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Barriers to Implementation of Lean Techniques in Printing Firms and the Impact of Implementation

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Barriers to Implementation of Lean Techniques in Printing Firms and the Impact of Implementation

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Certificate of Approval

Barriers to Implementation of Lean Techniques in Printing Firms and the Impact of Implementation

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Abstract

Lean practices including 5S Lean Manufacturing, Six Sigma DMAIC and Value Stream Mapping are gaining more and more importance in a wide range of industries. Firms in various industries have implemented one or more of the techniques that comprise Lean techniques and have realized reduced wastes that in turn has contributed to increased profits. The researcher, being associated with the field of printing, has observed the Lean techniques practicing trends in the printing industry. This report builds upon the previously published research that has examined the implementation of Lean Methodologies, including studies that have investigated the impact of the adoption of these techniques as well as those that have researched the difficulties and obstacles faced by firms when considering Lean Manufacturing implementation.

The purpose of this study was to observe the level of awareness of Lean techniques in the printing industry, together with the perceived barriers to Lean Manufacturing adoption implementation and the impact of the implementation. Using the 24 factors to successful implementation of Lean techniques identified by Jadhav, Mantha, and Rane (2012) and the barriers faced by firms when faced with the adoption of Lean techniques as described by Lean Enterprise Institute (LEI) the researcher observed the relevancy of these factors and barriers in the printing industry.

Utilizing an online survey, the researcher collected and analyzed data to address the research questions and determined the most significant factors or reasons that impede firms from implementing Lean techniques and also the most significant factors for successful implementation.

Chapter 1

Introduction and Statement of the Problem

In this chapter, relevant background information to the proposed study are provided, and the problem is stated.

Background

It is widely recognized that the printing industry has been experiencing steadily rising costs and declining profits, at times leading to restructuring, consolidating, or even closing printing companies altogether (Smyth, 2015). Lean Manufacturing has proven to be an effective tool that has helped several printing companies to overcome rising costs by reducing the cost of production and by improving productivity (Cooper, Keif & Macro, 2007); the authors indicate that Lean Manufacturing techniques are a proven way to alleviate the impact of slimmer profits for printing firms. Lean Manufacturing techniques have gained recognition over the recent past among various industries in the United States and other countries around the world. Karlsson and Ahlstorm (1996) wrote that "Lean Manufacturing aims at the elimination of waste in every area of production, including customer relations, product design, supplier networks and factory management" (p. 24-41).

Several researchers have studied Lean Manufacturing in the printing industry, and have taken different approaches to their studies. Noteworthy examples include Nagarajan (2009) who studied the effects of implementing Lean Manufacturing in offset printing companies, Roth and Franchetti (2010) who studied the scope for process improvement for printing operations through the DMAIC Lean Six Sigma approach, and Austin (2013)

who observed the effect of Value Stream Mapping of activities in a print shop. Just like firms in any other industry, printing firms do face difficulties transitioning into a Lean workflow, and there is a need to explore the barriers associated with the implementation of Lean Methodologies in printing organizations.

Problem Statement

Despite the wide knowledge and available resources, many companies are struggling to become or stay "Lean." Engum (2009) observed the popularity of Lean Manufacturing among newspaper printing firms and the impact of the implementation on the productivity in these firms. Surprisingly, she found that relatively few printing firms have implemented Lean Manufacturing. Engum notes that many newspaper printers, although somewhat familiar with Lean concepts, are not aware of the proven advantages of the methodology and how the adoption can improve their organization.

With prior studies suggesting that the Lean techniques do help improve the performance of printing companies, the reason why firms fail to implement Lean techniques remains unanswered in an extensive review of the literature. It is therefore curious that the factors which impede printing companies from adopting "Lean" practices have not been addressed by previous studies; therefore, examining this lack of adoption is one goal of this research. In addition, relevant correlates to the awareness and adoption of Lean Manufacturing techniques is another question which guided this present study.

Reason for Interest in/Purpose of Study

The researcher comes from a family that owns and operates a medium size printing firm where they currently run jobs on multiple offset presses of varying capacities. Seeing the decline in demand for jobs processed through traditional printing methods and having read articles on the impact of Lean Manufacturing in printing firms, the researcher found special interest in this field, as he believes that the information obtained through this study would help his family's firm in the future.

The researcher also believes that the results of this study will help explain the reason behind the printing firms not implementing Lean Methodologies. Previous studies in this area focused on a particular segment in a firm for improvement or used small samples to survey which restricted the researchers from inferring results in general. Through this research, this void is filled.

Chapter 2

Theoretical Basis

This chapter outlines the theoretical foundations required to frame the specific research questions proposed to be addressed in this study.

Any research involving technology adoption needs to recognize the seminal work of Everett Rogers (1962) stemming from his landmark volume *Diffusion of Innovations*. Currently in its fifth edition (2003), *Diffusion of Innovations* is widely cited throughout all aspects of the technology adoption literature. Although typically associated with longitudinal studies that examine the adoption of a technology over time, Rogers also recognized both the characteristics of a specific innovation and the factors which influence the adoption of that innovation. These characteristics are both internal, that is, within the organization, and external, meaning those market forces that facilitate or impede adoption.

Using the terminology suggested by Rogers, the theoretical basis for the present study included other works that have subsequently built upon the foundation that Rogers established beginning in the early 1960s.

Rogers (1996) cited five observed characteristics of an innovation that were found to have an impact on adoption, namely: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) communicability. While many ensuing studies have sought to rank these factors in terms of importance, it is recognized that frequently the relative importance of these is context specific. Taken as a whole, the factors described as compatibility and relative advantage appear to be the most prominent across a wide range

of applications (Holak and Lehmann, 1990), and have provided the foundation for subsequent more parsimonious theories involving adoption (e. g.: Fishbein, 1967; Fishbein and Ajzen, 1975; Davis, 1980; Ajzen and Fishbein, 1980; Bagozzi and Warshaw, 1989; Ajzen, 1991.)

Relative advantage has been described as the "degree to which an innovation is perceived as superior to the idea it supersedes" (Ostlund, 1974). Rijsdijk and Hultink (2003) indicated that factors which influence perceived benefits include anticipated economic profitability, social prestige, and other context-specific specified advantages.

Rogers' construct of compatibility was concisely defined by Ostlund (1974) as "the degree to which an innovation is perceived as consistent with existing values, habits and past experiences of the potential adopter." Rogers (2003) himself indicated that an innovation which is consistent with the norms of an organization successfully implemented past ideas, or with customer needs is more inclined to be adopted.

Rogers (1996) defined complexity as the "degree to which an innovation is perceived as difficult to understand and use (p. 230)." Trialability is defined as "the degree to which it the innovation may be trialed and modified (p. 231)," and the construct termed Communicability was defined as "the degree to which the innovation extends itself to communication(p. 231)."

Having discussed Rogers' factors of an innovation which can influence adoption, the theoretical basis now turns to literature that cites internal and external characteristics that are also documented to influence technology adoption.

Internal organizational characteristics can often influence adoption, as well. Damanpour's (1992) meta-analysis examined the relationship between organizational size and innovativeness and concluded that size was more positively related to innovation in commercial enterprises than in not-for-profit and service organizations. In addition, Damanpour (1992) observed that the size of the organization is more strongly related to implementation than initiation.

It was observed that larger organizations include sufficient support staffing in areas such as in critical departments that can assist in the adoption of more innovations (e.g., Baldridge and Burnham 1975, Damanpour 1992). Baldridge and Burnham (1975) also suggested that larger organizations will naturally have an affinity for adoption of technologies that increase efficiencies due to their bureaucratic structure. On the other hand, Frambach and Schillewaert (2002) argue that smaller organizations can be more flexible and therefore are more likely to have an affinity for improvement, and therefore are more likely to implement change. The current research attempted to reconcile this disagreement for the chosen research context, that is, adoption of Lean Manufacturing techniques by commercial printing establishments.

In addition to internal organizational characteristics, the external business environment can be a key factor for organizational innovation adoption (e.g., Damanpour and Schneider 2006, Pierce and Delbecq 1977.) These external factors include economic as well as other innovations that compete for the mindshare of the management within the organization as it is recognized that too much change may result in organizational chaos.

Further, governmental regulations represent another source of potential influence on innovation adoption.

Having discussed Rogers' factors of an innovation that can influence adoption and literature that supports recognizing potential internal and external influences, the theoretical basis again returns to Rogers (2003) and his description of the five distinct stages of the adoption process, namely, awareness, interest, evaluation, trial, and adoption. In the awareness stage, "the individual is exposed to the innovation but lacks complete information about it." The interest stage is the time where "the individual becomes interested in the new idea and seeks information about it." In the evaluation stage, "the individual mentally applies the innovation to his present and anticipated future situation, and then decides whether or not to try it." In the trial stage, the individual "uses the innovation on a small scale in order to determine its utility in his own situation;" some would call this the probationary period. Lastly, the adoption is the "stage where the individual decides to continue full use of the innovation." This indicates a full commitment to the innovation.

This research is rooted in these well-established theoretical ideas. The following chapter, a preliminary review of the literature, focuses on studies that are specific to the context of the presently proposed research.

Chapter 3

Literature Review

Implementing Lean Methodologies is a trending practice in industries all over the United States. Various trend reports suggest that there is a need for such practices to be implemented in printing firms. A number of firms have implemented these practices and have found them to be useful in improving performance in areas of pre-press, press and also post-press or finishing (Nagarajan, 2009; Roth & Franchetti, 2010; Austin, 2013). This section includes relevant prior research that examined the factors that impede firms from adopting Lean practices together with these studies that expose the most significant factors leading to the uses of Lean techniques in a breadth of industries. In addition, the current state of the printing industry, in particular, are examined by presenting the results and findings of published trend reports and relevant articles, the goal of which is to provide a foundation of the current state of the industry. Prior research on this topic is reviewed in this chapter beginning with the studies on the implementation of Lean techniques in industries in general. Finally, the literature review examines those Lean Manufacturing studies specific to the printing industry.

Current trends in the Printing Industry

In the printing industry, the literature suggests that competition is growing and material costs are increasing significantly. As a result, firms in the industry are forced to hike prices to keep the businesses active and profitable, thus posing a threat to jobs in the United States as business is at risk of being lost to companies overseas where it is possibly cheaper and sometimes faster to complete a particular job. The latest

advancements in digital printing technology are reducing the costs associated with short-run jobs, resulting in further competitive pressures on firms offering traditional printing services.

Smyth (2015) observed a number of trends in the printing industry via survey data collection techniques. Notably, the researchers found that digital printing is increasingly capturing more market share.

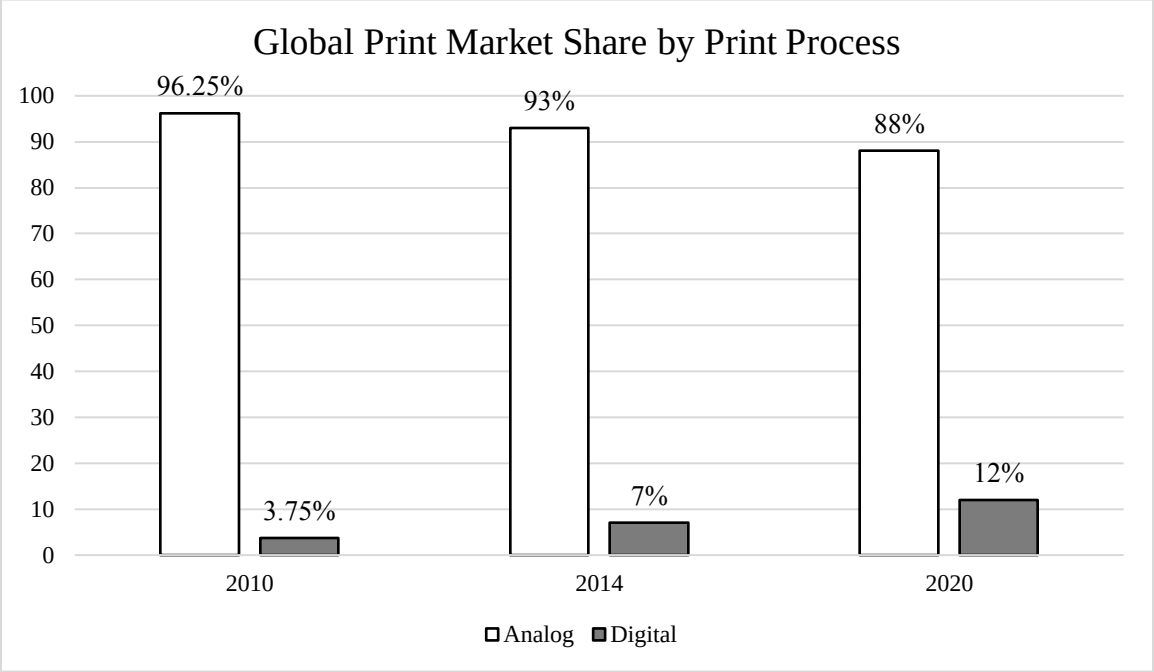

Figure 1. Global Print Market Share by Print Process

Source: Smyth, S. (2015). *The future of digital vs. analogue printing to 2020.* Smithers Pira, Akron, Ohio

Figure 1 shows the global print market share by print process as identified by Smyth (2015). Here, traditional printing processes accounted for over 96% of the jobs in 2010, however more recently that share has been reduced to 93% and is expected to decrease to 88% by 2020 due to the impact of digital printing technologies. The data showed that

digital printing is expected to take over a significant share of the print market in the graphics and advertising sector. Although the publication and packaging sectors are expected to capture more share of the market, they are expected to grow at significantly lower rates in comparison to advertising and graphics. These trends highlight the advantages of digital presses – faster make-readies result in more economical shorter run lengths with reduced waste and improved efficiencies, together with the enticement of variable data and "distribute and print" distribution models. In light of this realization, the implementation of Lean Manufacturing techniques could be especially beneficial to companies offering traditional printing as they allow printers that are not ready to adopt digital presses to remain competitive and to achieve the maximum benefit from their existing equipment.

Having discussed relevant printing industry trends, the following section will briefly describe the various Lean Methodologies and their functionalities.

Lean Methodologies

Lean Methodologies help firms in reducing waste associated with the workflow which in turn potentially improves both production and performance. There are several different practices under the broad category of Lean; however, an extensive review of the literature reveals three primary manifestations: 5S Lean Manufacturing, Six Sigma, and Value Stream Mapping (VSM). Each are described below.

5S Lean Manufacturing. 5S is a Lean Manufacturing technique developed in Japan and employed by Toyota in the 1950s. Douglas (2002) stated that "5S is a workplace environmental hygiene technique that originated in Japan. 5S gets its name

from the Japanese terms for the five stages involved in the process of implementation – seiri (sort), seiton (set in order), seiso (shine), seiketsu (standardize), and shitsuke (sustain) (p. 725).” 5S helps improve a process in an organization through a five-step structural improvement program. Each of the 5S guidelines helps managers and workers achieve greater organization, standardization, and efficiency—all while reducing costs and boosting productivity. Some core principles of the 5S concept involve creating and maintaining visual order, organization, cleanliness, and standardization. Each principle is described below:

1. Sort: "Sorting" means to sort through everything in each work area. Practitioners are advised to keep only what is necessary; materials, tools, equipment, and supplies that are not frequently used should be moved to a separate, common storage area. Items that are not used should be discarded or recycled (Patten, 2009).
2. Set in order: This S means to organize, arrange, and identify everything in a work area, as well as throughout the facility, so that items can be efficiently and effectively retrieved and returned to their proper storage location (Patten, 2009).
3. Shine: It involves regular, usually daily, cleaning. The work area should be returned to the condition it was in when the day started - including putting away all tools, materials, and supplies used that day. During the cleaning process, it is easy to inspect the machines, tools, equipment, and supplies (Patten, 2009).
4. Standardize: This means to develop a work structure, and written standards, that will support the new practices and turn them into habits. With standards

established everyone knows what he'she is supposed to do, how to do it, and when it needs to be done. In other words, standards produce new habits that result in 5S being effectively and efficiently implemented (Patten, 2009).

5. Sustain: This means to promote on-going training and maintaining the established 5S standards (Patten, 2009).

While 5S is sometimes referred to as only a "housekeeping" tool, it goes beyond that. It has been defined as "an idea that reshapes the workplace and provides a foundation for all improvement" (Patten, 2009).

Six Sigma. Six Sigma is a set of techniques and tools for process improvement. It was introduced by engineer Bill Smith while working at Motorola in 1986 (Tennant, 2001). Six Sigma seeks to improve the quality of the output of a process by identifying and removing the causes of defects and minimizing variability in manufacturing and business processes. It uses a set of quality management methods, mainly empirical and statistical methods; to create a special infrastructure of people within the organization, who are experts in these methods. The term Six Sigma originated from terminology associated with statistical modeling of manufacturing processes. The term "Six Sigma process" comes from the notion that if one has six standard deviations between the process mean and the nearest specification limit, then practically no items will fail to meet the specifications.

The Six Sigma DMAIC is a data-driven improvement cycle used for improving, optimizing, and stabilizing business processes and designs. The Six Sigma DMAIC approach is comprised of the following five steps:

1. Define: In this step, the business problem, goal, and potential resources are clearly articulated. Facts are clarified, objectives are set, and project teams are formed (Pande, 2002).
2. Measure: This is a data collections step where the process performance baselines are established, and the gaps between current and required performances are identified (Pande, 2002).
3. Analyze: Information obtained from the earlier steps is analyzed in this step to determine the potential causes for the problem and to come up with possible solutions to it (Pande, 2002).
4. Improve: In this step, the possible solutions are tentatively implemented and are checked for their effectiveness. If any solution were to be found effective, a detailed implementation plan is created for implementing it in the future (Pande, 2002).
5. Control: The goal in this step is to sustain the gains. The improvements made are monitored for their continued and sustainable success (Pande, 2002).

It has been shown that the proper application and implementation of Lean and Six Sigma techniques can be used to create a better process that is more cost-effective and can meet the demands of the customers.

Value Stream Mapping. Value Stream Mapping (VSM) is a Lean management method for analyzing the current state and designing a future state for the series of events that take a product or service from its beginning through to the customer. VSM's are largely regarded as rooted in work done by Toyota production systems in the late 1970's,

formalized by that same firms in the 1990's (Lian & Landeghem, 2007). Like 5S and Six Sigma, VSM employs a five-step approach. In the first step, the problem is defined, and goals and objectives are also defined. In the second step, using the standard symbols, a value stream map is drawn that shows the current steps, delays, and information flows required to deliver the target product or service. In the third step, the VSM is assessed to identify the problematic areas. With the assessment from the earlier step, a new value stream map is drawn in the fourth step that eliminates the waste and helps to reach the goal of delivering the target product or service. In the fifth and final stage, suggestions for future improvements are made.

Although VSM is a five-step approach like Six Sigma and 5S, it is largely regarded as much simpler to understand and to implement. To many, it is a quicker approach to identifying the problem and rectifying it.

Implementation of Lean Manufacturing Practices in General Manufacturing Companies

Lean practices have been implemented in various industries and have been proven to be effective. Pranckevicius, Diaz, and Gitlow (2008) applied the Lean Six Sigma DMAIC model to improve a plastic cup manufacturing process. The firms were experiencing problems managing the uniformity in the thickness of the plastic film and, as a result, the firms were forced to make changes to their pricing. Through the systematic and effective Lean Six Sigma approach, they were able to identify the areas that were causing the downtime and rectify them to achieve the desired rate of output without having to increase the prices.

Gupta and Jain (2015) applied the 5S concept to organize the workplace at a scientific instruments manufacturing firm and concluded that "5S is a powerful tool and can be implemented in various industries whether micro, small, medium or large" (p. 1). Through a simple approach, they were able to achieve overall improvement in the organization. The scientific instrument manufacturing firm had relied upon using old manufacturing technologies, but as the market became more volatile and competitive, there was an urgent need to respond to the changing environment to stay active in the business. Using the 5S Lean approach, Gupta and Jain (2015) analyzed different areas of the manufacturing facility and created a cause and effect diagram for the analysis of the shop. Data was collected using direct observations, participative observations, documentary analysis and semi-structured interviews. Based on the collected data and the observations, changes were made to the floor plans and to the workflow processes. With the changes made, the researchers concluded that the firm had seen an overall improvement of the organization.

It is a general misconception that Lean methods are suitable only for products and not services. A 5S management method helps improve conditions at the management level which further assists in improving the health of the business. Kanamori, Sow, Castro, Mastuno, Tsuru, and Jimba (2015) assessed how the 5S Management method created changes in the workplace and found that the services have become more efficient and safe. The research team carried out their study in a health center located in the Tambacounda region in Senegal. They asked the staff members to volunteer for the study and twenty-one of them volunteered to take part in the study. Each of the staff members

went through a three-phase training program in which they were made aware of the 5S management systems and practices and were educated about the various techniques. They were put in various locations and different working conditions which were controlled and monitored. Each staff member was personally interviewed after the training about his/her experience of the 5S management practices. They found that a majority of them perceived that the 5S program brought on changes in several areas, and they felt the 5S management improved the working environment and enabled them to be more efficient and to offer safer services.

Lamprea, Carreño, & Sánchez (2015) conducted a study to evaluate whether the 5S methodology could be considered an effective tool to improve manufacturing companies located in Bogotá. They defined the study factors to be quality, industrial security, organizational climate, and productivity based on prior studies that suggested that these were the key determining factors in a manufacturing firms. The study was comprised of a visual analysis and a mathematical/statistical analysis. The visual analysis was accompanied with the suggestions from the employees, and these suggested changes were employed during the five steps of 5S methodology. The conditions in the facility, in terms of human productivity, energy productivity, capital productivity, the percentage of waste, prior to the 5S implementation were observed, calculated and recorded. Other factors like industrial security and organizational climate were observed by taking into account the perspectives of employees at various levels as they rated their experiences before and after the 5S implementation. It was observed that 5S implementation had a positive effect on all of the factors. The productivity factors, on average, improved by

66%. The waste was reduced by 70%, and the employees felt that the values of industrial security were raised and the working environment was improved thus improving the organizational structure.

In conclusion, Lean Methodologies are currently trending across the globe. Industries both within and outside of the U.S are making use of these methodologies in efforts to improve conditions, increase productivity and remain competitive.

Implementation of Lean Methodologies in the Printing Industry

Some firms in the printing industry have chosen to implement Lean Methodologies over the past decade and have found them to be effective in either improving the performance of the operations at the firm or in helping them overcome the problems they were facing prior to the implementation.

Nagarajan (2009) studied the effects of implementing Lean Manufacturing in a web offset packaging facility. He found that the implementation of Lean Manufacturing helped significantly reduce the changeover times. He focused on studying the production department, and he believed that all the elements of Lean Manufacturing could be applied to any department in any firm. The study was conducted in a web offset printing plant that primarily worked on printing packaging products. Working through the five steps of 5S Lean Manufacturing techniques, the researcher categorized the tasks involved in the changeover process both internally and externally, recorded and monitored the activities during the changeover process, worked with the plant managers and designed a new workflow and monitored the changeover process again. The changeover times were recorded before and after the changes and were documented. The study found that the

implementation of Lean Manufacturing significantly reduced the changeover times in the web offset press.

Roth and Franchetti (2010) studied the scope for process improvement for printing operations through the DMAIC Lean Six Sigma approach. Breaking the study process into two stages, data collection and data analysis, and using the DMAIC methodology, they looked for areas for improvement in various stages of the printing at a small printing firm located in the Northwest of USA. The firm that was studied was in the business of printing sample boards. The machines at the firm had a production rate of printing 20 boards per hour and were not efficient enough to meet the yearly demand of 200,000 boards. The concerns or issues raised during the process were defined during the first step of the process, and the probable causes for that issue were listed and measured during the second step. Alongside the measuring process, the process diagram was made to help the observation. During the analysis phase, the observations were analyzed to determine the impact of each factor, and suggestions for improvements were made. Factors affecting the production were found to be the idle time of machines, time spent by workers on non-value added activities and the plant layout. From the findings, they determined that there was a need for more machines to be purchased to meet the requirements without an increase in the number of employees. Plant layouts for effective production were suggested. In order to ensure these proposed improvements were sustained, a Standard Operating Procedure (SOP) was designed which would reduce the idle time on the machines and eliminate the time spent by the operator on non-value added activities. The aim of this study was to examine the scope for improvement in the

process using Six Sigma. The researchers concluded that Six Sigma is a tool could be used to improve the processes within printing companies.

In a similar study, Austin (2013) observed the effect of VSM activities in a print shop. Through extensive observation, the researcher created a value stream map to identify the areas or departments that could be improved in order to reduce the amount of waste and came up with suggestions that would help towards building a better workflow through the guidelines of 5S Lean Manufacturing. This study was performed in a small size print shop that employed six individuals, and that offered a full range of print services. Briefing the employees about VSM, she had conversations with the employees to determine the key components of the value stream map. As the product families for the VSM were determined, she gathered the data directly with the help of a video camera and personal observation. Gathered data was documented as it occurred in the workflow, from acquiring the raw material to shipping the finished product, and the current VSM was created. She then analyzed the VSM to identify the waste in the system and then created the ideal and future VSM that were anticipated to reduce the waste in the system.

Austin found that creating a value stream map helped in identifying the waste that could be eliminated and in building an efficient workflow in a small sized press. By making suitable changes to the operations to meet the ideal or future value stream map recommendations, she believes that there will be little to no waste in the workflow. The researcher believes that the implementation of 5S Lean Manufacturing into the operations would benefit the print shop even more and suggests that future research could be done

on the grounds of observing the process of implementing Lean changes in small-sized print shops.

Though proven to be effective, implementation of these procedures is far from universal in the printing industry. For example, Engum (2009) found that significantly few newspaper printing firms were even aware of such practices. She also indicated that a majority of the firms that were aware of these practices chose not to implement them for several reasons.

Several researchers have studied companies to determine the factors which prohibit and impede adoption efforts in Lean Manufacturing methods. The review now turns to research that examines these factors.

Barriers to Implementation

The Lean Enterprise Institute (LEI) conducted a survey in 2007 in which they asked several firms in various industries for the reasons for non-implementation of Lean techniques. Figure 2 illustrates the results of this survey.

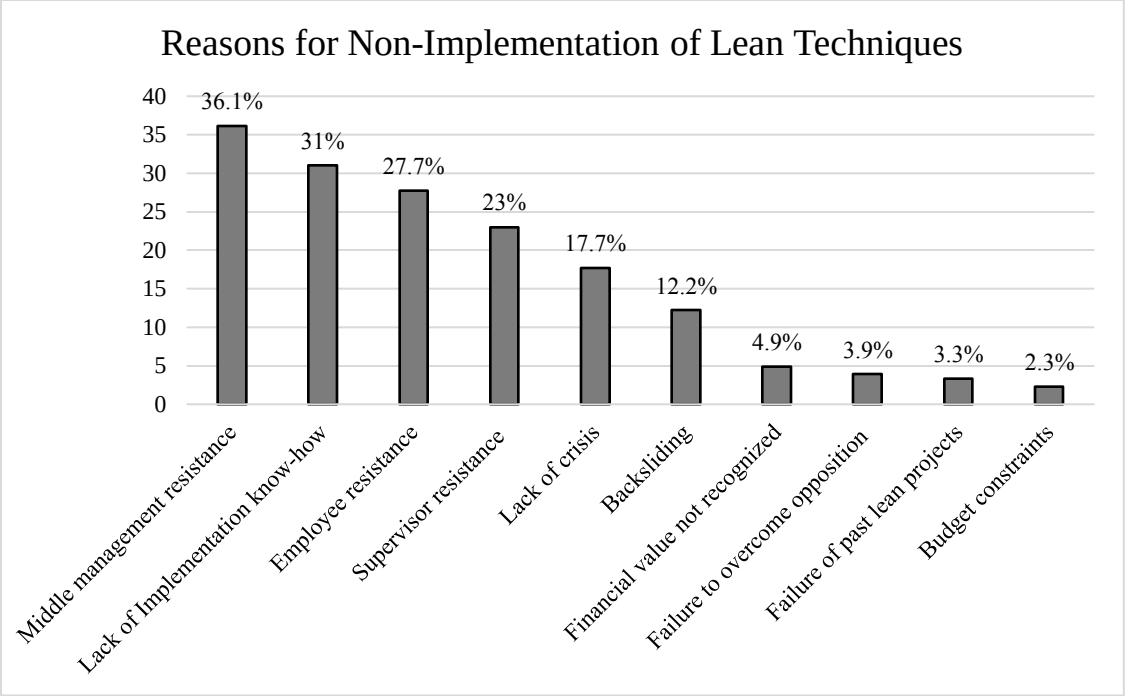

Figure 2. Results of Lean Enterprise Institute's Survey in 2007

Non-implementers of Lean Methodologies were asked about the reasons that stopped them from implementing these practices. The sample surveyed consisted of organizations from a diverse array of industries, and the results have been generalized. They found that the main obstacles for the implementation were management resistance, lack of implementation know-how and employee and supervisor resistance along with many other reasons like failing to recognize the financial value, failure of past Lean projects and budget constraints.

In addition, Jadhav, Mantha and Rane (2014) evaluated several publications related to Lean implementation and determined the barriers for successful Lean implementation. They identified twenty-four barriers that firms had to overcome to be successful in the implementation. They were as follows:

- “Top management resistance,
- Lack of top/senior management focus leadership,
- Lack of top/senior management involvement,
- Lack of communication between management and workers,
- Lack of empowerment of employees,
- Workers’ resistance,
- Lack of perseverance,
- Lack of consultants and trainers in the field,
- Lack of formal training for managers,
- Lack of formal training for workers,
- Cultural difference,
- Lack of cooperation and mutual trust between management and employees,
- Cross-functional conflicts,
- Incompatibility of Lean with the firms’ rewards systems,
- The lack of resources to invest,
- Slow response to market,
- Lack of information sharing,
- Lack of cooperation from suppliers,
- Lack of influence over suppliers,
- Lack of supplier collaboration,
- Quality problems with supplied material,

- Absence of a sound strategic action/logistical planning,
- Lack of logistic support,
- Problems with machines and plant configuration" (p. 126 – 132).

A primary goal of the present study was to determine the factors that are currently impeding firms in the printing industry from implementing these practices and together with the challenges they were facing prior to the implementation. Testing the generalized results cited by LEI in the printing industry, as well as examining if printing firms are experiencing the same barriers to the implementation of Lean Methodologies as other firms were two goals of this research.

Chapter 4

Research Objectives

One objective of this research was to examine the reasons that impede firms in the printing industry from implementing Lean techniques and also seek to assess the familiarity of these techniques among the managers in the industry and observe the possible relationship between the size of the organization and the impact on theimplementation of Lean practices. The researcher examined the following questions through this research

1) Are the factors cited by LEI and Jadhav et al. relevant in the printing industry?
2) Is there a relationship between the size of the firms and implementation of Lean Methodologies?

Chapter 5

Methodology

Using a cross-sectional survey technique, this study observed the implementation rate of Lean Methodologies in companies in the printing industry and also examined the potential relationship between the size of the firm and the implementation of Lean Methodologies.

Sample

The sample observed in this study consisted of commercial printing firms in the United States. The survey sample was comprised of companies that have been listed in "The 2015 Printing Impressions 400."

Procedure

The data was acquired through an online questionnaire. The participants were asked to fill out the questionnaire which included contingency questions that allowed the responses to be filtered into various categories. The survey questionnaire was designed in a way that the firms would not be asked to answer the questions for which they did not have the answers. The questionnaire consisted of three different sets of questions based on the firms' perspective about the implementation of Lean Methodologies. An initial question determined the firms' status and the following questions were based on their primary responses. The firms were segmented into three categories: companies who have implemented Lean Methodologies; companies who are aware of Lean Methodologies and have not implemented Lean practices; and the companies who are not aware of the Lean Methodologies. A following section of the survey was comprised of questions that were

designed to help in determining the size of the firms. The firms that have implemented Lean Methodologies were asked questions about the difficulties they had in the process of adoption. Firms that have not implemented Lean were asked questions about the factors that impeded them from taking steps towards implementing Lean Methodologies.

The individuals elicited as primary contacts at each of the 400 companies vary from Customer Service Representatives, Pre-Press Managers, Production Managers and all the way up to the Presidents. These contacts have been obtained through the respective firms' websites or through several other online sources like LinkedIn or similar services. An introductory letter was sent to the primary contacts to introduce them to the survey and alerted them to expect to receive a survey in the mail within a week. The letter asked for an alternative contact at the firm if the receiving individual was not able to answer the questions about production. This allowed the researcher to obtain more valid information if the alternative respondent were an individual familiar with the production operations. The database was updated to show any respondent changes. A letter with instructions and the link to the online survey was mailed out a week from the day the introductory letters were sent. To the firms that did not respond to the survey, reminder postcards were sent after two weeks from the day the initial surveys were sent out. The data, as they were received, were documented on a secure platform and the access was only limited to the researcher and the advisor.

Key Variables

This study has three notable variables that were observed: the size of the firm, the status of that organizations in regard to the implementation of Lean Methodologies and the factors that impede firms from implementing Lean Methodologies.

The independent variable, in this case, was the size of the firm.

The dependent variables that were observed were whether or not the firms have implemented Lean Methodologies and, if they have, they were asked to rate the relevancy of the factors that affected the implementation procedure, and if they haven't, they were asked for the reasons for not having implemented Lean Methodologies.

Table 1

Independent and Dependent Variables

Independent Variables	Dependent Variables
Size of the Firm	Firms' level of awareness about Lean techniques
	Firms' status of implementation of Lean techniques
	Reasons for not having implemented Lean techniques
	Difficulties faced by the firms on the road to implementing Lean techniques

Results

Response Rate and Non-Response Bias

A total of 73 out of 336 surveys were returned over a four-week period, resulting in a response rate of 21.7%. The respondents were divided into early and late and sub-groups based on their time of response – respondents that returned the survey in the first two weeks were considered early respondents and those that returned the survey in the final two weeks were considered late respondents. Thirty-three (45.2%) responses were received in the first two weeks, and 40 (54.8%) responses were received in the subsequent two weeks.

Demographics of Sample

Of those responding, 55% of the companies indicated that their operations were in a single location while 45% of the responding organizations were in multiple locations. Sixty-Five of the 73 respondents employed more than 50 employees at their locations. Ninety-six percent of the companies said they were familiar with some Lean Methodologies (5S, Six Sigma or VSM), and 74% of them have implemented at least one of the three methodologies at their facilities. With the demographic information presented, the report now considers the responses to the research questions.

Research Question 1: Are the factors cited by LEI and Jadhav et al. relevant in the printing industry?

Fifty-four of the 73 organizations that responded indicated implemention of Lean Methodologies. Lack of perseverance was cited as the most concerning barrier amongst a majority of the companies – 79% of the respondents stated that it was somewhat or

highly relevant as a barrier that they had to overcome. Workers' resistance was also cited as a major factor that impeded adoption: here 78% of the respondent felt it was either somewhat or highly relevant. Of all the factors, it was reported that top management resistance, supplier influence, and supplier cooperation were perceived as having the least impact when compared to the other factors and were most irrelevant to the process of implementing Lean Methodologies.

Table 2. shows the 24 factors and the percentage of respondents that considered the specific factor to be an implementation barrier.

Table 2.

Twenty-four factors and the percentage of respondents that saw it as a barrier

Rank	Factor	%
1	Lack of Perseverance	79%
2	Workers' resistance	78%
3	Cross-functional conflicts	67%
4	Management worker communication	63%
5	Strategic action	61%
6	Need for training for management	60%
7	Cultural differences	59%
8	Lack of mutual trust	57%
9	Machine plant configuration	57%
10	Training for workers	54%
11	Lack of employee empowerment	54%
12	Information sharing	48%
13	Slow market response	41%
14	Logistic support	40%
15	Management involvement	39%
16	Incompatible rewards system	37%
17	Lack of resources to invest	35%
18	Lack of top/senior management leadership	33%
19	Supplier collaboration	33%
20	Consultant trainer	30%
21	Quality materials	30%
22	Supplier influence	28%
23	Top management resistance	28%
24	Supplier cooperation	22%

From the responses, all of the 24 factors cited by Jadhav et al. (2012) were seen as a barriers to at least some extent, but a majority of the factors were not seen as concerning factors to the successful implementation of Lean Methodologies at

organizations in the printing industry as fewer than 40% of the respondents reported to see it as a barrier.

Of all the respondents, ten of them indicated that they were aware of Lean Methodologies and that the top management had discussed but had not implemented Lean Methodologies. Six suggested that they were aware, but the implementation was never discussed at their firm while three said they were totally unaware of Lean Methodologies.

The responding organizations who chose not to implement any of the constructs which comprise Lean Methodologies were asked about the factors which may have impeded adoption. Specifically, they were asked whether the factors cited by LEI had influenced their decision-making processes.

Table 3

Factors cited by LEI ranked according to the percentage of respondents that believed it was relevant to their decision to not adopt Lean Methodologies.

Rank	**Factor**	**%**
1	Lack of crisis	73%
2	Value not recognized	73%
3	Lack of know how	63%
4	Past failure	45%
5	Budget constraints	27%
6	Middle management resistance	27%
7	Supervisor resistance	27%
8	Employee resistance	19%

As indicated in Table 3. lack of crisis, not recognizing the value of and lack of know how to implement Lean Methodologies are the primary reasons organizations chose not to introduce Lean Methodologies into their operations.

Question 2: Is there a relationship between the size of the company and implementation of Lean Methodologies?

A chi-square test of homogeneity was used to determine if there is a relationship between the size of the responding organization and whether the respective organization has adopted any of the Lean Methodologies, the dichotomous dependent variable. Tables 3 - 6 show the summary of the survey response concerning the number of locations and the number of employees.

The null hypothesis for this case is stated that there is no significant relationship between the size of the firm and the implementation or non-implementation of Lean Methodologies.

Table 4. shows the responses sorted based on the number of locations the organizations were running operations in versus whether or not they have implemented Lean Methodologies. Companies with operations in more than one location are considered as a large size and the ones that operated in a single location were considered as small size companies.

Table 4

Cross-tabulation: Number of locations X Implementation of Lean Methodologies

			Implemented Lean		Total
			Yes	No	
No. of Locations	Multiple	Count	23	10	33
		Expected Count	24.4	8.6	33.0
		% within No. locations	69.7%	30.3%	100.0%
	Single	Count	31	9	40
		Expected Count	29.6	10.4	40.0
		% within No. Locations	77.5%	22.5%	100.0%
Total		Count	54	19	73
		Expected Count	54.0	19.0	73.0
		% within No. Locations	74.0%	26.0%	100.0%

Table 5

Chi-Square test results

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.572[a]	1	.450		
Continuity Correction[b]	.238	1	.625		
Likelihood Ratio	.570	1	.450		
Fisher's Exact Test				.593	.312
Linear-by-Linear Association	.564	1	.453		
N of Valid Cases	73				

a. Zero cells (0.0%) have expected count less than 5. The minimum expected count is 8.59

b. Computed only for a 2x2 table

Table 6. shows the data sorted based on the number of individuals employed at each of their locations versus whether or not they have implemented Lean Methodologies at their location. Companies that employed more than 50 individuals were considered large size and the ones with fewer than 50 employees were considered small size companies.

Table 6

Cross-tabulation: Number of Employees X Implementation of Lean Methodologies

			Implemented Lean		Total
			Yes	No	
No. of Employees	25-50	Count	6	2	8
		Expected Count	5.9	2.1	8.0
		% within No. Employees	75.0%	25.0%	100.0%
	> 50	Count	48	17	65
		Expected Count	48.1	16.9	65.0
		% within No. Employees	73.8%	26.2%	100.0%
Total		Count	54	19	73
		Expected Count	54.0	19.0	73.0
		% within No. Employees	74.0%	26.0%	100.0%

Table 7

Chi-Square Test Results

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.005[a]	1	.944		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.005	1	.944		
Fisher's Exact Test				1.000	.656
Linear-by-Linear Association	.005	1	.944		
N of Valid Cases	73				

a. One cell (25.0%) have expected count less than 5. The minimum expected count is 2.08

b. Computed only for a 2x2 table

There are multiple methods to gage the size of an organization; number of employees and the number of locations are two popular methods. In this study, organizations of 50 employees or fewer versus those with more than 50 employees as well as those companies with a single location versus multiple locations were examined. As such, the independent variables for both methods are dichotomous.

Because the small number of respondents from companies that employed 50 or fewer employees resulted in insufficient samples to run the test of two proportions, a Fisher's Exact Test (e.g., Blalock, 1972) was utilized to calculate a sampling distribution. There was not a statistically significant difference in proportions ($p > 0.99$).

Of the 33 responding organizations with multiple locations, 23 reported implementing Lean Methodologies, while ten (30.3%) did not. Of the responding organizations with single locations, 31 reported that they have adopted Lean Methodologies while nine (22.5%) did not. Fisher's Exact Test showed a difference in proportions of 0.105 ($p = 0.94$). Therefore, the null hypothesis is retained which is that the size of the firm in terms of number of locations they operate in and the number of employees at each location did not have any impact on the implementation of Lean Methodologies.

Summary and Conclusions

This chapter summarizes the results obtained, and suggests implications and future research in this domain. In so doing, the results are analyzed, and inferences are presented.

Analysis and Summary of Conclusions

Lean Methodologies, as manifested by 5S Lean, Six Sigma, and VSM activities, were established in the present study, the overarching goal of which is to help companies maximize their productivity while reducing manufacturing costs through streamlined operations. The literature concludes that these techniques have been proven to be effective in this regard.

As indicated in the literature review, several past studies have suggested guidelines to the adoption of Lean Methodologies and noted the factors for successful implementation. Particularly, Jaber (2013) researched and reported on the implementation of Lean 6 Sigma Methodologies in the oil industry and developed a general framework for successful implementation. Another landmark study was recently conducted by Hollingshed (2016), who conducted a similar study utilizing interpretive structural modeling, where manufacturing and service organizations were examined. Among the conclusions were critical success factors for the implementation of Lean Six Sigma. The present study builds on these and many others, but is focused solely upon the commercial printing industry. Using the salient factors that govern the successful

implementation of Lean Methodologies as indicated by the literature, the present study both builds upon and extends the relevant research in this domain.

One goal of the present study was to examine the importance of Lean Methodologies in the printing industry, and to investigate the level of knowledge regarding these methods among companies in this industry. From the academic literature, 24 factors germane to the adoption of Lean Methodologies spanning several industries were identified. Of these, fourteen were cited as most relevant to the printing industry.

Further, reasons for non-adoption were elicited from the literature. Based on responses these were ranked in order of relevance to non-adopters of Lean Manufacturing in the printing industry. Finally, any relationship between the size of the company and their decisions regarding Lean Manufacturing adoption were examined.

As indicated in the previous chapter, the most frequently cited barriers to adoption include perseverance, worker resistance, and training. Equally noteworthy are those factors from the literature which were not frequently cited as barriers, including supplier cooperation and influence, quality of materials, and resistance from top management.

Non-adopters most frequently cited lack of crisis as a reason for avoiding Lean Manufacturing techniques, followed by value not recognized and lack of know-how. Resistance factors were the least cited here, including management, supervisor and employee resistance. In examining the size of the company and its possible relationship to the adoption of Lean Manufacturing, no relationship was observed.

Implications and Suggestions for Future Research

It is recognized that many believe that Lean Methodologies are limited to heavy industries, such as automotive, airline, and military manufacturing. The present study potentially helps to dispel this myth in examining the printing industry which combines significant elements of service industries together with components common to manufacturing organizations. Further, non-adopters of Lean Methodologies often cited that they did not recognize the value offered, causing them to not even consider adoption. The present study concludes a relatively widespread use of Lean Methodologies in the commercial printing industry, which underscores the relevance of these techniques. This finding could potentially benefit printers who may have previously held doubts about the adoption of Lean Methodologies. Such organizations can now confidently realize that they are not alone in this endeavor. It is important to reiterate that a wide body of literature supports the adoption of Lean Methodologies; the premise is that the more printing companies move toward these techniques, the better they will be able to increase efficiencies and capture more business. Of course, this will help the local economies and enable them to provide more jobs while supporting their vendors, the industry, and the community-at-large.

Commercial printers are not the only constituency that could potentially benefit from the results of the present study. Indeed, consultants who aim to help printing organizations improve quality and productivity could rely on the data presented here to support their future activity in helping their customers meet their productivity goals. In addition, the vendor community could add value to their products by positioning them in

the context of the criteria which define Lean Methodologies; this may help them to better relate to the needs of the printing companies which they serve.

In the examination of the barriers to the adoption and successful implementation of Lean Methodologies, training for management and workers was among the most often cited. This suggests that educators and industry trainers could be influenced by the results presented here. A deeper integration of Lean Methodologies into curricula could result in more relevant pedagogical offerings and lay the groundwork for present and future managers to lead organizations which benefit from Lean Manufacturing techniques.

Of all the constituencies that could be influenced by the results of the present study, future researchers will perhaps be impacted the most. This is because, like any research, the present research has limitations which can be utilized by others wishing to deepen knowledge in this robust field.

For example, the present research utilized a cross-sectional survey technique which, while enabling the ability to reach a number of respondents efficiently and confidently and generalize the results to a wider population, does not examine a deep knowledge of an individual's perspectives. Therefore, future researchers may take a more qualitative approach by conducting case studies or in-depth interviews using open-ended questions. Such qualitative results could validate the conclusions drawn here, while contributing to an understanding in this field by allowing respondents to free associate and better address the "why" question.

Furthermore, the cross-sectional survey examined only a single point in time. Quantitative researchers may replicate this study in the future, which could potentially

allow for analysis of the state of adoption of Lean Methodologies. For example, in addition to the characteristics of an innovation, Rogers (1996) posits categories of adoption, namely, innovators, early adopters, early majority, late majority, and laggards. Analyzing these categories requires a longitudinal view. It is, therefore, reasonable to infer that using the present study as a base, other researchers could replicate the methods and the sample to examine the state of adoption of Lean Methodologies according to Rogers.

Other limitations of the present study suggest starting points for future researchers, as well. For example, here only the top 400 U.S. printing companies as listed by *Printing Impressions* magazine were included in the sampling frame. A future research effort may wish to examine smaller companies in addition to the larger organizations, or expand the methodology to other countries.

As cited in the literature review, a similar study in 2009 examined the adoption of Lean Methodologies among newspaper printers. After an extensive search of published literature, this was the only research that examined Lean Methodologies in the printing industry. Taken together with the present study, therefore, only two segments of the printing industry have been examined. This suggests that future researchers may expand this area of study into other printing segments.

Upon crossexamining the barriers to implementation and the factors for non-implementation, it was interesting to find that employee resistance was a major barrier to the implementation process while the same factor was reported as least relevant by the non-adopters. This phenomenon builds the base for future research for a qualitative study

where the perception of the employees in both companies that have adopted Lean Methodologies and the ones that haven't can be recorded through personal interviews

Finally, it is noteworthy to recognize that a minority of the respondents indicated a failed attempt at the adoption of Lean Methodologies. While the failure rate of adoption was not a primary focus of the present study, future researchers could potentially contribute to the body of literature by examining this particular phenomenon. It would be particularly interesting to take a qualitative approach to the examination of such companies to ascertain the reasons for failed adoption.

Bibliography

Austin, A. A. (2013). A case study of value streams and Lean implementation for a small printshop. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/1403379710?

Andre L. Delbecq., and Pierce, Jon L. "ORGANIZATION STRUCTURE, INDIVIDUAL ATTITUDES AND INNOVATION." *Academy of Management.The Academy of Management Review* 2.1 (1977): 27. *ProQuest.* Web. 13 Oct. 2016.

Baldridge V., Burnham R. (1975). Organizational Innovation: Individual, Organizational, and Environmental Impacts. *Administrative Science Quarterly*, 20(2):165-176

Becker, J. E. (2001). Implementing 5S: To promote safety & housekeeping. Professional Safety, 46(8), 29-31. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/200459377?accountid=108

Blalock, H. M. (1972). *Social statistics*. New York: McGraw-Hill.

Cooper, K., Keif, M. G., & Macro, K. L., Jr. (2007). Lean Printing: Pathway to Success. Sewickley, PA: PIA/GATF Press

Damanpour F. (1992). Organizational Size and Innovation. *Organizational Studies 13:375-402*

Damanpour F., Schneider M., (2006). Phases of the Adoption of Innovation in Organizations: Effects of Environment, Organization and Top Managers, *British Journal of Management,* 17: 215-236

Dillman, D.A., Smyth J.D., & Christian, L. M. (2009). Internet, mail and mixed-mode surveys: The tailored design method. Hoboken, NJ: Wiley.

Dorota Rymaszewska, A. (2014). The challenges of Lean Manufacturing implementation in SMEs. Benchmarking, 21(6), 987. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/1658144743?

Douglas, A. (2002). Improving manufacturing performance. Quality Congress. ASQ's Annual Quality Congress Proceedings, 725-732. Retrieved April 2016, from ABI/INFORM Global Database. (Document ID: 162226351)

Engum, M. (2009). Implementing Lean Manufacturing into newspaper production operations. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/305072100?a

Frambach, Ruud T., and Niels Schillewaert. "Organizational Innovation Adoption: A Multi-Level Framework of Determinants and Opportunities for Future Research." *Journal of Business Research* 55.2 (2002): 163-76. *ProQuest.* Web. 13 Oct. 2016.

Gupta, S., & Jain, S. K. (2015). An application of 5S concept to organize the workplace at a scientific instruments manufacturing companies. International Journal of Lean Six Sigma, 6(1), 73. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/1654894903?accountid=108

Holak, Susan L., and Donald R. Lehmann. "Purchase Intentions and the Dimensions of Innovation: An Exploratory Model." *The Journal of Product Innovation Management* 7.1 (1990): 59. *ProQuest.* Web. 13 Oct. 2016.

Hollingshed, M. (2016). A comparative study of the critical success factors for implementing lean six sigma in manufacturing and service organizations using interpretive structural modeling (Order No. 10582971). Available from ProQuest Dissertations & Theses Global. (1872705906)

Jadhav, J.,R., Mantha, S.,S., & Rane, S.,B. (2014). Exploring barriers in Lean implementation. International Journal of Lean Six Sigma, 5(2), 122. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/1650580254?accountid=108

Jaber, M. A. (2013). Implementing lean six sigma methodology in the oil industry: General framework (Order No. 1553759). Available from ProQuest Dissertations & Theses Global

Kanamori, S., Sow, S., Castro, M. C., Matsuno, R., Tsuru, A., & Jimba, M. (2015). Implementation of 5S Management method for Lean healthcare at a health center in senegal: A qualitative study of staff perception. Global Health Action, 8

Karlsson, C. and Ahlstrom, P. (1996). Assessing changes towards Lean production. International Journal of Operation and Production Management, Vol. 16 No. 2, pp. 24-41.

Lamprea, E. J. H., Carreño, Z. M. C., & Sánchez, P. M. T. M. (2015) Impact of 5S on productivity, quality, organizational climate and industrial safety in caucho metal ltda.

Lian, Y-H., Landeghem, H. (2007). Analysing the effects of Lean manufacturing using value stream mapping-based simulation generator. *Internationak Journal of Producyion Research, 45*(13), 3037. Retrieved, November 15, 2015, from ABI/INFORM Global database. (Document ID: 1276561321).

Luna, L. F. N. (2010). The effect of variation in production processes for Lean Manufacturing. Presented at the IIE Annual conference proceedings. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/733014408?

Lynch, L. L. (2005). The Relationship of Lean Manufacturing 5S Principles to Quality, Productivity, and Cycle Time. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/305397669?

Mehta, R. K., Mehta, D., & Mehta, N. K. (2012). Lean Manufacturing practices: Problems and prospects. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/1077750913?

McLeod, A. A. (2009). An assessment of small to medium size manufacturers practicing Lean manufacturing in Indiana. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/304987728?a

Monden, Y. (1993). Toyota production system. (2nd ed.). Norcross, GA: Engineering & Management Press.

Nagarajan, P. (2009). Reducing changeover times in a web offset packaging environment. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/305066123?

Obstacles to Lean Implementation. (2007). Lean Enterprise Institute (LEI) Retrieved May 31, 2016, fromwww.lean.org/stateofleansurvey_2007

Olsen, E. O. (2004). Lean Manufacturing Management: The relationship between practice and firm-level financial performance. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/305140398?a

Olson, D. J. (2010). A study of the relationships in financial performance, organization size, business classification, and program maturity of Six Sigma systems. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/755431482?

Ostlund L. (1974). Percieved Innovation Attributes as Predictors of Innovation? *Academy of Management Journal of Consumer Research*, 2(1): 23-29

Patten, J. (2009). A Second Look At 5S. *Quality Progress, 39*(10), 55-59. Retrieved November 22, 2015, from ABI/INFORM trade & Industry Database. (Document ID: 1153521771)

Pande, P.S. (2002). The Six Sigma way, team fieldbook: An implementation guide for process improvement teams. Nw York, NYL McGraw Hill.

Polischuk, T. (2009). What's Lean mean?. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/224553240?a

Pranckevicius, D., Diaz, D. M., & Gitlow, H. (2008). A Lean Six Sigma case study: An application of the "5s" Techniques. Journal of Advances in Management Research, 5(1), 63-79. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/603463064?accountid=108

Rijsdijk, S.A and E.J Hutlink. (2003). Honey, Have you seen our Hamster? Consumer Evaluations of Autonomous Domestic Products. *Journal of Product Innovation Management.* 20 (3), 204-217

Roth, N., & Franchetti, M. (2010). Process improvement for printing operations through the DMAIC Lean Six Sigma approach. International Journal of Lean Six Sigma. Retrieved from: http://dx.doi.org/10.1108/20401461011049502

Rogers, E.M. (1996). *Diffusion of Innovations.* New York City, NY: Glencoe FreePress.

Sweta. (2014). Implementing 5S methodology. Paper presented at the International Proceedings of Economics Development and Research, Singapore. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/1522321070?

Smyth, S. (2015). The future of digital vs. analogue printing to 2020. Smithers Pira, Akron, Ohio

Tennant, G. (2001), Six Sigma: SPC and TQM in Manufacturing and Services, Gower, Vermont.

Thanki, S. J., & Thakkar, J. (2011). Lean Manufacturing: Issues and perspectives. Productivity, 52(1), 12-22. Retrieved from http://search.proquest.com.ezproxy.rit.edu/docview/1024787619?

Appendices

Appendix A

Introductory Letter

R·I·T

Rochester Institute of Technology

College of Imaging Arts & Sciences
School of Media Sciences
Frank E. Gannett Hall
69 Lomb Memorial Drive
Rochester, NY 14623-5603
585-475-5992 Fax: 585-475-5336

<Date>

<Company>

Attn: <Contact>

<Address1>

<City>, <State> <Zip>

Dear <Salutation> <Contact>:

I am writing to ask for your help in an important study being conducted by Mr. Sandeep Yellinedi, a graduate student at Rochester Institute of Technology (RIT) working on his thesis. This study is intended to gather timely, descriptive information about the adoption of quality control methods by commercial printers.

You have been identified as an individual within a commercial printing organization who is knowledgeable about operational procedures utilized for production within your organization. If another individual is better suited to respond, please forward this correspondence to them.

Your company is an important part of the commercial printing industry, and has been selected as a sample representative of the industry at-large. Therefore, your response is critical to the validity of the research. In approximately one week, you will receive an invitation by mail to participate in this study by answering several questions. The purpose of this letter is because many people prefer a few days' notice prior to receiving a questionnaire.

This research depends on your generous assistance. As a thank you for your time, you will be offered an executive summary of the results of the study.

If you would like to change the contact information or have questions regarding the study, please email Sandeep Yellinedi at sy4858@rit.edu or call (717) 903-4771. You may also contact me as I am serving as one of Sandeep's academic thesis advisors: my email is bruce.myers@rit.edu and my direct telephone number is (908) 601-4646. For questions regarding your rights as a participant in this study, you may contact Ms. Heather Foti, Associate Director of the RIT Human Subjects Research Office at hmfsrs@rit.edu or (585) 475-7673.

Thank you,

Bruce Leigh Myers, Ph.D.
Assistant Professor

Appendix B

Informed consent and cover letter

R·I·T

Rochester Institute of Technology

College of Imaging Arts & Sciences
School of Media Sciences
Frank E. Gannett Hall
69 Lomb Memorial Drive
Rochester, NY 14623-5603
585-475-5992 Fax: 585-475-5336

<Date>

<Company>

Attn: <Contact>

<Address1>

<City>, <State> <Zip>

Dear <Salutation> <Contact>:

I am writing regarding the survey of companies in the commercial printing businesses being conducted by Rochester Institute of Technology. You should have received a letter in the past few days introducing you to the research study.

This research is intended to examine the current state of implementation of lean manufacturing and management techniques at your organization. You have been selected for participation as your organization has been listed on the 2015 version of "Printing Impressions 400". Your response is important to the validity of the research. The results of this study may offer significant insight and knowledge for companies in the commercial printing industry, such as yours.

There are no known risks or discomforts associated with completing the survey beyond those of everyday life. You will not receive any monetary compensation for completing the survey; however, you will be potentially contributing to increased understanding of the commercial printing industry. Participation in this study is voluntary and you may refuse to participate without penalty at any time.

Your completion of the survey will indicate your consent to participate in this study after having read and understood the information presented above. Please keep a copy of this consent information for your records. If you have any questions, please call me directly at (717) 903-4771 or contact me via e-mail at sy4858@rit.edu. For questions regarding your rights as a participant of this study, you may contact Ms. Heather Foti, Associate Director of the RIT Human Subjects Research Office (HSRO) at (585) 475-7673

Please find below the link to the online survey. I understand that that your time is valuable. The survey should take only about 5-10 minutes to complete. Your specific answers will be kept confidential and reported in aggregate form only. This research depends on your generous help and I would like to thank you in advance.

Survey Link: www.tinyurl.com/LeanPrinting

Sincerely,

Sandeep Yellinedi
Graduate Candidate, M.S. Print Media

Appendix C

Survey questionnaire

Introduction

This research is aimed at gathering information about the level of knowledge of Lean Manufacturing within commercial printing organizations. The survey is being administered as part of a Master's thesis at the Rochester Institute of Technology (RIT).

As a commercial printer, you are asked to provide information which will help in achieving the objectives of this research. The survey includes 10 questions and should take you no more than 10 minutes to complete. Your answers are important to us, so please take the time to read each question carefully.

I am taking steps to keep all the information and the responses anonymous. Enclosed with the mailed survey packet, you will find a return postcard; by returning it i will know that you have responded to the survey with no link to your responses. Based on your response to the questions on the return postcard, you may be contacted and asked to be a part of a more in-depth case study. To show how much your participation is appreciated, i am willing to share the executive summary of the survey results. Please indicate your interest in receiving the executive summary on the return postcard.

Information obtained in this survey is strictly for research purposes and will not be given out to any other parties. Access to the data is also restricted to the primary researcher and will not be provided to any other parties.

General Information

1. In how many locations does your company perform print production operations?

- ◯ Single Location
- ◯ 2 - 5
- ◯ 6 - 10
- ◯ 11 - 15
- ◯ More than 15

2. How many individuals are employed at your specific location?

- ◯ Less than 25
- ◯ 25 - 50
- ◯ More than 50

Familiarity with Lean Manufacturing and Management Techniques

3. Are you familiar with the concepts, tools and techniques of Lean Manufacturing techniques (Value Stream Mapping, 5S Lean or Six Sigma)?

- ◯ Yes
- ◯ Somewhat Familiar
- ◯ No

4. Has your location implemented any of the Lean Manufacturing and Management Techniques (Value Stream Mapping, 5S Lean orSix Sigma)?

- ◯ Yes
- ◯ No

Not Familiar/ No Implementation

5. Has implementing Lean Manufacturing into Production Operations been discussed by the Management?

- ◯ Yes
- ◯ No
- ◯ Not Sure

Reasons for Non-Implementation

6. What were the main reasons for deciding not to implement? Rank their relevancy by selecting the appropriate option

	Not relevant	Somewhat relevant	Highly relevant
Middle Management Resistance	○	○	○
Lack of Implementation Know-How	○	○	○
Employee Resistance	○	○	○
Supervisor Resistance	○	○	○
Lack of Crisis	○	○	○
Financial Value not recognized	○	○	○
Failure of past similar projects	○	○	○
Budget Constraints	○	○	○

Barriers to Implementation

7. What were the barriers that you faced in the process of implementing Lean Techniques? Rank their relevancy by selecting the appropriate option

	Not relevant	Somewhat relevant	Highly relevant
Top management resistance	○	○	○
Lack of top/senior management leadership	○	○	○
Lack of top/senior management involvement	○	○	○
Lack of communication between management and workers	○	○	○
Lack of empowerment of employees	○	○	○
Workers' resistance	○	○	○
Lack of perseverance	○	○	○
Lack of consultants and trainers in the field	○	○	○
Lack of formal training for managers	○	○	○
Lack of formal training for workers	○	○	○
Cultural difference	○	○	○
Lack of co-operation and mutual trust between management and employees	○	○	○
Cross-functional conflicts	○	○	○
Incompatibility of lean with the company rewards system Lack of resources to invest	○	○	○
Lack of resources to invest	○	○	○
Slow response to market	○	○	○
Lack of information sharing	○	○	○

	Not relevant	Somewhat relevant	Highly relevant
Lack of cooperation from suppliers	○	○	○
Lack of influence over suppliers	○	○	○
Lack of supplier collaboration	○	○	○
Quality problems with supplied material	○	○	○
Absence of a sound strategic action/logistical planning	○	○	○
Lack of logistic support	○	○	○
Problems with machines and plant configuration	○	○	○

Conclusion

You have completed the survey. Thank you for your response

Should you be willing to be contacted for a follow-up interview or choose to receive an executive summary of the survey results, please indicate your choice on the return postcard. Returning the postcard indicates that you have responded to the survey and would prevent us from reaching out to you further.

Appendix D

Return postcard

School of Media Sciences

Graduate Research

Lean Manufacturing in Printing Industry

I have completed the online survey and am returning this postcard to prevent future reminders and to indicate my desire to receive an executive summary of the results.

☐ Yes, I would like to receive a summary of the results by email at the conclusion of the study. Please send the results to the following email address

Email address:_____(required)

☐ No, I do not wish to receive a summary of the results at the conclusion of the study.

Rochester Institute of Technology
College of Imaging Arts and Sciences
School of Media Sciences
ATTN: Sandeep Yellinedi
69 Lomb Memorial Drive
Rochester, NY 14623

Appendix E

Reminder Postcard

Two weeks ago I sent your company a letter regarding the implementation of lean manufacturing techniques at your organization. I asked for your help with my graduate research because I believe you are a valuable part of the commercial printing industry. This postcard serves as a reminder to complete the survey.

I am entirely grateful for your help; research like this could not be completed without your generous support.

If you have already taken the survey, I sincerely thank you for your response. If you have any questions, please reach me at (717) 903-4771 or email sy4858@g.rit.edu and I would be happy to answer your questions.

To complete the survey online, please go to:

Website: www.tinyurl.com/LeanPrinting

Sincerely,
Sandeep Yellinedi

Rochester Institute of Technology

College of Imaging Arts & Sciences

ATTN: Sandeep Yellinedi
69 Lomb Memorial Drive
Rochester, NY 14623-5603

Website: www.tinyurl.com/LeanPrinting

Appendix F

Human Subjects Committee Approval

R·I·T

Rochester Institute of Technology

RIT Institutional Review Board for the
Protection of Human Subjects in Research
141 Lomb Memorial Drive
Rochester, New York 14623-5604
Phone: 585-475-7673
Fax: 585-475-7990
Email: hmfsrs@rit.edu

Form C
IRB Decision Form

TO: Sandeep Yellinedi

FROM: RIT Institutional Review Board

DATE: **September 28, 2016**

RE: Decision of the RIT Institutional Review Board

Project Title Barriers to Implementation of Lean Techniques in Commercial Printing Firms and the Impact of Implementation

The Institutional Review Board (IRB) has taken the following action on your project named above.

☒ Exempt 46.101 (b)(2)

Now that your project is approved, you may proceed as you described in the Form A.

You are required to submit to the IRB any:

- **Proposed** modifications and wait for approval before implementing them,
- Unanticipated risks, and
- Actual injury to human subjects.

Heather Foti, MPH
Associate Director
Office of Human Subjects Research

Revised 10-18-06