The role of communication and management support in a lean manufacturing implementation

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Abstract

Purpose – The purpose of this research is to investigate the role of management support in a lean implementation. The impact the lean implementation made on communication within the organization is also examined.

Design/methodology/approach – Qualitative methods were used to study the relationships between management support, organizational communications, and a lean manufacturing implementation. A case study was conducted in an electronics manufacturing company in the northwestern USA. Data were collected over a three-month time period. The data were coded using an evolving coding scheme and analysis was performed on the resulting data set.

Findings – Evidence was found to support the supposition that management support does play a role in driving a lean manufacturing implementation. Management support impacted the lean manufacturing implementation both negatively and positively. The research also found moderate support for improved communication in the organization attributable to the lean implementation.

Research limitations/implications – The organization studied was in the early stages of implementing lean manufacturing practices and principles. Future research should include multiple organizations with a longer history of lean manufacturing.

Practical implications – The research findings identified management support and communications as important variables in a lean manufacturing implementation. Furthermore, there is evidence that these variables are critical in not only the implementation of lean manufacturing practices and principles, but also in the ongoing planning and deployment efforts of organizational leaders.

Originality/value – This research provided empirical evidence for the role of management support and communication in an organization's lean implementation. The findings highlight the importance of studying organizational phenomenon within real-world settings. As a result of the methodology used, both positive and negative implications were identified. The research design has enabled the uncovering of a complex set of relationships that existed between two sociocultural variables and an organization's effort to improve performance through the implementation of lean practices.

Keywords Lean production, Communication, Qualitative research, Manufacturing systems, Management roles, Electronics industry, United States of America

Paper type Research paper

1. Introduction

As organizations have struggled to remain profitable during periods of economic slowdown, many have embraced lean manufacturing as a tool to improve competitiveness. Like many improvement programs, lean manufacturing

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implementations have not succeeded universally in their application. Many different variables may impact a lean implementation. This research investigated two specific variables – management support and communication.

The literature contains examples of both lean manufacturing implementation successes and failures. Both anecdotal (Ahls, 2001; Alavi, 2003, Parks, 2002; Stamm, 2004) and empirically evaluated (Bamber and Dale, 2000; Emiliani, 2001; Krafcik, 1988; Spear and Bowen, 1999; Womack *et al.*, 1990; Womack and Jones, 1994, 1996) studies have been completed. Few formal research studies have, however, focused on the linkage between sociocultural variables such as management support and organizational communication and the success or failure of a lean implementation. Previous research and existing practitioner case studies provided justification for this work.

The importance of the role of management support in any change program is widely acknowledged within the literature. This study has provided evidence that, in practice, management support is not related to the success of a lean manufacturing implementation in a simple or direct way. Similarly, this study also explored how a lean manufacturing implementation affected communication lines within an organization. Communication is often cited in the practitioner literature as an important factor in lean manufacturing success, but the specific details of how and why communication is important are not well delineated nor have they been empirically validated. This research revealed that a dynamic relationship exists between a lean implementation and organizational communications.

The relationships uncovered during data collection and analyses add to the body of knowledge by extending our understanding of complex organizational phenomenon and provide empirical evidence that will be of value to both practitioners and researchers. In particular, this research has empirically demonstrated that management support and communications are not related to the success or failure of a lean implementation in a one-dimensional way. Rather, as a result of the research design used, this study has uncovered a complex set of relationships between management support and communications and an organization's effort to improve performance through the implementation of lean practices.

2. Literature review

2.1. Lean manufacturing

The roots of lean manufacturing originate with early automobile manufacturing. The master craftsmen that first built individual cars possessed a wide range of skills and abilities, but with low efficiency and at high cost. Henry Ford recognized these limitations and broke the assembly process down into 30-second tasks, which were performed almost a thousand times a day (Krafcik, 1988). In the 1950's, Eiji Toyoda and Taiichi Ohno merged the knowledge and skill of master craftsmen with the standardization and efficiency of the moving assembly line and added the concept of teamwork to create the Toyota Production System (TPS) (Womack *et al.*, 1990). John Krafcik introduced the term "lean production system" in 1988 in his review of the Toyota Production System, and the term "lean manufacturing" was popularized by Womack *et al.* (1990), in *The Machine that Changed the World*.

Lean manufacturing has many definitions associated with it. Some researchers provide definitions specific to manufacturing processes while others employ a more general definition that could be applied to a variety of industries. For this research lean manufacturing, was defined as the systematic removal of waste by all members of the organization from all areas of the value stream (Worley, 2004). The value stream is defined as all of the activities that contribute to the transformation of a product from raw material to finished product including design, order taking, and physical manufacture (Womack and Jones, 1996). Waste is any non-necessary activity that does not add value for the customer.

Lean manufacturing is often associated with benefits such as reduced inventory, reduced manufacture times, increased quality, increased flexibility, and increased customer satisfaction (Ahls, 2001; Alavi, 2003; Emiliani, 2001; Ross and Francis, 2003; Womack and Jones, 1994, 1996). Some of the practices of lean manufacturing include Five S events, kaizen events, kanbans, pull production, quick changeovers, and value stream mapping. Table I provides a summary of the definitions of some common lean practices.

Though lean manufacturing can result in improved organizational performance, challenges do exist. Convincing managers and employees to think and act in ways that are foreign may be difficult. Employees may resist the tools of lean manufacturing or may experience difficulty thinking in new terms such as customer value and waste. It may also be difficult to adequately manage external relationships with customers and suppliers. Suppliers may be unable to deliver the smaller quantities of parts or subassemblies that are required for pull production. Customers may be unable to place predictable orders, causing the organization to stockpile inventory to meet demand (Womack and Jones, 1994). Though the challenges may be difficult to manage, lean manufacturing has nevertheless been embraced in many sectors of manufacturing.

Lean practice	Definition
Five S events	Defined as the five dimensions of workplace organization. The events are designed to organize and clean. Five S events are often incorporated with Kaizen events. The Five Ss are defined as sort (identify unnecessary equipment), straighten (arrange and label the area so all tools have a specified home), shine (clean the area and maintain equipment daily), standardize (establish guidelines and standards for the area), and sustain (maintain the established standards) (Worley, 2004)
Kaizen events	Defined as continuous improvement in small steps (Womack *et al.*, 1990), organizations typically use kaizen events to focus on improving a specific process
Kanban	Defined as a system that uses a card to signal a need to produce or transport a container of raw materials or partially finished products to the next stage in the manufacturing process (Nicholas, 1998)
Pull production	Characterized by the manufacture of a product only when a customer places an order
Quick changeovers	Characterized as a method for minimizing the amount of time it takes to change a machine's setting or to prepare an area to begin processing a new product (Worley, 2004)
Value stream mapping	Defined as investigating the flow of material through the manufacturing process from the customer's point of view. The end result highlights areas of waste (Rother and Shook, 1999)

Table I.
Examples and definitions of common lean practices

2.2. Management support

Though many variables may affect the success of a lean manufacturing implementation, many researchers agree anecdotally that commitment by top management is vital (Alavi, 2003; Bamber and Dale, 2000; Boyer and Sovilla, 2003; Parks, 2002; Womack and Jones, 1996). Management that fails to embrace the implementation may intentionally or unintentionally sabotage the effort (Boyer and Sovilla, 2003; Stamm, 2004).

Top management should not only demonstrate commitment and leadership, it must also work to create interest in the implementation and communicate the change to everyone within the organization (Boyer and Sovilla, 2003). Management must be visibly connected to the project and participate in the lean manufacturing events (Alavi, 2003; Boyer and Sovilla, 2003; Emiliani, 2001). A lack of investment by upper management in the lean manufacturing implementation may also affect the success of the implementation in less visible ways. If employees feel that the executive team does not respect their efforts, discouragement may take hold and the lean manufacturing effort will fail. Though it is often desirable to drive change from the factory floor, it is important that a transition to lean manufacturing be driven by the executive management team (Boyer and Sovilla, 2003).

2.3. Communication

The variables that will affect the success rate of a lean manufacturing implementation are important to understand, but it is also important to realize how the organization may be impacted by the lean manufacturing implementation. A lean manufacturing implementation may not only provide economic benefits to the organization, but other less tangible benefits as well. A key example of such a benefit is increased communication. Communication in any organization is important, but particularly in a manufacturing environment where multiple shifts are employed. When communication does not occur, production and quality may suffer and resentment between workers may occur (Hancock and Zayko, 1998).

Lean manufacturing requires clear communication, not only between shifts, but also between all value streams (Storch and Lim, 1999). All customer-supplier connections within the organization must have a direct connection and there must be a clear method for sending and receiving responses to problems (Spear and Bowen, 1999). Lean manufacturing enterprises must have communication pathways that are efficient and broad (Jenner, 1998).

3. Methodology

This study is well suited for qualitative methodologies and, in particular, for an exploratory case study. When a researcher is delving into the how and why of a set of events, the case study offers advantages not found in more quantitative research tools (Yin, 1994). Qualitative data allows the researcher to more fully explore complex relationships between variables in their natural setting. The complex interactions between humans and multiple variables can be difficult to capture in a quantitative study employing traditional tools such as surveys.

Qualitative research does rely on data collection methods that may be subject to biases such as researcher bias or over-reliance on one source. To negate the possible effects of some of these biases the researcher must develop a documented, systematic approach to data collection to allow other researchers to assess potential bias. Utilizing triangulation will also help increase research robustness (Patton, 1990). Triangulation is defined as occurring when data from multiple sources from different data collection methods support the same conclusion, or at the least, do not contradict it (Miles and Huberman, 1994).

A single site case study design was used for this research. Data was gathered from multiple sources, using four different data collection methods (observations, structured interviews, unstructured interviews, and value stream mapping). Unique sources were purposely sought to increase validity and to provide a wider perspective.

3.1. Variables

As the variables of interest have been studied across a variety of disciplines, it was critical to operationalize each variable for the purposes of this case study. Definitions were developed for each variable and were used to guide the analysis of data. For this study, management support was defined as the participation of the upper management team in leading or supporting the lean manufacturing implementation. Communication was defined as a method, usually verbal or written, by which employees in the organization transfer work related information to other employees.

Understanding the role of management support in a lean manufacturing implementation can be complex as the lean manufacturing implementation may impact so many aspects of an organization. The balanced scorecard concept provides an evaluation framework adaptable for investigating the potentially diverse impacts of a lean manufacturing implementation. The balanced scorecard developed by Kaplan and Norton (1992) incorporates a range of measures from four different perspectives: finance (profitability, growth, and shareholder value), customer (delivery timeliness and product quality), innovation (percentage of sales from new products), and internal (cycle times and productivity). Emiliani (2000) created an alternate version of the balanced scorecard that included measures from the perspective of customers, employees, investors, and suppliers.

A balanced scorecard framework was developed and used for this research to assess the impact of lean on organizational performance. As the study organization was privately held, the measures in the investor category did not directly apply. The scorecard developed for this research included elements from both Kaplan and Norton and Emiliani's frameworks. The scorecard incorporated three perspectives – customers, employees, and internal. The measures used within each category are summarized in Table II.

Employees	Customers	Internal
Employee attitude	Ability to meet customer's manufacturing needs through the use of lean practices such as kanbans	Streamlined processes (elimination of waste)
Improved employee skills	Customer satisfaction in areas such as on-time delivery or quality	Adaptation of lean manufacturing concepts/tools

Table II.
Balanced scorecard framework

3.2. Case study site

The subject of the case study was a printed circuit board electronics manufacturer in the northwestern USA. The organization is privately held and family owned. It has been in business for over 32 years. The current organization president is part owner and the son of the organization's founder. The organization employed 64 employees and had an organizational structure consisting of a president, an operations manager, a production floor supervisor and seven productions leads at the time of the study.

The skill level of most of the employees on the manufacturing floor was moderate, with many employees skilled in multiple tasks within their departments. Some of the employees were also trained in tasks in other departments and would perform duties in those departments when short-term labor was needed. The manufacturing floor was divided into functional departments, with a non-supervisory area lead in each department. The departments and the number of people in each department are shown in Table III.

The organization designed and manufactured products to meet customer needs, but also manufactured products based on customer specifications. At the time of data collection the organization manufactured over 1,800 different products with an approximate annual income of $6.5 million. The organization typically manufactured in varying batch sizes, resulting in large inventories of raw materials and finished products. The typical order size was 43 units. The organization averaged 210 orders per month. The organization had no minimum build order size and would build orders of one or two units when necessary.

Initial contact with the organization was made as part of a larger research project funded by the National Science Foundation (NSF) and administered by Toni Doolen, PhD of the Industrial and Manufacturing Engineering department at Oregon State University, USA. The NSF study investigated the link between specific lean practices and their outcomes.

Department	Primary function	Number of employees
Materials	Receive in all parts	
	Track part shortages	
	Assemble kits of raw parts for the floor	
	Prepare parts for the kits	
	Store and track finished goods	
	Ship all finished goods	6
Surface mount assembly (SMT)	Add components to boards with machines	
	Inspect boards	5
Hand assembly and quality assurance	Add components to boards by hand	
	Inspect boards	12
Cables	Make cable assemblies for use on boards	3
Mechanical Assembly 1 and wave	Assemble boards	
solder	Perform wave soldering function	3
Mechanical assembly 2	Secure components with chemical compounds	
	Wash boards	
	Perform additional assembly	6
Test	Test various board components	3

Table III. Manufacturing departments, functions, and size at the case study site

The implementation of lean manufacturing practices at the organization began in 2001. The operations manager led the efforts in the organization, with some assistance from the manufacturing engineer. Both the operations manager and the president expressed some skepticism when interviewed regarding the ability to successfully implement lean manufacturing in a small organization. The monetary benefits had not been made clear when compared to the costs required to undertake lean manufacturing projects. Though some doubt as to the ultimate success of lean manufacturing was voiced, both continued to invest time in reading about lean manufacturing concepts and in attending training.

Area leads were sent to a three-day training session on basic lean manufacturing concepts in early 2002. The leads were to disseminate information to other employees, but this did not occur uniformly. Some production employees had been exposed to lean manufacturing through previous employment. The lean manufacturing implementation was focused on the manufacturing floor at the time of data collection. Support functions such as engineering, purchasing, order entry and human resources did not participate in any of the lean manufacturing activities.

Practices implemented by the organization included a Kanban system for one customer, reorganization of individual work areas to improve information and material flow, and a Five S implementation. The kanban system had an impact on the ordering and management of materials, but the implementation of the Kanban was constrained by raw materials shortages. Initial efforts to improve information and material flow were initiated as part of a lean training workshop hosted by the organization. A variety of analyses and small changes were implemented as a result of this workshop. The Five S activity was introduced to employees in December 2002 through a two-page memo. Employees in each area were expected to work as a team in identifying unnecessary equipment, straightening and standardizing. Each team submitted a budget and was allowed to work without interference from management. The operations manager later inspected each of the work areas. Though this was a small step in the journey to utilizing lean manufacturing, it provided employees with an opportunity to work as a team and control some aspects of their work areas.

3.3. Phases of data collection and analysis

This study was divided into seven phases. Phases one through three involved data collection. Phases four and five concerned the transcription and sorting of the data. Phases six and seven involved the analysis process.

3.3.1. Phase one – structured interviews. Employees of the organization participated in structured interviews, unstructured interviews, and observations. Two interview instruments were developed for this research. The first interview instrument was developed for non-supervisory employees and focused on the details of the lean manufacturing implementation specific to the data source's area. The other interview instrument was developed for executive or managerial personnel who managed more than one area. Overall, 21.8 percent of the organization was interviewed using a structured interview instrument. The number of people interviewed and the corresponding percentage of the population for each employee category are summarized in Table IV.

3.3.2. Phase two – unstructured interviews and observations. During the second phase, observations and unstructured interviews were conducted on the manufacturing floor and in some support areas. An unstructured interview is more spontaneous than a structured interview and may be more conversational in tone (Patton, 1990). The researcher must be flexible and willing to follow multiple lines of inquiry (Patton). Multiple unstructured interviews were conducted at the case study site during the observations. In all circumstances, the unstructured interview took place as an informal conversation, with the researcher asking follow-up questions in response to statements made by the interviewees. This type of interview resulted in some irrelevant information, but also allowed evidence related to the variables of interest to emerge naturally.

Observations typically involve recording behaviors or conditions in an environment that are relevant to the research propositions (Yin, 1994). Understanding the complexities associated with an environment may best be attained through observation. Sometimes structured interviews may be biased by the emotional involvement of the interviewee with the topic. Observations permit the researcher to reach his or her own understanding. Observations also allow the researcher to collect data on routine activities that may never be discussed in structured or unstructured interviews. Observations, however, can also be biased. Data collected during observations may be limited by the researcher's judgment of what is important enough to record. The researcher's presence may also unintentionally affect the behavior or responses of the participants. People that know they are being observed may perform duties differently.

During observations conducted for this research, employees were informed that the general purpose of the study was to link lean manufacturing practices and organizational performance. The sociocultural variables studied in this research were not fully developed at the time of data collection at the case study site. As a result, the variables of interest were not disclosed to the participants. While this approach may have resulted in the loss of some information pertinent to this research, it also helped prevent inadvertent bias on the part of the researcher and the participants. Participants did not have the opportunity to consciously change their behavior or responses to specifically address the research questions investigated in this study.

In an effort to collect data in a uniform manner, a value stream map was used as the tool for summarizing the flow of product through each department. This tool served two purposes. First, the value stream map provided a focused reason for the observation. Second, it provided a system wide view of both information and product flow. Data collected during the value stream mapping process included manufacturing processes in each area, the technical tools needed, the placement of machines and support equipment, and the flow of data and paper through the department. The departments observed and the number of participants from each area are detailed in Table V.

Employee category	Number of employees	Percent of employees interviewed in category (%)
Executive	1	100
Managerial	3	100
Department leads	6	85.7
Production employees	4	12.9

Table IV. Interview statistics by employee category

Table V. Unstructured interviews and observations by department

Department	Number of employees	Percent of employees interviewed in department (%)
Materials	5	83.3
Surface mount assembly (SMT)	1	20.0
Hand assembly and quality assurance	3	25.0
Cables	2	66.7
Mechanical Assembly 1 and wave solder	2	66.7
Mechanical assembly 2	2	33.3
Test	2	66.7
Order entry	2	100
Production planning	1	100
Purchasing	3	100

In some departments (Surface Mount Technology, Hand Assembly, and Mechanical Assembly 2), English was not the first language of all employees. As a result, interviews were limited to those employees able to communicate effectively enough to participate in the study. Those employees with adequate communication skills as well as the leads in the departments were interviewed using both a structured interview and an unstructured interview. The researcher also spent a greater proportion of time observing in these departments. As the amount of data collected from these departments was not significantly less than data collected from departments where language was not a barrier, this limitation was not judged to have significantly impacted the study.

3.3.3. Phase three – document and organizational data collection. An overall organizational survey instrument was developed prior to the initiation of data collection. The survey was completed during an initial interview with the president and the operations manager of the case study organization. The topics covered in the overall organizational survey were divided into six categories: physical, production style, financial, customer/marketing, manufacturing personnel and internal operations. Table VI provides a sample of the items included on the survey.

3.3.4. Phase four and phase five – transcription and database development. After the initial data collection began, all field notes were transcribed using a word processor. Field notes will not usually reflect all of the content of the interview or observation.

Table VI. Sample of the data collected from the organizational survey

Physical average	*Production style*	*Financial*
Age of machinery	Production system	Average per unit cost
Square footage of buildings	Product variety	Revenue per full time employee
Number of managerial positions	Production volumes	Gross profit margin
	Skill level of production personnel	
Customer/marketing	*Manufacturing*	*Internal operations*
Average order completion time	Personnel Turnover rate	Number of suppliers
Average percentage of orders delivered on time	Average amount of initial training	Amount of inventory typically held
Average amount invested per year in marketing/sales	Compensation policies	Typical amount of work in progress

The transcribing process allowed for content to be added back to the notes as memory of events was stimulated (Miles and Huberman, 1994). Transcribing during the data collection phase also created opportunities for sources to verify data and for the researcher to obtain clarification.

The transcribed observations and interviews resulted in over 80 pages of electronic notes. As the amount of data to be analyzed was considerable and could not be expediently or accurately processed without the aid of a computer, a database was designed (Miles and Huberman, 1994). A database provides another advantage in that it allows other researchers the opportunity to inspect the data leading to the conclusions presented by the researcher (Yin, 1994).

3.3.5. Phase six and phase seven– data coding and analysis. Upon development of the research questions, a conceptual framework was developed to group the data into appropriate categories. Absolute rules do not exist for qualitative analysis. The primary goal of qualitative data analysis is to present the data fairly while communicating results from the data (Patton, 1990). The framework exhibited in Figure 1 displays the preliminary conceptual framework used for this study.

Using the framework as a guideline, the field notes were initially coded using the labels communication, management support, success, and failure. The data was entered into the database with codes corresponding to these four areas. Those sections of the field notes that provided only background information or did not apply to this study were not coded.

After entering the data into the database, a checklist matrix was generated and preliminary analysis occurred. A checklist matrix is a table display that lists the data associated with a variable (Miles and Huberman, 1994). The initial checklist matrix revealed that much of the data coded as management support provided background on management involvement in the lean manufacturing process, but did not indicate the impact, if any, of management support on the lean implementation. Likewise, the field notes coded, as communication did not indicate if the lean implementation had made any impact on communication within the organization.

As a result, a second coding scheme was developed to more accurately classify the data. The second coding scheme provided further definition for labeling successes and failures in terms of the balanced scorecard categories. A third code was added to assess the role of management support in the success or failure. Those notes coded as communication were also given a second code to assess the impact of the lean implementation on communication. The final coding scheme is summarized in Table VII.

The evolving coding scheme is consistent with grounded theory analysis as linkages are questioned and subcategories are identified (Eaves, 2001; Strauss and Corbin, 1990). Though both propositions were broadly developed before data analysis occurred, the evidence yielded patterns and implications not originally envisioned. This is characteristic of qualitative research and grounded theory as the theory is allowed to emerge (Eaves, 2001). Some could argue that the data was forced to fit the

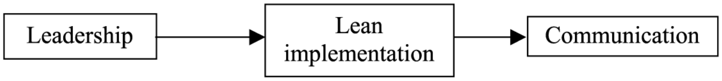

Figure 1.
Conceptual framework used for coding field notes and analysis

Table VII.
Final coding scheme

Initial code	Second code	Third code
Communication	Positive evidence, attributable to the implementation Positive evidence, but not attributable to lean manufacturing implementation Communication difficulties noted despite the implementation Communication deteriorated due to lean manufacturing implementation Communication deteriorated, but not due to lean manufacturing implementation	NA
Success, failure	Customer needs Customer satisfaction Employee attitude Employee skills noted Processes streamlined, waste eliminated Lean manufacturing concepts adopted	Management support played a direct role in the success or failure Management support did not play a role in the success or failure

research propositions (Eaves, 2001). For this research, the evolving coding scheme reiterated the flexibility of the methodology and its encouragement of the emergence of relationships not previously highlighted. After patterns emerged, interpretation of the patterns could occur. Both the negative and the positive evidence revealed by the data as well as the interpretation of the evidence are presented in the next section.

4. Results and discussion

The analysis of the coded field notes yielded interesting results. Evidence was found of management support both negatively and positively impacting the lean manufacturing implementation. Likewise, evidence was found of the lean implementation making a positive and negative impact on communication within the organization.

4.1. Management support

The number of failures attributable to management support was small, but provided interesting insight into the role of management support in the lean manufacturing implementation. Table VIII provides a summary of failures attributable to management support.

The evidence from the employee attitude category illustrated the frustration experienced by some of the employees regarding the changes within the work area. Employees did not understand why the organization was starting a lean manufacturing initiative. The evidence from the employee skills category and the processes streamlined category highlighted the amount of time the employees were allotted to complete activities associated with the lean manufacturing implementation. The employees felt the time pressure did not allow them to develop the skills necessary to continue the lean manufacturing initiative.

The evidence from the adoption of lean concepts category involved an operator who felt that management did not provide enough help implementing changes within the work area. The other piece of evidence from this category involved lack of participation

Balanced scorecard category	Number of pieces of evidence/sources	Sample evidence
Customer needs	0	NA
Customer satisfaction	0	NA
Employee attitude	4/3	Operator does not agree with the direction leadership is taking the lean effort
Employee skills	1/1	The cycle count was targeted when they had training by an outside facilitator. If they had more time as a group with the teacher from the class they could have done more
Processes streamlined, waste removed	2/2	Management previously was not receptive to giving them time to clean up their area. Time is a resource they (the department) just recently acquired
Lean concepts adopted	2/2	They (the personnel within the department) are trying to make it a go, but things are not put into place as they planned it. They have a good understanding of what they need

Note: Annotations provided by the researcher for clarification are shown in parentheses

Table VIII. Summary of lean manufacturing failures related to management support

in one of the work areas stemming from management's decision not to force employee participation in the activities associated with the lean manufacturing initiative.

The failures attributable to management support shared some common characteristics. First, executive management must provide employees with more information on the lean manufacturing initiative and why it is needed. Second, executive management must provide employees with resources such as time and materials to allow the employees to successfully participate in the lean manufacturing effort. If employees make plans for changes but do not see results, disillusionment may occur and future lean manufacturing activities may not be supported (Abrahamson, 2004; Alavi, 2003; Boyer and Sovilla, 2003; Kotter, 1995; Parks, 2002). Finally, the executive management team must create an implementation plan that includes all members of the organization to reduce friction among team members and to create an organization that is moving together towards a common goal.

Those portions of the field notes coded as successes provided evidence for all three categories of the balanced scorecard. The successes attributable to management support are summarized in Table IX.

Lean manufacturing activities were initially implemented at a customer's request. The customer wanted to achieve just-in-time deliveries and required cooperation from its suppliers. Some gains in product delivery time were achieved as a result of the lean manufacturing implementation. In the category of adoption of lean concepts, evidence of specific lean practices such as Five S, kanban, and color-coding were found. The management team led the lean practices that were cited.

While some success was achieved at the customer level, more success was realized from the employee perspective. Though the executive management team did not initially set out to implement lean manufacturing to create better relationships with employees on the manufacturing floor, strong evidence suggests this did occur. Employees expressed more positive feelings towards management. Many of the

Balanced scorecard category	Number of pieces of evidence/sources	Sample evidence
Customer needs	4/3	A large part of the lean effort is customer driven
Customer satisfaction	2/2	On time delivery has significantly improved in one case
Employee attitude	8/5	It is nice to get the employees on the floor involved. Employee morale seems better people seem excited about what they are doing
Employee skills	0	NA
Processes streamlined, waste removed	1/1	The Kanban system is working well. They never come up short on the parts that are kanbanned. (The operations manager led the Kanban effort. A line operator made the comment)
Lean concepts adopted	5/5	Some of the parts are on the Kanban system. Management gave them more shelf space, and the other areas cleaned out the stuff they had stored in their area so they have more room now (during the Five S activity)

Note: Annotations provided by the researcher for clarification are shown in parentheses

Table IX. Summary of successes linked to management support

employees also expressed satisfaction with the lean manufacturing implementation, which may aid the organization as it continues to introduce lean practices (Alavi, 2003; Boyer and Sovilla, 2003; Parks, 2002).

4.2. Communication

The field notes contained numerous examples of communication. Table X provides a summary of the field notes coded as communication that could be directly linked to the lean manufacturing implementation.

The evidence of the lean manufacturing implementation making a positive impact on communication primarily involved communication lines with management. Two of the line operators felt communication with management had improved since the initiative. A member of the management team also identified improvements in communication within the organization since the lean manufacturing implementation.

Examples of poor communication despite the initiative were more prevalent. One source identified deterioration in communication between departments with the implementation of lean manufacturing, but this example was not corroborated by other sources. A large proportion of the evidence of poor communication shared common features that fostered further analysis and categorization of the field notes. Six categories were identified based on previous research (Ahls, 2001; Alavi, 2003; Emiliani, 2000; Hancock and Zayko, 1998; Jenner, 1998; Spear and Bowen, 1999; Storch and Lim, 1999). Table XI summarizes the evidence of poor communication.

The lean manufacturing implementation was still in the early stages at the time of data collection. None of the lean activities at that time had involved working with other departments. The majority of evidence of poor communication (64.6 percent) involved communications between departments or communication necessary to facilitate material flow through the factory. As the lean manufacturing initiative continues to

Type of effect	Number of pieces of evidence/sources	Sample evidence
Positive evidence attributable to implementation	5/4	Communication has also improved Can talk to anyone about anything that is going to improve things (comment made by line operator)
Positive evidence not attributable to implementation	1/1	Everyone in the group knows it is an open forum
Communication difficulties despite implementation	48/16	There are no performance measures readily available to people at the operator level. No cost savings information is fed back to line employees. If the company wants to drive lean manufacturing it should have meetings devoted to it and talk about plans and timelines. Management may have these, but they are not communicated to the manufacturing floor level
Deterioration due to implementation	1/1	If the area had an order for something before lean, the other departments would send an e-mail. Now they (the other departments) have to go through the paperwork and wait to pull it. Now, instead of a few minutes, it takes a few days. They (the other departments) can't rush it

Note: Annotations provided by the researcher for clarification are shown in parentheses

Table X. Impact of the lean manufacturing Implementation on communication

Category	Number of pieces of evidence/sources	Category (%)
Lack of communication of performance measures	2/2	4.2
Lack of feedback loops	2/2	4.2
Lack of information about lean implementation	9/7	18.8
Lack of communication within the department	4/3	8.3
Lack of communication with other departments	9/4	18.8
Lack of clear communication for facilitating material flow	22/11	45.8

Table XI. Summary of evidence of poor communication despite lean implementation

progress, it is possible that many of the negative issues associated with communication between the departments will improve (Jenner, 1998; Spear and Bowen, 1999).

There was also strong evidence that dissemination of information to all employees about lean manufacturing did not occur. The executive management team and the area leads appeared to understand the concept of lean manufacturing, but the employees did not receive sufficient information. Though some employees identified communications with management as improved, most still did not see communication as a two-way channel. Specifically, three of the line operators did not feel as though management provided opportunities for feedback about the lean manufacturing implementation.

The field notes provided some evidence that communication in the organization had improved, but a great deal of improvement is still possible. The organization must focus on increasing communication between departments, especially as it pertains to the flow of materials through the factory. Communication is recognized as a vital part of lean manufacturing (Jenner, 1998; Spear and Bowen, 1999; Womack *et al.*, 1990). As the organization continues its lean manufacturing initiative, it is important that improving communication becomes a goal to maintain momentum.

4.3. Research validity

Four tests (construct validity, internal validity, external validity, and reliability) are used to validate empirical research (Yin, 1994). Internal validity is usually associated with explanatory or causal case studies. Reliability involves documenting the methodology thoroughly enough to allow another researcher to duplicate the conclusions of the first researcher at a similar case study site. For this research, as it was exploratory in nature, construct validity and external validity were considered particularly important when addressing the question of validity.

Construct validity involves linking the types of changes studied with specific measurements that reflect the changes (Yin, 1994). Using multiple sources of evidence, creating a chain of evidence, and asking sources to review the case study results for accuracy may increase construct validity. For this research, multiple pieces of evidence and multiple sources were used. The number of sources was reported with the number of pieces of evidence to allow the reader to judge the uniqueness of the data. The field notes were linked in the database with pertinent background information as well as the data type (observation, structured interview, unstructured interview). Each variable was also operationalized and linked to possible outcomes in the coding framework.

External validity involves the generalizability of the research (Yin, 1994). It defines how the findings of the research can be applied to other case study sites. Increasing external validity requires the replication of results at multiple case study sites. Because this research was exploratory in nature, only one case study site was involved. The results presented in this research are not generalizable to other organizations, but do provide strong justification for future research to further investigate the link between a lean manufacturing implementation and management support and communication.

5. Conclusion

Though this was an exploratory study of a single case study site, the evidence does support the proposition that management support plays a strong role in a lean manufacturing implementation. Most of the evidence related to the negative impact of management support involved the deployment process. Problems occurred because the management team did not require participation in the lean manufacturing initiative, creating a rift in one of the teams. Management also failed to provide a consistent education effort accessible to all employees in the organization.

The positive impact of management support on the lean manufacturing implementation was evident as well. The dedication of the executive management team was apparent to employees on the manufacturing floor. This dedication created more positive feelings towards management. The direct role of the executive team in leading the implementation of the new lean practices such as the kanban and the Five S activity also reinforced the importance of the new initiative and aided in opening communication lines with employees on the factory floor.

Increased communication with employees on the factory floor was a positive outcome of the lean manufacturing initiative, but many examples of poor communication were also collected. Most of the evidence of poor communication involved communication between departments. This is not unexpected as the lean manufacturing implementation was still very new and little focus had been placed on working as an organizational unit with a common goal. Some of the evidence of poor communication could also be attributed to failings in management support, illustrating the interconnectedness of the sociocultural variables studied.

Sufficient evidence was found to justify the call for further research to collect more evidence, both supporting and contradictory, to further study the relationships between management support, communication, and a lean manufacturing implementation. A follow-on study should involve multiple case study sites with collection of data occurring both before the lean manufacturing implementation and after the implementation was underway. Such an approach will strengthen the causal links between the variables and the lean manufacturing implementation and potentially expand the understanding of these links. To increase generalizability, the research methodology should be applied across a variety of organizations. Results from such a cross case study analysis would have far reaching implications for a variety of industries wishing to implement lean manufacturing.

Many organizations are attempting to implement lean manufacturing programs. Unfortunately, managers may fail to recognize that multiple variables contribute to a lean manufacturing success or failure. Executive management also may fail to understand how the lean manufacturing implementation can impact aspects of the organization, such as communication. Too often, lean manufacturing is thought of as a set of tools that can be implemented anywhere at anytime (Allen, 2000; Alavi, 2003; Bamber and Dale, 2000). Transforming an organization to a lean enterprise is a dynamic process, unique to each organization. The journey to create a lean enterprise is often difficult, but provides many benefits, both financial and non-tangible. This research has provided empirical validation for a complex set of relationships between management support, communication, and the overall performance of an organization engaged in a lean transformation effort.

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