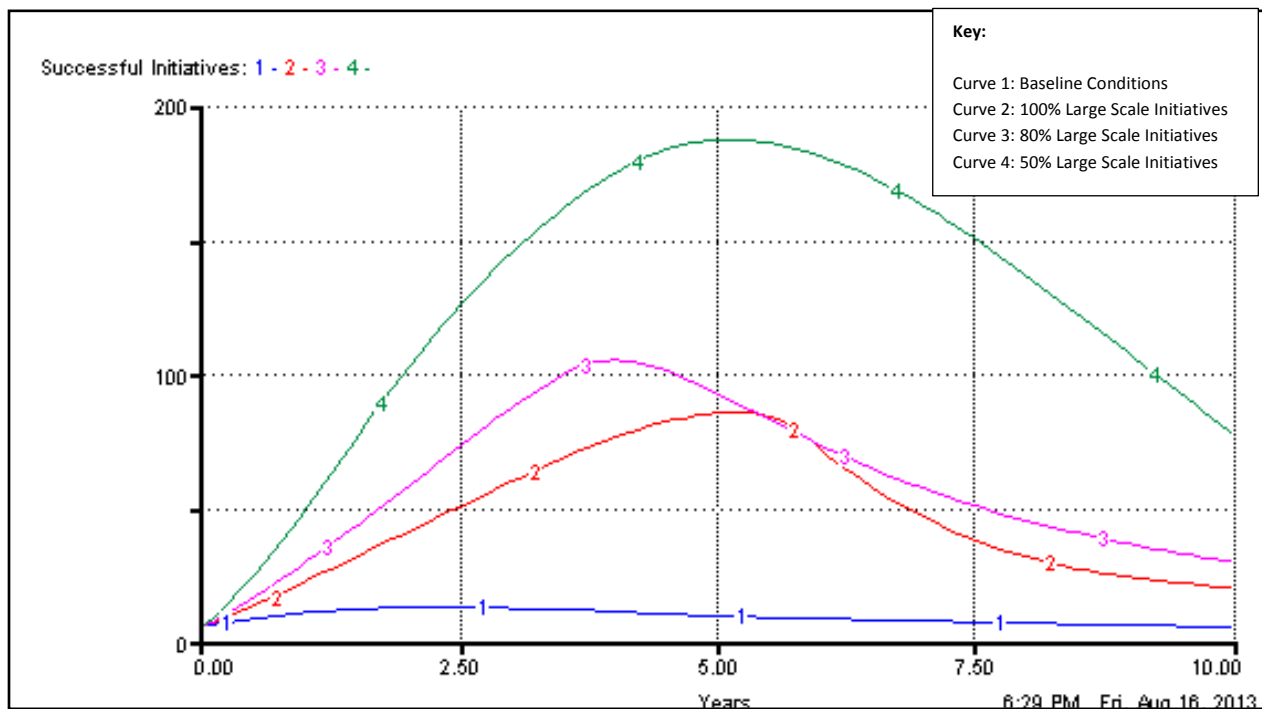
Figure 21. Count of Successful Initiatives by Year – Moderate Performing Organizations, Varying Staff and Facilitator Allocation



### Scenario 3 – Moderate Performing Organization:

The successful organizations reviewed in Chapter 1 all indicated a shift away from large scale, system-wide initiatives to a mix of small scale and large scale initiatives as key to their program success. This scenario attempts to evaluate the impact of the program portfolio balance (large scale vs. small scale initiatives) on program performance. Curve 1 represents the baseline. Curve 2 results were based on initial staff and facilitator levels were set to the maximum from Scenario 4 (200 staff, 40 facilitators), but at a program portfolio that represents 100% Large Scale Initiatives. Curve 3 represents 200/40 staff/facilitators, but at a program portfolio that represents 80% Large Scale/20% Small Scale Initiatives. Curve 4 represents 200/40 staff/facilitators, but at a program portfolio level that represents 50% Large Scale/50% Small Scale Initiatives. Note that at the more balanced program portfolio levels (80/20, 50/50), initiative ramp is significantly improved due to reduced support levels and time to completion for small scale initiatives, resulting in improved program results. Additionally, smaller scale initiatives do not contribute as significantly to the program complexity, allowing more stable initiative effectiveness. However, in Year 6, due to the significant number of initiatives, program complexity does increase beyond the capability and capacity of the program organization, eventually resulting in a significant decrease in program results.

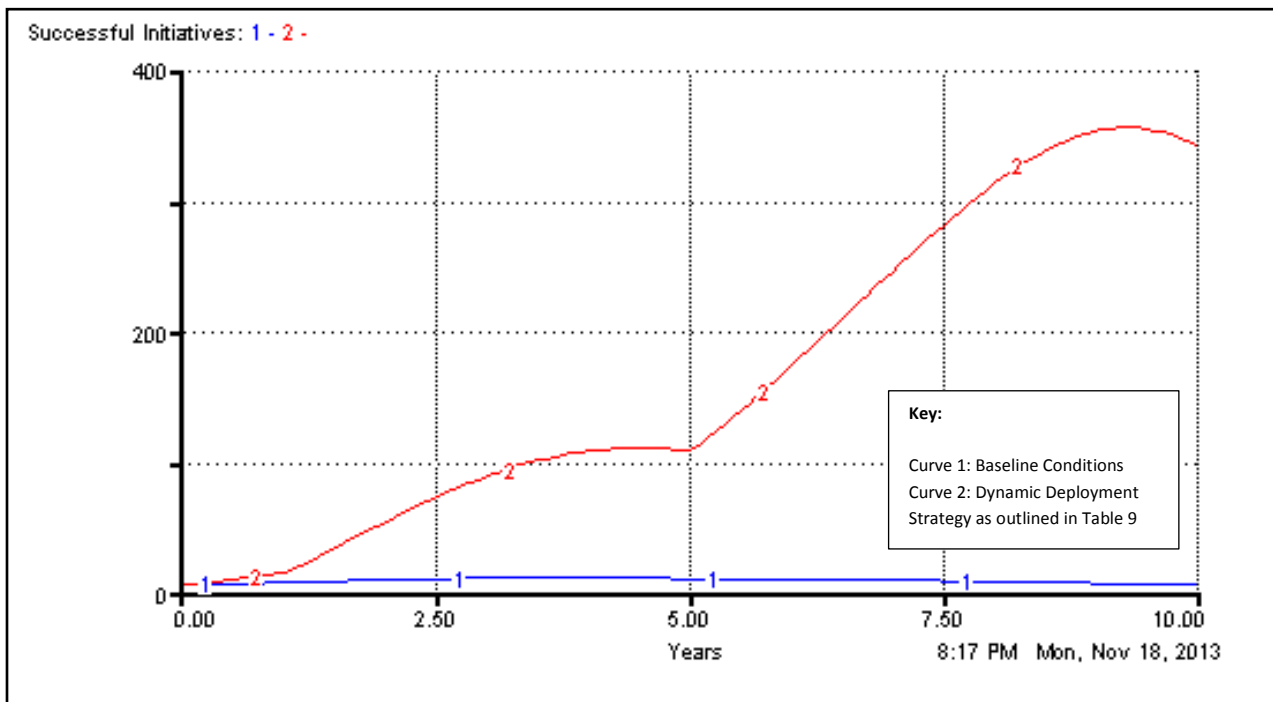
Figure 22. Count of Successful Initiatives by Year – Moderate Performing Organizations, Varying Portfolio Balance Levels



Scenario 4 – High Performing Organization:

The review presented in Chapter 1 indicates that high performing organizations utilized highly dynamic program implementation strategies, often adjusting initial staff and facilitator capacity as well as external facilitator capacity and portfolio balance levels in response to current program performance. In this scenario, exogenous variables were adjusted on an annual basis, based on prior year results, in order to optimize the staff, facilitation capacity, and the portfolio balance in order to maximize program results over time and sustain program performance beyond Year 10. Curve 1 represents the baseline results. Curve 2 represents staff and facilitator capacity levels adjustments on an annual basis to gradually increase capacity without significantly increasing the program complexity. Additionally, the portfolio balance was adjusted on an annual basis, starting at 100% Large Scale Projects for YR1, 80%/20% Large scale/small scale from YR 2-5, 50%/50% for YR 6+. Note the close match to the initial dynamic hypothesis.

Figure 23. Count of Successful Initiatives by Year – High Performing Organizations utilizing a Dynamic Deployment Strategy



## Discussion

The SD model sensitivity analysis clearly represents the importance of dynamic deployment strategies in creating successful, sustained enterprise-wide Lean programs. The results from this analysis indicate that initial conditions do not exist that would create sustained program results, even at very high staff and facilitator resource levels and with well-balanced initiative portfolios.

The transformational phases identified in Chapter 1 are shown to be the emergent response of highly experienced leadership teams shifting strategies to mitigate/eliminate identified gaps within program performance. Hence, the applications of these strategies potentially require a highly skilled, engaged and informed leadership team with a clear line of sight to program performance throughout the organization.

One concern highlighted from this finding is that the majority of leadership teams may not have the experience necessary to effectively navigate these transitional phases. An additional concern is whether compressing the deployment timeline is possible if leadership development/expertise is a primary constraint.

Potential options for overcoming this barrier include 1) creating a roadmap for Lean deployment that integrates the transitional phases without overwhelming the less experienced leadership teams with the complexity of a dynamic approach, 2) exploring/developing alternative deployment strategies that do not rely on leadership as the primary control and 3) developing healthcare leadership teams that are able to think in a more sophisticated and mature way about the dynamic deployment approaches.

## Conclusions:

We have created a System Dynamics model to test specific deployment scenarios typical of low, moderate and high performing organizations. Through the use of this model, we have confirmed the effectiveness of dynamic deployment strategies on the performance and sustainability of Lean Deployment Programs.

The next steps for this work are to continue to identify and test strategies to reduce the deployment timeline while improving long term sustainability of transformational Lean Enterprise programs. Additionally, we would like to continue to integrate additional strategies/mechanisms into the base iThink model and assess the impact of these strategies on program sustainability as well as to further explore the impact of organizational contextual features on the effectiveness of deployment strategies.

A secondary application of the SD model would be to inform strategic thinking on the part of Healthcare Executives as they consider the use and application of dynamic deployment approaches, such as those required for successful, sustained Lean Enterprise Deployment.

# Dissertation Conclusion

This research presents a body of work that describes an innovative framework for extracting, synthesizing and modeling the evidence base related to successful Lean Enterprise Transformation efforts in healthcare organizations. The focus of this work has been to critically review and synthesize the mechanisms that successful healthcare organizations utilize with their Lean Enterprise Transformation programs; link these mechanisms to specific deployment strategies through dynamic cross-case analysis techniques; and develop high-level theoretical hypotheses describing the dynamic nature of these deployment strategies. Within this work, systems approaches were utilized to translate these high-level theoretical hypotheses into mid-level dynamic hypotheses as well as operational models.

Our analysis indicates that no set of initial conditions exists that could insure sustainability of enterprise-level Lean Transformation Strategies over time. Additionally, the dynamic deployment strategies utilized by highly successful organizations in application of these strategies were found to be the emergent responses to mitigate or eliminate gaps in transformation program performance. As a result, the success of enterprise-level Lean Transformation programs will require highly skilled, engaged and informed leadership teams with a clear line of sight to program performance and a resilient management style.

We have also explored improvements to Lean Enterprise Transformation deployment strategies through the use of an operational system dynamics model. By using this model to test Lean Enterprise Transformation deployment scenarios, we have concluded that integration of Respect for People mechanisms, specifically higher levels of facilitator development and staff engagement, as well as Strategic Deployment mechanisms such as unit-based small-scale initiatives, earlier in the Lean transformation program, may improve program results.

Future plans for this work would be to test these findings by adapting deployment roadmaps utilized within healthcare organizations. Additionally, further investigation into the incentives that drive healthcare executives to deploy these types of transformational programs, in spite of the considerable expense of these programs as well as high rates of failure, may be useful.



# Appendix A: Glossary of Terms

**"True North" Drivers:** Critical goals (often less than 6) aligned with the designed outcomes from the enterprise-level transformation efforts.

**A3 Problem Solving:** standardized approach to process improvement often utilizing a single page (11"x17") format.

**Continuous Daily Improvement (CDI):** a concept of front-line staff, at the point that patient care is delivered, working to improve the systems and processes around them on a continuous basis.

**Hoshin Planning:** An overarching term used to describe policy deployment that includes a focus on shared goals, clear two-way communication pathways and accountability towards achieving those goals throughout the organization.

**Large System Transformation (LST):** the coordinated, system-side change affecting multiple organizations and care providers, with the goals of significant improvements in the efficiency of healthcare delivery, quality of patient care and population-level patient outcomes (Best, 2003).

**Lean Management System:** integration of Lean methods beyond the application of tools/methods within the initial stages of deployment. see Strategic Deployment.

**Plan-Do-Study-Act (PDSA) cycle:** cycle supporting basic improvement efforts (also known as Deming cycle or Plan-Do-Check-Act (PDCA) cycle).

**Rapid Improvement Events (RIEs):** focused improvement activities often compressed to 2-5 days. During the RIE, the improvement team applies Lean concepts and tools following an A3 improvement model. RIE events are often small scope/small scale to allow completion of activities within the compressed time frame. see Rapid Process Improvement Workshops (RPIW).

**Rapid Process Improvement Workshops (RPIWs):** see Rapid Improvement Events.

**Sensei:** External consultant utilized by organizations to advise on Lean Transformation efforts. Sensei typically advise through coaching and feed-forward guidance to executive staff.

**Strategic Deployment:** see Lean Management System.

**Toyota Production System (TPS):** Management method developed by Toyota post-WWII with a focus on creating value for the customer.

**Transformational Plan of Care (TPOC):** Strategic Planning process utilized to create the vision, goals and high level implementation plan for the upcoming year (see Transformational Value Stream).

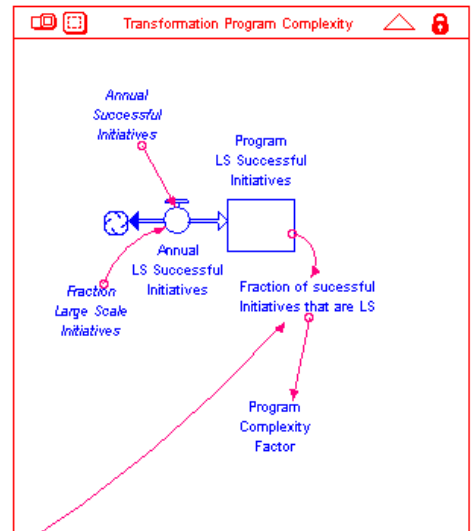
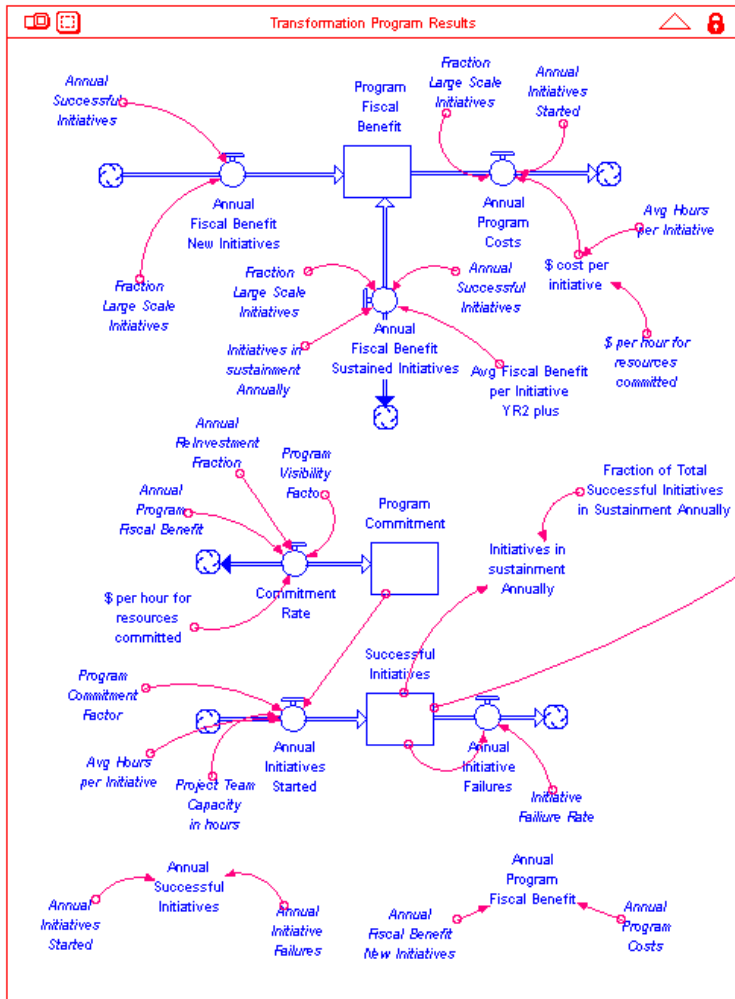
**Transformational Value Stream (TVSA):** see Transformational Plan of Care.

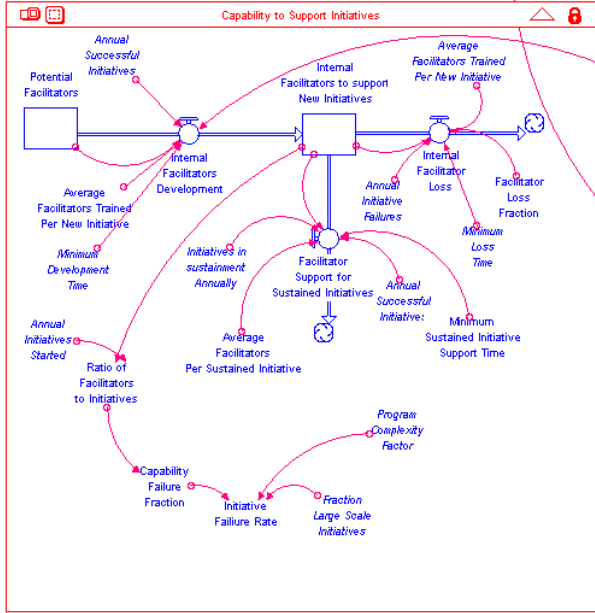
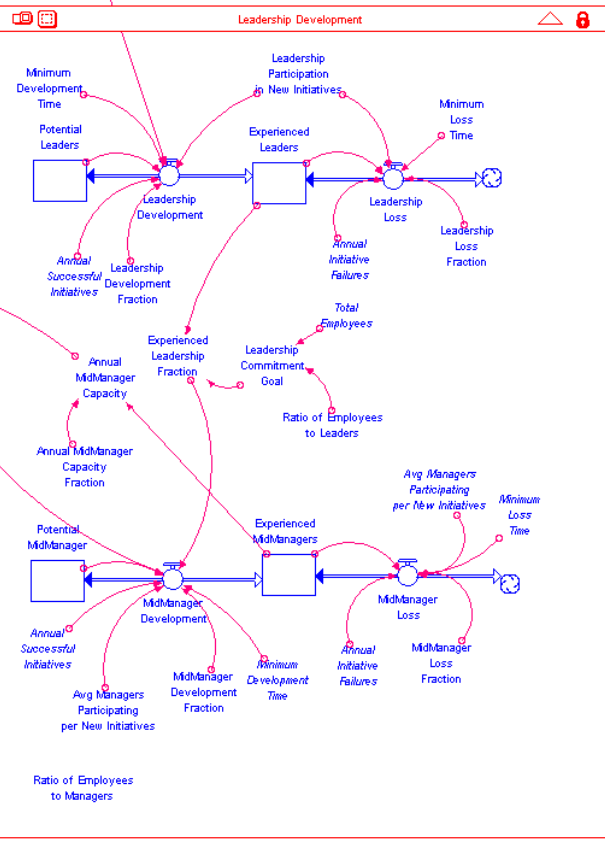
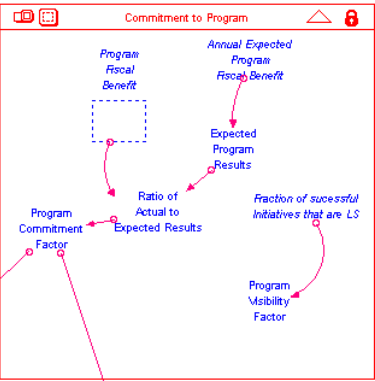
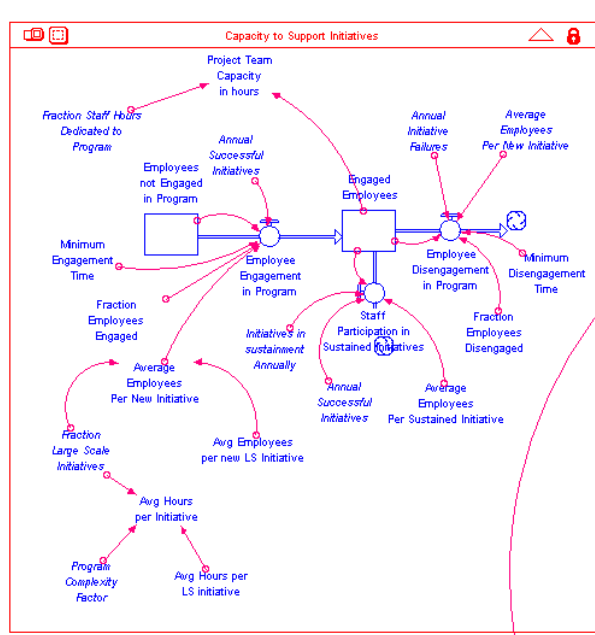
**Value Stream Analysis (VSA):** High-level tactical planning/problem solving session often utilized to identify follow-on Rapid Improvement Events.

# Appendix B: System Dynamics Model

## Exogeneous Variables

Initial Program Commitment Staff	Initial Initiatives	External Facilitators	Fraction Large Scale Initiatives	Internal Facilitators	Fraction Staff Hours Dedicated to Program	Annual Expected Program Fiscal Benefit	Annual Reinvestment Fraction	Total Employees
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## Appendix C: Constant Model Parameter Listing

<u>Constant Model Parameter:</u>	<u>Variable Setpoint</u>	<u>Source/Reference</u>
Average ROI per initiative (initial project year)	\$300,000	Dissertation, Chapter 1
Average ROI per initiative (subsequent project years)	\$100,000	Dissertation, Chapter 1
Average Cost per hour for staff resources	\$40/hour	Expert Panel Estimates
Average # of total manhours to complete each new large scale initiative (pre-sustain)	1000	Expert Panel Estimates
Average # of employees participating in each new large scale initiative	10	Dissertation, Chapter 1
Average # of employees participating in each initiative in sustainment	0.25	Expert Panel Estimates
Average # of facilitators supporting each new large scale initiative	2	Dissertation, Chapter 1
Average # of facilitators supporting in each initiative in sustainment	0.1	Expert Panel Estimates
Average # of mid-managers participating in each new large scale initiative	1	Dissertation, Chapter 1
Average # of executive leaders participating in each new large scale initiative	0.25	Dissertation, Chapter 1
Employee engagement rate per initiative	0.4	Expert Panel Estimates
Mid-Manager engagement rate per initiative	0.5	Expert Panel Estimates
Executive Leadership engagement rate per initiative	0.5	Expert Panel Estimates

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