Transformational Leadership and Lean Construction Implementation

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A thesis

submitted in partial fulfillment of the

requirements for the degree of

Master of Science in Construction Management

University of Washington

2013

Committee Chair:

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Program Authorized to Offer Degree:

Construction Management

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Abstract

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When an organization starts the journey of implementing Lean Construction on a construction project, several options are made available on how to mitigate technical challenges. Common solutions are centered on training current employees on Lean methods or hiring personnel who have experience in this field. However, what can be overlooked is how the challenges of organizational change can create barriers that cannot be mitigated with technical preparation. What this study has attempted to illuminate is how the relationship between project specific leaders and their direct reports could be a key to resolving the behavioral issues like resistance to change that is commonly found in all types organizational change. Using a quantitative survey distributed to several projects implementing Lean Construction, this study examined the relationship between the project leaders and followers and compared them to the attitudes towards Lean Construction. After reviewing the responses from the survey, a statistical analysis comparing the metrics showed evidence to suggest a relationship between Transformational

Leadership occurring in a project team and Lean Construction attitudes. Going forward, this information should prove useful to organizations and academics trying to understand how staffing selection of a Lean Construction project can lead to less painful transitions resulting from organizational change.

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ACKNOWLEDGEMENTS

This study is made possible by the encouragement, guidance, knowledge and support from Dr. Yong Woo Kim throughout my research. I am also incredibly grateful for the support of the entire UW Construction Management faculty with special thanks to Dr. John Schaufelberger, Dr. Omar El-Anwar, Dr. Ken-Yu Lin, Dr. Carrie Dossick, Len Holm and Theresa Taylor. You all transformed my journey at the University of Washington into a defining moment of my life.

I would also like to thank the statistics department at the University of Washington, specifically Brittany Sanchez, for helping me complete my statistical analysis. My report would not be possible without your help.

Special thanks needs to be given to Prof. Sten Bonke at the Technical University of Denmark. When the University of Washington was 5000 miles away, he and the staff at DTU made sure I was at home by providing me with a tremendous support group that allowed me navigate through the challenges of not having the facilities of UW available.

This report would also not be possible without the tremendous support I received from the construction professionals who participated and contributed to this report. Special thanks needs to go to Mike Humphrey and Dean Reed at DPR Construction, River Steenson at BN Builders, Dace Campbell, Carrie Boettcher at Sellen Construction, Jeff Cleator at Lease Crutcher Lewis, Matt Braun at H.S. Wright Construction, and Kevin McAteer, Aaron Evanson and the entire GSA staff at Seattle Metropolitan Service Center.

I cannot give enough praise to my family and friends who supported me though out this effort. Special praise needs to be given to my parents have always been a rock of support for all my endeavors in life.

And most importantly, none of this would possible without the continuous encouragement and confidence my wife, Megan, has in me. This report is dedicated to her and our two daughters, Lucille and Alice, who are my consistent source of love and happiness.

Introduction

Lean Construction has become a popular method for project delivery and this has lead to more organizations experiencing their own implementation journey. As these organizations may experience, successful implementation can be the result of training with Lean tools and also how well the staff is able to change their behaviors to suit this newer style of project delivery (Salem, et al. 2005). While the necessity of a successful training program has been declared a part of the effort needed for companies to make a Lean transformation, a significant portion needs to be dedicated to the effort of changing the leaders practices, behaviors and mindsets (Mann 2010). With the multitude of variables that may play a role in a companies Lean journey, it is becoming more understood that leadership plays a significant role in creating a companies Lean opportunities.

When leadership is simply viewed on a construction project it can be defined with flow chart where managers assign and distribute tasks and assignments to their direct reports. However, the dynamic is more complex as this relationship is also required to mitigate the chances of a failed implementation of organizational change like Lean Construction. What is known in this association is that the role of senior leadership has been noted as a factor in reducing the stresses in implementing Lean design and tools (Mann 2010). Also recognized is how the presence of leadership has to be consistent with an ability to change the company culture by changing management practices (Ballard and Kim 2007). With this said, simply viewing leadership as a facilitator of tasks and assignments is short-sided and further examination from this perspective is needed.

Understanding the role of leadership, as simply as it can be assigned, encompasses several elements that determine its effectiveness in practice. It is very popular to see this in the roles separated in Leadership and Management and the way the approaches are categorized could help companies make decisions on what is suited best for their needs (Toor 2011). Not only does this person need to be trained to overcome the technical challenges presented by learning new systems like Lean, but the person also needs to be determined to prevail when faced with soft issues found in organizational change (Lean Construction Institute 2013). While overcoming these soft issues can be linked to the values and culture of the company, it should be considered that the individual's ability to overcome the challenges lies within their power and status on a project (De Vries, Gullien and Korotov 2009).

It is with this person's power and status on a project that this study will attempt to understand how the personality, values and traits of a leader affect the implementation of Lean Construction. Can certain people be identified as the right type of leader who is more suited to lead a Lean effort? Can this person also have an adverse affect despite the inclusion of the values and culture of an organization to overcome the challenges of organizational change?

The focus of this research will start with the idea that senior leadership should be stressed as a key factor in implementing Lean design or tools (Mann 2010). The ability for organizations to navigate the implementation process not only requires the improvement of company's systems and training programs, but also understanding that a behavioral change must also occur (Salem, et al. 2005). Once the role of leadership can be refined to understand their influence within the

lean effort, a quantitative test will be created to comprehend how the direct reports respond to their manager. Hopefully a greater understanding will be gained on how people individually make a difference when trying to successfully implement Lean Construction.

Problem Statement

When an organization implements Lean Construction they need to mitigate several challenges to ensure success. A key factor is the selected staff that will be responsible for the success of the project and it's components. Whoever the company chooses to lead these efforts will have the ability to use their own knowledge, traits and values to affect the outcome. Will these people, who assume their roles as project leaders, be able to manage changes from their previous conceptions of project delivery while adapting to new power controls assigned to the team that were traditionally their role?

The research question to be spoken about is "how does leadership affect the implementation of Lean Construction?"

In order to address the research question, this study will be split up into four chapters. Chapter 1 is a review of existing literature relevant and suitable to the subject topic. Chapter 2 presents the research methodology used to answer the research question. Chapter 3 presents the results of the methodology and conclusions and recommendations are captured in Chapter 4.

Chapter 1.

Literature Review

In order to understand the empirical field of knowledge within this research, the literature has been split into four sections. The first section is a basic overview of Lean construction and it's origins in the manufacturing industry. The second section is a review of literature based on organizational change. The third section focuses on leadership and how it could be applied towards overcoming the challenges faced when implementing organizational change. The fourth section reviews case studies in construction management and Lean. Gaps in literature are identified and further refinement of the research problem is presented.

1.1 Lean Construction

While the point of this research is not to recap and define Lean Construction, it is important that past literature that addresses the origins is included in the literature review. In order to accomplish this two sources that describe the origins of Lean and it's relationship to construction have been included provide a basic overview. It is also important for this research to provide this baseline for readers not completely familiar with the origins of Lean Construction and also create confidence that the research is familiar with the project delivery style being investigated in this study.

The origins of Lean Construction are rooted in lean production principles developed by engineer Taiichi Ohno and Toyota. In the conference proceedings by Greg Howell, descriptions are provided on how Toyota and Ohno reinvented the automobile production systems to meet the specific requirements of the customer while instantly delivering the product without maintaining wasteful inventories (G. A. Howell, What Is Lean Construction - 1999 1999). While there is fairness in the perception that there is a significant difference between car production and

construction of unique projects, the author maintains that managing the shared effect of variation on dependence that is quintessential in mass production is related to construction project delivery. Furthermore, the cause and effect of waste and production lines is related to construction and a case is made that the traditional responses in each industry to make up for these defects are associated. Solutions are proposed on how to overcome these challenges including partnering, management of the planning systems, measuring reliability, smoothing of workflow, and understanding how human issues are related to implementation (G. A. Howell, What Is Lean Construction - 1999 1999). While these proceedings recorded by Howell give a detailed account into the origins of Lean Construction, there is a desire to gain further knowledge into the origins of lean at Toyota.

In order to gain more insight into the fundamentals of Lean Construction, the work of James Womack, Daniel Jones, Daniel Roos and Donna Sammons has been reviewed. In their publication, the researchers from the Massachusetts Institute of Technology analyzed how mass production transformed into Lean production (Womack, et al. 1991). The researchers explain the history of automobile production and how the transformation from craft production to mass production and eventually to Lean production took place. The details of how Lean production was started at Toyota with the help of Ohno was explained and the elements of Lean production are broken into five parts including running the factory, designing the car, supply chain coordination, customer service and management of the lean enterprise. Several case studies are examined that show the difference of traditional forms of mass production versus Lean production. Metrics including cost, delivery and defects are used to make a case for each philosophy presented. The book concludes with how to complete the transition to Lean

production by analyzing the obstacles of implementation including resistance from mass producers in western nations (Womack, et al. 1991).

1.2 Organization Change

Implementation of Lean Construction has challenges that are inherent to it's own specific principles and systems. Yet the challenges can also include what is found typically in any organizational change (Lean Construction Institute 2013). By understanding the challenges commonly created by organizational change, a better understanding of where to focus research can be obtained.

The idea that organizational change can be categorized is apparent in multiple publications. For example, it is suggested by Jeffery Liker, Mark Fruin and Paul Adler, who discuss the transformation of Japanese management systems in North America, that organizational change can be separated into "strategic design, social construct, and political." (Liker, Fruin and Adler 1999) Strategic design has more to do with the training and systems required to implement the organizational change (Liker, Fruin and Adler 1999). Social construct is more related to the company culture being able to accept the changes and the role of leadership. Political relates to the dynamic of how organizational change affects the power structure of a company (Liker, Fruin and Adler 1999).

Another way of categorizing the challenges of organizational change is to identify them as hard and soft issues. Further explained, the hard issues relate to technology, structures and systems and the soft issues have to do with values and corporate culture (De Vries, Gullien and Korotov

2009). These are similar to the categories identified in Liker, Fruin and Adler in that systems required for implementation have been separated from the affects due to company culture (Liker, Fruin and Adler 1999).

There are suggestions on how to overcome the challenges of organizational change made by Barbara Bunker and Billie Alban. Their key points address how to use large group methods in different stages and the use of open communication of stakeholders that has become very popular with today's large companies (Bunker and Alban 2006). The purpose of open communications is to help identify the barriers that may be occurring (Bunker and Alban 2006).

John Kotter delivers a step-by-step adaption to organizational change with an emphasis ranging from vision to culture and how they are seen as the keys to success (Kotter 1996). Economic and social forces are also seen as a driver for major change in an organization (Kotter 1996).

While the information is limited on how a construction organization could make the transition to Lean Construction, there is research on how a Lean Manufacturer could overcome these challenges. David Mann discusses how a company can implement Lean Manufacturing within its existing organization (Mann 2010). This book addresses how organizations use leadership to implement Lean Manufacturing tools like standardization and value stream mapping but also how the role of culture affects the outcomes (Mann 2010).

Organizational success is a topic that is addressed by Frank Watson (Watson 1994). While the popularity of Total Quality Management (TQM) has become very popular due to its focus on

customer satisfaction, quality, continuous improvement and power; the ability to make the organizational change is not simple (Watson 1994). The corporate culture of a company has been suggested to be more important than the strategy when implementing TQM and specifically the attitude of the employees as a critical factor to create success (Watson 1994).

1.3 Leadership

During the implementation of lean construction it is recommended that there is a presence of consistent leadership (Ballard and Kim 2007). It is with this suggestion that several publications were reviewed regarding leadership and the role within an organization implementing change. Some of the literature reviewed separated leadership and management to help bring focus to specific aspects and others discussed certain traits or values found in leadership styles. This study requires a great depth of knowledge of how leadership facilitates the challenges of organizational change.

The role of leadership in an organization willing to implement organization change has been documented. As Richard Lester noted, a key to effectively complete organizational change is leadership (Lester, Creative Leadership for Total Quality 1993). Any organization that wants to implement change can recognize the value of having leadership at every level (Lester, Creative Leadership for Total Quality 1993). It is with this leadership infiltrating at every level that company culture can accept change (Lester, Creative Leadership for Total Quality 1993).

While the role of leadership has been documented in academic findings mentioned, understanding how the actions of the leader affect the functionality of the organization

implementing these changes is still needed. Specifically, the author Manfred Kets DeVries identifies how leaders are unaware of how these actions may impede the functions within the organization (De Vries, Gullien and Korotov 2009). There is also an understanding that separate approaches may be needed to resolving hard and soft issues (De Vries, Gullien and Korotov 2009). Considering that hard and soft issues require a separate approach, it could be said that different styles of leadership can be used to overcome these challenges.

Several publications reviewed have separated the roles of leadership to be known simply as "leadership" and "management." For example, Lester explains that "management" can be defined as "doing things right" and leadership as "doing the right thing" (Lester and Kunich, Leadership and Management: The Quality Quadrants 1997). The division of leadership and management into quadrants to help the organization see where the deficiencies are occurring is used and include specific suggestions to the four variations (Lester and Kunich, Leadership and Management: The Quality Quadrants 1997). Overcoming the challenges each variation presents can be as simple as improving the training or learning of that system. However, leadership and "doing things right" are not typically corrected as easily as sending a person off to training. There are moral decisions to be made and being able to identify the right people for the specific leadership in operating these organizational changes could depend on the desired culture of the company (Lester and Kunich, Leadership and Management: The Quality Quadrants 1997).

Lester also discusses how creative leadership is necessary for "Total Quality" to occur (Lester, Creative Leadership for Total Quality 1993). The description of this leadership is based on values, vision and attitude (Lester, Creative Leadership for Total Quality 1993). Creative

leadership is also defined as being out front, taking initiative, imagination and innovation. An emphasis is put on teamwork and how interdependence and independence needs to be understood (Lester, Creative Leadership for Total Quality 1993). Leadership is also discussed not only in special projects where organizational change may be occurring, but also in the routine work as well (Lester, Creative Leadership for Total Quality 1993). It is emphasized that if you lead with your vision, values, goals and mission statement, you can have greater success in implementing changes as well as the established routines that can be improved on with this leadership style (Lester, Creative Leadership for Total Quality 1993).

Lester also contributes further by expanding the idea of leadership and management (Lester, Leadership for a Quality Organization 1995). By examining the roles of leadership and management separately, it makes it simpler to identify what qualities a leader and manager should posses (Lester, Leadership for a Quality Organization 1995). Lester describes how these qualities are not independent of one another, but interdependent in the success of creating a quality organization (Lester, Leadership for a Quality Organization 1995).

C. Lakshman addresses how leadership is valued and rated in order to meet the requirements of implementing Total Quality Management (Lakshman 2006). The underlying TQM principles requires leadership focusing on quality, and the leaders traits, behaviors and values will be the main factors to determine if the leader is successful (Lakshman 2006). The literature embeds key leadership constructs for the improvement of the organizational processes (Lakshman 2006).

With the idea that leaders specific values, traits or behaviors will affect their ability to navigate organizational change, being able to identify specific types can become useful knowledge. In an article by Deanne Den Hartog, Jaap Van Muijen, and Paul Koopman, the linking of organizational culture and the transformational-transactional leadership paradigm is made (Den Hartog, Van Muijen and Koopman 1996). They also discuss the relationship between leadership and organizational culture and how leadership styles should fit with the goals of the organization (Den Hartog, Van Muijen and Koopman 1996). For example, if your company has set goals and values, the leadership model should be created to support this (Den Hartog, Van Muijen and Koopman 1996).

How transformational leadership shapes its leaders and how it affects their followers extra effort is present in the study by Kevin Groves and Michael LaRocca (Groves and LaRocca 2012). The authors theorize how certain transformational values will affect the follower outcomes of corporate social responsibility (CSR) and extra effort (Groves and LaRocca 2012). In the test, the leaders score themselves on the certain transformational values, while the followers of the specific leader also rate the leader's transformational values and also rate their CSR beliefs and extra effort. Three out of the four transformational values theorized show a relationship to CSR and extra effort from their followers (Groves and LaRocca 2012).

The ideas presented by Robin Widgery show how understanding attitudes towards the working environment can help aide in the employee's commitment to an assignment (Widgery 1997). The three parts examined are the supervisor, the employee and the task itself. The author explains how supervisors who want to influence peers and subordinates attitudes needs to focus

and maintain their own credibility, which the authors have identified as the most important leader attribute (Widgery 1997). There is also a focus on the use of effective communication to project personal influence on others when it comes to commitment towards a task (Widgery 1997). For followers, it is explained that psychological discomfort can occur when feelings, values and perceptions of the individual's beliefs are in conflict (Widgery 1997). Using Heider's Theory to determine where there is a balanced or unbalanced system regarding the employee, supervisor and task, can help provide focus on where a change in attitude is required to complete the assignment (Widgery 1997).

Being able to address the challenges faced by middle and executive managers in a High Performance Work Environment (HIPO) are presented by Bradley Kirkman, Kevin Low and Dianne Young (Kirkman, Lowe and Young 1998). HIPO is broke up into five components: Employee Involvement, Self-Managing Teams, Integrated Manufacturing Technologies, Organization Learning and Total Quality Management (Kirkman, Lowe and Young 1998). Broad definitions and challenges associated for middle and executive managers are detailed. The challenges faced by middle managers are typical to organizational change and their role can be seen more as coach and facilitator rather than direction provider and agent of control (Kirkman, Lowe and Young 1998). As for executive managers, the challenges are of implementation are similar to the experience of middle managers but are involved at a higher level in the organization (Kirkman, Lowe and Young 1998). Additionally, executive managers are responsible for leading middle managers so developing leaders becomes a unique challenge (Kirkman, Lowe and Young 1998).

Jan Muczyk and Terry Adler dismiss the idea that theories of leadership tested in one situation are applicable in others (Muczyk 2002). The ideas presented detail how leadership studies that were tested in one situation cannot be blindly applied to another and expect the same results (Muczyk 2002). The author also provides detail of how leadership and management are related but different in application (Muczyk 2002). Overall, this paper helps define the overall framework of leadership while also clarifying when and where they are applicable (Muczyk 2002).

While the work of Watson contributed to the knowledge of organizational change, he also discussed the difference between leadership and management (Watson 1994). In this paper Watson touched on how a company wanting to implement TQM needs to focus more on the organization's culture rather than its strategy (Watson 1994). The attitude of the employees is a key factor in the success of the organizational change and that is created by the leader's own ability to put their values and principles into action (Watson 1994). This is not a coincidence because TQM philosophy is that of leadership, and not management, when then creates the culture that is based on a foundation of principles and demonstrated values (Watson 1994).

1.4 Case Studies in Construction Management

The research specifically focused on case studies in the implementation of Lean Construction is varied and covers several subjects. Organizational change is addressed and researchers have found that concepts like company culture and management can be very influential in predicting success. Addressing the barriers to implementation is not absent; suggestions and ideas to overcome these challenges are presented.

The implementation of Lean Construction projects is examined in Dae Young Kim's dissertation when the attitudes of implementing Lean Construction pre-2002 when Lean Construction was relatively new to organizations (Kim 2002). The author presents case studies from around the USA and notes where he saw cause and effects to the success and failures of implementation (Kim 2002). Leadership is not specifically addressed but the case studies do present testing and interviews where interpretations can be made (Kim 2002).

The barriers to standardizing construction activities on three projects in Sweden are presented by Pim Polesie, Mikael Frodell and Per-Erik Josephson (Polesie, Frodell and Josephson 2009). In their study, three medium-sized Swedish construction firms allowed eight site managers to be interviewed to understand their own practices in project management and how standardization within a company could help in implementation of Lean Construction (Polesie, Frodell and Josephson 2009). The authors address how construction site managers are in a unique situation where they have the authority to run a project as if it was their own firm (Polesie, Frodell and Josephson 2009). This can lead to the project taking on more of the individual characteristics of the site manager since their individuality is more linked than that of the company culture formed in the main office (Polesie, Frodell and Josephson 2009). The ability for company's to standardize while also being able to retain the company culture can help alleviate this situation while also allowing for the company to implement modern management principles like Lean Construction (Polesie, Frodell and Josephson 2009).

Anton Liegard and Sakari Pesonen discuss the challenges of implementing Lean Construction, specifically the Last Planner System (LPS), in their research paper (Leigard and Pesonen 2010). There is a focus on the large-scale implementation of LPS versus on just an individual project and also makes comparisons that this is not reserved to LPS but should be seen as implementing the philosophy and practice of Lean Construction (Leigard and Pesonen 2010). The authors also bring light to the challenges of implementing Lean where the company vision, social and technical competences need to be in line within the organization (Leigard and Pesonen 2010).

Glenn Ballard and Yong-Woo Kim present the process of implementing Lean on capital projects by using a 14-step model (Ballard and Kim 2007). The authors explain how projects within an enterprise that is committed to being a Lean builder will be more successful in overcoming the obstacles organizational change present (Ballard and Kim 2007). Simplistic as that may appear, Ballard and Kim also recommend a 14-step model on how to implement Lean on capital projects including the presence of consistent leadership and how to change company culture (Ballard and Kim 2007). Consistent leadership is explained as making sure the leaders do what they say and prevent lapses into previous habits (Ballard and Kim 2007). Leaders are also suggested to serve as mentors to help facilitate cultural change that has become a theme in overcoming the barriers to organizational change (Ballard and Kim 2007). With all the recommendations made for implementing Lean Construction within this paper, the knowledge displayed is numerous and detailed.

Not all literature relevant to this research shows a direct correlation between leadership and Lean implementation. In the paper by Thais Alves, Jose Neto, Luis Heineck, Sergio Kemmer, and

Pedro Pereira, the authors discusses how incentives and reward need to be created by the managers on the project to keep the participants engaged (Alves, et al. 2009). While the specific topic of leadership is not detailed, the ability to motivate and innovate can be linked (Alves, et al. 2009). The article also details how supervisors on the projects empowered their employees (Alves, et al. 2009). While the conclusions are made about incentives and innovation, this is another strong sign of leadership styles and values being used in Lean implementation (Alves, et al. 2009).

O. Salem, J. Soloman, A. Genaidy and M. Luegring present a case study of implementing Lean on a specific construction project (Salem, et al. 2005). The authors researched a general contractor, and the two subcontractors who supplied and installed rebar and concrete who were using Lean Construction tools and techniques for the first time. While the authors tested the effectiveness of the Lean tools used on the project, they also reported the frustrations and resistance of the users throughout the duration of the project (Salem, et al. 2005). There was evidence of the effectiveness for almost all the Lean tools being used and they also realized that training and behavior changes are needed for Lean tools to be effectively (Salem, et al. 2005). It is obvious in the beginning of the projects that leadership's enthusiasm and ability to convince others of using Lean was lacking and the question remains if the project could have experienced better results with the right staffing of supervisors (Salem, et al. 2005).

1.5 Summary of Literature Review

As the literature review has detailed, traditional barriers can exist for organizational change regardless of the specific tool/system being implemented, how the role of leadership has various

definitions and how it can be used in implementing organizational change and the general ideas of how leadership can affect implementation of Lean on construction project and companies. The specific types and details of leadership can be improved on when researching construction case studies. Considering that organizational change and the implementation of Lean appear to have similar barriers, this could present an opportunity to link the studies of how leadership is used to mitigate these effects.

1.6 Gaps In Literature

The desire of this study is to further understand the role of leadership in the implementation of Lean Construction. From the literature researched in this study, the connection between leaderships role in the implementation of organizational change can be made. A case could also be made that implementing Lean Construction faces the same challenges seen during organization change. However, the specific case in Lean Construction implementation could be improved upon by further identifying the challenges created by organizational change and leadership's role in overcoming them.

This does not mean that the role of leadership in Lean implementation was not addressed. As previously reviewed, consistent leadership is viewed as a player in the implementation of Lean on Capital Projects (Ballard and Kim 2007). The question remains on how is this can be tested and verified. Are their more factors involved in how the role of leadership is viewed rather than consistency? Considering that leadership is highly researched in psychological academia, further understanding of the traits and values of people would help us understand what type of people can drive successful implementation of Lean in construction.

As many authors have noted, the role of management and leadership are viewed as separate traits of supervisors. The need to know the success of certain training programs for Lean construction could help in understanding the direction organizations need to make in improving their desired results. Also understanding what traits or values certain leaders posses could help organizations understand the staffing needs of certain projects.

The Lean Construction Institute has called for the understanding of overcoming the soft issue challenges of implementation typically found in organizational change (Lean Construction Institute 2013). While this is agreed upon, there is little research within construction on how to view and approach these soft issues. A better understanding on how the construction industry is recognizing and approaching these barriers could help the effort to see how leadership could mitigate the challenges faced. It is possible that these organizations have made efforts that have been used to overcome these challenges or possibly they have submitted in defeat.

Simply stated, the relationship between leadership and implementation of Lean construction needs to be understood more specifically. This could include a relationship between an entire organization and dedication to lean construction overall or it could be a specific focus on a project-to-project basis. Considering that leadership is popularly referred to as being a key to the success to any project, a better understanding of how this actually occurs in success and failure could be expanded.

Chapter 2.

Research Methodology

2.1 Basic Study Approach

The popularity of Lean Construction is apparent among general contractors along West Coast of the United States of America. Representatives of these organizations that have participated in Lean implementation will be used in this study. The approach used to achieve the purpose of this research include the following:

a) Interview construction professionals who have experience in implementing Lean to further establish the relationship with organizational change.

b) Refine the original research question into a hypothesis that can be tested quantitatively.

c) Develop a quantitative questionnaire that can possibly address the leadership challenges identified during the interview process.

d) Selection of companies for testing of hypothesis who are implementing Lean construction.

e) Analyze questionnaire to understand possible relationships between leadership and Lean implementation

2.2 Objectives of Research

- Explore how leadership affects teams that are implementing new methods in project management that challenge previously considered successful modes.
- Understand how barriers to implementing Lean can be mitigated with leadership of varying values.
- Explore the relationship of leadership and followers on construction projects and understand how this relationship is related to Lean implementation.

- Study the relationship of transformational leadership and implementing Lean on a project-to-project basis.

2.3 Limitations of the Research Study

In an effort to include all the details, certain situations will limit the researcher's study.

- The research study is limited to the West Coast of the USA.
- Ability to collect responses will depend on the availability the participants.
- The experience of the organizations implementing Lean is variable.
- Focus will be on general contractors using Lean in building construction.
- The statistical analysis will be limited to the available resources of the researcher. Certain programs that have been used for statistical analysis are privy to certain organizations and the cost to obtain these programs and expertise could be limited.

2.4 Achieving the Goal

The following approach is used to gather and analyze data for review.

A. The study used the following data:

- The literature review that provides information relating to the challenges in implementing organizational change, how leadership factors in the implementation of organizational change and case studies on construction projects were Lean Construction was implemented.
- Interviews of representatives in the construction industry who have experience in organizational change on either projects or within their company. The responses from

the interviews will be compared to determine commonalities in responses and then used to improve upon the literature reviewed.

- The questionnaire created will quantitatively compare factors in leadership and overcoming the barriers to Lean implementation.

B. The study performed and evaluated the following information

1) Interviews and Email Conversations

Prior to the development of a hypothesis and survey questionnaire, interviews will be conducted with construction professionals who have experience with Lean implementation within their own company or specific project sites to provide insight into role of leadership. The interview questions listed in Appendix A were developed and collected to show the following:

- At the completion of the interviews, identify within the responses if common challenges can be identified.
- Determine if research on leadership found during the literature review can be used to address the barriers and challenges identified in the interviews.

2) Survey Methodology

A survey will be designed to quantitatively assess how leadership and overcoming the barriers to Lean implementation are related. The survey will be based on the following:

- The selection of participants will be determined by the willingness of construction professionals.
- Organizations actively using Lean implementation and where leadership and followers can be identified within their roles.
- The target participants will be office staff of the organization actively participating in Lean implementation including positions similar to project executives, project

managers, superintendents, estimators, site coordinators, project engineers and foremen.

- Taking into consideration of the interview responses, refinement of the problem statement will occur and a specific hypothesis within the parameters of leadership and Lean implementation will be developed.
- The survey will begin with general information about the participant regarding their organization, job role, education, experience using Lean, and project delivery systems. This is followed by three main sections of the survey.
    i. Questions determining a quantitative evaluation of their own leadership traits.
    ii. Evaluation of their own attitudes of Lean Construction before and after implementation. The questions asked will show if there is a change of perception towards Lean that is relevant to the leadership of the organization.
    iii. Determine the relevancy of leadership to the participants of the survey. The respondents will rate their attitudes towards variables to the success of Lean implementation to add to the body of knowledge of where these factors rank.
- The questionnaire to be developed using the University of Washington's online catalyst survey tools and the link to the survey will be forwarded to a point of contact at participating organizations for distribution. If the companies are willing to allow direct contact it should not compromise the results of the study.

2.5 Interview Responses

The responses from the interviews resulted the following categories: implementation, barriers and leadership. The three people interviewed each worked for a general contractor on the West Coast that uses Lean practices. They personally have an active role in the process. The following is a brief recap of the commonalities found and how they help refine the problem statement of this study. A complete recap of the interview questions can be found in Appendix B.

Implementation

Each company implements Lean on a project-by-project basis and uses support from the regional office for training and consultation. The decision on which projects use Lean can vary, with contract being a more common reason. This indicates that the most common application of Lean is on a project-to-project basis and availability of case studies for testing should be greater.

Barriers

The barriers described by each individual revealed the challenges faced in Lean implementation and commonalities can be categorized. There was mention of the technological requirements training require and the rigid structure of a contract; these barriers are categorized as hard issue. Their responses also identified factors like leadership setting the tone, company culture, trust and a general resistance to change that are identified as soft issues faced during organizational change (De Vries, Gullien and Korotov 2009). This further verifies that the barriers found in Lean implementation are similar to what is found in general organizational change.

Leadership

The role of leadership has been identified as a critical factor in the Lean implementation effort. Leadership was identified in various phases of a Lean project with the most common being onsite project staff. The ability to identify the right individual to lead this Lean effort has been identified as challenging as it can jeopardize the successful implementation of Lean.

2.6 Refinement of Research Question

The research question for this study is how does leadership affect the implementation of Lean Construction? This question remains too broad to test considering the wide interpretation of leadership and how leadership is viewed in its role with Lean construction. The responses in the interview section have been used to refine the research question into a relevant hypothesis to test.

Identification of hard and soft issues was found in responses about barriers to Lean implementation and the role of leadership in overcoming these challenges were suggested. These comments are similar to the categorization of these hard and soft issues by De Vries, Gullien and Korotov, and can also be linked to Lester's comparison of how management is to "do things right" and leaders are to "do the right things." Reason being that management is identified as being more concerned with the tactical details of the work and leadership setting the overall tone of the project. A comparison can be made where these more match the model of hard issue identified by De Vries, Gullien and Korotov. Considering the responses from the interview discussed the challenges of being able to operate within the confines of a contract, it can be said that the role of management, as defined by Lester, is needed to maximize the efficiency of these hard issues, like the details of that contract. Conversely, a challenge

identified was leadership setting the tone for the project and company culture and these are specifically identified in Lester's study as a Leadership trait while also falling under the definition of a soft issue by De Vries, Gullien and Korotov . So it could be interpreted that the roles of management and leadership and their relationship to hard and soft issues have commonalities in this study and also in the challenges seen in Lean Construction implementation (De Vries, Gullien and Korotov 2009)(Lester and Kunich, Leadership and Management: The Quality Quadrants 1997). This would allow the study to separate the barriers into categories and focus on overcoming the soft issues specifically by exploring leadership traits. From this point forward, this study will focus on defined leadership values in previous studies to further refine the research question.

It has been suggested that organizational culture can be linked to Transformational Leadership. Transformational Leadership has been identified as the ability of a leader to share a vision and go beyond their self-interest in order to gain compliance from their followers. This has resulted in improvement in subordinate performance and satisfaction with a high trust in the leader, greater cohesion in shared beliefs and low conflict within the group and the sense of empowerment (Den Hartog, Van Muijen and Koopman 1996). Considering that interviewees discussed the need for collaboration, trust and empowerment during Lean implementation, could Transformational Leadership values be related to overcoming the barriers of Lean Construction?

The ability to test for Transformational Leadership values, follower beliefs and leadership performance outcomes has been developed in the study by Groves and LaRocca. The study was developed to improve upon the empirical evidence to link these values, leadership style and

follower attitude and a questionnaire was developed to test several hypotheses relating transformational leadership values, leadership performance outcomes and follower beliefs in corporate social responsibility (CSR). The questionnaire was distributed to team leaders and their followers in various organizations. The leaders rated the importance of certain values according to a 7-point scale "as a guiding principle of my life." The values rated were self-transcendent values (social justice, correcting injustice, care for the weak), traditional values (self-discipline, self-restraint, resistance to temptation), openness to change values (a varied life, filled with challenge, novelty and change) and self-enhancement values (wealth, material possessions, money). The followers rated using various numerical points scales the characteristics of their leader's behavior based on five Transformational Leadership dimensions, their own beliefs on the importance of ethics and CSR, the extent of their extra effort to support their work unit's goals, and the leadership's performance in terms of accomplishing the goals with respect to their work units (Groves and LaRocca 2012).

By using these quantitative ratings provided by followers and leaders, the researchers were able to show support for the following hypotheses:

1. Leader openness to change values will be positively related to Transformational Leadership.
2. Leaders' self-transcendent values will be positively related to Transformational Leadership.
3. Leaders' self-enhancement values will be negatively related to Transformational Leadership.

4. Transformational Leadership will be positively related to follower stakeholder CSR beliefs.
5. Follower stakeholder CSR beliefs will partially mediate the relationship between Transformational Leadership and follower extra effort.
6. Follower extra effort will be positively related to leadership effectiveness.

This research on Transformational Leadership allows for this study to quantitatively test leaders for these values and possibly derive a relationship to the successful implementation of Lean on construction projects. Using the evidence found in this research the original research question can be refined into a testable hypothesis as follows:

Transformational Leadership values will be related positively to follower attitudes towards Lean Construction.

2.7 Questionnaire Development

In order to test the proposed hypothesis, a questionnaire will be developed using the previous research by Grove and LaRocca. The entire questionnaire is included in Appendix C. The questionnaire is developed to quantitatively assess the project staff for a general contractor on a construction project that has implemented Lean. The participants will be categorized into leaders/manager and followers/direct reports in order to show the relationship between the influences that a leaders transformational leadership values have on their subordinates. In order to show progress towards successful Lean implementation, the survey will include questions on the personal attitudes of the leaders and followers of Lean Construction before the selected

project and their current opinion. The questionnaire will be developed in the University of Washington's catalyst website so the survey participants will take the questionnaire online.

2.8 Measures

In order to test for the relationship suggested in the hypothesis, the leader's personal values and their direct reports require separate measures. These measures of the relationship between transformational leadership and direct outcomes will be consistent with the study presented by Groves and LaRocca and will also include the measures showing direct report CSR beliefs. The questions each participant responds to will depend on their role as a leader or direct on the specific project. The reasoning between the selection of the leader and direct report questions will be detailed as follows.

2.8.1 Leader Measures

The leaders of a project will rate three major clusters having to do with the leader's personal Transformational Leadership Values (TVL). These clusters were developed in the Groves and LaRocca study using Stern(Stern, Dietz and Guagnano 1998) shortened version of Schwart's human values instrument (Schwartz, Universals in the content of structure of values: Theoretical advances and empirical tests in 20 countries 1992). The three clusters assessed are self-transcendent values, openness to change values, and self-enhancement values. The leader will rate each value using a five-point scale to determine how they relate "as a guiding principle of my life"(Groves and LaRocca 2012). Each TVL is briefly described below.

Self-Transcendent Values (STV)

STV is a value based on how a person focuses attention away from oneself and instead concentrates on helping others in recognition of a natural connection with others. Examples of this value are social justice, altruism, benevolence, universalism and self-sacrifice (Schwartz and Boehnke, Evaluating the structure of human values with confirmatory factor analysis 2004).

Openness to Change Values (O2CV)

O2CV reflect the values of a persons interests stimulation, self-direction, novelty, change and changing the status quo by articulating the vision of better future for their direct reports and organization (Lan, et al. 2008)(Sosik 2005).

Self-Enhancement Values (SEV)

SEV reflect how a person's pursuit of personal interests is rooted in the self-enhancement values of material possessions, wealth, influence over people and personal pleasure (Schwartz, Universals in the content of structure of values: Theoretical advances and empirical tests in 20 countries 1992). For the purpose of this study, this is not a desired TVL to posses and will be tested to show an inverse relationship to follower responses that will be described in the section of expected results.

2.8.2 Direct Follower Measures

The direct followers identified on a specific project will use a five-point scale (0=not at all, 5, frequently, if not always) to rate their leader's transformational leadership skills using Bass and Avolio's MLQ Form 5X. The followers will be asked how frequently a list of 18 behaviors characterized their leader and can be categorized as one of the four transformational dimensions.

The dimensions included are idealized influence, idealized behavior, inspirational motivation and intellectual stimulation (Bass and Avolio 2007). These four dimensions will be summed into one category of follower transformational values (FTV) that will be compared to the leader's rating of their own TVL.

Direct reports rate their beliefs concerning the ethics and Corporate Social Responsibility (CSR) based on the study by Singhapakdi. Using a five-point scale (0=strongly disagree and 5=strongly agree) to indicate the importance of the person's views on ethics and CSR for organizational effectiveness, the questionnaire determines if the person represents a shareholder or stakeholder point of view relating to ethics and CSR (Singhapakdi, et al. 1996).

2.8.3 Common Measures

Both the leaders and followers in the questionnaire will rate their attitude towards Lean construction based on their opinion before the project in question started and how they feel at the time of the questionnaire. Using a five-point scale, all participants will rate their agreement with 10 statements concerning Lean (1-strongly disagree and 5=strongly agree). Eight of the comments rated are positive, like "Lean could improve the value of the project" and two of the comments rated are negative, like "Lean construction practices are time intensive."

All the participants of the survey will rate how certain aspects were influential in implementing Lean. Using a five-point scale, the respondents were asked to rate the influence of 10 items ranging from training to leadership (1=negative influence, 5=very influential).

2.9 Participants

The participants for this survey will be limited to general contractors who are implementing Lean on specific projects on the West Coast of the USA. The general contractors will be identified by using references available on the Lean Construction Institute's website that provides a list of active members (Lean Construction Institute 2013) while also searching the world wide web for general contractors who have developed their own Lean programs. Emails will be sent out to the general contractors who have offices on the West Coast and will be asked their willingness to participate in this study.

If a company is willing to participate, a point of contact (POC) will be established with the company to explain the purpose and process for the study and questionnaire. It is preferred to meet with the POC in person, but given the various locations of the participating companies this may not be plausible and contact via phone or email will have to be used instead. Instructions for the questionnaire will include how it needs to be distributed to a specific project using Lean and the participants need to be directly involved in the project's Lean effort. The links to the online test will be given to the company POC via email for them to distribute to their selected projects. Once the respondent has completed the survey, an email will be sent to the researcher indicating it has been completed and compiled for analysis. If the responses in the questionnaire are incomplete or require more information, the researcher will contact the POC in order to request further data.

2.10 Case Studies Developed

The overall results will be used to create two types of case studies based on the responses received in the survey. The first type of case study developed will be similar to the Groves and LaRocca study where a single leader/manager and their direct reports/followers are identified within their specific projects (Groves and LaRocca 2012). The second type of case study developed will be for each specific project identified where all the self-identified managers and direct reports' responses are averaged and analyzed despite the leadership-follower relationships identified by the participants. A higher consideration will be put towards the first type because it is consistent with the Groves and LaRocca study.

2.11 Case Study Analysis

The initial step to analyzing the responses is to determine the reliability of the responses within a cluster by using Cronbach's alpha reliability estimates that is consistent with the study by Groves and LaRocca. The Cronbach's alpha will be used to measure the internal consistency of how closely items in a group are related. If the Cronbach's alpha of a metric is above 0.9 it can be considered to have an excellent consistency. Above 0.8 will equate to good consistency and above 0.7 will be considered acceptable. The minimum level of acceptance for Cronbach's alpha will be anything above 0.6. If the Cronbach's alpha is below 0.6 the metric will not be considered since it will not be considered reliable (Institute for Digital Research and Education - UCLA 2013). If any metric is below 0.6 it will not be considered as a reliable indicator and all others above 0.6 will be used in the final analysis. The following table 1 has been included for clarity.

Cronbach's Alpha	Interpretation
1.00-0.90	Excellent
0.89-0.80	Good
0.79-0.70	Acceptable
0.69-0.60	Questionable
0.59-0.50	Poor
Less than 0.50	Unacceptable

Table 1 – Cronbach's Alpha Scale

Once the reliable metrics can be determined using the Cronbach's alpha, the results of the survey will be categorized according to the case studies described previously in section 2.8. The case studies will be entered into an Excel spreadsheet and will display the overall averages of the managers and direct report responses within the respective categories. The following figure 1 displays the relationships between the metrics that will be examined for correlations.

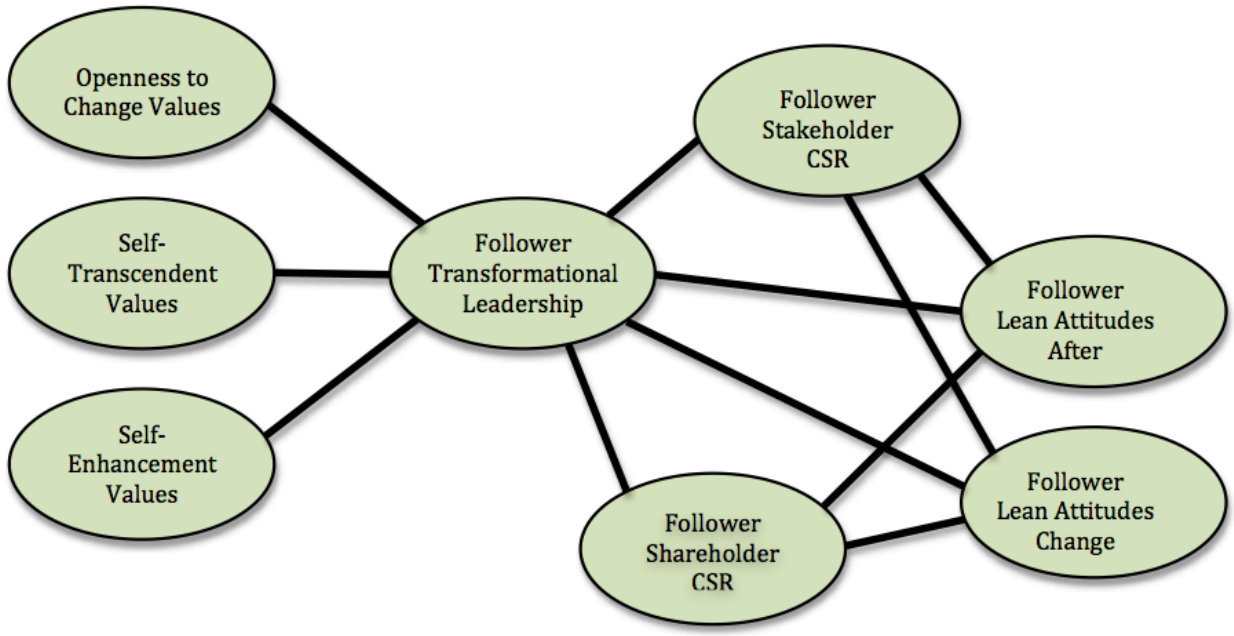

Figure 1 – Relationship Matrix

Per the recommendations of the University of Washington Statistics Department, the relationship of the responses between each metric linked in figure 2 will be compared using the Excel CORREL function to determine a relationship. This is based on the studies of Jacob Cohen where the correlation coefficient is analyzed as slope between the two linked metrics (Hopkins 2006). Interpretation of the results will be determined as described in table 2 with the corresponding color highlights being used for further transparency of the results.

+ Coefficient	Descriptor	- Coefficient
1.0 through 0.9	Nearly, practically, or almost: perfect, distinct, infinite	1.0 through 0.9
0.9 through 0.7	Very Large, Very High, Huge	0.9 through 0.7
0.5 through 0.7	Large, high, major	0.5 through 0.7
0.3 through 0.5	Moderate, Medium	0.3 through 0.5
01.through 0.3	Small, Low, Minor	01.through 0.3
0.0 through 0.1	Trivial, Very Small, Insubstantial, Tiny, Practically Zero	0.0 through 0.1
0.00	Not Distinguishable	0.00
0.0 through -0.1	Trivial, Very Small, Insubstantial, Tiny, Practically Zero	0.0 through -0.1
-0.1 through -0.3	Small, Low, Minor	-0.1 through -0.3
-0.3 through -0.5	Moderate, Medium	-0.3 through -0.5
-0.5 through -0.7	Large, high, major	-0.5 through -0.7
-0.7 through -0.9	Very Large, Very High, Huge	-0.7 through -0.9
-0.9 through -1.0	Nearly, practically, or almost: perfect, distinct, infinite	-0.9 through -1.0

Table 2 – Coefficient Correlation Scale

While the specific direction of the relationship cannot be determined using this method, a determination of relationship still can be accomplished. For example, if relationship correlation has a measure of 0.8 it can be said that the two metrics have a “Very Large, Very High, Huge” relationship per the descriptor in the table above. Opposed to this is when an undesired relationship identified as “- Coefficient” is being tested for, a negative number is desired and will be explained further in the Expected Results section (Hopkins 2006).

While this is not the precise method used in the Groves and LaRocca study, the level of analysis is similar considering this is using group-level measures to show correlations.

2.12 Expected Results

The questionnaire has been designed to be consistent with the results of the study of Groves and LaRocca. In this previous study, they compared the responses of managers and direct reports to determine if a relationship existed between the metrics measured (Groves and LaRocca 2012). In the questionnaire created for this research project, the results are expected to be consistent with the original study. However, a positive response in one metric when compared to another positive response in another metric is not always desired. For example, as consistent with the previous study, self-enhancement values are expected to have a negative correlation with direct reports evaluation of their manager's transformational values.

In the table below, relationship correlations highlighted in green are expected to have negative numbers and non-highlighted are to have positive. When comparing the results to the evaluation chart presented in Figure 2 below, the green highlighted relationship correlations are judged using the "- Coefficient" measures since a negative- to-positive relationship is desired. Conversely, the non-highlighted relationship correlations are judged using the "+ Coefficient" measures where a positive-to-positive correlation is desired. The following abbreviations have been summarized below.

- Self-Transcendent Values = STV
- Openness to Change Values = O2C

- Self-Enhancement Values = SEV
- Follower Transformational Leadership Values = FTV
- Corporate Social Responsibility-Shareholders = CSR (SH)
- Corporate Social Responsibility-Stakeholders = CSR (ST)
- Positive Lean Attitudes After = PLAA
- Positive Lean Attitudes Change = PLAD
- Negative Lean Attitudes After = NLAA
- Negative Lean Attitudes Change = NLAD

Relationship Correlation
STV-FTV
O2C-FTV
SEV-FTV
FTV-CSR (SH)
FTV-CSR (ST)
FTV-PLAA
FTV-PLAD
FTV-NLAA
FTV-NLAD
CSR (SH) - PLAA
CSR (SH) - PLAD
CSR (ST) - PLAA
CSR (ST) - PLAD
CSR (SH) - NLAA
CSR (SH) - NLAD
CSR (ST) - NLAA
CSR (ST) - NLAD

Figure 2 - Relationship Correlations To Test

2.13 Limits To The Questionnaire

The questionnaire has been developed to explore the relationship between Transformational Leadership and attitudes towards Lean Construction. The following are variances from the questionnaire developed by LaRocca and Groves and what will be distributed in this study.

- The questionnaire for this study has been created using LaRocca and Groves format, however the selection of the specific questions may vary. The reason for this is that the questions selected came from the direct sources LaRocca and Groves cited. Selection of the questions were subjective to the researcher's opinion of what would be more relatable to construction teams but they are still with the categories selected and weighted by LaRocca and Groves.

- The participants in the questionnaire by LaRocca and Groves involved a wide variety of organizational types and this study will only focus on teams from general contractors participating in Lean.
- The size of the individual groups studied by LaRocca and Groves were six people each and it is expected to not be that consistent on construction projects due to scope and contractual requirements.
- While the statistical analysis selected will provide insight into the relationship of the responses, the original LaRocca and Groves study used a different program for their analysis.
- The CORREL statistical analysis used does not test for the specific direction on how each metric is related to each other. It is simply identifying that a relationship exists.

Chapter 3

Survey Analysis

3.1 Survey Results

This chapter collects the information given in the online survey and derives its results based on the methodology proposed for determining conclusions. The chapter is divided into the following sections as identification of survey participants and study of results categorized by overall response and case studies developed. The entire survey results can be viewed in Appendix D.

3.2 Survey Participants

Requests were sent by email to the lean representatives of 16 general contractors located on the West Coast of the USA who were either Lean Construction Institute members or had a Lean program listed on their company's website. Seven contractors replied back to the email with interest in participating in the survey and of those seven, three agreed to distribute the survey to selected project sites that are implementing Lean that are over 50% complete in the scheduled progress of their project. The first contractor to respond has several offices in the USA and communication with the POC, who is located in the San Francisco Bay Area, was done by phone and email. The other two participants are both from large general contractors with offices located in Seattle, WA. Communication with each POC was done in person, by phone and email. Testing took place from July of 2012 to February of 2013. Descriptions of the general contractors who participated in this study are listed below. The letter, A, B, or C, are used to identify each contractor.

3.2.1 Organization A

Organization A is a general contractor who is an active member in the Lean Construction community who has regional offices around the USA. The company's core markets includes commercial offices, healthcare, biotech, life sciences and higher education. The POC for this project is located in the San Francisco Bay Area and the study scope and clarifications was made using telephone and email communications. All projects used in this study are located in the state of California.

3.2.2 Organization B

Organization B is a general contractor who is an active member in the Lean Construction community who main office is located in Seattle, WA. The company's core markets include commercial offices, healthcare, education, life sciences, mixed-use and historical renovations. The POC for this project is located in Seattle, WA and the study scope and clarification was made using a face-to-face meeting and email communications. All projects used in this study are located in the Puget Sound region of the state of Washington.

3.2.3 Organization C

Organization C is a general contractor that has established a Lean Construction program within its organization and has offices located in the Pacific Northwest region of the USA. The company's core markets include commercial offices, healthcare, higher education, biotech, life sciences, and historical renovations.

3.3 Categorizing of Results

The survey responses have been separated into three categories for analysis as described in the methodology:

- Overall results have been calculated to show the Cronbach's alpha Additionally, the results have been separated into two types of case studies as described in the methodology section for final analysis.
- Case study type 1's have been tabulated based on the responses from direct reports on who identified their specific manager on the project.
- Case study type 2's have been tabulated based all managers and direct reports as identified to a specific project.

The entire survey results are available in Appendix D.

3.3.1 Overall Results

The following is a recap of the response received from the survey.

-The survey had 79 responses total

-53 indicated themselves as leaders

-55 indicated themselves as followers

-34 indicated themselves as a follower and a leader

-5 responses did not indicate themselves as a leader or follower

-Company A had 54 responses

-Company B had 15 responses

-Company C had 10 responses

3.3.1.1 Overall Results Findings

The overall results have been calculated to show the Cronbach's alpha to determine the reliability of the responses.

Metric	Cronbach's Alpha	Interpretation
Self-Trancendent Values	0.76	Acceptable
Openness to Change Values	0.69	Questionable
Self-Enhancement Values	0.83	Good
Follower Transformational Values	0.95	Excellent
CSR - Shareholders	0.87	Good
CSR - Stakeholders	0.84	Good
Positive Lean Attitudes Before	0.91	Excellent
Positive Lean Attitudes After	0.92	Excellent
Negative Lean Attitudes Before	0.37	Unacceptable
Negative Lean Attitudes After	0.09	Unacceptable

Table 3 – Cronbach's Alpha Results

The metrics "Negative Lean Attitudes Before" and "Negative Lean Attitudes After" fell below the threshold of 0.60 to be considered as a reliable measurement for this study. They will be dropped from consideration when analyzing the relationship correlations with other metrics.

3.3.2 Case Study Type 1

A total of 17 case studies are identified based on the responses identifying the leader by the follower. In seven of the case studies multiple direct reports were identified and only one direct report was identified in the remaining 10. The negative Lean attitudes have been dropped from the analysis per the Cronbach's Alpha testing performed.

3.3.2.1 Case Study Type 1 Findings:

Case Study Type 1		Leader Metrics			Follower Metrics				
Case Study	Direct Reports	STV	O2CV	SEV	FTV	CSR-SH	CSR-ST	PLAA	PLAD
#1-1	6	4.20	3.40	2.60	4.37	1.95	4.57	4.24	0.12
#1-2	5	3.80	4.00	2.80	3.98	2.23	3.98	4.40	0.40
#1-3	3	4.00	3.80	4.60	4.13	1.43	4.52	4.52	0.24
#1-4	3	4.60	4.80	3.20	4.33	1.24	4.74	3.90	0.38
#1-5	3	3.20	3.40	3.00	4.13	1.90	3.96	4.19	0.33
#1-6	2	4.20	3.20	2.80	3.92	2.00	4.06	4.00	0.07
#1-7	2	2.80	3.40	2.20	3.86	1.93	4.56	4.64	0.00
#1-8	1	3.40	4.00	3.20	5.00	3.29	4.89	4.86	0.00
#1-9	1	4.00	3.60	2.80	4.72	1.00	5.00	5.00	0.00
#1-10	1	4.60	4.20	3.00	3.67	4.00	4.22	4.00	0.14
#1-11	1	4.40	4.00	4.00	3.83	1.86	4.11	4.00	0.00
#1-12	1	3.20	3.60	3.00	4.61	3.00	4.22	5.00	0.43
#1-13	1	2.40	3.40	3.40	5.00	2.00	3.67	4.71	-0.14
#1-14	1	3.40	4.60	3.80	4.00	5.00	5.00	4.00	-0.43
#1-15	1	4.40	3.60	3.00	3.94	2.86	3.78	4.57	0.00
#1-16	1	4.00	4.00	4.00	4.67	1.14	4.78	4.43	1.29
#1-17	1	3.80	4.40	3.00	3.44	1.43	4.22	4.14	0.00
Overall Average	2.00	3.79	3.85	3.20	4.21	2.25	4.37	4.39	0.17

Table 4- Case Study Type 1 Recap - Average of the ratings within each metric (column) sorted by case study (row).

Using the CORREL Function as described in the methodology section, the following tables and figures display the results of the case study type 1 findings. Table 4 shows the average score of the responses, categorized by the responses of a specific leader and the indicated followers. Table 5 shows a comparison of all relationship correlations with the highlighted cells identifying the relationships being tested. Green highlighted metric-cells are seeking a negative to positive relationship as described earlier. Color-coding of the measurements required for the test correspond with the highlights shown in Table 2 in the methodology section.

Case Study Type 1				Leader Metrics			Follower Metrics				
	Metric	Average	SD	STV	O2CV	SEV	FTV	CSR-SH	CSR-ST	PLAA	PLAD
Manager	STV	3.79	0.63	1.00							
	O2CV	3.85	0.46	0.35	1.00						
	SEV	3.20	0.60	0.15	0.35	1.00					
Direct-Reports	FTV	4.21	0.46	-0.38	-0.22	0.11	1.00				
	CSR-SH	2.25	1.07	-0.11	0.24	0.00	-0.13	1.00			
	CSR-ST	4.37	0.42	0.12	0.41	0.14	0.27	0.04	1.00		
	PLAA	4.39	0.37	-0.50	-0.45	-0.15	0.64	-0.11	0.09	1.00	
	PLAD	0.17	0.36	0.20	0.02	0.18	0.21	-0.44	0.07	0.06	1.00

Table 5 – Case Study Type 1 Correlation Results

Table 6 is a recap of the case study type 1 that shows only relationship correlations identified as relevant for analysis with a descriptor to show the strength of the relationship as defined in Table 2.

Relationship Correlation	CORREL Coefficient	Descriptor
STV-FTV	-0.38	Moderate, Medium
O2C-FTV	-0.22	Small, Low, Minor
SEV-FTV	0.11	Small, Low, Minor
FTV-CSR (SH)	-0.13	Small,Low, Minor
FTV-CSR (ST)	0.27	Small, Low, Minor
FTV-PLAA	0.64	Large, High, Major
FTV-PLAD	0.21	Small, Low, Minor
CSR (SH) - PLAA	-0.11	Small, Low, Minor
CSR (SH) - PLAD	-0.44	Moderate, Medium
CSR (ST) - PLAA	0.09	Trivial, Very Small, Insubstantial, Tiny, Practically Zero
CSR (ST) - PLAD	0.07	Trivial, Very Small, Insubstantial, Tiny, Practically Zero

Table 6 – Case Study Type 1 Correlation Recap

The Table 6 recap shows that eight out of the possible eleven metrics can be measured; a relationship consistent with the expected results can be derived. The three relationships where the expected relationship could not be shown were STV-FTV, O2C-FTV and SEV-FTV

(highlighted in the blue shade). The strongest relationships shown were the FTV-PLAA (Large, High, Major) and CSR (SH)-PLAD.

The figure below is similar to Figure 1 where the lines connect the metrics dimensions being tested for a relationship correlation but now the lines between the metrics have been highlighted to correspond with results displayed in Table 6.

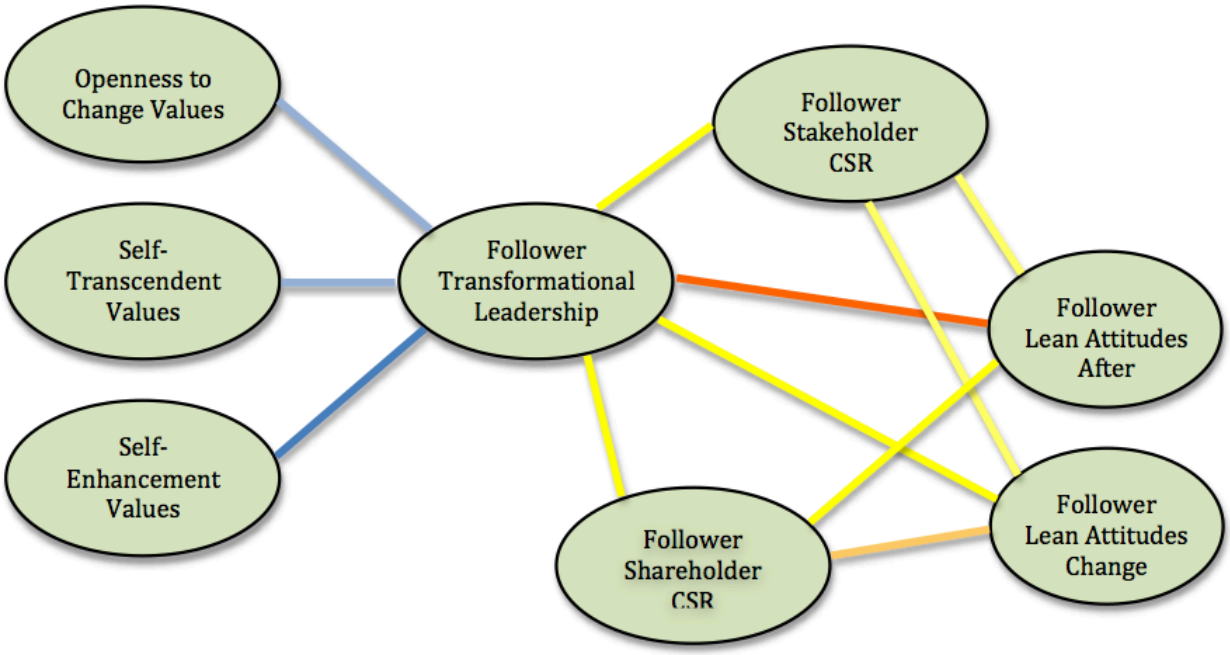

Figure 3 – Case Study Type 1 Relationship Matrix Results

3.3.3 Case Study Type 2

Case Study Type 2				Leader Metrics			Follower Metrics				
Case Study	M	DR	T	STV	O2CV	SEV	FTV	CSR-SH	CSR-ST	PLAA	PLAD
#2-1	11	11	13	4.05	4.07	3.18	4.19	1.81	4.44	4.25	0.26
#2-2	6	7	7	3.60	4.10	2.83	4.01	1.96	4.16	4.57	0.29
#2-3	4	6	8	3.65	4.10	3.25	4.29	3.29	4.37	4.52	0.26
#2-4	5	5	6	4.60	4.80	3.20	4.33	1.24	4.74	3.90	0.38
#2-5	2	4	5	4.30	4.20	3.00	4.43	1.18	4.81	4.18	0.29
#2-6	4	3	4	3.65	4.10	3.55	4.24	1.90	4.30	4.76	0.00
#2-7	4	4	4	4.05	3.85	3.55	3.75	2.93	4.17	4.00	0.07
#2-8	3	3	4	3.40	3.60	2.73	3.17	2.07	3.50	3.43	0.21
#2-9	1	1	4	3.20	3.40	3.00	4.28	1.86	4.14	4.36	0.46
#2-10	1	1	3	3.80	3.90	3.70	4.61	3.00	4.22	5.00	0.43
#2-11	2	2	2	4.40	4.00	4.00	3.83	1.86	4.11	4.00	0.00
#2-12	2	2	3	3.70	4.00	3.40	4.00	5.00	5.00	4.00	-0.43
#2-13	2	2	3	3.80	3.70	3.50	3.94	2.86	3.78	4.57	0.00
Overall Average	3.6	3.9	5.1	3.79	3.85	3.20	4.21	2.25	4.37	4.39	0.17

Table 7– Case Study Type 2 Recap – Average of the ratings within each metric (column) sorted by case study (row).

The following analysis has been created by forming case studies based on the relationship of identified leaders and followers on an individual project with the average of their ratings listed in table 7, categorized by leader and follower metrics. The quantity of leaders (M), followers (DR) and total (T) are listed to the right of each case study identified. As these numbers indicate, case studies can include multiple leaders and followers where respondents could be classified as a leader and follower and each project must have at least one leader and follower to qualify. Within these parameters 13 case studies could be formed. As discussed earlier, the negative Lean attitudes have been dropped from the analysis per the Cronbach's Alpha testing performed.

3.3.3.1 Case Study Type 2 Findings

Using the CORREL Function as described in the methodology section, the following figures display the results of the case study type 2 findings. Table 8 shows a comparison of all relationship correlations with the highlighted cells identify the relationships being tested in the study. Green highlighted metric-cells are seeking a negative to positive relationship as described earlier. Color-coding of the measurements required for the test correspond with the highlights shown in Table 2 in the methodology section.

Case Study Type 2				Leader Metrics			Follower Metrics				
	Metric	Average	SD	STV	O2CV	SEV	FTV	CSR-SH	CSR-ST	PLAA	PLAD
Manager	STV	3.79	0.40	1.00							
	O2CV	3.85	0.34	0.74	1.00						
	SEV	3.20	0.36	0.39	0.06	1.00					
Direct-Report	FTV	4.21	0.37	0.22	0.40	0.19	1.00				
	CSR-SH	2.25	1.03	-0.33	-0.25	0.29	-0.10	1.00			
	CSR-ST	4.37	0.41	0.44	0.64	0.07	0.61	0.16	1.00		
	PLAA	4.39	0.42	-0.22	-0.03	0.31	0.70	0.10	0.05	1.00	
	PLAD	0.17	0.24	-0.02	0.05	-0.40	0.36	-0.65	-0.20	0.20	1.00

Table 8 – Case Study Type 2 Correlation Results

Table 8 is a recap of the case study type 2 that shows only the relationship correlations identified as relevant for analysis.

Relationship Correlation	CORREL Coefficient	Descriptor
STV-FTV	0.22	Small, Low, Minor
O2C-FTV	0.40	Moderate, Medium
SEV-FTV	0.19	Small, Low, Minor
FTV-CSR (SH)	-0.10	Trivial, Very Small, Insubstantial, Tiny, Practically Zero
FTV-CSR (ST)	0.61	Large, High, Major
FTV-PLAA	0.70	Very Large, Very High, Huge
FTV-PLAD	0.36	Moderate, Medium
CSR (SH) - PLAA	0.10	Small, Low, Minor
CSR (SH) - PLAD	-0.65	Large, High, Major
CSR (ST) - PLAA	0.05	Trivial, Very Small, Insubstantial, Tiny, Practically Zero
CSR (ST) - PLAD	-0.20	Small, Low, Minor

Table 9– Case Study Type 2 Correlation Recap

The Table 9 recap shows that eight out of the possible eleven metrics that can be measured, a relationship consistent with the expected results can be derived. The three relationships where the expected relationship could not be shown were STV-FTV, CSR (SH)-PLAA and CSR (ST)-PLAD (highlighted in the blue shade). The strongest relationships shown were the FTV-PLAA (Large, High, Major) and CSR (SH)-PLAD

The figure below is similar to Figure 1 where the lines connect the metrics dimensions being tested for a relationship correlation but now the lines between the metrics have been highlighted to correspond with results displayed in Table 9.

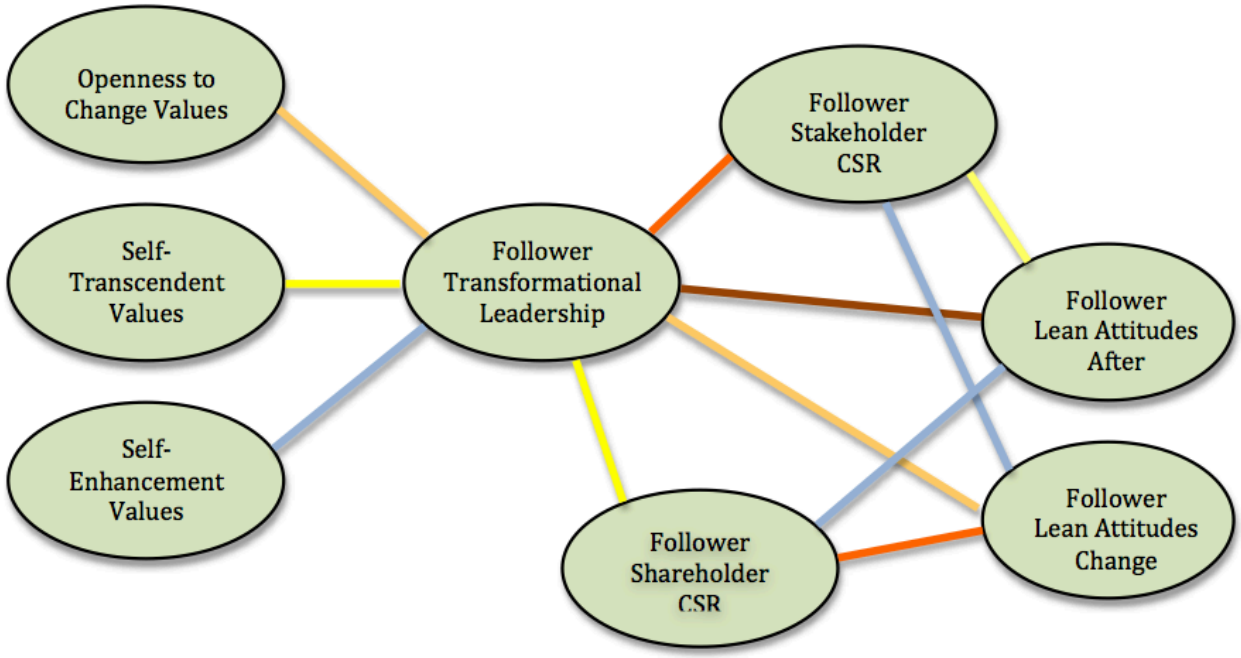

Figure 4 – Case Study Type 2 Relationship Matrix Results

3.4 Case Studies Recap

Table 2 below recaps the findings of both case studies.

Relationship Correlation	Case Study Type 1	Case Study Type 2
STV-FTV	-0.38	0.22
O2C-FTV	-0.22	0.40
SEV-FTV	0.11	0.19
FTV-CSR (SH)	-0.13	-0.10
FTV-CSR (ST)	0.27	0.61
FTV-PLAA	0.64	0.70
FTV-PLAD	0.21	0.36
CSR (SH) - PLAA	-0.11	0.10
CSR (SH) - PLAD	-0.44	-0.65
CSR (ST) - PLAA	0.09	0.05
CSR (ST) - PLAD	0.07	-0.20

Table 10 – All Case Studies Correlation Recap

In both types of case studies developed, 8 of the 11 relationship correlations examined were within the predicted results in the methodology. While the two types of case studies did not have an exact match in which relationship correlations between the two, 6 of the 11 were consistent with the relationship of FTV-PLAA and CSR (SH)-PLAD having the strongest statistical evidence of a relationship.

Chapter 4

Conclusions and Recommendations

4.1 Conclusions: Summary of Interpretations

As validated by the case studies there is more to understand about how leadership affects the implementation of Lean Construction. The duplication of the original study by Groves and LaRocca where leaders transformational values showed a relationship with the followers opinions of their leaders transformational values did not occur however there is evidence to suggest that leadership does affect the followers attitudes of Lean Construction. The statistical analysis provided the following insights and inferences.

- **Followers Opinions of Leaders TVL and Their Positive Attitudes Towards Lean Construction Could Be Identified**

There is evidence to suggest that project leadership affects the attitudes of the followers with regards to Lean Construction. While the type 1 case studies could not confirm a relationship between leaders transformational values and the follower's opinion of their project leaders' transformational values, there is a strong relationship with the follower's opinion of their project leader and their attitudes toward Lean Construction. These results were also consistent in the type 2 case studies was similar to what was displayed in type 1 case studies and even had stronger evidence that this relationship was taking place.

- **Followers CSR Beliefs and Positive Attitudes Towards Lean Construction Was Apparent**

While it may not be directly testing the leadership on the project, followers CSR beliefs and positive Lean attitudes had evidence to suggest a relationship in 6 of the 8 correlations and in the

type 1 case studies all four correlations were within the predicted results. This is significant because the evidence suggests that employees CSR-belief do affect their attitudes towards Lean Construction.

- **Leader Transformational Values Were Mostly Opposite of the Predicted Results**

While the follower's opinion of their project leaders' TVL showed a strong relationship with the positive attitudes towards Lean, the relationship of leader rated TVL and the follower's opinion of the project leader's TVL was not as apparent. Only 2 of the 6 correlations showed evidence of correlation and both instances occurred on type 2 case studies. It is unknown why this portion of the study could not duplicate the results in the original Groves and LaRocca study and any attempt to address this would be pure speculation.

4.2 Addressing the Hypothesis

In the methodology section of this study, the following hypothesis was presented for testing.

Transformational Leadership values will be related positively to follower attitudes towards Lean Construction.

In order to test this hypothesis the relationship between their assigned leaders' TVL and the follower's attitudes towards Lean Construction was judged. What is necessary to show evidence to support this thesis is the creation of transformational leadership relationship between the leader and follower and the follower's own positive attitudes towards lean construction. While

identifying the specific type of TVL as judged by the leader did not present a significant amount of evidence that a relationship occurred with the followers assessment of their leaders TVL, there is evidence to suggest that followers opinion of their leaders TVL is related to positive attitudes towards lean construction. With that said, it can be stated that there is evidence to suggest that the hypothesis presented is supported by the results of this study.

4.3 Recommendations

The following are suggestions to recommend enhancing the effectiveness of project leadership implementing Lean Construction.

1. When an organization is implementing organizational change like Lean, the relationship of the project leaders and followers must not be underestimated. If organizations are trying to understand why one project is more successful than the other, an examination of both the project leaders and followers opinions should be weighed equally.
2. Organizations understanding how the personal values of project leaders could affect the outcomes of organizational change and Lean implementation are significant. While staffing of a project is a dynamic process that involves several factors, the personality of the project leaders could have affect the followers and subsequently the performance of a project.
3. In order to understand the effectiveness of project leadership, organizations can gain insight by interviewing the followers. If the followers carry a high opinion of the project leader, the chances are that the project team will overcome the soft issues to implementing organizational change.

4. Being able to understand follower characteristics can be used to optimize leadership performance outcomes (Groves and LaRocca, 2012). While the focus can seem to appear to reside on the leader of a project, the followers have their own values and beliefs, which can set them apart from the leadership selected for a project. If an organization can identify the values and beliefs of personnel for a project team, their ability to positively affect organizational change could have a greater chance to succeed.

The staffing of construction projects will continue to be a challenge and with the advent of new technologies and delivery practices this challenge can become more difficult. How a organization decides they want to staff a project will come down to several factors and all this study can ask is that project participant personal values and the specific project challenges the team must overcome remain a factor.

4.4 Limitations

While this study was able to determine multiple follower subgroups and data sources it should be noted there are limitations to this study.

- The amount of case studies that were created in this study is significantly smaller when compared to the original test by Groves and LaRocca. Even though 3 companies contributed 16 projects and 79 responses, the numbers were roughly 1/5 of the original study formed.
- The case studies selected by the organizational POC could be biased to only present projects that have had a successful implementation of Lean. While this is only assumed, the chance for this happening cannot be ignored.

- The study was not able to track if full participation within the projects selected by the POC and follower response bias could have occurred. It is very possible that people with a happier disposition on their project were more willing to contribute to this research while workers who were not satisfied on their lean projects were less inclined to participate.
- The ability to identify the leader for each case study was done by asking the follower to identify this person by title only. On some projects there were multiple people carrying certain titles identified by the followers and further questions to the POC were needed. While this effort resulted in longer waits for results and general confusion of who was the appropriate leader, it was done in contrast to the original study where the researchers allowed for the leaders to identify their followers that they believe could have lead to allowing only direct reports who would offer positive ratings of leadership (Groves and LaRocca 2012).
- The questionnaire was supposed to be given to projects that were over 50% complete and while it appears that the projects meet this requirement, the ability to accurately rate the "before" Lean attitudes could be limited by personal recall abilities or prejudice created towards Lean throughout the duration of the project.
- This research is limited mostly to general contractors on the West Coast of the USA and the implementation of Lean is not isolated to this entity. This research viewpoint does not touch on the leadership relationship between different trades and disciplines.
- In the Groves and LaRocca study the researchers were able to perform a statistical analysis to justify the aggregation follower ratings and overall sampling reliability. They were also able to perform a monomethod bias when assessing the relationship between leadership outcomes and follower ratings of Transformational Leadership(Groves and LaRocca 2012). These

means were limited due to the researchers access to statistical analysis and the smaller amount of respondents did not make the monomethod bias practical.

- The original study by Groves and LaRocca was able to determine the direction of the metric relationships and this study was only able to test if a relationship was apparent.
- There is a desire to perform a regression analysis and the possibility of performing this on the results still exists. It was not included in this report due to the resources available to the researcher but efforts are being made to accomplish this for publication.

4.5 Future Studies

This study concludes that more research must be performed to understand how different styles of leadership affect certain aspects to organizational change. This could be accomplished in the same manner as this study where a different trait/quality/value is tested within the project teams with a focus on the relationships, or it can explore a different dynamic between the leaders and followers. Considering the basis that the soft barriers created with Lean implementation can fall under the category of organizational change, this means that the leadership relationship tested can also be applied to organizational changes in construction technologies like Building Information Modeling and delivery practices like IPD. The findings are mostly limited to the identification of one leader within a project however it apparent on several of the projects sampled that multiple leaders are created. How this collective leadership and its affect are understood could provide insight to how future projects are approached. With the study's focus solely on the general contractor project team, the relationship between other trades and practices and it's interaction within or with each other, could become a future study.

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Appendix

Appendix

Appendix A: Interview Questions

1. What is your role at your company with relation to Lean Construction?
2. What is your opinion of Lean Construction at your company?
3. What do you think is the most important factor in the successful implementation of Lean?
4. What are the most prohibitive barriers when implementing Lean?
5. How do you select people to lead a Lean effort?
6. Who has the most important role in the implementation of Lean?

7. How does your company address a situation where project leaders are not capable of leading a Lean effort?
8. What systems do you have in place to help your employees meet the challenges of Lean?
9. Is Lean implemented overall as a company or is it more project-specific based?
10. If you could describe Lean Construction in as few as sentences as possible, what would it be?

Appendix B: Interview Recap

Interviewee Profiles:

Interview #1: This interview was conducted in person with a representative of a Seattle based general contractor who has used Lean on specifically designated construction projects. While the company does not have a specific role dedicated to Lean, the interviewee has been involved with the Lean effort at his company at an organizational level. The questions asked were centered on Lean is implemented, the barriers to implementation, and what is leadership's role.

Interview #2: This interview was with a representative of a San Francisco general contractor that was conducted over multiple email exchanges. This organization has implemented Lean on several projects for several years and has specific staff with a focus on training and implementing Lean on a project level. The interviewee role with the organization is a regional executive who has been involved in implementing Lean throughout the organization as and on project specific basis depending on the demands of the company.

Interview #3: The interview took place over the phone with questions regarding how Lean is implemented in their company, barriers to implementation, and what is leadership's role. The interviewee works for a general contractor in Portland, OR who was the project manager for a federal project using Lean. The organization has recently become very active implanting Lean on their projects and their parent company has a section devoted to Lean Construction. The interviewee was asked questions regarding how Lean is implemented in their company, barriers to implementation, and what is leadership's role.

Implementation

Interview #1: Implementation of Lean has not been considered as an entire organizational model but has been used on a project-to-project basis. The interviewee believes that in order for Lean to be successful it needs to be incorporated on an entire organizational level, similar to the Building Information Management (BIM) program that has flourished with this approach. Despite those convictions, Lean is implemented only when required contractually for a specific project. At this point, a Lean consultant outside of their company will train selected members of the project team to be prepared for the project.

Interview #2: The implementation of Lean tools is done on a project specific level with support from Regional Management teams for training, software and making human resources available for the specific Lean effort. Projects that encompass Lean can be chosen by either contract requirements, directive from the regional leadership, or volunteered by project staff.

Interview #3:The Lean effort from this company is on a project-to-project basis with strong support from the organization for training and staffing needs. On the specific project the interviewee was working on, Lean was required per the contract. This project used "just-in-time design", strong collaboration efforts including early involvement with critical subcontractors, and "snap-shot estimates" every three to four months to refine the costs during pre-construction.

Barriers

Interview #1: The discussion of barriers present in Lean implementation was focused on the viewpoint of a project manager. These struggles were thought to have developed due to a lack of training and education in Lean, the nature of the PM to distrust anything new, being wary of the cost benefits and not being able to see how it fits within the project delivery. It was also noted that the overall culture of the company could become an asset or barrier to implementation. The interviewee assumed that past companies they have worked for would not be as open to project delivery philosophies like Lean.

Interview #2:The ability for the shareholders to see the benefit in implanting Lean is a challenge for the company. This was emphasized that this takes place at all levels from owners to builders and designers to inspections agencies. A significant barrier mentioned was that Lean practices are time intensive and this was the case because of the company focus on up-front project planning.

Interview #3: The barriers to this project seemed unique in its nature of being a federal project but were still familiar in previous frequency. The contract was seen as a barrier for using best practices used on past projects and its execution "on the basis of trust." The interviewee inquired about the possibility of compensation for the savings created during the early collaboration efforts could become a good motivational tool. Early involvement with subcontractors helped mitigate future challenges and collaboration and flexibility were seen as factors in the success of using tools like BIM.

Leadership

Interview #1: The manager for a specific project typically champions the Lean implementation effort. It was emphasized that "buy-in" from the top of the organization was seen as essential to previous organizational change efforts made by the company. An example presented was the effort from executive leadership of the company to support the BIM program. If similar enthusiasm could be generated for Lean this could help in its implementation.

Interview #2: The leadership role is highly recognized as a significant factor in the implementation of Lean at various stages. At the Regional Management level, strategic decisions are made on how to train, what software to invest in, and what people to hire and promote to support Lean implementation. The person identified as being the most critical in Lean implementation is the superintendent but the interviewee takes personal responsibility if the people he is leading in the Lean effort "give Lean lip-service or truly adopt it."

Regardless of the role of assigned position one person can be the deciding factor when implementing Lean. The interviewee defined three levels categorizing a lack of engagement in the Lean process and how he addresses the challenges associated with each one.

1. Detractors: People who display an outright lack of faith or disinterest in Lean. Often the people will uses phrase like "it takes too much time", I'm a good planner, look at my record, we don't need this" and "This is just another buzz-phrase, it will pass" to dismiss using Lean. The positive to this group is that they can be the easiest to address cause they are easy to identify and once this is done they can be trained to understand the benefits of Lean or not used on projects that use Lean.
2. Weak-Willed: People who struggle with their confidence or ability to remain strong when the other team members push back against Lean. When these people are identified the company will then assist them with further coaching or provide additional resources to help them motivate or change the mindset of other Detractors.
3. Counterfeits: This group will lie about their support for Lean and when the time comes they do not drive the process, or in worst-case scenarios, sabotage the entire effort. They are similar to Detractors but are much better and concealing their alternative motives. They have been identified as "the most dangerous group" for the organization to have on a Lean project since they can remain on a project for a significant amount of time before the lack of leadership is identified.

Identification of these certain types is a priority for the staffing of Lean projects and there is an indicated desire to identify these personalities early on in the process

Interview #3: The leadership from the ownership team was seen as a key to motivating the project team and was setting the tone for the project. The project team needs to consist of people who want to collaborate and also want to take input.

Appendix C: Survey Questions

https://catalyst.uw.edu/webq/build/hochstki/173055

Question 1.

What company do you work for?

Question 2.

What is your gender?

Female
Male

Question 3.

What is the highest level of education you have completed?

Did not graduate high school
Graduated from high school
Some college/trade school
Associates degree
Bachelors degree
Post-graduate certificate program
Post-graduate/masters degree

Question 4.

What degree did you receive?

Question 5.

What was your major/emphasis of study while attending college?

Question 6.

How many years of experience do you have in the construction industry?

Question 7.

What is your current role/job position within your company?
Project Manager
Superintendent
Foreman
Project Engineer
Other:

Question 8.

What are the most frequent types of construction projects you have work on? (please select up to 3)
Commercial
Healthcare
Educational
Residential/Multi-Use
High-Tech/Biopharmaceutical
Industrial
Infrastructure
Tenant Improvement
Federal Institutions
Other:

Question 9.

What size of construction projects do you typically worked?

Up to $1,000,000
$1,000,000 - $5,000,000
$5,000,000 - $20,000,000
$20,000,000 - $100,000,000
$100,000,000 +

Question 10.

How many projects using Lean Construction have you participated in?

Question 11.

What are the most frequent types Lean Construction projects have you worked on? (please select up to 3)

Commercial
Healthcare
Educational
Residential/Multi-Use
High-Tech/Biopharmaceutical
Industrial
Infrastructure
Tenant Improvement
Federal Institutions
Other:

Question 12.

For the purposes of this survey, your company has selected you and a specific project team that has used lean construction practices. What is the name of the specific project?

Question 13.

What type of project delivery method was used for this project?

Design-Bid-Build (DBB)
Design-Build (DB)
CM/GC at risk
Integrated Project Delivery (IPD)
Other:

Question 14.

Before this project, did you receive any training in Lean Construction?

Yes
No

Question 15.

Before this project, what type of training did you receive in lean construction practices? (select all that apply)

College course
Outside training form consultant group (i.e., Lean Construction Institute)
Company training
In-Field Training/Hands-On Experience
Other:

Question 16.

Before this project, have you trained/taught others in Lean Construction practices?

Yes
No

Question 17.

During this project, did you receive any training in Lean Construction?

Question 18.

During this project, what type of training did you receive in lean construction practices? (select all that apply)

College course
Outside training form consultant group (i.e., Lean Construction Institute)
Company training
In-Field Training/Hands-On Experience
Other:

During this project, did you train or teach others Lean Construction practices?

Yes
No

Question 20.

What lean construction practices/tools did you use during this project? (check all that apply)

Last Planner System (LPS)
Reverse Phase Scheduling
Six-Week Lookahead
Weekly Work Plan
Percent Plan Complete (PPC)
Pull Planning/Just-In-Time Scheduling
Increased Visualization
Daily Huddle Meetings
First Run Studies
Value Stream Mapping
The 5s Process
Lessons Learned (plus/delta)
Fail Safe for Quality and Safety
Other:

Question 21.

Were you in a supervisory role within your company's project team?

Question 22.

On a scale ranging from 1 to 5 (1 = opposed to my values, 2 = not important, 5 = of supreme importance) please rate each described value "as it served as a guiding principle of my life."

Social justice
Self discipline
A varied life filled with challenge
Wealth
Correcting injustice
Self-restraint
A varied life filled with novelty
Resistance to temptations
Material possessions
Care for the weak
A varied life filled with change
Money
Sense of belonging
Social power
Enjoying life
Social order
Equality
Authority
An exciting life
Loyal

Question 23.

Were you supervised by or directly reported to someone else on your company's project specific on-site team?

Yes
No

Question 24.

If you were supervised or directly reported to someone on your project team please indicate what job position/role this person was. (note, if you had more than one supervisor, please choose the one who was your most immediate supervisor on this project)

Project Manager
Superintendent
Foreman
Project Engineer
Other:

Question 25.

How frequently does the list of behaviors listed below characterize your leader's behavior (1 = not at all, 5 = frequently, if not always).

Go beyond self-interest for the good of the group.
Make personal sacrifices for others benefit
Provide reassurance that obstacles will be overcome
Consider the moral and ethical consequences of decisions
Specify the importance of having a strong sense of purpose
Emphasize the importance of having a collective sense of mission
Talk optimistically about the future
Talk enthusiastically about what needs to be accomplished
Articulate a compelling vision of the future
Express confidence that goals will be achieved
Provide an exciting image of organizational change
Re-examine critical assumptions to question whether they are appropriate
Seek differing perspectives when solving problems
Get others to look at problems from many different angles
Suggest new ways of looking at how to complete assignments
Encourage non-traditional thinking to deal with traditional problems
Encourage re-thinking those ideas which had never been questioned before
Improve decision-making process to increase its effectiveness.

Question 26.

Rate the extent to which each item accurately represents your views ranging from 1 (strongly disagree) to 5 (strongly agree).

Being ethical and socially responsible is the most important thing a firm can do.
While output quality is essential to corporate success, ethics and social responsibility is not.
Communication is more important to the overall effectiveness of an organization than whether or not it is concerned with ethics and social responsibility.
Corporate planning and goal setting sessions should include discussions of ethics and social responsibility.
The most important concern for a firm is making a profit, even if it means bending or breaking the rules.
The ethics and social responsibility of a firm is essential to its long term profitability.
The overall effectiveness of a business can be determined to a great extent by the degree to which it is ethical and socially responsible.
To remain competitive in a global environment, business firms will have to disregard ethics and social responsibility.
Social responsibility and profitability can be compatible.
Business ethics and social responsibility are critical to the survival of a business enterprise.
A firm's first priority should be employee morale.
Business has a social responsibility beyond making a profit.
If survival of a business enterprise is at stake, then you must forget about ethics and social responsibility.
Efficiency is much more important to a firm than whether or not the firm is seen as ethical or socially responsible.
Good ethics is often good business.
If the stockholders are unhappy, nothing else matters.

Question 27.

Before working with Lean Construction on this project please rate if you agree with the following statements on the scale of 1 (strongly disagree) to 5 (strongly agree).

Lean construction practices are time-intensive.
Lean construction practices could help reduce the overall project schedule.
Lean construction practices could improve the reliability of our subcontractors and suppliers.
Lean construction could improve the value of the project.
Lean construction practices reflect the values of my company.
"Lean construction" is just a buzz word. It will pass.
Lean construction practices could help with my project planning abilities.
Lean construction practices benefits outweigh any negatives it may create.
Lean construction practices are worth the work.

Question 28.

After working on this project please rate if you agree with the following statements on the scale of 1 (strongly disagree) to 5 (strongly agree).

Lean construction practices are time-intensive.
Lean construction practices could help reduce the overall project schedule.
Lean construction practices could improve the reliability of our subcontractors and suppliers.
Lean construction could improve the value of the project.
Lean construction practices reflect the values of my company.
"Lean construction" is just a buzz word. It will pass.
Lean construction practices could help with my project planning abilities.
Lean construction practices benefits outweigh any negatives it may create.
Lean construction practices are worth the work.

Question 29.

Rate the following on their influence in implementing lean construction practices on your project on a scale of 1 (negative influence) to 5 (very influential).

Training
Planning
Subcontractor ability
Work experience
Involvement/Commitment
Coordination/Communication
Change of organizational culture
Leadership
Project team ability
Contract requirement

Appendix D: Survey Responses