ABSTRACT

KONG, SHERRI RENEE. Perceptions of How Problem-Solving Tools Facilitate Learning and Knowledge Creation in a Lean Event: A Case Study. (Under the direction of Julia Storberg-Walker.)

Lean methodology is a business philosophy focused on removing waste from processes and products. Lean provides a competitive advantage for organizations when they have a self-driven workforce that is able to resolve problems and meet the needs of the customers. Lean events, lasting 3-4 days, are focused efforts by a team to resolve a particular problem. A group of individuals related to the process or product are presented with a set of tools and facilitated by a Lean leader to determine the most efficient solution.

The purpose of this study was to examine the perception of learning and knowledge creation during a Lean event. In addition, this study looked for evidence of enablers and barriers of learning in the Lean organization. Grounded in the understanding that there are two types of knowledge, (e.g., tacit and explicit), this study examined reports of learning in Lean events for evidence of the four modes knowledge creation proposed by Nonaka and Takeuchi (Socialization, Externalization, Internalization, and Combination).

The findings of this study supported three of the four modes of knowledge creation described above. This study found that participants perceived learning as beginning with the externalization of knowledge. In this phase of a Lean event, an analysis of how each person currently performed their job was conducted. The study found the next learning phase occurred when the participants began collaborating to remove waste from their current processes and make their daily work more effective. In this second phase, they combined their knowledge to develop a more efficient process. Finally, participants perceived that evidence of learning was made apparent when individuals internalized their new “lenses” of
Lean and began seeing other areas of waste in their work. The ‘lens’ analogy reoccurred several times in the data, which suggested that the Lean event helped participants see things differently—even beyond the scope of the initial Lean event.

In terms of identifying enablers or barriers to learning, this study found that worker autonomy and intention (or shared goals) were the main enablers of learning. Participants in this study believed that empowering employees to work independently and take ownership (autonomy) was key to the success of the Lean event. In addition, they believed that a clear vision and support from the organization’s leadership (intention) created the environment for autonomy.

On the other hand, this study found that organizational stories, such as those that were generated by long-term, change-resistant employees, were identified as the main barrier to learning. Participants perceived that employees with a long tenure on the job seemed to be more attached to their current ways of performing their work and more emotionally reactive when asked to identify waste.

The results of this exploratory instrumental case study confirm that experiences of learning and knowledge creation are perceived to occur in a Lean event. Specifically, the study confirmed three of the four modes of knowledge creation identified in Nonaka and Takeuchi’s (1995) theoretical model. Implications include the ability to strengthen activities and exercises to enhance these three modes of knowledge creation. In addition, understanding how learning and knowledge creation occur during a Lean event could enable an organization to capitalize on the Lean methodology to become a learning organization. An awareness of the enablers and barriers of learning in a Lean event provides insight for Lean facilitators to make the event as effective as possible.
Perceptions of How Problem-Solving Tools Facilitate Learning and Knowledge Creation in a Lean Event: A Case Study

by

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A thesis submitted to the Graduate Faculty of
North Carolina State University
in partial fulfillment of the
requirements for the degree of
Master of Science

Human Resource Development

Raleigh, North Carolina

2012

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BIOGRAPHY

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ACKNOWLEDGMENTS

I would like to first thank my Mom for the many sacrifices you made for me during graduate school, especially the many hours of free babysitting and for keeping me caffeinated. Thank you Dad for the early morning conversations about my papers, helping me work through my thoughts. Thank you Claudio for supporting me in all of my goals, even when it required us to make big sacrifices. Although you cannot read this right now, I thank my little Ariel for your support, for sitting beside me and “studying” with your toy computer to keep me company.

Thank you Dr. Storberg-Walker for helping me through this process and encouraging me to be persistent. Thank you Dr. Chapman and Dr. Bartlett for your support and insight, for asking the right questions to clarify my thoughts and my writing. A special thanks to Dr. Machles for the coffee conversations. A big “thank you” to Dr. Guerdat for being flexible and helping me stay on the path to graduation.

The unsung heroes of my graduate experience, and probably of many other graduate students at the university, are Ann Rothe and her “Tripsaver” team. They were always on top of my requests and in communication with me throughout my entire program. I am greatly appreciative of their hard work.

A great big thank you to my mentor and friend Debbie Morris for the lunch conversations about my projects and for opening your contact list to help me with my papers for the past three years. Thank you also to my dear friends Chad and Claudia for your support in this process. Thank you Nadienka for helping me cross the finish line!
A special thank you to Tom Walencik and Lisa McNary, for teaching me how to use the tools and sharing your passion for them. Thank you John for the opportunity to work with the amazing students of Carolina Leadership Development, my original purpose for going to graduate school. Finally, thank you to all of my Genworth friends for the lessons and laughter during my summers there: Pranjal, Larry, Javier, Jill, Kika, Tommy, Greg, April, Gina, Jo Anne, Sara, Charlie, Lee, Joanne, Julia, Mike, Sarah, Lee, Geriel, Fritz, Dan, Jorge, Cheri, Theresa, John, Dao, Stephanie, and Yvette.
# TABLE OF CONTENTS

LIST OF TABLES ………………………………………………………………………………………………………… vii

LIST OF FIGURES ………………………………………………………………………………………………………... viii

CHAPTER 1: INTRODUCTION .................................................................................................................. 1
  Context of the Problem .......................................................................................................................... 1
    Learning and Knowledge Creation ...................................................................................................... 1
    Quality Management .......................................................................................................................... 4
    Lean .................................................................................................................................................. 5
  Problem .............................................................................................................................................. 6
  Theoretical Perspective and Analytical Framework ............................................................................. 7
    SECI Model ....................................................................................................................................... 8
    Enabling learning ............................................................................................................................... 10
  Purpose and Research Questions ......................................................................................................... 12

CHAPTER 2: LITERATURE REVIEW ...................................................................................................... 16
  Adult Learning Theory .......................................................................................................................... 16
    Experiential learning .......................................................................................................................... 16
    Situated Learning ............................................................................................................................... 18
    Communities of practice .................................................................................................................... 19
    Knowledge creation ............................................................................................................................ 20
  Knowledge Creation in Quality Management ...................................................................................... 22

CHAPTER 3: DESIGN AND METHODOLOGY ....................................................................................... 33
  Design ................................................................................................................................................ 33
  Participants ......................................................................................................................................... 35
  Data Collection ................................................................................................................................... 37
    Semi-structured interviews ............................................................................................................... 37
  Observations ....................................................................................................................................... 37
  Data Analysis ..................................................................................................................................... 38
  Trustworthiness .................................................................................................................................. 39
  Ethical Considerations .......................................................................................................................... 40
  Limitations of the Study ....................................................................................................................... 41

CHAPTER 4: FINDINGS ............................................................................................................................ 42
  Four Modes of Knowledge Creation .................................................................................................. 42
    Socialization .................................................................................................................................... 42
    Externalization ................................................................................................................................. 43
    Combination ..................................................................................................................................... 44
    Internalization ................................................................................................................................. 45
  Enablers .............................................................................................................................................. 46
  Intention .............................................................................................................................................. 46
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>A Priori Codes Based on Nonaka and Takeuchi (1995)</td>
<td>74</td>
</tr>
<tr>
<td>D1</td>
<td>Literature review of studies based on Nonaka &amp; Takeuchi (1995)</td>
<td>86</td>
</tr>
<tr>
<td>E1</td>
<td>Combined Coding Results</td>
<td>89</td>
</tr>
<tr>
<td>F1</td>
<td>Enabler Codes</td>
<td>93</td>
</tr>
<tr>
<td>G1</td>
<td>Barrier Codes</td>
<td>95</td>
</tr>
<tr>
<td>H1</td>
<td>Inductively Developed Thematic Categories</td>
<td>96</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 1  Knowledge creation process ................................................................. 3
Figure 2  SECI Model ........................................................................................... 8
Figure 3  Six Sigma practices classified by knowledge creation mechanism... 23
Figure 4  Knowledge creation spiral of ISO 9000:2000 ..................................... 24
Figure 5  Implementation model for Six Sigma to enable knowledge creation. 26
Figure 6  Model of relations between enablers and organization design ....... 27
CHAPTER 1: INTRODUCTION

Context of the Problem

It is commonly acknowledged that the global economy has made a shift from the industrial age to the knowledge economy. A focus on employee learning and creation of knowledge is replacing the concentration on physical resources. According to Teece (2000), knowledge is a competitive asset to the extent that it can be transferred and used inside the firm. Therefore, the challenge for management is to understand how to facilitate learning and make the best use of the knowledge created.

Learning and Knowledge Creation

In order to facilitate learning and knowledge creation in an organization, it is important to first clarify what “learning” means and what constitutes “knowledge”. Dahlgaard-Park (2006) asserted that the overuse of the word “learning” has resulted in a loss or distortion of the central meaning of the word. The ancient Chinese character for learning contains two characters: “to study” and “to practice repeatedly.” Learning is a holistic practice involving simultaneously both the mind (cognitive) and body (learning by doing) (Dahlgaard-Park, 2006). Although it may not always observable, Huber (1991) stated that learning occurs “if, through its processing of information, the range of potential behaviors is changed” (p. 89).

Stacey (2001) explained how learning occurs through interaction and exchanges between individuals consisting of four different types of signals. “Data” includes the objective facts about events. When a person assigns meaning to the data it becomes
“Information”. “Knowledge” is the framework used for evaluating and incorporating the new information and experiences. Finally, “Action” consists of the choices made based on knowledge. Therefore, knowledge creation is “the process of generating insight by extracting information from data and the application of knowledge is the testing of these insights” (Stacey, 2001, p. 22).

Polanyi (1983) posited that there are two types of knowledge: tacit and explicit. Explicit knowledge includes the skills that can be outlined in a resume. According to Polanyi, explicit knowledge can be transmitted in formal, systematic language. Tacit knowledge, which is more difficult to express in clear and precise terms, is built over years of experience, often manifesting itself as intuition (Nonaka, 1991). While explicit knowledge can be codified and documented, tacit knowledge is communicated through social relationships (Polanyi, 1983). Tacit knowledge also includes the personal experiences, assumptions and intuitions of a person.

While learning can be considered a social process where the interaction with others affects the knowledge that is created and stored in the minds of the individuals, the assumption is that it is the individual who ultimately learns and creates knowledge (Stacey, 2001). Simon (1991) emphasized that all learning takes place inside the minds of individuals. Song and Chermack (2008) asserted, “integrated individuals’ knowledge is regarded as the most critical asset beyond any other resources” (p. 425). Therefore, an organization learns either by the learning of its members or through integrating new members with new knowledge.

Balbastre, Otra, Martinez and Moreno (2003) proposed a model of individual learning
based on the assumption that learning is defined as a process with knowledge as the output (Fig. 1). Beginning with tacit and explicit information as the input or starting point, an individual processes this information through individual learning processes. Sources of this tacit information include organizational and group knowledge as well as external stimuli. Balbastre et al. also specified that an individual’s previous knowledge, skills, and attitudes influence learning.

The product or output of the individual learning is knowledge. Balbastre et al. (2003) defined knowledge as “information that has been subjectively contextualized, interpreted, and assimilated by an individual, group, or organization” (p. 256). Elaborating on Balbastre et al.’s model, Moreno-Luzón and Lloria (2008) stated that knowledge “constitutes the capability of know-about and know-how, in other words, it interprets the world around it and acts on that interpretation” (p. 255). Therefore, new knowledge comes from an individual’s capacity for turning different stimuli into knowledge through learning. Knowledge created
by an individual as a result of a learning process can be useful as an input for the learning process of another individual (Balbastre, Otra, Martinez & Moreno, 2003).

If the key to competitive success in the knowledge economy is the generation and management of knowledge through employee learning, then organizations must focus their attention on the practices that support this goal. Common organizational interventions deployed in today's knowledge-intensive firms are quality management initiatives. Dooley, Johnson, and Bush (1995) asserted that quality management practices have the potential to serve as the bridge for companies to move from the industrial age into knowledge economy.

**Quality Management**

Quality management practices emerged in Japan following the end of World War II. The focus of the quality movement was to rebuild Japanese industry and become more competitive in the global market. Around 1980, the United States started paying attention to quality management practices when the Japanese products began to equal and even exceed US standards of quality (Hayes & Abernathy, 1980). When American companies realized that they were losing their competitive advantage to Japanese companies, they sought ways to imitate these practices. American companies began looking to quality management as the solution to all problems and the majority of the Fortune 1000 companies adopted quality management practices (Mohrman et al, 1995).

Hendriks and Singhal (1997) conducted empirical research to determine whether effective implementation of quality practices resulted in improved financial performance. In their study, Hendriks and Singhal selected 400 quality award winners from 1983 to 1993. The rational for selecting these 400 companies is that winners of quality awards undergo a
rigorous screening process and are recognized for effective implementation, regardless of financial performance. They examined the accounting records of the companies over a ten-year time period to test for changes in operating performance. The results of the study showed that overall quality award winners boasted a higher operating income and sales growth than the control group. However, over a long period of time, the overall operating costs showed little difference from companies that were not using a quality management program (Hendriks & Singhal, 1997). These results raised questions about whether the solutions produced by quality management programs are sustainable. Dooley, Johnson, and Bush (1995) argued that sustainability comes from learning.

**Lean**

Lean, also referred to as lean manufacturing, lean production or lean thinking, is a management philosophy originating in the Japanese practices of eliminating *muda* or waste in automobile manufacturing, specifically at Toyota. Waste is “everything that increases cost without adding value for the customer” (Dahlgaard & Dahlgaard-Park, 2006, p. 267). The core of Lean is continuous improvement of both process and product.

According to Feld (2000), the Lean process is highly dependent on the ability to transfer employee knowledge. The competitive advantage in Lean is accomplished through a self-directed workforce driven by outcome-based measures in alignment with customer performance requirements (Feld, 2000). A Lean event, also called a Rapid Improvement Event or kaizen blitz, is a weeklong event focused on a particular issue. Although the focus in Lean is on removing waste, a secondary benefit is improving the quality of products and processes. For this reason, many Lean organizations also ascribe to the same practices and
tools as total quality management programs such as Six Sigma. For this reason, the literature on learning in Six Sigma may also be applicable in studying a Lean organization.

**Problem**

Sitkin, Sutcliffe, and Schroeder (1994) contended that quality management practices are comprised of two fundamental goals: control and learning. Choo, Linderman and Schroeder (2007) asserted that knowledge types (explicit and tacit) and learning processes (exploitative and exploratory) are two key aspects of quality advantage and sustainability. Quality management programs use problem-solving tools that can significantly impact individual learning and contribute to a company’s competitive advantage.

Choo et al. (2007) explained that while the potential for exploration and knowledge creation is inherent in quality practices, companies often focus more on the exploitation and control aspect. Comprehensive quality programs place a strong emphasis on methods to measure and improve organizational processes. Quality initiatives and Lean events are usually action-oriented and focus on the improvement of existing processes and products within an organization. Sitkin et al. (1994) pointed out that the documentation requirements of many organizations focus on combining the explicit knowledge of employees with the intention of improving control over a process. Therefore, treating control as a priority may preclude a necessary emphasis on learning (Choo et al, 2007).

Sitkin et al. (1994) expressed their concerns that potential contributions of quality practices may be lost if organizations do not recognize and exploit the various types of learning that occurs in a quality initiative. Cameron (1986) encouraged organizations to learn how to manage the paradox of effectiveness. Focusing on control is important to
improve and maintain efficiency in existing practices. However, Choo et al. (2007) argued that an over-reliance on control could lead to overlooked opportunities for new advantages.

While learning may be inherent in Lean events, there are contributing factors or enablers within the organization that heighten the individual employee’s ability to learn from quality initiatives. In the same way, certain elements or circumstances in organizations act as barriers to the generation and or transfer of knowledge. Employees may not always recognize the organizational elements that enable or hinder their learning.

Understanding how learning occurs during a Lean event is essential to exploiting the full potential of the Lean tools. Employee learning plays an important role in the long-term success and sustainability of an organization. Therefore, if learning is inherent in using the tools during a Lean even, then organizations only need to turn their attention to promoting the enablers and reducing the barriers to learning.

**Theoretical Perspective and Analytical Framework**

As previously mentioned, knowledge is often divided into two categories: explicit and tacit. Explicit knowledge is easily transformed and acquired through practice, repetition, reinforcement, imitation, socialization or logical deduction and formal study (Akbar, 2003). According to Akbar, explicit knowledge is internalized through immersion, assimilation, experience, trial-and-error, learning-by-doing, observation, imitation and practice.

Tacit knowledge is person-embodied and ingrained, making it difficult to be formalized, organized or aggregated at a single location. Nonaka and Takeuchi (1995) affirmed that tacit knowledge has a cognitive dimension consisting of mental models and beliefs as well as a technical dimension gained from hands-on experience. People acquire
tacit knowledge as they actively create and organize their personal experiences.

**SECI Model**

Stacey (2001) explained how knowledge “arises in complex responses between human bodies, that knowledge itself is continuously reproduced and potentially transformed” (p. 3). Nonaka and Takeuchi explained that the creation of knowledge is a social process between individuals. The SECI model developed by Nonaka and Takeuchi (1995) presented four modes of knowledge conversion: Socialization, Externalization, Combination, and Internalization (Fig. 2). In the spiral of knowledge creation, these four modes are first experienced at the individual level and then become articulated and amplified at a group and organizational level.

![SECI Model Diagram](image)

**Figure 2. SECI Model**


Socialization is the conversion of tacit knowledge to tacit knowledge. Through sharing experiences, individuals can learn tacit skills from others without the use of language. For example, apprentices learn their trade through observing and imitating the
masters. Without the shared experience in the conversion of tacit knowledge to tacit knowledge, it is difficult for a person to make sense of the information outside of the specific context.

Externalization, the conversion of tacit to explicit knowledge, involves the articulation of a mental image through the use of metaphor or analogy. A metaphor is “a way of perceiving or intuitively understanding one thing by imagining another thing symbolically” (Nonaka & Takeuchi, 1995, p. 66). An analogy highlights the commonality of two different things to convey knowledge that is difficult to articulate. According to Nonaka and Takeuchi, externalization is the key to knowledge creation and innovation.

Combination involves knowledge conversion by combining different pieces of explicit knowledge. This type of knowledge conversion commonly occurs through shared documents, meetings, emails, or telephone conversations. Formal education and training are other ways to transmit explicit knowledge.

Internalization involves the conversion of explicit to tacit knowledge, the process of “learning by doing”. According to Nonaka and Takeuchi (1995), the process of internalization resembles the ACT model of cognitive psychology. In order for cognitive skills to develop for activities such as riding a bike or playing a piano, explicit knowledge must first be converted to procedural knowledge. After repeatedly using the tools, the new ways of seeing and analyzing problems becomes tacit and automatic.

On its own, socialization is a limited form of knowledge creation because it cannot be leveraged by the organization until it is made explicit. In the same way, combining the explicit knowledge from several different contributors does little to extend the existing
knowledge of the organization. Knowledge creation practices that result in a competitive advantage involve “a continuous and dynamic interaction between tacit and explicit knowledge…shaped by shifts between different modes of knowledge conversion” (Nonaka & Takeuchi, 1995, p. 70).

**Enabling learning**

Although management cannot force learning or knowledge creation, they can find ways to enable the process of learning by creating intentional interventions. Nonaka and Takeuchi (1995) proposed five enablers of knowledge creation: 1) intention 2) autonomy 3) fluctuation and creative chaos 4) redundancy and 5) requisite variety. In addition, Nonaka and Takeuchi discussed the importance of creating an environment of trust.

An organization’s goals and vision set the intention for the organization. The organization’s strategy is the way it aspires to meet its goals. Nonaka and Takeuchi (1995) emphasized that in order for an organization to enable learning and knowledge creation, they must identify the types of knowledge necessary to meet their goals and develop a plan for how that knowledge will be incorporated into the organization’s strategy.

Knowles (1990) asserted that independence is important for influencing adult learning. Therefore, autonomy is an important enabler for developing independent learners within an organization. Nonaka and Takeuchi (1995) explained that the knowledge gained and created from an individual learner diffuse to the team and then out to the organization.

Fluctuation and creative chaos involve the interaction between the organization and its external environment. While this fluctuation occurs naturally in the external environment, Nonaka and Takeuchi (1995) posited that organizations that are openly receptive to adapting
to changes in the external environment. Besides responding to external changes, organization leaders can also instill a sense of crisis or urgency within the organization to define and resolve a pressing problem. In their study of enablers of knowledge creation in Spanish companies, Moreno-Luzon and Lloria (2008) stated that they did not find evidence that fluctuation instigated within the organization enhanced knowledge creation.

Redundancy involves the availability of information beyond the immediate needs of the organizational members. The sharing of tacit knowledge is particularly important in the concept development stage because it provides the opportunity for individuals to cross the boundaries of organizational function to offer different perspectives, advice, or new information. Incorporating strategic rotation into the company or developing internal competition for projects are other ways to offer different perspectives about a problem (Nonaka & Takeuchi, 1995).

Variety, or the internal diversity of a company, should assist the organization in adapting to changes in the external environment (Moreno-Luzon, & Llora, 2008). This internal diversity offers a variety of viewpoints and perspectives about the same information (Nonaka & Takeuchi, 1995). Requisite variety is the bridge between external fluctuation and redundancy since open access to information for people of differing perspectives strengthens the organization’s ability to respond to changes in the external environment.

If creating knowledge requires the sharing of knowledge, then it is important to develop a context in which members are motivated to share and learn. Trust provides a context of security for employees to share their individual knowledge. A lack of a context of trust results in a dependence on individual experience to resolve a complex task rather than
using the combined knowledge of individuals sharing and creating knowledge (Von Krogh, 1998).

**Purpose and Research Questions**

Managers and practitioners may not recognize that in planning a Lean event, they are setting up a knowledge management application (Wu & Lin, 2009). Therefore, it is important to understand how knowledge is created and transferred in order to create the conditions most favorable to learning in a Lean event. Using Nonaka and Takeuchi’s knowledge creation model, this study builds on previous studies in exploring the factors that may influence or hinder learning and knowledge creation during a Lean event.

Learning is important for the development of best practices. The bottom line is impacted when future projects are completed more quickly due to the knowledge gained from previous projects. Understanding how adults learn and create knowledge during a Lean event allows organizations to enhance the conditions for learning with the expectation that the learning will lead to more effective solutions.

This study examines three questions related to adult learning and knowledge creation during a Lean event:

1. How do adults perceive learning and/or knowledge generation during a Lean event?

Akbar (2003) claimed that knowledge creation should not be separated from individual learning. *Learning* is defined by Akbar as the process of gaining knowledge about cause and effect relationships as well as the external effects on these relationships. Akbar defined *knowledge* as the subjective storage of aggregate knowledge or expertise.
The transfer of knowledge is key for learning and knowledge generation. While information gathering is an individual process, learning is a social process: knowledge is transferred in the context of relationships with other people (Nonaka & Takeuchi, 1995). Therefore, it is important to identify the circumstances that enable or inhibit the transfer of knowledge as this impacts learning and knowledge generation.

2. What enablers facilitate employee learning and knowledge creation during a Lean event?

Five enablers were examined in this study. Intention incorporates the vision and mission of the organization as well as a sense of shared goals and objectives among participants. Autonomy refers to the involvement of individual participants as well as the ability and opportunity to work independently. Redundancy refers to the sharing of information in open dialogue. Variety implies easy access to information as well as the availability of diverse views and perspectives. Finally, trust entails an environment of mutual care and respect.

3. What are the barriers to learning or knowledge creation during a Lean event?

Von Krogh et al. (2000) identified several different barriers to transfer of knowledge: hoarding of knowledge, the need for a common language, organizational stories, company paradigm, and company procedures. The hoarding of knowledge was not on the initial list of barriers in Von Krogh et al., but was mentioned later in their conversation about the role of inclusion in knowledge transfer. Relationships are key to the transfer and sharing of tacit knowledge as this knowledge transfer occurs in sharing the same space with others.
Akbar identified the role that language plays in the externalization of tacit knowledge. In using the tools of Lean, a common language is established making it easier to transfer knowledge. The practice of providing operational definitions in quality management should also assist in creating a common understanding of language. Developing operational definitions is also an important way to make tacit knowledge explicit.

Organizational stories may also work as barriers to organizational learning. Seemingly new ideas are often filtered through organizational stories to determine if something similar was attempted in the past. This filter may cause resistance and preclude conversations for organizational members with more years of experience. However, organizational stories have the potential of enhancing learning and knowledge creation if the participants are willing to engage in a dialogue about the similarities and differences between the ideas and the story.

Similar to organizational stories, the company paradigm serves as the outward filter for scanning an organization’s external environment. The company paradigm is also used along with the organizational stories to socialize its members into a common way of thinking. However, Von Krogh et al. (2000) pointed out that a company paradigm that places value on the creation of knowledge could actually enhance learning within the organization.

Summary

Company procedures that follow Lean methodology should facilitate the transfer of knowledge. However, as Choo et al. (2007) indicated, companies often use quality management for control rather than learning. Therefore, it is necessary to take a critical look
at whether the company procedures that were implemented for facilitating the flow of information really inhibit the generation and transfer of knowledge.

If the opportunity to learn and create knowledge is inherent in the Lean methodology, then it is important for Lean organizations to understand how to facilitate learning during a Lean event and make the best use of the knowledge created. An awareness of the enablers of learning and knowledge creation during a Lean event could serve as a guide for planning the Lean event to ensure that learning and knowledge creation are emphasized in the process. Identifying the barriers to learning and knowledge creation during a Lean event prepares the facilitators to mitigate potential hindrances both in the planning and facilitation of a Lean event.
CHAPTER 2: LITERATURE REVIEW

Adult Learning Theory

In order to address the research questions, an overview of adult learning theories in the workplace provides a foundation for understanding the process of adult learning and the conditions that enhance or inhibit the process. There are multiple theories on how adults learn in the workplace including experiential learning, situated learning, communities of practice, and knowledge creation. One key thread that is apparent in the various theories of learning in the workplace is an emphasis on experience. Experience embodies both the mental and physical aspects of learning.

Experiential learning

David Kolb (1984) introduced his experiential learning theory as a holistic perspective that integrated experience, perception, cognition, and behavior. Kolb proposed that learning should not be viewed as a series of outcomes but rather, as a continuous process of shaping and reshaping concepts. This cycle consists of four kinds of abilities: concrete experience (CE), reflective observation skills (RO), abstract conceptualization skills (AC), and active experimentation (AE). Kolb’s Experiential Learning Cycle is based on the contributions of Kurt Lewin, John Dewey, and Jean Piaget.

Kurt Lewin demonstrated the role concrete experience plays in testing and assigning personal meaning to abstract concepts. According to Lewin, learning begins with a concrete experience and is followed by a collection of data and observations about that experience. Lewin also emphasized the importance of feedback processes in reflecting on the
consequences of action. Hypotheses made from reflecting on observations act as guides for future actions.

John Dewey’s model of experiential learning is similar to Lewin’s model in the emphasis of learning as a dialectical process (Kolb, 1984). However, Dewey emphasized postponing action to make observations about possible consequences, referred to as “judgment”. In other words, Dewey stressed that learning involved understanding when to resist original impulses due to an anticipation of possible consequences.

Jean Piaget proposed his theory of the cycle of learning for the development of adult thought. Through interacting with the external environment, the individual develops mental concepts and schemas. New experiences are interpreted through these mental models resulting in either accommodation or assimilation. In accommodation, the mental models adapt to the experiences whereas in assimilation the individual imposes a concept regardless of external realities. According to Piaget, this cycle between accommodation and assimilation should move an individual through higher levels of cognitive thinking (Kolb, 1984).

Reflecting on the work of Lewin, Dewey and Piaget, Kolb (1984) described the most effective learning environment as one where there is “dialectic tension and conflict between immediate, concrete experience and analytic detachment” (p. 9). This dialectical tension involves experiencing events at one end and abstract conceptualization on the other. It also involves the tension between active experimentation and abstract conceptualization. Therefore, an individual moves between being actor to observer, from specific involvement to analytical detachment (Kolb, 1984).
Piaget (1978) described knowledge creation as one of three processes: knowledge emerges from the object, is created by the subject, or is the result of multiple interactions between subject and object. Kolb (1984) stressed that learning is the process of creating knowledge. According to Kolb, “knowledge results from the transaction between these objective and subjective experiences in a process called learning” (p. 37).

**Situated Learning**

Learning is a cyclical process that occurs within a context. The contextual aspect of learning is important because it acknowledges the role that the environment, power, and social interaction play in learning (Mackeracher, 2002). According to McLellan (1996), “knowledge is a product of the activity, context, and culture in which it is developed and used” (p. 101).

Brown, Collins, and Duguid (1989) introduced the concept of situated learning and credited the works of Vygotsky, Leontiev, Dewey, and Lave as being influential on their own work. In their theory of situated cognition, Brown et al asserted that learning is meaningful when it is embedded in the same physical and social context that it will be used, such as in the actual workplace. Brown et al argued that learning abstract concepts independent of the context overlooks the way that understanding develops through continued use.

In the Lean environment, employees who learn to use a tool actively develop a better understanding of the world in which they use the tool as well as the tool itself (Brown, Collins, Duguid, 1989). A person cannot be asked to use a tool without having learned the culture. Tacit and explicit knowledge are both important for the use of tools, whether they are analytical or physical tools. This tacit dimension of situated knowledge, developed
through experience, assists practitioners in responding to ill-structured problems and ambiguous solutions (Mackeracher, 2002).

Communities of practice

Based on the theories of situated learning, Lave and Wenger (1991) developed the concept of “communities of practice”. Lave’s work in studying apprenticeships in Liberian tailor shops led to the recognition of “a common structured pattern of learning experiences without being taught, examined, or reduced to mechanical copiers” (Lave & Wenger, 1991, p. 9). Lave and Wenger labeled this learning “legitimate peripheral participation”, an ongoing process of gaining acceptance in a community of practitioners through the gradual mastery of knowledge.

Wenger (1998) emphasized that communities of practice are comprised of informally bound members who are mutually engaged in sharing resources and knowledge. Wenger (2000) argued that communities of practice are the basic building blocks of social learning because competences are defined by one’s participation in a community of practice. Communities of practice also preserve tacit forms of knowledge that are not easily captured in a formal system. In addition, they exist as a home for identities since they are organized around what is important to the members. (Wenger, 1998)

Lave and Wenger (1991) asserted that learning is a social phenomenon shaped by hands-on experience through legitimate peripheral participation in a community of practitioners. As knowledge and meaning are socially negotiated and open-ended, Lave stressed that obtaining and internalizing knowledge should not be the end goal of learning.
Rather, ongoing participation in a shared community of practice should be the goal of learners.

Learning is referred to as a dialectical process since it involves dialogue with the self and with others. Meaning is created when information is exchanged with the environment and with other people (Mackeracher, 2004). In the dialectical process, individuals must feel empowered to give voice to their knowledge and ideas or the exchange of information will be hindered. Lave and Wenger (1991) pointed out that being able to speak the vocabulary and tell the stories of a culture of practice is fundamental to learning. Therefore, a situated learning environment promotes articulation to enable tacit knowledge to be made explicit (Collins, Brown and Newman, 1989).

It is important to note that communities of practice are not synonymous with teams. Communities of practice differ from teams since participation and the sharing of knowledge are due to mutual interest rather than an assigned task or problem. While the theory promotes an awareness of the informal networks and the influence they exert on knowledge sharing practices within an organization, this theory is not appropriate for the study of a Lean Six Sigma organization that relies heavily on the participation of cross-functional teams. However, Wenger (1998) noted that while knowledge is actually created within communities of practices, it is then brought to teams for the accomplishment of assigned tasks.

**Knowledge creation**

Nonaka, Toyama, and Konno (2000) emphasized that rather than merely solving problems, “organizations create and define problems, develop and apply new knowledge to solve the problems, and then further develop new knowledge through the action of problem
solving” (p. 6). For this reason, a firm’s greatest asset is the ability to continuously create new knowledge out of its existing capabilities. According to Nonaka and Takeuchi (1995), an organization creates knowledge through the interactions between explicit and tacit knowledge.

Nonaka (1991, 1994) asserted that knowledge creation is not through the “processing” of information rather, it is created through a continuous dialogue between tacit and explicit knowledge. Tacit knowledge is made explicit through the use of metaphors, models and analogies. Ideas originate in the minds of individuals and the interaction with and feedback from others develops the original idea (Nonaka, 2004). When the ideas of one person interact with the ideas of others and receive feedback, learning and new knowledge is produced.

Nonaka and Konno (1998) developed the concept of ba, or shared space for knowledge creation. Knowledge is embedded in ba where it is acquired through one’s experience or reflections. The concept of ba incorporates the important role that the context of a situation plays in the creation of knowledge.

Nonaka and Takeuchi (1995) proposed the SECI model outlining the four modes of the knowledge creation process: socialization, externalization, combination, and internalization. Nonaka et al. (2000) elaborated on the four modes of knowledge creation by providing examples of behavior reflecting each type of knowledge transfer. The first mode, socialization, involves the translation of tacit to tacit knowledge through shared experiences. Socialization occurs in traditional apprenticeships or at informal social meetings outside of the workplace. Externalization is the process of articulating tacit to explicit knowledge. One
example of externalization is the process of concept creation in the development of a new product.

Combination involves converting explicit knowledge into more complex and systematic sets of explicit knowledge. A financial report involves combining pieces of information from a variety of sources into one cohesive document. Finally, internalization is the process of embodying explicit knowledge into tacit knowledge. As explicit knowledge is distributed throughout the organization, individuals internalize the knowledge through experience or learning by doing.

Critics of Nonaka and Takeuchi’s model argued that tacit knowledge does not exist solely within the individual. Tsoukas (1996) asserted that tacit knowledge exists within a situation and individual knowledge exists because of the social space in which it was created. In other words, knowledge exists at both the individual and organizational level: it exists within the individual as well as between individuals in the collective. The knowledge of the organization is socially embedded; the external environment interacts with the internal organization to produce a distinct form of knowledge (Lam, 2000).

**Knowledge Creation in Quality Management**

In order to understand how knowledge is created in a quality management environment, Nonaka and Takeuchi’s model of knowledge creation is the most appropriate for this study. In fact, Nonaka and Takeuchi’s model has been used to evaluate learning and knowledge creation in several different empirical studies (Appendix D). Three of the studies reviewed focused on learning within a quality management environment (Anand, Ward & Tatikonda, 2010; Lin & Wu, 2007; Wu & Lin, 2009).
Anand, Ward and Tatikonda (2010) conducted a quantitative study on the role of explicit and tacit knowledge in Six Sigma project teams. From their study, Anand et al. classified the Six Sigma practices according to the type of transfer of knowledge they facilitated (Fig. 3). Anand et al. asserted that while their empirical study took place in a Six Sigma setting, the results are applicable to other processes. Therefore, a similar classification of tools and types of knowledge transfer may be present in a Lean event.

![Figure 3. Six Sigma practices classified by knowledge creation mechanism](image)


In their study, Anand et al (2010) emphasized that the transfer of tacit knowledge made the biggest contribution to the success of the project. According to the quantitative data, tacit knowledge transfer contributed to the success of a project team at a much lower percentage (4%) than explicit knowledge (11%). However, the follow-up interviews with
the executives of the participating companies pointed to the key role of tacit knowledge. Most of the executives emphasized the importance of tacit knowledge in framing a problem and commented that their project leaders received extensive training in capturing tacit knowledge.

In their qualitative study, Lin and Wu (2007) demonstrated how practices of ISO 9000:2000 theoretically coordinate with Nonaka and Takeuchi’s four modes of knowledge creation (Fig. 4). ISO 9000:2000 is a quality management system focused on standardizing procedures and meeting the needs of customers as well as stakeholders. In analyzing different practices that involved the transfer of knowledge, Lin and Wu demonstrated opportunities for innovation within the company.

Figure 4. Knowledge creation spiral of ISO 9000:2000
According to Lin and Wu (2007), the socialization mode is evident in conversations with customers and in developing a shared understanding of the customer’s needs within the organization. Externalization occurs when the customer requirements are translated into a document outlining specifications as well as developing a concept for a product, as tacit knowledge is being made explicit. Through analyzing the customer feedback and evaluating non-functioning products, the process of combination brings together pieces of explicit information to create a greater understanding of the overall process. The combination of these pieces of explicit knowledge is formulated into a type of report or new procedures. Passing through the three modes of socialization, externalization, and combination, employees gain new insight and knowledge.

As a result of their qualitative study, Lin and Wu (2007) concluded that most managers supported the hypothesis that practices of ISO 9000:2000 facilitate externalization. Externalization is facilitated by the tools of ISO 9000:2000, which incorporates a system of codes assisting in the transfer of tacit knowledge to explicit knowledge. One challenge for ISO 9000:2000 is the dependency on tacit knowledge in the customization of customer products. According to Lin and Wu, ISO 9000:2000 does not support an internal structure for socialization, the sharing of tacit knowledge within the organization.

Wu and Lin (2009) conducted a similar qualitative study in Taiwanese companies that use the quality management practices of Six Sigma. Six Sigma focuses on the improving work processes with the ultimate goal of improving the end product. Wu and Lin hypothesized that use of cross-functional teams in Six Sigma methodology would assist in socialization, or the transfer of tacit to tacit knowledge through in-person interactions. The
data revealed that Six Sigma methodologies assisted in the flow of information throughout the organization. Therefore, Wu and Lin proposed an implementation process for Six Sigma to enable knowledge creation (Fig. 5).

![Figure 5. Implementation model for Six Sigma to enable knowledge creation. Adapted from Wu, C. & Lin, C. (2009). Case study of knowledge creation facilitated by Six Sigma. *International Journal of Quality Science, 26*(9), 911–932.](image)

Beginning with top management, this model demonstrates the need to listen to the needs of the customer before developing the internal structure for a Six Sigma organization. Wu and Lin asserted that in the Six Sigma knowledge creation system, a “problem” should be viewed as an opportunity for improvement, making problem solving an integral part of the process of continual improvement. Continual improvement should consist of a company-wide effort focused on continuous and incremental innovation (Wu & Lin, 2009).

The results of these qualitative studies support the suitability of using the knowledge creation model to study learning the context of quality management. However, there are
concerns about the questions used in the two studies conducted by Wu and Lin. The language used in presenting the results if study indicates that the questions may have been leading the participants to identify the knowledge creation mode that is most appropriate for different quality practices.

For example, many managers pointed to internal communication as a method of socialization. However, Nonaka and Takeuchi’s model asserted that socialization occurs through face-to-face contact. In addition, managers pointed to training programs as a methodology for the internalization of explicit knowledge, whereas Nonaka and Takeuchi defined internalization as “learning by doing”. Therefore, it appears that the managers may not have had a clear understanding of the four modes of the SECI model.

In their study of enablers of knowledge creation, Moreno-Luzón and Lloria (2008) incorporated the knowledge enablers found in Nonaka and Takeuchi (Fig. 6). In the center of the model, the enablers of intention, autonomy, redundancy, variety, and trust are listed. Absent from the list is fluctuation and creative chaos.

Figure 6. Model of relations between enablers and organizational design
Enablers are the conditions or characteristics of an organization where management can intervene to enable learning. Moreno-Luzón and Lloria (2008) linked elements of organizational design with each enabler to demonstrate practical ways to enable knowledge creation. The standardization of work processes, skills, and outputs are non-structural coordinating activities, meaning they are activities that facilitate the coordination of work without necessarily affecting the organizational structure. “Interventions of socialization” and “mutual adjustment” are informal ways that management fosters informal relations between individuals.

Autonomy can offer the individual the personal freedom necessary to create, apply and absorb new knowledge. The standardization of skills is a way to ensure that employees have the necessary skills to perform their jobs. Employees that have the necessary skills are generally permitted autonomy to perform their jobs and allow the freedom for individual learning and knowledge generation. (Nonaka & Takeuchi, 1995; Moreno-Luzón and Lloria, 2008)

The standardization of outputs, as often seen in a quality management environment, defines what the final outcome of work should be and provides direction for the employees. Intention is the process of defining shared goals. Defining the “what” assists employees in moving in the same direction.

Training programs often attempt to create opportunities for socialization. Organizations focus on creating a sense of shared values among its members. Moreno-Luzón and Lloria (2008) argued that interventions for socialization should occur prior to standardization of outputs as trust and commitment facilitate intention.
Finally, mutual adjustment involves informal communication between individuals. The result of this communication is redundancy and variety. These enablers are especially important when confronting complex and uncertain work as it generates a variety of differing viewpoints on the same piece of information, leading to knowledge creation.

All of the proposed elements of organizational design demonstrated an impact on knowledge creation with the exception of standardization of work processes, which did not appear to have an impact on knowledge creation. Moreno-Luzón and Lloria (2008) noted that this study was conducted in Spanish companies and the results may or may not be the same in another cultural context. However, they argued that a context of mutual trust and commitment is a generalizable characteristic across cultures.

Other studies incorporating Nonaka and Takeuchi’s model of knowledge creation are listed in Table D1 (Appendix D). Sabherwal and Becerra-Fernandez (2003) examined the perceived effectiveness of individual knowledge management practices at NASA’s Kennedy Space Center. Knowledge management effectiveness refers to whether an entity receives and understands the knowledge needed to perform its tasks. The effectiveness of knowledge management is based on the perceptions of individuals who experience the consequences of knowledge management practices. (Sabherwal & Becerra-Fernandez, 2003)

In their study, Sabherwal and Becerra-Fernandez noted that internalization and externalization knowledge creation occurred at the individual level. Saberhal and Becerra Fernandez commented that this finding was not surprising as internalization is intrinsically related to learning and externalization is essential to knowledge articulation. In the case of
the Kennedy Space Center, the process of internalization was more common than externalization.

Choi and Lee (2002) also studied enablers of knowledge creation with the overall goal of understanding the impact of knowledge creation practices on corporate performance. They concluded that different departments emphasize different knowledge creating modes. For example, research and development relies heavily on tacit knowledge while manufacturing activities that are repetitive rely more on explicit knowledge. Technically oriented professionals are protective of their tacit knowledge until it is made explicit in published form. Therefore, they often rely on combination or the transfer of explicit knowledge.

Song (2008) studied the impact of culture on the knowledge creation process, focusing specifically on Korean culture. Applying Marsick and Watkins’ (2003) seven dimensions of learning organizational culture to Nonaka and Takeuchi’s knowledge creation model, Song proposed that organizations should move away from focusing solely on the process of learning within the organization. Rather, Song (2008) asserted that organizations should focus on the creation of actionable knowledge for the benefit of the organization.

Finally, Huang, Kristal, and Schroeder (2008) examined how an organization can improve their capability for mass customization through learning. Building upon Nonaka’s (1994) knowledge creation framework, Huan et al examined the types of product and process-related knowledge generated by internal and external learning. Internal learning involves using insights to solve internal problems while external learning routines incorporate external relationships with customers and other partners to improve products and
process design. Huang et al concluded that internal and external knowledge generating capabilities assist in improving mass customization capabilities.

While Nonaka and Takeuchi’s model of knowledge creation has provided insight into the learning and knowledge creating practices of organizations, there is a lack of empirical research about the perceptions of employee learning based on personal experiences using the problem-solving tools of Lean and Six Sigma. The closest study is Wu and Lin’s (2009) qualitative study on learning in a Six Sigma organization in Taiwan. However, the participants in the study were managers whose responses revealed misconceptions about the different knowledge creating modes. Therefore, there is a need for an empirical study that examines the perceptions of employees about learning and knowledge creating activities in a Lean event. Based on observations made from Wu and Lin (2009), the study should incorporate semi-structured questions that allow themes to emerge rather than ask the participants to specifically connect their experience with the model.

In addition, Moreno-Luzón and Lloria (2008) provided key insights into the practices that enable knowledge creation. In their quantitative study, Moreno-Luzón and Lloria solicited the responses of Black Belt project leaders to evaluate learning and knowledge creation at the team level. While their study was conducted in Spanish organizations, the results should be transferrable to other environments. Therefore, there is a need to follow-up on Moreno-Luzón and Lloria’s results by examining individual perceptions of the enablers of knowledge creation.

This qualitative study contributes to the literature by examining learning and knowledge creation in a Lean event using Nonaka and Takeuchi’s model of knowledge
creation. Specifically, this study will look for evidence of the transfer of both explicit and tacit knowledge within the context of a Lean event. In addition, the study will build on the literature about the enablers and barriers of learning and knowledge creation as proposed by Nonaka and Takeuchi.
CHAPTER 3: DESIGN AND METHODOLOGY

Design

This qualitative research study examined the perception of employee learning and knowledge creation while using the tools of Lean. The focus of this study was on the employee’s perception of how they learn and the factors that contribute to that learning. Therefore, the study addressed the following questions:

1. How do adults perceive learning and/or knowledge generation during a Lean event?
2. What enablers facilitate employee learning and knowledge creation during a Lean event?
3. What are the barriers to learning or knowledge creation during a Lean event?

In order to answer these questions, participants in the study needed to be trained in the Lean tools and currently participating in Lean events. Since all four participants interviewed in the study were also trained in Six Sigma, some answers reflected experiences with Six Sigma.

Qualitative research is a method for exploring and understanding the meaning individuals or groups attribute to a social or human problem. The focus of qualitative research is on understanding individual meaning and recognizing the complexity of a situation. (Creswell, 2009) Qualitative research can provide complex textual descriptions of how people experience a given research issue as well as information about the “human” side of an issue including the behaviors, beliefs, opinions, emotions, and relationships of individuals (Mack, Woodsong, MacQueen, Guest, & Namey, 2011).
In order for an organization to facilitate employee learning and knowledge creation through the use of Lean tools, it is important to understand the employees’ perceptions of learning and knowledge creation opportunities within the context of a Lean event. Through building an understanding of the factors that influence or inhibit employee learning and knowledge creation, an organization can adjust the way it organizes and facilitates Lean events to secure the most benefit from employee learning and knowledge creation.

In this qualitative research study, a case study design consisting of interviews from a purposeful sampling was employed. The case study method provides a description of an ongoing event, over a fixed period of time, in relation to a particular outcome of interest. Case studies elicit and analyze descriptive accounts in order to make sense of the stories people tell about their experiences. The emphasis is on the researcher’s ability to extract and understand the meaning of what participants say to him or her (Brewerton & Millward, 2001).

Patton (1980) asserted that it is important to know what qualitative data “looks like” in order to understand what the researcher is seeking. Qualitative data is found in detailed descriptions and direct quotations. Researchers look for themes in “chunks” of data using a priori coding or open coding. A priori coding is the use of previously established codes developed from the literature. Open coding is the practice of looking for the common themes that emerge in the data without a previous conception of themes or codes.

This study took both a deductive and inductive approach to the research design, data collection and analysis. Gummesson (2000) outlined the difference between deductive and inductive methods of research. The deductive method begins with a theory and tests the
theories through the research project while an inductive study begins with the “real world data” and allows the theory to emerge. In the inductive method, the categories of analysis emerge as the researcher comes to understand the organizing patterns that exist in the world under study (Patton, 1980).

Using the theory presented in the previous chapters, this study used a deductive approach to formulate the research questions for the study as well as a list of a priori codes for the data analysis. In addition, the analysis plan also involved open coding, which allowed data and themes to emerge from data that were not previously outlined. This second half of analysis was inductive in that it allowed the theory to emerge from the real world data.

Finally, there are two possible conclusions derived from research: general and specific. A general application of the researcher’s findings to other situations is cautionary. Making specific conclusions based on the context of the research study is more appropriate in a qualitative study. However, Gummesson encouraged the researcher to keep in mind the overall usefulness or usability of their research and consider whether the conclusions would be helpful in solving an actual problem.

**Participants**

The organization used in this study was selected from the researcher’s personal network. A *purposeful* sampling strategy was employed for selecting the participants in order to ensure that the participants would be able to provide information directly related to the central issues of the three research questions. Brewerton & Millward (2001) described purposeful sampling as selecting individuals from a population according to an underlying interest in a particular group (p. 117). Purposeful sampling provides in-depth detailed
information but the researcher cannot make generalizations about the findings because the sample is not random (Patton, 1980).

To identify the organization that was the site of the study, the following steps were taken:

1. Contacted individuals in my network who work for companies that have employees trained in Lean tools and are currently conducting Lean events.
2. Sent the Organization Recruitment Letter to the contacts that express interest.
3. Selected the organization based on the contact person’s position and influence in the organization in order to secure participants.

To identify the four participants for the study, the specific steps taken were:

1. Requested a list of 10-20 potential participants from the contact person specifying people who were trained in Lean and are currently using it in their work.
2. Randomly selected 4 participants from the list.
3. Sent the individuals the Participant Recruitment letter.

The four participants chosen for this study consisted of three females and one male. Names were assigned to the four participants and no information about the individual’s position or job description was collected. The four participants in this study will be referred to as Mary, Denise, Laura, and Bob. Since this organization only trains the leaders and facilitators in Lean, all four of the participants played a facilitator role in the Lean events.

The three women joined the organization about two years ago when the Lean initiative was introduced to their department. Bob had been with the organization for less than one year. All four of the participants have a background in Six Sigma methodology.
Therefore, the tools of Six Sigma were also incorporated in their work and mention of these tools may appear in the responses.

**Data Collection**

King (2004) summarized the goal of the qualitative research interview as seeing the research topic from the perspective of the participant. It is vital for the researcher to strive to understand how the participant developed that particular perspective. The researcher must also listen for repetition of words or phrases that identify something that is important to the participant.

**Semi-structured interviews**

Semi-structured interviews were conducted to gain an in-depth understanding of each participant’s perception of his or learning experience while using the Lean tools to facilitate a Lean event. The questions were directed towards the participants’ learning or perception of learning. Since the participants were also facilitators, some of the comments reflected their perceptions of the learning of others during the Lean event. In addition, the questions explored the perceived enablers and barriers of learning in the workplace. See the case study protocol (Appendix B) for further details about the data collection.

**Observations**

One of the immediate observations was that all four of the participants in the research study were facilitators of the Lean process. In choosing the organization, the researcher was not aware that only the leaders and facilitators of the Lean events received formal training in Lean and used it consistently in their work. Employees who participated in the Lean events
learned some of the pertinent tools for the specific event but consistently using the tools was not a required part of their daily work.

The nature of the relationship between the interviewer and participant played a role in this study, as there is no such thing as a “relationship-free” interview (King, 2004). Also, the perceived relationship between the researcher and the contact person at the organization may have also indirectly influenced the nature of some of the responses. In two of the interviews, the researcher noted that the answers were carefully crafted rather than being spontaneous answers within a conversation. The researcher was able to develop rapport with one of the participants through laughter.

However, in the case of the second participant, there are several possible explanations as to why the interview did not go beyond a fairly superficial level. The first possibility is that the researcher was not clear in the wording of the questions. A second possible explanation is that the participant may not have had the experience to give more specific answers. Finally, the participant may not have felt comfortable giving detailed information based on the researcher’s relationship with the participant’s supervisor.

**Data Analysis**

Data analysis is a systematic way to search for meaning by processing the qualitative data in a way that what is learned can be communicated to others (Hatch, 2002). In a qualitative study, the researcher is the main measurement device and most analysis is done with words (Miles & Huberman, 1984). For this study, a two-phased analysis process was deployed. In the first phase, as described in the case study protocol, a priori codes gleaned from Nonaka’s theory of knowledge creation were used. The second phase was inductive
and involved open coding. Using constant comparative strategy in order to understand from the text directly (e.g., without preconceived codes), the data, or words, were “chunked” into smaller meaningful parts.

In the initial data analysis, each interview was treated as an individual case. Eisenhardt (1989) emphasized becoming familiar with each case individually before trying to make generalizations across cases. Employing a deductive coding process with a priori codes, the researcher looked for key words reflecting the themes initially outlined in the list of codes (Appendix A).

Following the coding of the individual cases, a cross-case constant comparative analysis was employed. A cross-case search for patterns examined the subtle similarities and differences between each case. The cross-case analysis was conducted for both the a priori and open coding.

Another important aspect of data analysis is the consideration of alternative explanations. According to Yin (2003), the search for rival explanations is one method for identifying independent variables. One important variable to consider is the subject’s desire and pursuit of learning irrespective of the use of Lean tools. A person who is more purposeful in their pursuit of knowledge and learning experiences may view the use of Lean tools from a different perspective as a casual learner.

**Trustworthiness**

Validity is important because it promotes the trustworthiness of the research. Internal validity addresses the credibility of the research findings and their applicability to the
specific case. External validity refers to the transferability of the results. In this study, we’re focusing on building internal validity.

The data analysis in this study included member checking to ensure trustworthy findings. Some of the interview participants were asked to review the researcher’s analysis of their interview. Then the participants were given the opportunity to offer any clarification or explanations if they felt it necessary.

**Ethical Considerations**

Conducting interviews and recording observations requires ethical considerations. There are two categories of concern in this study: 1) informed consent and 2) protecting participants. Informed consent is a process used to communicate explicit details to the participant and allow him/her the freedom to withdraw from participating at any time without penalty. The informed consent process used in this study is described in detail in the case study protocol and the IRB application.

The second category involved protecting the participants from any negative consequence that could result from participating in the study. The researcher was aware that the participants could possibly be concerned about making comments that appear critical about their current or previous places of employment. Therefore, steps to maintain confidentiality and data protection were detailed and shared with the participants. Please see the IRB application (Appendix C) as well as the case study protocol for details about the steps that were taken to ensure informed consent and protection of participants.

Understanding these concerns for privacy, information gathered from the study was kept confidential. No reference in oral or written reports linked the participants, or any
identifying information, to the study. Following a final analysis, *audiotape files were destroyed and the transcripts stored in a password-protected computer along with all other collected data*. See the case study protocol and IRB application (Appendices B and C).

**Limitations of the Study**

There are four broad categories of limitations to this exploratory multiple case study design. First, a convenience sampling process was employed to identify the participating organization. Second, only one type of data was collected in this study. The only data collected was from the participants themselves as they describe how they learn using the Lean tools during a Lean event. Data about the relevant culture of the organization, management practices, and leadership was not collected, although some participants referred to culture, management and leadership in some of their responses. While these data are relevant to learning, they are beyond the scope of this exploratory study. Third, the findings of the study should not be generalized to other populations because of the qualitative processes deployed in the study. Finally, due to time constraints, a peer review was not conducted on the interview transcripts to verify the coding.
CHAPTER 4: FINDINGS

This first section presents the combined findings of the four case studies using Nonaka and Takeuchi’s (1995) knowledge creation model. Chunks of interview data were categorized using the codes generated from the model (Appendix E). In addition, the interviews were analyzed for evidence of enablers and barriers using codes also found in Nonaka and Takeuchi (Appendix F and Appendix G).

Four Modes of Knowledge Creation

After categorizing the data from the interviews, it was apparent that all four modes of knowledge creation were present in the participants’ answers to some degree. One interesting finding was the prevalence of internalization over the other three modes. This observation will be further discussed in Chapter 5. The following results from the interviews are organized according to the four modes of knowledge creation.

Socialization

Although not present directly in the Lean event, socialization was found to be present in other activities of the Lean organization. For example, in preparation for a Lean event, Mary commented that she tries to experience the jobs of the people that she’s working with in order to understand their process better and gain credibility. This form of socialization allows for the facilitator to develop an awareness of both the explicit and perhaps tacit knowledge required for a job. Having this experience also builds the facilitator’s credibility when leading a Lean event.

A commonly cited practice involving socialization occurred during 6S Workplace Organization events, also referred to as “waste walks”. Three of the four participants
discussed taking the participants into the field and pointing out instances of waste in order to teach them what to look for in their work areas. Pointing out the waste in the individual’s work area increased their awareness of practices that are non-essential and raise costs. Mary commented, “people get so ingrained in their daily activities that they just don’t see it”.

Another form of socialization noted in the interviews was learning how to facilitate an event through the observation of seasoned facilitators. Working on a team with Six Sigma Master Black Belts who had received their training at the most respected organizations socialized Bob into the thinking processes that are not taught in a certification course. Bob explained that the “art” of using the tools is learning what type of questions to ask once you have used the tools to analyze the data.

**Externalization**

Externalization is perhaps the most challenging of the four modes because it is difficult to identify when tacit knowledge becomes explicit. Nonaka and Takeuchi (1995) talked about the use of metaphors, analogies, concepts, hypotheses, and models as ways of identifying the conversion of tacit to explicit knowledge. Since tacit knowledge is tied to experience, the interviews revealed that emotions were sometimes attached to tacit knowledge.

All four interviews referred to process mapping as the tool that facilitated the transfer of tacit to explicit knowledge. Mary pointed out that “a big tool for providing a common language was the process map.” In each interview, the participants described the use of a process map to arrive at an “aha” moment, whether it was recognizing where all of the pieces fit together or where the key to understanding a problem could be found. As Laura noted,
“it’s really the tools of Lean Sigma that tells you and educates you.” Bob explained that this education occurs when the process map takes in all of the group’s thoughts and insights and then feeds it back to them in an organized manner.

All four participants also emphasized the importance of the visual display of information in an objective manner, removing the emotional nature of some tacit knowledge. Laura described how tacit knowledge is often a result of a process that a person has been doing for 10 or 20 years, “it’s very innate and part of their identity so it’s hard for them to let go of it.” Denise asserted that using the tools “takes out the subjectivity and makes it more objective.”

**Combination**

The collaborative nature of Lean events lends itself to the facilitation of the transfer of explicit knowledge. While combining knowledge from various sources to generate new knowledge is characteristic of Lean, the participants did not share as many stories as expected. However, all four participants did mention some form of combination in their interviews. For example, Laura labeled the Lean events as “best practice sessions”.

One form of combination revealed in all four of the interviews was the central repository for sharing lessons learned. Both Denise and Bob explicitly stated that they revisited lessons from their own experiences or from other business units before beginning a similar project. Reviewing this information helped to ensure that the lessons learned were taken into consideration. One concern expressed by Mary was that sometimes the lessons learned were not written in a clear language for people outside of a specific business unit, making it difficult to understand and apply the lessons to their own area.
Bob also commented that sometimes the lessons learned are framed in negative language. These reports focus more on the things that did not work rather than the actual lessons that were taken away from the experience. Bob suggested answering the questions, “What did we do well? What are the areas we can improve?”

**Internalization**

Internalization was the most prevalent mode revealed in the interviews. The word “apply” was present in many comments, reflecting that lessons learned in one area were being applied in another. Applying lessons learned is the essence of internalization, transferring explicit knowledge into tacit knowledge.

Different forms of “seeing” were used to describe instances of internalization. Bob talked about the tools providing a “totally different lens.” Mary stated that she now looks at everything through what she refers to as “Lean glasses”. Denise talked about how she’s “seen” Lean work as well as fail in businesses. Laura used the words “identify” and “observe” to talk about how individuals take Lean back to their jobs and begin to recognize waste.

Another analogy describing internalization was moving from the “dark” to “light” as the result of a Lean event. Prior to the Lean event, Mary asserted that “so many people operate in the dark, there is no reason for them to change.” Mary stated that “for some people the light comes on and they can take things back to their lives and to the workplace…it’s such a new concept to them, a new way of thinking.”

Denise specified the goal of the Lean events in this organization is to teach the people how to use the tools and then for the individuals to use the tools in day-to-day tasks. She
pointed to people taking the Lean tools back to their work as evidence that the organization is “mature in Lean methodology.” Using the tools transforms the way people look at their work and the workplace.

Bob differentiated between the art and science of using the tools. Learning how to use the tools is the “science” but learning how to think about the knowledge gained from the tools and what to do with that knowledge is the “art”. Adapting a new way of seeing the workplace, through “Lean glasses” for example, is one way that the lessons of Lean are internalized. Once internalized, practitioners can grow in the “art”.

**Enablers**

The five enablers coded for this study were Intention, Autonomy, Redundancy, Variety and Trust. Intention, autonomy and redundancy were the most prevalent in the data. Both trust and variety appeared in the data but was less frequent. However, the importance of trust emerged implicitly in some of the responses.

**Intention**

The overall goal of the organization to become more “lean” provides a clear purpose and understanding for a Lean event. Denise stated that prior to the event, the facilitators work with management, sponsors, and SME’s to understand the problem and clarify the objectives for the event. Laura stated that going into the meeting with the objectives and scope have approved by management enables the participants to make decisions more easily. She commented that this structure allows people to focus on the improvements rather than spending time discussing whether or not an idea would be approved.
Mary explained that it may take two or three days for the group to feel that they are “starting to gel” and become unified in a group process. Laura pointed out that the process is affected when the group consists of people from different acquisitions or different geographical locations who come to the meeting with their own established processes. Therefore, the first two days of the Lean event is often spent developing an environment of trust and easing fears or defensive attitudes.

**Autonomy**

Autonomy emerged as the most prevalent enabler in the data. One of the main themes of Lean was “ownership”. As Bob stated, “if there is a way to improve the process, it should come from you. It shouldn’t come from me and it shouldn’t come from somebody else, you own this, you’re the owner.” He continued to assert that in order to build an organization of learners, process owners should become “disciples or evangelists” of process and share their learning with the rest of the organization. Laura also asserted that the individuals who are traveling around the company should be the ones who are best able to identify areas of improvement. Therefore, they are empowered by the company to begin improvement processes.

**Redundancy**

Mary asserted that in the beginning of the Lean event, she works hard to create an environment where there is open communication and dialogue. She stated, “what I try to do is hear all sides and collect data points…I try to find common ground for all sides, which is not always easy.” Open communication is necessary to the process and Mary pointed to
using the tools as key to finding that common ground where they can take ownership of the
project.

**Variety**

Access to information is an important enabler to learning. For this reason, all of the
participants talked about the availability of lessons learned from previous projects. However,
access to other types of information or resources within the organization was not explicitly
mentioned in any of the four interviews.

**Trust**

Only Mary commented on the issue of trust, although it was an implicit statement
referring to the “gelling” of the participants. She talked about the participants being able to
arrive at a common process only after spending a couple of days with each other. Initially,
she stated that process owners often felt like they were on the “hot seat” when their process
was being addressed and would often become defensive. A common statement in three of
the four interviews was “We are hard on the process and easy on the people.” This refrain
was used to establish trust and remove feelings of defensiveness because the focus is on the
objective evaluation of the process.

**Barriers**

The barriers identified from Nonaka and Takeuchi (1995) were company procedures,
hoarding knowledge, company paradigm, and organizational stories. In analyzing the
interviews, evidence for only two of the four barriers emerged: company procedures and
organizational stories. Two participants identified company procedures as a barrier at the
department level. One participant identified company procedures as an enabler.
Company procedures

Laura pointed out how the company structure of a Lean organization removes the barrier of company procedures. In a Lean organization, the company is organized in a way to support learning as the necessary approvals are attained ahead of time. A Lean organization encourages the individual to be autonomous and empowers them to implement the necessary changes. Therefore, in this case study, company procedures were not found to be a barrier.

However, while the overall company procedures of a Lean organization may actually facilitate learning, the procedures of independent departments may serve as a barrier. Both Bob and Denise pointed to the independent processes of an IT department as a barrier because the individuals may not see the value of adopting any other process.

Organizational stories

Organizational stories were found to be the most prevalent barrier. Bob stated that “tenure is a barrier, for most people, because when you’re trying to do organizational change you want to unfreeze them, move them, and then you want to freeze them.” Laura explained that many people want to hold on to their processes and do not want to open their minds to other ideas because they feel like they’re being told that their work has not been good enough. Rather than listening to the ideas or other people, Laura stated, “everyone wants to build a case about why you should keep theirs (way of doing things).”

Summary

Using deductive analysis of the interviews based on Nonaka and Takeuchi’s model, this study found the following answers to the research questions.
1. How do adults perceive learning and/or knowledge generation during a Lean event?

In a Lean event, the facilitators perceived learning as beginning with the *externalization* of knowledge of how each individual currently performs their job through the use of process mapping. Once the tacit knowledge was externalized, the participants used the Lean tools such as a root cause analysis to analyze the effectiveness of their current process. When the participants began collaborating to remove waste from their current processes and make their daily work more effective, they *combined* their knowledge to develop a more efficient process. In addition, evidence of learning was made apparent when individuals *internalized* their new “lenses” of Lean and began seeing other areas of waste in their work.

2. What enablers facilitate employee learning and knowledge creation during a Lean event?

Autonomy and intention were the most prevalent enablers in the study. Empowering employees with the Lean tools to remove waste from their current processes enabled employees to learn and create new ways to do their jobs more effectively both during and after the Lean event. Outlining the desired state of the process provided a goal or intention for the employees to focus on during the event. Being able to focus on the objective guided the employee’s learning and knowledge generation facilitated by the use of the Lean tools.

3. What are the barriers to learning or knowledge creation during a Lean event?

The most prevalent barrier to learning and knowledge creation were the organizational stories shared usually by employees with tenure. The perception of the participants was that the employees with many years of experience working at their current
position were more attached to their processes. At the beginning of the Lean event, these employees appeared to be resistant or emotionally reactive when waste was pointed out in their process. In order to overcome this barrier, the participants pointed out the importance of building trust and using the data to make the conversation more objective.

**Emerging Codes**

In this section, the interviews were analyzed without the use of a priori codes. In order to examine different possible interpretations of the data, themes that appeared to be repeated across different cases was noted without the use of predetermined codes. Two themes emerged in this inductive reading of the data: self-directed learning and emotion.

**Self-Directed Learning**

Two themes that appear in the open coding related to being self-directed learners. First, the concept of “ownership” over a process was expressed as a motivation for learning. Secondly, the skill of asking questions that revealed higher levels of thinking emerged both directly and indirectly during two of the interviews. The ability to ask the appropriate questions is a skill of self-directed learners.

**Ownership**

The first theme that emerged in the open coding was the concept of ownership. Three of the four interviews referred to ownership. Laura and Bob emphasized ownership of the process as motivation for identifying and learning about a problem. Mary explained how she built a sense of ownership into Lean events so that participants felt invested in the development of the solutions.
Laura explained that often the person who brings a problem to management’s attention is the process owner because “they’re the ones travelling within the company so it’s easy for them to identify areas of improvement”. When asked if the person receives an incentive for bringing a problem to management’s attention, Laura responded that incentives were not tied to the improvements because often “you cannot tie an improvement to the bottom line.” Laura described these process owners as “a person who wants to keep the organization as efficient and as effective as possible.”

Beyond identifying problem areas, Bob emphasized that if there is a way to improve the process, it should come from the process owner. Bob asserted that process owners should be empowered to make the improvements because they are the best person to know what needs to be done. By teaching people to identify and solve problems using the tools, Bob stated that people will realize, “I am not a robot. I have ownership over this.”

Bob encouraged process owners to be disciples or evangelists for learning by first learning everything they can about the problem. Once the process owner fully understands the problem, Bob stated that they should begin educating others in the organization. Bob explained that this is the process for building “an organization of learners”.

Mary discussed using the tools to help people find a common ground on making improvements and show the participants “what’s in it for them.” Each participant is selected to be part of the event for a reason. Therefore, Mary explained how she tries to help each one understand why they are there. By facilitating an event in such a way that people feel that they are affecting the process, the participants also develop a sense of ownership, even if they are not the process owners.
Art of Questions

The second theme that emerged in the open coding of the interviews was a different way of seeing and thinking about a person’s work. In her interview, Mary mentioned that she now sees the world through “Lean glasses”. She reported that she was not an analytical person prior to learning the Lean and Six Sigma tools. Mary used the analogy of light and dark to illustrate how people change the way they think after being exposed to the Lean tools.

The interviews with Mary and Bob revealed glimpses into the way their minds work. Both interviews were peppered with the questions that run through Bob and Mary’s minds either during an event or in their daily lives. Mary even commented that she finds herself asking these questions in her sleep.

Bob explained that he learned to ask questions by spending time with Master Black Belts in Six Sigma. He described the “art” of using the tools as knowing which questions to ask when looking at the information gleaned from using the tools. The majority of the questions in Appendix H were from Bob’s interview. As he spoke about his experiences with using the tools, he would interject questions to share his thought processes. It appeared that the questions flooded his mind in a way that he could not turn off; it became part of his everyday thinking processes.

Emotion

The second theme that emerged in two of the interviews was the presence of emotions as a barrier to learning. Mary described how the participants who felt threatened became defensive. These process owners felt like they were “in the hot seat” because the group was addressing problems with the current process. According to Mary, it appeared that these
individuals’ immediate reactions were to close their minds to the suggestions of others and insist on defending their way of doing things. When Mary removed the emotion of the situation by transitioning the focus from the person to the process, the participants became more open to listening to the ideas of others and evaluating the process in an objective manner. The refrain that was shared by both Mary and Laura was that “we are hard on the process and easy on people.”

Laura also talked about using the tools to remove emotion from the situation. She encouraged participants to “really look at the process and take the feelings out of it so that you’re not too emotionally tied to it.” In addition, Laura pointed out how the tools “make it very black and white rather than optional or personal.”

Part of the emotion of learning is feeling that one has a voice. Denise asserted that it is important to make sure “people are aware of what’s going on, [and that] they can give their input…everyone wants to feel that they have some say in it.” Mary explained how she tries to write all ideas and concerns on the board so that people feel that they are included because they are being heard.

**Summary**

An inductive analysis of the data revealed that the Lean methodology contributes to the development of self-directed learners. In addition, the success of Lean events is dependent on self-directed learners continuously applying their knowledge to improving the organization. Self-directed learning involves the ability to ask questions to reveal deeper causes of problems as well as thinking critically about the future state.
Emotions act as enablers or barriers to learning in a Lean event. Fear causes people to be defensive and closed to the sharing of knowledge. Therefore, it is important for facilitators of Lean events to focus on mitigating fear at the beginning of an event in order to create the conditions for learning and knowledge generation.
CHAPTER 5: DISCUSSION AND IMPLICATIONS

Although this small study has its limitations, it found that Nonaka and Takeuchi’s (1995) framework is helpful for understanding learning and knowledge creation in an organization that uses Lean tools to improve processes. This study sought to gain a better understanding of the connection between using the Lean tools to solve a problem and learning. Specifically, the findings of the study suggested that the tools used during Lean events facilitated learning. In addition, this study identified specific enablers and barriers to learning in a Lean environment.

Implications for HRD

After synthesizing the data from the four interviews, three main implications emerged for the field of Human Resource Development. First, Lean events are natural environments for learning and knowledge creation as participants interact with each other sharing knowledge, facilitated by the use of Lean tools, to resolve a problem. Therefore, an organization can use the tools and organizational structure of Lean to facilitate the development of a learning organization. Secondly, the Lean projects can be used as vehicles for organizational change through knowledge creation. Finally, practitioners need to be mindful of managing the emotions involved in the process, especially by mitigating fears.

Learning Organization

Senge (1990) presented the five disciplines of the learning organization: personal mastery, mental models, systems thinking, team learning, and shared vision. Ballé, Chaize, Fiancette, and Prévot (2010) argued that the Lean toolset could be used to leverage each of
these five disciplines. Interwoven into the five disciplines are opportunities for self-directed learners to engage in knowledge creation.

**Personal mastery**

Personal mastery is closely tied with the theme of self-directed learning. Lean encourages personal mastery by teaching and empowering people to solve their own problems. In order for the tools of Lean to be effective in creating sustainable solutions, the process owners need to take ownership of their learning in resolving problems. Ballè et al. (2010) asserted that the lean practice “requires not just learning, but *learning how to learn*” (p. 2).

The ultimate purpose of the Lean events is to teach managers and other process owners how to understand and better manage their own processes (Ballè et al., 2010). Candy (1991) explained that self-directed learning is the foundation for conceiving goals and plans as well as assessing plans and choices. Although you cannot force a person to learn, Ballè et al. recommended encouraging personal mastery by setting challenging targets and tracking the progress towards those goals. A self-directed learner gains skills and competencies in gathering data, organizing and retrieving information, thinking critically, setting goals, and assessing progress (Mackeracher, 2004).

Grow (1991) outlined how to transition learners to become more self-directed. In the first stage, the learners are dependent on the instructor but then they gradually move towards the second stage of becoming less dependent on the instructor to provide the information. In the third stage, the instructor takes on the role as facilitator and eventually acts as a mentor or coach as the learner becomes more self-directed. As a learner is taught how to learn and is
provided with opportunities to use their newly learned competencies, they become more self-directed (Mackeracher, 2004). Personal mastery is contingent on individuals becoming self-directed learners.

**Mental models**

Mental models are the deep representations that people hold of reality (Senge, 1990). Exposing mental models is important for challenging habits. Carroll, Rudolph, and Hatakenaka (2005) explained how tools such as the “root cause analysis” often stop at the level of controlling a process rather being engaged further to lead to learning. While the “root cause analysis” can be used to identify the cause of a problem, it can also be used to “to challenge deep assumptions with rigorous and systemic thinking” (Carroll, Rudolph, and Hatenaka, 2005, p. 595).

Carroll et al. clarified that it is not the tools themselves that lead to learning, but they provide an opportunity to have conversations, develop new skills and build new relationships. Tools such as the root cause analysis help to surface mental models. As Bob explained, the facilitator must also be skilled in asking the right questions to make sure that the team is working with the right issues. Questions, such as those listed in Appendix H, reveal the higher level thinking skills required to challenge mental models.

**Systems thinking**

Systems thinking is at the essence of Lean. According to Deming (1993), a system is “a network of interdependent components that work together to try to accomplish the aim of the system” (p. 98). Lean tools provide a way to look at the business as a whole, rather than as a sum of its parts.
As Bob explained, when you use a tool such as the fishbone diagram, you have to think about the impact of your decisions on the rest of the business, “upstream and downstream”. Process owners monitor how the system behaves and understand how their process works as a holistic organism. In addition, process owners must understand the links between the processes, to work on improving the “handoff” to and from their processes.

**Team learning**

Baile et al. (2010) asserted, “individual employees develop knowledge more quickly if there are robust mechanisms for sharing knowledge and experiencing learning together“ (p. 10). Unless there is a focus on learning in the Lean event, it can become another way to just “fix” people and problems.

Ballé et al. argued that an organization needs the rigor of a toolset such as Lean to become a learning organization. As it was revealed in the findings, all four types of knowledge creation were present in a Lean event. However, learning experiences that were reported appeared to be the result of using a particular tool. For example, socialization and internalization was reported as a result of the 6-S Workplace Organization, or “waste walk”. Developing a process map helped to externalize tacit knowledge but also involved the combination of explicit knowledge in order to develop a best practice.

In a Lean event, participants are removed from their normal work activities to focus their attention on a work-related problem. As reported in the findings, the participants are chosen to contribute to this Lean event because they have tacit or explicit knowledge related to the process that is being examined. However, Baile et al. encouraged using cross-
functional teams to address problems in order to move people away from discussing the knowledge they already share to learning from other functions.

**Shared vision**

Deming (1993) stated, “Without an aim, there is no system” (p. 98). In a Lean event, the Lean leader facilitates the team to create a shared vision of the future process. However, the shared vision of the overall system and its goals must come from the senior management. Although the changes are planned and implemented by individuals at all levels of the organization, all four interviews revealed the importance of support of the organization’s leadership for implementing and enforcing the changes.

In order for Lean to work, it has to have the support of leadership as a way of resolving problems. As Laura pointed out, establishing an agreed upon scope with the project sponsors empowers the participants in a Lean event to focus on resolving problems without much discussion about whether their ideas will be approved. The shared vision of empowering workers at all levels of the organization is imperative for the success of a Lean organization.

**Organizational Change**

A second important implication for the field of HRD is the potential of Lean events to influence organizational change. By engaging employees at all levels of the organization in process improvement projects, leadership can facilitate evolutionary change. Burke (2011) referred to the practice of *kaizen*, or continual improvement, as a form of evolutionary change. The Lean events are modeled after the Japanese practice of *kaizen*. The idea is that
small, incremental changes across various departments can accumulate into substantial change (Burke, 2011).

O’Toole (1995) emphasized that while change must be supported by top management, the actual change involves people at all levels of the organization and occurs in the “guts of the organization”. Change also needs to include the voice of the customer or other key stakeholders. Lean events are platforms for individuals from all levels of the organization to participate in planning and initiating the changes. As Mary explained, involving the people and demonstrating how their ideas are being incorporated in the decisions helps gain their buy-in for when the changes need to be implemented.

Bob emphasized that each project was a form of organizational change. He stated that the individuals in charge of the changes needed to be learners, to learn about their own processes so that they could teach others. For Bob, the purpose of using the tools is to develop an organization of learners looking for ways to make continuous improvement.

**Emotions**

Emotions are intense feelings that are felt as a reaction to a person or an event (Robbins & Judge, 2011). As previously mentioned, Lean events lead to evolutionary changes within the organization. Therefore, individuals will experience different emotional reactions when faced with potential changes.

Mackeracher (2004) explained that distressed adults “may become totally engaged in their own feelings” (p. 124). Fineman (2005) explained that knowing and learning are steered and shaped through feelings…feelings “tell” us what is worth learning, what should be ignored, how to evaluate alternatives…” (p. 560). Mary described how process owners
initially feel that they are in the “hot seat” or “under the gun” at the beginning of a Lean event as their process is under scrutiny. It is important to mitigate negative emotions at the beginning of a lean event as the emotional brain can sometimes overpower the thinking brain (Mackeracher, 2004).

Adults may feel more threatened than a child in a learning situation because “their self-concept is already well organized” (Mackeracher, 2004, p. 126). Laura pointed out that when people have doing the same process for 10 or 20 years it becomes part of their identity. Therefore, in criticizing a process, some people feel that the criticism is personal as if people are saying that their work “hasn’t been good enough”.

In a Lean event, the focus is on removing “waste”. When people are deeply connected to a process or way of doing something, it may be difficult for them to differentiate themselves from the criticism of the process. As Denise commented, “A lot of times people are not aware that some of the stuff they’re doing is actually not value adding and it’s not that they’re waste, but the things they’re doing or have to do for the results they want is actually waste.” Employees may feel that their jobs are threatened when processes are examined.

The emotion of fear can be counterproductive to the process as the person may feel they have to defend their position rather than focusing on how to improve the process. This is where the “art” of facilitating a Lean event requires the ability to mitigate fears and create a safe environment to objectively examine the process. Burke (2011) explained that emotional resistance to change is rooted in the perception that the change is being imposed and that the individual does not have a choice. HRD professionals can work with Lean facilitators at the beginning of a session to develop an open environment of trust through
team building exercises or having an open conversation, rather than delving directly into the problem.

**Enablers and Barriers**

Autonomy, allowing employees to work independently and take ownership of the process, was a clear enabler in the study and is key to the success of Lean methodology. Also, Intention, or clear vision and support from the organization’s leadership, appeared to be mutually related to Autonomy. Redundancy and Trust were key enablers within the actual Lean event. Participants must feel that they are in a non-threatening environment before they engage open communication to share their ideas. This relates to the concern of workers that if they share their knowledge, they will no longer be useful to the organization. The success of a Lean event requires the open sharing of knowledge.

The main barrier that emerged in the interviews was the perceived resistance of people who have been working at their position for a long time. This barrier was tied to the emergence of Emotion as a major theme in the interviews. In order to capitalize on the experience of employees who have a lot of organizational knowledge, trust must be built into the Lean event. Helping employees with tenure feel ownership in the changes that are taking place will transform this barrier into a competitive advantage.

**Conclusion and Future Research**

Although it has been criticized for an over-emphasis on control, the tools of Lean have the potential to facilitate the development of a learning organization. As demonstrated in this study, using the Lean tools to solve a problem resulted in the creation and transfer of both tacit and explicit knowledge. One of the challenges is appropriately capturing the
knowledge from the Lean events. Another challenge revealed in the study is appropriately managing emotions so that they do not become barriers to learning and knowledge creation.

This research focused on the perception of learning in a Lean event. However, these interviews were based on participants’ generalizations of their experiences of learning and observing learning based on several different Lean events. In addition, the participants selected for the study were all facilitators and potentially provided a different perspective than a person who participated in a Lean event without previous training in the use of the tools.

Future research building on this study could include the observation of several participants in one Lean event followed-up with interviews immediately after the event. Observing the participants working with the tools could provide more insightful interview questions that are specific to each learner’s individual experience. Dissecting one specific event may also provide more insight into the model than combining experiences from unrelated events. The goal of this future research study would be to provide specific practices other organizations could include in their Lean events to enhance the opportunity for learning.

A Lean organization can become a learning organization if there is an emphasis on learning and knowledge creation during a Lean event. Lean leaders or facilitators encourage systems thinking in a team-learning environment focused on accomplishing a shared vision. The Lean tools surface mental models and provide a methodology for personal mastery. Using Lean to develop a learning organization will provide a competitive advantage for
organizations as it supplies the tools for learning how to learn through asking the appropriate questions about the present and future state of the organization.
REFERENCES


APPENDICES
APPENDIX A

Table A1

A Priori Codes Based on Nonaka and Takeuchi (1995)

<table>
<thead>
<tr>
<th>Theory</th>
<th>Category</th>
<th>Terms and Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Knowledge Creation Model</td>
<td>1. Socialization</td>
<td>Observation, mentors, job rotation, informal conversations, intuition</td>
</tr>
<tr>
<td></td>
<td>2. Externalization</td>
<td>Tools provide language,</td>
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<tr>
<td></td>
<td>3. Combination</td>
<td>Brainstorming</td>
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<tr>
<td></td>
<td>4. Internalization</td>
<td>Lesson learned</td>
</tr>
<tr>
<td>B. Knowledge Enablers</td>
<td>1. Intention</td>
<td>Shared goals, vision, mission, objectives</td>
</tr>
<tr>
<td></td>
<td>2. Autonomy</td>
<td>Independent, confidence, innovative, involvement, commitment</td>
</tr>
<tr>
<td></td>
<td>3. Redundancy</td>
<td>Share information, open communication, dialogue</td>
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<tr>
<td></td>
<td>4. Variety</td>
<td>Diverse views and perspectives, easy access to information</td>
</tr>
<tr>
<td></td>
<td>5. Trust</td>
<td>Caring environment, non-competitive, camaraderie, sense of team or interconnectedness</td>
</tr>
<tr>
<td>C. Barriers to Learning</td>
<td>1. Company procedures</td>
<td>Approvals, complicated, hierarchical</td>
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<tr>
<td></td>
<td>2. Hoarding knowledge</td>
<td>Credit, recognition, not team player</td>
</tr>
<tr>
<td></td>
<td>3. Company paradigm</td>
<td>Control, avoid risk, centralized, bureaucratic</td>
</tr>
<tr>
<td></td>
<td>4. Organizational stories</td>
<td>Employees with tenure as filter,</td>
</tr>
</tbody>
</table>
APPENDIX B

Case Study Protocol

I. Background
A) Previous Research
   a. The structure of Six Sigma organizations facilitates the flow of knowledge.
   b. Cross-functional teams assist with the transfer of tacit knowledge.
2. Lin & Wu (2007)
   a. Knowledge about products and services is explicit.
   b. Knowledge about customized products is tacit.
   c. Socialization is a challenge for ISO 9000:2000
   a. Leaders can facilitate the translation of tacit knowledge in short-term teams
   b. Categorized Six Sigma tools under each mode of knowledge creation
   a. Identified 5 enablers of knowledge creation
   b. Autonomy, Redundancy, Variety, Intention, and Trust

B) Main Research Question
1. How do adults learn and/or generate knowledge in planning and implementing a quality initiative?

C) Additional Research Questions
1. What factors enable learning and/or knowledge creation?
2. What factors inhibit learning and/or knowledge creation?

II. Design
A) Multiple case study at one “typical” organization
1. The organization is representative of standard implementation of lean practices.
2. Each individual will be treated as a separate case.
B) Object of study is employee perception of learning and knowledge creation during the planning and the implementation of a lean quality initiative.
C) Propositions to be studied
1. Working on projects in teams provides the socialization to transfer tacit to tacit knowledge.
2. The tools of Lean provide a way to translate tacit to explicit knowledge in externalization.
3. Compiling reports at the end of the project provide an opportunity for combination.
4. Reflecting on the project facilitates the internalization of explicit knowledge, which becomes tacit knowledge for future projects.

3. Case Selection and Procedure
   A) Criteria for case selection
      1. Trained in lean thinking
      2. Currently using lean practices for daily work
   B) Case study procedure
      1. Identify organization
      2. Receive organization’s consent
      3. Identify potential participants
      4. Select participants
      5. Participant consent
      6. Conduct interviews
      7. Transcribe interviews
      8. Submit transcripts to participants for verification
      9. Analyze key themes in transcripts
      10. Report on findings

V. Data Collection
   A) Identify the data to be collected
      1. Data will be collected through interviews with participants
      2. A director in the selected organization will identify participants based on the outlined criteria
   B) Define a data collection plan
      1. Semi-structured interviews will be conducted with participants
      2. Interviews will be recorded on a recording device
      3. Immediately following interviews, observations will be recorded in the fieldnotes.
      4. Interviews will be transcribed
   C) Define how the data will be stored
      1. Data will be stored in a password-protected computer
      2. Recordings will be stored in a locked file and destroyed at the end of the analysis

VI. Analysis
   A) A predetermined list of themes and key words indicating theoretical connections (Appendix B)
   B) Possible Responses or Explanations
      1. Learning by socialization in informal settings and conversations.
      2. The process of using tools in planning a quality initiative aide in the externalization of tacit knowledge.
      3. Recognition of learning and knowledge creation by the combination of
ideas and information in the team setting.
   a. Does learning occur if it is not internalized?
   b. Can knowledge creation occur without learning?
4. Recognition of internalization may be triggered by the questions asked in the interview.
C) Inductive analysis through the emergence of new codes and themes.

VII. Plan Validity
   A) General: Runeson and Höst’s (2009) checklist items for the design and data collection plan
   B) Construct validity
      1. Concepts being studied
         a. Employee learning
         b. Employee knowledge creation
      2. Appropriate operational measure
         a. Employee perception
         b. The tacit nature of learning and knowledge creation is difficult to measure and therefore, the perception of learning and knowledge creation through self-reporting is the most appropriate measure
   C) External validity
      1. Results would not be generalizable to all organizations matching the same profile.
      2. Similar case studies could confirm the generalizability of the results.

VIII. Study Limitations
   A) Self-reporting of learning or knowledge creation
      1. Questions about learning may lead participants to realize learning or experiences involving the creation of knowledge that they may not have identified previously.
      2. Reports of learning are subjective to the participant’s interpretation of what constitutes learning.
   B) Inherent complexity in defining or identifying tacit knowledge

IX. Reporting
   A) Target Audience
      1. Organizations currently using Lean practices that are seeking ideas for improving learning and knowledge creation
      2. Organizations investigating the possibility of incorporating Lean practices
      3. Thesis committee and academic community
   B) Relationship to Larger Studies
      1. Extends Wu and Lin’s investigation of the implications of Nonaka and Takeuchi’s model for the quality management community.
      2. Contributes to the greater conversation about learning and knowledge creation in organizations
X. Schedule

A) Planning: December 2011-January 2012
   1. Contact Director to explore the possibility of using the organization
   2. Complete IRB application
   3. Submit IRB application to committee
   4. Make edits according to thesis committee suggestions
   5. Submit IRB application to IRB board

B) Data Collection-February-2012
   1. Contact Director to identify potential participants
   2. Contact participants
   3. Participant consent
   4. Conduct and record interviews

C) Data Analysis-March 2012
   1. Transcribe interviews
   2. Use codes to analyze data
   3. Meet with participants to clarify any questions about interpretation or unclear statements

D) Reporting-March 2012
   1. Incorporate results in master’s thesis
APPENDIX C

North Carolina State University
Institutional Review Board for the Use of Human Subjects in Research
SUBMISSION FOR NEW STUDIES
GENERAL INFORMATION

1. Date Submitted: 01/02/2012
2. Title of Project: “Quality” Learning: Exploring perceptions of how quality tools facilitate learning and knowledge creation in the workplace.
3. Principal Investigator: Sherri Kong
4. Department: Workforce and Human Resource Education
5. Campus Box Number: 7801
6. Email: srbadour@ncsu.edu
7. Phone Number: 919-676-4677
8. Fax Number:
9. Faculty Sponsor Name and Email Address if Student Submission:
10. Source of Funding? (required information): None
11. Is this research receiving federal funding?: No
12. If Externally funded, include sponsor name and university account number: N/A

13. RANK:
   - [ ] Faculty
   - [x] Student: Undergraduate; [x] Masters; or [ ] PhD
   - [ ] Other (specify):

As the principal investigator, my signature testifies that I have read and understood the University Policy and Procedures for the Use of Human Subjects in Research. I assure the Committee that all procedures performed under this project will be conducted exactly as outlined in the Proposal Narrative and that any modification to this protocol will be submitted to the Committee in the form of an amendment for its approval prior to implementation.

Principal Investigator:
Sherri R. Kong
* 12/23 2011

As the faculty sponsor, my signature testifies that I have reviewed this application thoroughly and will oversee the research in its entirety. I hereby acknowledge my role as the principal investigator of record.

Faculty Sponsor:
Julia Storberg-Walker
* 12/24/2011

*Electronic submissions to the IRB are considered signed via an electronic signature. For student submissions this means that the faculty sponsor has reviewed the proposal prior to it being submitted and is copied on the submission.

Please complete this application and email as an attachment to: debra_paxton@ncsu.edu or send by mail to: Institutional Review Board, Box 7514, NCSU Campus (Administrative Services III). Please include consent forms and other study documents with your application and submit as one document.

For SPARCS office use only
In your narrative, address each of the topics outlined below. Every application for IRB review must contain a proposal narrative, and failure to follow these directions will result in delays in reviewing/processing the protocol.

A. INTRODUCTION
   1. Briefly describe in lay language the purpose of the proposed research and why it is important.

   This explorative study explores how employees perceive the impact of using quality tools on learning and knowledge creation in the workplace. The study is important because companies have invested a lot of money in training their employees in quality practices and some are moving away from using such practices because of an over-emphasis on control and efficiency. Understanding the enablers and barriers to learning and knowledge creation can help companies become more flexible and innovative.

   Simply, the MS thesis explorative qualitative study will interview 3-4 employees of a company that is or recently has initiated a quality intervention (e.g., Six Sigma or lean type interventions). The interview will focus on what the employees learned during the quality intervention, and how/why they learned what they did. The interviews will be analyzed, and it is hoped that the findings will contribute to enhanced learning during the implementation of quality interventions.

   2. If student research, indicate whether for a course, thesis, dissertation, or independent research.

B. SUBJECT POPULATION
   1. How many subjects will be involved in the research?

   Estimates or ranges are acceptable. Please be aware that if you recruit over 10% more participants than originally requested, you will need to submit a request to modify your recruitment numbers.

   3-4 (estimate)

   2. Describe how subjects will be recruited. Please provide the IRB with any recruitment materials that will be used.

   Organization recruitment: Through my personal network, I have communicated with the Supply Chain Director of a company that is currently using Lean quality tools. She has expressed interest in participating in the study. I will send her the official organizational recruitment letter following the IRB approval of the application.

   Participant recruitment: After the organization has been recruited, the Organizational Contact from my personal network will be asked to provide a list of potential participants (10-20) with email information. The Organizational Contact will be asked to include only those employees who have experienced a quality intervention and use quality tools in their daily work. Because the study is exploratory and for a MS thesis, other selection criteria are not needed. Further, because any written report will be anonymous, any bias by the Organizational Contact during the selection is not relevant.

   Once the potential participant list is obtained, an email (attached) will be sent to them asking for their participation. The first three-four participants agreeing to participate will be selected. The study hopes to identify four participants, however three could be sufficient for
this MS thesis exploratory study.

3. List specific eligibility requirements for subjects (or describe screening procedures), including those criteria that would exclude otherwise acceptable subjects.

The Organizational Contact will be asked to use only two criteria for creating the list of 10-20 employees. The two criteria are necessary due to the study’s research question. The criteria are:

1. Trained in the use of quality tools (Six Sigma, Lean)
2. Currently using the quality tools in their work

The Organizational Contact may necessarily have to exclude any number of qualified employees from the list. The exact decision-making used by the Organizational Contact is out of the scope of this exploratory MS thesis study. In broad terms, the Organizational Contact will be asked to identify, from these two criteria, a diverse spectrum of employees that cut across length of service, gender, rank, etc. Organizational Contact’s list will contain employee name and email address. I will invite all employees on the list to participate (e.g., all have an equal opportunity to participate) and accept the first 3-4 who agree.

4. Explain any sampling procedure that might exclude specific populations.
See #3 above.

5. Disclose any relationship between researcher and subjects - such as, teacher/student; employer/employee.
The Director of Supply Chain is a colleague/friend of the researcher.

6. Check any vulnerable populations included in study:

☐ minors (under age 18) - if so, have you included a line on the consent form for the parent/guardian signature
☐ fetuses
☐ pregnant women
☐ persons with mental, psychiatric or emotional disabilities
☐ persons with physical disabilities
☐ economically or educationally disadvantaged
☐ prisoners
☐ elderly
☐ students from a class taught by principal investigator
☐ other vulnerable population.

7. If any of the above are used, state the necessity for doing so. Please indicate the approximate age range of the minors to be involved.

C. PROCEDURES TO BE FOLLOWED

1. In lay language, describe completely all procedures to be followed during the course of the experimentation. Provide sufficient detail so that the Committee is able to assess potential risks to human subjects. In order for the IRB to completely understand the experience of the subjects in your project, please provide a detailed outline of everything subjects will experience as a result of
participating in your project. Please be specific and include information on all aspects of the research, through subject recruitment and ending when the subject's role in the project is complete. All descriptions should include the informed consent process, interactions between the subjects and the researcher, and any tasks, tests, etc. that involve subjects. If the project involves more than one group of subjects (e.g. teachers and students, employees and supervisors), please make sure to provide descriptions for each subject group.

As described in #3 above, the Director of Supply Chain will provide the contact information for 10-20 individuals who are currently using quality tools in their work. The researcher will send an email to the individuals on the list describing the study and requesting an interview. The first four volunteers will be selected. If four volunteers are not identified, the Director of Supply Chain will be asked to produce another list of 10-20 employees. The process will continue until four volunteers have agreed to participate in the study.

The researcher will make arrangements via email to conduct a face-to-face interview at a location and time convenient to the participant. Interviews will not take place on the work premises in order to prevent other colleagues from overhearing the interview or any other issue that may compromise confidentiality.

The first step during the interview will be to go over the informed consent form (attached). The second step will be to conduct the interview. During the interview, the researcher will ask questions related to how the employee perceives learning in the use of the tools. This interview will use semi-structured questions (attached). The interview will be recorded on a portable voice recorder and the dialogue will be transcribed by the researcher. A copy of the transcription will be sent to the participant for verification. The participant will be asked to review the transcript for accuracy and to provide any further feedback/ideas about the questions.

Member Checking Details:
To protect participants, transcripts will be printed out and either handed to or USPS mailed to the participant for member checking. Participants will NOT receive electronic copies, and the specific steps I will take to ensure that the participant receives his or her transcript (and not another participant's) are:
1) print out the section(s) of the transcript from the electronic file on my home printer. The file name of the electronic document will contain a hidden code that identifies the actual identity of the participant (e.g., number code will be used).
2) immediately staple and secure the transcript in an envelope; seal the envelope
3) in the alternate secure location, pull out the identification matrix (participant name attached to number code). This document is hand written (no computer trail) and will be hidden and secure in my personal desk area. I will match the number to the participant, and then write the initials of the participant on the envelope.
4) I will follow that process for each member check
5) after confirming with the participant how they want to receive the transcript, I will either arrange to deliver it in person OR mail it to an address they provide.

After this member-checking process, the researcher will analyze the transcripts for key themes and write up the findings and implications of the study.

2. How much time will be required of each subject?
   Approximately 1-2 hours

D. POTENTIAL RISKS
1. State the potential risks (psychological, social, physical, financial, legal or other) connected with the proposed procedures and explain the steps taken to minimize these risks.

   No risks anticipated because the findings and implications will not provide any personal identifying information. For example, the written report will not contain any demographic information that could otherwise identify a participant. In written quotes, any potentially harmful information (like references to specific machines, events, shifts, etc.) will be altered to protect anonymity. The participant pool will not be made public, so people employed at the same organization will not be able to determine who was invited to participate. Finally, in the written report, direct quotes from the participants may be combined and attributed to a fictitious character.

2. Will there be a request for information that subjects might consider to be personal or sensitive (e.g. private behavior, economic status, sexual issues, religious beliefs, or other matters that if made public might impair their self-esteem or reputation or could reasonably place the subjects at risk of criminal or civil liability)?

   No

   a. If yes, please describe and explain the steps taken to minimize these risks.

3. Could any of the study procedures produce stress or anxiety, or be considered offensive, threatening, or degrading? If yes, please describe why they are important and what arrangements have been made for handling an emotional reaction from the subject.

   No

4. How will data be recorded and stored?

   In a password-protected computer in a password-protected file.

   a. How will identifiers be used in study notes and other materials?

   All study notes and materials will protect the identity of the participants. Each respondent will be given an alias name prior to the interview, and the interview transcription will include only the alias. There will be no list created that connects the alias to the real name.

   b. How will reports will be written, in aggregate terms, or will individual responses be described?

   Sections from the interviews may be used to describe a phenomenon, however, it will be attributed to the alias. Care will be used to only use quotes that could not potentially disclose the identity of the participant.

5. If audio or video recordings are collected, will you retain or destroy the recordings? How will recordings be stored during the project and after, as per your destruction/retention plans?

   The audio files will be stored in a locked file cabinet until the recordings are transcribed. Then the recordings will be destroyed.
6. Is there any deception of the human subjects involved in this study? If yes, please describe why it is necessary and describe the debriefing procedures that have been arranged.

No

E. POTENTIAL BENEFITS
This does not include any form of compensation for participation.

1. What, if any, direct benefit is to be gained by the subject? If no direct benefit is expected, but indirect benefit may be expected (knowledge may be gained that could help others), please explain.

The subject may become more conscientious of learning and knowledge creation opportunities in the workplace.

F. COMPENSATION
Please keep in mind that the logistics of providing compensation to your subjects (e.g., if your business office requires names of subjects who received compensation) may compromise anonymity or complicate confidentiality protections. If, while arranging for subject compensation, you must make changes to the anonymity or confidentiality provisions for your research, you must contact the IRB office prior to implementing those changes.

1. Describe compensation

None

2. Explain compensation provisions if the subject withdraws prior to completion of the study.

3. If class credit will be given, list the amount and alternative ways to earn the same amount of credit.

The MS thesis requires six credits of EAC-692. These credits are earned by designing a small exploratory study, defending a proposal, conducting a study, and by defending the findings/implications.

G COLLABORATORS
1. If you anticipate that additional investigators (other than those named on Cover Page) may be involved in this research, list them here indicating their institution, department and phone number.

No

2. Will anyone besides the PI or the research team have access to the data (including completed surveys) from the moment they are collected until they are destroyed.

No

H. CONFLICT OF INTEREST
1. Do you have a significant financial interest or other conflict of interest in the sponsor of this project? 

No

2. Does your current conflicts of interest management plan include this relationship and is it being properly followed? 

N/A
I. ADDITIONAL INFORMATION
1. If a questionnaire, survey or interview instrument is to be used, attach a copy to this proposal.

2. Attach a copy of the informed consent form to this proposal.

3. Please provide any additional materials that may aid the IRB in making its decision.

J. HUMAN SUBJECT ETHICS TRAINING
*Please consider taking the Collaborative Institutional Training Initiative (CITI), a free, comprehensive ethics training program for researchers conducting research with human subjects. Just click on the underlined link.
APPENDIX D

Table D1

*Literature review of studies based on Nonaka and Takeuchi’s (1995) model*

<table>
<thead>
<tr>
<th>Reference</th>
<th>Type of Study</th>
<th>Instrument</th>
<th>Findings</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anand, Ward, Tatikonda (2010). Role of explicit and tacit knowledge in Six Sigma projects: An empirical examination of differential project success. <em>Journal of Operations Management, 28</em>(4), 303–315.</td>
<td>Quantitative</td>
<td>Surveys</td>
<td>Despite the absence of strong social ties, team leaders can make use of knowledge-creation practices to facilitate the sharing of tacit knowledge within the planning and implementation of a quality initiative.</td>
<td>Categorized Six Sigma practices under the knowledge creation modes</td>
</tr>
<tr>
<td>Choi, B. &amp; Lee, H. (2002). Knowledge management strategy and its link to knowledge creation process. <em>Expert systems with applications, 23</em>, 173–187</td>
<td>Qualitative</td>
<td>Questionnaires</td>
<td>Knowledge creation modes differ according to the department as well as whether the company focuses on a systems or human (individual) strategy.</td>
<td></td>
</tr>
<tr>
<td>Reference</td>
<td>Type of Study</td>
<td>Instrument</td>
<td>Findings</td>
<td>Other</td>
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<td>Morena-Luzon, M.D. &amp; Lloria, M.B. (2008). The Role of Non-structural and Informal Mechanisms of Integration and Coordination as Forces in Knowledge Creation. <em>British Journal of Management, 19</em>(3), 250–276.</td>
<td>Quantitative</td>
<td>Questionnaire s w/ Likert scale</td>
<td>Enablers of knowledge creation included standardization of skills, standardization of outputs, socialization interventions, and mutual adjustment as well as intention, autonomy, redundancy, variety and trust. Standardization of work processes was found not to be an enabler.</td>
<td>Appendix includes items to look for as evidence of the presence of enablers.</td>
</tr>
<tr>
<td>Wu, C. &amp; Lin, C. (2009). Case study of knowledge creation facilitated by Six Sigma. *International</td>
<td>Qualitative</td>
<td>Interviews</td>
<td>Six Sigma program facilitates knowledge flow. The use of cross-functional teams helps with the</td>
<td>Develops an initial model for an organization that wants to</td>
</tr>
<tr>
<td>Reference</td>
<td>Type of Study</td>
<td>Instrument</td>
<td>Findings</td>
<td>Other</td>
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<td><em>Journal of Quality Science, 26</em>(9), 911–932.</td>
<td></td>
<td></td>
<td>sharing of tacit knowledge. Developed a model for the knowledge creation process in a Six Sigma program.</td>
<td>facilitate knowledge creation according to the prevailing Six Sigma approach.</td>
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</table>
## APPENDIX E

Table E1

*Combined Coding Results*

<table>
<thead>
<tr>
<th>Category</th>
<th>Quotes</th>
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</table>
| 1. Socialization | • It’s such a great way to get the training session started because they say ‘wow, there is actually a lot of waste that I have in my normal daily processes.”  
  • It was like the first one (test) was the science part and this one (test) was the art part and you had to pass both…They didn’t train us in the art, we had no clue.  
  • My senior Master Black Belt was from Motorola, trained in Motorola, at the beginnings of Six Sigma at Motorola, another Master Black Belt was from Honeywell…and then another Master Black Belt was from GE…so I got a really good indoctrination into Six Sigma  
  • That’s what I learned from the process executive because that’s what they did, I wasn’t a big believer until I saw her facilitate a meeting  
  • I’ve been to so many places where they have a good process that is very lean or low quality issues and so if I go to a place, it’s easy for me to pick out or spot, not all the time  
  • During what we call a waste walk, looking for a non-value add versus value add. A lot of times people are not aware that some of the stuff that they’re doing is actually value adding and it’s not that they’re waste but the things that they’re doing or have to do for the results they want is actually waste or leads to a rework or something of that nature.  
  • People get so ingrained in their daily activities that they just don’t see it… So I am training people and I just point out stuff if they are training with me and we’re doing a walk through  
  • I’ve seen it work in businesses and I’ve seen it fail in businesses as well.  
  • One of the things I get comments about is “you don’t know this, you don’t do this job, you don’t know, come and spend a day here doing this job, come spend a day here out in the field with me.” And most of the time, I try to do that ahead of time so that I can ward off that comment. |
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| 2. Externalization | • So a big tool that helps us with (providing a common language) is process mapping  
• A lot of times these guys have their jobs in their head but they couldn’t put it in procedures and you’d be surprised how process mapping, just getting people up there and getting the steps out everybody can say “Oh well, even though I haven’t done that job, I know see what it takes to do that”  
• The good thing about Lean is that everything is visual. We’re not going to hide anything, we’ll make everything visual  
• When you have those reoccurring themes, you know someone keeps saying something over and over we stop and go back to that, we talk about it  
• But we worked through a process to verify all of the potential causes and really get down to the critical ones so that we could say this is what is really affecting the process and this is what we can do to fix it.  
• We help them document their existing processes or new processes  
• The final report, which includes the charter, the opportunities that were identified, the future state improvement   |
| 3. Combination   | • So in some instances, you may have geographical differences based on how the company actually came together so they might have had an existing process in place.  
• Actually, it’s like a best practices session  
• Let’s share how you do it  
• One of the things we do in project is write down lessons learned. Before we just made a list and no one looked at it again. Here it’s “What did we learn? What can we apply from this?” So it is learning, it’s not forgotten, it’s always going back and looking at it.  
• We have a central repository that we store all of our projects events, final projects in so that others can see our process.  
• And then you develop this plan or have this of action items to execute it following that event  
• We have a centralized location, we call it a Sharepoint site, where we put all of the outcomes of our events into a centralized location where we document all of our findings from those events  
• So if there is something that one business unit wants to work on and typically I’ll go into that centralized location and someone in another business unit has done the same thing, I will at least review that material or contact that person that facilitated that event so that we can leverage learning. |
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| 4. Internalization | - What happens is as you’re learning the principles people start to apply it to their everyday work. So in that essence, they’re piloting their normal day to day processes and they are weighing them against each of the principles that they are learning in the learning session.  
- I think it’s one of the greatest ways to have your peers learn is during that process because they hear things that they can then apply more to their day to day versus scenarios that just may not be applicable.  
- A lot of times it’s the person b/c their ongoing job is to just own the process and to identify areas of opportunity so if within that process they are hearing a lot of pain points or they’re observing a lot of waste in the process, they say I see an area of improvement.  
- They’re the ones traveling within the company so it’s easy for them to identify areas of improvement or an opportunity to standardize and gain some efficiency in some of those areas.  
- It’s totally a different lens  
- I shared with them that when I did my green belt, that’s what we ran into because we were building a process and we weren’t sure if we needed to do a fourth level so that was sort of the “aha” that we don’t need to go  
- One of the things we do in project is write down lessons learned. Before we just made a list and no one looked at it again.  
- It’s just thinking about how to do something differently  
- It makes you think about “what could I have done differently, I am in this now, what could I have done different?”  
- I was not an analytical person before, but I am now…I see a lot of value in it and in removing waste in your life and going back and asking “why”.  
- I’ve used the tools a lot in my personal life, just trying to think about what I’m trying to do to get the waste out….  
- I hear a lot of people go back to their work areas and they try to do things differently.  
- I’ve been to so many places where they have a good process that is very lean or low quality issues and so if I go to a place, it’s easy for me to pick out or spot, not all the time  
- I think for some people, the light comes on and they can take some
<table>
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<th>Category</th>
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|          | things back to their lives and to the workplace  
|          | • It’s such a new concept to them, a new way of thinking…they’ve not had to think that way because they’ve not had that platform that forced them to think that way.  
|          | • So I look at everything through what I call “Lean Glasses”  
|          | • Especially during what we call a waste walk, looking for a non-value add versus value add. A lot of times people are not aware that some of the stuff that they’re doing is actually value adding and it’s not they’re waste but the things that they’re doing or have to do for the results they want is actually waste or leads to a rework or something of that nature.  
|          | • Some folks actually take what they learn and use it in a day to day task  
|          | • That’s really what we’re trying to do and that’s how you are able to really say that you’re mature in the lean methodology when you have individual contributors using these tools in their day to day task and that’s what we’re really trying to achieve.  
|          | • I’ve seen it work in businesses and I’ve seen it fail in businesses as well. |
## APPENDIX F

Table F1

*Enabler Codes*

<table>
<thead>
<tr>
<th>Category</th>
<th>Quotes</th>
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</table>
| 1. Intention | • You can make those decisions because you’ve already started with the sponsorship saying “hey I understand the scope of the problem, I understand your objectives, I agree with your deliverables. I like what’s in scope, I think that’s manageable, I like what you’ve tapped as being out of scope
• Yes, you have to leave the room with a consensus
• By the second or third day the people are starting to gel because they’ve spent so much time or they see where they are arriving at a group process or approach.
• You work with management and maybe a lead SME to help understand what the problem is and what the objectives are going to be for the lean event |
| 2. Autonomy | • We’re empowering them to make decisions, so the team is totally empowered
• So getting that sponsorship ahead of time and then communicating to the team, “Hey, we can make decisions” paints the picture that we’re really thinking about this.
• It’s a great structure of sponsorship so that the approval is ahead of time so the team can just really focus on the improvements.
• They’re the ones traveling within the company so it’s easy for them to identify areas of improvement or an opportunity to standardize and gain some efficiency in some of those areas.
• There is this piece of the process, if there is a way to improve the process, it should come from you. It shouldn’t come from me and it shouldn’t come from somebody else, you own this, you’re the owner
• To build an organization of learners, I think what we’re going to have to do with our process owners and process designers make those people the key learners. They are like the disciples or the evangelist of process. |
| 3. Redundancy | • They might have had an existing process so the company came and kind of challenged it (voice gets soft). Usually these things surface when we find that there is an opportunity for synergy
• By the second or third day the people are starting to gel because they’ve spent so much time or they see where they are arriving at a |
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<th>Category</th>
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<tbody>
<tr>
<td></td>
<td>group process or approach.</td>
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<td></td>
<td>• What I try to do is hear all sides and collect data points.</td>
</tr>
<tr>
<td></td>
<td>• I try to find common ground for all sides, which is not always easy.</td>
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<tr>
<td></td>
<td>• At the end of the day, we’ve got a product to get out or a service to provide and so we’ve got to find the linkages to that and so with the structured approach that we have with the tools, we can generally arrive at that point.</td>
</tr>
<tr>
<td>4. Variety</td>
<td>• Actually, it’s like a best practices session.</td>
</tr>
<tr>
<td>5. Trust</td>
<td>• By the second or third day the people are starting to gel because they’ve spent so much time or they see where they are arriving at a group process or approach.</td>
</tr>
<tr>
<td></td>
<td>• We like to say that we are “hard on the process and easy on the people.”</td>
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APPENDIX G

Table G1

*Barrier Codes*

<table>
<thead>
<tr>
<th>Category</th>
<th>Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Company procedures</td>
<td>• Actually not a barrier b/c the approval is received ahead of time&lt;br&gt; • So if it gets to a point where you feel like you are a roadblock, that’s when you call your sponsor&lt;br&gt; • It was challenging because when you are dealing with a lot of technical folks, they already have a lot of their own processes and methodologies in place that they want to use.</td>
</tr>
<tr>
<td>2. Hoarding knowledge</td>
<td></td>
</tr>
<tr>
<td>3. Company paradigm</td>
<td></td>
</tr>
<tr>
<td>4. Organizational stories</td>
<td>• Everyone wants to hold on to their process&lt;br&gt; • No one wants to be told that their process had a lot of waste built into it or it may be a process that they have been doing for 10 or 20 years&lt;br&gt; • If you have a variety of those people, in these situations, it’s really hard to let go and open your mind up to someone else b/c in essence it feels like what you’re saying is what I’ve been doing hasn’t been good enough&lt;br&gt; • Everyone wants to tell a story and everyone wants to build a case about why you should keep theirs&lt;br&gt; • Sometimes at first they don’t understand the value of using Six Sigma or Lean, especially if they have not been exposed to it so that was a challenge with that project&lt;br&gt; • It was challenging because when you are dealing with a lot of technical folks, they already have a lot of their own processes and methodologies in place that they want to use.&lt;br&gt; • Tenure is a barrier, for most people because when you’re trying to do organizational change you want unfreeze them, you want to move them, and then you want to freeze them.</td>
</tr>
</tbody>
</table>
APPENDIX H

Table H1

*Inductively Developed Thematic Categories*

<table>
<thead>
<tr>
<th>Emerging Codes</th>
<th>Quotes</th>
</tr>
</thead>
</table>
| Self-directed Learner | • We need to help people see what’s in it for them  
• We can generally arrive at point where they find that ownership, they find what’s in it for them, how they affected it.  
• By the second or third day the people are starting to gel because they’ve spent so much time  
• Listen to people, listen and make sure that you get the group or the employees engaged because you can’t be a lone ranger out and make improvements  
• If you want something to stick, if you want buy-in, if you want really good ideas, you need to engage people, and stay the course  
• They may not take ownership or see what’s in it for me  
• You need to make sure the event or the effort is communicated up front so that people are aware of what’s going on, they can give their input, so that everyone wants to feel that they have some say in it  
• We’re empowering them to make decisions, so the team is totally empowered, you don’t have to make calls during the event or during a blitz.  
• It’s the person b/c their ongoing job is to just own the process and to identify areas of opportunity so if within that process they are hearing a lot of pain points or they’re observing a lot of waste in the process, they say I see an area of improvement.  
• They’re the ones traveling within the company so it’s easy for them to identify areas of improvement or an opportunity to standardize and gain some efficiency in some of those areas.  
• There are not incentives tied to the improvements because a lot of times you cannot tie an improvement to the bottom line  
• This is just a person who wants to keep the organization as efficient and as effective as possible  
• I am not a robot. I have ownership over this. |
<table>
<thead>
<tr>
<th>Emerging Codes</th>
<th>Quotes</th>
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<tbody>
<tr>
<td>• You really weren’t trained to think about it b/c you were taught the tools and you were taught the process but you weren’t taught to think about the process.</td>
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<tr>
<td>• If there is a way to improve the process, it should come from you</td>
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<td>• It shouldn’t come from me and it shouldn’t come from somebody else, you own this, you’re the owner</td>
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<td>• If something is not working correctly, process owners should be working with their people and figure out what they’re doing.</td>
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<tr>
<td>• Doing a project, you change part of the organization, you impact some part of the organization, it’s a change so understand that, own it, live it.</td>
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<td>• To build an organization of learners, I think what we’re going to have to do with our process owners and process designers make those people the key learners.</td>
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<tr>
<td>• They are like the disciples or the evangelist of process. They are working with the people who are actually doing the work</td>
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<td>• They are learning from having ownership.</td>
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<td>• So now you as the person who has learned is teaching everyone else.</td>
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<tr>
<td>• If we’re not mentoring and coaching, how do we know they are actually getting it and growing and all of this feeds back into continuous improvement</td>
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<thead>
<tr>
<th>Art of Questions</th>
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<tbody>
<tr>
<td>• She’s done that three times, I wonder if she knows...</td>
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<tr>
<td>• Why are you doing it that way?</td>
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<td>• What other way could you do it?</td>
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<tr>
<td>• Have you thought about this?</td>
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<tr>
<td>• What do you do?</td>
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<tr>
<td>• How long does it take?</td>
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<tr>
<td>• Why does it take so long?</td>
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<tr>
<td>• What tools did you use in the project?</td>
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<tr>
<td>• Why did you use those tools?</td>
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<td>• If you had to do it over again, would you use the same tools?</td>
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<tr>
<td>• What did you learn from those tools?</td>
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<tr>
<td>• What is the process telling you?</td>
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<tr>
<td>• What’s the impact of the process?</td>
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<tr>
<td>• Where do the sub-processes connect?</td>
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<tr>
<td>• What do we with it?</td>
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<tr>
<td>• Is the process broken?</td>
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<tr>
<td><strong>Emerging Codes</strong></td>
<td><strong>Quotes</strong></td>
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<tr>
<td>• What are we hearing the process feedback to the process?</td>
<td>• The first couple of days are very challenging b/c the people want to get their opinion across</td>
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<tr>
<td>• Where do we focus?</td>
<td>• They have a very strong opinion about something, I write it down and capture it and you’d be surprised how that makes people feel because now you’ve heard me and you’re going to include what I said in what we’re trying to do</td>
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<tr>
<td>• Do we really understand what that means?</td>
<td>• It’s amazing how it makes people feel when they think they are being heard or their opinions are being incorporated.</td>
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<tr>
<td>• What’s the next evolution of Lean Six Sigma?</td>
<td>• So those first couple of days, people are on the edge or feel like they’re in the hot seat if they are performing the process or the one who has the control over it</td>
</tr>
<tr>
<td>• What’s the next level?</td>
<td>• It’s very uncomfortable for people and I’ve watched people where if they were not in the hot seat, they wanted to participate and share but when they get in the hot seat they clam up and don’t want to share</td>
</tr>
<tr>
<td>• What’s the future?</td>
<td>• A lot of times people are not aware that some of the stuff they’re doing is actually <em>not</em> value adding and it’s not that <em>they’re</em> waste, but the things they’re doing or have to do for the results they want is actually waste</td>
</tr>
<tr>
<td>• How do you mentor and coach people?</td>
<td>• When you are under the gun or under pressure and someone is scrutinizing you and what you’re doing to affect the quality of that process, it’s very uncomfortable</td>
</tr>
<tr>
<td>• How do I use my facilitation skills to get the information out?</td>
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<tr>
<td>• What do I use in my toolbox to present the information back?</td>
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<tr>
<td>• What’s the flow of the information in the tools through the process?</td>
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<tr>
<td>• What is the role of mentoring and coaching as part of learning using the tools?</td>
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<tr>
<td>• Do I improve the process or do I improve the people?</td>
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<tr>
<td>• So you’ve done a root cause analysis, did you really find the root cause?</td>
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<tr>
<td>• What’s the upstream and downstream impact of that change?</td>
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<tr>
<td>• I was not an analytical person before.</td>
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<tr>
<td>Emerging Codes</td>
<td>Quotes</td>
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<td></td>
<td>• So I try to remove all of the emotion out by either making it visual or talking to data.</td>
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<td></td>
<td>• Just trying to keep it from being subjective and it's an art.</td>
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<td></td>
<td>• No one wants to be told that their process had a lot of waste built into it or it may be a process that they have been doing for 10 or 20 years so it's very innate and part of their identity so it's hard for them to let go of it.</td>
</tr>
<tr>
<td></td>
<td>• It's really hard to let go and open your mind up to someone else b/c in essence it feels like what you're saying is what I've been doing hasn't been good enough.</td>
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<td></td>
<td>• So let's really look at the process and take the feelings out of it so that you're not too emotionally tied to it.</td>
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<td></td>
<td>• You are applying the tools versus the emotion.</td>
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<td></td>
<td>• That makes it very black and white rather than optional or personal.</td>
</tr>
</tbody>
</table>
APPENDIX I

Definitions

Lean Methodology: The establishment and enhancement of system flow through the identifying and eliminating waste and reducing required resources.

Lean Event (Rapid Improvement Event or Kaizen Blitz): A 3-5 day event led by the Lean Leader and the designated SME. The purpose of the event is to address a specific problem by improving a process. Prior to the event, the business identifies key stakeholders, experts and employees who are involved with the current process.

Lean Process: A set of operations required to assemble, manufacture, or produce a product or component. Lean seeks to improve the flow of the entire process, as opposed to 'maximizing' the output of each operation.

Lean Leader: The individual who is trained in the use of the Lean Tools and facilitates the Lean Event. The Lean Leader trains others in the use of the Lean Tools for the purpose of improving a process.

Value Stream Analysis (VSA): Physical mapping of each process step in the value stream; identifying waste, unevenness, and overburden, speaking with data, sizing the opportunity for improvement, creating the plan of action and predicting the improvement results. Shares a future state vision.

Waste: Any task, process, or portion of a system that doesn't directly provide value to a paying customer. The seven common types of waste are: transport, inventory, motion, waiting, overproduction, over processing, and defects.

Tools or Toolkit: This organization uses a combination of tools from Lean and Six Sigma.

Below is a list of commonly used tools:

<table>
<thead>
<tr>
<th>Define and Prioritize</th>
<th>Measure Performance</th>
<th>Implement Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affinity Diagram</td>
<td>Histogram</td>
<td>5S tool</td>
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<tr>
<td>Value Stream Analysis</td>
<td>Pareto Chart</td>
<td>Brainstorming</td>
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<tr>
<td>Process Flow Chart</td>
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<td>Corrective Action Matrix</td>
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<tr>
<td>Project Priority Calculator</td>
<td>Analyze Root Cause</td>
<td>Error-Proofing</td>
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<tr>
<td>Value-added Flow Chart</td>
<td>5-Why Analysis</td>
<td>Kaizen</td>
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<td></td>
<td>Design of Experiments</td>
<td>One Piece Flow</td>
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<td></td>
<td>Fishbone Diagram</td>
<td>System Diagrams</td>
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<td></td>
<td><strong>Control the Process</strong></td>
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<td></td>
<td>Standardized Work</td>
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</tbody>
</table>
APPENDIX J

Sample Agenda of Lean Event

Day One

9am-10am  Overview of Lean
10am-12pm  Tool Training
12pm-1pm  Lunch
1pm-4pm  Map the current processes (multiple sites)

Day Two

9am-12pm  Identify waste in the current processes
12pm-1pm  Lunch
1pm-4pm  Root cause analysis on areas of waste

Day Three

9am-12pm  Develop a future state of the process
12-1pm  Lunch
1pm-4pm  Identify steps and resources necessary for future process

Day Four

9am-12pm  Develop an action plan
12pm  End of session if all objectives are complete