The Impact of Leadership on Systematic Organizational Change

by

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Submitted to the System Design and Management Program in Partial Fulfillment of the Requirements for the Degree of

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ABSTRACT

The United States Aerospace Industry over the past decade has undergone a steady transformation from traditional "Mass" production organizations to adopting the principles and practices of "Lean". Due to changes in markets, customers, competition and technology, many organizations within the U.S. Aerospace Industry have begun to implement lean principles and practices. However, the transformation of an enterprise based on traditional mass production to lean principles and practices requires a major comprehensive change in behavior throughout the organization. A change initiative of this size and scale must be led from the "top" of the organization, specifically the Chief Executive Officer (CEO) and senior management.

The research presented is guided by an overarching hypothesis: there is a positive correlation between "top" level management leadership and the successful outcomes of a "lean" change initiative. For the analysis, a model is created to quantify and correlate leadership attributes against productivity outcome metrics for specific lean change initiatives. The data used to calculate the leadership and productivity values were collected through the utility of a survey questionnaire sent out to a random sample of professionals representing both Aerospace and Non-Aerospace organizations.

The thesis analyzes five different case scenarios. Each scenario uses statistical and regression analysis to identify any particular trends of leadership attributes and productivity outcomes that may exist. Conclusions are formed based on the data analysis.

The first scenario analyzes the overall survey sample data. The second scenario analyzes the Aerospace vs the Non-Aerospace organizations. The third scenario analyzes various functional roles within an organization (i.e., CEO/Executive/Sr. Management vs Middle Management vs Sr. Technical Staff/Technical Workforce). The fourth scenario analyzes "Top Down" vs "Bottom Up" evolution of the lean change initiative. The fifth scenario analyzes Textron System's Division in Wilmington, Massachusetts as a case study.

In all scenarios, the research supported the same conclusion; there is a positive correlation between leadership and productivity outcomes within the survey sample. Therefore, the hypothesis fails to be rejected.

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Chapter One - Introduction and Statement of the Problem

1.0 Introduction

1.1 Statement of the Problem

Do successful outcomes that are associated with a "Lean" change initiative positively correlate with the level of "Top" management leadership and commitment driving the change?

1.2 Lean and the U.S. Aerospace Industry

The United States Aerospace Industry over the past decade has undergone a steady transformation from traditional "Mass" production organizations to adopting the principles and practices of "Lean". Due to changes in markets, customers, competition and technology, many organizations within the U.S. Aerospace Industry have begun to implement lean principles and practices to do one or more of the following: clarify their values; develop new strategies; and, learn new ways of operating their enterprises. However, the transformation of an enterprise based on traditional mass production to lean principles and practices requires a major comprehensive change in behavior throughout the organization. A large-scale organizational change such as this will affect each and every person and position within the company.

1.3 Importance of "Top" level leadership in Organizational Change

A change initiative of this size and scale must be led from the "top" of the organization, specifically the Chief Executive Officer (CEO) and senior management. "The success of the transformation effort will depend strongly upon the personal involvement, understanding, and leadership of top management within the organization." (Mize, Joe. "MIT-Working Paper – Executive Overview of Lean Thinking and Knowledge", June, 1999.)

Art Byrne, President and CEO of Wiremold Company (a firm that has made the transition to lean) makes the following statements:

> "...the single most effective action in converting an organization to lean practices is for the CEO to lead the initial improvement activities himself"

> "...big changes require leaps of faith in which the CEO must say 'Just-do-it', even when 'it' seems contrary to common sense."

Mike Rother, reporting on several lean transition efforts in the book *Becoming Lean*, edited by Jeffery Liker, (Oregon: Productivity Press, 1998) concludes that "the notion that you can drive change to lean from the bottom is 'pure bunk'." (Liker, 1998)

Not only is CEO commitment necessary and essential to leading change successfully, the role of senior management is also critical to continue to nurture and make visible the benefits of lean to the organization. Ultimately, the successful implementation of lean within an enterprise will sustain a positive reinforcing cycle of continuous improvement. Thomas M. Hout and John C. Carter, reporting in the Harvard Business Review article "Getting It Done: New Roles for Senior Executives", November/December, 1995 suggest the following:

> "...Today's CEO's operate differently from executives in the past. The CEO as a hero no longer exists. Given the complexities of modern business competition, no single individual or even the top two or three people – can do all it takes to achieve success for a company. Success depends on the willingness and ability of the entire senior executive group to address not just their individual functional or divisional responsibilities but also their collective responsibility for the company as a whole." (Hout & Carter, "Getting it Done: New Roles for Senior Executives" Boston: HBR, November/December, 1995 p. 39)

According to David A. Nadler and Mark B. Nadler, *Champions of Change: How CEO's and Their Companies Are Mastering the Skills of Radical Change.* (San Francisco: Jossey-Bass Publishers, 1998 page 269):

> "...there is no substitute for an active, personally committed CEO who is willing to do the critical things that only a CEO can do during periods of change. Every successful change leader will tell you the same thing. 'You can't subcontract it out,' says PepsiCo's Craig Weatherup (Nadler, Shaw, Walton and Associates, 1994, p. 264). The chief executive simply cannot delegate the leadership of change."

1.4 Research Objective

This thesis is guided by the overarching hypothesis: There is a positive correlation between "top" level management leadership and the successful outcomes of a "lean" change initiative. For the analysis, a model was created to quantify and correlate leadership attributes against productivity outcome metrics for specific lean change initiatives. The data used to calculate the leadership and productivity values were collected through the utility of a survey questionnaire sent out to a random sample of employees of aerospace and non-aerospace organizations.

1.5 Thesis Structure

This thesis is comprised of seven chapters. Chapter 1 is the Introduction. Chapter 2 introduces the leadership theory that was adopted and used throughout the study. The leadership theory was created by Burt Nanus in his book *Visionary Leadership: Creating a Compelling Sense of Direction for Your Organization*, (San Francisco: Jossey-Bass publishers, 1992).

Chapter 3 introduces the productivity outcome theories that were adopted and used throughout this thesis. A combination of two literary sources were used: the first, Dave Ulrich, et. al., *Results-Based Leadership: How Leaders Build the Business and Improve the Bottom Line*, (Boston: Harvard Business School Press, 1999); and the second, Kaplan Robert S., and David P. Norton, *The Balanced Scorecard*, (Boston: Harvard Business School Press, 1996).

Chapter 4 introduces the reader to the central hypothesis used as the basis for this research study. Key questions and a proposed correlation model are outlined in this chapter that will link the existing theories to either rejecting or failing to reject the proposed hypothesis.

Chapter 5 describes the research design, and methods and materials used throughout the thesis including: the development of the survey instrument, its sample population, and the data and instrumentation used to collect and analyze the research data.

Chapter 6 provides the analysis and discussion of the survey data. The survey data is presented in six sections. Section 6.1 details the results of the overall survey sample. Section 6.2 provides the author's interpretation of the survey results. The next three sections (6.3 to 6.5) provide the results of three specific scenarios: 1) Aerospace versus Non-Aerospace organizations; 2) CEO/Executive/Senior Management versus Middle Management versus and Senior Technical Staff/Technical Workforce; and, 3) "Top Down" versus "Bottom Up" evolution of the change initiative. The last section 6.6 presents Textron System's Division (Wilmington, Massachusetts) as a case study.

Chapter 7 provides the conclusions to the research project. Validation of all hypotheses, research questions and specific findings are presented in this section.

This thesis intends to provide the reader with a leadership/productivity correlation model that may be useful as a tool capable of benchmarking, assessing and/or improving leadership capabilities within his/her organization.

Chapter Two – Leadership

2.0 Leadership

2.1 Visionary Leadership

Top management's visionary leadership is essential in the development and implementation of a change initiative. Most large-scale organizational change initiatives require a significantly different method of operations that affects each and every employee.

The driving theory that is used throughout this thesis is adopted from Nanus' *Visionary Leadership*, 1992. Nanus explains that the formula for successful visionary leadership is based on the following concept:

> "...There is no single thing a person can do to lead an organization through a change initiative. Communication alone will not do it, no matter how eloquent or persuasive the leader is. Organizational changes alone will not do it, no matter how appropriate they may be or how great an impact they have on the organization. Effective individual participation or teamwork alone will not do it either, no matter how competent or well supported. It is essential to have a formula that synthesizes all of these together."

Nanus' theory is represented in equation's 1 and 2 below.

Leadership Formula (Nanus, 1992 p.156)

Vision + Communication = Shared Purpose **equation 1**

Shared Purpose + Empowered People + Appropriate Organizational Changes + Strategic Thinking = Successful Visionary Leadership **equation 2**

2.2 Other Current Leading Change Theories

There are many theories and methodologies in the literature that detail how management can lead change initiatives. However, there are two other theories found in the literature that arguably can be relevant to this thesis.

In John Kotter's book on *What Leaders Really Do*, (Boston: Harvard Business School Press, 1999) he describes the leadership model for change including the following variables. *Setting the direction*: developing a vision for the future along with strategies for producing the changes needed to achieve that vision. *Aligning people*: communicating the new direction to those who can create coalitions that understand the vision and are committed to its achievement.

Motivating and inspiring: keeping people moving in the right direction, by appealing to basic but often untapped human needs, values, and emotions.

Scott Buckhout, et. al., "Making ERP Succeed: Turning Fear into Promise", *IEEE Engineering Management Review*, fall 1999, describes the importance of CEO leadership in the success of an Enterprise Resource Planning system implementation. "The chief executive should get involved in three ways: by *clearly outlining the organization's strategic priorities*; by *involving the organization at the appropriate level*, and *linking management controls and incentives to project success*."

Nanus's theory is more comprehensive and robust in structure than those exposed by Kotter and Buckhout, as such it addresses the multi-faceted complexities of implementing change throughout an organization. With this in mind, Nanus' leadership theory (equations 1 and 2) is further broken down into the following independent variables.

2.3 Shared Purpose

Recall from equation 1 (above) that the formula for Shared Purpose is equal to the sum of Vision plus Communication.

> "A vision is little more than an empty dream until it is widely shared and accepted. Only then does it acquire the force necessary to change an organization and move it in the intended direction." (Nanus, 1992, p.134)

> "The way in which a leader describes the future purpose of his or her organization is, in essence, the vision." Jay A. Conger, "Inspiring Others: The Language of Leadership," *Academy of Management Executive*, 1991 Vol. 5.

A shared purpose is the combination of vision and communication to the organization. In order to get organizational commitment to the vision; the leader must communicate to each employee in such a way that will enhance participation. It is essential that each person in the organization feel that they are partners with the enterprise, matching the terms of the vision to their own concerns and interests.

Kouzes J.M., and Posner, B.Z., *The Leadership Challenge: How to get Extraordinary Things Done in Organizations*. (San Francisco: Jossey-Bass, 1987, p. 115) write the following analogy: "Leaders find that common thread that weaves together the fabric of human needs into a colorful tapestry. They seek out the brewing consensus among those they would lead. In order to do this, they develop a deep understanding of the collective yearnings. They listen carefully for quiet whispering in dark corners. They attend to subtle cues. They sniff the air to get the scent. They watch faces. They get a sense of what people want, what they value, what they dream about."

Leaders must create the vision based on the knowledge of the values already alive within the organization and combine the new vision with the existing mental framework of each

stakeholder involved. Conger in his publication, *The Leadership Challenge,* (1991) explains: "To create a meaningful frame for an organizational mission or vision, values and beliefs are an essential component – especially those that reinforce commitment and provide guidance for daily actions. Their selection is crucial since they are the mechanical guts that power the vision's acceptance and accomplishment." Leaders accomplish this task best through communication.

Leaders can communicate the vision using numerous types of media. Without communication, the vision has a very high probability of failure. Leaders use the following types of media to convey their vision to the organization: simple dialogue, memoranda, public speaking, letters or pamphlets, posters, bulletin boards, video tape presentations, and, email & the internet.

2.4 Empowered People

Nanus explains: "...the theme for leadership in the 1990's has been empowerment. The vision is the beacon, the sense of destination shared by the people who care most about the organization's future. Once people buy into the vision, they possess the authority, that is, they are empowered, to take actions that advance the vision, knowing that such actions will be highly valued and considered legitimate and productive by all those who share the dream." (Page 18) Total employee empowerment can be described as the following: Information on "key" business issues is available to all employees, and decisions are made at the lowest appropriate levels within the organization.

2.5 Appropriate Organizational Changes

The organizational environment consists of the strategy, structures, systems and corporate culture that collectively dictates how the organization will function. The visionary leader must overcome the resistance to change and adapt the organization's environment to the vision's terms and goals. It is important that the visionary leader matches the organization's functional and cultural objectives to that of the vision.

> Christopher Bartlett and Sumantra Ghoshal in their publication "Changing the Role of Top Management: Beyond Strategy to Purpose," *Harvard Business Review,* 1994, p.4 suggest the following method that top management can utilize to help foster an organization adaptable to change. "...First they place less emphasis on following a clear strategic plan than on building a rich, engaging corporate purpose. Next, they focus less on formal structural design and more on effective management processes. Finally, they are less concerned with controlling employee's behavior than with developing their capabilities and broadening their perspectives. In sum, they have moved beyond the old doctrine of strategy, structure and systems to a softer, more organic model built on the development of purpose, process and people."

2.6 Strategic Thinking

Nanus (p. 142) suggests the following: "Knowing where the organization should be headed is one thing; developing a strategy for getting there is quite another."

One important decision that the visionary leader must determine early is whether to pursue his or her vision alone or to seek strategic alliances to help with the implementation. Nanus explains (p. 142): "...Even giant IBM, with all its resources and innovative capacity, has found it necessary to build strategic alliances with other strong domestic and foreign firms to retain and build its competitive position."

Another important decision for the leader is to make clear the vision's goals and objectives, that is, specific goals to be accomplished and when. Nanus explains (p. 143) "...In larger organizations, it is the leader's job to see that the goals and objectives are established by others, perhaps reserving approval authority to verify their consistency with the vision. In some of the best-managed companies, the responsibility for setting goals and objectives is widely dispersed, sometimes reaching right down to the workers on the production line."

The leader must also consider making strategic investment decisions that include committing resources to new facilities, locations and equipment as needed to help accomplish the vision. The leader must also verify that there is a sufficient capital base to implement the vision. Physical capital is the most obvious: the sum total of the cash, facilities, equipment and tools, and other hard assets that will be needed in the implementation of the vision.

Building the organization's human capital is the last major strategy the leader must consider strategically to accomplish the vision. Human capital consists of all of the skills, experience, technical 'know-how', and capabilities of the employees in the organization. The leader has the ability to build on the human capital through decisions based on hiring, staffing and training.

Establishing strategic alliances, clear goals and objectives, and allocating both physical and human capital, the visionary leader will have built the necessary framework to host the organizational changes needed to accomplish the vision.

To be successful at visionary leadership, each element or variable (Shared Purpose, Empowered People, Appropriate Organizational Changes, and Strategic Thinking) must be optimized according to each organizations competencies or capabilities.

Chapter Three – Productivity Outcomes

3.0 Productivity

Productivity is a common measure of how well an organization is using its resources. In its broadest sense, productivity is defined as Outputs/Inputs. The productivity outcomes used throughout this thesis are a balanced combination of External and Internal measures. The productivity measures will help quantify the 'success' of a change initiative.

The driving theory used to determine the success of the change initiative is adopted from Dave Ulrich, Jack Zenger and Norm Smallwood. *Results Based Leadership: How Leaders Build the Business and Improve the Bottom Line,* (Boston: Harvard Business School Press, 1999).

> Ulrich (1999), et al., suggest: "Leaders who aren't getting results aren't truly leading. Or, more specifically, leaders who aren't getting desired results aren't truly leading."

Robert Kaplan and David Norton, *The Balanced Scorecard,* (Boston: HBR Press, 1996), suggest the following: "The Balanced Scorecard provides executives with a comprehensive framework that translates a company's vision and strategy into a coherent set of performance measures." (p. 24) "The Balanced Scorecard translates mission and strategy into objectives and measures, organized into four different perspectives: financial, customer, internal business process, and learning and growth."

For the purposes of this thesis, two perspectives were examined: External or Customer Value and Internal or Business Process Value as identified in equations 3 and 4 below.

Productivity Outcomes Formula (Ulrich, et al., (1999) and (Kaplan & Norton, 1996)

External Value	=	Customer Satisfaction + Schedule/Delivery performance + Quality of Product or Service.	**equation 3**
Internal Value	=	Resource Utilization + Return on Assets + Cycle Time	**equation 4**

3.1 External Value

3.1.1 Customer Satisfaction

Customer satisfaction can be defined as the satisfaction level of each customer interacting with the organization. Customer satisfaction measures can provide feedback on how well the

company is doing. It is arguably the most important of all output metrics. Kaplan and Norton explain the following:

> "Recent research has indicated that just scoring adequately on customer satisfaction is not sufficient for achieving high degrees of loyalty, retention, and profitability. Only when customers rate their buying experience as completely or extremely satisfied can a company count on their repeat behavior."[1]

The most common technique to solicit feedback from an organization's customer base and measure customer satisfaction is through the utility of a survey. Mail surveys, telephone interviews and personal interviews are the three most effective techniques used.

> Ulrich, et al., describe the following: "Leaders obtain customer results and build firm equity, first, by understanding and making sure employees understand why customers buy products or services and, second, by ensuring that customers have experiences consistent with their intent." (p. 118)

In order to do this each employee must understand each customer's buying patterns as well as continuously improve upon the already existing policies within the organization that deliver what the customer values. Firm equity evolves from maintaining a vision of the firm's exclusive culture in the minds of its primary customers.

Customer satisfaction is a measure of success to the organization and can be linked to revenue enhancement in some cases. In Stanley A. Brown's, *What Customers Value Most*, (New York: John Wiley & Sons, 1995 p. 6) a Customer Satisfaction/Revenue Enhancement model is created and summarized below in Figure 1. The model illustrates that revenue enhancement and improved profitability are the by-products of external customer satisfaction. It is intuitive to realize that satisfied customers lead to increased revenue or revenue enhancement. In addition, improved customer satisfaction can lead to even greater profitability in ways most organizations do not yet appreciate.

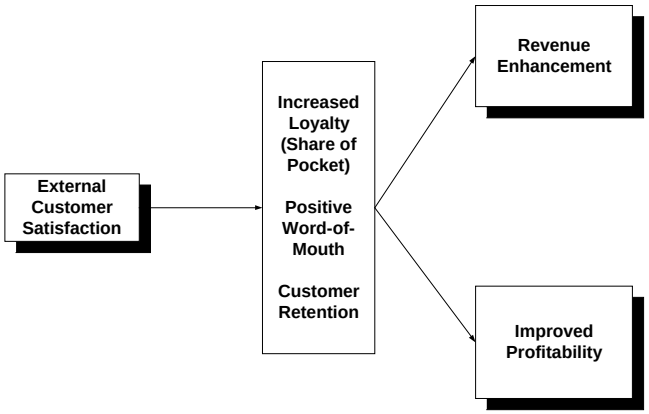


Figure 1. Customer Satisfaction/Revenue Enhancement Model (Source: Brown, 1995)

[1] T.O. Jones and W.E. Sasser, "Why Satisfied Customers Defect," *Harvard Business Review* (November-December 1995): 88-99.

3.1.2 Schedule/Delivery Performance

Another external measure of success is the schedule/delivery performance or on-time delivery (OTD) of a product or service. OTD can be defined exactly as it is written; customers receive the product or service ordered on the date promised. OTD works in conjunction with the customer satisfaction measure, specifically customer loyalty and retention (which is described above).

> Kaplan & Norton suggest "...Analysis of customer preferences may reveal that on-time delivery of orders is highly valued by customers. Thus, improved OTD is expected to lead to higher customer loyalty, which, in turn, is expected to lead to higher financial performance." (p. 30)

3.1.3 Quality of Product or Service

The quality of product or service can be measured by incidence of defects or part-per-million defect rate as measured by customers. The measurement of quality must include the customer's perception and changes in perception - of what they believe to be quality. Quality not only means quality of technology, it must also include quality to the customer in product service and reliability.

There are also other measures of quality including: customer returns, warranty claims, and, field service requests. For products, the assurance of quality to the customer is provided through the utility of returns or repair warrantees. For services, the assurance of quality is provided through the utility of a service warrantee. Both types of guarantees create a 'win-win' scenario for both the customer and organization. For example, a guarantee would allow the organization to retain its customer who without it would most likely be lost forever. Second, the organization receives information and record of the defect(s). Lastly, the guarantees will provide strong motivation to the organization's customer service people to avoid defects that would cause the need for a warrantee claim.

3.2 Internal Value

3.2.1 Resource Utilization

An organization's resources supply the infrastructure for accomplishing work. Resources are defined as the following: Physical capital - including information systems, specialized equipment, distribution facilities, and other buildings and physical facilities; Labor – in the form of human capital; and, Materials. Resource utilization is defined as the application of these in the manufacturing of a product or service.

3.2.2 Return on Assets

Return on assets is a basic measure of the efficiency with which a company allocates and manages its resources. It is a measure of the productivity of assets. It is different from Return

on Equity (ROE) in that it measures profit as a percentage of the money provided by owners and creditors as opposed to only the money provided by owners.

3.2.3 Cycle Time

Cycle time is the total lifecycle time of a product or process from accepting the order to delivery to customer. Cycle time is a measure of efficiency. Arguably, cycle time can be described as an indirect measure of both Return-on-Assets as well as Resource Utilization. For example, a longer than normal product cycle time may indicate a lower ROA and inefficient Resource Utilization and vice versa. Of all of the productivity measures outlined above, changes in cycle time tend to be recognized more easily throughout the organization, since each person can directly relate themselves to the organization's product or process in some respect.

3.3 Contribution to Current Theories

Chapter's Two and Three identify the previous theories and existing knowledge in the literature on the topics of Visionary Leadership and Productivity. To date, there is not any literature that analyzes the impact of "Top" management leadership on the success of a "lean" change initiative. The objective of this thesis intends to build upon the aforementioned current theories through gathering additional research. It is anticipated that research results uncovered through this thesis will conclude that the level of "Top" management leadership has an impact on the success of a lean change initiative.

Chapter Four – Hypothesis, Key Questions and Proposed Model

4.0 Hypothesis, Key Questions and Proposed Model

4.1 Hypothesis

This thesis is guided by a central hypothesis suggesting that research can prove that there is a positive correlation between "Top" management leadership and the success of a lean change initiative. Quantitatively, equation 5 below outlines the hypothesis.

h_1 = Pearson product-moment correlation coefficient (r) **equation 5**
is a positive numeric value.

4.2 Key Questions

4.2.1 How do you measure "Top" management involvement or leadership in a lean change initiative?

The level of "Top" management leadership in a lean change initiative will be quantified by using Burt Nanus's Visionary Leadership formula and assigning weights to each of the variables within the equation as identified in equation 6 below. The data used for each of the variables represented in equation 6 was gathered using a survey instrument.

Visionary Leadership Formula (f(x)) **equation 6**

f(x) = [(w)(Shared Purpose) + (w)(Empowerment)
+ (w)(Appropriate Organizational Changes) + (w)(Strategic Thinking)]

Where:
(w) = weight factor
Shared Purpose = Vision + Communication

4.2.2 How do you measure the success of a lean change initiative?

The success of a lean change initiative will be quantified through the use of Ulrich, et al., 1999, Productivity Outcomes theory with weights assigned to each of the variables within the equation as identified in equation 7 below. The data used for each of the variables represented in equation 7 were collected using a survey instrument.

Productivity Outcomes Formula (f(y)) **equation 7**

f(y) = [(w)(External Outcomes) + (w)(Internal Outcomes)]

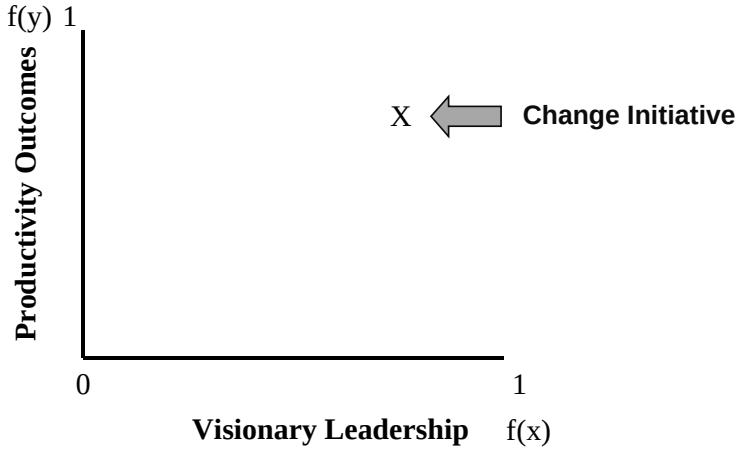
Where:
(w) = weight factor
External Outcomes = Customer Satisfaction + Schedule/Delivery Performance + Quality of Product or Service
Internal Outcomes = Resource Utilization + Return on Assets + Cycle Time

4.3 Proposed Correlation Model

4.3.1 Can the research results be modeled to show a correlation between strong visionary executive leadership and the lean initiative's relative success?

A correlation model is created based on equations 6 and 7 mentioned above. The proposed model will include two weighted functions f(x) and f(y) graphed accordingly. Each function represents an index with a numerical range between (0 – 1). A weighted calculation of Productivity Outcomes vs Visionary Leadership will be determined for each different change initiative evaluated through the data collection process or survey. One advantage of this model is that the functions (x and y) can be customized for each user by changing the weights on the variables to match whatever scenario the user wants. For example, if the user evaluates his/her own change initiative and finds that the core competency of the organization is heavily weighted on a certain variable then that can be accommodated for in the analysis. For the purposes of this thesis, all variables in both the leadership and productivity indices are equally weighted. Figure 2 below illustrates a graphical representation of the proposed correlation model.

Proposed Correlation Model



f(x) = [(w)shared purpose + (w)empowerment + (w)appropriate organizational changes + (w)srategic thinking]

f(y) = [(w)External outcomes + (w)Internal outcomes]

Figure 2. The proposed correlation model of Productivity Outcomes vs Visionary Leadership

Chapter Five – Research Design, Method and Materials

5.0 Research Design, Method and Materials

The research design for this thesis will lead to ultimately rejecting or failing to reject the central hypothesis that suggests there is a positive correlation between "Top" management leadership and the successful outcomes of a lean change initiative. Figure 3 below illustrates the thesis' research design flow. In brief, the research design begins with the formation of the hypothesis. Second, to build on the hypothesis, the adoption of existing theories from experts on leadership and productivity were used to help form a quantitative basis to measure the hypothesis. Third, equations were developed for quantifying leadership and productivity outcomes using the existing theories. Fourth, a survey instrument was created to measure the variables within each of the equations with research. Fifth, a correlation model was developed to record on a scatter plot the values derived from the leadership and productivity equations. Finally, based on the scatter plot results trend line derived from the correlation model, the hypothesis will either be rejected or fail to be rejected. The hypothesis, existing theories, key questions and correlation model were previously discussed in the Chapter 4. This Chapter will focus primarily on the development of the survey instrument used to collect research.

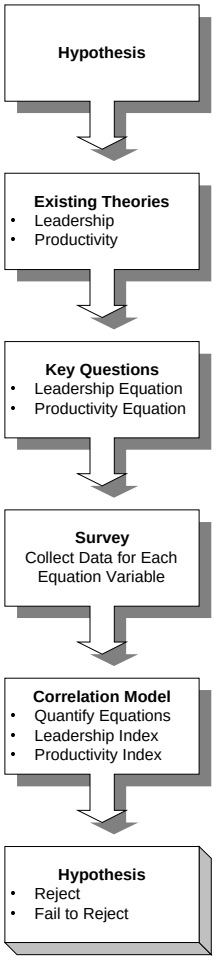


Figure 3. The thesis research design flow

5.1 Survey Sample Demographics

The primary data were collected through a survey that was distributed to professionals representing the United States Aerospace Industry as well as other Non-Aerospace industries. The targeted survey respondents represent a wide spectrum of leadership levels and functional capacities within various organizations. The only requirement for each respondent to participate in the survey was that they needed to be actively involved or have participated in a "lean" change initiative within their organization.

5.2 Survey Sampling Plan

The sampling frame that was used to represent the targeted population consisted of a list of MIT's Lean Aerospace Initiative Consortium Members, MIT's System Design and Management Students, MIT's Leaders for Manufacturing Students and the Council of Industrial Engineers. A simple random sampling protocol process was employed using the population frame. This process would ensure that no bias in the sample occurs.

5.2.1 MIT's Lean Aerospace Initiative Industry Consortium Members

Massachusetts Institute of Technology's Lean Aerospace Initiative's industry consortium members represent approximately 14 major Aerospace organizations and their associated divisions. The population size of LAI industry members is approximately 1350 persons.

5.2.2 MIT's System Design and Management & Leaders for Manufacturing Programs

Massachusetts Institute of Technology's System Design and Management (SDM) and Leaders for Manufacturing (LFM) Programs are two professional student programs offered through a joint partnership of MIT's School of Engineering and its Sloan School of Management.

> "Both programs share a "Total Enterprise" approach that embraces a holistic view of the entire organization. SDM is concerned with the front end of the commercialization process and takes a 'Big E' approach to the critical functions of engineering complex systems design and new product development. LFM is concerned with the back end of the commercialization process, focusing on 'Big M' manufacturing and new product delivery."[2]

Students in both the SDM and LFM programs are experienced professionals with an engineering discipline.

5.2.3 Council of Industrial Engineers

The Council of Industrial Engineers is an executive group within the Institute of Industrial Engineers whose members meet periodically to share knowledge and experience. The

[2] MIT LFM/SDM Joint publication, *Throughput.* Hanson Printing Company, Inc., Summer 1999, page 1.

sample represented Ten respondents from both Aerospace and Non-Aerospace Companies who held Senior Management/Executive roles within their organizations.

5.3 Survey Design

The survey was designed as an instrument to help quantify the impact of leadership on a lean change initiative. The survey consisted of three distinct sections: Section A – General Information; Section B – Implementation; and Section C – Outcomes. The questions within the survey were developed intentionally to quantify the variables of both the leadership and productivity outcome equations. A copy of the survey is located in Appendix One.

5.3.1 Leadership Equation Variables

Recalling from equation 6, the Visionary Leadership Formula is:

Visionary Leadership = [(w)(Shared Purpose) + (w)(Empowerment) + (w)(Appropriate Organizational Changes) + (w)(Strategic Thinking)]

Where:
(w) = weight factor
Shared Purpose = Vision + Communication

5.3.1.1 Shared Purpose

The following survey questions were used to quantify the Shared Purpose variable.

Question B.4 "Which of the following statements best characterizes the role played by the Enterprise Leader in formulating the lean initiative's vision?"

Question B.5 "Which of the following leaders is recognized throughout the organization as the most influential driver of the lean change initiative?"

Question B.6 "Which of the following statement(s) best describe the process or processes undertaken to enable your organization to learn & understand the lean initiative's vision?"

Question B.7 "Which of the following statements best characterizes the organization's level of understanding of the lean initiative's vision?"

Question B.8 "Which of the following statements best characterizes the visibility of the lean initiative's vision to the organization?"

5.3.1.2 Empowerment

The following survey question was used to quantify the Empowerment variable.

Question B.12 "What is the extent of employee decision making applied within your organization?"

5.3.1.3 Appropriate Organizational Changes

The following survey questions were used to quantify the Appropriate Organizational Changes variable.

Question B.9 "Which of the following statements best describes the level of integration between the organization's functional objectives and the lean initiative's vision?"

Question B.10 "Which of the following statements best describes the process or processes employed to enable integration between the organization's functional objectives and the lean initiative's vision?"

5.3.1.4 Strategic Thinking

The following survey questions were used to quantify the Strategic Thinking variable.

Question B.13 "To what extent (Effectively, Too much, or Not enough) have the following strategies been implemented during the lean change initiative?"

- Clear goals and objectives were used to accomplish the lean initiative's vision.
- Strategic alliances were used to accomplish the lean initiative's vision.
- Committing new resources to facilities, locations and equipment were used to accomplish the lean initiative's vision.
- Building the organization's human capital were used to accomplish the lean initiative's vision.

5.3.2 Productivity Outcomes Variables

Recalling from equation 7, the Productivity Outcomes Formula is:

Productivity = [(w)(External Outcomes) + (w)(Internal Outcomes)]

Where:
(w) = weight factor
External Outcomes = Customer Satisfaction + Schedule/Delivery Performance + Quality of Product or Service
Internal Outcomes = Resource Utilization + Return on Assets + Cycle Time

5.3.2.1 External Outcomes

The following survey questions were used to quantify the External Outcomes variables.

Question C.1 "To what extent (Not at all, Somewhat, and Very) have the following outcomes improved since the implementation of the lean change initiative?"

- Customer Service
- Schedule/Delivery Performance
- Quality of Product or Service

5.3.2.2 Internal Outcomes

The following survey questions were used to quantify the Internal Outcomes variables.

Question C.1 "To what extent (Not at all, Somewhat, and Very) have the following outcomes improved since the implementation of the lean change initiative?"

- Resource Utilization
- Return on Assets
- Cycle Time

5.4 Survey Analysis Tools

The following computer software tools were used in analyzing the data collected through the survey instrument.

5.4.1 Survey Data Analysis

The survey responses were entered into a database and analyzed using SPSS 9.0 for Windows - a computer software data analysis tool. SPSS contains the following capabilities including:

- Spreadsheet-like Data Editor for entering, modifying and viewing data files
- Statistical procedures, including t-tests, analysis of variance, crosstabulations, and multi-dimensional scaling.
- Interactive graphics allowing the user to change or add chart elements and variables dynamically.

5.4.2 Correlation Data Analysis

The values generated from the leadership and productivity outcome formulas were entered into a spreadsheet database and analyzed using Microsoft's Excel 97 edition computer software. A scatter plot was created and a best-fit trend line was determined using Excel's data

analysis package which included an evaluation of the Pearson product-moment correlation coefficient or (r) factor.

The Pearson product–moment correlation coefficient is a measure of the linear correlation of two variables. It is a number that ranges from –1 to 0 to 1, representing the strength of the relationship between the variables. A correlation of +1 denotes a perfect positive relationship. A (r) value of –1 denotes a perfect negative correlation between two sets of numbers. A perfect negative correlation indicates an inverse relationship between two variables, i.e., as one gets larger the other gets smaller.

Chapter Six – Survey Results and Discussion

6.0 Survey Instrument

6.1 Results

The survey was distributed to approximately 425 people as sources of data and information. There were 325 'hard copies' mailed out via U.S. Postal Service and 100 'soft copies' emailed via computer. The distribution included all levels and functions of people working in both the Aerospace and Non-Aerospace Industries. The data collection period lasted approximately eight weeks and the total number of surveys collected was 98, representing a response rate of 23 percent. In addition to the surveys, nine face to face interviews were conducted, comprising various levels and functions within one organization. This data will be used later in this chapter as a case study. The actual survey instrument distributed can be found in Appendix One of this thesis and the survey frequency response charts are located in Appendix Two.

6.1.1 Demographics of Survey Sample

The majority (over 80%) of the survey sample included organizations that employed "more than 1,000 people" as shown in Figure 4 below. The remainder of the organizations in the sample was almost uniformly distributed across the categories at less than 5 % each.

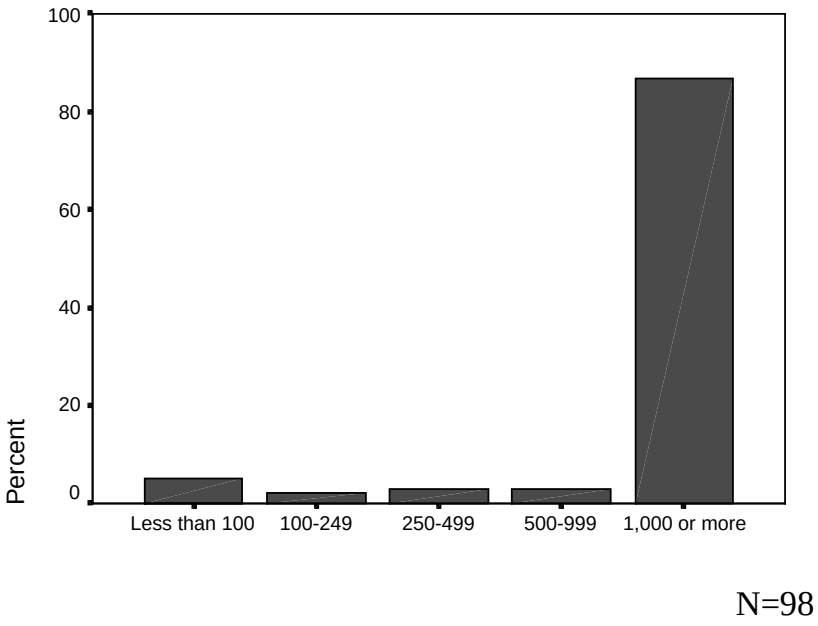


Figure 4 – Employees at each location

The survey sample had many different organizations with various products and services. Figure 5 identifies the different types of products and services along with their associated frequencies in the sample.

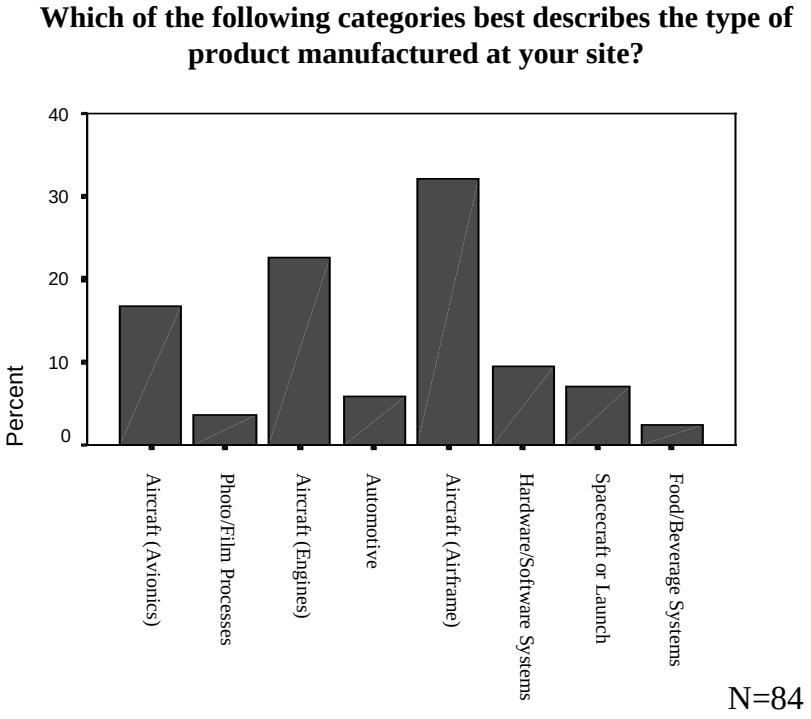


Figure 5 – Product manufactured at your business location

The majority of the survey sample organization's products/services relate to the Aerospace Industry. For example, the category "Aircraft" consisting of three sub-elements: "Avionics and Electronic Systems", "Engines", and "Airframe" in total aggregated to 71.4% of the sample. "Hardware/Software Systems" comprised 9.5% of the sample, "Spacecraft or Launch Systems" 7.1%, and "Automotive" 6% of the sample respondents. Other categories (all with a frequency of approximately 1%) not listed in Figure 5 above were the following: "Assembly Operations", "Space-Mission Control", "Defense Electronics", "Elevators", "Environmental Protection", "Industrial Products", "Off-Road Vehicles", "Pumps", "Railroad Transportation", and "Training".

The survey sample respondent's "title" or "role" they represented within their organization were as follows: "CEO/Executive", "Senior Management", "Middle Management", "Senior Technical Staff", and "Technical Workforce". Of the collected responses, the frequencies were as follows: Senior Management (26.5%), Middle Management (28.6%) and Senior Technical Workforce (22.4%) categories as identified in Figure 6 below. Technical Workforce (15.3%) and CEO/Executive (7.1%) response frequencies followed.

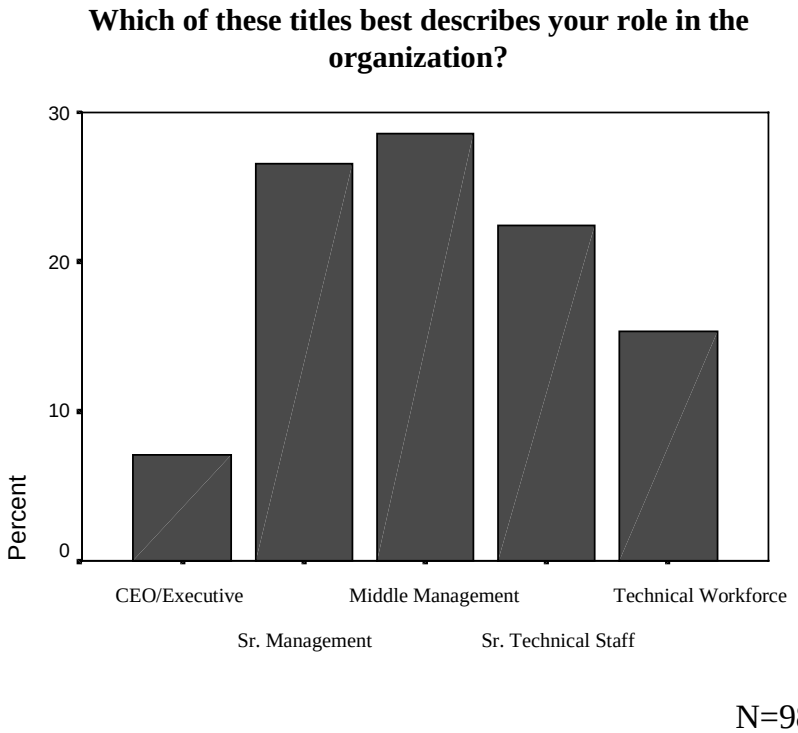
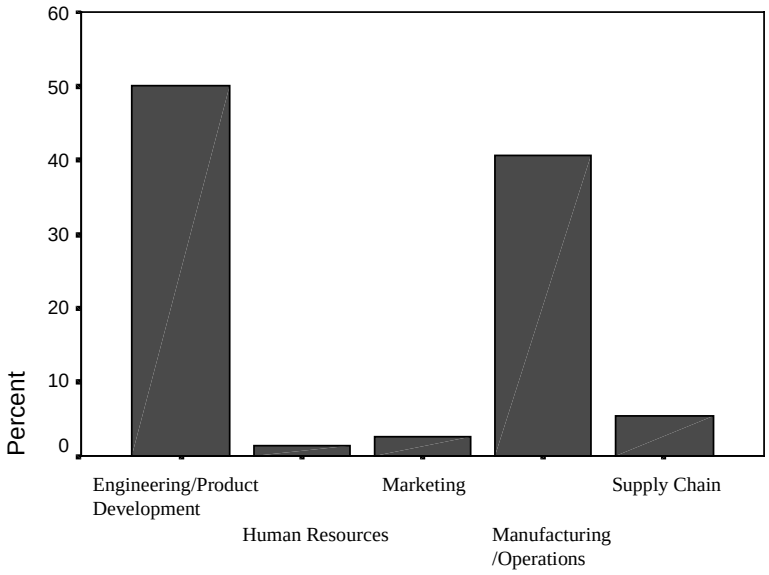


Figure 6 – Title or role within the organization

The functional areas of the organization where the respondents worked had high response frequencies in two areas: "Engineering/Product Development" (50%), and "Manufacturing/Operations" (40.5%). Other areas included "Supply Chain" (5.4%), "Marketing" (2.7%), and "Human Resources" (1.4%). Figure 7 below illustrates the response frequencies.

In which functional area of the organization do you work?

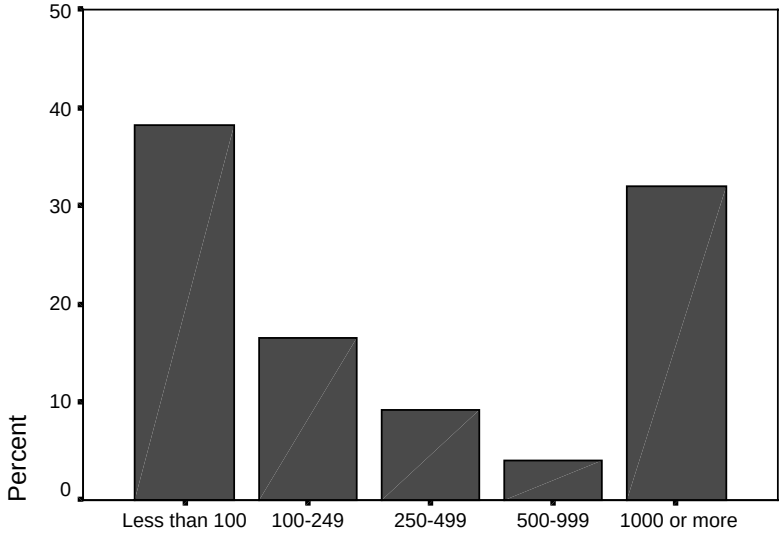


N=74

Figure 7 – Functional area of organization where respondent works

Illustrated in Figure 8 below, the number of people in each organization actively working on or participating in the change initiative had high response frequencies in three areas: "Less than 100 people" (38.1%), "1000 or more" (32%), and "100-249 people" (16.5%). Other areas, which were not as dominant, included "250-499 people" (9.3%) and "500-999 people" (4.1%).

How many employees were actively working on or participating in the lean change initiative?



N=97

Figure 8 – Number of employees actively working on or participating in the lean initiative

The evolution of the lean change initiative was mostly driven from "Top Down Influence" (80.2%). The evolution driven from "Bottom up influence" (18.8%) was less as illustrated in Figure 9 below.

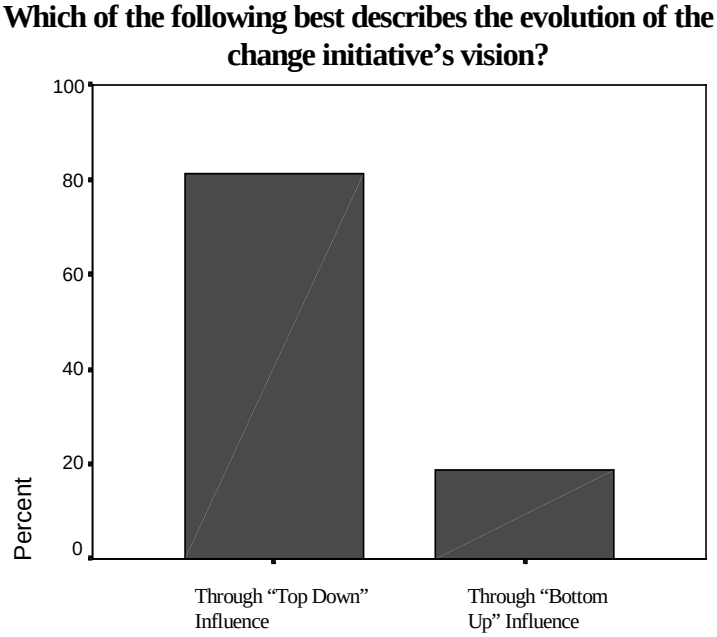


Figure 9 – Top Down or Bottom Up evolution of the lean change initiative

6.1.2 Leadership

The involvement of the Enterprise leader in formulating the lean initiative's vision had the highest frequency for the response "Composed by team of Senior Managers including Enterprise Leader" (35.5%). The next highest frequency response was "Written by staff, approved by Enterprise Leader" (29%). Following was the response "Composed by Enterprise Leader, reviewed by Senior Managers, consensus reached" (20.4%) as illustrated in Figure 10.

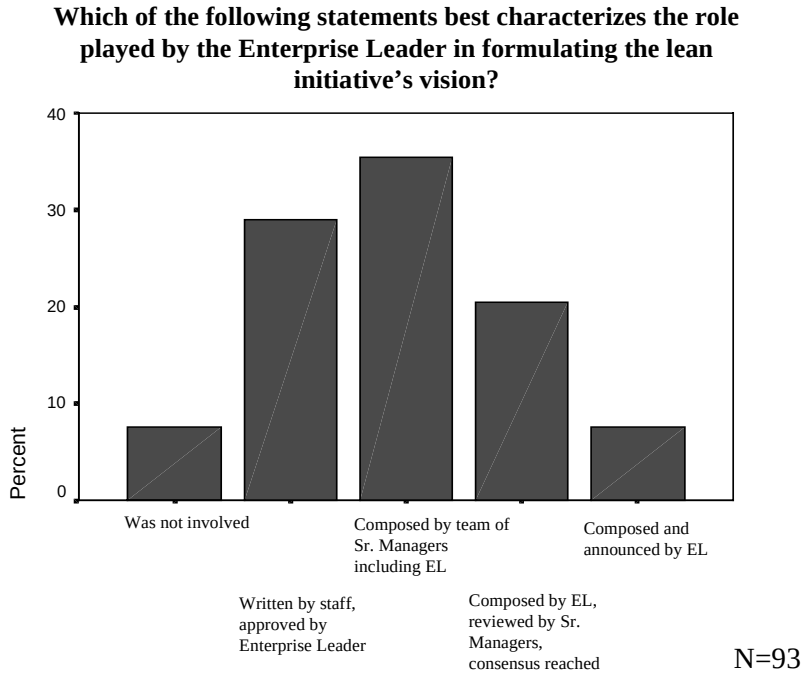


Figure 10 – Role of Enterprise Leader in formulating the initiative's vision

The leader recognized throughout the organization as the most influential driver of the lean change initiative had the highest responses in the following areas. The highest response was "Senior Manager - Direct report to Enterprise Leader" (43.3%), next "Enterprise Leader" (38.1%), and next "Middle Manager" (11.3%) as illustrated in Figure 11.

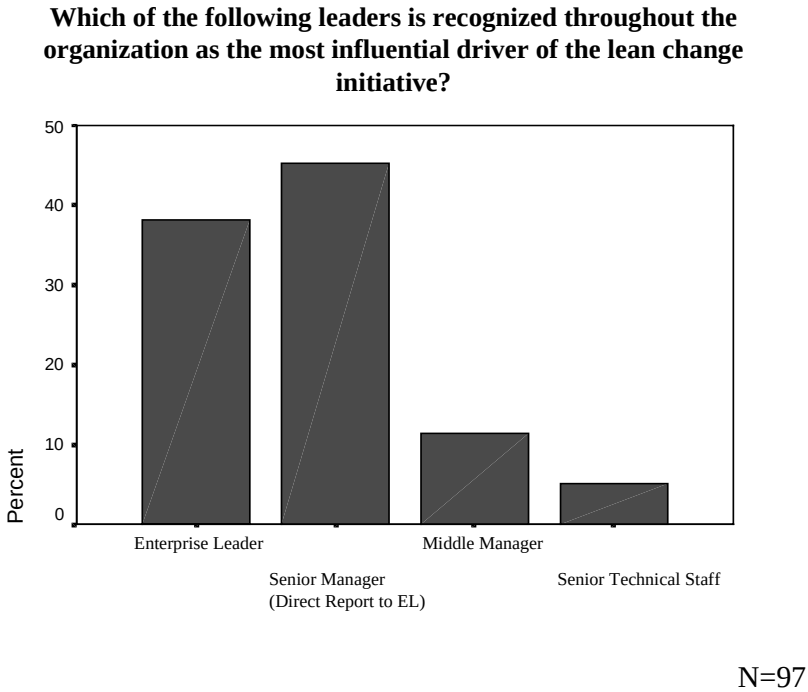


Figure 11 – The leader who is recognized as the most influential driver of lean initiative

6.1.2.1 Shared Purpose

Shared purpose can be decomposed into two elements: the first is the existence of a vision for the lean change initiative and the second is the communication of the vision to the organization. The shared purpose responses are shown in Figures 12 and 13.

The two highest responses from the sample regarding the organization's level of understanding of the initiative's vision was "Understood by some employees" (44.3%), and "Understood by most employees" (39.2%), as illustrated in Figure 12 below.

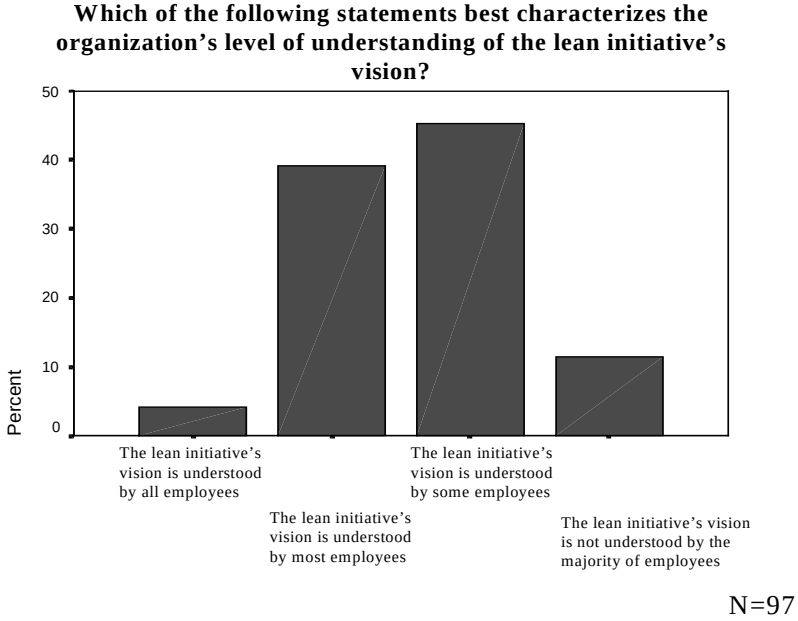


Figure 12 – The organization's level of understanding of the lean change initiative's vision

As shown in Figure 13, the highest responses for the visibility of the initiative's vision to the organization were the following. "The vision is displayed in some locations throughout the organization" (38.9%). The next highest response frequency was "None of the above" (27.4%), followed by "The vision is very visible throughout the facilities" with a response frequency of 22.1%.

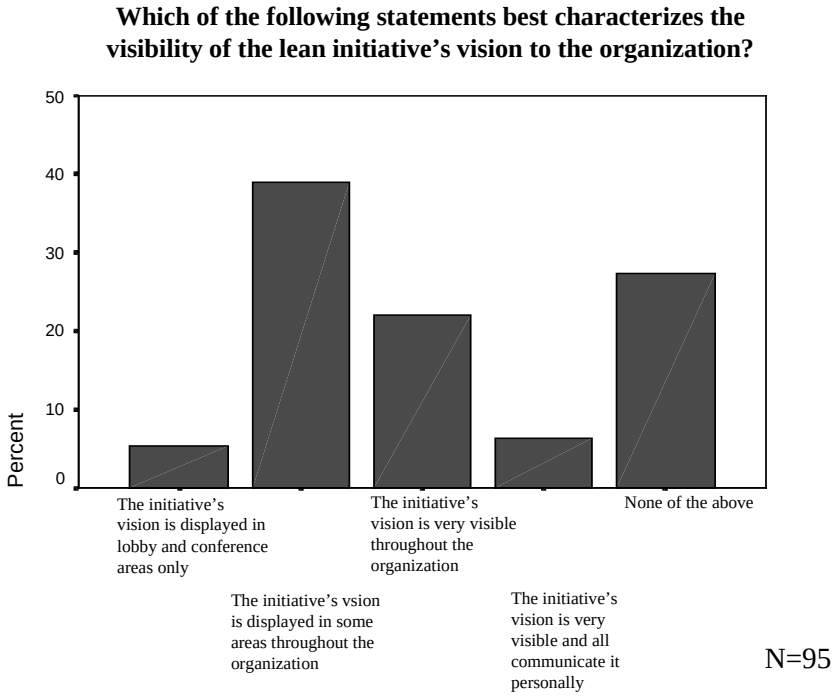


Figure 13 – The visibility of the lean initiative's vision to the organization

6.1.2.2 Empowerment

Employee decision making in the survey sample organizations had the majority of responses claim that "Key issues are available to some employees, however most decisions are made at senior levels" (45.8%). Next highest in response frequency was "Information on issues is available to most employees, however most decisions are made at less than senior levels" (22.9%). This was followed by "Significant decisions are made at senior levels and information is filtered down by management" with a response frequency of 20.8%. The lowest response frequency claimed that "Information on issues is available to all employees, decisions are made at the lowest possible levels" at 10.4% as shown in Figure 14.

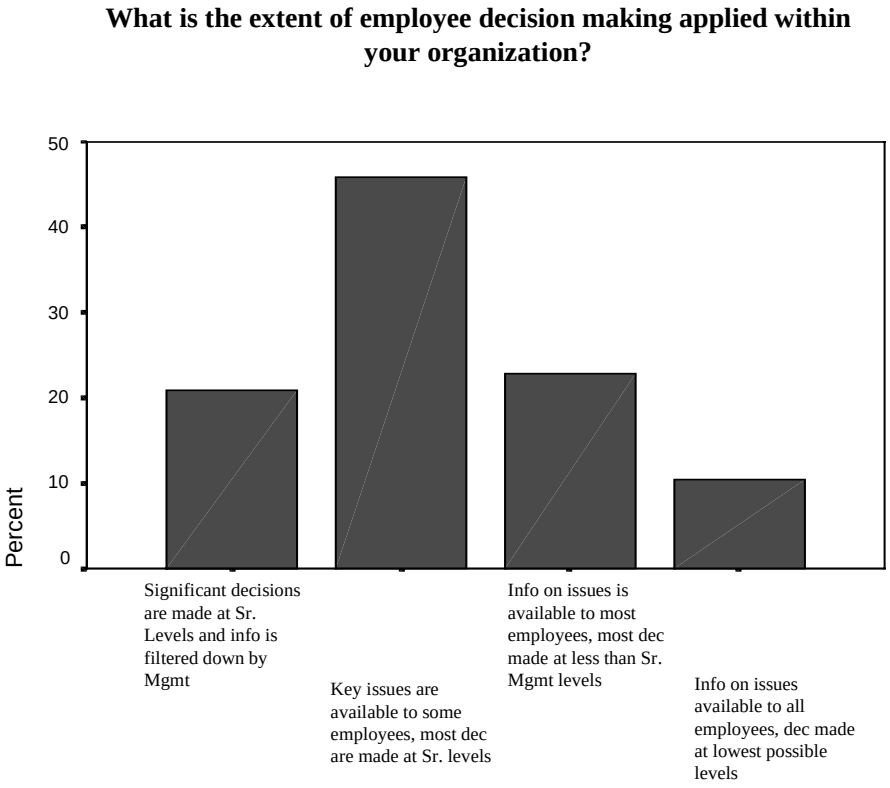


Figure 14 – The extent of employee decision making within an organization

6.1.2.3 Appropriate Organizational Changes

The term "Appropriate Organizational changes" used throughout this thesis is in the context of the level of integration between the organization's functional objectives and the lean initiative's vision only. In Figures 15 and 16 below, the sample responses addressing the level of organizational changes are given.

The sample respondents stated that "Functional objectives are integrated and most support the initiative's vision" (58.8%). Next highest in response frequency was, "Functional objectives are integrated, but often conflict with the initiative's vision" (19.6%). This was followed by "Functional objectives are integrated and all support the initiative's vision" with a response frequency of 16.5% as illustrated in Figure 15.

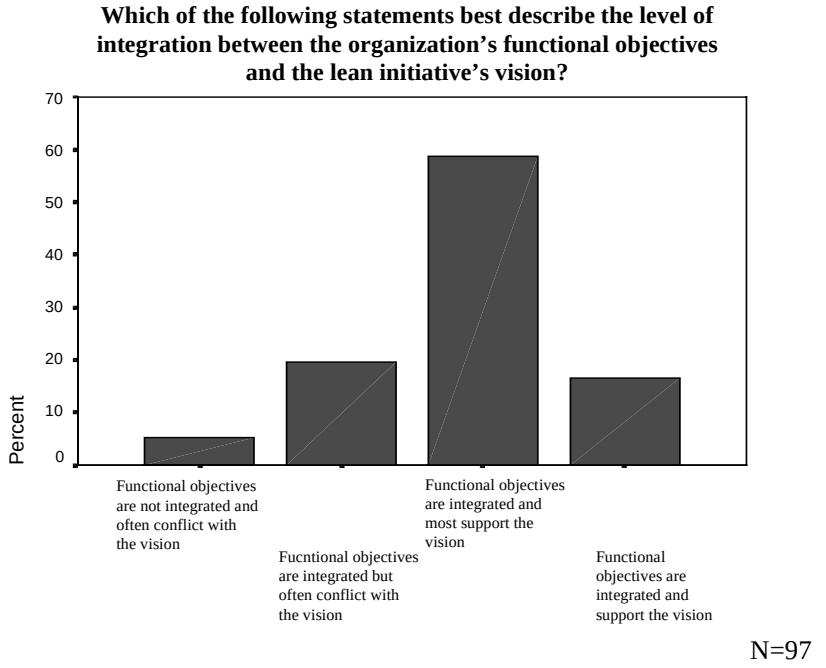


Figure 15 – Level of integration between the organization's functional objectives and vision objectives

The highest frequency response claimed that the processes used to integrate the organization's functional objectives and the initiative's vision were employed through: first, "Discussion within departments, between departments and with Senior Management" (41.7%). Next highest in response frequency was, "Objectives are discussed only within departments" (25%). This was followed by "Objectives are discussed within departments and between departments" with a response frequency of 22.9% as illustrated in Figure 16.

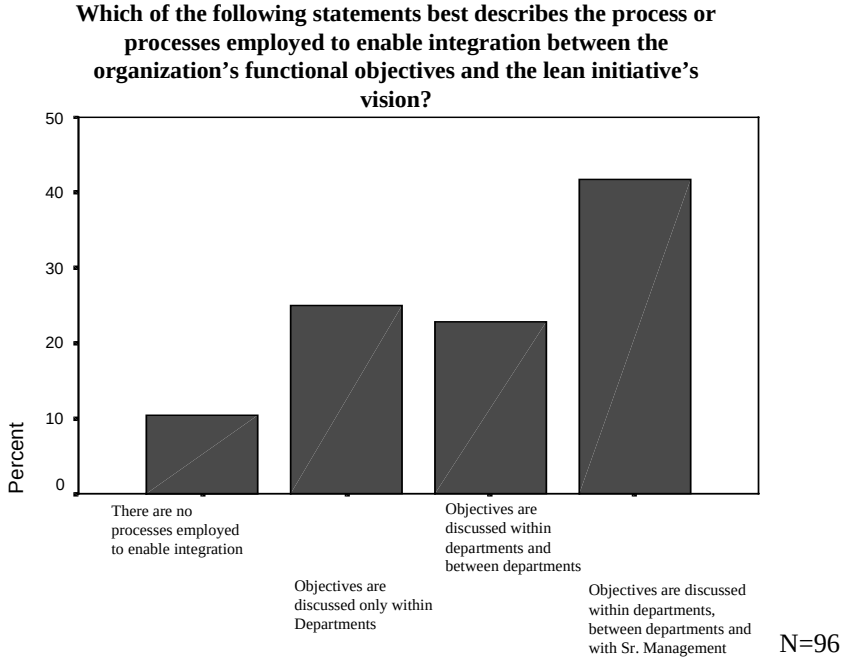


Figure 16 – The process employed to enable integration between functional and vision objectives

6.1.2.4 Strategic Thinking

The results for the strategic thinking section of the survey included four questions asking each respondent "To what extent has the following strategy been implemented during the lean change initiative?"

The survey results indicated that 48.5% of the sample believed that "Clear goals and objectives strategy" was effectively implemented during the lean change initiative. However, 45.4% believed that "Clear goals and objectives strategy" were not implemented enough during the lean change initiative. Figure 17 presents the percent response to this survey question.

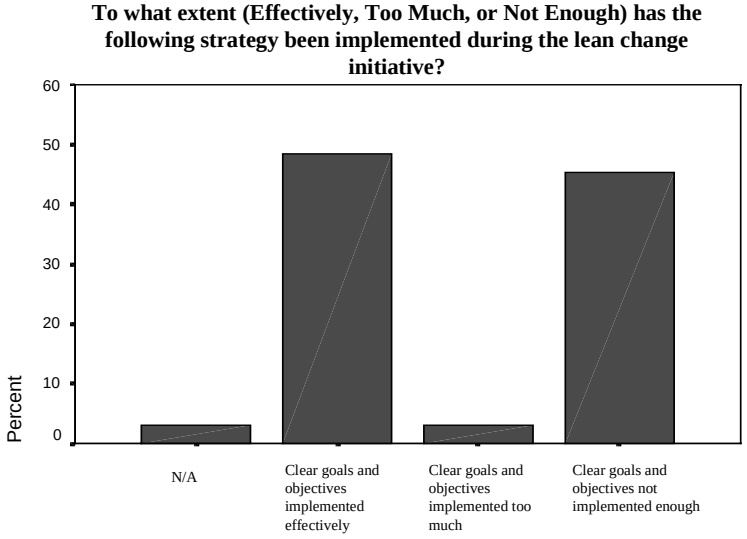


Figure 17 – Extent of clear goals and objectives implementation strategy

The survey results indicated that 53.1% of the sample believed that "Strategic Alliances" were not implemented enough during the lean change initiative. 19.8% of the sample believed that "Strategic Alliances were implemented effectively during the lean change initiative. Figure 18 presents the percent response to this survey question.

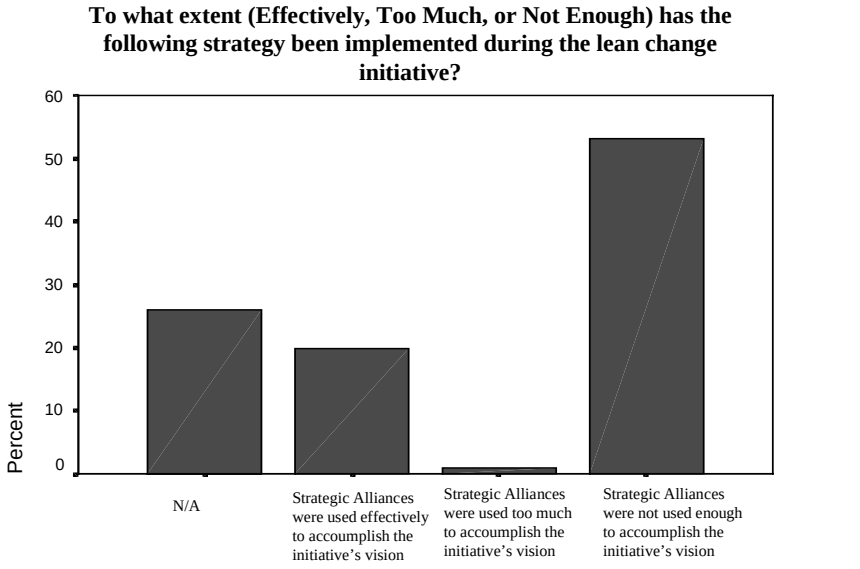


Figure 18 – Extent of strategic alliances implementation strategy

The survey results indicated that 44.8% of the sample believed that "Committing new resources to facilities and locations" was not implemented enough during the lean change initiative. 40.6% of the sample believed that "Committing new resources to facilities and locations" was implemented effectively during the lean change initiative. Figure 19 presents the percent response to this survey question.

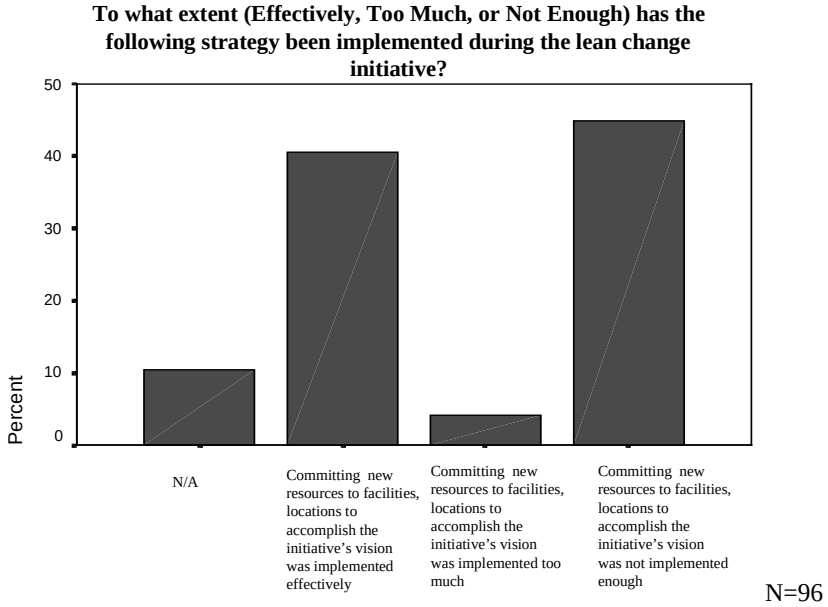


Figure 19 – Extent of committing new resources implementation strategy

The survey results indicated that 63.9% of the sample believed that "Building the organization's human capital" was not implemented enough during the lean change initiative. 28.9% of the sample believed that "Building the organization's human capital" was implemented effectively during the lean change initiative. Figure 20 presents the percent response to this survey question.

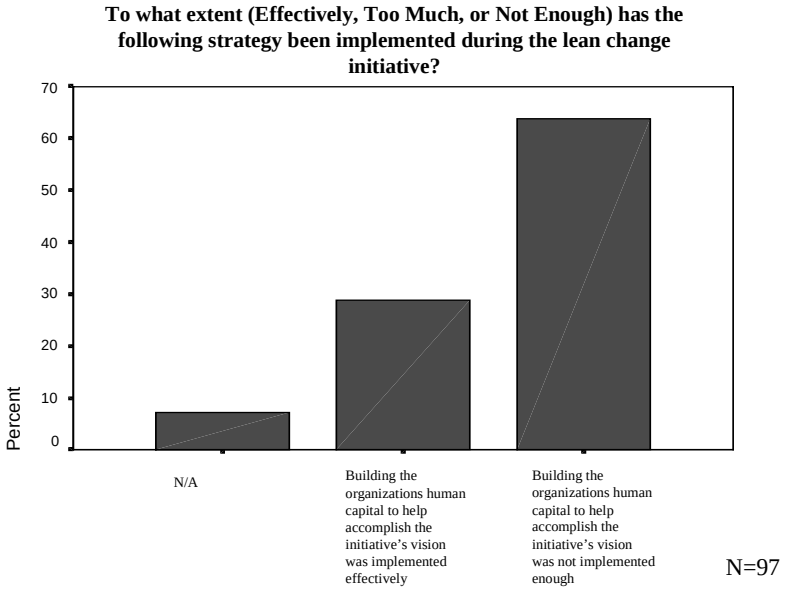


Figure 20 – Extent of building the organization's human capital implementation strategy

6.1.3 Productivity Outcomes

6.1.3.1 External Value

Recalling from Chapter 3, the External Value has three components: Customer Satisfaction, Schedule/Delivery Performance, and Quality of Product or Service. The presented results are determined from the respondents' perception of the extent of success of each outcome. In addition, for each outcome listed, there are actual "net change percentages" listed to help the reader understand the relative magnitude of each outcome's improvement.

On a scale from 1 to 7 (1,2 = not at all, 3,4,5, = somewhat, and 6,7 = very) 27.2% of the sample respondents believed that Customer Satisfaction scored a "5" or improved more than "somewhat" after the lean change initiative was implemented. 20.7% of the sample believed that Customer Satisfaction improved by a score of "4"; 18.5% of the sample believed that Customer Satisfaction improved by a score of "3". The remaining results are presented in Figure 21 below.

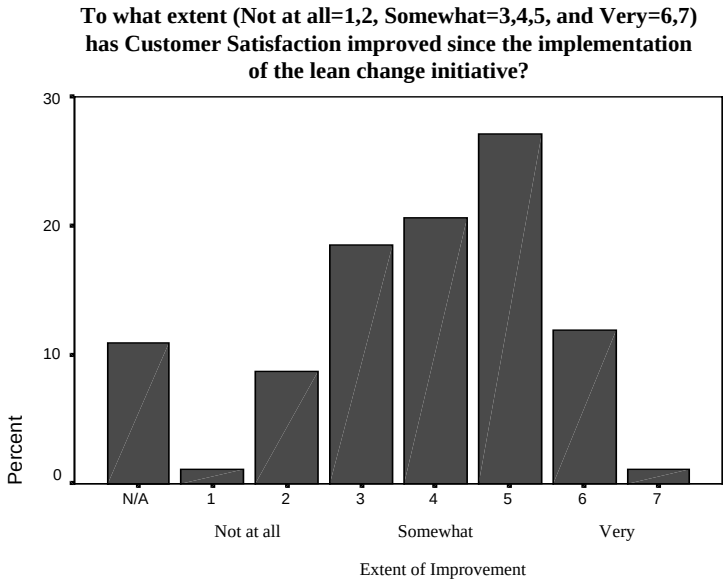


Figure 21 – Extent of customer satisfaction improvement

Out of a sample of 21 respondents, 19.6% estimated that the Net Change in Customer Satisfaction to be a 20% improvement. 14.3% of the respondents estimated that the Net Change in Customer Satisfaction to be a 25% improvement. 14.3% of the respondents estimated that the Net Change in Customer Satisfaction to be a 5% improvement. The remainder of the results is presented in Figure 22 below.

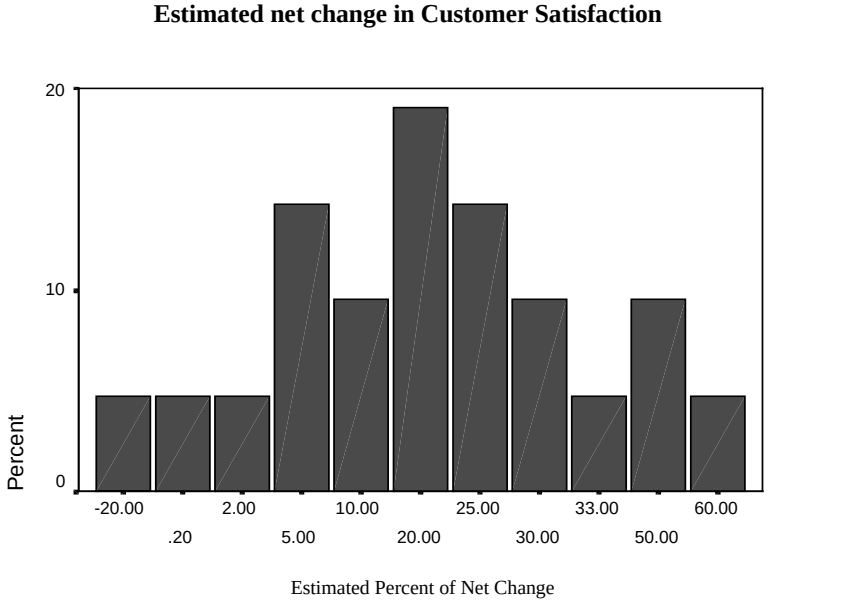


Figure 22- Estimated net change in customer satisfaction

On a scale from 1 to 7 (1,2 = not at all, 3,4,5, = somewhat, and 6,7 = very) Schedule/Delivery Performance improvement was estimated. Of the sample respondents, 25% believed that Schedule/Delivery Performance scored a "5" or improved more than "somewhat" after the lean change initiative was implemented. 19.6% of the sample believed that Schedule/Delivery Performance improved by a score of "3"; 18.5% of the sample believed that Schedule/Delivery Performance improved by a score of "6". The remaining results are presented in Figure 23 below.

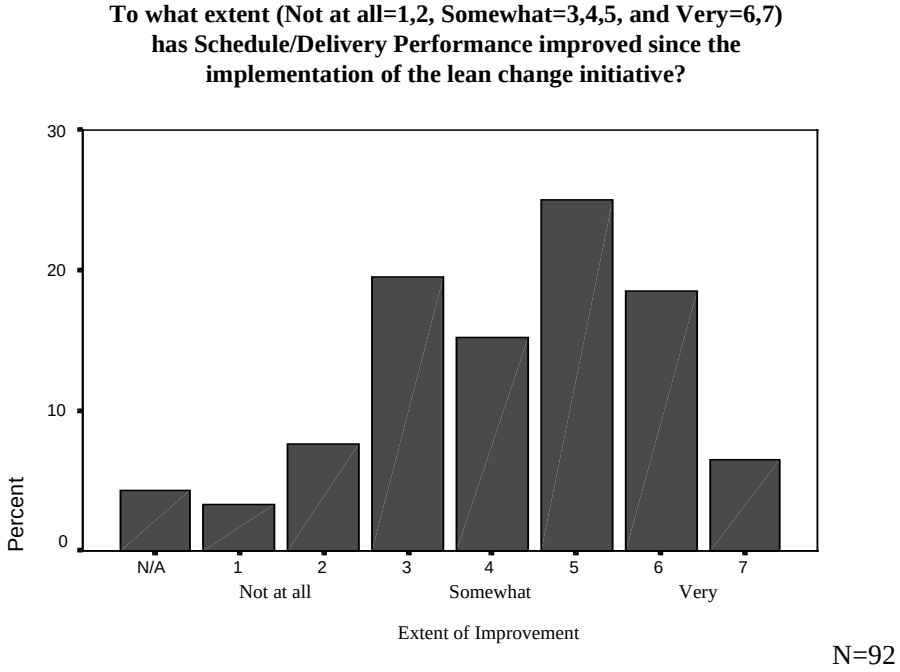


Figure 23 – Extent of schedule/Delivery performance improvement

Out of a sample of 22 respondents, 27.3% estimated that the Net Change in Schedule/Delivery performance to be a 10% improvement. 18.2% of the respondents estimated that the Net Change in Schedule/Delivery Performance to be a 30% improvement. 13.6% of the respondents estimated that the Net Change in Schedule/Delivery Performance to be a 20% improvement. The remainder of the results is presented in Figure 24 below.

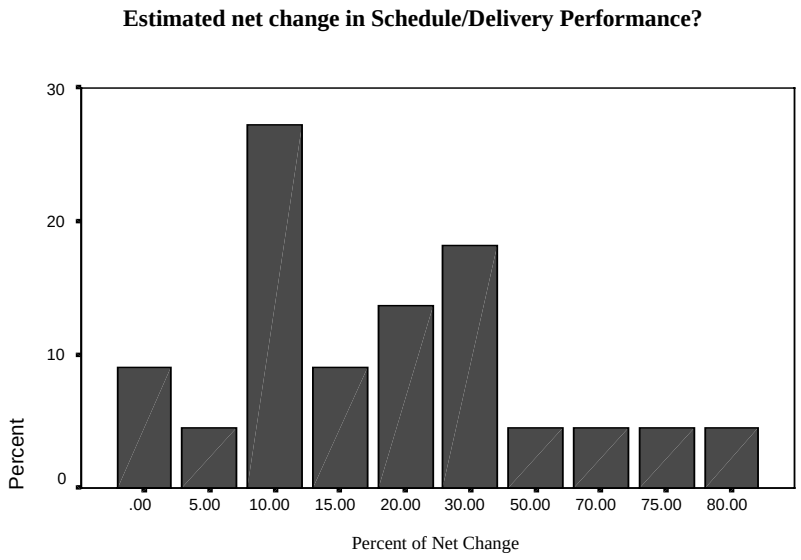


Figure 24 – Estimated net change in schedule/delivery performance

On a scale from 1 to 7 (1,2 = not at all, 3,4,5, = somewhat, and 6,7 = very) Quality of Product or Service was estimated. Of the respondents, 27.2% believed that Quality of Product or Service scored a "4" or improved "somewhat" after the lean change initiative was implemented. 18.5% of the sample believed that Quality of Product or Service improved by a score of "5", 18.5% of the sample believed that Quality of Product or Service improved by a score of "6". The remaining results are presented in Figure 25 below.

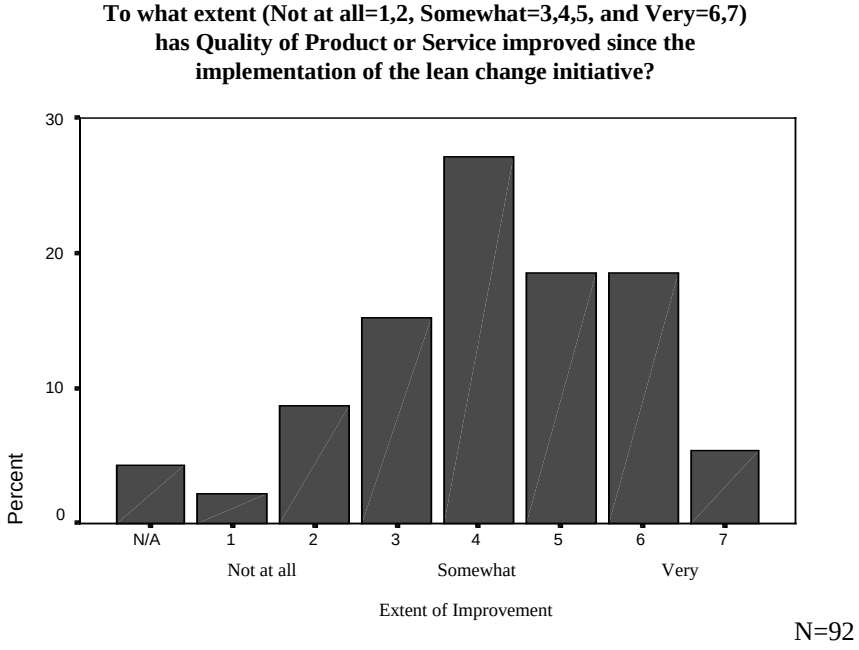


Figure 25 – Extent that quality of product or service has improved

Out of a sample of 20 respondents, 25% estimated that the Net Change in Quality of Product or Service to be a 10% improvement. 15% of the respondents estimated that the Net Change in Quality of Product or Service to be a 40% improvement. 15% of the respondents estimated that the Net Change in Quality of Product or Service to be a 5% improvement. The remainder of the results is presented in Figure 26 below.

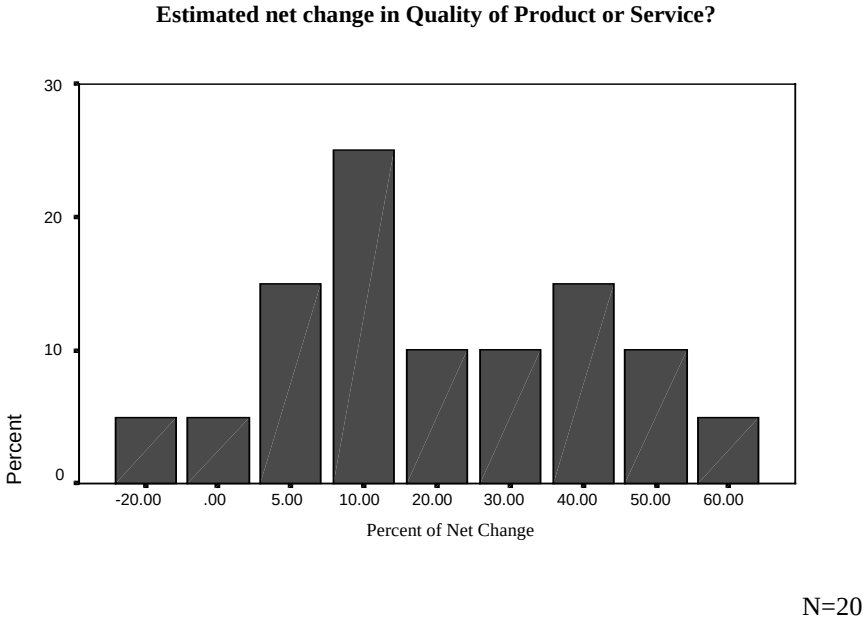


Figure 26 – Estimated net change in quality of product or service

6.1.3.2 Internal Value

Recalling from Chapter 3, the Internal Value has three components: Resource Utilization, Return on Assets, and Cycle Time. The results presented in this section are determined from the respondent's perception of the extent of success of each outcome. In addition, for each outcome listed, there are actual "net change percentages" listed to help the reader understand the relative magnitude of the outcomes improvement.

On a scale from 1 to 7 (1,2 = not at all, 3,4,5, = somewhat, and 6,7 = very) 27.2% of the sample respondents believed that Resource Utilization scored a "5" or improved more than "somewhat" after the lean change initiative was implemented. 23.9% of the sample believed that Resource Utilization improved by a score of "6", 13% of the sample believed that Resource Utilization improved by a score of "3". The remaining results are presented in Figure 27 below.

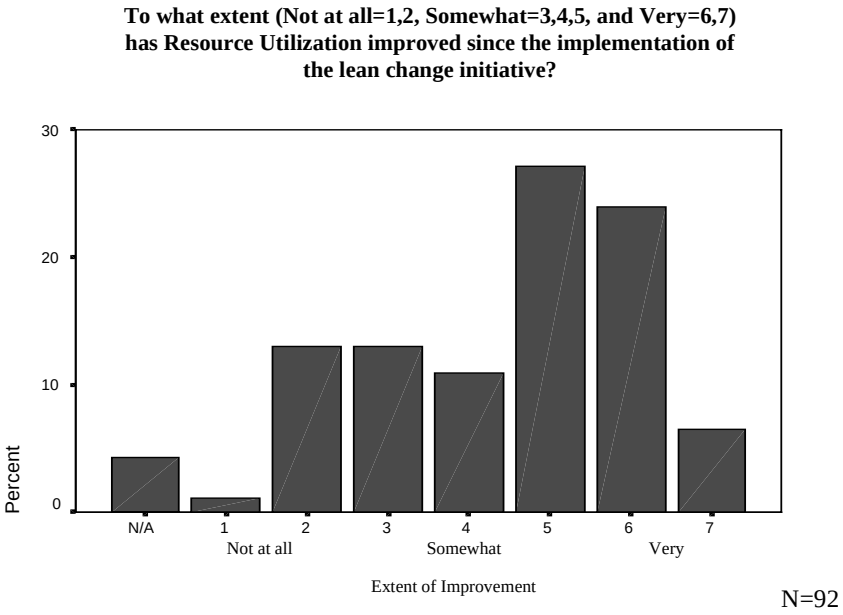


Figure 27 – Extent of resource utilization improvement

Out of a sample of 21 respondents, 23.8% estimated that the Net Change in Resource Utilization to be a 20% improvement. 14.3% of the respondents estimated that the Net Change in Resource Utilization to be a 30% improvement. 14.3% of the respondents estimated that the Net Change in Resource Utilization to be a 10% improvement. 14.3% of the respondents estimated that the Net Change in Resource Utilization to be a 5% improvement. The remainder of the results is presented in Figure 28 below.

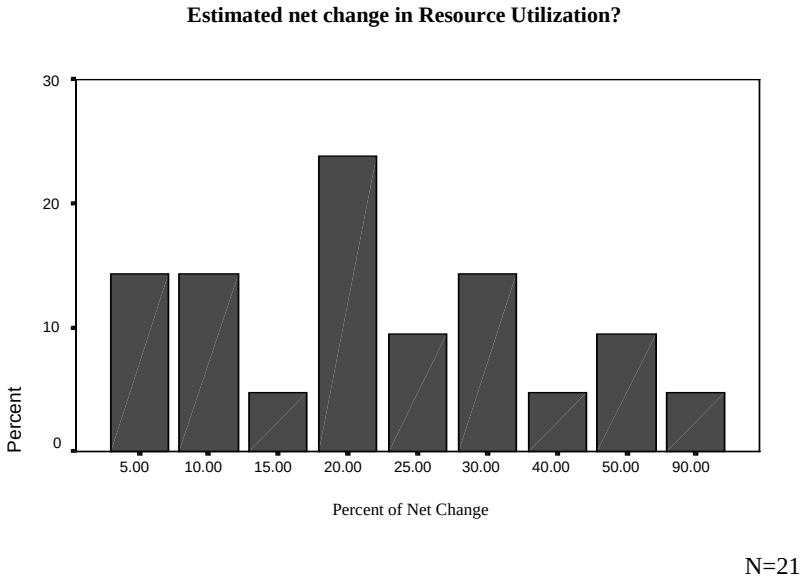


Figure 28 – Estimated net change in resource utilization

On a scale from 1 to 7 (1,2 = not at all, 3,4,5, = somewhat, and 6,7 = very) 27.5% of the sample respondents believed that Return on Assets scored a "5" or improved more than "somewhat" after the lean change initiative was implemented. 17.6% of the sample believed that Return on Assets improved by a score of "3"; 15.4% of the sample believed that Return on Assets improved by a score of "4". The remaining results are presented in Figure 29 below.

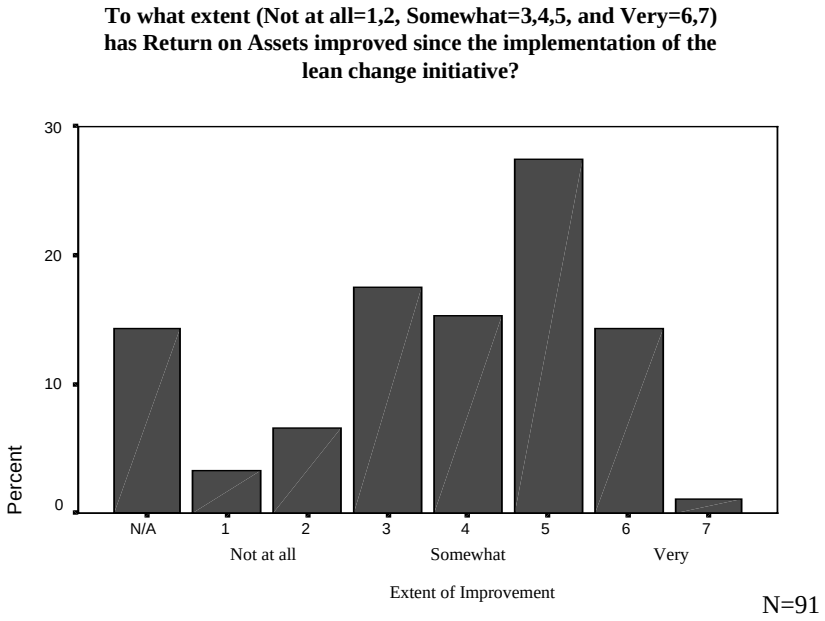


Figure 29 – Extent of return on assets improvement

Out of a sample of 18 respondents, 27.8% estimated that the Net Change in Return on Assets to be a 10% improvement. 16.7% of the respondents estimated that the Net Change in Return on Assets to be a 20% improvement. 11.1% of the respondents estimated that the Net Change in Return on Assets to be a 25% improvement. 11.1% of the respondents estimated that the Net Change in Return on Assets to be a 5% improvement. The remainders of the results are presented in Figure 30 below.

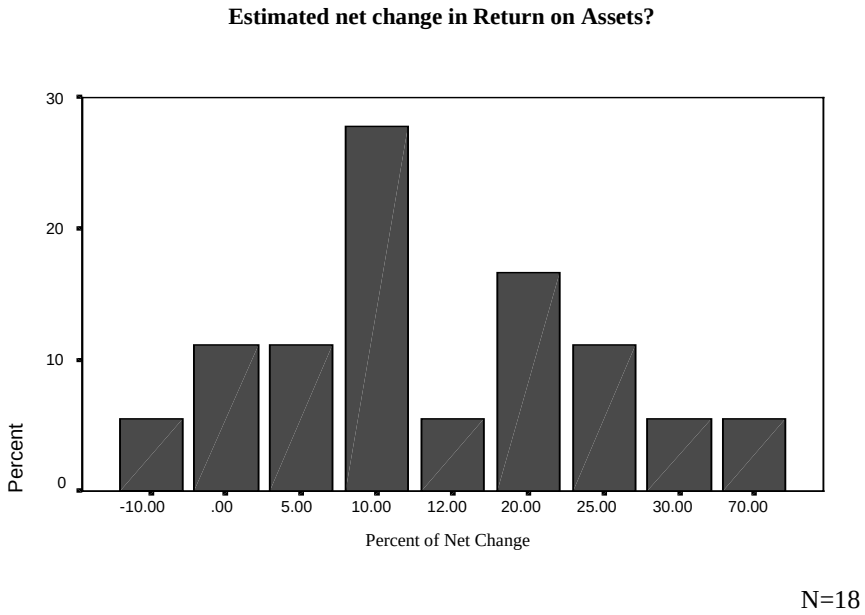


Figure 30 – Estimated net change in return on assets

On a scale from 1 to 7 (1,2 = not at all, 3,4,5, = somewhat, and 6,7 = very) 24.2% of the sample respondents believed that Cycle Time scored a "6" or improved "very much" after the lean change initiative was implemented. 19.8% of the sample believed that Cycle Time improved by a score of "5"; 19.8% of the sample believed that Cycle Time improved by a score of "4". The remaining results are presented in Figure 31 below.

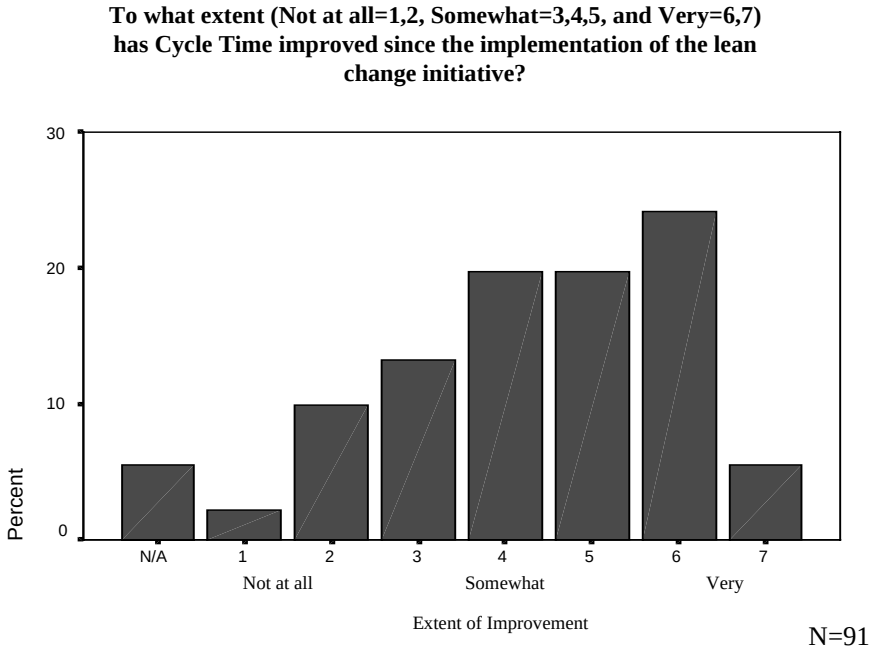


Fig 31 – Extent of cycle time improvement

Out of a sample of 22 respondents, 22.7% estimated that the Net Change in Cycle Time to be a 50% improvement. 22.7% of the respondents estimated that the Net Change in Cycle Time to be a 10% improvement. 13.6% of the respondents estimated that the Net Change in Cycle Time to be a 20% improvement. The remainders of the results are presented in Figure 32 below.

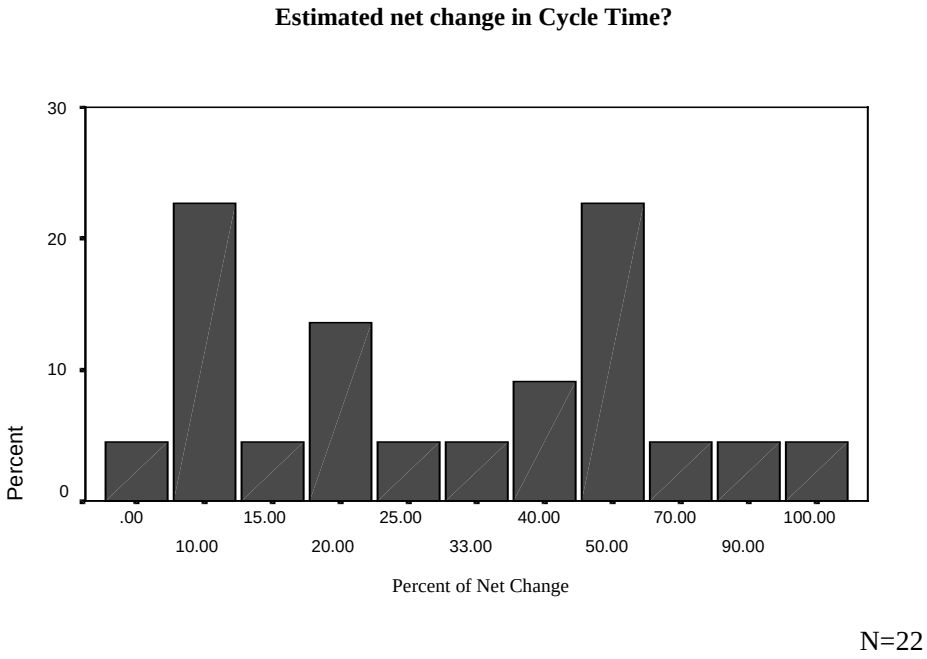


Figure 32 – Estimated net change in cycle time

6.1.3.3 Overall Outcomes

When the survey respondents were asked the question "To what extent do you believe the lean change initiative was successful" the respondents answered the following. On a scale from 1 to 7 (1,2 = not at all, 3,4,5, = somewhat, and 6,7 = very) 38.3% of the sample respondents scored a "5" or the lean change initiative was more than "somewhat" successful. 21.3% of the sample believed that the lean change initiative was "somewhat" successful with a score of "4"; 16% of the sample believed that the lean change initiative was "very" with a score of "6". The remaining results are presented in Figure 33 below.

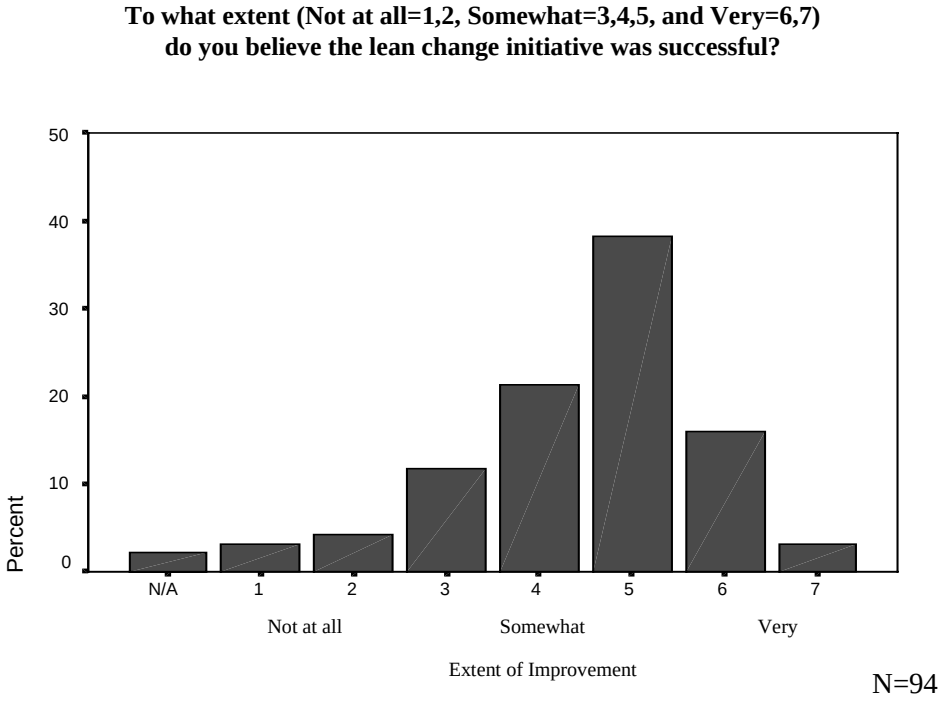


Figure 33 – Extent that lean initiative was successful

6.1.3.4 Reasons for Overall Outcomes

The survey sample respondents were asked to fill in an answer to the following question: "In your view, what were the main factors that contributed to either the success or lack of success of the lean change initiative?" It is noted that 27.4% (or 20 of the 73 respondents) replied to this question that the future potential of lean was not yet fully determined for their facility. Since these data points were not explicitly expressed by the respondents as reasons for success of the lean change initiative, they were treated as outliers and left out of this piece of the analysis. Of the remaining 53 respondents, the data was boiled down into the following categories.

Successful lean change initiative – Key variables

TM The initiative was successful due to a strong commitment by top management.
TW The initiative was successful due to the organization embracing the change effort as a team.
E&T The initiative was successful due to focused education and training.
GO The initiative was successful due to the organization having clear goals and objectives.
SV The initiative was successful due to small victories (i.e., Kaizen events, plant cycle time reduction, etc.) which continued to fuel the organization's acceptance of the initiative.
RS The initiative was successful due to the rewards/recognition system in place.

The response frequencies to the above key variables that were collected from the survey sample are located in Table 1 below.

Successful Key Variable	Response Frequency (N=53)
TM	**37.7 %**
TW	**22.6 %**
SV	**20.7 %**
GO	**9.4 %**
E&T	**7.5 %**
RS	**1.9 %**

Table 1 – Reasons for success of lean change initiative

Lack of success of lean change initiative – Key variables

LL The initiative lacked success due to a lack of top management leadership supporting the change.
LU The initiative lacked success due to the organization's lack of understanding of the change.
LG The initiative lacked success due to a lack of clear goals and objectives to support the change.

CC The initiative lacked success due to lack of acceptance of the change by the organization's corporate culture.

The response frequencies to the above lack of success key variables that were collected from the survey sample are located in Table 2 below.

Unsuccessful Key Variable	Response Frequency (N=14)
LL	**35.7 %**
LU	**35.7 %**
LG	**21.5 %**
CC	**7.1 %**

Table 2 – Reasons for lack of success of the lean change initiative

6.1.4 Correlation Model

As described in Chapter 4 of this thesis, a correlation model was developed. The model transforms the data collected through the survey instrument into two final index values (see equations 6 and 7 below), one for visionary leadership attributes and one for productivity outcomes. Each change initiative surveyed constitutes a data point on a scatter plot. The results of the survey are located below on the scatter plot in Figure 34.

Recall from equations 6 and 7:

Visionary Leadership Formula (f(x)) **equation 6 (restated)**

$$f(x) = [(w)(\text{Shared Purpose}) + (w)(\text{Empowerment}) + (w)(\text{Appropriate Organizational Changes}) + (w)(\text{Strategic Thinking})]$$

Where:
(w) = weight factor
Shared Purpose = Vision + Communication

Productivity Outcomes Formula (f(y)) **equation 7 (restated)**

$$f(y) = [(w)(\text{External Outcomes}) + (w)(\text{Internal Outcomes})]$$

Where:
(w) = weight factor
External Outcomes = Customer Satisfaction + Schedule/Delivery Performance + Quality of Product or Service
Internal Outcomes = Resource Utilization + Return on Assets + Cycle Time.

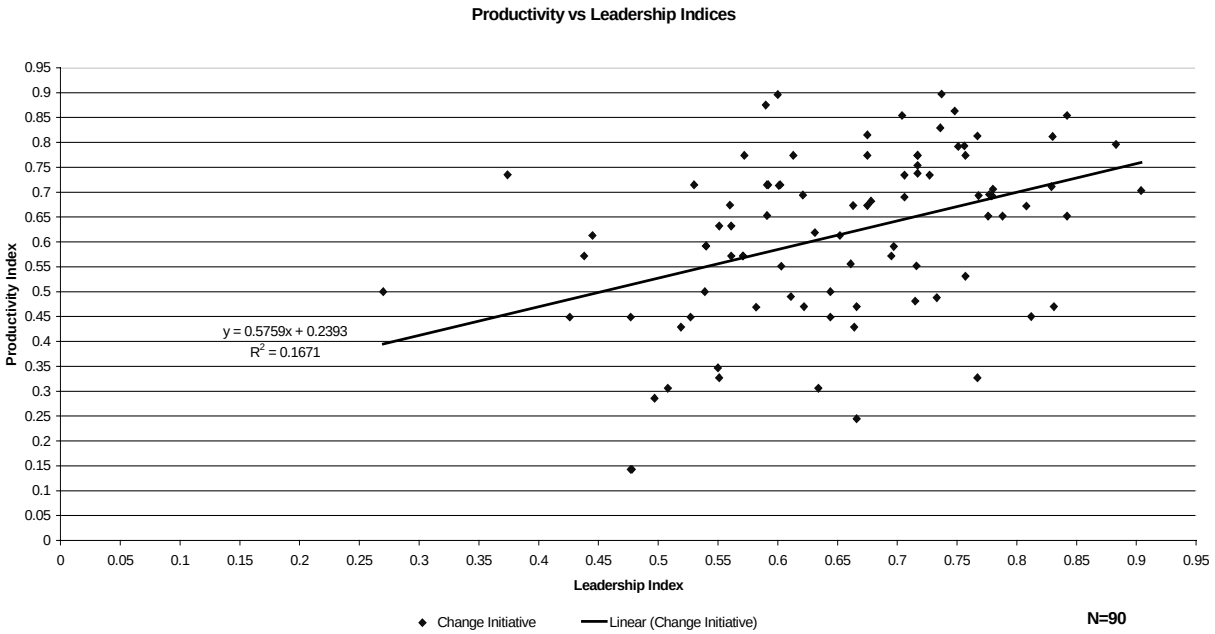


Figure 34 – Productivity vs Leadership correlation model

The correlation model consisted of 90 data points, each representing a change initiative within an organization. The scatter plot's results produced a trend line with a positive correlation. Equation 8 identifies the model's slope and intercept. Equation 9 identifies the model's Pearson product-moment correlation coefficient (r).

$$y = 0.5759x + 0.2393 \quad \textbf{equation 8}$$

$$r = 0.4088 \quad \textbf{equation 9}$$

Where:
y = y coordinate on graph
x = x coordinate on graph
r = Pearson product-moment correlation coefficient

6.1.4.1 Hypothesis Testing of the Model

To test the overall significance of the correlation model, an F test was computed using Microsoft Excel '97 edition. The hypothesis being tested in this regression is as follows.

$$H_o: \beta_1 = 0 \quad \textbf{equation 10}$$

$$H_1: \beta_1 \ \gamma \ 0 \quad \textbf{equation 11}$$

Where:
H_o = Null hypothesis
H_1 = Alternate hypothesis
β_1 = Slope of trend line

The null hypothesis assumes that the sample populations trend line slope is zero. Figure 35 below is the Excel regression output results. The test of the hypothesis is assuming the α = 0.05 (i.e., 95% confidence interval). From the ANOVA (Analysis of Variance) in Figure 35 below the "significance of F" column is the probability that the population sample's slope is 0. With a numerical value for "significance of F" equaling 6.34 E-05, this means that it is highly unlikely that the population of this sample's slope is zero and it is highly unlikely that there is no prediction due to regression from this model given the sample statistics obtained. Hence, it is highly likely that this regression model adds significant predictability of the dependent variable. Null hypothesis in equation 10 above is rejected.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.408766627
R Square	0.167090156
Adjusted R Square	0.157625271
Standard Error	0.155508513
Observations	90

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.42691742	0.42691742	17.65369182	6.3367E-05
Residual	88	2.12809498	0.024182898		
Total	89	2.5550124			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.239278162	0.090959696	2.630595441	0.010061824	0.05851474	0.420041583	0.05851474	0.420041583
X Variable 1	0.575870461	0.137058834	4.201629662	6.3367E-05	0.30349462	0.848246302	0.30349462	0.848246302

Figure 35 – Regression output for correlation model

6.2 Interpretation of Results

The following section provides a discussion of the survey results outlined in Section 6.1 based on the author's interpretation of the collected responses.

6.2.1 Demographics

The majority of the organizations that are represented are large Aerospace companies with "greater than 1,000 employees". The Aerospace segments represented include "Avionics and Electronics", "Engines", "Airframe", "Spacecraft or Launch" and "Defense Electronics". Other types of organization are "Automotive", "Hardware/Software Systems", "Food & Beverage Systems", and "Photo/Film Processes".

The survey respondents vary in titles and functions within their organization. The majority describes their title as "Middle Managers", "Senior Managers", or "Senior Technical Staff". To a lesser percentage, the participants are "Technical Workforce" and "CEO/Executive". Almost all of the survey participants work in either the "Engineering/Product Development" or "Manufacturing/Operations" functions within their organizations.

The numbers of employees who are actively working on or participating in the lean change initiative are dispersed into two segments: “less than 100” and “1000 or more”. This can be interpreted as follows. Less than 100 may indicate that the lean change initiatives are small “Islands of Success” projects (such as “Kaizen events,” “Manufacturing cycle time reductions,” etc.). Large organizational transitions (1000 or more) are when the entire organization is involved with the change initiative. An overwhelming majority of the respondents indicated that the evolution of the lean change initiative is through “Top down” influence as opposed to “Bottom up” influence.

6.2.2 Leadership

Senior Management with the assistance of the Enterprise Leader is the most likely to create the lean change initiative’s vision. The “Senior Manager” function is recognized throughout the organization as the most influential driver of the lean change initiative.

6.2.2.1 Shared Purpose

An organization’s lean initiative’s vision is in most cases “understood by its employees”. In some cases, the “majority of employees did not understand the lean initiative’s vision”. This may be attributed to certain cases where the employee did not actively participate in or was not involved with the initiative. In the majority of cases, the lean initiative’s vision was “very visible throughout the organization”, enabled by good communication efforts.

6.2.2.2 Empowerment

The empowerment or decision making capabilities of the organization’s employees on “Key” business or technical issues are mostly “made at Senior Management levels”. There are a moderate number of decisions made at “less than Senior Management levels”. In support of this answer, “Key” decisions made in the Aerospace Industry sometimes can translate into life or death scenarios. It is common in this type of environment to make “Key” business or technical decisions at the Senior Management levels. In the cases of decisions that may not be “Key” in the context of life or death, it is most likely that the employee decision capabilities are made at less than Senior Management levels.

Empowerment is an important element of successful visionary leadership. Empowering the organization to maintain the momentum of the change initiative creates a positive reinforcement state, and is critical to success. Without empowering the workforce to make day to day decisions that support the implementation of the change initiative, a vicious cycle exists and a high probability of failure of the initiative is likely.

6.2.2.3 Appropriate Organizational Changes

In the majority of the cases, the organization’s functional objectives “integrate well and support with the lean initiative’s vision”. In addition, “Communication within departments, between departments and with senior management” enables a process for integration between functional objectives and the vision.

6.2.2.4 Strategic Thinking

The most effective strategy used during the implementation of the lean change initiative was that "clear goals and objectives" were available to the organization. "Committing new resources to facilities and locations" to accomplish the initiative's vision was also moderately effective. In some cases, equipment was moved from one facility to another to help accomplish the vision. In others, highly committed people would voluntarily work on the lean implementation in addition to their current roles and responsibilities.

"Strategic Alliances" (Consultants, external change agents, partnerships, etc.) in the majority of cases, were not effectively implemented during the lean change initiative's. "Building the organization's human capital" to accomplish the initiative's vision in the majority of cases, was not effectively implemented during the lean change initiatives.

6.2.3 Productivity Outcomes

6.2.3.1 External Value

The external value components (Customer Satisfaction, Schedule/Delivery Performance, and Quality of Product or Service) all were favorable. The survey participants acknowledged significant improvements in all three metrics.

Customer satisfaction had improved more than "somewhat" (on the scale of 1 to 7) or approximately 20 percent after the lean change initiative was implemented. Schedule/Delivery Performance had improved more than "somewhat" or approximately 10 percent after the lean change initiative was implemented. Quality of product or service had improved "somewhat" or approximately10 percent.

It is noted that these improvement percentages are not normalized. A 20 percent increase in Customer Satisfaction may not be comparable to a 10 percent increase in Schedule/Delivery Performance nor 10 percent increase in Quality of Product or Service. However, acknowledging the significant increases in each of these metrics, a measure of success is indicated.

6.2.3.2 Internal Value

The internal value components (Resource Utilization, Return on Assets and Cycle time) all were favorable. The survey participants acknowledged significant improvements in all three metrics.

Resource Utilization had improved more than "somewhat" to almost "very much" (on a scale from 1 to 7) or approximately by more than 20 percent. Return on Assets had improved more than "somewhat" or approximately more than 10 percent. Cycle time had improved "very much" or approximately more than 50 percent. It is noted that these improvement percentages are not normalized. A 10 percent increase in Return on Assets is not comparable to a 20 percent increase in Resource Utilization or 50 percent increase in Cycle time. However, acknowledging the significant improvements in each of the metrics, indicates a measure of success.

6.2.3.3 Reasons for Success

Strong leadership and commitment by top management are key enablers to the successful outcomes of a lean change initiative. In addition to this, the lack of strong leadership and commitment by top management are key enablers to the lack of successful outcomes of a lean change initiative. For example, in the cases in which the lean initiative was not so successful, the main reason was the lack of top management leadership and support to the initiative. With these examples in mind, the following is implied: Top management leadership and commitment to a lean change initiative has a positive correlation to its successful outcomes.

The remaining sections of Chapter Six (section 6.3 to section 6.6) detail four different data analysis scenarios that were mentioned earlier in Chapter One. The first scenario analyzes Aerospace versus Non-Aerospace organizations. The second scenario analyzes CEO/Executive/Senior Management versus Middle Management versus and Senior Technical Staff/Technical Workforce. The third scenario analyzes "Top Down" versus "Bottom Up" evolution of the change initiative. The fourth scenario analyzes Textron System's Division (Wilmington, Massachusetts) as a case study.

6.3 Scenario One – Comparison of Aerospace vs Non-Aerospace Organizations

The data analysis section provides four interesting scenarios that will be presented within this chapter. The first scenario analyzed segregates the survey sample's Aerospace organizations from the Non-Aerospace organizations (the charts can be found in Appendix Two). As previously described, the Aerospace segments represented include "Avionics and Electronics", "Engines", "Airframe", "Spacecraft or Launch" and "Defense Electronics". Non-Aerospace organizations were represented by the following industries: "Automotive", "Hardware/Software Systems", "Food & Beverage Systems", and "Photo/Film Processes".

For the most part, the overall leadership results were fairly the same between the Aerospace and Non-Aerospace groups studied. For the productivity section, the Aerospace organizations on average had greater improvements in both the external value and internal value metrics. One large difference in answers for the external value metrics section was the perceived improvement in Quality of Product or Service. The Aerospace organizations' responses or perception of improvement to this metric were on average higher than the Non-Aerospace organization's responses (see Figure 36 below).

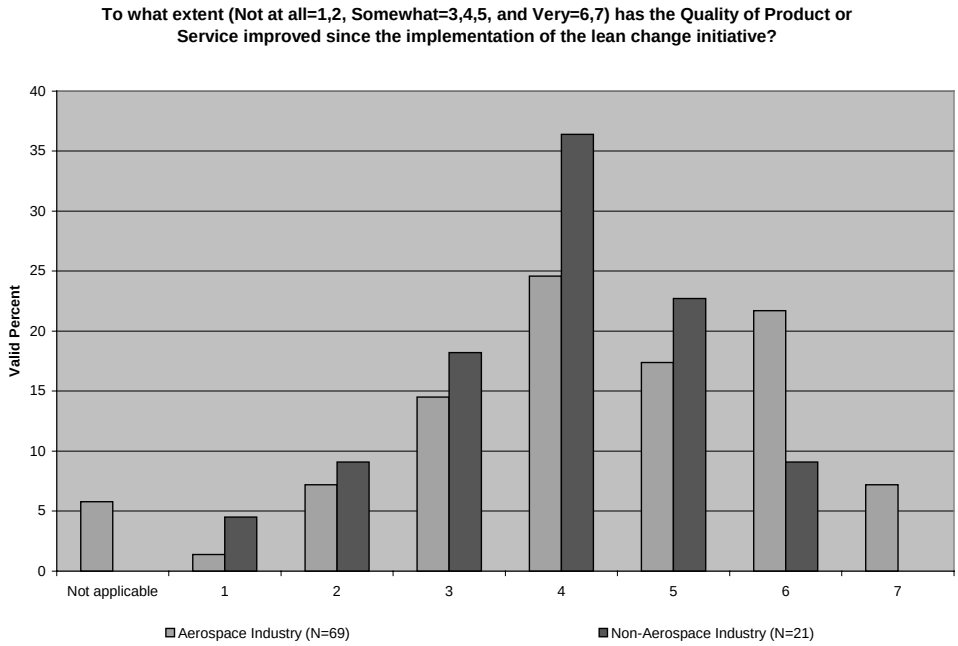


Figure 36 – Extent of quality improvement

A possible interpretation of this difference between the two groups could be the recent re-focusing on product quality within the U.S. Aerospace Industry. The customer is not only expecting but also demanding a commitment to quality of the products it purchases from its aerospace organizations. The increased competition for defense contracts in conjunction with government procurement reform results in the U.S. Aerospace Industry continuously improving its product quality.

For the Internal Value metrics, the Aerospace group had on average a higher response for Cycle Time improvement (see Figure 37 below). A possible interpretation of this difference could be that the U.S. Aerospace Industry is currently implementing "Lean" principles and practices throughout their organizations. One of the metrics that can be positively correlated to the effectiveness of "Lean" is improved cycle time. Cycle time reduction can be directly measured as a result of implementing a lean process within a manufacturing facility. Aerospace organizations have shown major improvements in implementing "Lean" throughout their manufacturing/production facilities, specifically in the area of Cycle Time reduction.

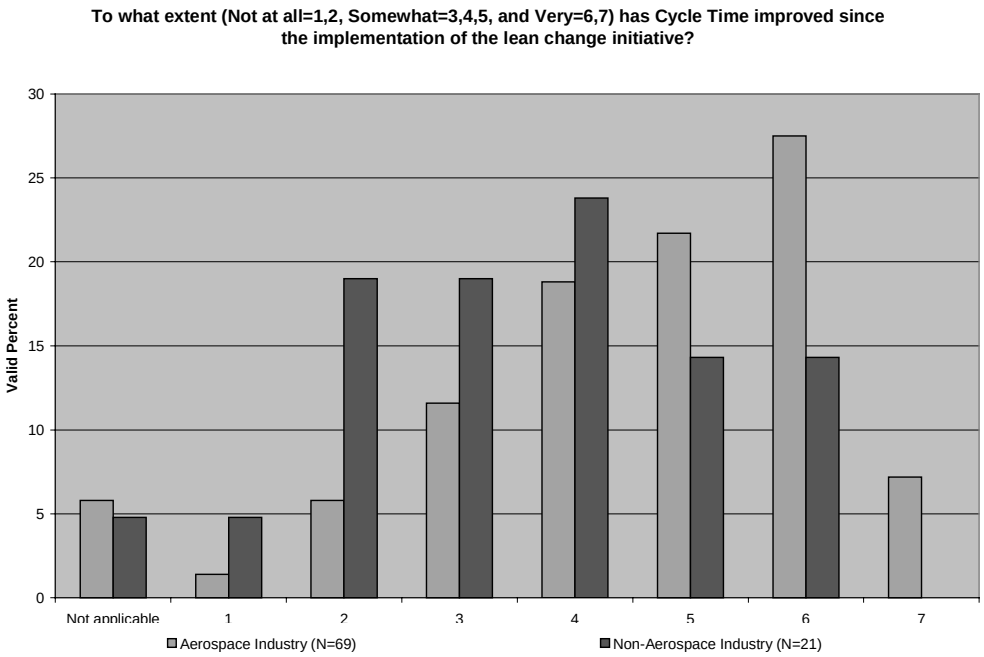


Figure 37 – Extent of cycle time improvement

An analysis of correlation's was performed to see if any differences existed between the Aerospace and Non-Aerospace segments (see Figure 38 below).

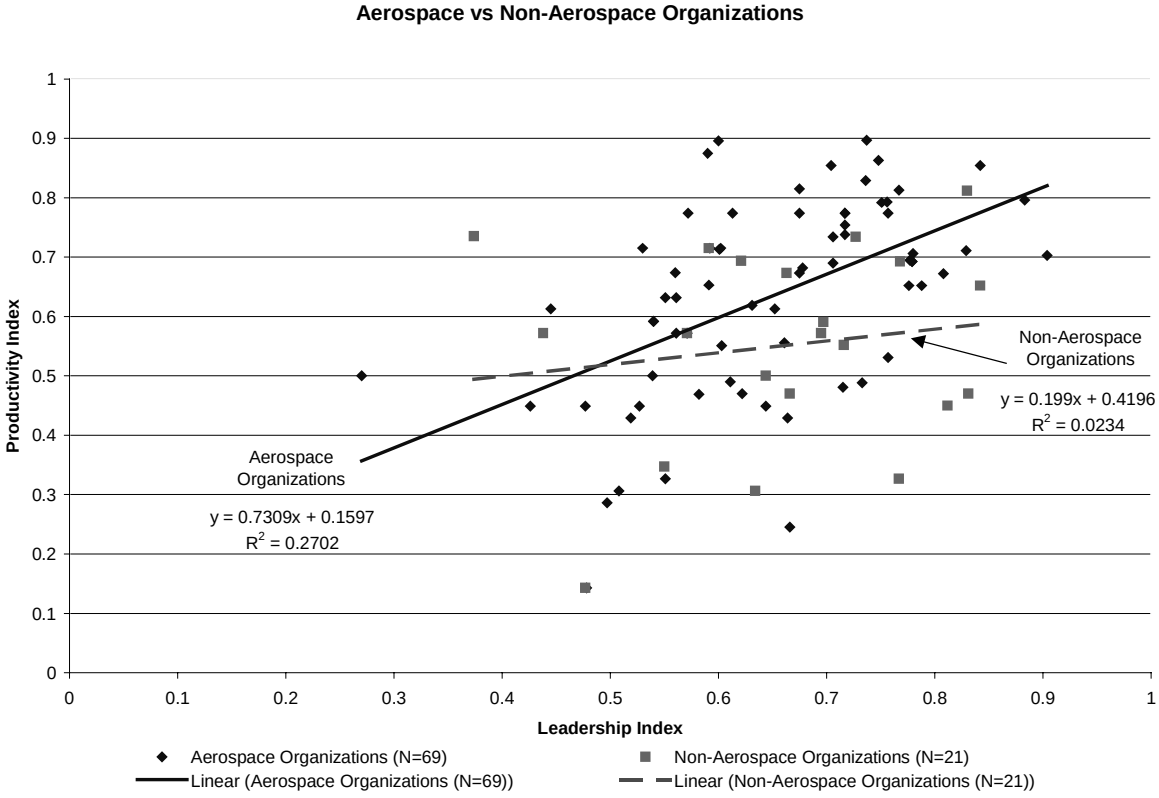


Figure 38 – Correlation of Aerospace vs Non-Aerospace Organizations

Figure 38 depicts two regression trend lines, one for the Aerospace segment and one for the Non-Aerospace segment. Equations 12 through 15 below detail the equations for each trend line on the chart.

For the Aerospace Segment:

$$y = 0.7309x + 0.1597 \quad \textbf{equation 12}$$
$$r = 0.5198 \quad \textbf{equation 13}$$

For the Non-Aerospace Segment:

$$y = 0.1990x + 0.4196 \quad \textbf{equation 14}$$
$$r = 0.1530 \quad \textbf{equation 15}$$

The differences between the two segment's trend lines are interesting. The Aerospace trend line has a slope of 0.7309, which can be interpreted as a strong positive correlation between successful visionary leadership and productivity. For example, for one unit increase in visionary leadership, productivity increases by 0.7309 units. For Non-Aerospace organizations, the slope is much lower, however still a positive correlation. For example for an increase in one unit of visionary leadership an increase of 0.1990 units in productivity occurs.

The Aerospace segment data has a Pearson product-moment correlation coefficient of 0.5198, which provides a modest positive correlation. There is a large difference between the Aerospace and Non-Aerospace Pearson correlation coefficients (r) on Equations 12 and 14). The Non-Aerospace (r) is 0.1530 or only a slight positive correlation.

One way to interpret the data from Figure 38 is to take it from a "Leadership" perspective. As the trend line moves more toward the right of the figure, the Aerospace organization's perception of productivity is much higher than the Non-Aerospace organization's for the same amount input of visionary leadership. It can be suggested that since the Aerospace Industry is highly involved in implementing the "Lean" principles and practices, more of the employees notice the improvements in both the external as well as internal value metrics.

One potential answer to this is that the Non-Aerospace organization's data points exhibited high variability. If selected points below the trend line were so called "outliers" and could be eliminated from the data set, then it is quite possible that the slopes of each line could be equal. Since the Non-Aerospace data is highly variable, then with outliers eliminated the actual trend lines slope and Pearson Coefficient for this population may be much different.

6.4 Scenario Two – Comparison of Different Leadership Roles within the Sample

The second scenario analyzes the different roles within an organization and the perceptions of leadership and productivity associated with each role. The segments are as

follows: CEO/Executive/Senior Managers, Middle Managers, and Senior Technical Staff/Technical Workforce.

The majority of the three segments are best represented by the Aircraft (Airframe) sector with CEO/Executive/Sr. Managers (33%), Middle Managers (32%), and Sr. Technical Staff/Technical Workforce (30%).

For the most part, the leadership results collected by each group were fairly even, or approximately the same. Overall, the external value metrics had higher perceived improvements by the Middle Managers segment, followed by the CEO/Exectutive/Sr. Managers (see Appendix Two). An example of these perceptions can be illustrated with the Quality of Product or Service metric response frequencies in Figure 39 below. Examining Figure 39, the Senior Technical Staff/Technical Workforce's; and CEO/Executive/Sr. Manager's perceptions seemed to be lower than the Middle Manager on this metric. A potential explanation for this is that the Middle Manager segment is directly responsible for this specific output metric, i.e., they may have more knowledge of what actual improvements occurred due to the implementation of the lean change initiative.

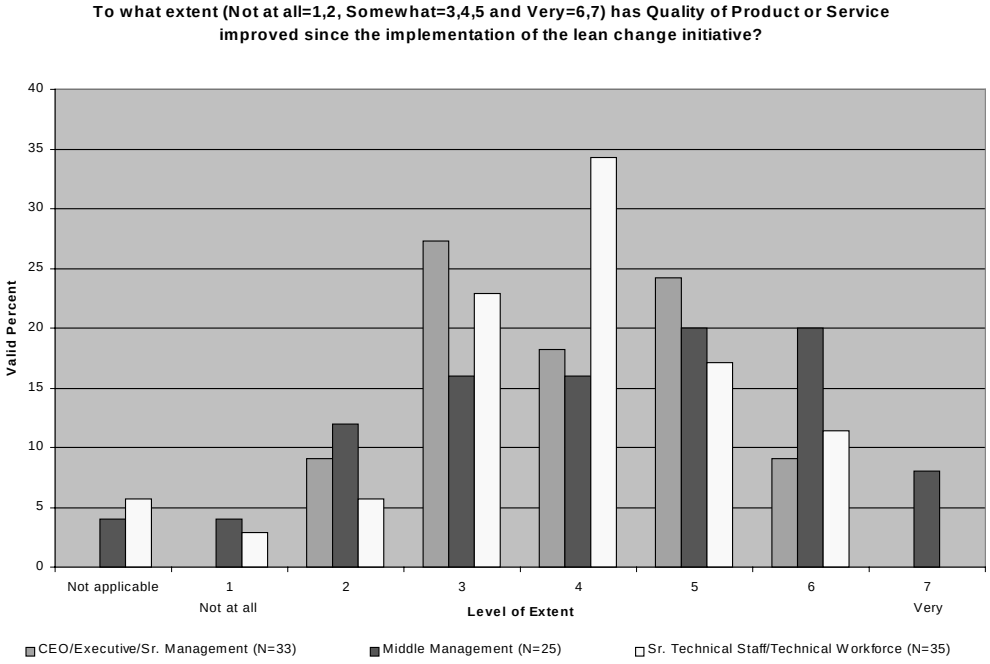


Figure 39 – Extent of schedule/delivery improvement

For the internal value metrics, the three groups were fairly close in their perceptions of improvement. One interesting chart was the improvement of Resource Utilization (Figure 40 below). The CEO/Executive/Sr. Managers; and Middle Managers responded approximately the same with a higher average than the Sr. Technical Staff/Technical Workforce. One reason could be that the level of information on Resource Utilization might be richer at the CEO/Executive/Sr. Managers level, which is transferred down into the Middle Managers to actually implement the lean change initiative. Sr. Technical Staff/Technical Workforce may not be as involved with the implementation of the initiative as the other two groups.

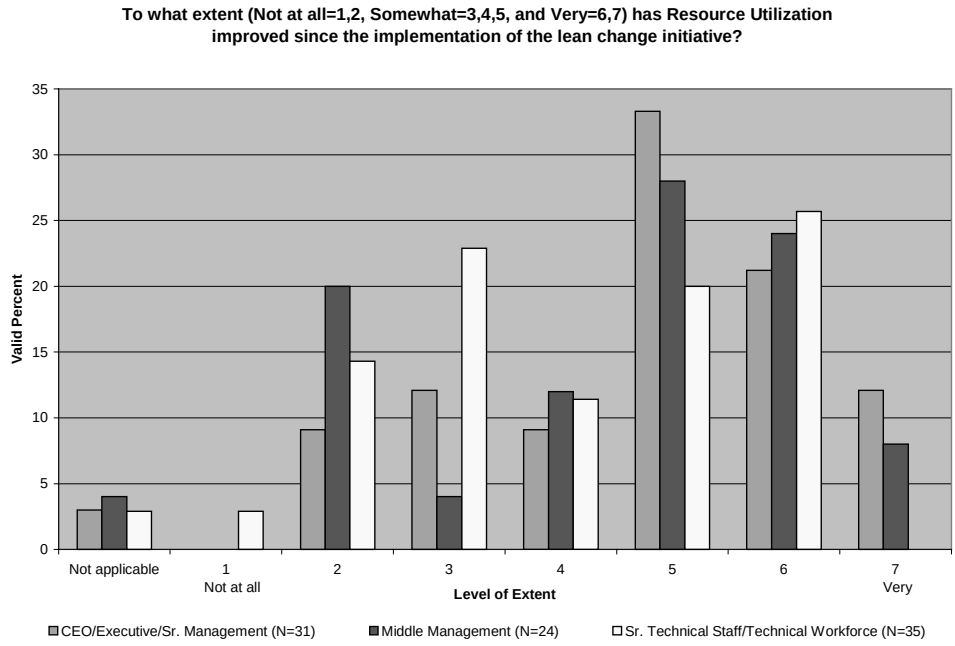


Figure 40 – Extent of resource utilization improvement

The correlation chart for this scenario had interesting trend lines (see Figure 41 below). Equations 16 through 21 depict the equations for the trend lines in this model.

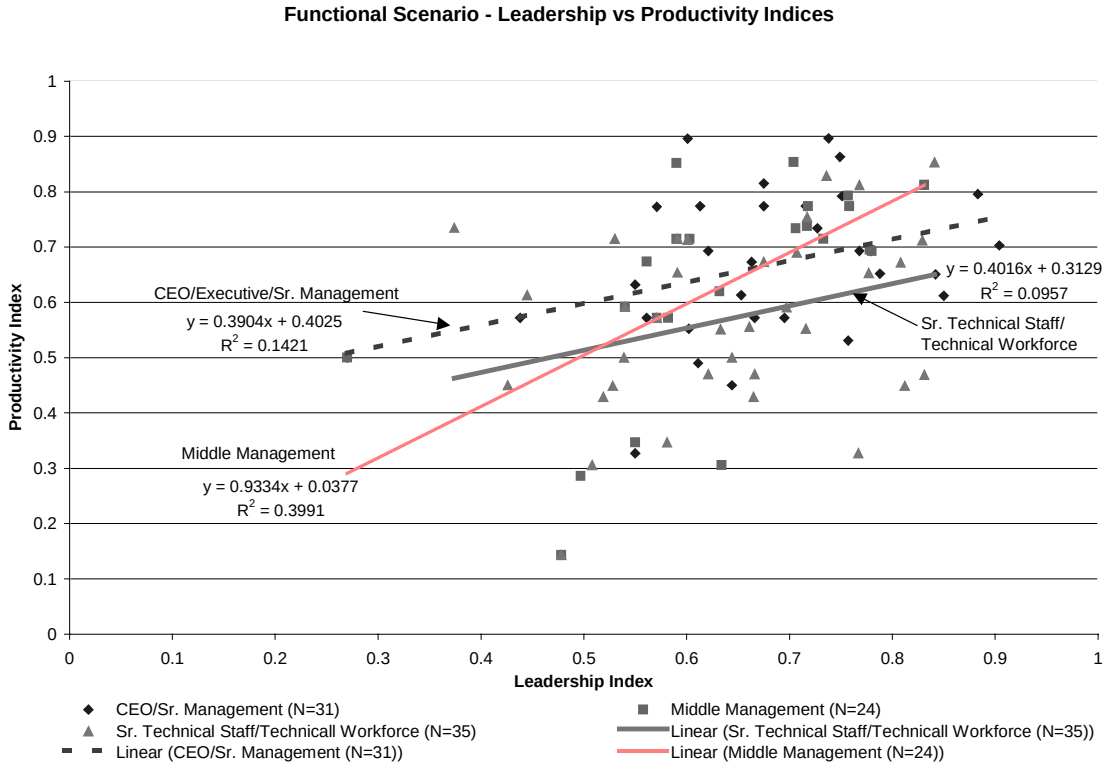


Figure 41 – Leadership roles in organization correlation chart

For the CEO/Executive/Sr. Management Segment:

y	=	0.3904x + 0.4025	**equation 16**
r	=	0.3770	**equation 17**

For the Middle Management Segment:

y	=	0.9334x + 0.03077	**equation 18**
r	=	0.6317	**equation 19**

For the Senior Technical Staff/Technical Workforce Segment:

y	=	0.4016x +0.3129	**equation 20**
r	=	0.3094	**equation 21**

The CEO/Executive/Senior Management segment's slope was 0.3904. An example would be for one unit increase in visionary leadership, the productivity increase would only be 0.3904 units. Basically, the trend line represents that the amount of productivity per leadership unit is only approximately 40 percent. This segment's perception of productivity is increased in comparison to the same amount of visionary leadership in the other two segments. An exception occurs when the leadership index reaches approximately 0.675, where the middle management perception of productivity is greater than top management's at this leadership level.

The CEO/Executive/Senior Management segment may have in general a higher productivity perception since they are very familiar with the output metrics within their organization's division/section. In most cases, this group is directly responsible for reporting the outcome metrics to other entities within the organization. With this in mind, they may believe that they have the most accurate information on the actual increases in productivity due to the lean change initiative. The Pearson Correlation Coefficient is a modest positive correlation, due to a high variation in data points.

The Middle Management segment is very interesting. The slope of visionary leadership to productivity is 0.9334. This is very close to a slope of 1, meaning that the Middle Manager's perception of productivity increases at almost the same rate that the visionary leadership is increased. The role of the Middle Manager typically is to implement top management's business objectives. In doing so, the Middle Manager requires various levels of prescribed leadership in order to perform his or her functions. This requires a certain amount of dependence on leadership to get the task completed. Middle management also is directly involved in implementation, and expects to be a "key" person in the implementation of a lean change initiative. In the role as the implementers, the Middle Manager will have information on program productivity metrics, or the success of the implementation. Therefore, the Middle Manager's perception of leadership and productivity should increase at approximately the same rate.

The Middle Management segment's Pearson Correlation Coefficient was 0.6317, which resembles a moderate positive correlation. The data points had less variance than the other two segments.

The Senior Technical Staff/Technical Workforce segment had approximately the same slope (0.4016) as the top management segment. This segments perception of productivity is the lowest of the three segments for the same amount of visionary leadership. An exception to this occurs at approximately from the 0 to 0.51 leadership index values (where this segment's perception of productivity is higher than Middle Management's). A possible reason of the overall low perception of productivity per visionary leadership unit may be due to this group being very technically oriented. They may not be as informed as the other segments when it comes to productivity metrics. In addition to this, the data points have a very high variance from the trend line with an r of 0.3094, indicating a slight positive correlation. With such a high variance, the data may contain specific "outliers" which can skew the accuracy of the results.

6.5 Scenario Three – Comparison of "Top Down" vs "Bottom Up" Evolution

Scenario three analyzes the data by grouping the respondents into two categories, the ones who believed the evolution of the lean change initiative was from "Top Down" influence, and those who believed that the evolution came from "Bottom Up" influence. The correlation model in Figure 42 below provides some interesting trend lines. Equations 22 through 25 depict the slope, intercept and Pearson coefficient for the listed trend lines.

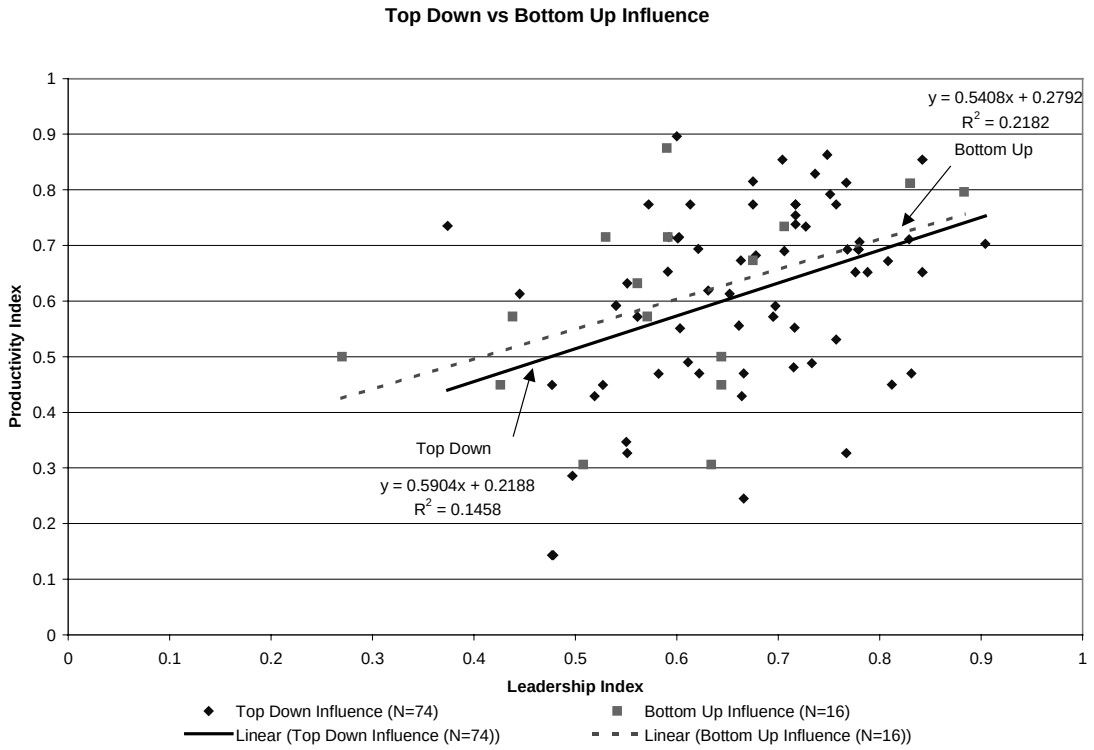


Figure 42 – Top down vs Bottom up evolution

For the "Top Down" influence Segment:

y	=	0.5904x + 0.2188	**equation 22**
r	=	0.3818	**equation 23**

For the "Bottom Up" influence Segment:

y	=	0.5408x + 0.2792	**equation 24**
r	=	0.4671	**equation 25**

The interesting thing about these two trend lines is that both of the slopes are very close to each other. This may suggest that it may not matter whether the evolution of the lean change initiative, is "Top Down" or "Bottom Up" influenced. What does matter is the implementation of the lean change initiative. The implementation needs both "Top Down" to drive and lead the change, as well as "Bottom Up" to implement, continuously improve and maintain the momentum of the lean change. Without both, the lean change initiative will have a less of a chance of success.

Another interesting interpretation of these two trend lines could be that strong leadership driving the change may exist at either the Senior Management level in a "Top Down" or Technical Workforce level in a "Bottom Up" evolution. It implies that in either case, ("Top Down" or "Bottom Up") strong leadership may be the critical element enabling the successful outcomes of a lean change initiative.

The Pearson Correlation Coefficient for both trend lines is a modest positive correlation. There is high variance from the trend line for the data points collected.

6.6 Scenario Four – Textron Systems Case Study

Scenario Four analyzes the Textron System's organization located in Wilmington, Massachusetts as a case study to this thesis. The analysis consists of nine personal interviews from various levels and functions within Textron Systems. The information from the interviews was processed and compared to the survey sample and correlation model described throughout this thesis.

6.6.1 Introduction[3]

Textron Systems Division launched a continuous improvement process in its Operations Division with a vision of raising its capabilities and performance to such levels as to make them a competitive advantage in the marketplace. The process is called 10X™.

[3] Textron Systems Site Report Special Edition, 1998.

6.6.2 Overview of the 10X™ Process[1]

"The meta-principles of the 10X™ Continuous Improvement process are to: stimulate and focus the emotional and physical energy of the workforce through the creation of a compelling vision; set challenging goals for improvement that force out of the box thinking; develop mutual trust with the workforce such that improvements don't equate to loss of jobs; and, recognize and reward success."[4] The objective of 10X™ is to continuously improve each process within the organization by 10 times each year.

The 10X™ Continuous Improvement methodology consists of five key principles: 1) Understand requirements; 2) Measure process capability; 3) Improve the process; 4) Control process variables; and, 5) Satisfy the customer (internal and external).

The implementation of 10X™ Continuous Improvement is a "Top Down," "Bottom Up" balance. Senior management drives down the continuous improvement vision and challenges, provides training and leadership, and fosters recognition, rewards and trust. The product or process teams possess the understanding of customer requirements and detailed knowledge of the process capabilities that allow improvement opportunities and the related enablers to be identified and implemented. It is the "grass roots" involvement and accountability, which engages the hearts, not just the minds, of the workforce.

Textron Systems' Wilmington facility produces Sensor Fused Munitions products for the U.S. Government. Production processes include printed-wiring assembly, Electro-mechanical assemblies, and machining operations. Final assembly of the munitions is done at a subcontractor's facility in Kansas, but is managed as one of Textron's own process steps.

In 1996, Wilmington was in the process of ramping up from Low Rate Initial Production (LRIP) to Full Rate Production (FRP). The facility had been constructed early in the program with ample capacity for volume production. By 1996, it was apparent that manufacturing technology had not kept pace with product technology, in terms of accuracy and speed. As a result, defect levels rose along with production volume.

Introduction of the 10X™ process in late 1996 was essential to confronting this challenge. Process understanding, problem solving techniques and integrated enablers provided the tools needed to achieve 10X™ goals. In the first year, root cause analysis of defects pointed to issues with solder application in the printed wiring assembly. Improved control systems and new equipment were identified and installed to improve accuracy of component placement. The machining operation was found to be another source of variation in producing defects. Equipment capabilities were unable to meet the required dimensional tolerances. In this case, a multi-year strategy was prepared to upgrade equipment. The first installment of capital was put in place in 1997, demonstrating a positive influence on defect reduction.

By 1998, in addition to a continued focus on defects, the teams focused on other improvements such as reducing cycle time and re-engineering processes to eliminate unnecessary operations. Cross - training proved to be a very effective enabler. A formalized,

[4] Ibid., Textron Systems, 1998

documented program was instituted with mentors, training matrices for each employee, and skill evaluations. Team members were provided with >80 hours of training per year allowing for rotation within a given process, as well as the ability to move between multiple processes. While the focus on training helped improve process controls and reduce defects, the cross-training initiative allowed for total flexibility of the workforce to meet challenging schedule needs.

The improvement activities in Wilmington were further challenged in 1998, when several Product anomalies were reported. Operations teams worked with design engineers to investigate these anomalies and resolve issues for the customer. The foundation provided by the 10X™ methodology assisted the teams in both problems solving efforts and corrective action implementation.

6.6.3 Case Study Analysis

The following sub-sections represent the author's interpretation of the data collected at Textron Systems during the case study interviews. Appendix Two will include the appropriate data charts for viewing.

6.6.3.1 Demographics

The Textron System's group that was interviewed represented multiple roles within the organization including "Senior Management", "Middle Management", "Senior Technical Staff", and "Technical Workforce". The majority (68%) of the group worked in the "Manufacturing/Operations" function. Other functions were "Engineering/Product development", "Supply Chain" and "Human Resources".

6.6.4 Leadership

The lean initiative (or 10X™ Continuous Improvement Process) at Textron Systems had evolved from "Top Down" influence. The vision was "composed by Senior Management", who later was recognized throughout the organization as "the most influential driver of the initiative".

6.6.4.1 Shared Purpose

The majority of the responses (55%) claimed that "some employees understood the 10X™ vision," since it originated in one division, specifically in Manufacturing/Operations. Thirty-two (32%) of the responses believed that "most of the employees understood the 10X™ vision." The majority of the responses (68%) claimed that "the vision was very visible and all employees communicate it personally."

6.6.4.2 Appropriate Organizational Changes

Fifty three percent (53%) of the respondents believed that 10X's vision was "well integrated with Textron System's functional objectives." Thirty seven percent (37%) of the respondents stated that the process, which enabled to organization to better integrate the vision's

objectives with Textron's functional objectives was "accomplished through discussing the objectives within departments and between departments."

6.6.4.3 Empowerment

Over fifty four percent (54%) of the respondents stated that employee empowerment was in the form that "key business and technical issues are available to some employees, however most decisions are made at the senior management levels."

6.6.4.4 Strategic Thinking

While implementing the 10X™ initiative, 100% of the respondents claimed that "Clear Goals and Objectives were used effectively as a strategy." Over 78% of the respondents stated that "Committing New Resources to Facilities, Locations and equipment to accomplish the vision was used effectively as a strategy." Thirty two percent (32%) of the respondents stated that "Strategic Alliances were used effectively as a strategy." Thirty two percent (32%) of the respondents believed that "Building the Organization's Human Capital to help accomplish the vision was used effectively."

6.6.5 Productivity Outcomes

6.6.5.1 External Value

Over fifty four percent (54%) of the respondents stated that "Customer Satisfaction had improved more than "somewhat" (on a scale from 1 to 7) since the implementation of the 10X™ initiative." Over fifty four percent (54%) of the respondents stated that "Schedule/Delivery Performance improved "very much" since the implementation of 10X™." Figure 43 below illustrates how the Textron 10X™ initiative had an overwhelmingly higher performance compared with the Aerospace and Non-Aerospace organization's analysis. Thirty two percent (32%) of the respondents claimed that the "Quality of Product or Service improved "very much" since the implementation of the 10X™ initiative."

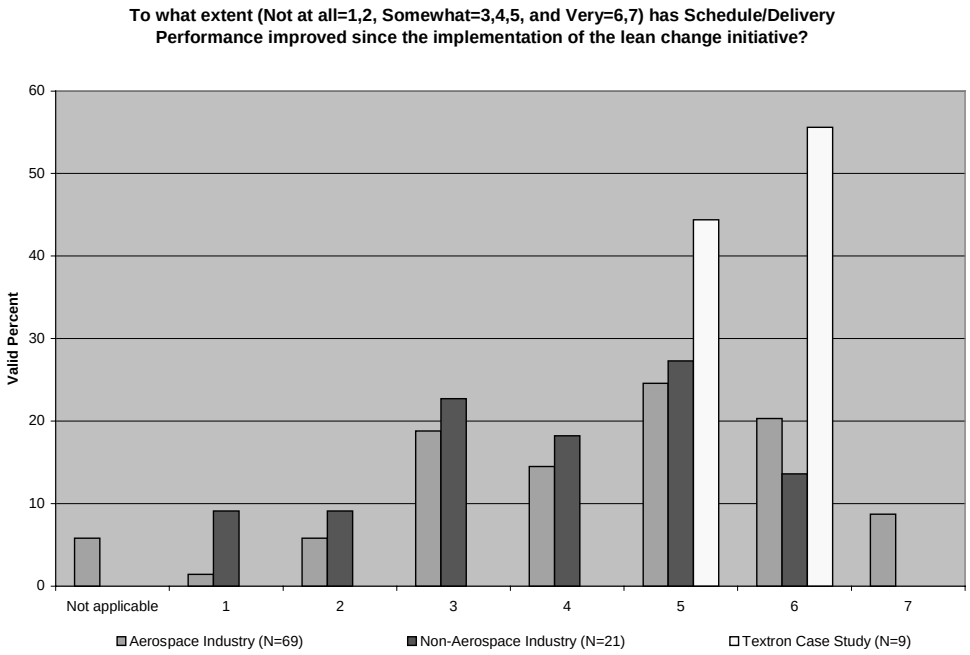


Figure 43 – Extent of schedule/delivery performance improvement

6.6.5.2 Internal Value

Over forty four percent (44%) of the respondents stated that "Resource Utilization had improved "very much" since the implementation of the 10X™ initiative." The majority (78%) of the respondents claimed that they "did not know whether Return on Assets had improved with the implementation of 10X™." Over seventy five percent (75%) of the respondents stated that there was "very much" an improvement in Cycle Time since the implementation of the 10X™ initiative. Figure 44 below illustrates Textron System's improvement in cycle time versus the Aerospace and Non-Aerospace organizations surveyed.

Over sixty eight percent (68%) of the respondents stated that "the 10X™ initiative was very successful."

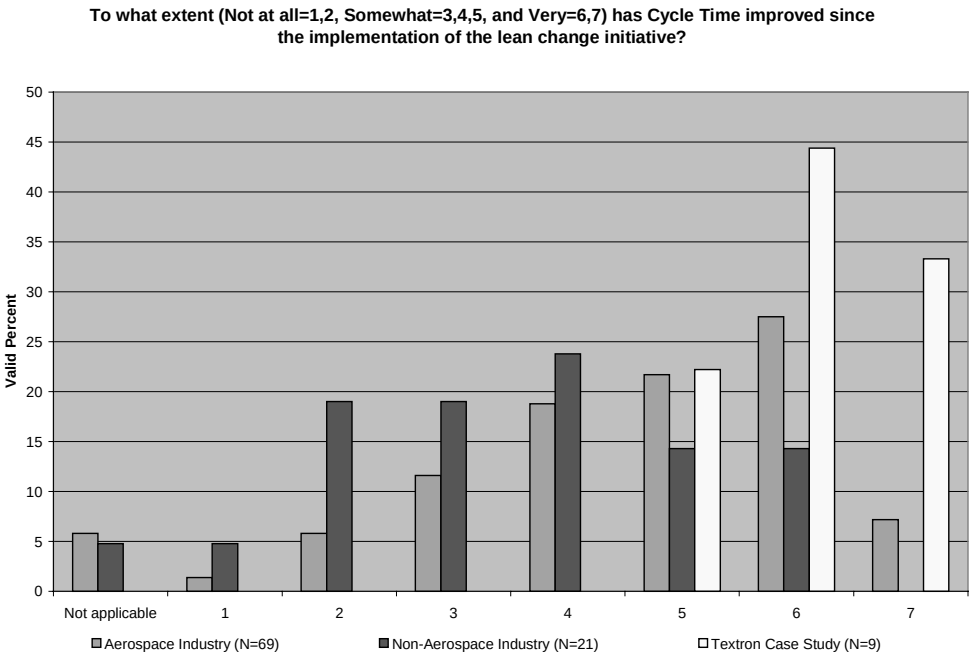


Figure 44 – Extent of cycle time improvement

6.6.5.3 Correlation Results

The Textron System's 10X™ initiative was modeled and plotted in Figure 45 below. It was very interesting to test this Productivity/Leadership model with a real case study. The model developed within this thesis plotted Textron System's 10X™ initiative almost identically on the trend line. In comparison to all of the other sources of data 10X's results were better than 90 percent of the survey sample. This can arguably be even better than 90 percent since nine interviews results were averaged together to determine a data point.

Since the Textron System's data point fell very close to the model's trend line the following equation can be assumed (see equations 26 and 27 below).

$$y = 0.5759x + 0.2329 \quad \textbf{equation 26}$$

$$r = 0.4088 \quad \textbf{equation 27}$$

The slope of the trend line is 0.5759 which dictates that for every 1-unit increase in leadership, a 0.5759 units increase in productivity follow. The Pearson Correlation Coefficient is 0.4088, or a modestly positive correlation. The collected data had a high variability off the trend line, which caused a lower Pearson coefficient value. However, it is noted that a positive correlation exists in each case.

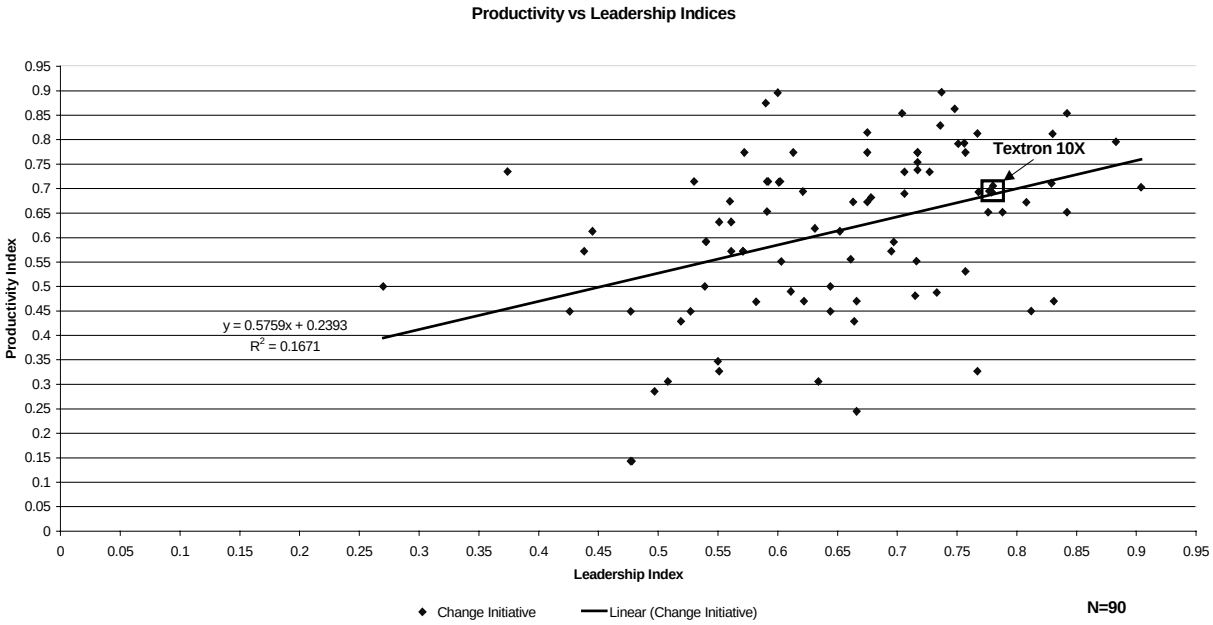


Figure 45 – Overall correlation model (including Textron data point)

At Textron Systems, the implementation of the 10X™ initiative resulted in many product and process improvements. Almost all-External as well as Internal output metrics improved. For example, metrics such as throughput yield, inventory turns, on-time delivery and cycle time all performed better than expected.

Textron's 10X™ initiative had top management commitment from concept to implementation. Senior management at this facility were committed to meet with each product and process team on a weekly basis to discuss and review the performance metrics associated with the 10X™ initiative.

One hundred percent (100%) of the respondents interviewed stated that the primary enabler for the success of the 10X™ initiative was "driven from Senior Management commitment and leadership throughout the entire change process."

Chapter Seven - Conclusions

The following conclusions are based on the results and interpretations gathered throughout this research experiment and data collection process.

- The hypothesis stated earlier in Chapter 4 suggesting that research could prove that there is a positive correlation between "Top" management leadership and the success of a lean change initiative is not rejected. The correlation models presented in Chapter 6 further reinforce with data this conclusion.

- The visionary leadership formula identified in Chapter 4 (equation 6) proved to be an effective method to measure "Top" management involvement or leadership during a lean change initiative. In order to attain successful visionary leadership the following elements or variables need to be assessed or measured: Shared purpose, Empowerment, Appropriate organizational changes, and, Strategic thinking.

- The productivity outcomes formula identified in Chapter 4 (equation 7) proved to be an effective method to measure the success of a lean change initiative. Successful outcomes equated to a combination of both external and internal value metrics. External value metrics consists of: Customer satisfaction, Schedule/Delivery performance, and Quality of product or service. Internal value metrics consists of: Resource utilization, Return on assets, and Cycle time.

- The proposed correlation model identified in Chapter 4 (Figure 2) and used throughout this thesis is an effective tool that can be applied to quantify both the visionary leadership and productivity outcomes of a change initiative. The model is an assessment tool for an organization to measure any strength and/or weakness attributed to both visionary leadership and productivity outcomes. The model can be used as a benchmarking tool, to visibly see where a division or section fits versus others within the organization based on the two measures. The model can also be used as a strategic forecasting tool, to determine where the organization wants to or has to go in order to maintain competitive advantage and market share.

- Top management involvement and leadership is essential in driving a change initiative to successful implementation within an organization. However, this is not a one way process. Bottom up involvement is also a major element of the successful implementation of a change initiative. Senior management should be tasked with exposing the initiative's vision and challenges to the organization so that all employees understand what needs to be accomplished. The employees possess the detailed knowledge of the customer requirements and the process capabilities that will allow and enable improvement opportunities to be identified and implemented to continue the momentum of change. As Textron System's phrased it, "It is the "grass roots" involvement and accountability which engages the hearts, not just the minds, of the workforce."

- Without Top management involvement and leadership driving a change initiative a large barrier to success exists. In most cases when the lean change initiative was not so

successful, the majority of the survey respondents stated that it was due to a "lack of leadership of top management to support the initiative."

The converse of this is also true and supported by research. In the cases where the lean change initiative's were perceived to be successful, the majority of the respondents claimed that the reason for the success was due to "strong leadership and commitment by top management."

- The Aerospace Industry organizations' perception of productivity for a given amount of leadership is higher than the Non-Aerospace organizations in the survey sample. The Aerospace industry had a relatively high slope trend line, indicating that it was perceived that the amount of productivity output was almost directly proportional to the amount of visionary leadership input for the change initiative. In addition, the Aerospace Industry's perception was that a moderate positive correlation between leadership and productivity existed.

- Middle managers had almost a 1/1 slope trend line of all the functional categories, indicating a perception that the amount of productivity output was almost directly proportional to the amount of visionary leadership input. This was clearly the highest of all three segments studied (CEO/Executive/Sr. Management, and Senior Technical Staff/Technical Workforce). Middle managers perception was that a modest positive correlation between leadership and productivity existed.

- The evolution of the change initiative either "Top Down" or "Bottom Up" driven resulted in almost identical trend lines on the correlation chart. This arguably can be due to the fact that the idea or evolution of the lean change initiative can come from anywhere within the organization. However, in order to successfully implement lean change, both "Top Down" and "Bottom Up" types of leadership need to exist as well as complement each other.

- The correlation model is tested through the collection of data points and subsequent analysis at Textron Systems as a case study. The equations listed in Chapter 4 (equations 6 and 7) prove to be valid tools to measure visionary leadership and productivity outcomes. The Textron System's case study proved to be in the top ten percent of highest scores of the ninety (90) cases studied. Textron System's 10X^{TM} initiative was very successful due to top management leadership and commitment and resulted in achievements beyond expectations on output metrics such as Throughput Yield, Inventory Turns, Cycle Time, and On-time Delivery.

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APPENDIX ONE

Survey of the Impact of Leadership on a Change Initiative

Survey of the Impact of Leadership on a Change Initiative

This survey is designed to measure the impact of leadership on change initiatives within an organization. The survey contributes to the on-going research at MIT's Lean Aerospace Initiative (LAI), specifically, to the Transition to Lean Enterprise Roadmap. The purpose of the Transition to Lean Roadmap is to provide a general framework for assisting companies on the journey to Lean.

Your participation in this survey is very important to the success of this master's degree research thesis. Please be candid and honest in your responses, it is very important to get factual answers regarding your experience. Under no circumstances will the data be reproduced in any way that will damage and/or result in embarrassment to either you and/or your represented organizations. All responses will be kept confidential. Only aggregate statistical results will be reported.

Filling out the complete survey should only take approximately 15 minutes. There are three sections: Section A – General Information; Section B – Implementation; and Section C – Outcomes. I have left areas in the survey open for your feedback. I would be happy to address any comments that you may have regarding this research topic.

The survey can be completed on paper or electronically at the web site http://web.mit.edu/dtonaszu/www/survey/survey_cover.html. *We respectfully request that you complete the survey* ***on or before September 1, 1999****. A return envelope is enclosed to return the paper survey to David Tonaszuck at Building 41-205, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02137. A summary of research results will be available on request. Thank you for your help in this important project.*

Name (optional): _____

Title (position): _____

Organization: _____

Address: _____

Telephone: _____ email: _____

May we contact you about the survey and topics covered? ❑ Yes ❑ No

Do you wish to see a copy of the results? ❑ Yes ❑ No

Please provide the most appropriate response to each question based on the organization in which you currently work. If you do not know the answer to a question, if a term is unclear in a question, or if a question does not apply, simply leave the answer blank.

Section A- General

A.1 What is the nature of manufacturing operations for primary products at this plant? *(Select one)*

1❑Discrete 2❑ Process 3❑ Both or Hybrid

A.2 How many employees are at this business unit location? *(Select one)*

1❑ Less than 100 2❑ 100-249 3❑ 250-499 4❑ 500-999
5❑ 1,000 or more

A.3 Which of the following categories best describes the type of product manufactured at your site? *(Select one)*

1❑ Aircraft (avionics and electronic systems)
2❑ Photo/Film processes
3❑ Aircraft (engines)
4❑ Automotive
5❑ Aircraft (airframe)
6❑ Hardware/Software systems
7❑ Spacecraft or launch system
8❑ Digital copiers
9❑ Food/Beverage systems
10❑ Retail
11❑ Other _____

A.4 Which of these titles best describe your role in the organization? *(Select one)*

1❑CEO/Executive 2❑ Senior Management 3❑Middle Management
4❑Senior Technical Staff 5❑Technical Workforce 6❑ Other _____

A.5 In which functional area of the organization do you work? *(Select one)*

1❑ Engineering/Product development 2❑ Human Resources 3❑Marketing
4❑ Manufacturing/Operations 5❑ Supply Chain 6❑ Accounting/Finance
7❑ Other _____

Section B- Implementation

Please provide answers to the questions regarding a lean change initiative within your organization in which you have participated.

A lean change initiative is a large-scale organizational transformation with the intent to eliminate or improve upon any non-value activities that consume resources within your organization.
An Enterprise Leader is the person who is managerially responsible for this business unit.

B.1a Which functional areas of the organization did the lean change initiative affect? *(Select all that apply)*

1❑ Engineering/Product development 2❑ Human Resources 3❑Distribution
4❑ Manufacturing/Operations 5❑ Supply Chain 6❑ Entire organization
7❑ Other _____

B.1b Please describe the type of lean change initiative undertaken. (Attach any additional pages or previously prepared materials if appropriate.)

_____
_____
_____

B.2 How many employees were actively working on or participating in the lean change initiative? *(Select one)*

1❑ Less than 100 2❑ 100-249 3❑ 250-499 4❑ 500-999
5❑ 1,000 or more

B.3 Which of the following best describes the evolution of the lean change initiative's vision? *(Select one)*

1❑ Through "Top Down" influence (Executive level)
2❑ Through "Bottom up" influence (Middle management or workforce)

B.4 Which of the following statements best characterizes the role played by the Enterprise Leader in formulating the lean initiative's vision? *(Select one)*

1❑ Was not involved
2❑ Written by staff, approved by Enterprise Leader
3❑ Composed by team of Senior Managers, including Enterprise Leader
4❑ Composed by Enterprise Leader, reviewed by Senior Managers; consensus reached
5❑ Composed and announced by Enterprise Leader (not reviewed by Senior Managers)

B.5 Which of the following leaders is recognized throughout the organization as the most influential driver of the lean change initiative? *(Select one)*

1❑ Enterprise Leader
2❑ Senior Manager (Direct report to Enterprise Leader)
3❑ Middle Manager
4❑ Senior Technical Staff
5❑ Other _____

B.6 Which of the following statement(s) best describe the process or processes undertaken to enable your organization to learn & understand the lean initiative's vision? *(Select all that apply)*

1❑ Formal training for introducing the vision to new employees and for refreshing the current understanding of existing employees
2❑ Small group meetings for thorough discussion by all employees.
3❑ Departmental meetings to obtain written feedback from all employees.
4❑ There were no systematic plans or processes.

B.7 Which of the following statements best characterizes the organization's level of understanding of the lean initiative's vision? *(Select one)*

1❑ The lean initiative's vision is understood by all employees
2❑ The lean initiative's vision is understood by most employees
3❑ The lean initiative's vision is understood by some employees
4❑ The lean initiative's vision is not understood by the majority of the employees

B.8 Which of the following statements best characterizes the visiblility of the lean initiative's vision to the organization? *(Select one)*

1❑ The lean initiative's vision is displayed in lobby areas and in conference rooms.
2❑ The lean initiative's vision is displayed in some locations throughout the company's facilities.
3❑ The lean initiative's vision is very visible throughout company facilities.
4❑ The lean initiative's vision is very visible and all employees communicate it personally, inside and outside the company.
5❑ None of the above

B.9 Which of the following statements best describes the level of integration between the organization's functional objectives and the lean initiative's vision? *(Select one)*

1❑ Functional objectives are not integrated and conflict with the lean initiative's vision.
2❑ Functional objectives are integrated but often conflict with the lean initiative's vision.
3❑ Functional objectives are integrated and most support the lean initiative's vision.
4❑ Functional objectives are integrated and all support the lean initiative's vision.

B.10 Which of the following statements best describes the process or processes employed to enable integration between the organization's functional objectives and the lean initiative's vision? *(Select one)*

1❑ There are no processes employed to enable integration between the organization's functional objectives and the lean initiatives vision.
2❑ Objectives are discussed only within departments so that department's objectives can be integrated with the lean initiative's vision.
3❑ Objectives are discussed within departments and in meetings between departments so that objectives can be mutually integrated across departments.
4❑ Objectives are discussed within departments and between departments and with Senior Management in cross functional meetings to ensure integration across the enterprise.

B.11 How involved are you in decisions that have impact on the following (Quality, Cost, Cycle time, and Resource utilization)? *(Select all that apply)*

	Quality	Cost	Cycle time	Resource Utilization
I participate in most decisions and they are encouraged by management	1❑	2❑	3❑	4❑
I participate in most decisions and they are supported by management	1❑	2❑	3❑	4❑
I am permitted by managers to participate in some decisions	1❑	2❑	3❑	4❑
I am not permitted by managers to participate in decisions	1❑	2❑	3❑	4❑

B.12 What is the extent of employee decision making applied within your organization? *(Select one)*

1❑ Significant decisions are being made at the senior levels and key information is being filtered through management.

2❑ Information on "key" business issues is available to some employees, but most of the decisions are made at the senior levels in the organization.

3❑ Information on "key" business issues is available to most employees, and most of the decisions are made at the lower than senior levels in the organization.

4❑ Information on "key" business issues is available to all employees, and decisions are made at the lowest appropriate levels within the organization.

B.13 To what extent (Effectively, Too much, or Not enough) have the following strategies been implemented during the lean change initiative? *(Check one for each question in each row)*

To what extent have each of the strategies listed been implemented?	N/A	Effectively implemented	Too much implementation	Not enough implementation
Clear goals and objectives (that is what you intend to be accomplished and when) were used to accomplish the lean initiative's vision.	1❑	2❑	3❑	4❑
Strategic alliances were used to accomplish the lean initiative's vision.	1❑	2❑	3❑	4❑
Committing new resources to facilities, locations and equipment as needed to accomplish the lean initiative's vision.	1❑	2❑	3❑	4❑
Building the organizations human capital to help accomplish the lean initiative's vision.	1❑	2❑	3❑	4❑

Section C- Outcomes

Please provide answers to the questions regarding the after effects of a change initiative implemented within your organization.

C.1 To what extent (Not at all = 1, 2, Somewhat = 3, 4, and Very = 6, 7) have the following outcomes improved since the implementation of the lean change initiative? (*Check one for each question in each row)*

Outcomes	N/A	Not at all		Somewhat			Very		Estimated Net Change (+/- %)
Customer service	0	1	2	3	4	5	6	7	%
Schedule/delivery performance	0	1	2	3	4	5	6	7	%
Quality of Product or Service	0	1	2	3	4	5	6	7	%
Resource utilization (space, labor, mtl)	0	1	2	3	4	5	6	7	%
Return on assets	0	1	2	3	4	5	6	7	%
Cycle time	0	1	2	3	4	5	6	7	%

Cycle time: ***The elapsed time to perform an activity.***

C.2 To what extent or degree do you believe the lean change initiative was successful? *(Circle one)*

N/A	Not at all		Somewhat			Very	
0	1	2	3	4	5	6	7

C.3 In your view, what were the main factors that contributed to your answer provided in question C.2 above? (Attach any additional pages or previously prepared materials if appropriate.)

_____

_____

_____

If you have any questions about this survey or the objectives of the research, feel free to contact:

David Tonaszuck
Lean Aerospace Initiative
Massachusetts Institute of Technology
77 Massachusetts Ave., Room 33-409
Cambridge, Massachusetts 02139
tel.: (617) 258-7585
email: dtonaszu@mit.edu

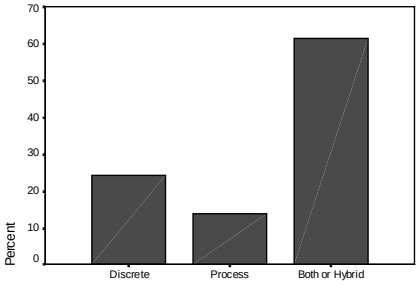
Thank you very much for your time!

APPENDIX TWO

Survey response frequency data

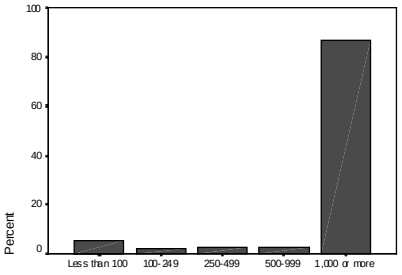
Thesis: Overall Results Ch. 6, Section 1

What is the nature of manufacturing operations for primary products at this plant?



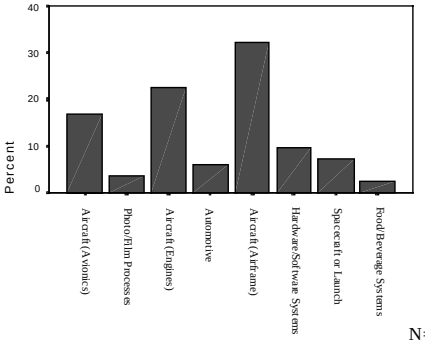
N=86

How many employees are at this business unit location?



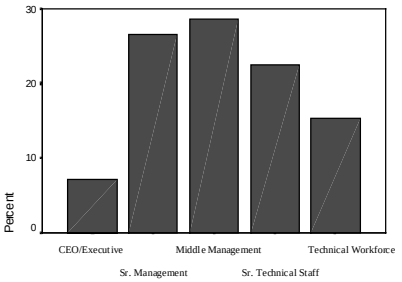
N=98

Which of the following categories best describes the type of product manufactured at your site?



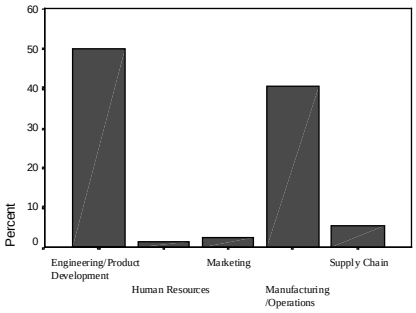
N=84

Which of these titles best describes your role in the organization?



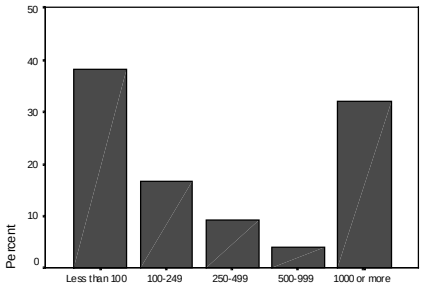
N=98

In which functional area of the organization do you work?



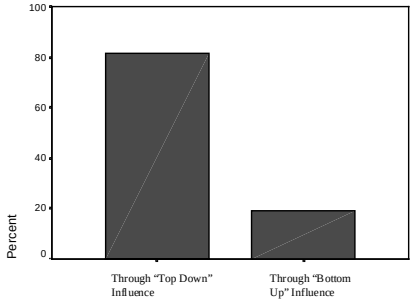
N=74

How many employees were actively working on or participating in the lean change initiative?



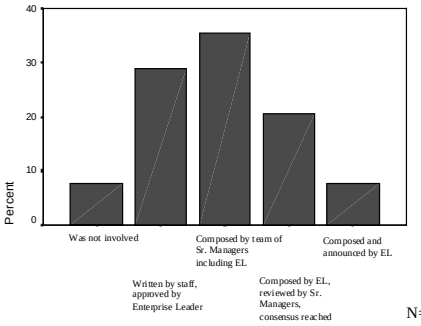
N=97

Which of the following best describes the evolution of the lean change initiative's vision?



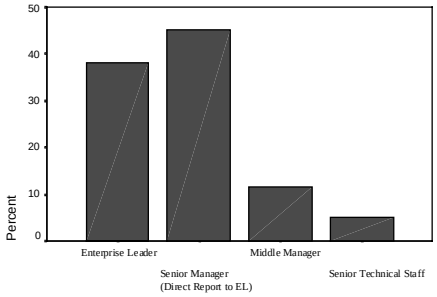
N=96

Which of the following statements best characterizes the role played by the Enterprise Leader in formulating the lean initiative's vision?



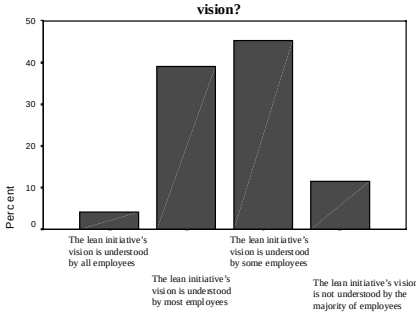
N=93

Which of the following leaders is recognized throughout the organization as the most influential driver of the lean change initiative?



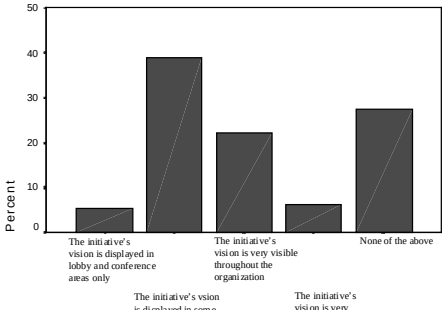
N=97

Which of the following statements best characterizes the organization's level of understanding of the lean initiative's vision?



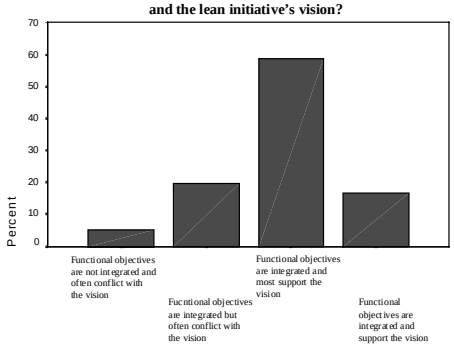
N=97

Which of the following statements best characterizes the visibility of the lean initiative's vision to the organization?



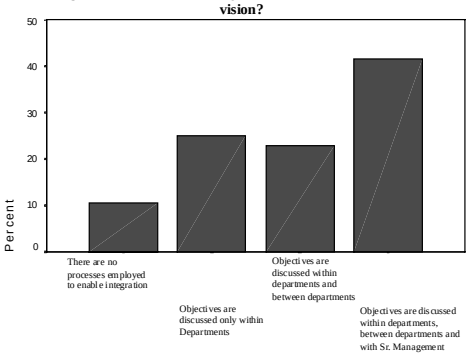
N=95

Which of the following statements best describe the level of integration between the organization's functional objectives and the lean initiative's vision?



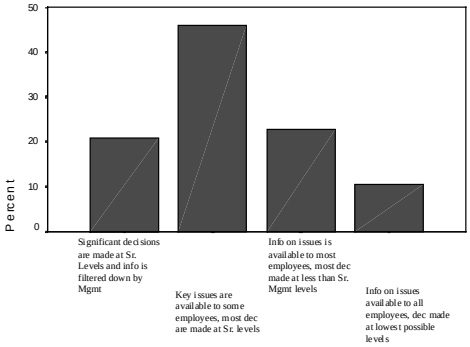
N=97

Which of the following statements best describes the process or processes employed to enable integration between the organization's functional objectives and the lean initiative's vision?



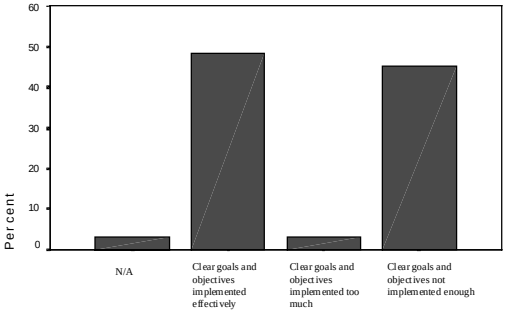
N=96

What is the extent of employee decision making applied within your organization?



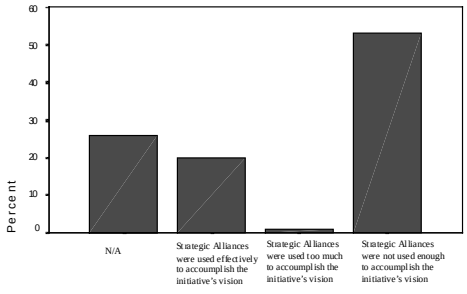
N=96

To what extent (Effectively, Too Much, or Not Enough) has the following strategy been implemented during the lean change initiative?



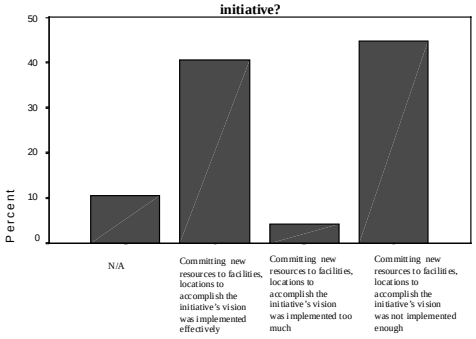
N=97

To what extent (Effectively, Too Much, or Not Enough) has the following strategy been implemented during the lean change initiative?



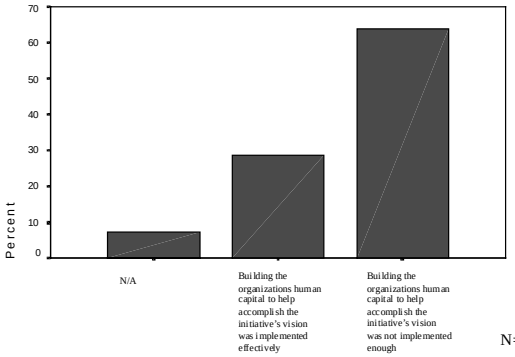
N=96

To what extent (Effectively, Too Much, or Not Enough) has the following strategy been implemented during the lean change initiative?



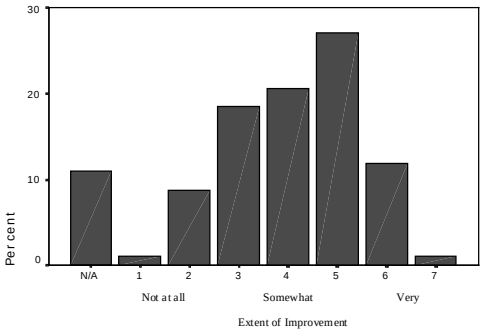
N=96

To what extent (Effectively, Too Much, or Not Enough) has the following strategy been implemented during the lean change initiative?



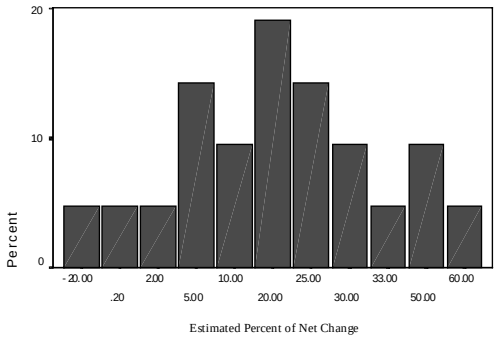
N=97

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Customer Satisfaction improved since the implementation of the lean change initiative?



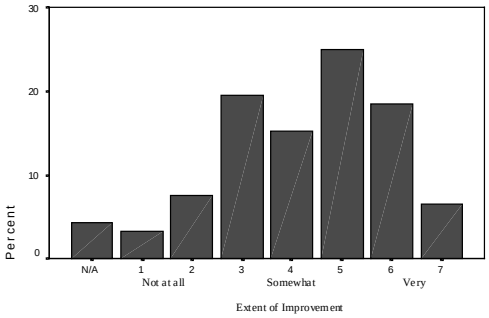
N=92

Estimated net change in Customer Satisfaction



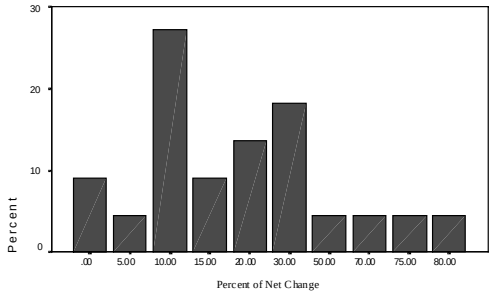
N=21

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Schedule/Delivery Performance improved since the implementation of the lean change initiative?



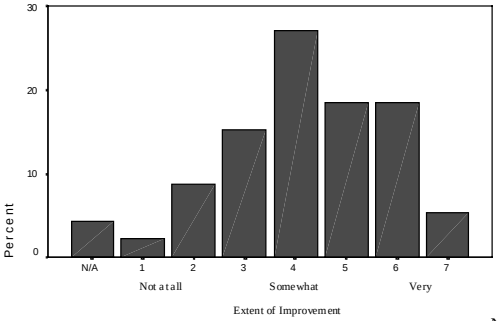
N=92

Estimated net change in Schedule/Delivery Performance?



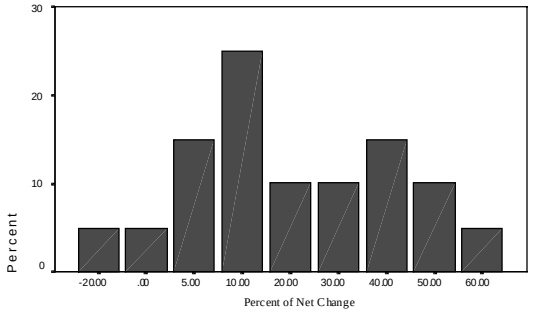
N=22

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Quality of Product or Service improved since the implementation of the lean change initiative?



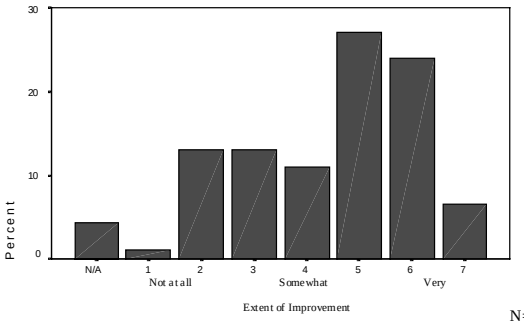
N=92

Estimated net change in Quality of Product or Service?



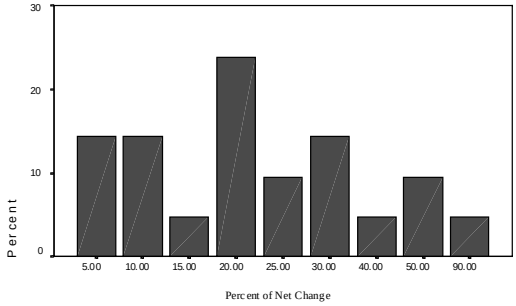
N=20

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Resource Utilization improved since the implementation of the lean change initiative?



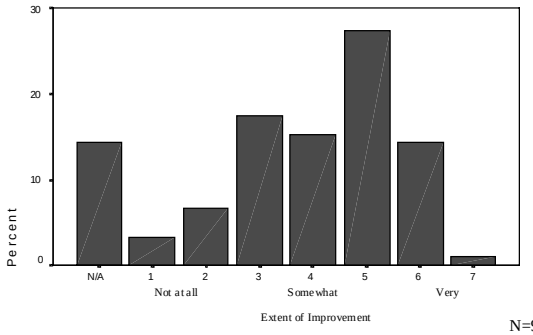
N=92

Estimated net change in Resource Utilization?



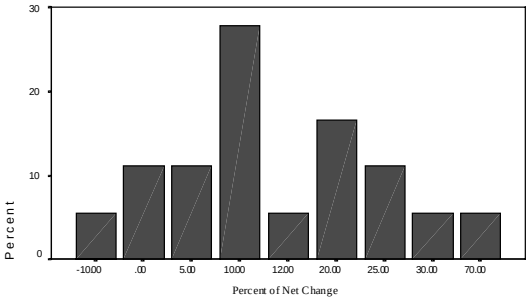
N=21

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Return on Assets improved since the implementation of the lean change initiative?



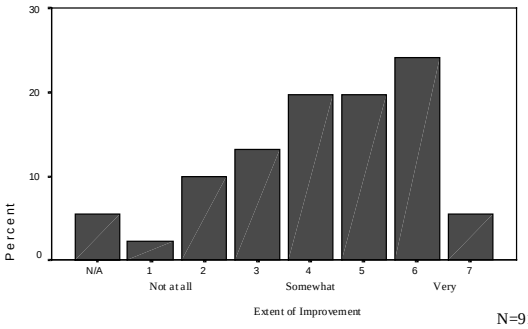
N=91

Estimated net change in Return on Assets?



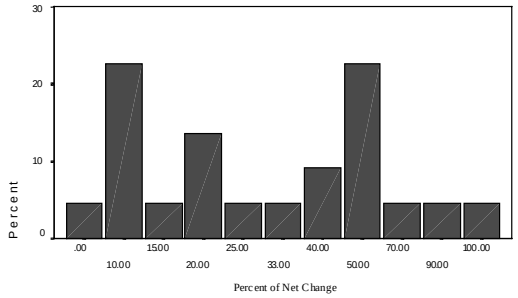
N=18

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Cycle Time improved since the implementation of the lean change initiative?



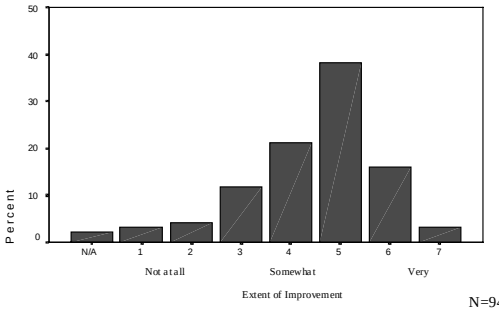
N=91

Estimated net change in Cycle Time?



N=22

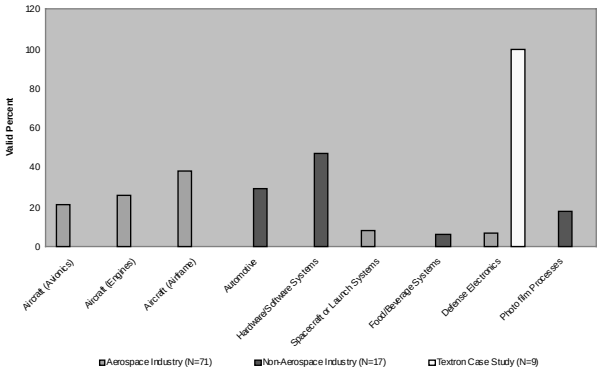
To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) do you believe the lean change initiative was successful?



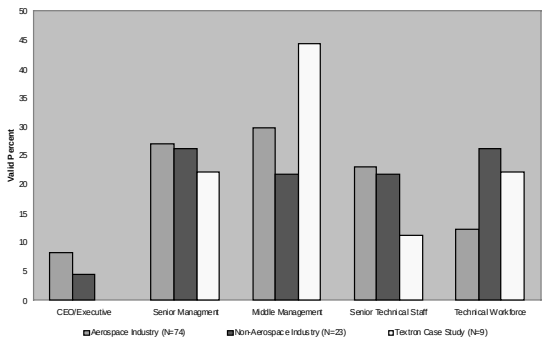
N=94

Results Ch. 6, Scenario One Aerospace Vs Non-Aerospace Vs Textron Case Study

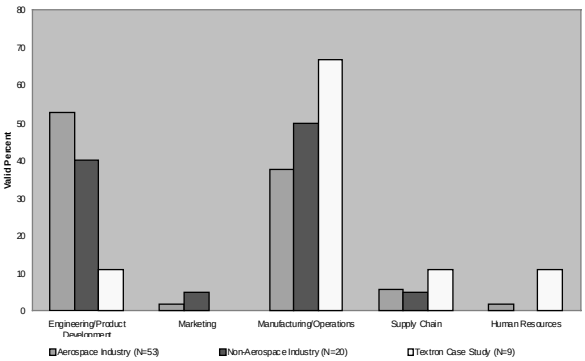
Which of the following best describes the type of product manufactured at your site?



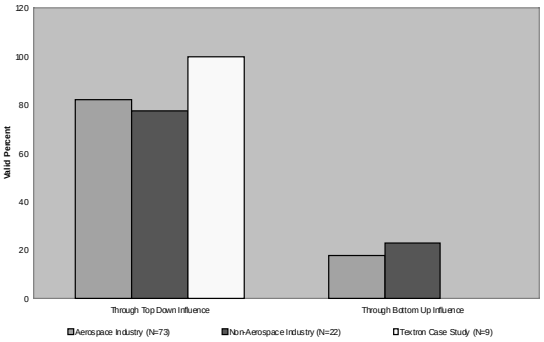
Which of these titles best describe your role in the organization?



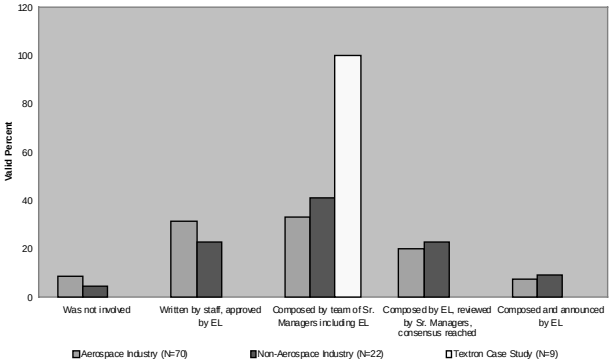
In which functonal area of the organization do you work?



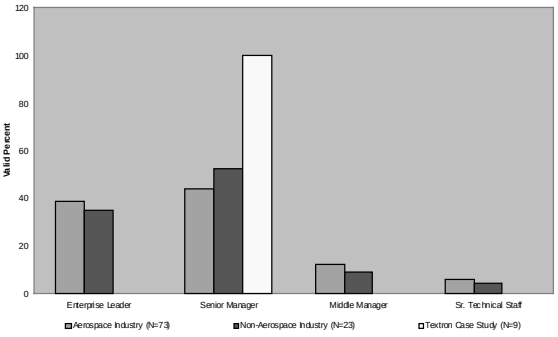
Which of the following best describes the evolution of the lean change initiative?



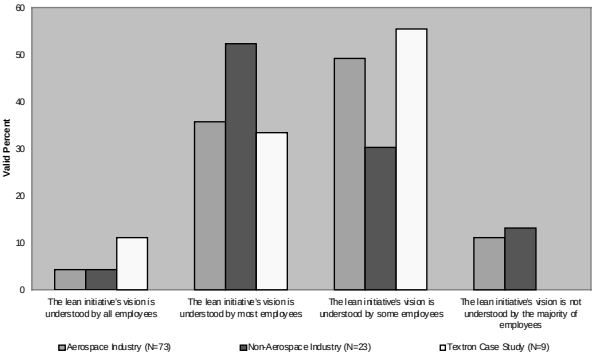
Which of the following statements best characterizes the role played by the Enterprise Leader in formulating the lean initiative's vision?



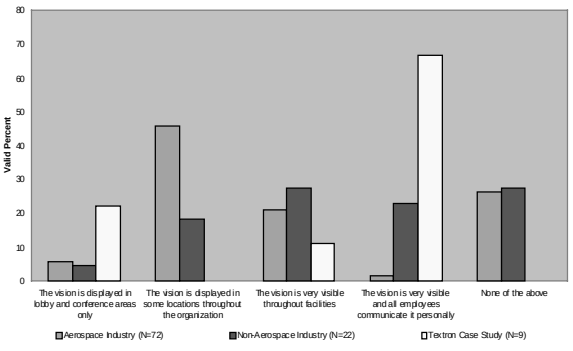
Which of the following is recognized throughout the organization as the most influential driver of the lean change initiative?



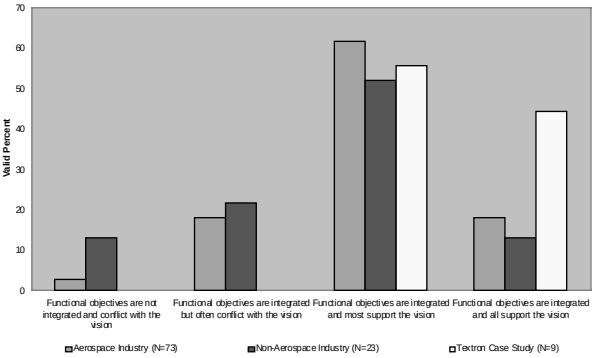
Which of the following statements best characterizes the organizations level of understanding of the lean initiative's vision?



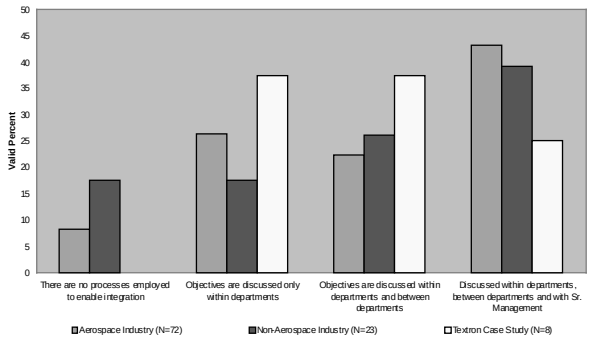
Which of the following statements best characterizes the visibility of the lean change initiative's vision to the organization?



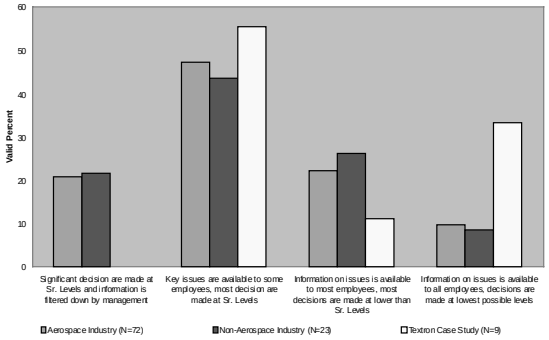
Which of the following best describes the level of integration between the organization's functional objectives and the lean initiative's vision?



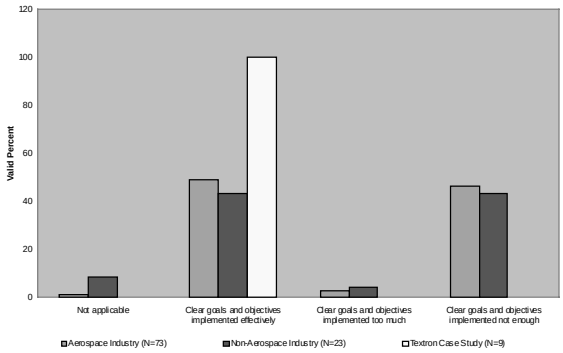
Which of the following statements best describes the process or processes employed to enable integration between the organization's functional objectives and the lean change initiative's vision?



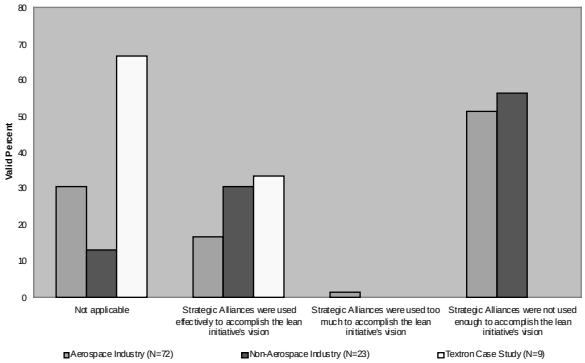
What is the extent of employee decision making applied within your organization?



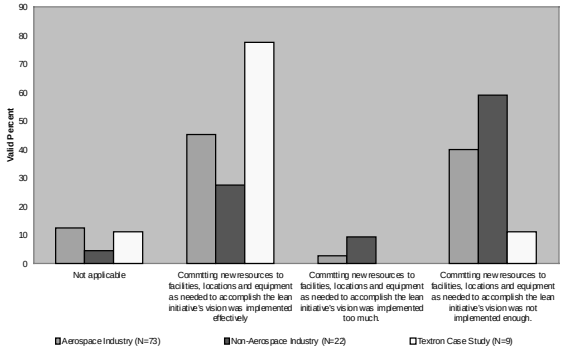
To what extent has the following strategy been implemented during the lean change initiative?



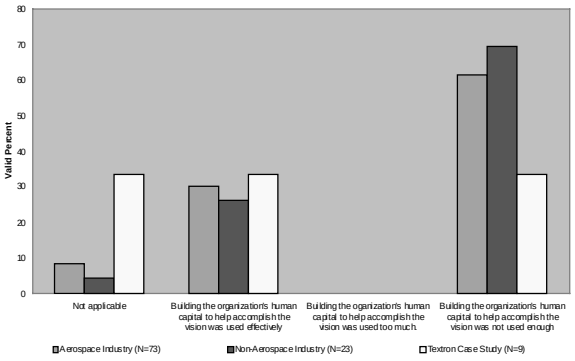
To what extent has the following strategy been implemented during the lean change initiative?

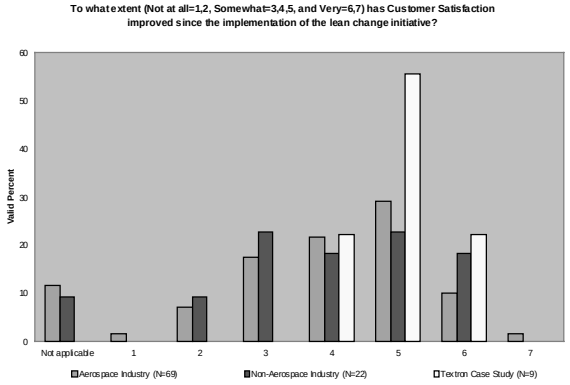


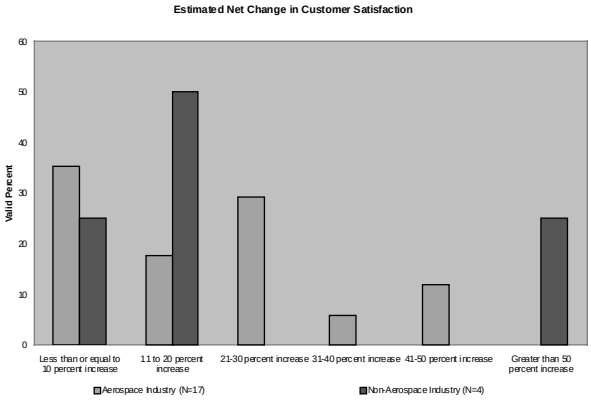
To what extent has the following strategy been implemented during the lean change initiative?

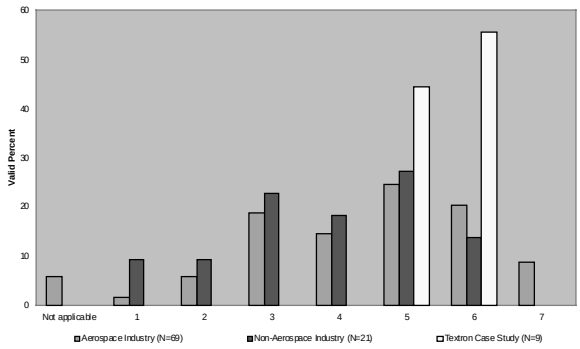


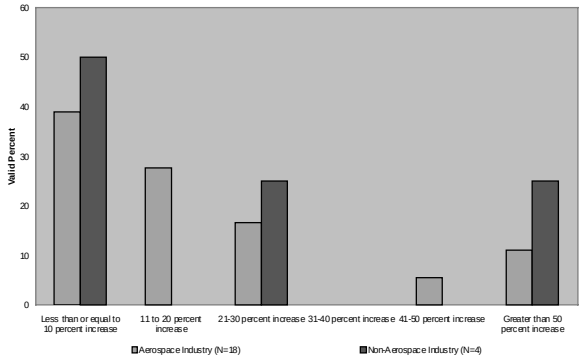
To what extent has the following strategy been implemented during the lean change initiative?

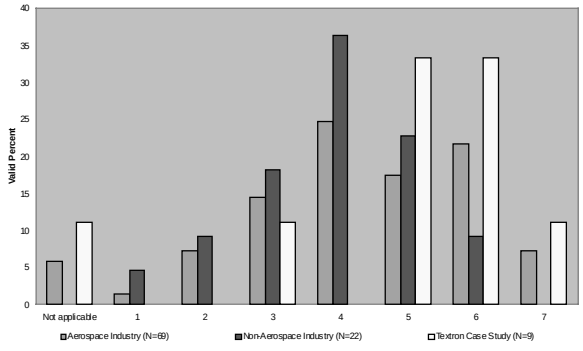


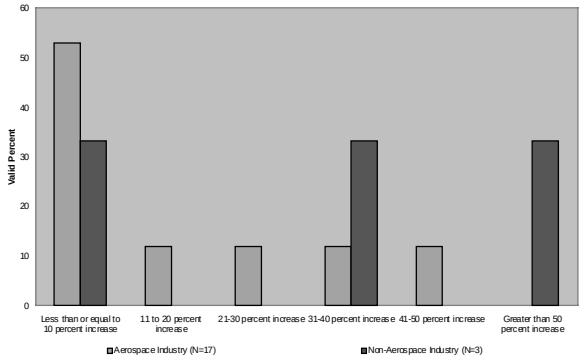

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Customer Satisfaction improved since the implementation of the lean change initiative?
Valid Percent
60
50
40
30
20
10
0
Not applicable
1
2
3
4
5
6
7
Aerospace Industry (N=69)
Non-Aerospace Industry (N=22)
Textron Case Study (N=9)

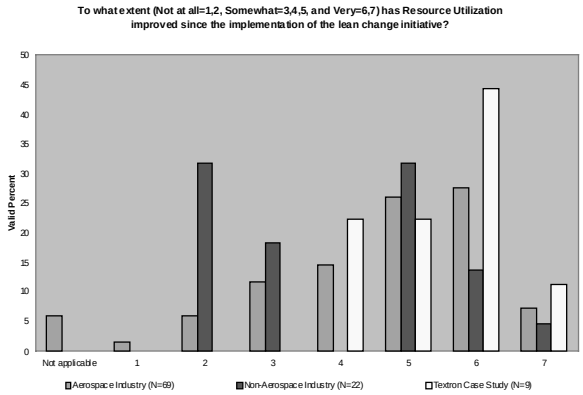

Estimated Net Change in Customer Satisfaction
Valid Percent
60
50
40
30
20
10
0
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
Aerospace Industry (N=17)
Non-Aerospace Industry (N=4)

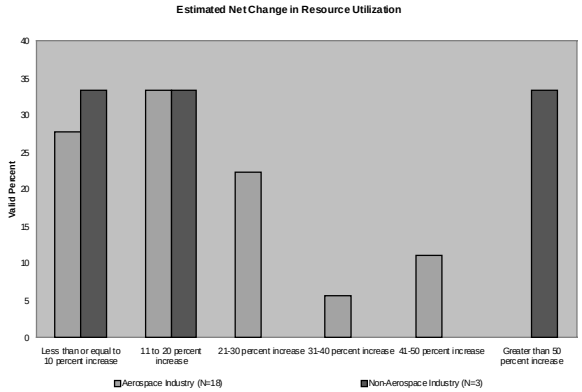

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Schedule/Delivery Performance improved since the implementation of the lean change initiative?
Valid Percent
60
50
40
30
20
10
0
Not applicable
1
2
3
4
5
6
7
Aerospace Industry (N=69)
Non-Aerospace Industry (N=21)
Textron Case Study (N=9)

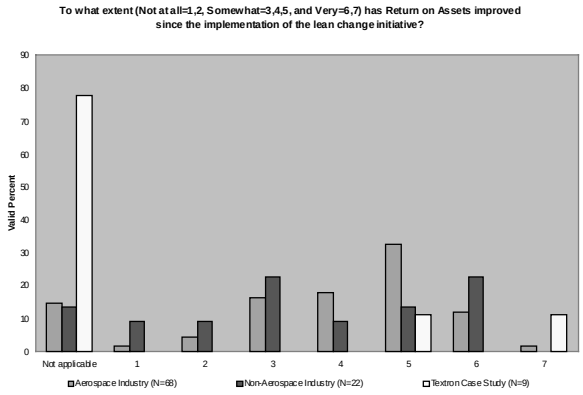

Estimated Net Change in Schedule/Delivery Performance
Valid Percent
60
50
40
30
20
10
0
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
Aerospace Industry (N=18)
Non-Aerospace Industry (N=4)

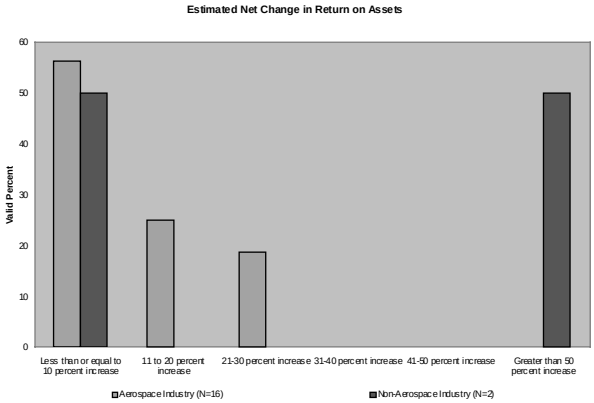

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has the Quality of Product or Service improved since the implementation of the lean change initiative?
Valid Percent
40
35
30
25
20
15
10
5
0
Not applicable
1
2
3
4
5
6
7
Aerospace Industry (N=69)
Non-Aerospace Industry (N=22)
Textron Case Study (N=9)

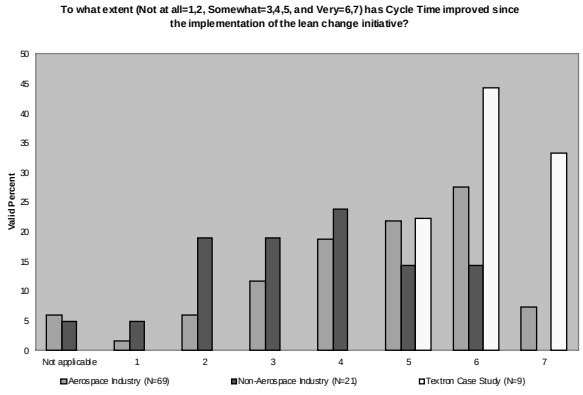

Estimated Net Change in Quality of Product or Service
Valid Percent
60
50
40
30
20
10
0
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
Aerospace Industry (N=17)
Non-Aerospace Industry (N=3)

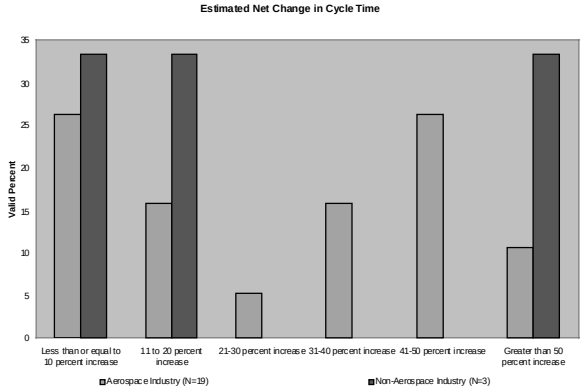

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Resource Utilization improved since the implementation of the lean change initiative?
Valid Percent
Not applicable
1
2
3
4
5
6
7
Aerospace Industry (N=69)
Non-Aerospace Industry (N=22)
Textron Case Study (N=9)


Estimated Net Change in Resource Utilization
Valid Percent
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
Aerospace Industry (N=18)
Non-Aerospace Industry (N=3)

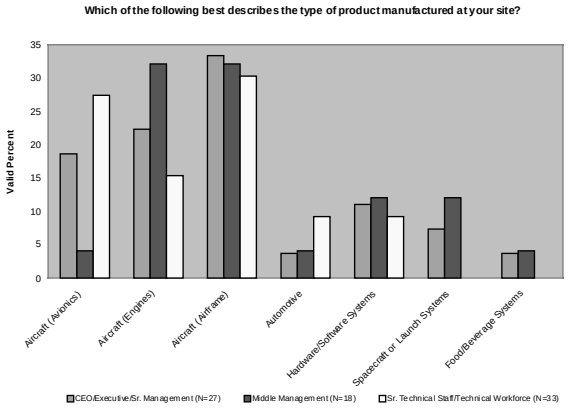

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Return on Assets improved since the implementation of the lean change initiative?
Valid Percent
Not applicable
1
2
3
4
5
6
7
Aerospace Industry (N=68)
Non-Aerospace Industry (N=22)
Textron Case Study (N=9)

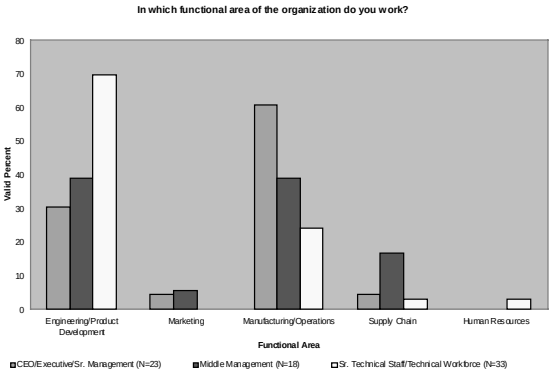

Estimated Net Change in Return on Assets
Valid Percent
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
Aerospace Industry (N=16)
Non-Aerospace Industry (N=2)

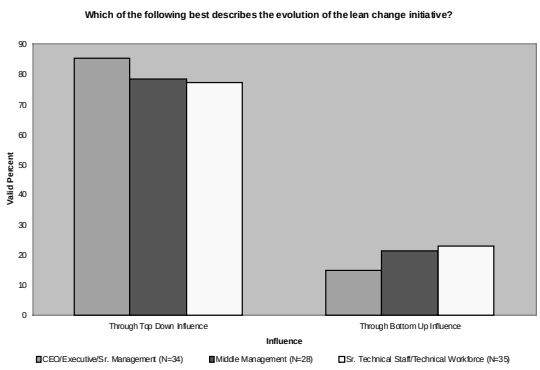

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Cycle Time improved since the implementation of the lean change initiative?
Valid Percent
Not applicable
1
2
3
4
5
6
7
Aerospace Industry (N=69)
Non-Aerospace Industry (N=21)
Textron Case Study (N=9)

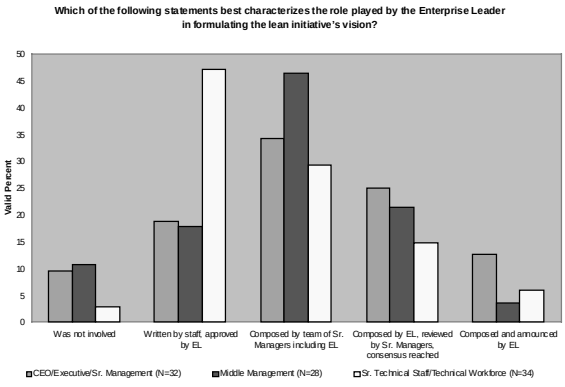

Estimated Net Change in Cycle Time
Valid Percent
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
Aerospace Industry (N=19)
Non-Aerospace Industry (N=3)

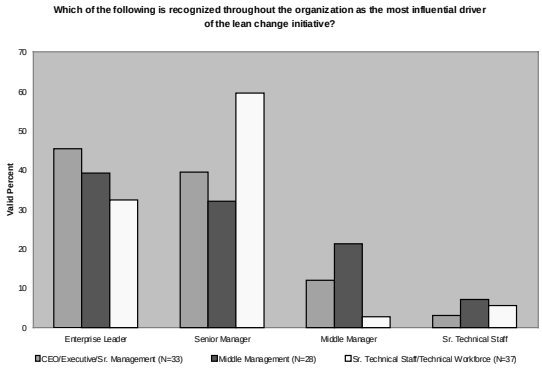
Results Ch. 6, Scenario Two



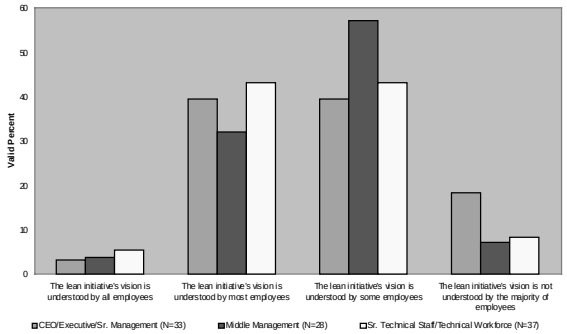




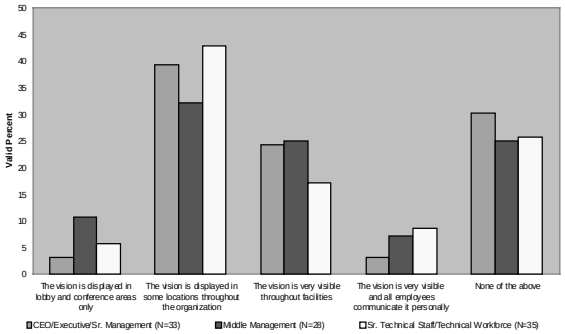




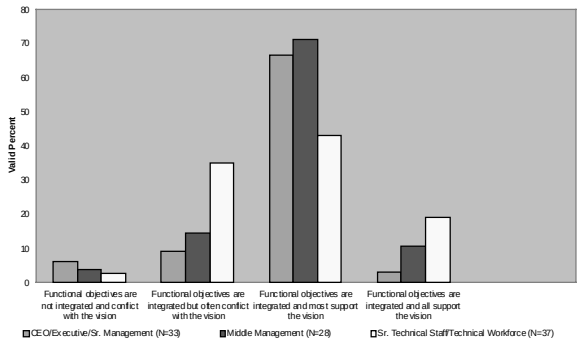
Which of the following statements best characterizes the organizations level of understanding of the lean initiative's vision?



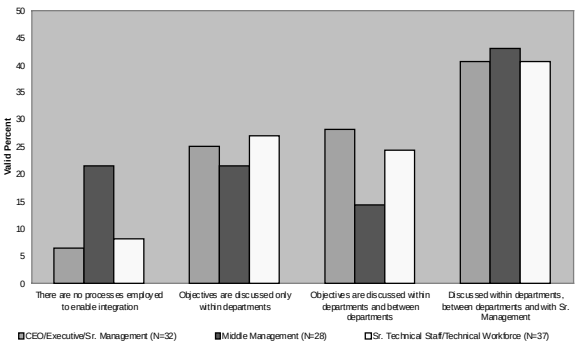
Which of the following statements best characterizes the visibility of the lean initiative's vision to the organization?



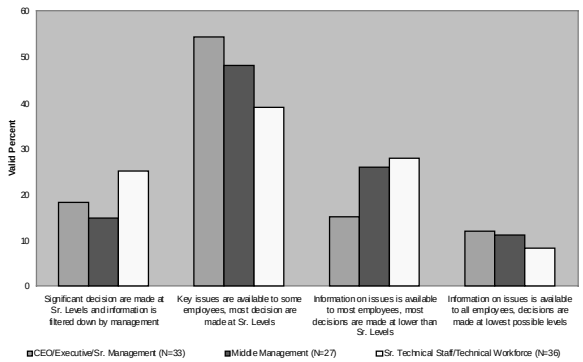
Which of the following best describes the level of integration between the organization's functional objectives and the lean initiative's vision?



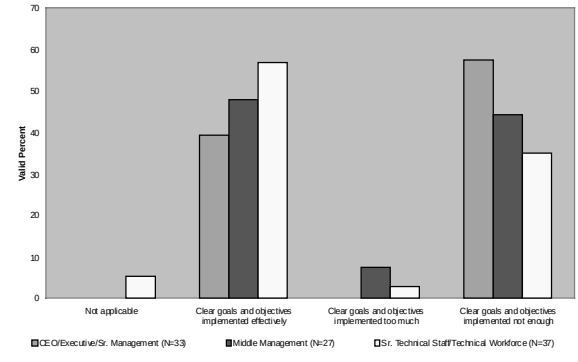
Which of the following best describes the process or processes employed to enable integration between the organization's functional objectives and the lean initiatives vision?

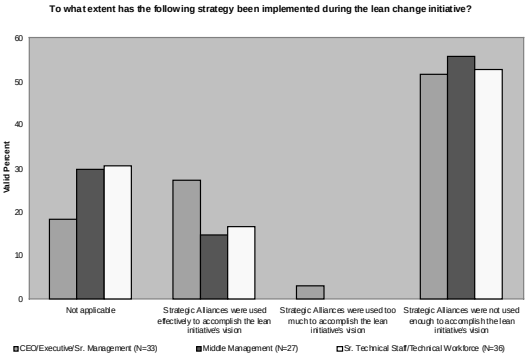


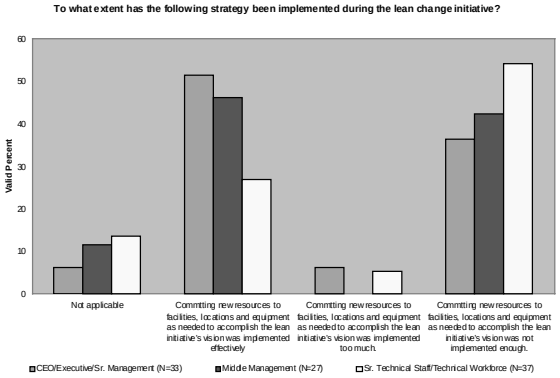
What is the extent of employee decision making applied within your organization?

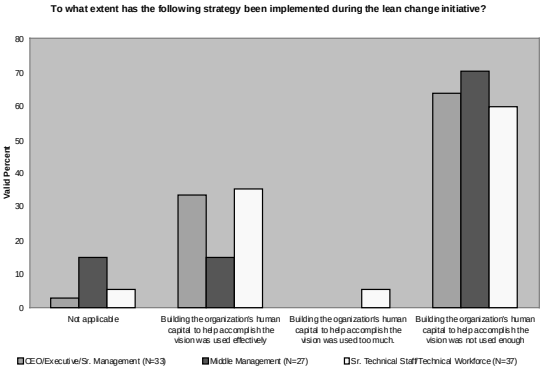


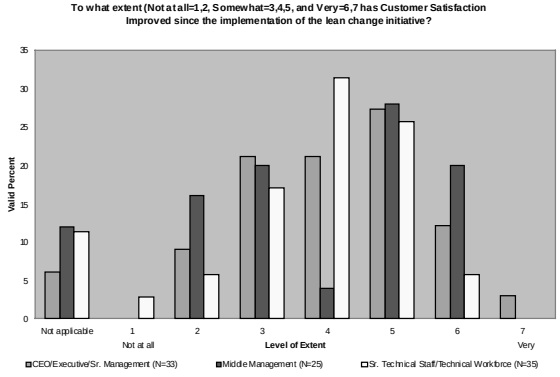
To what extent has the following strategy been implemented during the lean change initiative?

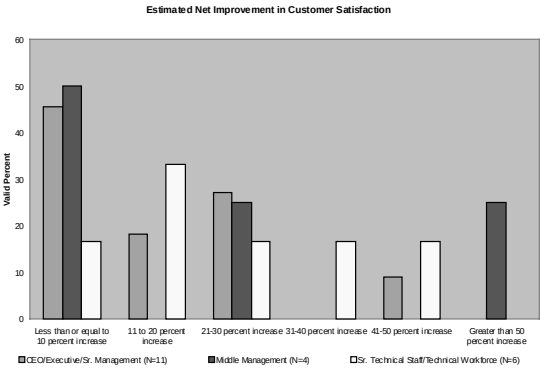


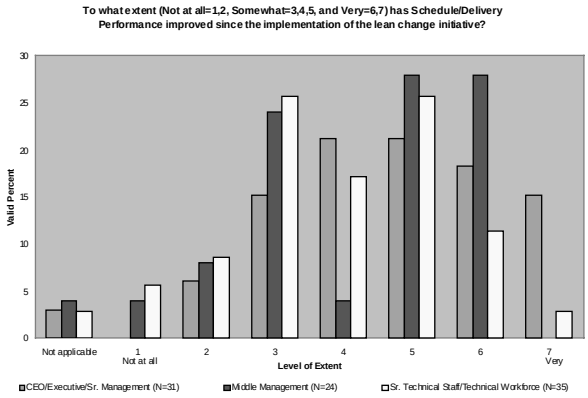

To what extent has the following strategy been implemented during the lean change initiative?
Valid Percent
Not applicable
Strategic Alliances were used effectively to accomplish the lean initiatives vision
Strategic Alliances were used too much to accomplish the lean initiatives vision
Strategic Alliances were not used enough to accomplish the lean initiatives vision
CEO/Executive/Sr. Management (N=33)
Middle Management (N=27)
Sr. Technical Staff/Technical Workforce (N=36)

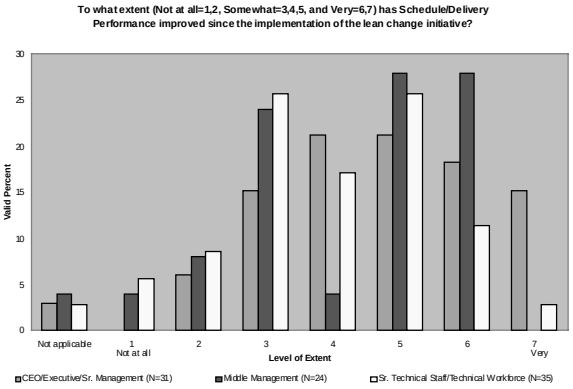

To what extent has the following strategy been implemented during the lean change initiative?
Valid Percent
Not applicable
Committing new resources to facilities, locations and equipment as needed to accomplish the lean initiative's vision was implemented effectively
Committing new resources to facilities, locations and equipment as needed to accomplish the lean initiative's vision was implemented too much.
Committing new resources to facilities, locations and equipment as needed to accomplish the lean initiative's vision was not implemented enough.
CEO/Executive/Sr. Management (N=33)
Middle Management (N=27)
Sr. Technical Staff/Technical Workforce (N=37)

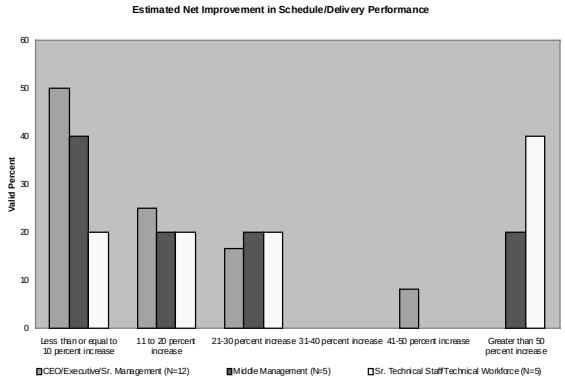

To what extent has the following strategy been implemented during the lean change initiative?
Valid Percent
Not applicable
Building the organization's human capital to help accomplish the vision was used effectively
Building the organization's human capital to help accomplish the vision was used too much.
Building the organization's human capital to help accomplish the vision was not used enough
CEO/Executive/Sr. Management (N=33)
Middle Management (N=27)
Sr. Technical Staff/Technical Workforce (N=37)

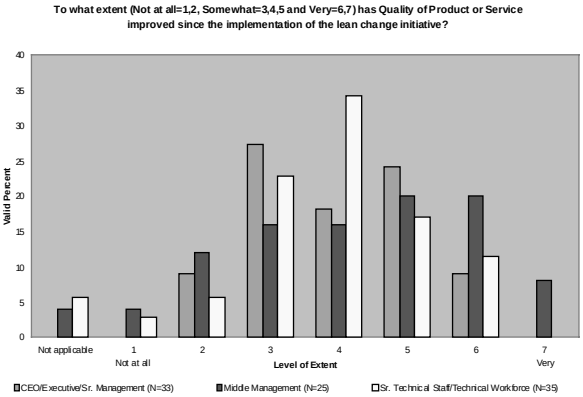

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7 has Customer Satisfaction Improved since the implementation of the lean change initiative?
Valid Percent
Not applicable
1
Not at all
2
3
4
5
6
7
Very
Level of Extent
CEO/Executive/Sr. Management (N=33)
Middle Management (N=25)
Sr. Technical Staff/Technical Workforce (N=35)

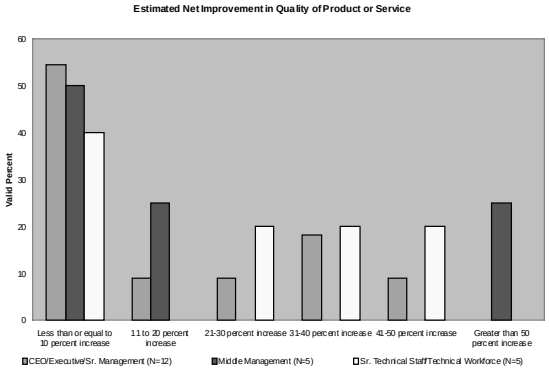

Estimated Net Improvement in Customer Satisfaction
Valid Percent
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
CEO/Executive/Sr. Management (N=11)
Middle Management (N=4)
Sr. Technical Staff/Technical Workforce (N=6)

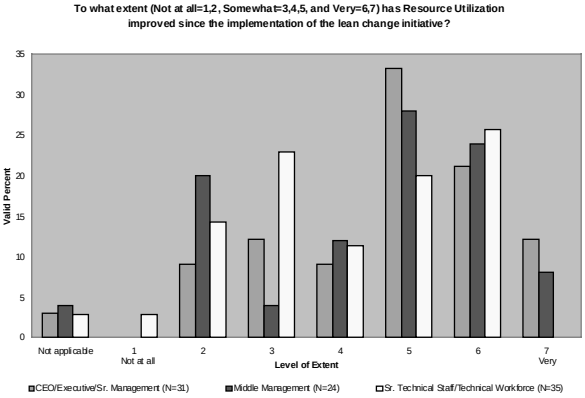

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Schedule/Delivery Performance improved since the implementation of the lean change initiative?
Valid Percent
Not applicable
1
Not at all
2
3
4
5
6
7
Very
Level of Extent
CEO/Executive/Sr. Management (N=31)
Middle Management (N=24)
Sr. Technical Staff/Technical Workforce (N=35)

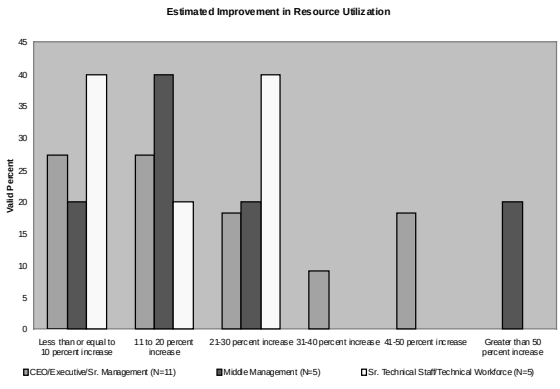

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Schedule/Delivery Performance improved since the implementation of the lean change initiative?
Valid Percent
Not applicable
1 Not at all
2
3
4
5
6
7 Very
Level of Extent
CEO/Executive/Sr. Management (N=31)
Middle Management (N=24)
Sr. Technical Staff/Technical Workforce (N=35)

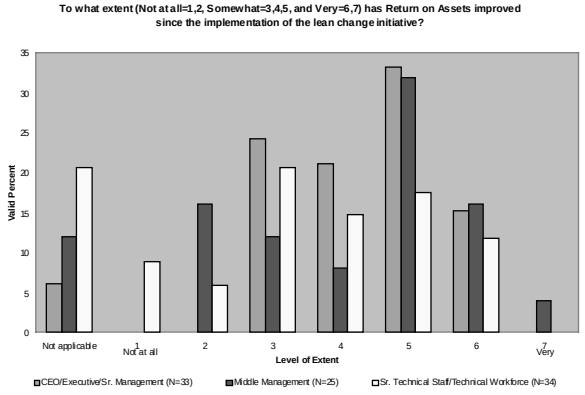

Estimated Net Improvement in Schedule/Delivery Performance
Valid Percent
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
CEO/Executive/Sr. Management (N=12)
Middle Management (N=5)
Sr. Technical Staff/Technical Workforce (N=5)

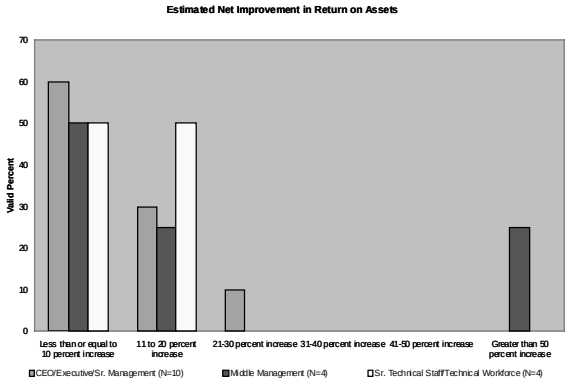

To what extent (Not at all=1,2, Somewhat=3,4,5 and Very=6,7) has Quality of Product or Service improved since the implementation of the lean change initiative?
Valid Percent
Not applicable
1 Not at all
2
3
4
5
6
7 Very
Level of Extent
CEO/Executive/Sr. Management (N=33)
Middle Management (N=25)
Sr. Technical Staff/Technical Workforce (N=35)

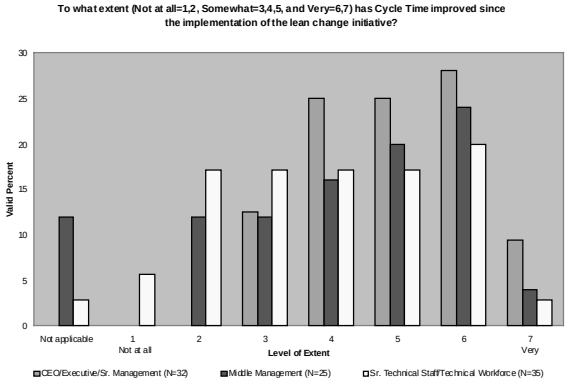

Estimated Net Improvement in Quality of Product or Service
Valid Percent
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
CEO/Executive/Sr. Management (N=12)
Middle Management (N=5)
Sr. Technical Staff/Technical Workforce (N=5)

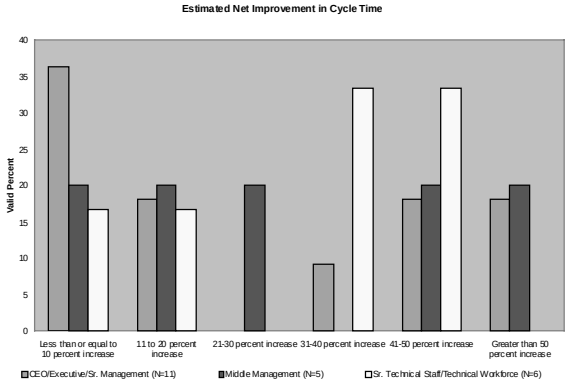

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Resource Utilization improved since the implementation of the lean change initiative?
Valid Percent
Not applicable
1 Not at all
2
3
4
5
6
7 Very
Level of Extent
CEO/Executive/Sr. Management (N=31)
Middle Management (N=24)
Sr. Technical Staff/Technical Workforce (N=35)

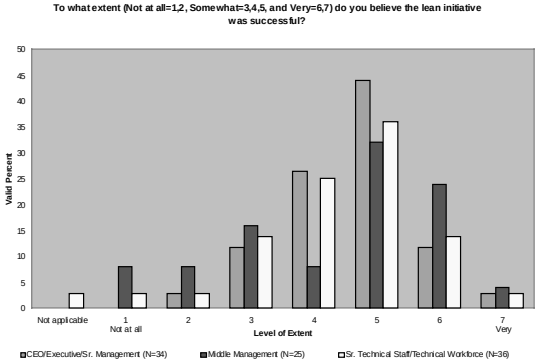

Estimated Improvement in Resource Utilization
Valid Percent
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
CEO/Executive/Sr. Management (N=11)
Middle Management (N=5)
Sr. Technical Staff/Technical Workforce (N=5)


To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Return on Assets improved since the implementation of the lean change initiative?
Valid Percent
Not applicable
1 Not at all
2
3
4
5
6
7 Very
Level of Extent
CEO/Executive/Sr. Management (N=33)
Middle Management (N=25)
Sr. Technical Staff/Technical Workforce (N=34)

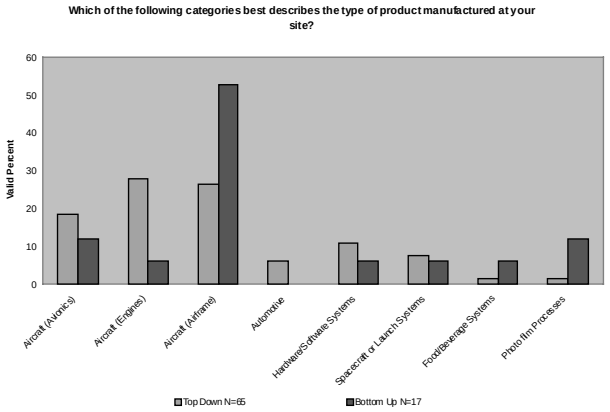

Estimated Net Improvement in Return on Assets
Valid Percent
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
CEO/Executive/Sr. Management (N=10)
Middle Management (N=4)
Sr. Technical Staff/Technical Workforce (N=4)

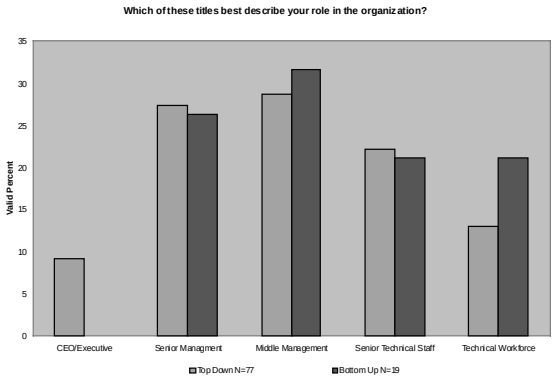

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Cycle Time improved since the implementation of the lean change initiative?
Valid Percent
Not applicable
1 Not at all
2
3
4
5
6
7 Very
Level of Extent
CEO/Executive/Sr. Management (N=32)
Middle Management (N=25)
Sr. Technical Staff/Technical Workforce (N=35)

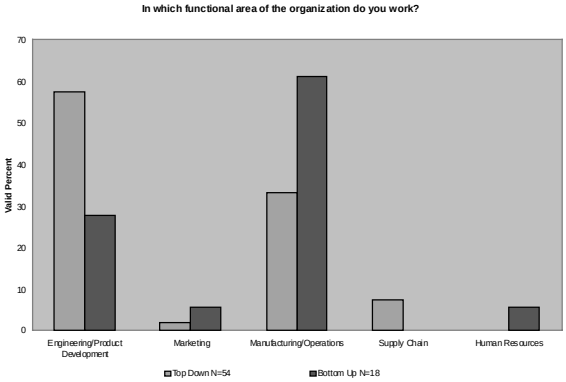

Estimated Net Improvement in Cycle Time
Valid Percent
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
CEO/Executive/Sr. Management (N=11)
Middle Management (N=5)
Sr. Technical Staff/Technical Workforce (N=6)

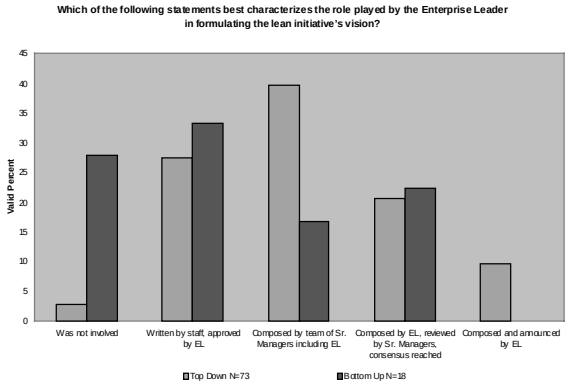

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) do you believe the lean initiative was successful?
Valid Percent
Not applicable
1 Not at all
2
3
4
5
6
7 Very
Level of Extent
CEO/Executive/Sr. Management (N=34)
Middle Management (N=25)
Sr. Technical Staff/Technical Workforce (N=36)

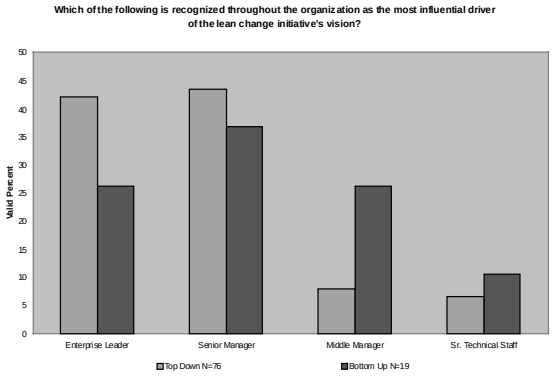
Results Ch. 6, Scenario Three



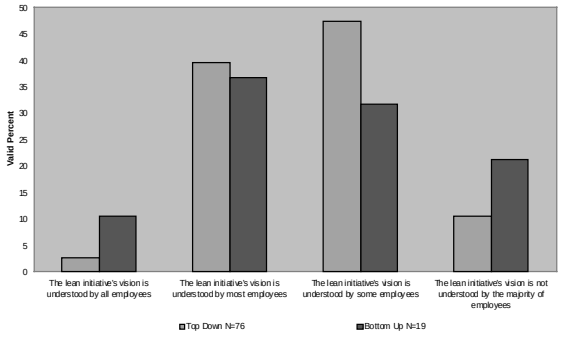




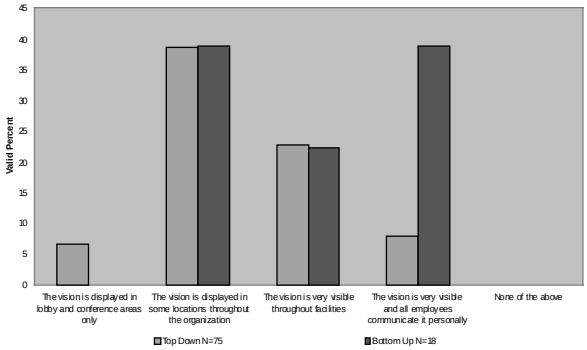




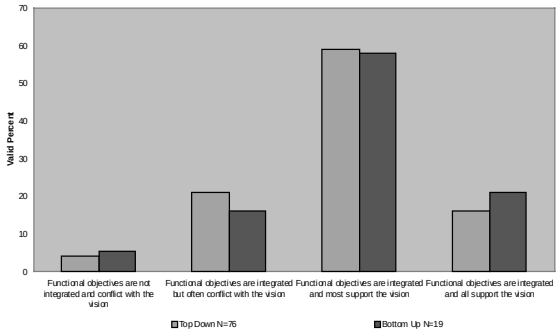
Which of the following statements best characterizes the organizations level of understanding of the lean initiative's vision?



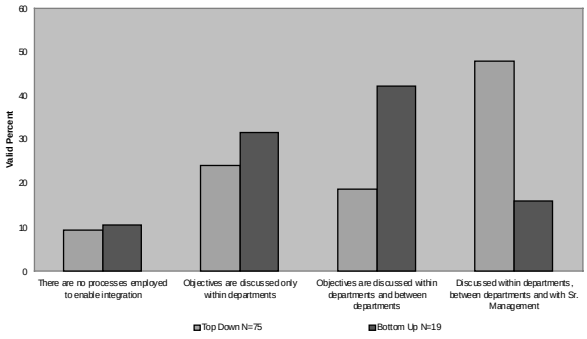
Which of the following statements best characterizes the visibility of the lean initiative's vision to the organization?



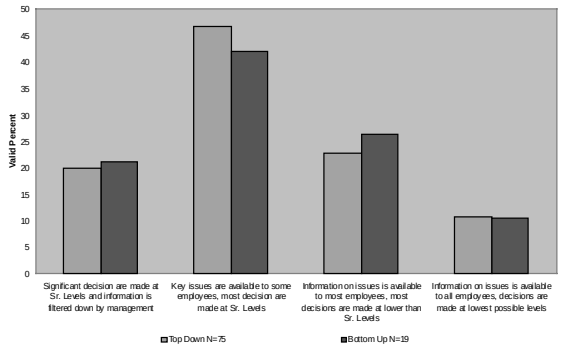
Which of the following best describes the level of integration between the organization's functional objectives and the lean initiative's vision?



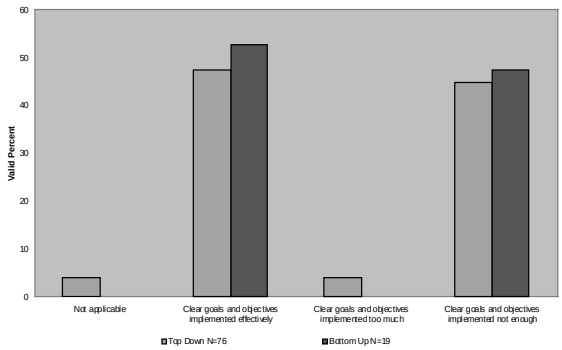
Which of the following statements best describes the process or processes employed to enable integration between the organization's functional objectives and the lean initiative's vision?

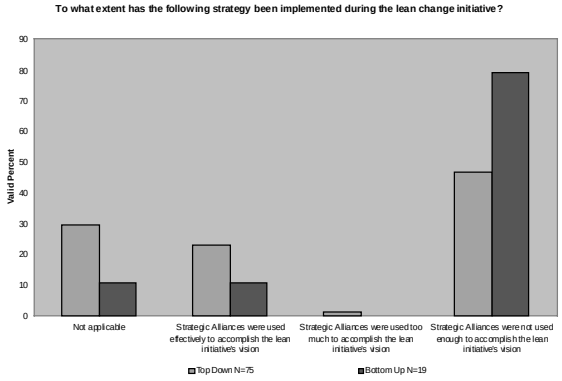


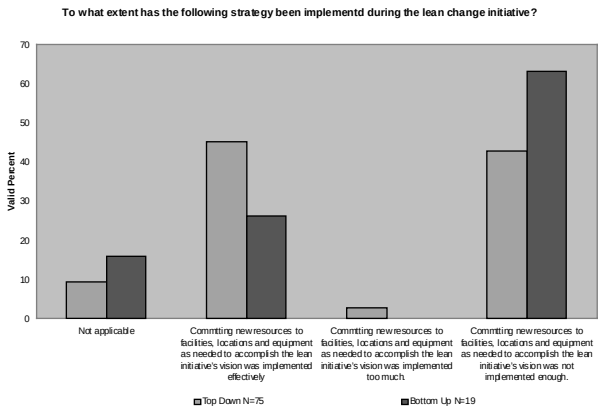
What is the extent of employee decision making applied within your organization?

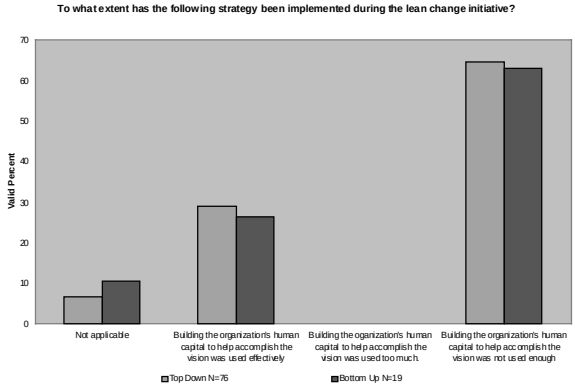


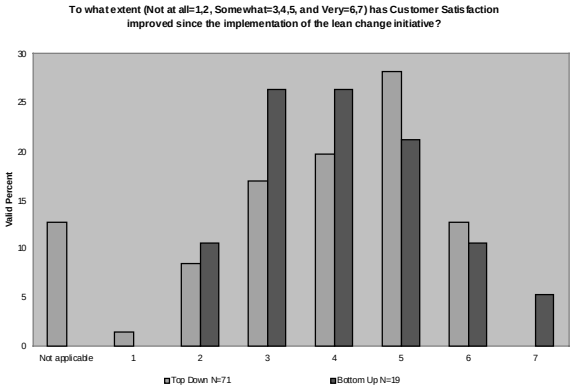
To What extent has the following strategy been implemented during the lean change initiative?

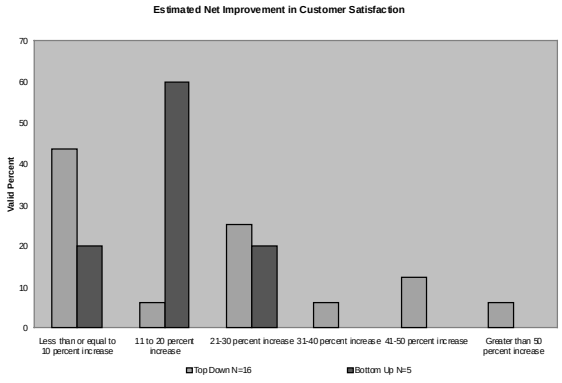


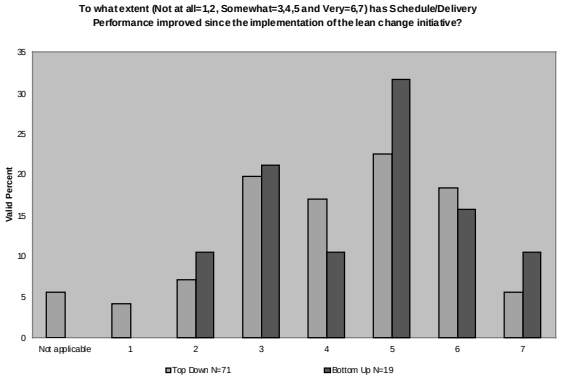

To what extent has the following strategy been implemented during the lean change initiative?
Valid Percent
Not applicable
Strategic Alliances were used effectively to accomplish the lean initiatives vision
Strategic Alliances were used too much to accomplish the lean initiatives vision
Strategic Alliances were not used enough to accomplish the lean initiatives vision
Top Down N=75
Bottom Up N=19

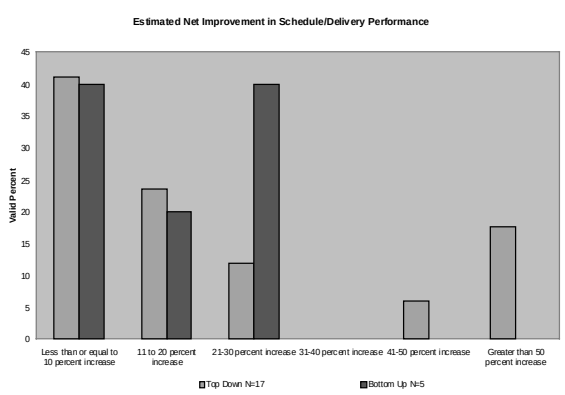

To what extent has the following strategy been implementd during the lean change initiative?
Valid Percent
Not applicable
Commtting new resources to facilities, locations and equipment as needed to accomplish the lean initiative's vision was implemented effectively
Commtting new resources to facilities, locations and equipment as needed to accomplish the lean initiative's vision was implemented too much.
Commtting new resources to facilities, locations and equipment as needed to accomplish the lean initiative's vision was not implemented enough.
Top Down N=75
Bottom Up N=19

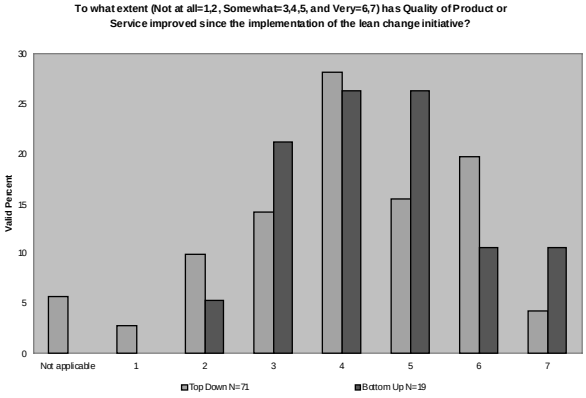

To what extent has the following strategy been implemented during the lean change initiative?
Valid Percent
Not applicable
Building the organization's human capital to help accomplish the vision was used effectively
Building the organization's human capital to help accomplish the vision was used too much.
Building the organization's human capital to help accomplish the vision was not used enough
Top Down N=76
Bottom Up N=19

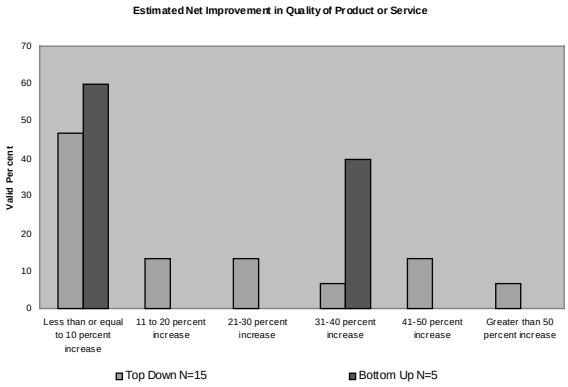

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Customer Satisfaction improved since the implementation of the lean change initiative?
Valid Percent
Not applicable
Top Down N=71
Bottom Up N=19

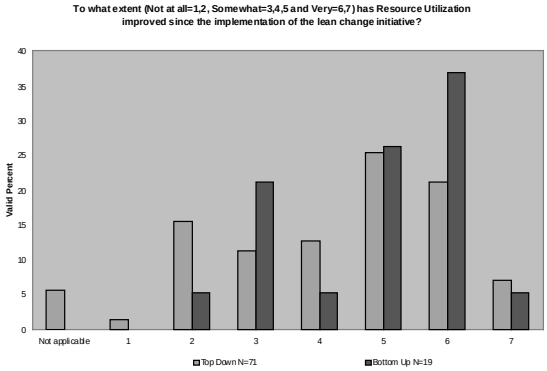

Estimated Net Improvement in Customer Satisfaction
Valid Percent
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
Top Down N=16
Bottom Up N=5

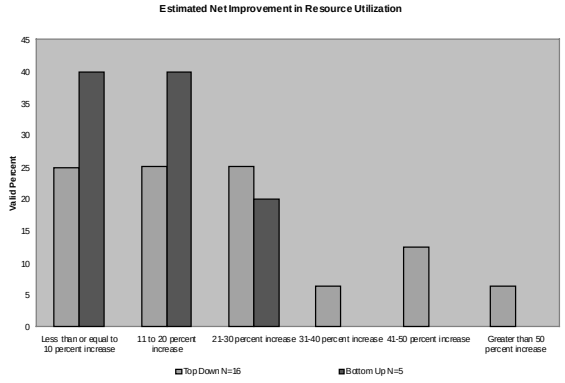

To what extent (Not at all=1,2, Somewhat=3,4,5 and Very=6,7) has Schedule/Delivery Performance improved since the implementation of the lean change initiative?
Valid Percent
Not applicable
Top Down N=71
Bottom Up N=19

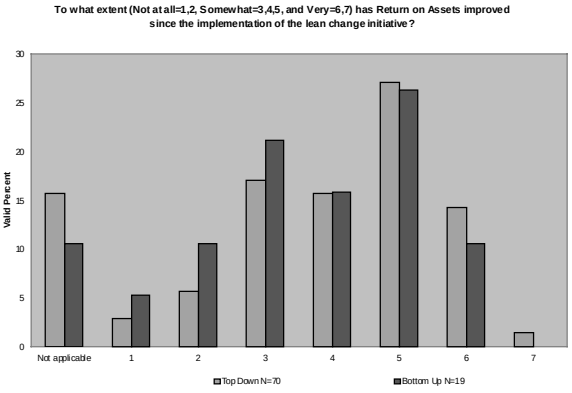

Estimated Net Improvement in Schedule/Delivery Performance
Valid Percent
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
Top Down N=17
Bottom Up N=5

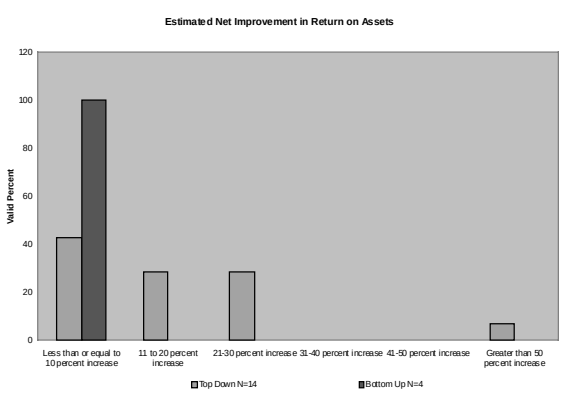

To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Quality of Product or Service improved since the implementation of the lean change initiative?
Valid Percent
Not applicable
Top Down N=71
Bottom Up N=19

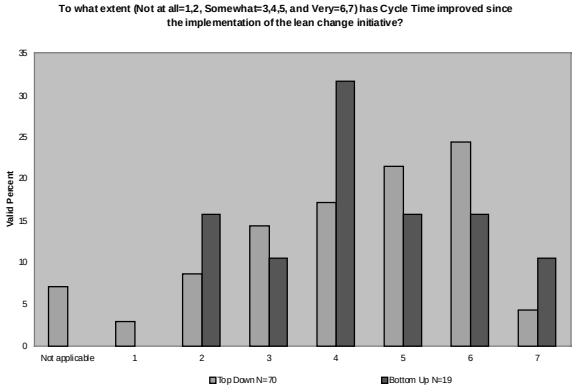

Estimated Net Improvement in Quality of Product or Service
Valid Percent
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
Top Down N=15
Bottom Up N=5

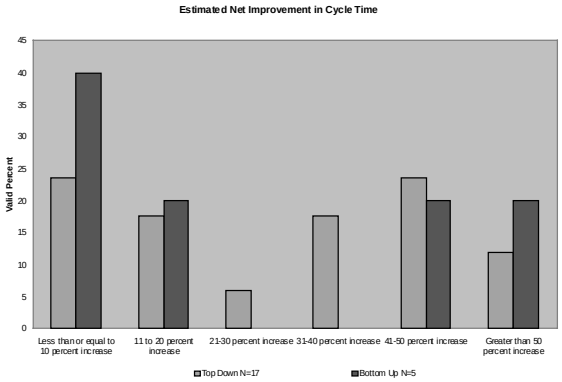

To what extent (Not at all=1,2, Somewhat=3,4,5 and Very=6,7) has Resource Utilization improved since the implementation of the lean change initiative?
Valid Percent
Not applicable
Top Down N=71
Bottom Up N=19

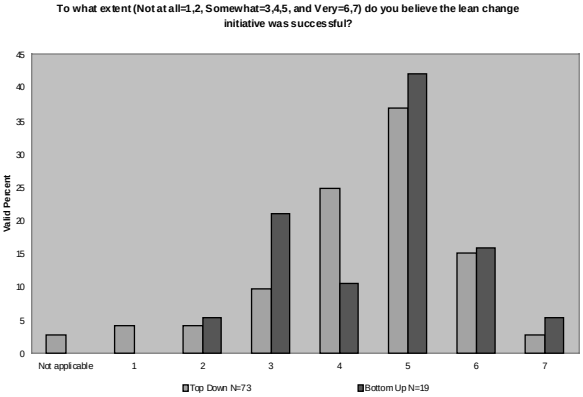

Estimated Net Improvement in Resource Utilization
Valid Percent
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
Top Down N=16
Bottom Up N=5


To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Return on Assets improved since the implementation of the lean change initiative?
Valid Percent
Not applicable
Top Down N=70
Bottom Up N=19


Estimated Net Improvement in Return on Assets
Valid Percent
120
100
80
60
40
20
0
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
Top Down N=14
Bottom Up N=4


To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) has Cycle Time improved since the implementation of the lean change initiative?
Valid Percent
35
30
25
20
15
10
5
0
Not applicable
1
2
3
4
5
6
7
Top Down N=70
Bottom Up N=19


Estimated Net Improvement in Cycle Time
Valid Percent
45
40
35
30
25
20
15
10
5
0
Less than or equal to 10 percent increase
11 to 20 percent increase
21-30 percent increase
31-40 percent increase
41-50 percent increase
Greater than 50 percent increase
Top Down N=17
Bottom Up N=5


To what extent (Not at all=1,2, Somewhat=3,4,5, and Very=6,7) do you believe the lean change initiative was successful?
Valid Percent
45
40
35
30
25
20
15
10
5
0
Not applicable
1
2
3
4
5
6
7
Top Down N=73
Bottom Up N=19