ABSTRACT

The purpose of this study is to investigate the impact of lean transformation success on improved organizational performance and competitiveness. Data is collected via survey of diverse organizations pursuing lean transformation. Results suggest that transformation towards a lean operating philosophy can significantly influence the competitive position of the organization.

KEYWORDS: Lean Manufacturing, Organizational Change

INTRODUCTION

The lean management philosophy has evolved into a premier supply chain management strategy with widespread implementation in diverse manufacturing and service industries in every corner of the globe. For the past few decades, organizations throughout the world have implemented lean practices and refined various business processes. Today, organizations face fierce competition from other firms within the dynamic global market, which serves as a catalyst for rapid lean transformation in an effort to enhance performance and gain a competitive edge. Lean management, or more appropriately Lean Thinking, was thrust into the limelight with the original publication of the groundbreaking book *The Machine that Changed the World* (Womack, Jones, & Roos, 2007). According to a survey conducted by Michael A Lewis and Slack (2003), *The Machine that Changed the World* was once identified as the most influential published work upon the academic study and industry practice of operations management. While both industry and academia originally pursued lean production or lean manufacturing, we now focus more on extending lean throughout the entire enterprise and value chain (Womack & Jones, 2003).

Scholars argue that implementation of lean improves the competitive position of a firm due to the performance enhancing nature of the lean production practices, particularly waste reduction, continuous improvement, and total quality management programs, among others (R. R. Fullerton & McWatters, 2001; Lawrence & Hottenstein, 1995; Sakakibara, Flynn, Schroeder, & Morris, 1997). There is widespread contention that lean practices are beneficial to an organization. Therefore, it is imperative that we attempt to gain additional insight in regard to the true impact of lean transformation success on competitiveness. Unfortunately, lean transformation can be equated to climbing Mount Everest or any other monumental task, where many have tried but few have truly succeeded. Over the years, anecdotal evidence suggests that many organizations pursuing lean transformation, quite often do not achieve the goals and/or improvements outlined in the lean transformation strategy, which leads to a breakdown or failure of the lean transformation journey (Bhasin, 2008). Failure typically stems from an organization abandoning or drastically modifying the lean transformation strategy and resuming
a more traditional management philosophy based on internal and external forces. Recent estimates of lean transformation failure rates approach 70% and beyond because many organizations are not readily prepared to admit failure, or are aggressively adapting their strategy to prevent failure (Bhasin, 2008). One misunderstanding of modern literature rests in the notion that improvements in organizational outcomes and efficiency can be achieved solely by implementing lean practices and techniques. Most studies overlook the importance of successfully transforming the organization to a lean operating philosophy, and more importantly, sustaining the lean transformation long-term. While organizations can certainly achieve short-term gains by deploying lean techniques, a truly successful and sustainable lean organizational transformation requires a cultural shift to fully embrace the lean philosophy with commitment and support from personnel at every level within the organization (Liker & Hoseus, 2010).

Holsapple and Jin (2007) contend that “competitiveness is a pressing concern that demands never-ending attention because of the complexities, challenges, and opportunities posed by today’s environment” (Holsapple and Jin, 2007, p. 20). Lewis (2000) studied the impact of lean production on sustainable competitive advantage based on empirical data gathered from three case studies. Lewis primarily focused on productivity improvements fostered by implementation of lean principles and concludes that firms can increase their competitive position as long as the firm can embrace the savings created by implementation of lean production practices. However, there are many other avenues or channels that organizations can exploit to increase their competitive position in addition to enhancements in productivity. Holsapple and Singh (2001) suggest that firms can enhance competitiveness through improvements in productivity, agility, innovation, and reputation (PAIR).

The purpose of this study is to expand the work of Lewis (2000) by investigating the impact of lean transformation success on improved organizational performance and competitiveness. While the preliminary study conducted by Lewis (2000) provided some clarity based on an analysis of 3 cases, we contribute by conducting a broad and comprehensive survey of diverse organizations. Here, we seek to explore the relationship between the success of various lean production practices and the competitiveness of a firm to determine if implementation of lean is truly beneficial or if there may be some trade-offs that inhibit long-term sustainable competitive advantage. Hence, the question we seek to answer in this study is: What is the impact of lean transformation success on organizational competitiveness?

The rest of the paper is organized as follows: Section 2 provides the background for this study by highlighting, at a high level, the major elements of lean and by providing a brief overview of competitiveness. The background concludes by discussing the theoretical foundation for this study and offering hypotheses. Section 3 presents details of the methodology employed for this research. The next section offers the results of the data analysis followed by a discussion of the results. Finally, we conclude the paper by presenting the implications of this study to practitioners and researchers, discussing limitations to the study, and describing future research directions concerned with the impact of lean transformation on organizational competitiveness.

LITERATURE REVIEW

There is considerable research literature examining practices and principles of Lean Thinking (see (Holweg, 2007; Moyano-Fuentes & Sacristán-Díaz, 2012; Ramarapu, Mehra, & Frolick, 1995; Shah & Ward, 2003) for reviews). While we do not intend to provide a comprehensive review of the literature here, we do find it important to expand the key elements of lean in an effort to define our constructs and frame this study. Over the years, lean research has evolved from early conceptualization (Monden, 1981; Ohno, 1988; Sugimori, Kusunoki, Cho, &
Uchikawa, 1977), to the purported benefits of implementation (Flynn, Sakakibara, & Schroeder, 1995; R. R. Fullerton, McWatters, & Fawson, 2003; Sakakibara et al., 1997; Shah & Ward, 2003), to a unified definition (Shah & Ward, 2007), with various extensions such as agility (Goldsby, Griffis, & Roath, 2006), or even the possibility of becoming “too lean” (Eroglu & Hofer, 2011). Despite the abundance of research, a gap that currently exists in the literature is the absence of any study that specifically assesses the success of lean implementation and transformation strategies. The next sections briefly identify some of the key characteristics of lean and competitiveness.

Characteristics of Lean

In an effort to understand the relationship between lean and competitiveness, we must first develop an understanding of lean concepts and highlight the common practices that are implemented throughout various industries. Most ascribe that, lean is the evolutionary product of and term used to describe the Toyota Production System (TPS). In the early days, lean was characterized by certain elements of modern day Lean Thinking, namely just-in-time production, which created tremendous confusion in academic and industrial circles alike (Shah & Ward, 2007). Additionally, many scholars have characterized lean based on the diverse practices that underlie the lean management philosophy. Originally adapted from McLachlin (1997), Shah and Ward (2003) highlight 22 common practices associated with lean along with a wealth of sources for additional information (see table 1, p. 131). While the lean practices identified by Shah and Ward (2003) are important to consider when conceptualizing the lean concept, some scholars would argue that a truly lean organization would not only implement and refine the various lean practices, but also strive to develop human resources as the centerpiece of a lean culture (Liker & Hoseus, 2010).

While the lean philosophy can be applied in nearly all organizational settings, there is no one-size-fits-all transformation strategy. A lean transformation strategy that works well for one organization may or may not work well for another. Many empirical studies associated with lean transformation have investigated relationships between the various lean practices and some measure of organizational performance. However, in this study, we focus on the perceived success of lean transformation based on the organization’s chosen lean transformation strategy, which to our knowledge is a novel and unique approach.

A people centric lean culture, popularized by TPS purists, serves as the lens through which we develop our conceptualization of lean transformation success (Liker & Hoseus, 2008). In this study, we define our higher-order construct, Lean Transformation Success, as the extent to which the organization has successfully transformed the organization towards a lean management and operating philosophy. By adopting and adapting the planning systems success construct from Papke-Shields et al. (2002), we include the three dimensions of objective achievement/fulfillment, improved capabilities, and strategy alignment in our conceptualization of lean transformation success. Achievement of objectives refers to the extent of fulfillment of organizational objectives associated with lean transformation. Improved organizational capabilities refer to the extent to which the organization has noticed improvement in key organizational capabilities associated with lean transformation. Alignment with organizational strategy refers to the extent to which the lean transformation strategy aligns with the formal organizational strategy. A list of items comprising each first-order construct available upon request.

Characteristics of Competitiveness

Competitiveness is arguably the primary point of emphasis within an organization in an increasingly global marketplace. Nearly all organizations seek to maximize returns and,
ultimately, gain an advantage over other competing organizations by exploiting core competencies and developing new technologies. Perhaps the most influential work on the nature of competitiveness and competitive advantage stems from the work of Michael Porter. As Porter (2008b) outlines in his “five forces” model, the forces differ by industry and/or application but can have lasting effects on the overall landscape and profitability of the industry. Intense forces can limit industry progression, while gentle forces typically allow competitors to thrive in the industry (Porter, 2008b). Cockburn et al. (2000) captures Porter’s microeconomic theory with an example:

A firm operating in an industry in which there are substantial returns to scale coupled with opportunities to differentiate, that buys from and sells to perfectly competitive markets and that produces a product for which substitutes are very unsatisfactory (e.g., the U.S. soft drink in the 1980s), is likely to be much more profitable than one operating in an industry with few barriers to entry, and a large number of similarly sized firms who are reliant on a few large suppliers and who are selling commodity products to a few large buyers (e.g., the global semiconductor memory market). (Cockburn et al., 2000, p. 1126)

In addition to the five forces, Porter (2008a) went on to define activities that create value for the customer as a primary source of competitive advantage. The value chain consists of the five primary activities of: inbound logistics, operations, outbound logistics, marketing and sales, and service. Porter also identified four secondary activities that support the primary activities and consist of: firm infrastructure, human resource management, technology development, and procurement. It was Porter’s belief that, with the support of the four secondary activities, organizations could create value and ultimately gain a competitive advantage by leveraging the five primary activities. Beyond Porter’s work on competitiveness, many other streams of research have identified potential causes or paths to competitive advantage, such as the resource-based view that suggests competitive advantage is generated from the resources contained within the firm (J. Barney, 1991).

By extending notions of Porter’s value chain to the context of knowledge management, Holsapple and Singh (2001) identify five knowledge manipulation activities (primary) and four managerial influences (support) that can enhance the competitive position of an organization based on four dimensions that formulate the ‘PAIR’ model, namely Productivity, Agility, Innovation, and Reputation. Holsapple and Singh (2001) break down the four dimensions of PAIR to illustrate the potential enhancements that may improve organizational competitiveness by offering the following examples:

- **Productivity** – lower cost or greater speed
- **Agility** – rapid response ability, more alertness, or great flexibility and adaptability.
- **Innovation** – inventing new products, processes, or services
- **Reputation** – better quality, dependability, and brand differentiation

It is through the PAIR lens that we examine the relationship between lean principles and competitiveness. In this study, we adopt the competitive advantage construct developed by (Li, Ragu-Nathan, Ragu-Nathan, & Subba Rao, 2006). Competitive advantage is a higher-order construct and consists of the first-order dimensions of: cost, quality, delivery, innovation, and time to market. Li et al. (2006) define competitive advantage as “the extent to which an organization is able to create a defensible position over its competitors” by leveraging
competitive capabilities. The research framework proposed by (Koufteros, Vonderembse, & Doll, 1997) provides the foundation for the competitive advantage construct based on competitive capabilities of: competitive pricing, premium pricing, value-to-customer quality, dependable delivery, and production innovation.

THEORETICAL FOUNDATION

According to Rumelt et al. (1994), the fundamental question investigated in the field of strategic management over the years is how firms achieve and sustain competitive advantage. The seminal resource-based view suggests that resources that are valuable, rare, imperfectly imitable, or without an equivalent substitute can lead to sustainable competitive advantage for the firm (J. Barney, 1991). Teece et al. (1997) extended the resource-based view based on the suggestion that the resource-based view does not adequately address the competitive environment in a dynamic and unpredictable market. As Teece et al. (1997) describe, a firm’s dynamic capabilities stem from the firm’s ability to “integrate, build, and reconfigure internal and external competencies to address rapidly changing environments,” which serves as a catalyst for achieving and sustaining competitive advantage. Eisenhardt and Martin (2000) further conceptualized dynamic capabilities theory as consisting of “specific strategic and organizational processes like product development, alliancing, and strategic decision making that create value for firms within dynamic markets by manipulating resources into new value-creating strategies (p. 1106).” Moreover, dynamic capabilities hinge on the ability of the organization to accomplish internal and external transformation to reconfigure the organization’s assets (Amit & Schoemaker, 1993). Successful transformation relies on environmental scanning and market evaluation to develop organizational knowledge and foster learning (Amit & Schoemaker, 1993).

Changing routine operating processes through organizational learning to improve operational performance has been defined as a dynamic capability (Zahra, Sapienza, & Davidsson, 2006). Anand et al. (2009) offered the notion that continuous improvement can serve as a dynamic capability from an organizational context. Grounded in organizational learning theory, they develop a conceptual map of continuous improvement infrastructure to demonstrate that continuous improvement (Lean, Six Sigma, etc.) can serve as an organizational dynamic capability. Wu et al. (2010) highlight operational capabilities as a potential source of competitive advantage. They develop a taxonomy of operational capabilities including: operational improvement, operational innovation, operational customization, operational cooperation, operational responsiveness, and operational reconfiguration. Wu et al. (2010) define their operational reconfiguration capability through a dynamic capability lens as a “differentiated sets of skills, processes, and routines for accomplishing the necessary transformation to re-establish fit between operations strategy and the market environment (p. 730).” Other scholars have focused simply on implementation of the lean production element of the overall lean philosophy that leads to sustainable competitive advantage (R. Fullerton & Wempe, 2009; M.A. Lewis, 2000; Shah & Ward, 2007). Based on the Anand et al. (2009) characterization of continuous improvement as a dynamic capability leading to competitive advantage, we offer the theoretical model in figure 1. We propose that the extent to which an organization successfully transforms towards a lean operating philosophy will enhance the competitive position of the organization. We offer the following hypothesis:

**H1 – The extent of Lean Transformation Success leads to Competitive Advantage for the organization.**
The next section details the methodology employed to test the hypotheses offered above including a discussion of the instrument development, data collection, and data analysis processes.

METHODOLOGY

Instrument and Scale Development

In order to evaluate the relationships between constructs in this study, a survey was developed and conducted following Dillman’s Tailored Design Method (Dillman, 2007). The survey instrument was developed and subsequently validated for this study using a multi-step process (Churchill Jr, 1979). First, preliminary interviews were conducted with senior executives and managers from organizations in various stages of lean transformation to formulate and refine the domain for this research. Second, a thorough review of relevant literature was conducted to grasp the existing realm of knowledge and to provide guidance for this research in terms of existing constructs, definitions, and measurement items. Several scales were developed for this study to assess the extent to which the organization’s lean transformation journey has been successful in addition to assessing how well the organization has achieved competitive advantage. Scales are grounded in the extant literature and rely on scale development techniques employed by prior research (DeVellis, 2011; Dunn, Seaker, & Waller, 1994; Stratman & Roth, 2002).

Multi-item reflective measures were utilized for each construct with Likert-based scales anchored at 1 = no extent to 7 = great extent for the Lean Transformation Success construct, and 1 = strongly disagree to 7 = strongly agree for the Competitive Advantage construct. The Lean Transformation Success construct measured the extent to which the organization 1) achieved lean transformation objectives, 2) improved organizational capabilities, and 3) developed a lean transformation strategy that aligned with the overall business strategy of the organization. The competitive advantage construct captured the extent to which the organization offers 1) competitive prices, 2) high quality products, 3) dependable delivery, 4) innovative products, and 5) delivers products to market rapidly. The items, means, standard deviations, and corresponding sources for the constructs utilized in this study are available upon request.

Validated measures from prior literature were incorporated into this study as often as possible; however, new items that were grounded in prior literature and developed from our interviews with industry professionals were added for some of the constructs based on the lack of existing scales. To further validate and refine the new items and the previously validated items, a group of industry professionals and academics were gathered to conduct a Q-sort exercise (Moore &
Benbasat, 1991; Nahm, Solís-Galván, Rao, & Ragu-Nathan, 2002). Each respondent for the Q-sort exercise was provided a cover page with an introduction to the research project and instructions for the Q-sort method. Each respondent was also presented a document that contained a group of categories (constructs) and a group of items. Respondents were asked to match the appropriate category with the item(s) that represented the category, in their opinion. In total, we collected seven responses to the Q-sort exercise, which is consistent with the sample size of other recent studies employing the Q-sort method (Cao & Zhang, 2011; Kianto, 2008; Kroes & Ghosh, 2010; Wong, Boon-it, & Wong, 2011). The responses to the Q-sort exercise were compiled in a spreadsheet, and items with an item placement rate less than 70% among the respondents on the appropriate category that represents the item were eliminated from the final draft of the survey instrument (Moore & Benbasat, 1991; Nahm et al., 2002).

A pretest was conducted as the next phase of instrument development. The survey instrument was delivered to a total of eight academics and industry professionals. Each respondent was asked to thoroughly review the survey and provide feedback on the construction, content, clarity, and quality of the survey. Based on the results of the pretest, the survey was modified to improve flow, decrease the length of the survey, and remove or reword ambiguous items according to the respondents to the pretest. Next, a pilot test was initiated by creating a web-based version of the survey and sending it to a diverse group of industry professionals from organizations actively pursuing lean transformation. The pilot test was delivered to individuals that originally participated in structured interviews to establish the conceptual domain for this research in addition to professional contacts acquired through industry events associated with supply chain management and lean, respectively. Based on an initial 50 invitations to participate in the pilot test, we received 29 completed questionnaires. Although a sample of 29 is not large enough for robust statistical analysis, we analyzed the descriptive statistics to look for any abnormalities with the data. The pilot test was helpful to understand the time investment required to complete the survey and provided some insight on the variability that can be expected from the full-scale survey. Based on the results of the pilot study, the survey was revised to improve clarity, reduce content, and minimize ambiguity.

Data Collection

A web-based survey was utilized for the large-scale data collection effort. The sample consisted of executive and managers randomly selected from a database provided by a consulting firm specializing in lean supply chain practices. The respondents targeted as part of this sample frame are those individuals that are typically involved and often leading the lean transformation activities within their respective organization. The survey was initially administered via the monthly newsletter published by the consulting firm. Approximately one month later, an email reminder was sent to the sample, followed by one additional reminder two months from the launch of the original newsletter. As an incentive, respondents that completed the survey within the first month were entered into a drawing for a full tuition scholarship to complete a lean certification program at a major university. Those respondents that completed the survey within the first two months were entered into a drawing to receive a book from a select group of titles related to lean transformation. Initially, the newsletter was issued to 7,959 potential respondents, of which 835 of the messages bounced due to an incorrect/inactive account. Of the remaining 7,124 potential respondents, 769 individuals opened the newsletter and 61 respondents clicked on the survey link. The first reminder was issued to 7,944 potential respondents, of which 938 of the messages bounced due to an incorrect/inactive account or due to recipients opting out of the newsletter distribution list. Of the remaining 7,006 potential respondents, 902 individuals opened the newsletter and 100 respondents clicked on the survey.
link. The second reminder was issued to 7,914 potential respondents, of which 1,179 of the messages bounced due to an incorrect/inactive account or due to recipients opting out of the newsletter distribution list. Of the remaining 6,735 potential respondents, 742 individuals opened the newsletter and 98 respondents clicked on the survey link. The survey link was also posted on the Lean Consulting Firm’s member blog, which resulted in an additional 60 responses.

A total of 319 responses to the survey were received, which equates to a 13.2% initial response rate, when adding the total number of recipients (2,413) that opened the original newsletter and the total number of recipients that opened the two subsequent reminder messages. However, it is certainly plausible that there is tremendous overlap between the recipients that opened the original newsletter and the recipients that opened the two reminder messages. Based on 100% overlap between recipients that opened the original newsletter and recipients that opened the subsequent newsletters, the initial response rate would be 35.4%. Because of the uncertainty associated with determining how many of the recipients that opened the original newsletter were also recipients that opened one or both of the reminder messages, it is virtually impossible to calculate a truly accurate response rate. It is expected, albeit not scientifically confirmed, that the true response rate would fall somewhere near the middle of the 13.2% - 35.4% range.

Consistent with prior literature, two questions were added to the survey to further qualify respondents (Grawe, Daugherty, & Dant, 2012). The first question asked respondents the extent to which they possess the necessary knowledge and information to answer the survey questions. The second question asked respondents the extent to which the survey questions applied to their organization. Another question designed to qualify respondents and their respective organization, asked the respondents how long their organization had been pursuing lean transformation from “Not at all” to “More than 20 years.” In total, 147 responses were eliminated from the final sample due to excessive missing data, excessive responses at either scale anchor (i.e., selected 7 for every question), excessive neutral responses, respondents answered “Not at all” to the duration of lean transformation, or respondents indicated that they did not have enough information to answer the questions or the questions were not relevant to their organization. After eliminating surveys based on the aforementioned factors, the final sample size is 172. Respondents primarily represented the manufacturing position in the supply chain (30.7%), with 25 industry types represented in the survey. Most respondents worked for smaller companies with less than 25,000 employees. Respondents were also very experienced with the lean philosophy with over 50% of the respondents indicating that they have delivered lean training to others. Detailed demographic information for the survey respondents available upon request.

A time-trend extrapolation test was utilized to examine non-response bias, which assumes that non-responses will resemble late responses (Armstrong & Overton, 1977). To test for non-response bias, we conducted a multivariate analysis of variance between the first 25% of responses and the last 25% of responses. The result of the test suggests that non-response bias is not present as no significant differences between groups were detected (Wilks’ Lambda = 0.006, p = 0.38).

Harman’s single-factor test was used to check for common method variance (Malhotra, Kim, & Patil, 2006; Podsakoff & Organ, 1986; Spector, 2006). If common method bias exists in the data, a single factor will be present following exploratory factor analysis of the variables included in the study. After conducting exploratory factor analysis, our analysis revealed 13 factors with
Eigenvalues greater than 1 with no single factor explaining more than 21% of the variance. Therefore, we can conclude that common method bias is not a concern for this study.

Data Analysis

Partial least squares (PLS) path analysis was utilized to investigate the relationship between Lean Transformation Success, Organizational Performance, and Competitive Advantage. There are a few distinct features about PLS that distinguish the method from other structural equation modeling techniques. PLS is component-based unlike other covariance-based techniques (AMOS, LISREL, EQS), allows both formative and reflective constructs, and applies bootstrapping technique to determine the significance of associations within the model (Chin, 1995; Chin, Marcolin, & Newsted, 2003; Marcoulides, Chin, & Saunders, 2009). Further, PLS does not require the normality assumption, which allows for smaller sample sizes and places minimal demands on measurement scales without sacrificing predicting power (Chin, 1998). This research utilizes the software package PLS Graph 3.0 with bootstrapping parameters set at 500 re-samples for both measurement model validation and hypothesis testing.

Tables 1 and 2 below present the factor loadings and cross-loadings for the higher-order constructs employed in this study. Please note that 13 total items from both Lean Transformation Success and Competitive Advantage were dropped due to low factor loadings.

Table 1: Lean Transformation Success Factor Loadings

<table>
<thead>
<tr>
<th>Items</th>
<th>Achieve Objectives</th>
<th>Improved Capabilities</th>
<th>Alignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>achieveobj3</td>
<td>0.646</td>
<td>0.433</td>
<td>0.331</td>
</tr>
<tr>
<td>achieveobj4</td>
<td>0.580</td>
<td>0.452</td>
<td>0.401</td>
</tr>
<tr>
<td>achieveobj6</td>
<td>0.658</td>
<td>0.374</td>
<td>0.441</td>
</tr>
<tr>
<td>improvecap2</td>
<td>0.551</td>
<td>0.577</td>
<td>0.327</td>
</tr>
<tr>
<td>improvecap3</td>
<td>0.536</td>
<td>0.592</td>
<td></td>
</tr>
<tr>
<td>improvecap4</td>
<td>0.425</td>
<td>0.561</td>
<td></td>
</tr>
<tr>
<td>align3</td>
<td>0.377</td>
<td>0.412</td>
<td>0.772</td>
</tr>
<tr>
<td>align4</td>
<td>0.424</td>
<td>0.458</td>
<td>0.716</td>
</tr>
<tr>
<td>align5</td>
<td>0.383</td>
<td>0.377</td>
<td>0.759</td>
</tr>
</tbody>
</table>

Values less than 0.3 not displayed
Table 2: Competitive Advantage Factor Loadings

<table>
<thead>
<tr>
<th>Items</th>
<th>Factors</th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Price</td>
<td>Quality</td>
<td>Delivery</td>
<td>Innovation</td>
<td>Time</td>
</tr>
<tr>
<td>Price1</td>
<td>0.814</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Qual2</td>
<td>0.895</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Qual4</td>
<td>0.826</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deliv1</td>
<td></td>
<td></td>
<td></td>
<td>0.770</td>
<td></td>
</tr>
<tr>
<td>Innov1</td>
<td>0.352</td>
<td></td>
<td></td>
<td></td>
<td>0.691</td>
</tr>
<tr>
<td>Time1</td>
<td>0.326</td>
<td>0.362</td>
<td></td>
<td></td>
<td>0.636</td>
</tr>
<tr>
<td>Time2</td>
<td></td>
<td>0.360</td>
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<td></td>
<td>0.709</td>
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<tr>
<td>Time3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.811</td>
</tr>
</tbody>
</table>

Values less than 0.3 not displayed

The psychometric properties are generated by PLS Graph, and were used to assess convergent validity, discriminant validity, and internal consistency reliability (ICR). Table 3 displays the ICR, square root of the AVE (diagonal terms), and the correlation between constructs. To assess convergent validity, we examined the square root of the average variance extracted (AVE), which should generally be greater than 0.707 or AVE > 0.5 (Fornell & Larcker, 1981). The square roots of the AVE values in this study, which can be equated to an R-square value in simple regression, were all greater than 0.707 with a lowest AVE value of 0.787. To assess discriminant validity, we compared the AVE square root to the correlation with other constructs. The AVE square root should be larger than the correlation with other constructs to confirm discriminant validity (i.e. measures for a specific construct are unrelated to measures of a different construct). From table 3 below, one can see that the square root of the AVE exceeds all correlations (horizontal rows and vertical columns) for each construct, which supports discriminant validity. The ICR values (similar to Cronbach’s alpha) should all be larger than 0.7 (Fornell & Larcker, 1981). As illustrated in the table, the lowest ICR value in this study is 0.891, which supports the reliability of the constructs.

Table 3: Reliabilities, Convergent Validities, and Discriminant Validities

<table>
<thead>
<tr>
<th>Factors</th>
<th>ICR</th>
<th>Correlations and AVE Square Roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean Transformation Success</td>
<td>0.921</td>
<td>Lean Transformation Success: 0.758</td>
</tr>
<tr>
<td>Competitive Advantage</td>
<td>0.891</td>
<td>Competitive Advantage: 0.717</td>
</tr>
</tbody>
</table>

Table 4 presents the path coefficient and t-statistic between the higher-order constructs in this study. As you can see from the table, we found significant support for a positive relationship between Lean Transformation Success and Competitive Advantage.
Table 4: Path Coefficient and T-Statistic

<table>
<thead>
<tr>
<th>Path</th>
<th>Path Coeff.</th>
<th>t-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean Trans. Success → Comp.</td>
<td>0.235</td>
<td>2.67*</td>
</tr>
</tbody>
</table>

*p<0.01

DISCUSSION

The purpose of this study is to investigate the relationship between lean transformation success and competitive advantage. Building upon prior literature, we found that the extent to which an organization can successfully transform towards the lean operating philosophy, can significantly influence the competitive position of the organization. The findings suggest that in addition to concentrating on implementation of the various practices associated with lean transformation, organizations can assess the success of their lean transformation initiatives based on the extent to which the organization has achieved the objectives associated with lean transformation, improved the capabilities of the organization, and increased alignment between the lean transformation strategy and the overall business strategy.

Researchers can find this study helpful in a few ways. Lean research has matured to the point that we can move towards investigating long-term, sustainable, lean transformation solutions. Indeed, a few studies have peered into the critical success factors of other continuous improvement methodologies (Swink & Jacobs, 2012), yet no previous studies specifically address the dimensions of lean transformation success. This study takes the first step towards developing a comprehensive view of the critical success factors associated with lean and adds to the current body of work. To some, it may make sense to achieve some quick solutions by conducting Kaizen blitzes or implementing lean in small phases; however, our results support and suggest a shift towards investigating long-term solutions for sustained lean transformation success.

This study stresses the importance of not getting bogged down in the nuances inherent in the various lean practices. Instead of concentrating solely on lean practices, managers need to look at the big picture and identify strategies that will promote lean transformation success throughout the supply chain. In other words, instead of focusing solely on implementation of lean practices (kanban, quick changeover, etc.), managers can drive lean transformation success by establishing comprehensive strategic goals and assessing the extent to which the organization has achieved the goals to improve organizational capabilities. It may be helpful to document the current state in order to paint an accurate picture of the true improvement of organizational capabilities. Strategic alignment between the lean transformation strategy and the overall business strategy is also a driver of lean transformation success that requires managerial attention. Based on our findings, organizations may achieve a greater level of lean transformation success and, ultimately, competitive advantage by developing a long-term lean strategy instead of focusing on small projects or isolated implementation.

CONCLUSION

Countless studies have purported to investigate the relationship between lean implementation and organizational performance. Here, we depart from the mainstream and study the impact of lean transformation success and competitive advantage. This research makes several important contributions. First, this study empirically tests and confirms the long-standing notion
that investments into lean initiatives can yield positive results for the organization. Indeed, our results support such contentions. However, our results stress the importance of a long-term lean strategy, aligned with the business strategy, to define targets, goals, and outcomes of the lean transformation journey. To our knowledge, this is the first study to develop a framework for lean transformation success. While we anticipate additional dimensions, we have established solid footing for future research to conceptualize, define, and empirically test lean transformation success.

While it is no surprise that lean transformation success can lead to competitive advantage as we find here, there may be a so-called tipping point. Most scholars would agree that the Toyota Production System has revolutionized the manner in which many firms operate. Yet, since the start of the new millennium, Toyota products have not been produced without fault. A simple web search will yield stories of recalls from 2000-2013 that number in the thousands for a variety of issues. Is it possible to become “too lean”? Eroglu and Hofer (2011) first brought forth the position that it may be possible to trim too much from the organization. While their study did shine critical light on the potential pitfalls of lean transformation, many stones remain unturned.

A possible extension of this study would empirically investigate the impact of the four PAIR dimensions on organizational competitiveness from both an individual and collective perspective. Various lean practices could be classified under the four PAIR dimensions to assess the relative importance and impact of each lean practice as presented in figure 2 below. As Liker and Hoseus (2008) describe, organizations should strive to develop a lean culture as the ultimate outcome of the lean transformation initiative. Another extension of this study would require investigation of the impact of a lean organizational culture on competitive advantage through the lens of (Liker & Hoseus, 2010) or (J. B. Barney, 1986). Additional research is also need to further develop the lean transformation framework presented here. While we believe that we have provided an adequate foundation, we acknowledge that additional dimensions of lean transformation success most likely exist. Finally, a longitudinal study of lean transformation can be very valuable and powerful to further refine/develop the underlying dimensions. While a cross-sectional analysis is indeed important and justifiable, a longitudinal study may provide valuable insight to the long-term strategies, methodologies, and contextual factors that underpin lean transformation success leading to competitive advantage for the organization.

![Figure 2: Lean practices and PAIR framework](image-url)
Despite the positive results obtained from this study, there are a few limitations that we would like to address. First, we dropped several measurement items from the final analysis in an effort to achieve the most parsimonious model. While this approach is consistent with prior literature employing partial least squares methodology, it is, nevertheless, a limitation to this study. Ideally, we would use all measurement items; however, our effort to achieve parsimony, without concerns of convergent or discriminant validity, trumped our concern for inclusiveness. Our sample, while certainly large enough for partial least squares path analysis in this study, could have been more robust. We trimmed the initial sample based on excessive missing data, mostly from respondents that clicked on the survey link but did not actually start the survey or completed very little of the survey. We further eliminated responses based on excessive selections at either scale anchor (i.e., selected 7 for every question), excessive neutral responses, respondents answered “Not at all” to the duration of lean transformation, or respondents indicated that they did not have enough information to answer the questions or the questions were not relevant to their organization. Our close scrutiny provided, in our opinion, a very adequate and representative sample. Unfortunately, we were forced to sacrifice sample size.

References

References available upon request