INSTITUTIONALIZING CHANGE IN AEROSPACE PROCESS AND PRODUCT SETTINGS

by

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S.B., Aeronautics and Astronautics

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ABSTRACT

This thesis is an examination of the methods used to introduce and sustain change to help answer the reasons why some organizations are successful at adapting and some are not. If there is agreement on the necessity to adapt an organization for improved performance, there may be some identifying features of successfully adapted organizations that could assist those still trying or about to embark. In order to affect beneficial change, strategies to promote transformations must recognize the political, economic, and social issues, as well as the capabilities of the organizations. A greater understanding of the instigators and barriers to lasting change provides a helpful guide to develop policy initiatives that incorporate these considerations and result in agreements or operations with more cooperative stakeholders.

The research method used in this thesis was four separate case studies conducted in parallel. The organizations selected for these case studies produce, or manage the delivery of, a technically complex good or service. The methods used included interviews of key employees using a standard questionnaire format to facilitate data categorization and a review of any archival material that may have been made available.

The trends in the data suggest that more commitment from lower level leadership and a wider availability of best practice documentation corresponds to less regression to former practices. More formal training led to wider diffusion in these case studies, but the availability of documentation did not correspond to greater diffusion or adoption of the practices. However, better availability of documentation did correspond to less regression. The strongest defenses against regression were not supporting the old process or making permanent or semi-permanent physical changes to the work area.

The recommendations centered on management policies, providing incentives, and creating organizational structures to promote initiatives and their diffusion throughout the organization, reduce regression, and reconcile resistance to change. They include using small, organic change offices in business areas that do not have a history of mature change practices to use as models, setting aside a percentage of realized savings for human resources investment, and time-in-grade provisions for management positions to allow for greater continuity.

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Dedicated in memory of my father, Alfred Kassin
For guiding me and inspiring me to study aerospace engineering

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1.0 Background and Motivation

In today's environment of rapid technological change, firms and non-business organizations are challenged to respond effectively or risk losing competitive advantage, market share, or public confidence. Technological advances and global competition are providing the impetus for changes at unprecedented frequencies. The stress placed on flexible and evolving management practices in this environment is significant. Despite the differing motivations of business and public service, common features exist in how they react to change as organizations. The root commonality is that organizations consist of people and a study of organizational change involves both psychosocial and economic perspectives.

A realistic view of the effects of policy in the technical arena must account for how organizations respond to changing environments. These pressures might be political, economic, or social. In order to affect beneficial change, strategies to promote transformations must recognize these issues, as well as the capabilities of the organizations. A greater understanding of the instigators and barriers to lasting change would provide a helpful guide to develop policy initiatives that incorporate these considerations and result in agreements or operations with more cooperative stakeholders.

In business, many change initiatives and methodological philosophies have been promoted in the last half-century. The non-profit sector has also emulated many of these initiatives, since profit maximization is not the only possible goal to which an organization may aspire. More efficient provision of services and customer satisfaction are also motivators for organizational change.

1.1 Overview and Problem Definition – Why Adaptation and Change are Important in Aerospace Companies

The aerospace industry has embraced many of the change initiatives that have been traditionally associated with the automotive industry and large-scale manufacturing. Shrinking defense and space program budgets and losses in the airline industry have resulted in company consolidations, greater competition for a smaller number of programs or customers, and smaller production runs. Aerospace companies are also managing a larger supplier base as they outsource non-core competencies and become system integrators by deciding what they will manufacture internally and what they will buy from suppliers. In cooperation with many of their customers, aerospace companies have been motivated to adopt productivity enhancing initiatives in an attempt to reduce costs and retain or expand markets.

Many change initiatives were brought to the forefront by Japanese management practices. These initiatives may come under the aegis of quality circles, Total Quality Management, Lean Thinking, Six Sigma, 10X, or other programs related to Japanese management practices or systems dynamics views of corporate processes. Some of these ideas were initially introduced into Japan by Deming, an American. As global competition emerged,

American firms could no longer rest on the laurels of their achievements of the first half of the century and looked to the success of Japanese manufacturing, particularly the Toyota Company, for ways to improve productivity. Current global competition requires flexibility and absorption of principles from various cultures.

Most major firms have recognized the need to change effectively and have embraced these philosophies to varying degrees. Some do not seem to truly internalize these changes, and as soon as the change effort loses favor, or is replaced by a different program, the fledgling changes may be discarded and the organization reverts to its previous practices.

The aerospace sector has traditionally been seen as more of a craft industry than a mass production industry for some of its products. Aircraft and spacecraft are not produced in as large a number as many other goods, such as automobiles, and are very complex systems when characterized by the engineering, material, and safety considerations that are required in their design, manufacture, and testing. These differences have provided a challenge to the acceptance of change initiatives in these companies because of the existing practices and culture and the perception that initiatives that are useful for mass produced items will not apply to specialized and technologically advanced or highly complex systems.

The effectiveness and staying power of organizational change mechanisms have a profound effect on the strength and productivity of firms, the capabilities of governmental organizations, and the economies and societies that depend upon them. The health of the aerospace industry is important for the national security and economic strength of the United States, so the successful adoption of initiatives which promote improved manufacturing and business practices is especially critical. Since various change philosophies have been attempted, there are numerous examples of successes, partial successes, and failures. Failures in this sense would refer to an inability to incorporate the proposed changes in a permanent manner, which would result in a return to previous inefficient practices.

In light of the proliferation of these programs and the length of time they have been practiced, significant and useful observations can be made about how change initiatives are implemented and sustained. Since current global competition requires flexible and adaptable management practices, these external observations of the instigators and barriers to lasting, institutional change would be useful for firms attempting to maintain their competitive positions.

An examination of the methods used to introduce and sustain change would help to answer the reasons why some organizations are successful and some are not. If there is agreement on the necessity to adapt an organization for improved performance, there may be some identifying features of successfully adapted organizations that could assist those still trying or about to embark.

This is not a study of best practices that constitute the nature what the organization wishes to become. The methods and structure of the organization and how these affect its ability to adopt and sustain best practices and change its culture is the focus of this research. The dynamic interrelationships amongst different parts of an organization and its financial and political environment may illustrate the struggles, illuminate the barriers faced, and point to ways to address these issues in either business practice or policy development.

1.2 Key Research Questions

Questions still remain as to the efficacy of change initiatives and how particular companies are able to maintain their emphasis on change. These include the following:

- How are initiatives introduced and implemented?

Aspects of this problem include the mechanisms by which organizations decide change is necessary and choose a philosophy to follow or emulate. What functional part of the organization acts as a promoter and how is the organization as a whole structured with regard to its eventual achievement of its stated goals?

- How do organizations actually attain senior management endorsement as well as employee cooperation and empowerment?

Are the particular people entrusted to implement or promote change placed in influential positions? To what extent are the job security concerns of employees allayed? Does management recognize differences in performance when change initiatives are attempted but not fully incorporated into the organization's culture and when they are truly successful?

- What are the barriers to complete and lasting change in large, complex organizations?

What is the nature of misunderstandings between the professed long-term goals of upper management and the perception by operational members of the organization? Is communication enough to seal the breach? How do organizations deploy resource savings from change efforts? If change is considered beneficial in the current environment, why is it sometimes so difficult for large organizations, which have been successful at their endeavors in the past, to change even in their best interests?

- In organizations with a history of change initiatives, what mechanisms to maintain momentum are evident?

Are the change initiatives self-reinforcing? Are limiting factors that counteract initial advances recognized? Are fundamental or only symptomatic causes in the system identified and addressed? How is the evolution through multiple change initiatives or programs characterized?

2.0 Literature Review

The subject of organizational change has received numerous treatments from behaviorists, economists, and management theorists. There has been much discussion about organizational decision-making, methods to implement changes and the effectiveness of these methods, barriers to change and to optimal problem solving, and the effects of technological innovation on organizational change. Most of this literature is predicated on the definition of a firm as an organization, since the strong economic motivation for change, in many instances, has put the business firm in the center of these discussions; however, these behaviors can be extended to cover many different types of organizations. Since organizations comprise individuals, I also found it helpful to examine literature about how individuals adopt changes.

2.1 Behavioral Models of Organizations and Communities

Allison adopts the concepts of routines and standard behavioral patterns in large complex organizations in his Organizational Process Model.[1] In this model, he looks at governmental actions by viewing governments as a collection of quasi-independent organizations with different primary responsibilities. Rather than acting as a monolithic, rational, maximizing decision-maker, governments perform complex routines defined by the programs within the organization's repertoire.

He also uses the concept of "bounded rationality" as developed by Simon. Simon defined limits to rationality encompassed within the skills, values, and knowledge of the decision-maker.[2] This rests on a principle of efficiency defined by a rational maximization of goal attainment. The limits to this rationality may be described by the amount of knowledge a human can accumulate and also apply, the ability to assimilate information, and distortions in communication.

Allison then continued by explaining how decision-makers simplify the process in five ways, given the limit to the alternatives that humans can comprehend in a complex problem. The problems are factored so that separate pieces of the problem are assigned to separate organizational units. Satisficing becomes the goal rather than optimization or maximization when an alternative is found that is good enough. Satisficing allows a simplified search because every possible alternative is not considered. The search order is also a significant indicator of which alternative will be chosen. Uncertainty avoidance is accomplished by quick corrective action rather than evaluating the probability of all outcomes. Repertoires of existing programs or routines provide the choices for organizational action.

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[1] Allison, Graham T., *Essence of Decision*, (Boston: Little, Brown, and Company, 1971)
[2] Simon, Herbert A., *Administrative Behavior, 2nd Edition, A Study of Decision-Making Processes in Administrative Organizations*, (Toronto: Collier-MacMillan, Canada, 1945, 1968)

In this model, the choices available to government leaders exist in the repertoires of its component organizations. These repertoires consist of rehearsed standard operating procedures, which is how the organizations can coordinate complex actions. Once again, the goals of a particular organization are defined by bargaining amongst different interests within the organization. Difficult trade-offs are not made, as problems are addressed sequentially. In a governmental or military situation, these different goals and routines are illustrated by budget requests and plans for standard combat scenarios.

Organizational learning occurs as new situations are faced. However, significant change does not occur unless the organizations are faced with major environmental shifts. Leaders can use excess budget funds to effect change. Additionally, a budget shortfall or a severe performance failure may prompt fundamental change.

Government leaders exercise control by deciding which repertoires are used where and at what time. A good predictor of how an organization will act is its prior actions. The standard operating procedures do not provide flexibility in different circumstances; therefore, change is incremental, as new procedures are adapted from old ones. In addition, organizational momentum may carry operations past its beneficial lifespan. Since organizations will rarely depart from their routines, direction which contradicts organizational goals, requires coordination with other organizations, or requires tasks other than those contained in the organizational repertoire will not be accomplished as the leader intended.

Cyert and March use the concepts of organizational goals, expectations, and choices to describe their behavioral theory of the firm.[3] They posit that a firm may contain many different types of goals including market share, sales, and production, not only profit. These goals may be contradictory in different parts of the firm and, therefore, lead to unresolved conflict. The sequential manner in which goals are addressed allows the firms to make decisions in the presence of conflicting goals.

Organizational expectations affect decisions by tempering the amount and kind of information available to decision-makers, thereby affecting search patterns and the relative strengths of various options. Information about relevant choices are not simply equally available for those who wish to find it. The conflicting goals of the firm's subunits determine the kind of information that is presented.

The way in which firms implement decisions conforms to standard operating procedures already developed in the firm's practices. The choice taken by the firm will tend to satisfy the goals agreed upon by a coalition of subunits. Since the search is motivated by a problem, the search will begin in the neighborhood of the problem symptoms and then proceed to an alternative near the first solution, if that one is lacking.

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[3] Cyert, Richard M. and March, James G., *A Behavioral Theory of the Firm*, (New Jersey: Prentice-Hall, 1963, 1992)

Any change initiative in an organization must account for these behavioral characteristics. Realistic expectations of what will be accepted must be based on an understanding of what information is available and how decision-makers use this information to search for alternatives, categorize options, and implement solutions.

In an attempt to avoid uncertainty, organizations will gather feedback from the effects of their decisions and negotiate with the environment to reduce uncertainty. Examples of these negotiated environments are trade associations and industry common practices as applied to external environments, and budgets that necessarily define the internal environment. As organizations adapt by changing search, decision, and goal formulation rules, they become learning organizations. The theory of Cyert and March has contributed to other studies that attempt to predict and understand the decision outcomes of firms, given that firms operate in a manner consistent with behavioral theories.

The idea of a firm as an organization was expanded in Nelson and Winter's evolutionary theory.[4] They dismiss the orthodox view used in most economic theory that firms act with perfect information to maximize profits or other measures of firm success. The characteristics of the parameter that is maximized would then determine the decision rules used to achieve the maximization. They disapprove of the orthodox theory as a basis for conducting any real understanding of the internal dynamics of the firm as it undergoes change in response to market conditions or other impulses. They support the concept of "bounded rationality", whereby managers make decisions without perfect information and not necessarily to the economic optimum. Despite their attempt to introduce some realism into the explanation of how economic decisions are made, the orthodox theory still holds sway, even in advanced microeconomics courses.

Their evolutionary theory parallels the constructs of biological evolution to describe how organizations change. They view the standard operating procedures, or routines, as the genetic material that is passed to future manifestations of the organizations that have either been changed or replicated. The routines are a form of memory storage and are influenced by the individual skills and knowledge of the members of the organizations, much of it tacit. Organizations use routine functions in order to maintain a truce amongst conflicting internal goals. Therefore, the choices available to the firm are actually very narrow and their actions can be predicted by the routinized behavior observed in the past. Even when attempting a change, the heuristics of the firm will dictate how the strategy develops. Drastic or extreme changes will probably not be easily adopted.

Anderson and Tushman examine technological change and provide a cyclical model to describe technological change using an historical study of the flat glass, container glass, cement, and minicomputers industries.[5] Their model is influenced by the evolutionary

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[4] Nelson, Richard R. and Winter, Sidney G., *An Evolutionary Theory of Economic Change*, (Cambridge: Harvard University Press, 1982)

[5] Anderson, Philip and Tushman, Michael L., "Technological Discontinuities and Dominant Designs: A Cyclical Model of Technological Change", *Administrative Science Quarterly*, Vol. 35, Issue 4, December, 1990

theory groundwork provided by Nelson and Winter, as they describe a process of variation, selection, and retention.

In their model, a technological discontinuity, in which new innovations are significantly different than the existing technology, is followed by an era of ferment. The discontinuity expands the frontier by fundamentally changing the process, not the scale. Discontinuities that are competence-enhancing build upon the current body of knowledge. Those that are competence-destroying cause certain skills to become obsolete. Eventually a dominant design emerges and becomes the industry standard. Then incremental change and improvements, focusing on lower cost and design differentiation, take place until a new technological discontinuity occurs.

Their results show that there are a significant number of new designs introduced during eras of ferment as compared with eras of incremental change, and eras of ferment were significantly longer for competence-destroying discontinuities. Sales peak after a dominant design emerges due to increased demand; however, a discontinuity itself never becomes the dominant design. Dominant designs were also not on the technical frontier. Competence-enhancing discontinuities tend to be supported by industry incumbents, but there was no clear correlation between competency-destroying discontinuities and newcomer introduction. They surmise that newcomers may be necessary to initiate the destruction of old ways of thinking, but institutional experience may still be required. Their findings also showed that most of the technological progress occurs in the discontinuity and not during the era of incremental change.

Anderson and Tushman raised further questions about how the sociological and economic aspects of organizations affect the selection of a dominant design and what characterizes companies that pioneer industry standards. They also questioned the recurring effect technological cycles might have on organizational evolution. They also stress the organization's ability to create networks and coalitions to maintain a variety of competencies and exploit technological capabilities in order to affect industry standards.

It has already been established that organizations must become learning organizations in order to grow and effectively change when necessary. Schein explains how companies should treat organizational learning as a change process and create parallel systems.[6] Organizational slack is required in order to create parallel systems in which employees can reflect and practice so that they can reframe their thinking and test new behaviors. These parallel systems are often created with organizational slack as pilot or experimental programs. It is also necessary to locate the parallel system near the positions of power and, in some cases, the CEO is the initial learner. Parallel systems located in the middle of the power structure may be threatening to upper management unless higher levels can be involved in some way. Other ways of gaining support are to use consultants or organizational sets consisting of other learning companies. Consortia can provide new

[6] Schein, Edgar H., "Learning Consortia: How to Create Parallel Learning Systems for Organization Sets", *Society for Organizational Learning online working paper*, August, 1995

outlooks from those not entrenched in your own corporate culture and can expose learners to researchers and coaches.

Much of these works have identified challenges to organizations in recognizing, formulating, and accepting change. They summarize the dilemma faced by managers and other employees in complex organizations, who may individually see the need for improvement, but are stymied by the nature in which organizations behave. The notions of bounded rationality and programmed routines tend to limit the available alternatives an organization can follow. Understanding how organizations behave can clarify the need for methods by which organizations can introduce and implement change.

In his book Diffusion of Innovations[7], Everett Rogers examines the way in which an innovation is communicated within a social system and is diffused from its source to the adopters. He recognized the presence of a common interest in the diffusion of innovations in the research traditions of anthropology, early sociology, rural sociology, education, industry, and medical sociology. He found that those within these different research traditions were unaware of the applicability of studies done in each others' areas that could contribute to a more general theory of the adoption and diffusion of innovations. He used studies from the adoption of agricultural technology and innovations, the adoption of new prescription drugs by physicians, and the adoption of innovations in developing societies to bolster his arguments.

He defined an adoption process and the characteristics of those involved in the process. He made the distinction between adoption as an individual decision and the process of diffusion occurring among the adopters. This has some bearing on company or organizational initiatives, even though adoption here refers to an individual choice, whereas company leadership generally directs that a particular initiative be used. He used learning theory to begin to explain how innovations are adopted by individuals. Learning requires continued reinforcement of response to stimuli. Adoption is a process of learning, deciding, and acting over a period of time. Education level was also correlated with rational and discriminating decision-making.

Rogers defined five stages in the adoption process and five adopter categories to describe individuals. The five stages are awareness, interest, evaluation, trial, and adoption. The adopter categories are innovators, early adopters, early majority, late majority, and laggards. The adopter categories are defined by individual characteristics, modes of communication, and social relationships. Each adopter category, in the order listed above, displays significant characteristics described as venturesome, respect, deliberate, skeptical, and tradition. Figure 2.1 illustrates the adoption process and is adapted from Rogers' diagram[8].

[7] Rogers, Everett M., *Diffusion of Innovations*, (New York, The Free Press of Glencoe, 1962)
[8] Ibid. 1, Figure 11-1, page 306

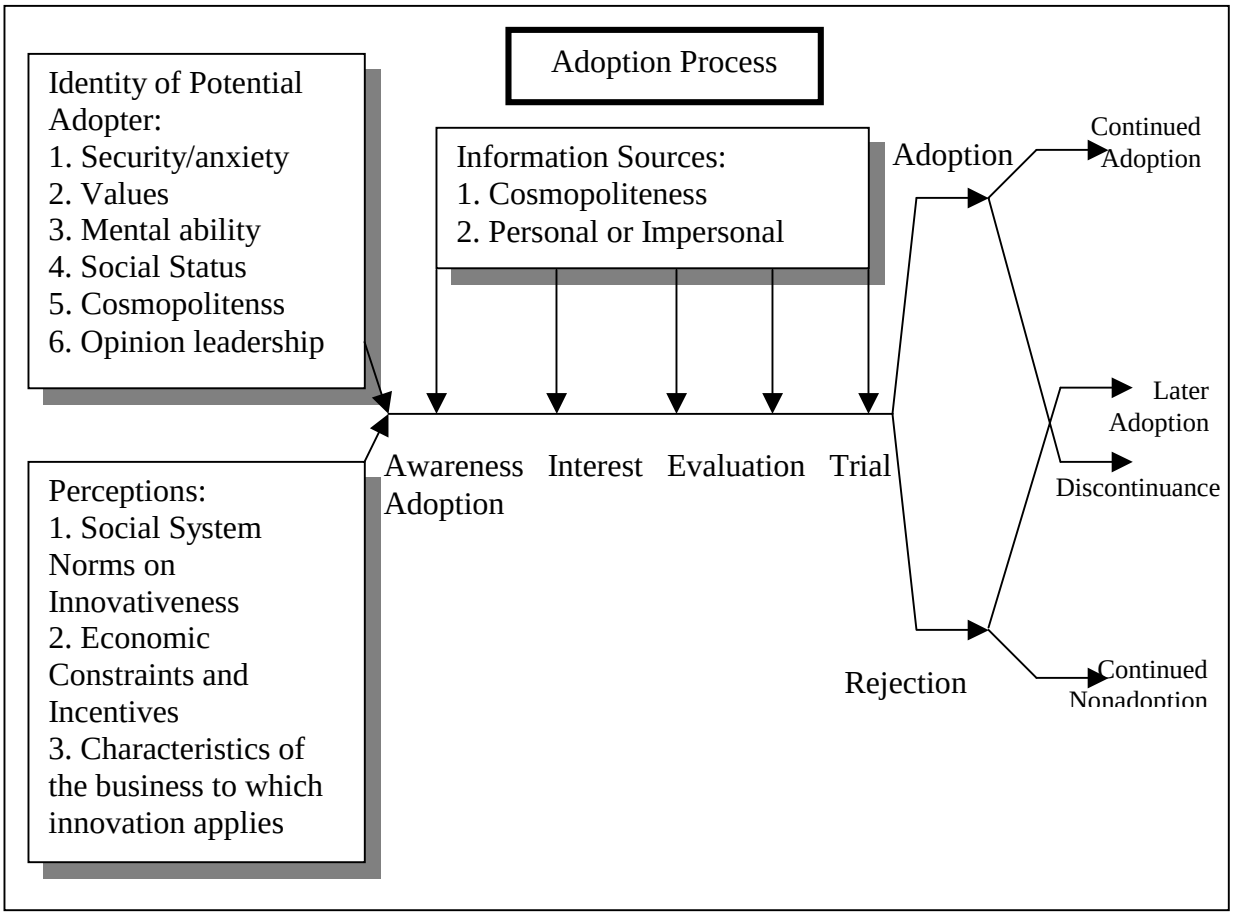

Figure 2.1: The Adoption Process
Adapted from <u>Diffusion of Innovations</u> by Everett M. Rogers

Based upon the studies he reviewed, he made generalizations about the diffusion of innovations and ideas, the roles of opinion leaders and change agents, and means of communication. Opinion leaders are crucial to the diffusion of innovations and ideas. There may be opinion leaders in several adopter categories. Opinion leaders are important because personal influence from peers is important in the evaluation stage and for later adopters. They provide reinforcement and validation. Although opinion leaders may often be of a higher social status than their followers, too wide a difference in social status can be a barrier to diffusion.

The characteristics of the innovation as perceived by potential adopters is often more important than the benefits that experts might attach to the innovation. Innovations with material benefits that are visible and easily communicated are more easily diffused than non-material innovations or ideas. There is also an interaction affect that tends to increase adoption as more people in a social system become adopters and, therefore, interact with those who have not yet adopted.

A change agent who is trying to promote an innovation is usually an outsider to the social system. This may mean that they lack accountability and do not share in the risk that adopters face. That may not be true in commercial companies where the official change agents responsible for implementing the initiative may also have similar incentives to others in management and act in the interest of company profitability. Behavioral changes require effort, but a change agent may overdo his efforts at promotion because at some point word-of-mouth becomes more influential to the spread of an idea. Because cultural values and past experiences affect how people perceive innovations, the change agent should try to change the norms of the social system rather than promote single innovations as separate entities. They must also be aware of the needs of the system and promote competence so that potential adopters can better evaluate ideas. .

One of Rogers' generalizations was that impersonal information sources, such as mass media, are more important in the awareness stage, but that personal contacts are most important during the evaluation stage. Personal communications are more influential because of the selective exposure, perception, and retention displayed by individuals to information they receive. Reception to new ideas is subject to selective exposure because individuals tend to seek information or sources that coincide with their own ideas and opinions. Some people are marginal to different adopter categories so they can bridge the gap or diffusion would occur too slowly. He also found that since adoption follows the trial stage, one way to speed adoption would be to provide incentives for trial of the innovation. The adoption to trial phase has been found to be longer for early adopters than for later adopters because early adopters take greater risks and the increased time they spend may provide more confidence to later adopters to adopt more rapidly.

In their work concerning organizational learning contained in a resource book for how to achieve a learning organization, Senge, et al.[9], spoke about the role of leadership in organizational change. They believe that leadership comes from the creative tension formed by people when they truthfully articulate their current reality and vision for the future. They make a distinction between the myth of leader-heroes and what they call leadership communities. The myth of the hero-CEO, who will come in and transform an organization from the top using his or her superior vision and special skills and influence, is actually a distorted view. The idea that an overpowering leader will bring about change runs counter to the current views that empowerment throughout the organization is a better way to cultivate change and develop adaptive behavior, and that real and lasting change must come from diverse sources. An overbearing, forceful leader may be able to demand compliance, but will be unable to change internal values, because those must be formulated voluntarily. In addition, the myth that managers must only present solutions and not problems hinders practices that can promote learning in teams.

In contrast, leadership communities consist of local line leaders, network leaders, and executive leaders. Local line leaders have direct impact on and accountability for the

[9] Senge, Peter; Kleiner, Art; Roberts, Charlotte; Ross, Richard; Roth, George; Smith, Bryan, *The Dance of Change, The Challenges to Sustaining Momentum in Learning Organizations*, (New York, Doubleday, 1999)

results of an initiative. Network leaders use their contacts outside of the business unit to help to diffuse the change across the entire organization. Executive leaders must take a long-term view, provide infrastructure support for change, and lead by example, as well as recognizing that traditional models and their own behaviors may be obstacles to change. Senge, et al. describe this using an ecological model to show that each type of leader needs the other types in order for the whole to be effective so that a diversity of leadership can interact to sustain change.

They recognized that many change initiatives are not successful because the leaders concentrate mainly on growth mechanisms and not on the limiting mechanisms that are barriers to change. They name ten challenges to initiating and sustaining change. These are lack of time and guidance, justifying the relevance of change, management clarity, fear and anxiety, misunderstandings about success measures, groups that feel they're misunderstood, governance structure, diffusion, and questions about the strategy and direction of the organization. Many of these challenges highlight the cynicism and distrust that people feel toward the various change initiatives that have been promoted in their organizations.

2.2 Organizational Structure and Complexity

The behavioral aspects discussed above are evident in the view of firms as complex organizations. A paper by Wang and von Tunzelmann investigated how complexity in organizations affects the firm's structure and management.[10] They define complexity in the two dimensions of depth and breadth. Depth refers to analytical sophistication and breadth describes a range of heterogeneous areas. Firms may face complexities of technology, markets, production processes, administration, or products. They examine how complexities across functional areas can be coactive or conflictual. Coactive complexity, which requires integrative management, would have a positive effect on performance.

The firm's ability to perform complex functions rests with its body of knowledge. The ability to address a large variety of different functions may come into conflict with its ability to concentrate advancement in particular components. For instance, a product may contain cognitive complexity in its individual components as well as complexity in breadth by the difficulty of integrating them. Different processes may require cognitive skills and interactive skills. Wang and von Tunzelmann promote a dynamic approach to cope with shorter product lifecycles and the multidimensional complexity found in firms. They also note the concept of bounded rationality as a constraint on management's ability to process information.

A look at some methods for structuring flexible organizations that are responsive to change is in order. One form of organizational structure for dealing with complex products is a project-based organization (PBO). Hobday studied the effectiveness of a

[10] Wang, Q. and von Tunzelmann, T., "Complexity and the functions of the firm: breadth and depth", *Research Policy*, 29 (2000) 805-818.

PBO versus a matrix organization in a case study of a European firm in which each structure was used at a different division to manage the development and production of complex products or systems (CoPS).[11] In a PBO, the firm is organized by project rather than by functional units as in a matrix organization. The PBO is used in order concentrate distinctive knowledge and skills toward a particular product and is more flexible and responsive to innovation. Another feature of the PBO form is the high status and authority accorded to the project manager (PM), who otherwise must negotiate with functional managers for resources in a matrix organization. The PBO is considered a better form to handle technical complexity, shortened product cycles, and changing consumer demands.

CoPS are defined as high value, high technology, complex, and usually business to business products or services that are characterized by small production amounts, direct user involvement in development, and innovative designs or processes. They may require expertise across many disciplines and are sometimes produced by alliances of firms with distinctive resources they can contribute to the project. Many non-routine tasks or intelligent processes, an uncertain production environment, and changing user requirements also characterize CoPS.

Hobday found that the PBO was better suited to CoPS management; however, there were certain disadvantages to a pure PBO form. The company studied eventually changed its PBO division to a project-led organization to address these concerns. Its functional matrix division was changed to a project matrix organization, where PM's and functional managers have equal authority. Although the pure PBO form was most effective at resource allocation, knowledge management, and design optimization for a CoPS, employees could not always benefit from cross-project learning and could not see clear career paths and learning silos that are evident in matrix organizations. There were few incentives for senior staff to mentor new employees and pass on tacit knowledge. This led to job insecurity and concern over the long-term effectiveness of the PBO in communicating lessons learned from project to project. In the project-led organization, the PM's could still exert authority over allocations for the project, but some weak functional lines existed to provide for organizational learning and to develop future leadership.

Another form of organization to commercialize complex technologies is a network. Networks were a strategy also recommended by Anderson and Tushman. Kash and Rycoft discuss the network strategies used in the evolution of six technologies in jet turbine blades, radiation therapy, cardio-imaging, audio compact disks, the 3.5 inch floppy disk, and Intel's microprocessor.[12] These self-organizing networks of various firms combine their resources of core capabilities and complementary assets and, through

[11] Hobday, Mike, "The project-based organization: an ideal form for managing complex products and systems?", *Research Policy*, 29 (2000) 871-893.
[12] Kash, Don E. and Rycoft, Robert W., "Patterns of innovating complex technologies: a framework for adaptive network strategies", *Research Policy*, 29 (2000) 819-831.

their interactions, demonstrate a capacity to learn. Trust and reciprocity play significant roles, since members of the networks must have confidence in shared information.

Kash and Rycoft describe three patterns of innovation that may determine the trajectory of a network as technology evolves. New technologies and scientific breakthroughs characterize the transformation pattern, which is usually chaotic and uncertain. Transition patterns are characterized by major advances in existing technology and innovations made with the current body of knowledge. Continuous problem solving and exploitation of complementary capabilities are evident in the normal pattern.

Networks allow adaptability to innovation within these patterns by sustaining leading edge scientific and technological knowledge, broadening learning, and providing flexibility by self-organization. Networks can better react to four indicators of innovation pattern shifts. These indicators include technical community disintegration, invaders as new competitors, new technology waves, and market or governmental policy climate change. Networks can use a shared strategic intent and continuous trend monitoring and communication to develop trajectory roadmaps. These roadmaps provide a forum for debate and a sense of direction to help integrate the network capabilities. Since risk in technological innovation is an expected condition, the flexible structure of the network allows for experimental approaches and removes a hindrance to creative decision-making.

How companies respond to technological change is a predominant theme in the literature and is very timely, as current Internet business models now place a premium on exploiting innovations quickly. Stringer offers a view on how large corporations can commercialize innovations made by small entrepreneurial organizations.[13] Most large corporations are not radical innovators and corporate size has been shown to be inversely correlated with innovation.

Once again, the biological parallel is made, as he describes how large companies are genetically conservative and unable to learn fast enough. This is because industry leaders are more likely to adopt sustaining technologies that improve product performance over disruptive technologies, which may initially lead to customer dissatisfaction and loss of market share. Bureaucracies also favor stability and incremental improvements. In addition, internal research and development departments cannot adequately cover the entire range of emerging technologies. The work environment in large corporations is not conducive to innovators, as they are high achievers and seek conditions where they have individual responsibility. Large corporate environments are characterized by social skills reflecting an emphasis on power. Smaller companies, by contrast, have lower investments in the status quo and are closer to the market, making them more responsive to the changes in demand. They are also characterized by a higher concentration of innovative entrepreneurs.

[13] Stringer, Robert, "How to manage radical innovation", *California Management Review*, Vol. 42, Issue 4, Summer 2000

Stringer recommended nine strategies for large corporations to encourage and commercialize innovation. Those changes within the organization include creating an innovation culture, hiring more creative people, establishing informal project laboratories, creating idea markets, and separating the organization into the core, traditional business and an entrepreneurial side. Strategies that use resources from outside the organization include acquisitions, joint ventures, alliances, corporate venturing and a corporate venture capital fund, and emerging industry funds.

An example of a change agent and a method for growing an internal coalition is described by Hamel in an article about how IBM capitalized on the Internet.[14] An IBM programmer named David Grossman recognized many of the application opportunities of the Internet and brought it to the attention of those at headquarters when IBM content at the Lillehammer Olympics was being used by Sun Microsystems on the web. He took the initiative of demonstrating the web to those in management who were unaware of its existence or potential.

Grossman was joined by John Patrick, a well-respected staffer. Patrick became the business translator for Grossman and other Internet followers within IBM. He was able to obtain resources such as people and hardware, especially when they prepared an IBM website and received the support of CEO Lou Gerstner. Working outside of normal channels, they were able to showcase IBM products and capabilities, culminating in their 1996 Summer Olympic website. This created outside expectations that the Web group was able to use for its advantage. If they had to give up a person to another business unit, they didn't view it as a loss, but as an opportunity to colonize other parts of IBM with their way of thinking.

The concept of self-renewing organizations as a key to success in the current economic climate is discussed by Kets de Vries.[15] He observes common values in organizations that recognize business environment changes and develop and retain their best people. They are characterized by an atmosphere of trust, candor, and fairness, which allows for better decision-making. These organizations also form teams and encourage diversity, which empowers employees and enables them to work towards a common agenda. They also value their customers' perspective as the ultimate arbiter of their success and promote achievement and creativity by being less critical of well-meaning mistakes. Self-renewing organizations also provide training and development, and practice distributed leadership to coach future leaders.

Kets de Vries explains that the ability of these companies to succeed lies in their recognition of the psychological motivational needs of individuals. The human needs for attachment and exploration are extended to affiliation and assertion in the corporate

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[14] Hamel, Gary, "Waking Up, IBM: How a Gang of Unlikely Rebels Transformed Big Blue", *Harvard Business Review*, July-August, 2000

[15] Kets de Vries, Manfred, "Beyond Sloan: trust is at the core of corporate values. Technocrats no linger rule and hierarchies are dead", *London Financial Times*, October 2, 2000.

setting. When these companies provide a milieu that aligns individual motivational systems with corporate objectives, it allows people to transcend individual needs in order to experience fulfillment.

Kotter addresses the missing elements in failed change initiatives.[16] He finds that companies who attempt shortcuts in the process don't fully understand all of the steps that must be followed. In particular, a sense of urgency must be created and led by change champions who aren't inhibited by the possibility of being blamed for a crisis. The urgency must push people out of their comfort zones and facilitate open debate. Then a coalition of powerful people who can operate outside of the hierarchy must snowball from the initial instigators. This coalition must develop a clear and coherent vision to inspire change. The vision must be communicated using every available avenue and must be demonstrated by the actions of senior leadership.

The transformation cannot be successful unless obstacles, which could include the organizational structure, are removed. Other obstacles may be the compensation or appraisal systems, or even individual naysayers. Another important step is to celebrate short-term wins to maintain momentum, but not to declare the entire war won too quickly. The entire process may take up to ten years and is very vulnerable to regression in the early stages. The changes must be incorporated into company culture and become part of normal behavior in order to become permanent.

2.3 Improvement Models and Methods

Many present techniques for change management have been adopted from Japanese management practices since World War II. One of these philosophies, Lean principles, is described by Womack and Jones.[17] They enthusiastically promote five major principles of lean thinking as the way to eliminate *muda* (waste in Japanese). These principles include identifying value from the customer's perspective, defining the value stream, causing the process to flow, reacting to customer pull, and striving for perfection. These concepts in practice have produced dramatic production efficiencies and, if extended over many firms in a value stream, can establish a lean enterprise.

Defining value requires a dialogue with customers and a rethinking of traditional definitions. Then the entire value stream from raw material producers of component parts to the customer can be mapped. This will facilitate the identification of three types of processes, those which create value, those which create no value, but are currently required (Type One *muda*), and those which do not create any value and can be eliminated immediately (Type Two *muda*). This analysis may reveal wasted transport, inventory, excessive defects, or inactivity. They propose that mass production and batch and queue processes lead to much of this waste. In the cases where firms have made large capital investments to reduce manufacturing costs by a reduction in direct labor, the

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[16] Kotter, John P., "Leading Change: Why Transformation Efforts Fail", *Harvard Business Review*, March-April, 1995

[17] Womack, James P. and Jones, Daniel T. *Lean Thinking*, (New York: Simon and Schuster, 1996)

savings may be offset by other costs downstream, including the technical support and large inventories.

In order to produce flow, the firm must focus on the product itself and ignore traditional job definitions. By forming real product teams in more than name, cross-functional employees can utilize other skills they may never have exercised. In addition, they discuss the importance of *takt* time as opposed to Material Requirements Planning systems (MRP's). Level scheduling would facilitate the use of *takt* time as a production driver, which relates production to the actual rate of sales. Reconfiguring plant layouts, right-sizing equipment, and reducing machine changeover time from one product variation to another would contribute to flow. In this case, the scope of production might change as necessary, but the level of effort would still conform to *takt* time. In fact, they cite a study by Csikzentmihalyi that defines the most rewarding work as that which shares the same characteristics as flow, intense concentration on a challenging yet achievable task, with immediate positive feedback.

Pull requires reaction to actual demand and not "created demand" or forecasts that require large numbers of parts in inventory, but not necessarily a large variety. In order to use level scheduling effectively, the firm would have to practice level selling so that items produced would reflect average demand. The premise of perfection rests on constant assessment and continuous improvement. Since perfection cannot be described accurately, it requires constant effort. By focusing on a particular vision and committing resources to it, management can develop a policy deployment, which defines targets and timelines for achieving them. Another requirement for effective change is a change agent who operates as a beneficent tyrant in order to facilitate a change that will eventually benefit everyone.

Another key element to promote lean thinking is to address the loss of employment as waste is removed from the value stream. Resources made available by eliminating waste can be directed to other activities that have future benefits, such as producing more items in-house or developing new product lines. To avoid resistance to change, employees must be guaranteed job security. Employee morale may suffer if they cannot distinguish between layoffs due to decreased sales or those due to dramatic internal change. A one-time reduction in the workforce might be necessary, but prolonged or piecemeal reductions would poison the atmosphere for change.

Continuous improvement (CI) is another method used by companies to remain competitive. Terziovski and Sohal surveyed 385 Australian manufacturing firms to determine the extent of and motivation for CI programs.[18] Continuous improvement is based on concepts by Deming and by Imai's *Kaizen*. Kaizen is composed of the four stages of plan, do, check and act. It involves ongoing improvements throughout all layers of the organization. Organizational learning is a necessary prerequisite for continuous improvement so that knowledge can be created, communicated, and utilized.

[18] Terziovski, Mile and Sohal, Amrik, "The adoption of continuous improvement and innovation strategies in Australian manufacturing firms", *Technovation*, October, 2000

Respondents to the survey were motivated by production efficiency, reduced production costs, and improved performance quality. Half of the respondents limited CI to manufacturing and did not apply it across the organization. Organizational success was positively correlated to the length of time CI had been implemented and the extent of CI within the company. They recommend that large companies introduce CI throughout their entire organizations and use globalization, which provides a larger pool of knowledge, to facilitate innovation. Smaller companies can exploit globalization through joint ventures.

Ravichandran and Rai investigate quality management programs, including Total Quality Management, in information systems and software development.[19] Information systems developers are presented with problems in product quality, long lead times, and user dissatisfaction. They found that successful performance was linked to process management efficacy. This, in turn, was associated with management infrastructure sophistication and stakeholder (including programmers and vendors) involvement. Senior management leadership was an important aspect related to management infrastructure sophistication. They recommended that management provide a coherent commitment to quality performance by establishing practices that promote coordination and learning. They warn against senior management providing too much direction rather than facilitating change at the functional level. By promoting skill development, management will enhance stakeholder empowerment for the benefit of future development.

The effectiveness of Total Quality Management (TQM) in the public service sector in Austria was the subject of a longitudinal case study by Scharitzer and Korunka.[20] The impetus for creating a more customer-oriented, efficient public sector has led to an emphasis on new public management (NPM).

They used surveys of employees and customers of a large public housing agency. These surveys revealed a decrease in customer satisfaction during the organizational change, but a marked increase a year after the change was implemented. Customers were not only concerned with the outcome of the service, but also with the reliability and competence of those involved in the problem solving process. They were also less critical than the employees and displayed an increase in loyalty to the municipal service after the change policies were implemented.

The employees also showed increased stress and dissatisfaction immediately following the implementation. Higher strain and lower job satisfaction were correlated with those less involved in the organizational redesign. In addition differences in job satisfaction

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[19] Ravichandran, T. and Rai, Arun, "Quality management in systems development: An organizational system perspective", *MIS Quarterly*, Vol. 24, Issue 3, pages 381-415, September, 2000

[20] Scharitzer, Dieter and Korunka, Christian, "New public management: Evaluating the success of total quality management and change management interventions in public services from the employees' and customers' perspectives, *Total Quality Management*, Vol. 11, Issue 7, September, 2000

and perceptions of job security were evident in different work categories. Management and customer representatives showed significant job content dissatisfaction. They recommend passive and active participation measures, such as more formal distribution of information to compensate for the negative effects on employees. The positive customer satisfaction reports were provided as feedback to employees with good effect. They had been unaware of the positive effects of their organizational change on their customers.

The literature carries common themes of flexible organization and continuous learning to adapt to changes in technology and the economic climate. Networks and coalition building were also recurring suggestions of recommended strategies. The situation today provides a fertile environment in which to examine organizational change. Many of the barriers to the acceptance of change initiatives and their diffusion throughout organizations still exist, despite decades of research identifying these challenges.

3.0 Research Design and Methodology

The research method used to study the aforementioned questions was four separate case studies conducted in parallel. The large size of the organizations necessary to make meaningful observations does not lend itself to experiential manipulation of variables. The Lean Aerospace Initiative, under whose auspices I conducted graduate student research, consists of a consortium of companies in the aerospace industry and related government agencies. I selected a sample of case studies from this population. Four case studies, rather than one, will greatly enhance the applicability of the study to other circumstances.

The organization selected for a case study produced, or managed the delivery of, a technically complex good or service. A firm that produced a variety of separate products, which resulted in organizational complexity, was also a viable candidate. The organization had to have chosen to follow a major change initiative during the past five years, either in part or throughout its entire organization. A large, division-level operation with between 1000 and 20,000 employees was sought.

3.1 Hypotheses

The research questions in Chapter 1 and the literature review in Chapter 2 led to an examination of three major aspects of the adoption and diffusion of change initiatives in the organizations studied. These broad areas are leadership, training, and communication. The approaches taken by the organizations in this study to promote the initiative, reconcile resistors, and attempt to engrain the initiative into the company culture include emphasis on different levels of leadership, training procedures, and communication methods. The three hypotheses that follow each address one of these areas.

Hypothesis 1. If lower level leadership is more committed to the initiative, there will be less regression, even if measures were not taken to make the changes to the process irreversible.

Although those in the senior leadership of a company or organization define the vision, identify the strategies, and are often the more visible champions of an initiative, they must identify and nurture leaders throughout the organization in order to affect the changes at the operational level and eventually transform the culture. Short-term goals might be accomplished by dictate, but will not become enduring once the person or persons in senior positions leave, as the change will have been driven mostly by personality in those cases. The leaders who work directly with operational employees must be motivated to help change the organization by providing incentives that, as close as possible, align their personal goals with those of the company.

Many change initiatives are deployed in such a way as to make regression to the former state difficult, if not impossible. In some cases, however, there are still examples of departments that have not fully realized cellular manufacturing, or old databases and

legacy software that are still supported. Some initiatives are accomplished in stages over a long period of time so that the opportunity for slippage is constantly present. In individual cells or departments where measures have been taken to make the changes irreversible, the physical layout and available equipment has been so altered that the employees cannot simply revert to an old method on their own.

Hypothesis 2. Training a larger part of the workforce leads to the employees having a greater ability to integrate, diffuse, and initiate change.

Approaches to training can be described as two extreme cases in terms of inclusion of employees, where most real situations are somewhere along a continuum between these two extremes. In some change initiatives, there have been attempts to include as many employees as possible in training and events such as kaizens where work practices are redesigned. In these cases, the desire is to elicit ideas from the lowest level possible and to engage subject matter experts. At the opposite end of the spectrum, companies may use only a core group of planners to redesign the processes and deploy the new processes as a finished product to those who must work to it.

Hypothesis 3. Having a formal best practices or lessons learned documentation available to all results in better diffusion and less regression.

This hypothesis follows from hypothesis 2, as many companies with formal training programs within their change initiatives who include employees throughout the process produce documentation to record the characteristics of the change as well as the manner in which it was produced. When the reasoning behind changing a process is explained, employees can better use these lessons in other situations. They have not only learned how to implement a particular new process, but can apply their training and the body of knowledge already collected within best practices to stimulate new ideas and build a culture of learning, continuous improvement, and adaptation.

3.2 Research Instrument

The methods used included guided interviews of key employees using a standard questionnaire format to facilitate data categorization. Broad access to interviewees at each site was requested in order to triangulate data and to pursue emergent trends in the study. Observations were made of employee attitudes and reactions while responding to questions. The visible effects of the initiative as well as employee behavior were observed during plant tours. The case study also involved a review of any archival material that may have been made available. The data collection portion of the research schedule spanned approximately two years from January, 2001 until October, 2002.

The questionnaire can be found in the Appendix. It consisted of eighteen questions that were worded to elicit responses that would provide information relevant to the key research questions. Some of the questions referred to the individual's experience with change initiatives in the organization in order to build the history of the initiative from various pieces, to determine its origin, and to characterize the interviewee's role in the

change. They were also asked what effects the initiative had on their job description, whether it involved training, and what level of effort was dedicated to the initiative.

Other questions dealt with the perceived champions of the change and the support of leadership, what savings were realized, and how these savings were measured and redeployed. In addition, interviewees were asked to characterize the resistors to the initiative and explain how resistance was resolved. The final question asked about the current status of the change and how it appeared to be evolving. This question addressed regression.

3.3 Data Collection

Ideally, the kind of data I collected would have been defined directly from the information necessary to test the hypotheses. All of the interviewees would have been asked identical questions in an identical fashion and would have provided answers that could be calibrated and quantified in distinctly measurable ways. This was not the case, however.

The questionnaire was written with the intention of capturing the data necessary to answer the various research questions. Many of the questions were open ended and provided an opportunity for interviewees to expound on particular issues of interest or competence. Interviewees in different functions and at different levels in the hierarchy could provide more complete information in some areas than in others. For instance, some interviewees had a clearer perspective about where savings might be redeployed than others. Therefore, many answers could not be simply categorized or were not direct equivalents to other answers to the same question.

I also found that I could group certain questions into one longer question if the amount of available time was an issue. I also individualized the questions to build upon themes that interviewees may have introduced or I changed the emphasis depending on whether I was speaking to a director, manager, front line supervisor, engineer, or factory worker. Their roles and perspectives in the initiative and how they might understand the questions were different, so evoking responses required different manners of questioning.

Another issue that affected data collection was the difficulty of gathering additional data after site visits. I discovered that I was more likely to receive useful data if I insisted on it while I was still at the site than if I tried to collect it later through telephone calls. The contact people were generally cooperative, but, in a practical sense, my research was not a priority for which they were responsible. I could have requested items such as training records or proof of savings more vigorously and in person. The training records or history of kaizen events might have provided dates, manhours spent in training, and frequency of training throughout the life of the initiative. This information would have provided more objective data to support histories related in the interviews and it could have been used to more formally judge the extent of training and to identify periods of time of more intense training. It may have been awkward to obtain more specific data about savings to compare the planned and actual business cases made for improvement

implementations because the financial information they contain might be sensitive or proprietary.

In each case study, I asked to speak to employees who had resisted change efforts as well as ardent supporters. In general, I was given fairly wide access to people, but resistors were not well represented in my sample, either because they had left voluntarily, were removed from the organizations, or I was not aware of their existence or names and so could not request their participation. I relied on the institutional knowledge of my sponsors to choose appropriate interviewees and to provide introductions to prepare the way for their participation.

3.4 Case Study Framework

The organization of the case studies emerged from the interviews and the structure of the questionnaire. Certain question families formed the major subject headings of the case studies. These are the initiative history, champions for the initiative, training and level of effort, communications, success measures, savings, regression, resistance, and continuing evolution. I recognized certain trends in the discussions about resistance which gave rise to the categories I called reconciliation strategies. They were addressing cultural issues, mitigating resistant behaviors, areas of management emphasis, and actions taken toward regressive tendencies. In case A2, the natural categorization of the differentiation of the resistance data was by that evident within the directorate, from external suppliers, from the contracting community, and from internal customers and suppliers.

3.5 Case Study Descriptions

The observations made in these case studies are not only descriptive, but also offer additional insight into organizational change processes actually occurring throughout the world. Four case studies were used, although the initial intention was to do two case studies at three companies for a total of six. The plan was to have a mix of manufacturing and business process initiatives and to showcase both a mature and a newer initiative at each company.

3.5.1 Case Studies at Company A

Case studies A1 an A2 were conducted at a division that is part of a larger aircraft company. The division manufactures large aircraft structures for numerous product lines for the larger company. I visited the division four times from March 2001 to August 2002. During those visits hosted by the Company A Production System Office, I was given tours of the major manufacturing facilities, spoke with various people connected with change initiatives, and formally interviewed 54 employees from directors to hourly factory floor workers. The interviewees included directors of the major functional areas and product families, product line managers, shop workers, team leaders for specific initiative implementations, and representatives from the various aircraft structures groups, strategic planning, finance, struts and nacelles, and coaches and facilitators from the Company A Production System Office.

The interviewees identified a number of different change initiatives in which they had personal experience. The change initiatives that are being implemented at Company A are many and varied. This allowed an examination of the various initiatives and how they interacted across the organization, as well as a more detailed analysis of strategies employed by certain sub-groups within the larger organization.

Once I had spoken with employees and managers throughout the organization who were familiar with the numerous change initiatives that had been undertaken throughout the years, I continued my inquiries with a focus on two particular initiatives in order to understand these processes in more depth. In consultation with my sponsor from the Company A Production System Office, I chose the Lean deployment within the Skin Fabrication Directorate and the Material Flow Optimization effort in Supplier Management. These not only provided an opportunity to examine initiatives in both a manufacturing and a business process, but also a chance to see the effects of an initiative with a slightly longer history and to compare it to a newer effort.

During the initial site visits, I was able to speak with people across the division and in many disciplines to get an overview of the major initiatives occurring throughout the organization. During my final visit, the interviews were concentrated in Skin Fabrication and Supplier Management so that I could focus on the two particular initiatives being implemented in those organizations. The initiatives in these organizations were LEAN production and Materials Flow Optimization, respectively. These choices not only allowed the inclusion of both manufacturing and business process initiatives in the study, but also detailed observations of the influences of leadership changes and time on these initiatives. It also broadened the mix of the types of employees involved and the skill sets they possessed.

I interviewed 14 different people in Skin Fabrication over the course of three site visits. The interviewees included the director, two product line managers (PLM, second level managers), three supervisors (first level managers), a manager in the support organization, a quality focal, a capacity planner, three lead workers, and a floor mechanic, and another PLM in an informal, partial interview. In Supplier Management, I interviewed a total of 10 people. They included the manager and project leader for the initiative, a manager who reports to the director, a second level manager in material management (a counterpart in manufacturing services), a first level manager in business management, an e-business project leader, three material management analysts, and a purchasing analyst. These interviewees provided information based upon their understanding and experiences related to the Lean and MFO implementations. The different perspectives illustrated the degree to which the knowledge of the initiatives and the associated principles had penetrated into and across the organizations.

3.5.2 Case Studies at Company B

Company B is a consolidated company of what had been three separate full service aerospace companies. For the purpose of discussion, the headquarters site will be called

site 1 and the other sites, site 2 and site 3. My initial contact was at site 2, where I made a site visit and conducted five interviews in June 2001. Soon after that, my contact retired. I was later referred to a new contact at site 1. By this time, I had already defined a need to seek both a manufacturing initiative and a business process initiative. My new sponsor gathered information on various initiatives and I chose two.

I visited site 1 in October 2002 and interviewed 12 people for both case studies. During analysis, I determined that what would have become the business process case study for Company B was too wide in scope and did not have enough in common for a comparison with the other case studies. It would have required more site visits to all three sites and interviews with more than the five people I had already interviewed.

The manufacturing case study that remained was the successful adoption of LEAN manufacturing principles in an electrical harness production cell at site 1. The impetus for this initiative was the impending decision to transfer the work to a plant in a foreign country. I interviewed seven people who had been involved with this initiative. They included the project leader and a facilitator from the LEAN department, the cell supervisor, a production line support specialist, a planner, an electrical engineer, and a harnesser.

3.5.3 Case Study at Company C

My initial contact for this case study was at the headquarters company, which is a division of a larger corporation. I made two site visits to the company headquarters in March 2001 and July 2001and interviewed four people informally, including three key people in the office that is the umbrella organization for the company-wide improvement initiative. When my contact moved to a different function, my new contact looked for candidate case studies at the headquarters plant. I made two more site visits in January 2002 and February 2002 and interviewed six people in the Quality section of a program office and in the International Business Development Group.

My new contact found an opportunity for me to study the transformation of a plant located in a different state from the headquarters company. This plant manufactures turbine fan blades and other jet engine parts for aircraft engines. The corporation had formally launched a corporate-wide LEAN-type initiative in 1996. The adoption of the initiative by this plant was the focus of the case study. The initiative will be referred to as the Continuous Improvement (CI) initiative in the text, although all continuous improvement activities at the company headquarters were not merged with the larger initiative until mid-2000.

I made two site visits to this plant in July and August 2002 and interviewed 12 people formally and one informally. The interviewees were from different manufacturing units and support units. They included a manager in the CI office, a facilitator in the CI office, a supervisor in non-destructive testing, five CI leads, a manufacturing cell leader, an engineering technician, a quality engineer, and two machinists.

4.0 Company A – Two Case Studies: LEAN Manufacturing and Supplier Management

These case studies were conducted at a division that is part of a larger aircraft company. The division manufactures large aircraft structures for numerous product lines for the larger company. Another core product and competency is tooling.

The consolidation of aircraft manufacturing companies in recent years has concentrated manufacturing into fewer, but larger, companies. In addition, global competition provides an impetus to reduce costs, improve quality, and, thereby, maintain a larger share of sales to customers. This division is a cost center for the corporation and does not produce its own profits. It is an internal supplier to its parent company and must therefore compete for work that could be distributed among several plants.

The current change initiative environment is a culmination of various initiatives that began in the early 1980's that are depicted in Figure 4.1. In October 1981, the division started using Quality Circles, based upon a model from Florida Power and Light. This was a grassroots effort that involved management when approval was needed. In the mid-80's, the quality effort progressed from the Total Quality Concept to Total Quality Commitment to Continuous Quality Improvement. The current emphasis on Lean, applied to manufacturing and other processes, began in 1996.

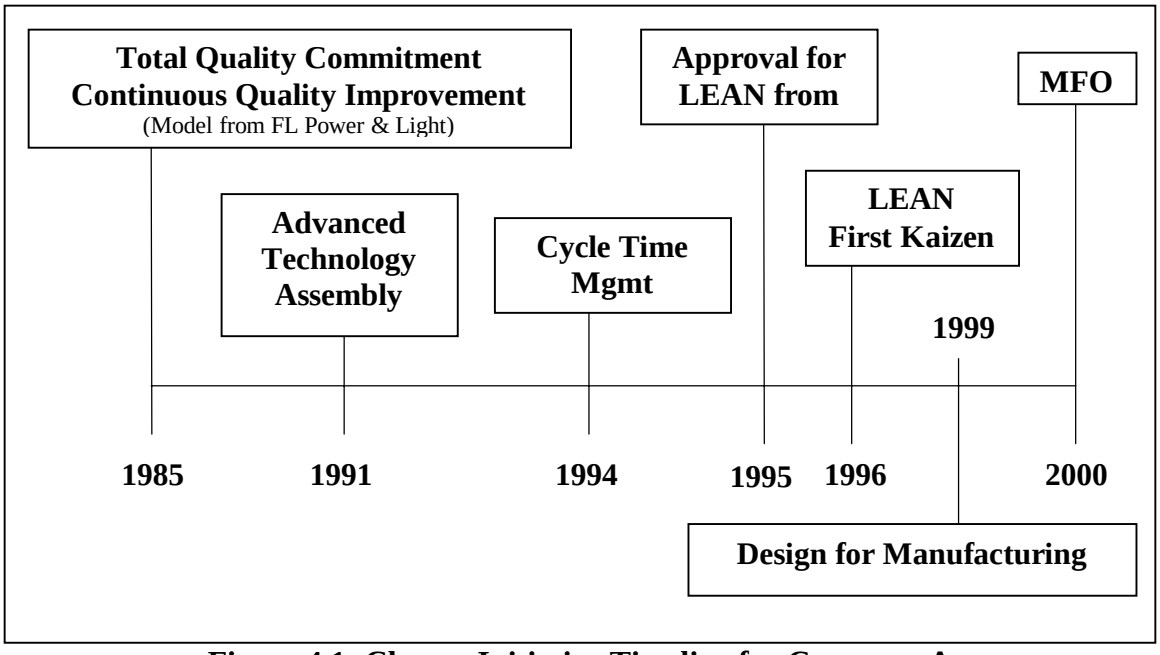

Figure 4.1: Change Initiative Timeline for Company A

Much of the initial groundwork and curriculum came from a major supplier to the division. The Company A Production System Promotion Office now coordinates the educational and coaching efforts. Employees attend a Lean class for two weeks in order to learn the principles and vocabulary used in Lean. When a particular process is targeted

for a Lean transformation, selected employees attend a kaizen event and apply the result to the factory floor.

4.1 Case Study A1: Lean Production in Skin Fabrication

The skin fabrication unit builds exterior skins and nacelles and involves work with sheet metal, a stretch forming process, preparation for chemical milling, and corrosion protection. As an internal fabrication shop, this unit affects all of the product lines and is in a unique position between suppliers of raw materials and assembly operations throughout the organization. This directorate made remarkable gains in reducing unit costs over a three year period. A new director was assigned in April 1999 to lead the directorate through a LEAN transformation that was enormously successful. Even after one year, rework and scrap costs per unit, as well as shortages, had dropped dramatically. Figure 4.2 provides a summary of the major milestones for the LEAN implementation in the directorate.

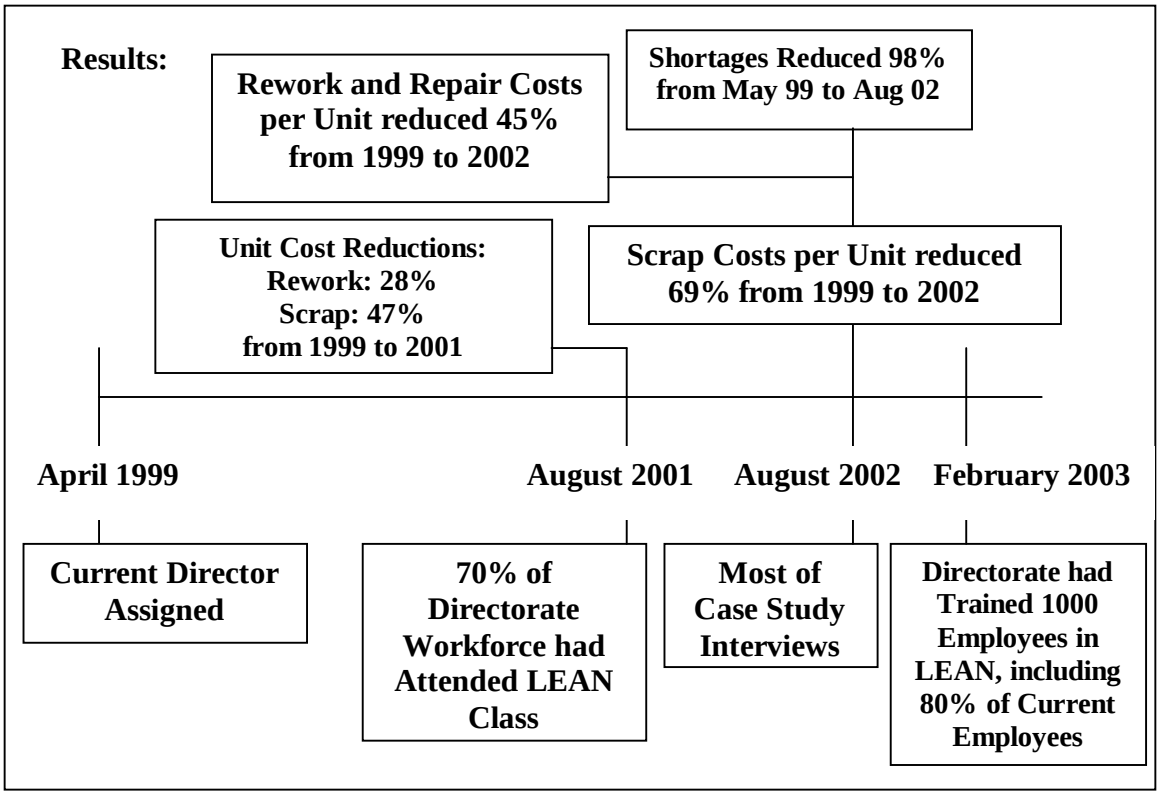

Figure 4.2: Case Study A1 Initiative Timeline and Results

4.1.1 Initiative History

Current continuous improvement programs at the company had their genesis with Quality Circles in 1982. In 1994, they emphasized cycle time management and, in 1995, Just-in-Time manufacturing gained attention. That year, upper management visited Japan and then approved an approach to use LEAN by 1996. In the first two years, they made attempts at shop floor improvements using kaizens. It was not until 1998 and 1999 that

there was an effort to look at the entire value chain. In 1998, the corporation also suffered heavy losses and that directed attention toward reducing costs. This integrated approach was not begun in earnest until 1999. Although most efforts at implementing LEAN practices began on new product lines, the skin fabrication unit was one of the first units in the division to start sending employees to Company A's formal LEAN classes.

The current director was appointed in April 1999, for the purpose of alleviating systemic problems that had resulted in high scrap and rework costs. He had previously spent 19 years in manufacturing research and development with the company. This was his first position in which he was responsible for building the product. He had had previous experience with the development of Determinate Assembly, an initiative that began in manufacturing research and development. The people he named as champions for this initiative, the general manager and another executive who has since moved to corporate headquarters, had faith in his ability to turn this unit around.

4.1.2 Champions for the Initiative

The interviewees were asked to name the person they perceived as the champion for the initiative. The champion would provide support in terms of resources, visibility, and enthusiasm. They could name more than one person and many did, as some people might have been able to distinguish a single champion and others recognized significant contributions from a couple of people. Figure 4.3 illustrates the distribution of the champions along the hierarchy continuum in relation to the relative level of the respondents within the hierarchy of the interviewee pool.

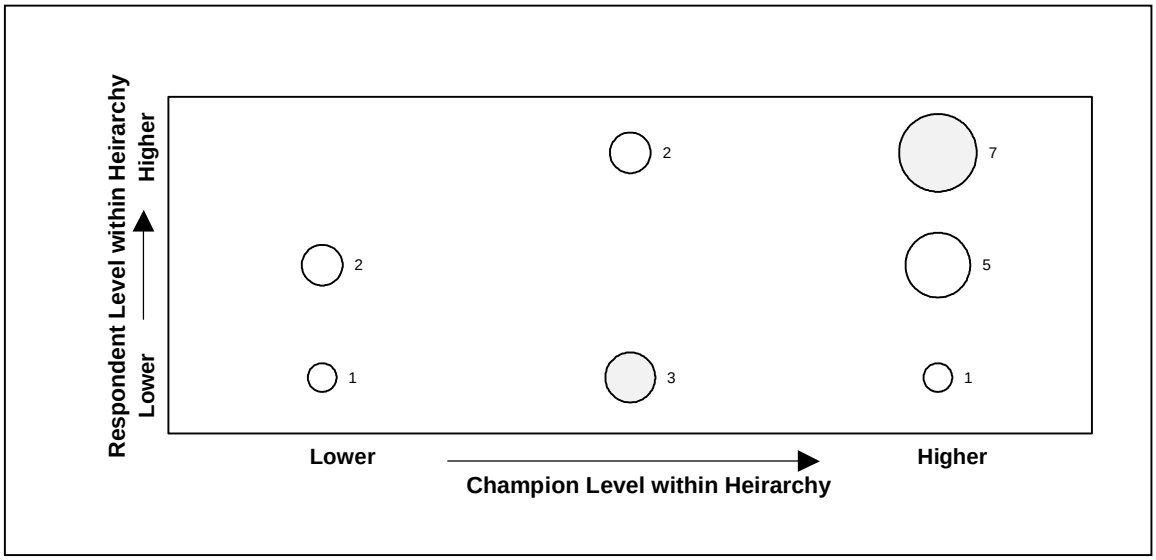

Figure 4.3: Naming Champions in Skin Fabrication: Frequency and Management Level

The most frequently named individual was the director, as either the sole champion or in combination with others. The second most frequently mentioned champion was the

program manager of the Company A Production System Office. Others who were considered champions of the initiative included the general manager, a former director of operations at the time of initial implementation and now at corporate headquarters, the current director of operations, their own product line manager (PLM), and a manager in the support organization of the directorate (who has since left the company).

The level of the employee within the organization influenced their opinion of who they considered a champion. When the perceived champions were at higher levels in the company or were those who represented different functional organizations, they had generally been named by the interviewees in management positions. The factory workers or interviewees without direct reports usually named their own PLM or others within the directorate with whom they had more direct contact or who they perceived as providing direct support to the daily or detailed implementation of the initiative. This does not mean that the leadership was not effective at all of these levels, but that it is important to cultivate leadership throughout the hierarchy, as employees at different levels appear to have been motivated by those who have more visibility at their level.

4.1.3 Training and Level of Effort

The formal training in Lean implementation consists of a Lean class and kaizens, which focus on particular processes in particular shops to apply solutions directly following the exercises. The format and curriculum are based on models developed by a major supplier of raw materials to the division who shared their accomplishments and know-how in a mutually beneficial arrangement. This strategic relationship would allow for improvements in the processes of a major customer, would strengthen the business that produces the product, and perhaps later generate greater sales for the supplier.

This director was one of the first managers to take the course and further required all of the 39 management-level employees in his directorate not only to take the course, but also to teach it at least once a year. This mandate illustrated his belief that the managers themselves must believe in the program in order to remain engaged and to impart this enthusiasm to workers. As of August 2001, when I interviewed the director, 70 percent of the directorate had attended class. The organization held one LEAN class on average every two and one half weeks and included personnel on all three shifts. As of February 2003, the directorate had trained over a thousand employees and 80% of the current 540 employees in the directorate had gone through training. Because of lay offs and subsequent movement of employees within the company, they had actually trained more people than were currently within the directorate.

The time devoted to this implementation provides some idea of the scope of the project and its significance. Two former PLM's are dedicated full time to the project across the directorate. Some efforts are sporadic, but involve many hours and people while they are active. Although the time spent directly on tasks associated with LEAN were not tracked separately, one supervisor who had been involved with the original implementation effort provided some estimates of the number of manhours initially invested. He indicated that 20 people working 20 hours each developed a mission statement in 1999. These 20

people each spent three and a half days in initial training, and a team of five people held daily and weekly meetings, and spent time doing factory walk-throughs. The number of hours he estimated was 66% of a full-time equivalent. One PLM said that during the first four months, five employees were dedicated full-time in his area.

All of the interviewees had attended the LEAN class. Many had participated in multiple kaizens. Not surprisingly, those in production management positions stated that they spent approximately 25% to 30% of their time on issues related to change initiatives. Those in non-management roles spent less than 10% of their time occupied directly with change initiatives, although they were in the positions most directly affected by changes to processes. Some of this apparent difference in emphasis may be due to different perceptions about what constitutes tasks or work efforts related to change. Some of it may be due to the different roles of those in management and those on the factory floor in bringing a change to fruition. One PLM described his job as more visionary than looking at individual activities and processes. He felt he must ask what the future will look like and concentrate on system management rather than process management. This described a strategic, system-wide and forward-looking approach.

4.1.4 Communicating the Initiative

The importance of developing leaders at all levels of the organization who support and inculcate trust in the initiative is also shown when considering how employees were generally informed of upcoming initiatives or specific process changes and how they best absorbed this information. Almost all respondents listed daily crew meetings as a source of important information regarding change initiatives. The personal, face-to-face interchanges played a significant part in transferring information from supervisor to crews, shift to shift, and from kaizen participants to the rest of the crew.

Many different avenues were used to provide information about new or ongoing initiatives. These included management talks with employees, all-hands meetings, celebrations of successes, official company publications, memos across shops or shifts, word-of-mouth, and even showing audit results. Employees were asked to volunteer for kaizen events or de facto leaders were chosen to attend. They, in turn, shared information with the rest of the crew. Management tried to elicit ideas from hourly employees and supported their participation in kaizens.

One manager spoke about building coalitions by speaking with two to three lead mechanics (those who are assigned additional coordinating duties, but are not in management positions) rather than announcing an initiative cold. The supervisor can inform the lead who will have influence with the rest of the crew. This agreed with what other managers said about the need to make communication continuous. The original group involved with the implementation tried to constantly talk about LEAN with those in the shops. A manager observed that the implementation team must continually talk with those affected by the change and demonstrate procedures to effectively communicate.

4.1.5 Success Measures in Skin Fabrication

The success of the implementation was recognized internally through a number of means, including an employee opinion survey, scrap and rework costs reductions, inventory reductions, and external recognition. The directorate improved by 14 points in two years in a survey designed to measure employee satisfaction. In addition, the unit applied for and was recognized with a statewide award based on Baldridge criteria. (Since the division is a cost center for a larger corporation, it is not eligible for the Baldridge award itself.)

An example of a particular improvement was implemented in laminates. A dedicated team was assigned to the problem and consisted of representatives from five shops, quality assurance and a line manager. At the beginning of the process, where the aluminum is stretched, there were 66 separate part numbers. They did not want to track 66 part numbers along the length of the line. The team built a simulation of the factory and was able to reduce the part numbers carried throughout the process to six, based upon combinations of material thickness.

The metrics recorded for shortages, rework and repair costs, and scrap costs illustrate significant improvements compared to levels before LEAN was implemented. Shortages were reduced by 98% from a high in May 1999 to August 2002. The weekly average from January through July 2002 was 83% below the target amount. Rework and repair costs per unit were reduced by almost 25% from 2001 to 2002, using a three-month average of the first seven months of data for 2002. Scrap costs were reduced by nearly 42% in the same time period. The current rework and repair costs and scrap costs per unit compared with 1999 correspond to reductions of 45% and 69%, respectively.

Other areas of improvement were in reduced inventory, cycle time, and part travel time. Some of the reduced inventory was due to implementation of Min/Max, an initiative that is the subject of the case study of supplier management at this division and is discussed in greater detail in a later section. One example of cycle time improvement resulted in a decrease from 44 to 21 days. Some of this was due to process improvements that reduced run times, such as in the chem mill tanks, and set-up times. The movement of parts within the shops has improved, resulting in a better flow pattern. Unnecessary part travel is also a quality issue, as the parts can be damaged each time they are handled. One supervisor said, “In my 24 years in [Skin Fabrication], this is the most streamlined process I’ve ever seen. Panels aren’t traveling all over the plant.”

Scheduled maintenance of shop machinery was instituted and they found they had fewer severe breakdowns. In addition, if the outcome of a kaizen includes a recommendation for new equipment, the case may be more convincing and the expenditure more likely to be made because previous kaizens resulted in savings elsewhere.

4.1.6 Savings

The division is an internal supplier of major assemblies to the corporation, therefore, it competes for work among other divisions and even external suppliers for its share of aircraft orders. This means that savings do not necessarily belong to the division, but directly affect the cost of the airplane and the division's competitiveness within the corporation. The various efficiency initiatives are designed to reduce cost per aircraft.

In Skin Fabrication, 70 percent of their cost is in material, so scrap and rework reduction contribute heavily toward reducing unit cost. The director identified the motivation concerned with personal incentives to reduce scrap and rework as "pride in work." People do not want to remake the same part twice or scrap work that they have spent time and effort accomplishing.

The issue of labor costs is tied not only to savings, but also to workers' perceptions and possible resistance. I was told repeatedly that there was no intention to lay off personnel due to improvement gains. However, people had to be flexible enough to accept job changes if new opportunities for work opened within the division as work was realigned. Although the union has specific job codes, there is some flexibility in the contracts to allow people to be moved for short terms. This unit has not met with resistance from the union. They have managed their headcount through their work statement. In anticipation of lower production rates, they did not hire to an absolutely full level. Rather than lowering headcount through lay offs, they can reduce overtime and use natural attrition. One manager noted a reduced overtime rate from 20% to 2.8% over one year.

Eight of the respondents said that they had seen no lay offs due to LEAN improvements. One noted that lay offs in other areas affected manpower in their area because of shifting jobs to other areas. Most acknowledged that reductions in labor were due to lower production rates and the cyclical nature of the business. One manager said that LEAN improvements would allow them to use their current headcount during accelerated production schedules, rather than rehiring and then reducing the workforce to follow the ups and downs of aircraft orders.

A shop employee acknowledged that the productivity improvements meant progress for the company, but was hard on individuals. It appears to people that they are producing more with fewer people. More employees are cross trained and are able to do many of the different tasks necessary within their shops. In one shop, they have reduced the number of employees from 22 ten years ago to 7 today and it appeared to an interviewee that they were doing the same amount of work with fewer people.

4.1.7 Regression

The differing responses regarding degree of regression illustrate that respondents within the organization possess different views and that the culture is still evolving. Although the organization's metrics showed that the initiative had improved operations, the answers to questions about whether the processes had changed and if, in fact, any

processes had returned to the way they were before the initiative began were inconsistent. If the cultural change had been complete, you would expect to receive the same answers from all respondents about regression.

In some cases, the process was allowed to regress if the results were not as intended. Discontinuance of kanban cards and reverting to the hot list were seen by some employees as a return to the old processes. There were conflicting opinions about the degree of regression. Some felt that they were continually learning and progressing towards a more ideal state. Others perceived the productivity gains as producing the same products in much the same way, but with fewer people.

The regression seemed to be linked to a lack of focus. Kaizen events focus attention on a particular problem in a particular shop. Once the resources are no longer concentrated and the stress is removed, there is a tendency to regress to the old process. One respondent thought that management focus and follow through were weak. Lower rates also allow some slippage in discipline because the regressive tendencies will not be felt as strongly during lower production. This regression is manifested by a return to a hot list, the loss of FIFO, and the disuse of kanbans. These components of a LEAN process were discarded if the production rates were not high enough to force people to push the limits of productivity gains. The differing perspectives of respondents about whether there truly were regressions of this sort highlighted views about the necessity of these components for continuing productivity improvements.

One PLM said that the hot list was really only a placebo because it did not hurt to reassure employees, and that the floor was really run on LEAN principles. One lead felt, however, that although they received new equipment to help simplify tasks, the actual process has not changed in five years. A first level manager recognized some room for improvement when there are still two people dedicated to checking for defects, indicating that they have yet to achieve a level of surety in their methods. As discussed above, some regression is allowed if management feels that the improvement is not as effective as originally intended. If the metrics for quality, cost, and delivery show improvements, regardless of the extent that LEAN principles are followed, then management might regard the implementation as successful. There was no desire to just follow the form of the initiative if the tools they do choose to use and maintain are effective.

4.1.8 Resistance

Blatant resistance was very light in Skin Fabrication. The director reported that he had only one in 500 people leave the class after the first day. They had expected that there would be more. Other managers reporting outright refusal of employees to participate also indicated that there were very few employees who fit that category. Estimates of the number of employees who still resisted either by complaining or by providing a challenge to managers ranged from 5 to 30 percent.

The director reported that newer employees with less than 3 years in the company seem to be completely behind the initiative. In some cases, those with 25 years of experience

have already made up their minds that nothing would really change. Even if those with greater seniority and more experience showed some resistance, they also knew the processes so well that their advice and input are respected and are to be valued.

There was no agreement among respondents of where the most resistance was displayed within the hierarchy. Not surprisingly, interviewees tended to consider the strongest resistors as belonging to a different group than their own. These groups could be differentiated by management level or seniority.

One respondent said that lower level managers seemed to be more hesitant at first than senior level managers by appearing reluctant and disbelieving in their initial verbal reactions to the initiative. However, he noted that their early resistance may have been due to the expectations placed on them. The first level managers are closer to the product and the deadlines, so adjustments to changes have a direct impact on their teams' output. However, the interviewee observed that once you make the change and it is successfully implemented, you would not have a stronger supporter than the lower level manager and his team. He used the example of changes in the laminate section to describe how a first level manager became a better advocate. Those changes worked because the first level supervisor was assigned to the implementation team full-time and was pulled from other responsibilities that might have distracted from his efforts toward the improvement initiative.

Although others reported that first level managers, especially those on second shift, might have been more resistant initially, these managers now express their wish that they had begun improvements earlier. Managers on second shift were thought to be more inclined to be resistant since they may not have been directly involved with planning and meetings regarding these changes that occur on first shift. Others also reported that supervisors or PLM's could be more resistant depending on how the change might affect their shops. In some cases, counterproductive decisions might have been made which might aggravate perceptions and cause resistance. It is difficult for people to see the entire picture and put a company perspective over the interests of their particular shop. The individual may not recognize the gains he has made.

Some respondents noted that resistance was more likely to come from shop floor employees. Others felt that hourly workers could be very receptive if the changes were presented well in advance of implementation and in a manner that did not threaten their job security. The kind of resistance that could be displayed at this level could take the form of apathy and a desire to just do the job and go home. Employees can also hold up an initiative for what seems like legitimate reasons. Since they are accustomed to being held to a target, they might find something to build rather than wait for the kanban signals in place to work as intended. The resistors may also be those who were not included in kaizens or idea solicitation.

In order to address expected resistance to the changes, a number of strategies were followed. Some were planned purposely to counter resistance and others were perhaps not planned for that intention, but were later found to be useful. These strategies could be

classified into those addressing culture, mitigating resistant behaviors, management emphasis, and actions taken towards regressive tendencies. They are interconnected and many approaches contain aspects of more than one category.

4.1.8.1 Culture and Resistance

Since the aircraft manufacturing business is cyclical and this has resulted in downsizing in response to downturns, people may link efficiency efforts with workforce reductions and perceive these initiatives as another threat to job security. In addition, resistance is to be expected when the average age of the workforce is 47 and the average seniority is 17 years, numbers quoted by one PLM. The employees are accustomed to an ingrained culture.

The culture is influenced by a very knowledgeable and experienced workforce. The director recognized that he had to work with the union from the beginning on this implementation. When teaching LEAN classes, he emphasized the combined work experience of the participants as one reason for why their ideas would be welcomed. Other respondents equated cultural change with comfort level. Since it takes time to develop comfort, the cultural changes must precede the process changes in order to prepare the workforce and improve acceptance. There seemed to be tension between the length of time necessary to evolve cultural change and the ability to sustain enthusiasm for an initiative over the time required for such a change.

A counter approach to allowing more time for acceptance and comfort to build was also in play. Some spoke of a clear message that you must get onboard or clear the way for others moving in the direction of change. Employees would need to open their minds to this new way of thinking. In this approach, the new model was how the business would be conducted and employees would have to just get used to it. One respondent indicated that many initial resistors in management had since retired and some resistors may have been moved to another part of the company. This tough talk may have been difficult to enforce. Union rules would make it difficult to remove people entirely if they otherwise performed their job, but showed resistance to adopting a change initiative.

4.1.8.2 Mitigating Resistant Behaviors

Actions or conditions that helped smooth acceptance included peer pressure and the existence of a critical number of accepting people within the organization. The critical number may be a core group of well-respected co-workers. Many employees I spoke with were repeatedly asked to participate in kaizen events because they were well regarded and had influence in their shops. Peer pressure was mentioned specifically by three respondents, but an accepting atmosphere engendered by fellow employees was a common theme in other answers related to reconciling resistance. Another reason peer pressure was effective is because others would have to carry the workload for a non-participating co-worker.

Not surprisingly, one lead stated that those who participated in kaizens were generally more receptive. Although it would seem that providing opportunities for nearly everyone to be in kaizens would provide a greater pool of non-resistors, the reality is that production must continue and the entire shop cannot be pulled offline to accommodate a kaizen event.

Allowing people to voice negative comments was also viewed as important because it provided an opportunity for management to explain the reasons for a decision. Giving consideration to negative comments would signal that other opinions were also considered valid and, in addition, would allow managers and supervisors to look at things differently and not be locked into a predetermined path. The challenge was to do this while attempting to focus on the positive aspects.

4.1.8.3 Management Emphasis

The emphasis that management placed on change initiatives indicates the relative importance of the initiative and the consequences of non-compliance. The director reported that there was a great emphasis placed upon quality for the customer as an outcome for LEAN transformation. He has made it a priority for his managers to teach the LEAN classes to the employees. If they are initially uncomfortable, they have an opportunity to teach as a team with another manager. The leadership must be convinced of the importance of the initiative before they can effectively instruct and persuade their crews. One first level manager also described how second shift leads were matched with those on first shift in order to pass information more smoothly and maintain continuity between shifts. There was also some indication that some initial adversaries in management had since retired and that the company seemed to move the most recalcitrant resistors elsewhere so that they would presumably do less harm to the initiative.

Since this initiative was broadly directed from the very top of the division, it had high visibility for corporate headquarters. Any successes or failures could draw attention at very high levels, depending on the impact to programs. One way to provide incentives for the implementation of a major change initiative is to tie results to performance appraisals. One PLM said that 50% of his merit increase was tied to LEAN implementation.

One such performance plan for a management position in Skin Fabrication illustrates the relative weight given to the initiative from 1998 through 2001. This performance plan is only representative of targets in Skin Fabrication. The increasing weight over time shows that LEAN became more important within this time period. Although the format and headings changed slightly from year to year, it is still possible to compare the importance given to various goals. Table 4.1 provides a summary of the performance plans with regard to LEAN and other improvement areas, although these goals were listed separately. The weight percentage is the amount that each area contributed to the person's overall rating. The difficulty level refers to management's perception of how difficult it was to achieve the goals within that category. The listing category is the major heading under which LEAN was included on the performance plan. A comparison of the

listing category was included to show how LEAN emerged from a special, separate program to become embedded within primary manufacturing objectives of delivery and cost.

Table 4.1: Comparing LEAN and other Categories in Performance Plans

Yr	Comparisons	LEAN	Quality	Cost	Delivery
98	Weight	**5%**	10%	15%	20%
	Difficulty	Difficult	Very Diff.	Very Diff.	Very Diff.
	Listing Category	Breakthrough Policies	Improvement Goals	Improvement Goals	Improvement Goals
99	Weight	**10%**	27%	15%	15%
	Difficulty	Very Diff.	Very Diff.	Very Diff.	Very Diff.
	Listing Category	Key Cost Reduction Focus Areas	Qual. Impr. & Improvement Goals	Cust. Satis./ Improvement Goals	Cust. Satis./ Improvement Goals
00	Weight	**30%**	10%	25%	10% (not incl. LEAN)
	Difficulty	Very Diff.	Very Diff.	Very Diff.	Difficult
	Listing Category	Delivery	Key Organizational Focus Areas	Key Organizational Focus Areas	Key Organizational Focus Areas
01	Weight	**30%**	15%	65% (including LEAN)	10%
	Difficulty	Very Diff.	Very Diff.	Very Diff.	Diff. To Very D.
	Listing Category	Cost	Performance Commitments	Performance Commitments	Performance Commitments

LEAN progressed from a more tentative and separate policy with very little weight and not very difficult targets to an initiative with a larger share of the performance goals and a recognition of the greater difficulty involved in achieving them. The initiative also became more integrated into the other key improvement areas, although its place within these headings moved. The areas of quality improvement (scrap and rework reduction), cost reduction, and delivery are linked to LEAN implementation because LEAN activities facilitate improvements in these categories.

4.1.8.4 Actions Taken Towards Regressive Tendencies

Providing visibility to process changes and their results was another way that management dealt with resistance. Huge kanban cards would serve as reminders to a new method and vocabulary. Digital imaging used as part of a shop improvement and other improvements that become an advantage to workers were also used to dispel negative mind-sets.

Some of the PLM's had positive attitudes regarding regression. They viewed disappointment with regression as due to unrealistic expectations. They saw the need to discuss regressions early and, during instruction, warned workers not to be impatient about achieving significant gains quickly.

4.1.9 Continuing Evolution

In some conversations I had at this division, the implementation of the broader LEAN initiative was described as a LEAN journey. A journey implies an evolving path and possibly new and broadening directions. The future and the health of the initiative is expressed in views about the culture, current regression, the ability to learn, and the choices made for the subsequent steps.

The culture has changed to the point where people realize that the initiative is not just new jargon, but is a different way of doing things and is not going away. They see a need to continually progress and alter their far-reaching goals. Better management support is evident by more teaming of different functional areas for projects in order to include more voices. One first level manager stated his opinion that to improve even more, the first level managers must be empowered to a greater degree. This desire for more empowerment seemed to come from the frustration of operating within an atmosphere that was unforgiving of mistakes and an inability to advise or provide ideas to other managers because there is no authority to do so.

There were many learning opportunities that were used to advantage. Some lessons learned, if put to good use, could be used to more effectively utilize LEAN. They realized that some process changes are better resolved without kaizen. In some cases, though, the kaizen was helpful in identifying boundaries across shops or the division that would be affected by the process change. One PLM said that if you listen to the factory, it would signal where to go next. Some employees said that the gains they accomplished were being kept, but that they must continuously and gradually improve. The initiative requires vigilance and constant revisiting.

Openness to ideas has also improved. There are hourly employees looking for opportunities and the management tends to listen to them. Some respondents spoke about giving ideas to managers and the cascade of ideas throughout the division. There is also better communications with suppliers.

There are a number of ideas about where to go next. The director indicated that the first processes at the beginning of a part's journey through their directorate must be revisited in order to make the back-end flow. This would move emphasis upstream. Most of the difficulty now is aligning improvements from within the directorate at these interfaces with other organizations within the division. The two managers who are dedicated to LEAN implementation across the organization had once been assigned to either ends of the flow and so understand the implications. The directorate is trying to move from pockets of improvement to linking the entire chain. This provides a challenge to management to motivate their own peers and facilitate cooperation with organizations

they do not directly control. This is different from the leadership they must provide to those already under their supervision.

They would also like to institute electronic signaling and changes that minimize handling of the skins to protect them from damage. Some spoke about including their suppliers and customers. They have recognized some cross-ownership issues with changes that have effects across more than one shop and the need to coordinate for better implementation. At a time of fewer orders they recognize that they must remain nimble and flexible.

4.2 Case Study A2: Material Flow Optimization in Supplier Management

The initiative called Material Flow Optimization (MFO) was begun with the recognition that the value chain of this division extends to the suppliers and that improvements in supplier management will be an enabler for other LEAN measures as well as a full initiative on its own. Many benefits from this ongoing initiative have already been realized. Buyers are able to handle twice as many part numbers, inventory has been reduced by 75%, and supplier consolidation has significantly reduced the number of suppliers with whom Company A's buyers must directly interact. In addition, tier 1 suppliers have adopted this initiative for use with their own suppliers, thereby spreading the efficiencies and cost reductions farther up the value stream. Figure 4.4 illustrates the major achievements during the MFO implementation.

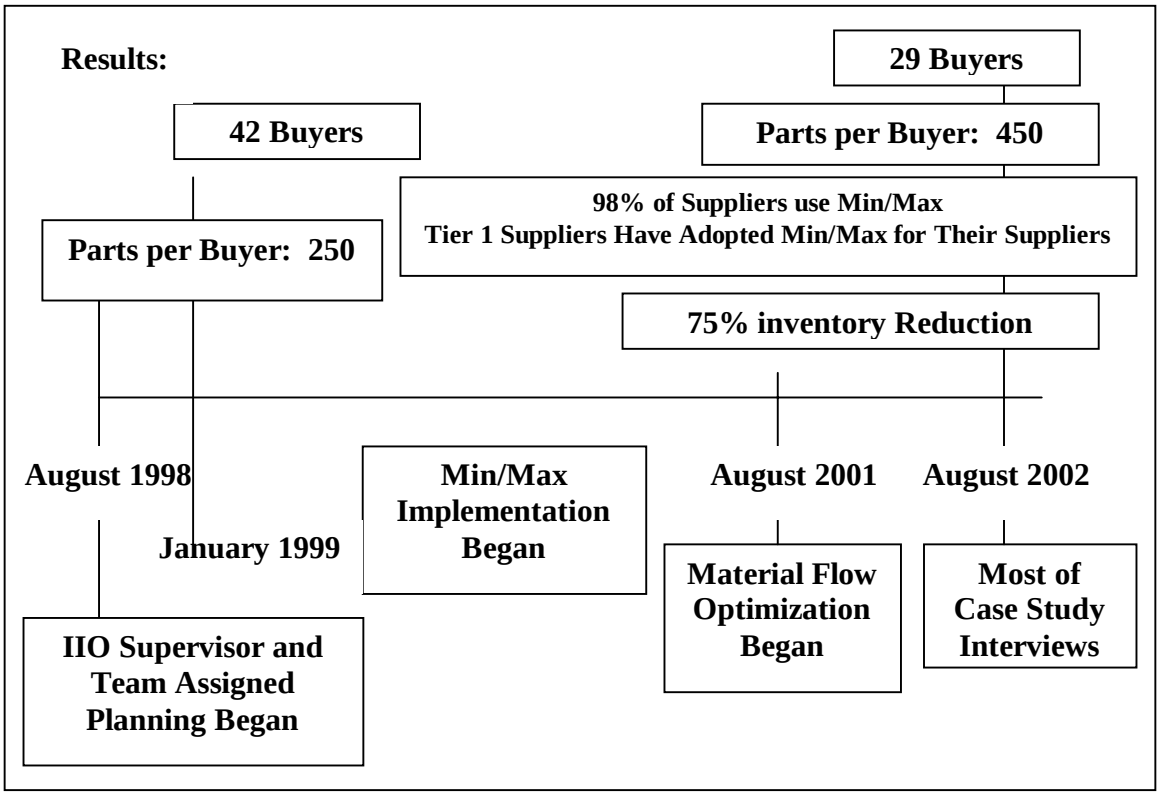

Figure 4.4: Case Study A2 Initiative Timeline and Results

This initiative consists of two phases and Phase I, called min/max, had been implemented in 2000. Phase II consists of a more comprehensive collection of sub-initiatives including kitting and reducing the number of tier 1, or direct, suppliers. Phase I was begun in conjunction with the start of a particular improved product line and the need to address part shortages and extraneous inventory early in the process. This is an example of an initiative that spans the enterprise and crosses company boundaries.

Because of globalization, the supplier base is less restricted, but Company A would like to deal directly with only the best suppliers. This requires classifying and evaluating suppliers. The corporation is attempting to make these classifications uniform across the divisions. These evaluations, as well as attempts to buy subassemblies rather than individual parts, has led to fewer direct tier 1 suppliers. Some suppliers who have been dropped from tier 1 status might still supply to other suppliers and their products are part of the ultimate assembly, but they can no longer call themselves Company A suppliers. There is an enormous amount of pride and the related business benefits that come from being a Company A supplier.

The purpose of this initiative includes meeting production levels with no inventory shortages, working with fewer suppliers, but in greater partnership, and implementing point-of-use delivery. Just-in-time (JIT) delivery confronts union issues because, by convention, the supplies stop at the dock and are delivered to the shop by Company A personnel. If the supplier were to have the responsibility of delivering directly to the shop, a non-Company A person would be on the shop floor doing a traditionally union designated job. Inventory is regulated by providing minimum and maximum levels to suppliers and allowing them to manage their deliveries while keeping Company A's inventory within the given range.

This new paradigm has also required a change on the part of Company A and min/max has, therefore, resulted in a major cultural change. In order to relinquish micromanaging their suppliers, they must make their production and delivery schedule more transparent. Company A had to share production schedule information with suppliers in order for this procedure to work properly. This is accomplished through electronic communications and a web-based network. Historically, Company A did not feel comfortable releasing this kind of information. Suppliers did not violate this trust, but if they had, Supplier Management would have used that information to determine that the supplier was not a good business partner. What they asked of suppliers was to keep their inventory within a particular range, but they let the suppliers run their own businesses as they saw fit. This approach helped suppliers prioritize the part numbers and load their own shops accordingly.

Supplier Management also instituted changes with internal suppliers, or fabricators, and interdivisional suppliers. The initiative allowed them to use the analysis to look at their entire supply management as an integrated system. This directorate does not have direct control over internal suppliers the way it does over outside vendors. The programs or product line management assist in that regard by applying pressure and influence when

and where needed. Since rules for external suppliers have already been established, this directorate can affect its influence by sharing best practices.

The initiative was launched because a particular forward-thinking shop in the improved product line which had been highly successful with LEAN needed further improvements in the supply chain to facilitate the best flow and to make further productivity improvements. They helped to develop min/max. A current senior manager in the major product line that was implementing LEAN was then the assistant director of Supplier Management. He and a PLM from manufacturing wrote the initial agreement between the directorates. The current manager of the IIO had the action to implement it for the whole division.

Phase II of MFO began once min/max became a stable method. This part of the initiative is concerned with facilitating true one-piece flow and kitting. There are four elements of MFO: min/max, packaging and kitting of parts and point-of-use deliveries, supplier consolidation, and reviewing make/buy decisions. The benefit of kitting is reducing the number of part numbers in the system. Kitting may not always reduce waste and increase efficiency, as it may be less responsive to engineering changes.

4.2.1 History of MFO in Supplier Management

About ten years ago, Supplier Management and Contracts worked together in one organization. At that time, the Material Management Analysts (MMA's) and the Procurement Agents (PA's) were placed in separate organizations. It was thought at the time that the MMA's role would eventually move to the suppliers. The ultimate goal of the initiative is to reduce inventory and shortages and that is an MMA focus. Unit cost reduction is a PA focus. Sometimes these aims are not compatible if a supplier who is effective at inventory control and managing deliveries is not the lowest cost vendor.

The Materiel Management Organization (MMO) has an initiatives integration group with a manager and 5 full-time staff members. They represent former managers from the materials management group. There are also some industrial engineers. Min/max began in 1999 and MFO at the beginning of 2001.

I spoke with two members of the Initiative Integration Organization (IIO) for the directorate. One is the project leader for the automated packaging plan that is used to analyze part families and determine which parts are candidates for purchase as kitted sub-assemblies. This interviewee was also the buyer who began the drive for min/max at the division. Shortages and inventory were characterized as out of control and min/max was to become the vehicle to improve these problems. They began with an account for the worst supplier Company A had at the time. This buyer was enthusiastic about correcting the situation. The other interviewee was the head of the IIO and was brought into the directorate from the Program Management Office to find out what this buyer had done and to coordinate the project.

The buyer who started min/max began it as a full-time assignment four and a half years ago. This buyer was joined a couple of months later by a team of four shortage administrators. The supervisor of the Initiative Integration team has 9 direct reports to him. He began in August of 1998 in this position. Before that, he was at the Program Management Office (PMO). His perspective included the meta projects of continuous improvement, and inventory management and the specific initiatives that support those goals, namely, min/max, MFO, and the automated packaging software

Originally, they gave him a three-month assignment with part-timers assigned to work with him. This proved difficult because the loyalties of the group members were divided and the initiatives were huge projects added to their full workload. A dedicated group was critical to their success. Since this group understands LEAN better than others not directly involved in the project, management has been talking about rotating people through the group to cross train others.

This is a completely different assignment from his previous one in PMO, but his experiences and working relationships formed links with some key people early in this initiative. At the time, his current director was the director of PMO, where she had spent much of her career. Materiel had problems, so they assigned her as a co-director for about one and a half years. She brought the current IIO leader to Supplier Management with her. Then she left for a while for another assignment. Another major change agent, now a senior manufacturing manager in a major product line, had been an assistant director under the current Supplier Management director. The IIO leader had worked for that manager on the min/max implementation.

4.2.2 Champions for the Initiative

The person or persons that the various interviewees named as champions for the initiative also highlighted the cross-organizational emphasis of the initiative. Some of the named champions were members of organizations affected by inventory issues, but were outside Supplier Management. A champion would provide support in terms of resources, visibility, and enthusiasm. Most respondents named more than one champion which highlighted the contributions made by the many different organizational interests in this initiative. Only one interviewee named a champion above the director level and, in that one case, the leadership positions were named in a general way and not as particular persons. The initiative may have visibility above the director level, but, from the interviewees' perspectives, the sponsors of the initiative are closer to the actual problems being solved. Figure 4.4 illustrates the distribution of the champions along the hierarchy continuum in relation to the relative level of the respondents within the hierarchy of the interviewee pool.

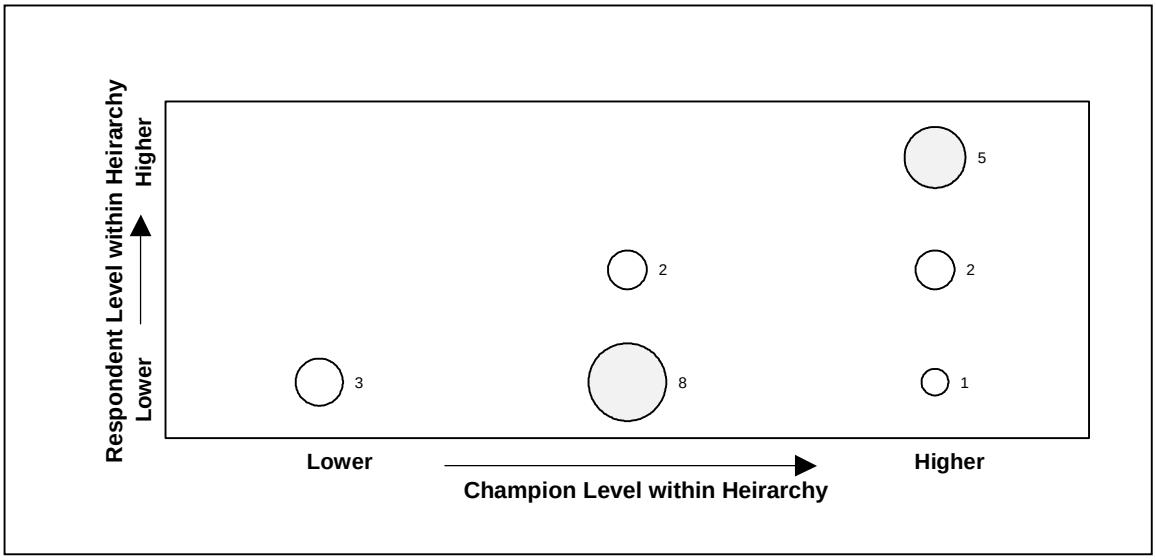

Figure 4.5: Naming Champions in Supplier Management: Frequency and Management Level

The most frequently named individual was the IIO supervisor, as either the sole champion or in combination with others. The second most frequently mentioned champions were the current Director of Supplier Management and a senior manager in that directorate. Others who were considered champions of the initiative included the former directors of Operations and Supplier Management, the Director of Manufacturing Services, a former assistant director of Supplier Management, and a senior manager in Manufacturing Services. A champion in a higher level is at a higher position than a high level respondent because the interviewees were all below the director level. The levels are relative within the separate groupings of interviewees and champions.

The level of the employee within the organization influenced their opinion of who they considered a champion. When the perceived champions were at higher levels in the company or were those who represented different functional organizations, they had more often been named by the interviewees in management positions. This does not mean that the leadership was not effective at all of these levels, but that it is important to cultivate leadership throughout the hierarchy, as employees at different levels appear to have been motivated by those who have more visibility at their level. In particular, there were a large number of mid-level champions named by lower level respondents. These champions were 1st and 2nd level managers.

4.2.3 Training and Level of Effort

Initiatives in this organization tend to be implemented by a dedicated team of seven to eight employees. The team may be assigned a specific supplier, shop, or project. This requires changing job assignments by reassigning buyers engaged in buying parts and placing them on study teams. The teams may develop business cases used to decide whether the division should fabricate particular parts or only assemble those parts after they have been fabricated elsewhere, otherwise known as make/buy.

The persons on the Initiative Integration Team spend 100% of their time on change initiatives. The senior managers tend to spend 30% to 50% of their time on initiatives. Those not currently on project teams spent a couple of weeks or months at the beginning of the implementation either training or on specialized teams. They no longer spend any significant amount of time working on change initiatives specifically.

4.2.4 Generating Ideas

The origin of the ideas and how they are communicated also influences how the initiatives are received and accepted. They did not train their entire workforce in formal classes or in as comprehensive a way as LEAN tries to do in manufacturing. That means that the idea paths, the working relationships of the idea sources, and the communication means are even more critical to the success and diffusion of the initiative.

At a broad level, the ideas begin in strategic planning activities. Division goals and the plans to achieve them may originate with the Quality Council, a group consisting of 40 to 50 executives. Directors also help to establish the vision, according to one manager.

Two respondents mentioned that ideas flow from both the bottom up and the top down. A manager said that they are "continually asking people to think of ways to do things." The ideas were well-received, if there have been previous successes in the area. According to another manager, the path of ideas and their accomplishments form a single thread if traced from those in upper management who initiate them to the employees who accomplish them. This manager felt that the organization had improved its capabilities in providing a continuous course between the broad goals of upper management to the specific accomplishments expected of employees.

All of the respondents had different notions of where specific ideas originate. Ideas may come from the users within Supplier Management. Some of the changes may even be suggested by the suppliers to the buyers. Some changes are suggested by the manufacturing shops. It is a joint implementation effort with the manufacturing customers, but driven by manufacturing needs. When subject matter experts (SME's) are solicited for ideas, they also become the trainers, lending credibility to the effort.

According to one MMA who cited cooperation between procurement and manufacturing for min/max, they usually assign a generalist who works with SME's when making procedural changes. For instance, in the Business to Business software project, the team member may not be an expert on writing purchase orders, but they coordinate, arrange meeting, and resolve issues between parties. The project leader creates the changed procedures based upon the knowledge of experts.

The IIO plays a significant part in bringing ideas forward and implementing them. One buyer thought that most of the changes have come through the IIO, although they may come from outside the group originally. The IIO members might go on fact finding trips. Another MMA considered min/max a LEAN initiative because it leads to even leaner

JIT, Point-of-Use, and packaging. This MMA is not in the IIO, but works with them to do kitting. The initiatives group consolidates the ideas and develops them to the best potential.

The Company created MFO themselves to encapsulate related initiatives, although min/max was a given process. The specific changes involved with a significant initiative like min/max are kept within the project teams. The IIO gathers information and a project team may be formed with representation from affected parties throughout the division. Every team has buyers and contract administrators. Some teams have a few representatives from shop operations. The SME's develop preferred processes and then the team can develop a Statement of Work (SOW). The project teams refine the processes and are responsible for communication, status reporting, and reviews with upper management. In August 2002, they had 70 to 80 active MFO projects with functional people involved.

4.2.5 Communicating the Initiative

The IIO placed emphasis on communication early and used several different communication avenues. They had more hour-long all-hands meetings, but one interviewee thought that this form of communication may have been over utilized. The director spoke about the initiative at all-hands meetings. The members of the group approached managers of different programs and spoke at their staff meetings. A routine called staff notes allows them to give status updates at staff meetings. They also held weekly meetings with operations and solicited input at crew meetings. The project leaders speak with management weekly. Other methods of communication included Quality Councils, the web, cascade training, one-on-one meetings, mentorships, coaching direct reports, newsletters, informal reports from SME's, and TIP sheets. The degree of communications depended on the type and impact of the change. Other types of communication that were mentioned included word of mouth, rumors, and e-mail memos.

Although they strive for widespread visibility, the information that is made available is not always fully absorbed by users until they have a specific application that requires its use. In these cases, more focused instruction for an individual is required. This may sometimes be planned instruction with well-developed background documentation or spontaneous training. An example is when MFO or a sub-initiative will affect a specific buyer. The buyer is given specific attention and a primer and TIP sheets. There are also piecemeal communications when information does not reach those involved. For instance, the B to B software has an internal webpage on the directorate website, but SME's were not necessarily spreading the word. A buyer had approached the B to B focal and said that a supplier wanted to use electronic purchasing. That buyer didn't know about the webpage, but was shown by the focal after she had raised the subject.

The sub-initiatives in the Phase II portion of the initiative were very familiar to those heavily involved in project implementations, which is to be expected. However, the distinction between the implementation of min/max and the full complement of MFO is not necessarily clear to all of the users. There was not a universal recognition of a formal

announcement to launch MFO. Although min/max has been implemented and seems to be fully accepted, there did not seem to be as clear an understanding that min/max was part of a larger ongoing MFO. There remain various other projects under the same framework that are receiving similar attention and will have significant consequences. Employees speak about min/max as a discrete initiative. I was told that the contracting arena started hearing about MFO in 2001. They do not consider themselves to be directly affected unless a procurement agent (PA) is assigned as a focal or advisor for a project team.

Procedural changes related to the initiative are distributed to the buying community by releasing notices. Although the procedures are documented, I was told that people may not always refer to the formal procedure book all of the time. The procedure written to deploy min/max in commercial contracts is an example of how new procedures were developed. Only one PA was given the separate assignment to develop the procedures and training for the PA's, with consultation from a manager. This PA was referred to the project leader and spent three weeks working full-time on this special assignment. Since this procedure was unlike anything they had had before, the PA had to look carefully at the contract language. They have to ensure that the company was covered and understand what adjustments had to be made. This PA learned the details about the initiative by being so completely involved in the implementation.

There is also an e-business initiative that originated at the corporate level. This allows business-to-business electronic communications and transactions with suppliers and is part of the vision for MFO implementation. One example given for why this division is a more innovative organization is their advanced status on this initiative. The corporate level has a longer decision timeline, but this division did not want to wait. They found a company that could provide software that would meet their needs. Some of the features are unique to the division and some come from corporate. The web network existed before min/max, but min/max was incorporated into it. The B-to-B software is used for purchase orders, change orders, and bar coding in receiving areas. The e-business team also tries to think of ways to incorporate what other groups are doing into the network to provide an integrated system.

Min/max and MFO have also required communication with suppliers. Each member of the group started with one or two key suppliers. A key supplier was defined as those who made many parts or served more programs. One form of assistance they provided to suppliers was sending Company A personnel to the supplier's site to assist them with lessons learned from Company A's LEAN experiences.

Before the group made a visit to a vendor, the group would meet with the internal customer first and coordinate. The customer reviewed the min/max levels and decided if they were acceptable. MMA's and PA's were invited on visits. This on-the-job experience and TIP sheets, which are written instructions, constituted the formalized training. The MMA's are trained first in order to explain the process to suppliers.

Many of the respondents said that min/max was how they operated now. Those who have been using min/max, but just recently have been called upon to help with other aspects of MFO, such as point-of-use, still were not completely clear about what MFO includes, although they could see some connection to the particular aspect in which they were involved.

4.2.6 Success Measures in Supplier Management

The objective of this initiative was to reduce inventory and shortages and to increase the number of part numbers handled by a purchaser by defining sub-assemblies rather than details, where possible. These success measures were established to assist programs in meeting their milestones. The goals of improved quality, cost, and delivery were a recurrent theme. The directorate also wanted to double the statement of work that procurement could handle with the current headcount. They had more than doubled the parts per buyer from approximately 250 in 1998 to 450 in 2002. Inventory had been reduced by 75%.

The division has also recouped savings by ordering parts as kits and by reducing the number of direct suppliers. One example for a particular manufacturing cell showed a reduction from 69 different outside suppliers for 452 part numbers to 27 kits and one supplier.

When they change to fewer suppliers, they do not cancel the contract, but reassign them. Some suppliers become tier 2 suppliers and supply part of the kit to the tier 1 supplier. The tier 1 supplier has the authority to decide whether to make or buy those parts sold by tier 2 after the tier 2 contacts expire. Tier 1 suppliers are now using min/max with their suppliers because they have seen how beneficial it is and do not want to revert to managing discrete purchase orders. There is a published schedule of when the suppliers will transition to min/max. As of August 2002, 320 or 98% of the outside suppliers were in the program.

Of 7000 active part numbers in August 2001, 40% were detail parts that would later be joined in sub-assemblies. Buying 3000 sub-assemblies would be preferable to buying 7000 individual parts. This goal also aligns with their core competency of building large assemblies.

One MMA went from approximately 300 parts to handling 734 parts. The greater efficiency allows this buyer to participate on 4 or 5 other teams working on LEAN activities or supplier development, not necessarily the norm for most MMA's. This buyer described the old process as being a supplier babysitter.

Supplier Management sets the minimum and maximum inventory levels by determining the average daily demand for parts for the coming six months. The lowest minimum level is two weeks worth of inventory on hand. The maximum levels are based on the category of the part, which depends on part cost, demand, and usage. Category A parts require 1 month of inventory, category B, 2 months of inventory, and category C, 50

days. These minimum and maximum levels had only been guidelines and not stringent requirements before the initiative was implemented.

Before min/max was implemented, outside suppliers could not prioritize their orders because they lacked information about Company A's priorities. The company had high expediting charges because the old process required many phone calls and intensive work by the buyers to resolve issues.

An MMA said that before min/max was implemented, buyers had to do many change orders in response to slowing or speeding schedules. With min/max, there are no change orders, just changing minimum and maximum levels. When production rates are high, this is helpful. For slow rates, this may still be good for the company because it still has to deal with various orders, but there are more complaints from the suppliers. For instance, a min/max of 2 and 3 may meet the company's requirements, but the supplier my consider min/max unnecessary for that kind of order.

The directorate used various tools to assist suppliers. One is a master schedule with an 18-month forecast of build requirements. It is updated weekly. The daily min/max worksheets contain the supplier's delivery targets. On a monthly basis, the division shares delinquencies and other metrics with suppliers. This provides frequent feedback so that suppliers can see how Company A has assessed them so they can react quickly and adjust accordingly. The emphasis is on providing the right metrics to drive the right behavior. Suppliers are given the chance to excel according to their own actions. The assessment based upon objective measures also strives to remove the human element so there is less danger of choosing favorites based on subjective criteria.

Examples of the metrics kept on suppliers illustrate what is expected of suppliers. For instance, a supplier is penalized if they are below the minimum. The division had also experienced difficulties with receiving. When the receipts are not received quickly enough, the supplier is penalized. The supplier has the responsibility to contact the MMA if they have a bad metric. The MMA adjusts the measure according to the actions taken to improve.

One MMA who has fewer part numbers and fewer suppliers than before found that it is much easier to manage. The workload also depends on the complexity of the parts. There are also good and bad suppliers. This buyer has one that the buyer was embarrassed to say they never have to call. Some must be called four to five times a day.

The web-based network is also used to facilitate this initiative by sharing min/max information on the web with outside suppliers and other divisions. They also use a consolidated inventory database to analyze purchasing and receiving data.

According to a manager, the organization has less than half of the planners and buyers than they had four years ago. This decrease was not all due to production rate reductions. They also reassigned about 40 buyers to be negotiators to work on lowering unit costs. Another product line's parts were also added to the workload.

The MMA's have reported that this initiative has changed their jobs a great deal. They handle more part numbers, have far fewer purchase order changes and less paperwork. At first, they might have had to cancel purchase orders, calculate one-year usage, and reissue purchase orders, but once that initial hurdle was over, the process saved them time and eliminated what some considered busy work. They have reported that the initiative has facilitated ease in scheduling and has created more of a pull system. The shops also like min/max because it provides them with more space that has been freed of excess inventory. Employees usually perceived labor decreases as mainly due to rate reductions and not increased efficiency. One acknowledged that it hard to say whether excess personnel were laid off or if the company found other ways to utilize them.

4.2.7 Savings

The impression from the interviews is that Company A management is committed not to lay people off, but to use the remaining employees more effectively. However, natural attrition and a voluntary layoff had resulted in a 29 buyers compared with 42 in 1999. They did not hire to replace attrition. They claim not to have eliminated any MMA's due to the initiative, but the increased efficiency has allowed the remaining buyers to manage more part numbers. The average was 450 part numbers per buyer as of August, 2002, or double what was possible before min/max.

One manager stated that the company looked at the increased productivity as "instead of how can we do things better so we can lay people off, how can we do things better and do other things?" The initiative contributes to survival because headcount has been decreasing due to fewer product orders because less work is available.

One manager thought that the savings might be in the hundreds of millions of dollars. They have had a 75% reduction in inventory. Min/max was an enabler, although there have also been inventory reductions associated with material savings from other processes.

A few MMA's could credit non-specific, but significant savings due to min/max, but did not perceive any direct correlation between min/max implementation and labor reductions. There were fewer buyers as a result of attrition and a layoff as a result of rate reductions following 9/11. Some of the decrease has been gradual and some people have been moved to other parts of procurement. The increased efficiency and freed time has allowed them to spend more time on LEAN initiatives and to become more than just buyers. Manpower has also been freed because the supplier handles more of the inventory responsibility.

Savings go back to the program at the corporate level. The operating plan is adjusted accordingly and they must commit to this new business plan. They work to their new budget and attempt to find opportunities to save money and reduce risk. The savings are rarely reinvested, but one manager stated that they sometimes approached management with opportunities to add people and make money.

Production rate changes after 9/11 did not affect their MFO targets. They gave their suppliers forecasted requirements and the suppliers appreciated the shared information because excess raw materials cost them as well.

They have seen savings by being able to control inventory without change orders and saving the time associated with that paperwork. They have also reduced material holding costs. They have eliminated the need for three buildings for raw material storage. Another advantage of a smaller inventory is that if parts are modified due to engineering changes, large inventories can become rework or scrap. There are savings due to the new PA procedures because of the reduced potential for termination claims and the workload those entailed. They expect savings in receiving because there will be bar coding and advance notice of shipping.

More savings are expected when they incorporate e-buy procedures. Savings from the B to B software use would include time and other expenses eliminated due to electronic documents. They had not realized these savings yet because of delays in implementing the software, but the budget had already been committed. The product still needed improvement, but this division has been more aggressive about this change than other divisions. Some of the delay has been caused by the difficulty of achieving a common product because there are 29 different sources feeding it.

Min/max is also affecting internal suppliers. An example is the skin fabrication unit. It is an expensive process and productivity increases and reduced inventory would provide significant advantages. The managers who understood the issues worked with the major supplier. The Lean Promotion office also has a stronger role. One of the aims is for the different programs to level load the internal shop.

4.2.8 Resistance

Resistance to this initiative comes from many sources. Most of the interviewees described resistance from the outside suppliers who had to adapt to Company A's new policies. There was also resistance in the Supplier Management community, Contracting, and internal suppliers and customers. Most interviewees were the ones now using the system or had played key roles in the implementation. People named resistor categories that were different from the category in which they belonged.

4.2.8.1 Resistance within Supplier Management

Among the interviewees, the perception about resistance within Supplier Management was inconsistent. According to one manager, there has been a minimum of resistance, because they have effectively used communication strategies and managed an open-door policy with management. There is a Materiel Employee Evaluation Form for every employee in the directorate and adoption of the initiative and related goals has been tied to their performance appraisals.

Another manager stated that individual "force fields" went up and many employees did not want to have anything to do with the initiative when min/max was first introduced. Once it proved a success, however, many people may have claimed that they had initiated it. From this manager's perspective, all of the lower level employees displayed resistance. At higher levels, this manager thought that political correctness gave the appearance of acceptance at first. Some had an attitude similar to "not invented here."

In general, there has always been resistance to change, according to one manager. Another manager said that the workforce was fairly evenly divided between supporters and resistors, with not many in between. Most interviewees viewed resistance as inevitable. Some said that the tendency was for the resistors to be the ones who had been there the longest. They had been doing it the same way for many years. The seasoned people in purchasing wanted to keep a thumb on suppliers. Some who displayed resistance were worried that it might require more work from them without any benefit. Resistors seemed to have had many reasons to show that their way, the old way, was better.

A number of approaches used to deal with resistance were cited by the interviewees. One MMA said that people just needed to see the advantages of the initiative and would have to get used to it. Many who did not want to change either left the company, moved to other jobs, or were laid off. This was a harsher strategy that attempted to change the culture by removing resistance or eliminating the old procedure in such a way as to prevent any regression.

Another strategy was to involve those most agreeable to change and improvement. The project leader the IIO manager chose had only been there a short time, asked questions about the process, and was eager to fix it. The employees currently using min/max, as represented by the interviewees, were the ones who were most enthusiastic and understood the reasons for change. One MMA was personally glad because they no longer had to do change orders. Another said that those who have gone through the change and have seen the benefits are now enjoying the new process. Some who adapted even acknowledged that they may not have supported it before, but have changed their minds.

Those MMA's who are in the IIO may also be perceived as receiving special treatment because they do not buy parts as conventional MMA's do. In answer to whether there have been attempts to get resistors on teams, an MMA said that there are just some people who battle for the initiative. To this interviewee, everybody knows about the initiative and they see and recognize its contribution to success. There has been emphasis on including the input of SME's within the organization so that they will feel ownership towards the initiative. They have also assigned resistors to suppliers who have been successful with implementation.

Communication has played a significant role in allaying fears and lessening resistance. Project leaders and managers have tried to present a very positive picture and explain

why they are using this initiative. Each week, product line managers (PLM's) and mechanics present success stories.

They have tried not to define this as only a Supplier Management initiative to emphasize the contributions and responsibilities of other functional silos. A manager thought it has been successful because they have passed off the processes after development. They also maintain visibility with the project managers because the initiative needs supporters high enough for attention, but close enough to the products and projects to have credibility with employees.

The initiative has only recently gained particular attention as an incentive included on performance appraisals. Although items such as inventory and shortage reduction have always been a Supplier Management responsibility, and those metrics have been a significant part of the performance standards for the directorate, the specific name Material Flow Optimization had not appeared on a manager's performance plan until 2001.

4.2.8.2 Resistance from External Suppliers

Many of the interviewees stressed the resistance from external suppliers rather than resistance within the organization. The outside suppliers may have perceived this initiative as placing the burden of managing Company A's inventory on them. The suppliers were also concerned about being measured to different or stricter standards.

According to one interviewee, many of the suppliers now like min/max because they can determine their own destinies. They have also solicited written testimonials about challenges and successes from the more successful suppliers who participated in pilot program so that they can distribute them in-house or to recalcitrant suppliers. One MMA said that one of the characteristics of the initiatives group is that they can facilitate between parties. Company A is also large and powerful enough to strongly persuade suppliers. The B-to-B software will eventually have a yearly cost to suppliers that may cause concern. They have had one-on-one meetings with suppliers to explain the advantages of the system.

They have not lost any suppliers because of difficulties in transforming an otherwise cooperative supplier into a lower cost supplier or an already lower cost supplier into one who adopts min/max. LEAN facilitators from Company A go to the supplier's site and help them to attain the goals required of the initiative. There has been a great deal of importance placed upon building partnerships with suppliers.

4.2.8.3 Resistance within Contracting

Within Contracting, the emphasis has been on getting lowest unit cost. The MMA's interviewed felt that there was a tendency in contracting to think that MFO occurred in the Material Management Organization and that it did not affect contracting until it was done and in place. They did think that the relationship has improved over time.

Some of the conflicts were a result of the different emphasis each organization places on determining the best supplier. An MMA may not be as concerned about a difference of 2 cents a part, but a million of such parts could cost a great deal. A PA may be concerned about an individual part's cost, while the MMA is creating a package and the entire package costs less than the total of the individual parts. Another MMA complaint might involve problems with a first delivery after contracting has changed a supplier because of cost savings. PA's may not see the sense of controlling some parts with min/max, such as those that require large batches like sheet metal or those with expensive freight costs.

Much of this was resolved when the director became involved and championed the initiative. Upper management directed the MMA's and PA's to work together. Now each area considers the other's interests. The PA's have received information on how good the suppliers are. They have also compromised and satisfied the goals of each by allowing continuous improvement credit for packaging. They had meetings and some head-to-head discussions to reconcile this. This initiative has required the cooperation of other parts of the division and has reached across organizational boundaries.

MMA's sent copies of supplier testimonials to PA's who had difficult suppliers. Usually the PA's did not need to get heavily involved, unless a supplier had major issues with adopting min/max. With practice, people got used to the new process.

4.2.8.4 Resistance from Internal Customers and Suppliers

Some of the interviewees in Supplier Management have played a role in influencing the internal customer to change. It requires a working relationship with manufacturing and a group effort to set the min/max levels. Some of the team members interact often with shop personnel. MFO and min/max have visibility and some advantage with manufacturing because a former Supplier Management senior manager is now a manager on the operations side of a major product line.

According to one manager's perspective, the difficulty has been with suppliers from other divisions and not internal suppliers. This manager still described some barriers to MFO's acceptance by internal suppliers. Although everyone may have agreed with the concept, the implementation has been more difficult because of conflicting interests. These conflicts surface because one aspect of MFO would require moving work that they do not do well outside and moving work that they do well from suppliers into the division. This manager thought that the strongest deterrent and biggest frustration has been contractual problems with the union with regard to shifting work.

4.2.9 Continuing Evolution

Min/max started in 1998 in a manufacturing cell and the implementation is now considered complete. MFO is still in its infancy. Before the implementation of min/max, they held enormous inventory and experienced horrible delivery performance. Now they are refining min/max. Nothing has reverted to former ways according to a manager.

Another manager reiterated that min/max is now how they do business. They do not have to promote it vigorously anymore.

Most interviewees referred to min/max as how they operate. They felt that min/max had become deeply embedded in the organization and that everyone had fully embraced it. A PA said that min/max had become part of the organizational culture and that Corporate and other divisions have copied it. Min/max is no longer perceived as an initiative, according to a manager in manufacturing services, because it is the way they conduct business. Although the initial sponsors may have left the division, it has continued under other leadership.

One interviewee found it hard to recall how it was before the initiative. She started in January 1997. There have been no more termination claims. There have been real benefits to both suppliers and buyers. One MMA described the transformation as unbelievable change. This buyer considered herself more of a change agent now. The IIO leader also thought that it had been immersed within the whole organization, but acknowledged that since initiative are his entire job, he might have a prejudiced perspective.

This manager felt that MFO would benefit from the min/max initiative that employees have already experienced. They anticipate useful input from people. Everyone has seen the vision they have for MFO, although most may not be able to quote it. The have the incentives to achieve these goals will be met through inventory and shortage metrics.

Another manager said that although, there is still some confusion as to what MFO is, they have good people working with customers. This manager did not see any problems with implementing it in Supplier Management. There has been some reluctance from the unions, but, in the end, the health of the company in general will provide jobs. An MMA said that people were not yet familiar with MFO. They still did not have a clear idea about how the company defined MFO. Another MMA said that suppliers were more willing to adopt changes introduced by the company because they appreciate being able to do what makes sense and have accepted LEAN practices. This buyer had not heard of any challenges to MFO. Some interviewees did not use the name MFO when referring to projects that fell within the initiative. MFO has still not gained the visibility and clarity that min/max has accomplished.

The experience with min/max does seem to have had a positive effect regarding the organization's acceptance of change. People have a vocabulary they can apply to other things and they seem to be learning. They have taken the min/max language and have modeled it for PO changes and kitting. The MFO team has sought input from a diverse group of people who will be the first to implement it. Then they issue TIP sheets in order to instruct everyone to do it that way. This MMA sees kitting as the next major order of business. With the old method, suppliers usually complained, but now they want to work for you. The suppliers understand the company's priorities and reasons and feel more like a partner because the company has been sharing information.

Some MMA's see the change as positive because of their deeper involvement and a greater sense of being a change agent and not just a conduit for a given process. There are opportunities to volunteer and the teams are becoming more diverse. They usually assign a high performance buyer to help a supplier. Some see further improvements in the areas of integrated packages and kitting, point-of-use deliveries, and achieving nearly JIT quantities. Min/max is still constantly improving. It is considered a method of communication with suppliers and defines the way they write PO's. An MMA thought that they could not have reached this point without the min/max embryo.

Although the organization has had a positive experience with min/max and change has been accepted for the most part, there are still indications that not everyone can or will participate actively by applying these lessons learned. One interviewee said that "Company A employees who are not actively doing change are followers." Another MMA said, "Sadly enough, some people are just negative. Most people, if given a chance, come to realize it's not a bad thing." Another MMA referred to the project team in a positive way as "that group", but indicated by this reference that the changes come from above and only a small group of MMA's have been involved. Another MMA is always surprised to get a call from a buyer asking what min/max is because they had been doing it for three years. This buyer did not think that it had fully permeated throughout the entire organization, but had been accepted by all of the external suppliers

Some glitches with advancing min/max and MFO in particular applications were cited. One MMA said that they have talked about or "payment upon consumption", or not paying the supplier until the parts are used, which this MMA did not consider realistic. Min/max may also be harder to adapt to standards like fasteners. One complaint regarding this issue was that corporate had gotten involved and confused the process. Corporate may have a tendency to impose its own way even if a division is more advanced or complete in its implementation.

There has also been a cultural change for suppliers. Moving from 300 to 100 suppliers means that some are no longer Company A suppliers and no longer have the prestige that comes with that. Also, originally continuous improvement was perceived by suppliers as trying to squeeze more cost savings out of them and forcing them to change their processes. Now it is seen as more of a partnership for mutual benefit.

Another complaint may be how they measure suppliers. One MMA thought that it might be hard to grade a company when there are so many variables at work. It is also the supplier's responsibility to catch problems in their metrics. For instance, you cannot tell from looking at a receipt when the receipt was entered, but you can tell when the item was received. The supplier is penalized until the receipt is entered which is a Company A responsibility.

Other adjustments have been necessary in the relationships with contracting. With the old process, the contractor decided who would make the parts and told the buyer. Now, the customer feeds information to the MMA who feeds it to the contracting. Contracting has

their own initiative of supplier consolidation and Supplier Management must prove that if they use MFO, it will help organizations achieve other metrics.

Since Supplier Management is a support organization, they work closely with the customer in the factory. Their goal is to be an integrator and to bring parts in as sub-assemblies. Their role is to ensure they have the right supply base. Initiatives in Supplier Management and LEAN initiatives in internal suppliers complement one another. The successes are spread to other programs because management has been seeded with those with experience in other successful initiatives. The IIO also keeps in mind that there are still other groups that have yet to begin min/max, even if it has been successful elsewhere. Raw materials had only been using min/max for a year.

There is also a new value chain concept taking hold, according to one manager. Managers are looking at the whole value chain and not just their assembly. Directors have removed themselves from the daily operations to allow them to examine implications to the value chain. They assign their sub-directors manage the day-to-day operations.

A change of personnel in management positions has also changed everyone's perspectives creating an "environment is more ripe for change and initiatives," according to one manager. Another manager said that the next steps would be to restructure the organizational design to reflect these changes.

5.0 Case Study B: Lean Production in Aircraft Electrical Harness

The impetus for the successful adoption of LEAN manufacturing principles in this electrical harness production cell was the impending decision to transfer the work to a plant in a foreign country. The cell used LEAN to reduce labor costs by 72% and made a successful bid to keep the work in-house. Three and a half years after the effort began, the cell's achievements are touted as a shining example for the rest of the company and show what is possible through implementing LEAN practices. Figure 5.1 provides a timeline of the significant events during this implementation and the results achieved.

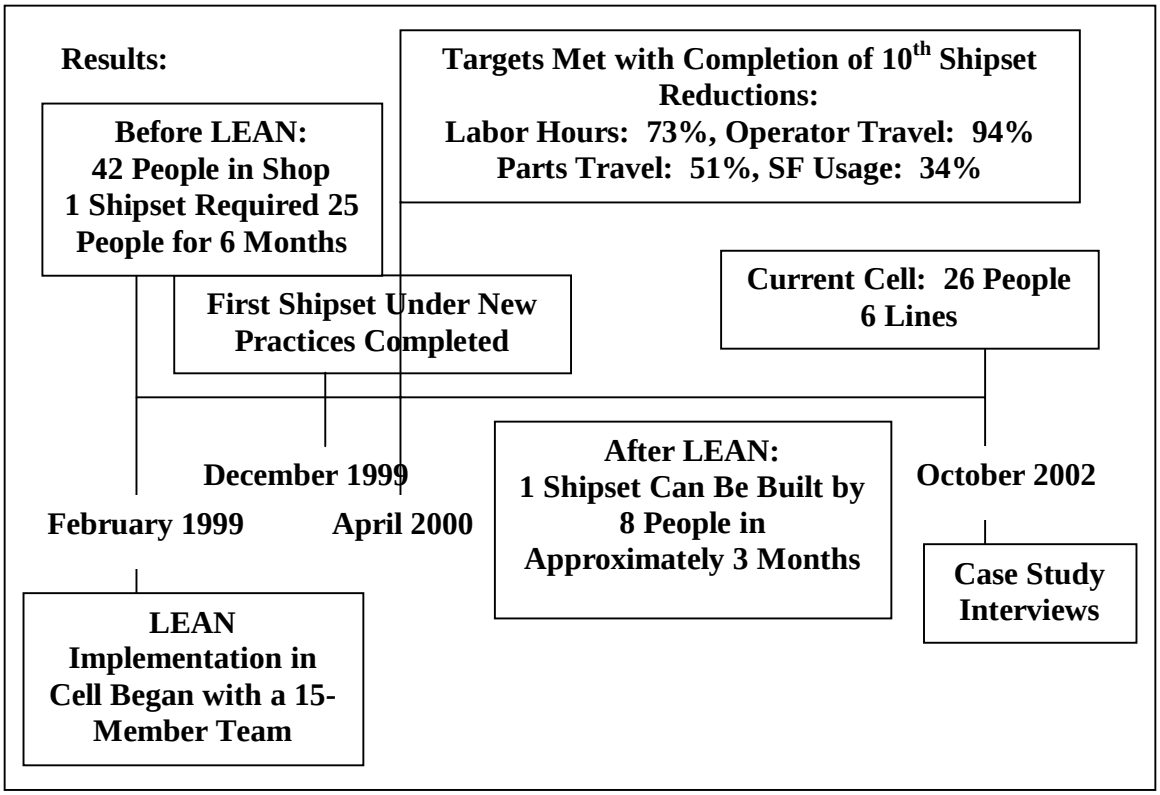

Figure 5.1: Case Study B Initiative Timeline and Results

The use of LEAN in this instance followed a long history of LEAN at Company B that began in the mid-1980's. Figure 5.2 shows the significant milestones for LEAN and other improvement initiatives for the entire company. The case examined here was an example of an improvement initiative that was conducted within a corporate environment that recognized that adopting change initiatives could result in the benefits of increased efficiency.

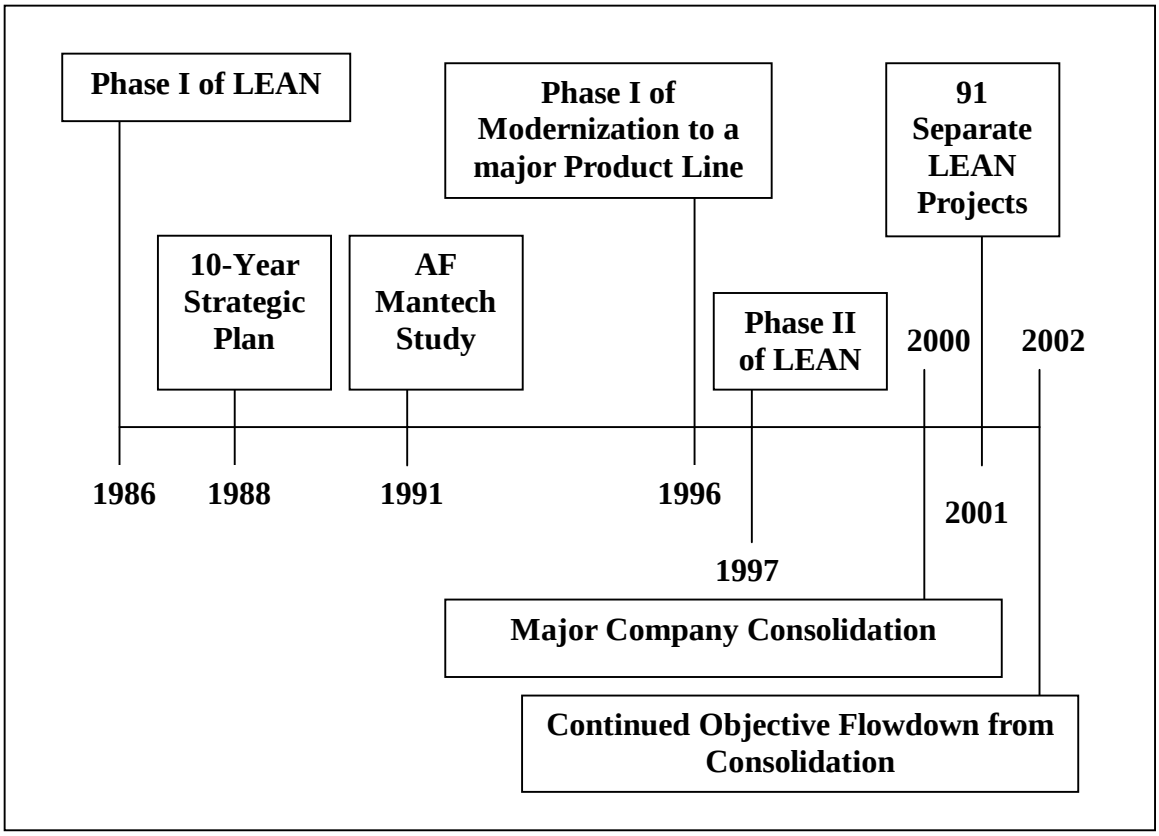

Figure 5.2: Change Initiative Timeline for Company B

5.1 Initiative History

Cost reduction efforts during the Engineering and Manufacturing Development phase identified harness production as a candidate for outsourcing, since lower foreign labor costs would more than compensate for the added transportation of the parts. Since a similar decision had already resulted in the loss of 900 local wire harness jobs on another aircraft, there was strong evidence that management was inclined to make a similar decision for this aircraft. Five women employees in the harness shop were the initial catalysts who approached upper management with a request to allow the shop to work on improvement in order to match or improve on a foreign bid. They also galvanized their fellow employees and created the atmosphere of enthusiasm and acceptance within the shop.

The challenge was daunting, as their target for labor cost reduction was 74%. The group of five knew that they had to do something different and initiated the endeavor. They asked a union representative to speak to the shop employees. That discussion encouraged them enough to make an appointment with a company vice president to ask for the opportunity to make improvements so that they could produce the harnesses of higher quality as inexpensively as the foreign plant. The consequences were serious because all of the harness work for the other aircraft had been outsourced. All that remained in the plant of the electrical work for that aircraft was the panel assembly and switches. This vice president gave the approval to begin the initiative.

At the beginning, the director had a meeting with employees at which he showed the numbers and explained the predicament. Some employees had already been involved with the effort. The manager of the LEAN department was called in, as well as others who had just begun work in that department. The manager of the LEAN group acted as a liaison with upper management. They started the work in February 1999 and the first shipset of 122 harnesses (a set for one aircraft) was finished by the new cell that December. They were still implementing improvements at that time. All told, there were the five direct employees working on the initiative full-time for six months and another five full-time equivalents for one year. By the time this case study was conducted, the cell had been LEAN for 2 ½ years after one year devoted to implementation.

The team locked themselves into a conference room with brown paper all over the walls. There, the team conducted a value stream analysis by documenting every step and task that was being done at the time in the production of harnesses and describing the as is process. The physical construction of the harness was essentially the same as it had been in 1991. However, new ways to organize and accomplish the work could make significant improvements in the cost of production.

The LEAN department staff acted as facilitators. They asked questions of the harnessers to determine why something was done in a particular way or at all. They dissected everything. If something was determined to be a necessary task, the harnessers had the opportunity to say how it could best be done.

Some of the team participants already had formulated some idea for what the layout should look like. They also had the understanding that building sub-assemblies that fed into the line would help to level the workload and eliminate wasted time. The first end termination sub-assembly is the first work station after wirecutting. Some of the time was saved by utilizing new equipment.

Once they had designed a new process, the accounting department helped to prepare a bid that connected the dollar cost to the number of hours involved. The factory employees did not know the equivalent dollar amount. This effort successfully kept the work in-house.

5.2 Champions for the Initiative

All of the interviewees, except an employee who had been laid off from another program and rehired after the change was in place, could name a champion or group of champions who supported the initiative. Since none of the interviewees for this case study were at a higher level than first level manager, the data are skewed toward those champions at lower levels who had the greatest visibility with the employees directly involved with the implementation. There may have been more higher level champions who supported the project, but their role was not as apparent to those interviewed. The hierarchy scales are relative within each group and a particular level of respondent may not fall into the same

group on the champion side. Figure 5.3 shows the correlation between the level of the interviewee and the champion or champions they named.

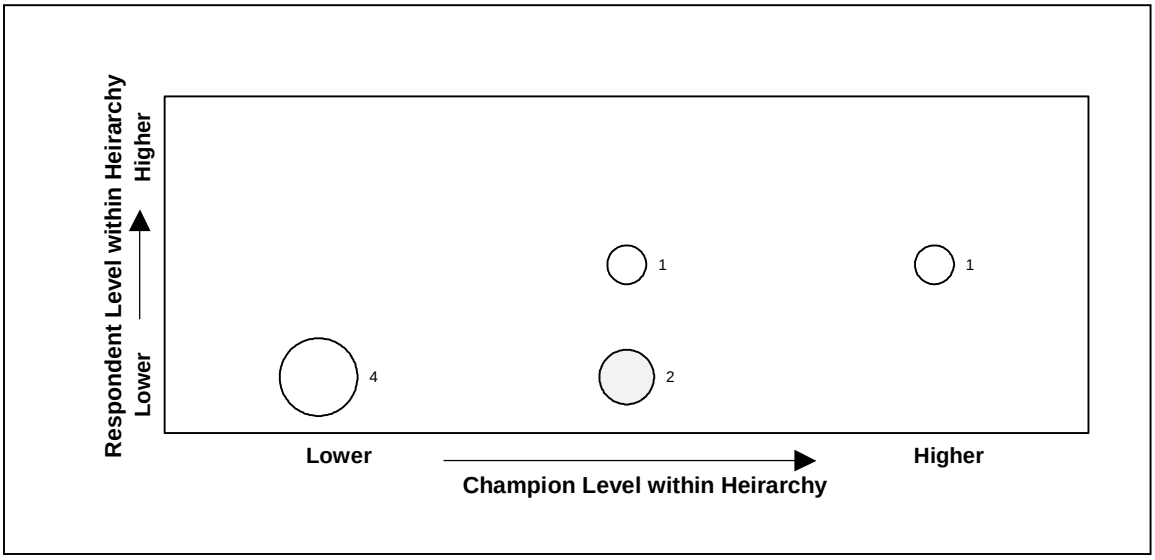

Figure 5.3: Naming Champions for the Electrical Harness Cell: Frequency and Management Level

Not everyone who had been involved with the initiative is still involved with the cell. Of the original group of 5 harnessers, one passed away, one moved to another program, one moved to a different assembly on the same program, and two retired. The director of the LEAN department has since moved to another plant within the company and the two LEAN department staff members had recently moved to other organizations at the time this case study was conducted. The manager of the electrical department had since moved to tooling.

5.3 Training and Level of Effort

Some of those who worked through the transformation remain either in the cell or in positions supporting it. The supervisor of the Aircraft Electrical LEAN Cell was part of the initiative team. The supervisor now has 26 direct reports and ensures that work moves smoothly and that schedule and costs are maintained. This supervisor reports to the manager over electrical bench whose responsibilities cover three other aircraft and mock-up. The specialist in support of this production line and others also played a key role in the transformation. One of his roles is to research new equipment and have vendors demonstrate new equipment.

When the implementation began, the LEAN department asked for volunteers to join a team to work on producing flow and creating a LEAN cell. The team consisted of 15 people for one year. Some were dedicated full-time to the transformation, and some contributed as they were needed. It included eight harnessers, including the original group of five and the shop supervisor, staff from the LEAN department, a specialist who supports the production line, a planner, an engineer, and a representative from

manufacturing control. The manufacturing control person was not assigned to this project full-time, but that representation was essential for buy-in from that area and to support plant-wide efforts to produce flow. Although it was a cross-functional team, those who came from other than manufacturing functions saw it as mainly a manufacturing change effort. Those on the team who thought that no one group was dominant appreciated the way in which the LEAN department assisted them along the right path and ensured actions were accomplished.

At the time, LEAN was a new concept even to some of those in the LEAN department. They had some classroom training to familiarize themselves with the principles and methods. Before the decision was made to use LEAN in this shop, the company had already adopted other improvement techniques. They had trained the workforce in and had used 6S to better organize the shops, remove clutter, and improve safety. At the beginning of this shop's transformation, they conducted training in LEAN that was attended by the full-time members of the project team. Most of the training of the current workforce in the cell is now done on the floor in an on-the-job mode rather than in a formal classroom setting.

The workforce was comprised of very experienced harnessers. Many had over 20 years of experience, even if on different aircraft. Some had been laid off when 900 jobs were lost and were later recalled for this program. One interviewee was experienced enough to have spent significant time training other harnessers. Although many did not have specific experience with LEAN manufacturing, they were all extremely experienced in their occupation and only needed training in LEAN principles that they could apply them to tasks they already knew very well.

The planner whose primary concern is this cell was the one who rewrote the detailed work instructions for this cell. He spent 100% of his time for several weeks working on the LEAN transformation. The standard work instructions are stored centrally and are available through the computer network. He had taken a daylong LEAN course at the beginning of the initiative in order to participate. In addition to planning, they also made changes in how material is delivered to the cell.

Engineering became involved only when actions affected them. They helped facilitate flow in the cell, which also aids scheduling, by instituting red line procedures that allow them to mark up harness layout boards. The cell had been building harnesses faster than changes could be incorporated. In the old procedure, they would have had to pull the entire layout board, even for minor changes. Now, they splice the change on paper onto the mylar overlay on the boards. All documentation accompanies the package. This procedure was approved in a memorandum that was approved by engineering management. They use tools such as Temporary Deviation Authorization (TDA) to try to quickly fix problems. This is an example of how significant changes in a manufacturing cell affected a connecting organization and its procedures in a positive way.

5.4 Generating Ideas

Employees are encouraged to submit ideas and seem to be enthusiastic about sharing their ideas. Although, during the first year, many team members spent 100% of their time on the effort, key personnel currently dedicate 25% to 50% of their time on change specific functions. The emphasis must now be on supervising the crew, building the product, and maintaining continuous improvement efforts.

At the beginning of the project, if a team member had an improvement idea, the team would implement it as soon as possible because they would be able to more immediately determine whether it would be advantageous. The current employees who did not go through the conversion to LEAN have been able to absorb the LEAN principles and new procedures by observation and just being immersed in the environment. They are already highly skilled harnessers who apply these skills in a particular context. The workers are cross-trained and can cover any part of the line when necessary.

There were other manufacturing shops in the plant also working on implementing LEAN practices, including those that produce larger components. Many of the electrical shops for the older aircraft model had not entirely become LEAN, but were expected to do so after the cells were moved to a new location in the plant that would allow them to design the cells as if they were greenfields.

5.5 Communicating the Initiative

In order to document the new procedures, the team developed a book for the electrical department that serves as a central repository for their best practices. There are notebooks with illustrations and descriptions of standard work for each process.

The story of this shop's transformation from a shop whose work was about to go out the door to a highly successful LEAN cell was published in an article on the company website. They have also received recognition in company newsletters and the LEAN department published publicity pamphlets. The article appeared in a magazine and that attracted interest from sister divisions and outside companies. Representatives asked to come and see what was done. The LEAN staff felt that conducting tours of the cell was the most effective way of sharing information. The visible success convinced management to bring more work into this cell and they had not lost any electrical work.

5.6 Success Measures in Electrical Cell

Early in the planning, the team set aggressive improvement targets. The planning began in March 1999 and the targets were to be met by the time the 10^{th} shipset (122 harnesses for one aircraft) was completed in April 2000. These targets included metrics in direct labor hours, operator travel distance, parts travel distance, and space usage. The most significant improvement that directly affected cost savings was the reduction in hours required to produce the product. Improvements in the cell design and process changes

that reduced the unnecessary movement of parts and people contributed to these savings. Table 5.1 contains the improvement metrics for these key areas.

Table 5.1 Improvement Metrics for the LEAN Electrical Cell

Improvement Metric	Old Process	LEAN Cell	% Improvement
Labor Hours per shipset (122 harnesses)	9389	2555	73%
Operator Travel Distance	13089 feet	830 feet	94%
Parts Travel Distance	15225 feet	7470 feet	51%
Square Footage Usage	13600 sq. ft.	9000 sq. ft.	34%

The project team conducted a value stream analysis in which they documented all of the tasks that were done to produce harnesses using the old method. They labeled these tasks as value-added, non-value-added, or waste. In designing the new procedures and the physical layout of the cell, they attempted to remove as much waste or non-value-added steps as possible. The order and organization of some of the sub-processes were also changed. Table 5.2 lists the sub-processes in order of occurrence and the number of steps by category for the old and new process.

Table 5.2 Value Stream for the LEAN Electrical Cell

	Old Process			LEAN Cell		
Order of Sub-processes:	Wire Cut Braid Layout after Braid Test Layout after Test			Wire Cut Sub-Assembly Layout Braid Test Dress Out		
Tasks	Value-Added	Non-Value-Added	Waste	Value-Added	Non-Value-Added	Waste
Number	35	104	24	52	61	2
Total	163			115		

In the old system, the orders were simultaneous and 122 harnesses were due on one date. They could not level load their orders and could not affect the ordering process. The new process allows the flow of a harness as a separate deliverable to the program, with 122 harnesses still comprising an entire shipset. They now use kitting, with three kits in one kanban, to supply the line with the materials needed for a harness. They were soon to increase to five kits because of a production rate increase.

The kanbans help the cell respond to a pull system and reduce the amount of work-in-process inventory. Movable carts containing tools and production hardware are used. The carts have bins, some of which are shadowed with foam. This system eliminates

sorting, and makes the progress of kits and shortages more visible. There is also a central supply supermarket.

In wire cutting, they utilize a two-bin system. They purchased new equipment to cut and label the wires with a laser printer. The data are downloaded into the machine from a network database. After wire cutting, the harness moves to the sub-assembly workstation. The sub-assembly workstations are cells themselves and were the first major change made to balance the workload and reduce cycle time. They are L-shaped and have specific locations for parts and tools, requiring only a slight rotation as the worker produces a sub-assembly.

The harness goes from the sub-assembly workstation to the harness boards. In the old process, most of the 122 boards would have to be set up at one time. After implementation, there were only four lines, which later increased to six lines due to rate increases. Engineering had to agree to changes as well so that the harnessers did not have to expend wasted effort by placing a harness on a board multiple times for markings, cutting, and finishing. Special markings are placed on the board and the tape marking particular locations on the harness is placed while the harness is still on the board. Engineering also allowed the workers to cut the wires while still on the board. The process was tested to ensure that enough was left for shrinkage and creep and that the harness was within an acceptable length range after braid. The red line process that engineering approved and that had been in place for a year when this case study was conducted, improved the turn around time for a change on the harness from two weeks to one day.

Another improvement to the layout process was the installation of tilting layout boards to replace the wooden tables that had been used previously. One of the harnessers initiated this idea and handled the logistics to acquire the tables. These adjustable tables not only improved efficiency by reducing the need to travel around a large object, they also reduced injuries and discomfort caused by leaning over the work.

The bundled wires are covered by a knitted nylon sheath in a process called braiding. The braiding is done on three 50-year-old machines that are still working very well. The machines are noisy and need to be in an enclosed area. They were building a room in the new area where the cell was to move to accommodate these machines.

Testing the harnesses for continuity and leakage after it has been braided can be very difficult to repair so the harnesses are tested before they move to braid. They actually have a very low failure rate of approximately 1%, usually from crossed wires. The finished or partially finished harnesses are now placed on rolling peg boards which support the assembly. In the old procedure, the wire could be damaged when stuffed into bins and moved a great deal.

The movement of harnesses through the cell is also represented on a prominent status board. The status board shows each production line and has magnetic icons that mark the appropriate location. The icons include finish flags, braid, test, and dress out.

The employees generally consider this a more organized work environment. It was difficult for them to show the comparison side by side because there were not many layout boards for the other aircraft left in house. The cell is also more efficient. All of the tools and parts are supplied with the job. The crimpers and heatguns are stored on the carts and workers do not need to look in many different places for the supplies they need. Before LEAN, the harnessers had to get to the tool cabinet early and hope to find their tools. Now, the breadcarts are stacked with kits and there is always a job waiting to be done. When finished, the workers do not have to hunt for something to do. In addition, the old method was organized with sub-assemblies in a separate area from the layout boards and not in continuous lines. The current process is more interesting to workers because workers are cross-trained to work any part of the line and can move when and where needed. The diversity keeps employees challenged and they enjoy working on a variety of sets, rather than doing the same tasks every day for a month to complete a batch, as would have been done in the old method.

5.7 Savings

The largest portion of hard savings came from reducing the number of labor hours needed to build a shipset. A shipset is 122 different wire harnesses for one aircraft. They realized a 72% reduction in direct labor. Before LEAN, 25 people could build a shipset in 6 months. After LEAN, 8 people could build the same shipset in 3 months.

In 1999, there were 42 people in the shop and in 2002 there were 26. Some cuts were made through layoffs, voluntary and non-voluntary, and some workers had moved to other areas. They had also rehired harnessers each time the production rates increased, for example when the aircraft moved into low rate initial production (LRIP). They began with 4 lines in the LEAN cell and now have 6 lines. They have decreased the time to produce one shipset from 35 days to 21 days. By December, 2002, they had planned to start to overlap the orders and have a 19 day build span.

The final result actually saved the jobs, even if some individuals had already moved into areas with higher labor grades, such as mock-up, part of engineering development. One concern voiced at the time the case study was conducted was that the workers laid off 7 years before were imminently going to lose their rehire rights, and, if they could not be rehired soon, they would be considered new hires.

In the first year of the LEAN implementation, some savings were used to purchase new equipment. Another benefit to the company was that the Electrical Harness Cell was co-located in the same plant as the aircraft, instead of in a foreign country. There were not only no shipping costs, but when they have had to replace a harness, the cell has a one week turn around time.

Although the harnessers were not aware of the actual dollar amount saved by using LEAN, the visible and dramatic changes made in the shop had convinced them that the

savings were real and significant. The company has a reporting mechanism to summarize savings realized as a result of improvement initiatives.

5.8 Resistance

Most interviewees had not seen any significant amount of resistance to the initiative from employees other than those who were near retirement. The resistance was usually characterized by disbelief that the process could be done a different way or declarations from the resistor that they would not do what a co-worker might have suggested. The strategies used to address resistance could be classified into those dealing with culture, mitigating resistant behaviors, management emphasis, and actions taken towards regressive tendencies.

5.8.1 Culture and Resistance

Most of the employees had over 20 years of experience and were comfortable with a particular way operating the shop. Some may have resisted the initiative at first, but the very real possibility of eliminating all of the jobs persuaded the employees to welcome new possibilities. The fact that the workforce was more mature and experienced actually aided acceptance in this case because a knowledgeable and effective crew was able to adapt once they had overcome initial hesitancy and had practiced and validated the new procedures. The education in LEAN practices and the effort to provide employee participation in the initiative also helped to establish ownership and trust.

5.8.2 Mitigating Resistant Behaviors

The project team implemented ideas from employees as soon as reasonably possible in order to counter statements of disbelief and to provide tangible evidence that a change could lead to improvement. The attitude of considering ideas until they were proven beneficial or not was contagious. Examples of employee ideas that improved the transition were workstation lights and kit layouts on the toolcarts. This fostered an environment where “there is always room for something more we can do.”

5.8.3 Management Emphasis

People were mostly cooperative because the very existence of their jobs and those of their co-workers were at stake. The five initiating employees were essential communicators of their plight. One was a union representative. This group’s intense communications with the crew helped the project team by ensuring that the crew was committed.

One disappointment that could have been addressed by management action was the loss of many of the initial crew to other organizations. This problem arose because harnessers for mock-up (engineering development) are in a higher labor grade classification. The more experienced harnessers were able to take opportunities in other organizations in order to earn more money, but that took knowledge from this cell. They have gone through three waves of people and no regular floor workers remain from the initial

conversion. If the company had reclassified these jobs at a higher rate, some of this movement might have been prevented. There is a cost associated with retraining people.

The employees in the cell receive incentives for incorporating and embracing LEAN. They receive merit increases based upon the results of continuous improvement projects. There had been talk about including such incentives for management. Those in management positions may have quantifiable goals to reach a particular reduction in certain metrics, but they need not use LEAN specifically to achieve them.

Engineering was also fearful that they would lose configuration control by instituting the red line process. There was tension between the perceived informality of a patch and the formal and lengthier procedure for releasing documentation.

This LEAN project was the only one where so many people were devoted for so many hours to the initiative. The LEAN department had not received as much management support nor had they experienced as much interaction with employees since then. Another difference was that the employees and the management from electrical solicited the LEAN department for their assistance. In a completely separate shop where management had directed the LEAN department to take action, they did not receive similar engagement.

5.8.4 Actions Taken Towards Regressive Tendencies

Where resistance within the cell remained, it was usually manifested by resistance to a co-worker and the individual preferences employees had for certain tasks. The LEAN department staff acted as mediators and set a standard, usually by having employees do the task in question. The work was timed and videoed to enable validation and documentation.

One team member acknowledged that there had been slight regression on small improvements that had been implemented. However, the changes that resulted in significant savings were retained. In addition, rehires were trained in the new procedures and the cell has been redesigned so drastically that it would be impracticable to easily return to the old way.

5.9 Continuing Evolution

This initiative was prompted because of the impending crisis of permanently losing jobs at the plant. The added benefit of showing employees that operating more efficiently can actually make their jobs easier was only apparent after the fact, but the atmosphere of disruption was the critical reason for embarking on the transformation. The problem of remaining competitive enough to retain jobs is still on the horizon, so they cannot slacken. The current orders are in aircraft lots, so the jobs are safe for the near future.

The validation of the change was expressed when returning employees were amazed at how much less troublesome their jobs were and how their ideas were welcomed. They no

longer had to spend time running around gathering the tools necessary for their jobs. They were able to reduce hours and keep pace while the product was undergoing engineering changes. When new people have been brought in, they have been meeting their goals within a month. This has been one of the major selling features. In comparison, most of the problems have been with outsourced harnesses, highlighting the greater quality product that results from this LEAN cell.

Although the documentation of standard work and best practices has been formalized, much of the tacit knowledge collected in the minds of key team members has not been deployed or exploited. Two interviewees indicated that they are the repository of much information that has not sufficiently been used as a resource for others going through similar initiatives in other organizations. Their available time is already limited. If knowledge has not been dispersed, the loss of certain key people could either cause difficulties in the current organization or waste resources used for reinvention in others. Some of this lack of dispersal has been due to organizational boundaries because an outside company has built the harnesses on a newer aircraft. Some ideas adopted by other organizations in the company are the pegboard carts and tool carts.

The cultural change seems to reside as much in the organization as in the people. The harnesser workforce is completely different from that which was directly involved in the implementation. All of the rehires have to repeat the learning curve. Employees who have moved are not using LEAN and this unintentional seeding of other organizations has not resulted in a call for LEAN in those areas. This cell is the only one in the wire area that operates under LEAN principles.

The members of the cell consider LEAN to be ingrained in the organization and to be a description of how they operate. The red line process was instituted so that changes could be incorporated quickly and nothing had to stop. Even though the kanban signal lights were not working at the time the case study was conducted, the process still worked as intended and the plan was to hold off on repairing the lights until the move to another location in the plant.

The more workers used the new practices, the more open they were to new ways. They were immersed in a mindset that promoted change. They have written special notes on the harness boards so that procedures would not just be in the official notebooks. They have shared best practices among cell members and have helped each other learn exceptional tasks that only a few may have previously performed. Some of them have developed notebooks on their own initiative.

6.0 Company C – One Case Study: Quality Improvement in an Engine Parts Product Center

This case study describes the transformation of a plant that manufactures precision machined parts for aircraft manufacturers. The plant is located in a different state from its headquarters company and employs approximately 1400 non-union employees. The headquarters company is a division of a larger corporation.

The plant, called Company C in this study, was in danger of closing in 1993. In fact, company headquarters had instructed the general manager, who was eligible for early retirement, to close the plant and retire. Rather than find comfort in his own salvation and abandon the cause, the general manager reinvigorated his staff and workforce and used the crisis to turn the plant around. The wholehearted adoption of continuous improvement and LEAN practices not only saved the plant from closure, but resulted in stunning ratings for the cells at Company C, where the first cell in the entire corporation reached the highest rating. Figure 6.1 provides a timeline of these milestones.

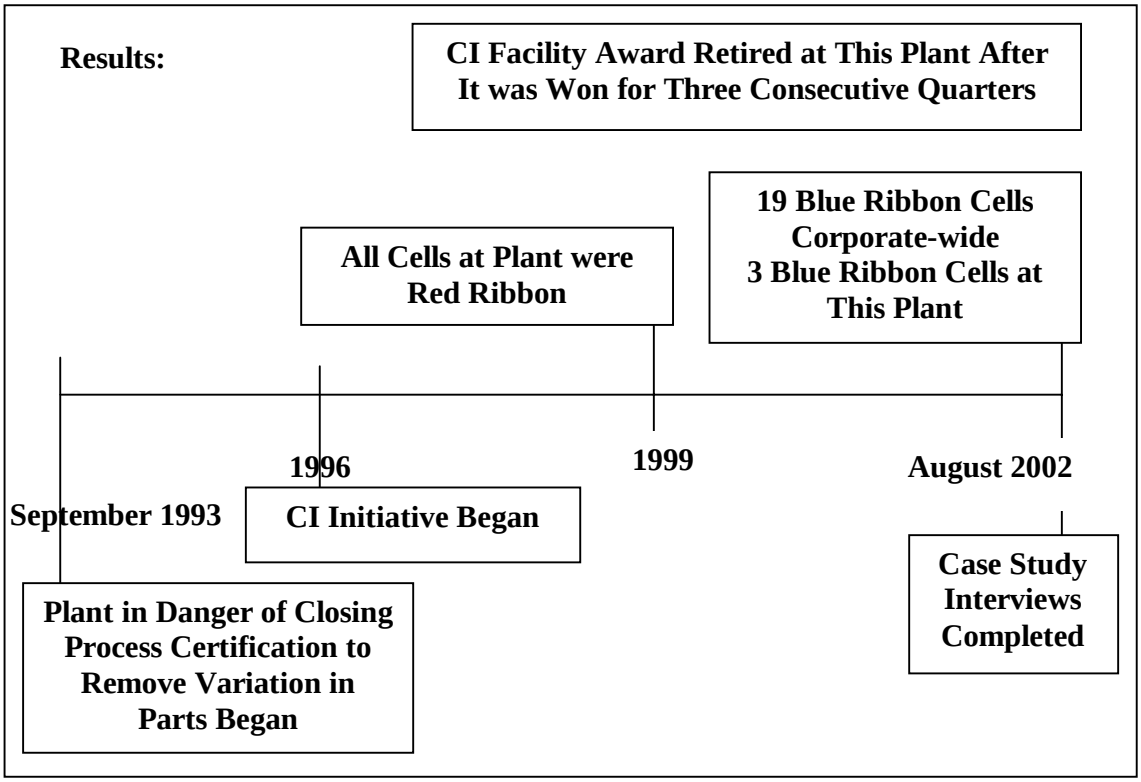

Figure 6.1: Case Study C Initiative Timeline and Results

The CI initiative followed a long history of LEAN or similar concepts at Company C. Figure 6.2 shows the significant milestones for the improvement initiatives for the entire company and not only this particular plant. The case examined here was an example of an improvement initiative that was conducted within a corporate environment that has a formal organizational structure governing change initiatives and a standard format for measuring, assessing, and reporting improvements.

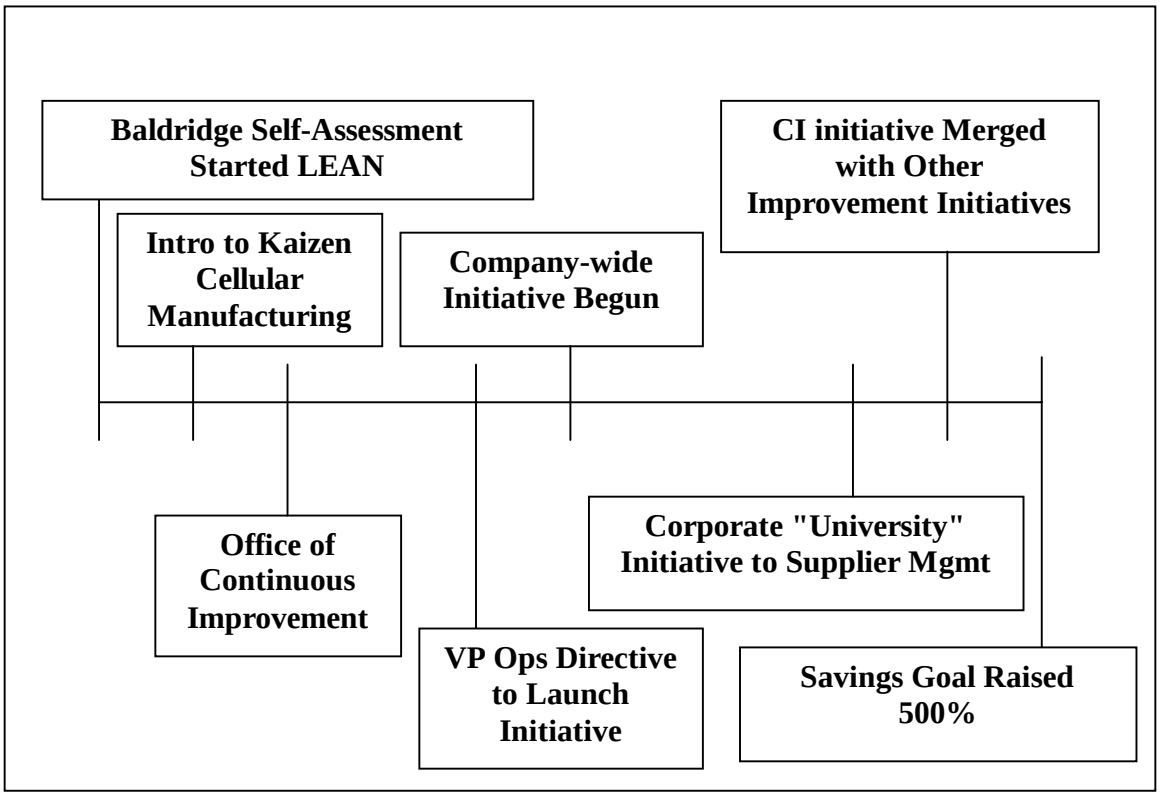

Figure 6.2: Change Initiative Timeline for Company C Corporate Level

6.1 Initiative History

Some of the reasons for wanting to close the plant were linked to a major aircraft manufacturer's dissatisfaction with the quality of the products from the plant. The quality manager and a statistician in the CI office at the plant began work in September 1993 on process certification to remove variation in the parts.

Following heavy losses in the aerospace industry in 1994, the corporation expanded its LEAN program and Japanese manufacturing methods, such as kaizen, cellular manufacturing, and standard work. In 1996, CI was formally launched as an all-encompassing initiative particular to the corporation. It was the corporation's brand of LEAN and contained many quality improvement principles and tools under one umbrella. The adoption of the initiative by this plant is the focus of the case study. The initiative will be referred to as the Continuous Improvement (CI) initiative in the text, although all continuous improvement activities at the company headquarters were not merged with the larger initiative until mid-2000.

The plant became the proving ground and showcase for CI. The plant was so successful that it won a facility award designed by the primary LEAN focal at headquarters for three consecutive quarters and retired the award at the plant. That result was not foreseen.

A number of factory workers were given training in CI tools and became CI leads, some of whom work full-time on the initiative. These CI leads were first taught in weeklong modules at the company headquarters. Many of the CI leads have been with Company C for over 20 years and have been CI leads from the early stages of the initiative. A plant-wide office for CI was established to spearhead these efforts and is currently structured with one manager handling supplier quality issues and one handling CI issues internal to the plant.

They were already using many quality tools before the LEAN focal from headquarters arrived. These tools were folded into CI and include kaizen events, 6S, Total Productive Maintenance (TPM), quality control data collection and charting, process certification or standard work, mistake proofing, root cause analysis, gap analysis, and set-up time reduction. One particular root cause analysis tool was developed internally by mechanical engineering as a more prescriptive and scientific way of categorizing and solving problems. Since they already have an established root cause analysis process, they saw no reason to repackage it as a value stream analysis. One CI lead who was involved soon after the launch said that process certification was the initial focus and then they concentrated on TPM. Another interviewee close to the initiative said that the initiative first emphasized quality and then delivery. "A quality product improves other metrics automatically." The emphasis was originally on efficient manufacturing, but was later extended to all aspects of the plant's operations.

The plant is divided into business units that may have a common part family. There are seven Original Equipment Manufacturing units and one After Market unit. There are also 18 different support cells and 15 business process cells. Within a business unit, there may be four manufacturing cells. The number of CI leads varies by business unit. Some may be dedicated full-time and some also work the particular process in their cell. Some CI leads report to a business unit manager and have a couple of other CI leads working in the cells.

The manufacturing or process cells are measured against common metrics and receive either a qualifying status or one of three awards designating gradations of achievement in the CI initiative. For the purpose of this report, I will call them yellow ribbon, red ribbon, and blue ribbon, from the lowest to the highest level. Audits are done to determine the appropriate award level. In an older system, the audit was done with a checklist and it only involved the CI lead and did not always involve the cell leader. In the new system, the cell leader must also be knowledgeable about CI and its tools. The auditor may ask questions of someone on the factory floor and one interviewee said that you could possibly fail an audit if the auditor randomly chose someone who did not understand CI and indicated that by his answer. The Company C CI office does an assessment before auditors from headquarters arrive. The blue ribbon audits can only be done by the CI focal from headquarters.

When they started the CI program, it was strictly for improving manufacturing and the production business units. Now, the support functions, such as quality assurance and

facilities and equipment maintenance are also included. All of the departments at Company C participate in CI.

6.2 Champions for the Initiative

There has been high turnover in management at Company C, which might affect the emphasis placed on CI or the perceptions of support, as people observe different management styles. Since the general manager who first turned the plant around left, there have been two other general managers, including the current one. The second had been a business unit manager and then the Operations Manager. There have also been three Operations Managers in the same time period. Some of these managers move through different levels of management, some retire, and some leave the company. Those in the higher levels of management have supported and emphasized CI to varying degrees. Interviewees said that one may be an active visible proponent, another may somewhat support it, and another may not walk through the plant as much as the stronger supporters. Some were described as better listeners than others.

This management turnover is also evident at the business unit level. In one manufacturing business unit, there have been six managers since 1991. Another manufacturing unit has had five managers since 1993. One respondent in yet another unit reported that the tendency has been to change business unit managers every three years and his unit has had the same manager and cell leaders for the past three years. In that business unit, the cell leaders change with the manager as the manager brings his people with him. The Quality department has had four different managers in a span of six years. Many of the successful managers move up through the hierarchy.

I interviewed six CI leads, many of whom had been in those positions for five to six years. Some still did machinist jobs, but most worked full-time on CI. Although they have seen many management changes, some of the same people moved through different positions within the plant. I asked who they perceived as champions. Some listed more than one. Figure 6.3 contains a graphical representation of their responses.

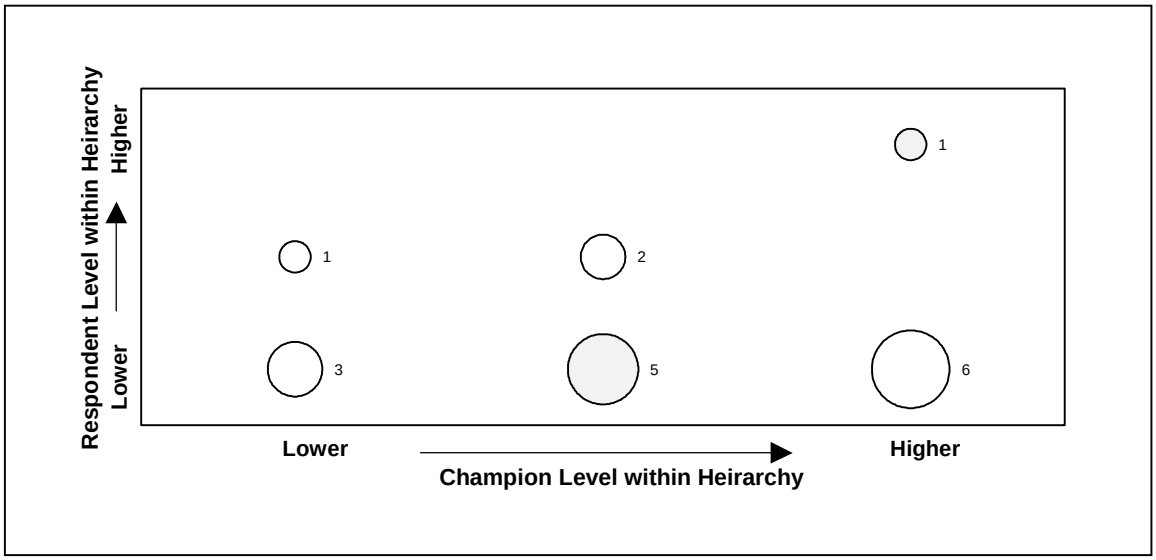

Figure 6.3: Naming Champions in Company C CI initiative: Frequency and Management Level

The levels within the hierarchy for respondents and champions are relative to the group along that axis. The respondent at the highest level is in the middle category on the champion axis. In this case, the highest level of respondent was a manager and the highest champion was a plant general manager. These were also the most commonly named champions of the initiative. The higher level champions had greater visibility to lower level employees and were recognized as often as the champions at lower levels of the organization.

Interestingly, two respondents said that the champion should be the general manager, but did not name a particular person, only the position. One respondent who, when asked to name an executive level champion, said that although there is one, he did not know his name nor had he ever met him. There does not seem to be much visibility of leaders outside of the plant at the headquarters or corporate level.

6.3 Training and Level of Effort to Support the Initiative

The CI leads are chosen mainly from the machine operators because they are closer to the shop floor and can serve as a liaison to upper management. One CI lead said the CI leads "stood the best chance of implementing change to our peers." They were sent to the company headquarters for several weeklong module training sessions. They learned skills such as team building, as well as how to use and deploy the CI tools. They also had on-the-job training to learn computer skills. One CI lead expressed a willingness to have more training on how to deal with negativity and with crises.

The training for other factory employees is deployed through kaizen participation and information passed by the CI leads. Many had already been trained to use and had been using some of the various CI tools before the initiative was formally launched. The

employees are also cross-trained in operations to facilitate the needs of cellular manufacturing. An employee noted cross training as a significant change compared to previous ways.

The interviewees spent different amounts of time in support of the initiative. Figure 6.4 gives a spectrum of the percentage of their time that a typical employee may use to support CI. It ranges from 100% for full-time CI office personnel and some CI leads to 2% to 5% averaged over the course of a year for factory workers. Some workers may spend work numerous hours on a particular project or process change, but there may be a long time between changes that affect them or require their participation. Some CI leads were dedicated full-time to the initiative. Others worked their production jobs and punched out to fulfill their CI obligations that could include gathering data and preparing charts, which might amount to the equivalent of one day a month.

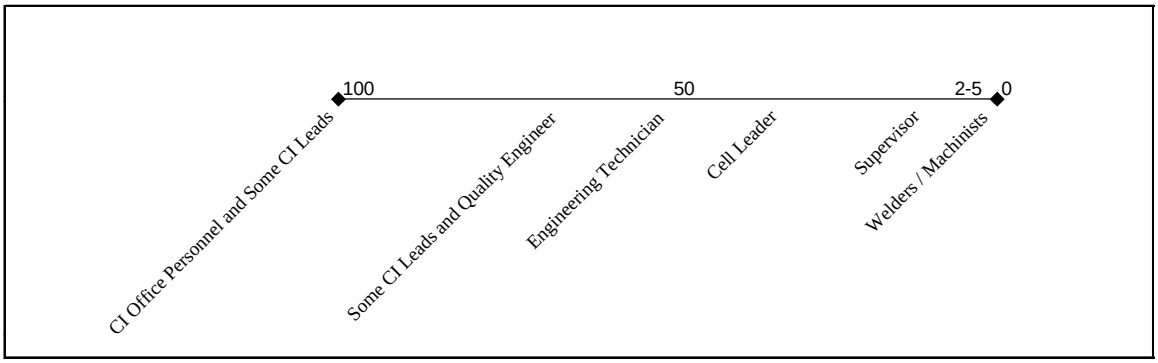

Figure 6.4: Percentage of Time Spent in Support of the CI Initiative

Occasionally CI leads are asked to put aside their CI duties and work a machine when production schedules merit. There are also what they call champions who spend time working a particular project for a short duration. The entire cell stops operations for one hour a week to do preventative maintenance on the equipment, clean and tidy the cell area, and paint lines. Five respondents mentioned preventive maintenance and the appearance of the work area as significant indicators for the time employees spend on CI.

Four of the interviewees expressed some degree of frustration between the amount of time available and the time necessary to fulfill CI obligations. One CI lead who had been dedicated to a different project for a few months recognized that not dedicating CI leads full-time could send a signal to employees that it was more of a transient initiative. Some of the time crunch comes from combining the responsibilities of more than one job into one due to competitive pressures. Even though the collection of data, such as that on machine performance, has been automated, there are still reporting requirements that place time stress on those tasked. The CI work may be used to move or combine machines, reduce inventory, or improve flow, but the emphasis must be on production time. Some specialists may only have time to work their projects and cannot help others with similar loads. This might hinder cooperation that could be mutually beneficial.

6.4 Idea Sources

They made numerous attempts to solicit ideas from the operators and build a feeling of ownership. One interview stated, "The only good way to get a good process is to have buy-in by all operators." The operator's primary motivation may be making their day easier rather than producing the product more inexpensively. Almost everyone is involved in a kaizen at some point and the CI leads try to make people feel comfortable sharing their ideas. The leads provide guidance or put the ideas into the proper format for approval or for the formal use of a CI tool.

There is a formal form that operators can submit for manufacturing processes they would like to improve. The part is measured with gauges and the form is reviewed and signed by two other people. Normally, a process change can be made immediately if brought to the attention of a mechanical engineer. This procedure allows those shifts without immediate access to mechanical engineers to affect a change. Sometimes, an operator who thought of an idea that is not used is not informed of the reason their idea was not accepted. Although those who solicit ideas realize that nothing can replace having your hands on the part, they also understand that the suggested improvement might not be optimal. For instance, the improvement might speed the production, but not produce a flat enough part.

One CI lead described the idea generation as a CI lead role with critiquing from the operators. Some co-workers appreciate the creativity of the leads. They are the focals to which workers can bring ideas. One lead said that working on the floor instead of in a cubicle making charts makes operators more inclined to come to him because they know he cannot dictate as if he were management. He described himself as the publisher who shares their ideas.

There is also an emphasis on teaming. Some interviewees described bringing together operators, designers, and manufacturing engineering to address problems. Another interviewee said, "A team is a lot stronger than one person. Somewhere in that team lies the answer." Another, when describing how the group works together to work on process improvement, said, "They're the ones we have to please to make the work flow." Teams may generate ideas that would not have been expressed otherwise.

6.5 Communicating the Initiative

The CI initiative and its component changes are actively communicated. The bulletin boards dedicated to CI are very prominently displayed at the entrance to a cell. They show the award level achieved by the cell and charts containing the metrics and the status for that cell. Three of the interviewees mentioned the bulletin boards as a communications method. One stated that someone would have to make a purposeful effort to be uninformed.

Regularly held meetings were mentioned by eleven of those interviewed. At monthly meetings, time is set aside for CI issues and there is time for discussion. The financial

information and schedules are shared with employees. The CI leads also have an open door policy with the CI office at the company headquarters. They used to attend monthly or quarterly meetings at headquarters, but now they or Company C CI officer personnel can call headquarters when necessary. Other formal communications methods include newsletters, handouts, e-mail, and an intranet. The results of kaizens are presented to management and then the information is passed to those on the floor. The CI leads spend much of their time on the shop floor and are readily available to pass information face-to-face.

Some of the reasoning behind decisions is not well communicated to employees. The form and procedure used by the floor to suggest process changes to engineering is an example. The suggestion might be the start of a good idea and engineering might respond in writing, but the form may be placed on file and the person who made the suggestion may not get personal feedback. I was told that some of this is due to a lack of time. The procedure has been improved from a hand-written, hand drawn version to an electronic version.

In some cases, the only people involved in a process change are those who touch the part in question. Information is passed to second and third shift operators by the CI lead, other operators or manufacturing engineers. The first shift operator may act as the sounding board for who is getting the best results and why. Some of the information is gleaned from the automatic signals from the machines which, in some cases, make the meetings between shifts unnecessary. Workers utilize simple rules-in-use for standardization.

6.6 Success Measures

An interviewee stated, "The plant is a good low cost producer and CI had a lot to do with it." Many metrics are used to measure the improvements made by the cells and to judge their standing for CI awards. The manufacturing metrics include process delays (rework), equipment downtime, market feedback or customer satisfaction, scrap reduction, safety, inventory reduction, raw material waste reduction, travel time reduction, delivery hours, and space usage. The metrics are standardized, so everyone reports against the same metrics.

A database developed by someone in the CI office tracks process delays and serves as a prioritization mechanism for deciding when to use relentless root cause analysis and mistake-proofing. Other computer databases make information readily available and reduce the search time that a machinist might previously have spent looking for a print. One CI lead who spends time throughout the plant said that the work is not only more efficiently done, but people are more cooperative about improving the quality of the parts.

A major improvement was in equipment maintenance. They instituted electronic gauging to monitor the machines, analyzed the data, and made repairs before costly breakdowns occurred. One CI lead in a maintenance cell said their goal was for a 5% reduction in

downtime. The cost savings were difficult to determine because it would depend upon what machine was down and for how long, as the parts have different values. The perception of one operator was different than that of the employee in maintenance because he thought CI would do more to assist with operator maintenance. He noted that the machines still break as often as before and that it is difficult to persuade operators to do the preventive maintenance and pre-checks.

The electronic controls also help them program standard run procedures. They can write a program to abort the operation if the machine exceeds the run time, for instance. The gauges provide repeatability and reproducibility to a greater degree than mechanical systems. One CI lead described what CI had done as making it harder to disprove a claim that you are making a good part. The quality improvements in the product are associated with CI, so the expected quality of parts produced in a cell using CI processes is higher.

Another improvement in maintenance was in the prioritization of repair for the 2154 assets at Company C. Since there are 125 people in the maintenance department, there were at least that many possible avenues available to inform the department that a machine was down. The old system was haphazard and users had the perception that broken assets were the property of maintenance and they would be informed when it was fixed. CI was used to analyze the flow for that process. The interviewee used the term "in tune with what delights our customers," which illustrated the customer-focused approach. Now priorities are set according to the production delivery schedule.

There are also examples of significant improvements from kaizens. One involved two almost identical parts that were 1 ½ inch high rings with 30-inch diameters. The old process time was 18 to 20 hours, produced a great deal of waste, carried 250 pieces as work in progress, and utilized four lathing machines and a five-axis milling machine. The best operator was assigned to the project to prove out the best process. They standardized the fixtures to accommodate either part so they could process either part without tooling changes and reduce set up time. The difference between the two parts became the cutting program. They co-located the lathes and replaced the 4 ½ hour milling machine process with an 18-minute process on a laser machine. Total processing time was reduced to 12 hours, there were only 36 pieces of work in progress, and lead time was improved from eight weeks to one. The projected savings that was formally documented was $3.5 million over three years.

Another example of waste reduction includes a kaizen event that focused on a 22 pound part that began with a 450-pound forging. The supplier was keenly interested because their market share had slipped from 60% to 25%. The supplier put a whole new management team in place in order to have people who were enthusiastic about CI working the issue. They were rewarded with a climb to a 70% share within a couple of years after the improvements were made. Another kaizen improvement using mistake proofing in chemical mixing reduced hazardous waste, water usage, and electricity usage in nondestructive testing.

There is also a corporate-wide computerized database to document significant improvements. Although one of the interviewees was not familiar with this system, all of the CI leads knew about it or had used it. The entries are not so descriptive that you could duplicate it without calling the contact and learning more. Improvements that require initial investments have to show a return within one or two years. Not all of the improvements that result in savings are documented here because the CI leads would rather devote their limited time to improvements rather than documenting them.

The most frequently mentioned improvements were the cleanliness and organization of the plant as compared to before the CI initiative. Six people spoke of cleanliness and six, including three in the first group, mentioned the better-ordered work areas. Another interviewee used the term "structured". One interviewee spoke about the improved safety due to guards on the machines. Before the initiative, the plant smelled dirty and oily, oil puddles were visible, drip pans were full, and the floor was littered with cigarettes. Now the plant is clean, the machines are well maintained, lines are painted, and items are organized in shadow boxes. Some of the emphasis on cleaning seems to have displaced people's perceptions about all of what CI was to do, although you need organization as a precursor. One interviewee mentioned the disappointment of preparing and cleaning the cell for a VIP visit, only to have the VIP not visit the cell.

The results of all of these improvements are the CI awards received by the cells. Table 6.1 shows the breakdown in manufacturing and support. Company C is planning to move 33 cells forward to the next level this year, including seven to blue ribbon. The first cell in the entire company, and not just this plan, to achieve a blue ribbon award was a cell at Company C. They were able to design the cell as a Greenfield because the cell had been moved off of the main floor. Although the cell has since had problems with suppliers, they proactively worked with the suppliers and had no slips in delivery, so the problem was transparent to the customer.

Table 6.1: CI Award Levels for Cells at Company C

Award Level	Manufacturing	Support
Blue Ribbon	3	0
Red Ribbon	34	17
Yellow Ribbon	4	1
Qualifying	2	0

A corporate requirement is that blue ribbon cells are audited every year thereafter. One hurdle between red and blue may be that red only requires that two thirds of a cell's metrics be green. They may choose to focus on low-hanging fruit. One CI lead described their three-year journey to the red ribbon level as dynamic because they were writing the script as they went.

6.7 Savings

The intent was described as cutting waste, increasing machine capacity, and lowering the cost per standard hour so they can bring in more work. Two people from one business unit reported that their group had brought in more work.

There have been savings in labor. One blue ribbon cell had had 22 people and now had seven. They also eliminated a shift. The other 15 people were still at the company working in other cells. One cell that instituted standard work and identified the labor they needed saved $450,000. The equipment maintenance area cut 47% of its workforce in the last two years, including a reduction from six to two supervisors, while increasing the number of assets for which they were responsible and increasing machine reliability. Another employee reported that Company C tries not to lay off workers, but uses natural attrition, 32-hour workweeks, cuts in benefits, and furloughs, when necessary. A different employee stated his belief that the savings were due to outsourcing.

One example of savings was a decrease in scrap rates in one cell from 10% to 4% to 1% to <1%, according to the CI lead. Another example was a savings of $5000 per year in nondestructive testing by sending two employees to training on x-ray film processing machines to avoid the down time while waiting for a contractor.

The savings are documented quarterly and the business units are measured monthly against their budgets. Business units have reviews with the general manager. Some savings are cost avoidance, but projected savings are committed in the budget. One interviewee said that they did not appear to follow up to see if savings were actually realized. Much of the savings are returned to the program. Through "gain sharing" all employees are rewarded at year-end for plant-wide savings and they see which areas contributed to the savings.

Savings are entered electronically when an engineer documents it for traceability and it is charged against a document number. Substantial savings are reported to the CI office by the CI leads. Some savings are submitted to the corporate-wide database. The audits for CI awards are yearly and do not show savings over a series of years.

Projects that are submitted for the computerized corporate-wide best practices documentation are reviewed by financial personnel in a pre-audit. They are now requiring submission as a prerequisite or obtaining the next CI award level. This may be a good requirement, as one pilot said that people are disappointed if their achievements are not celebrated. Some reported that the system is not very user friendly and requires training to use and this, as well as a reported lack of time, has resulted in less enthusiasm about submitting projects.

People also apply to be cost metric champions for a particular project that is too small for the corporate-wide system and are compensated according to the savings amount realized. Another program provides $100 that can be used to choose gifts from a catalogue to individuals whose ideas save money.

Some savings are reinvested at the plant. A CI lead can also authorize some common sense items without a formal business case. These items might be a floor washer, computers, or shadow boxes.

6.8 Regression

Some interviewees reported that that enthusiasm and discipline had waned since the initiative had first been introduced. Although the plant as a whole was moving forward, some groups may have found it harder to hold onto their gains. On the other hand, it was also noted that supervisors and CI leads were actively monitoring their progress, could take action when they encountered slippage, and there was no thought of turning back or discontinuing the initiative.

The leadership changes at the plant and at headquarters may have contributed to a perception that there was a lack of focus on CI because new management promoted their own priorities. A CI champion at headquarters who had celebrated and publicized plant successes had passed away. There was some concern that employees at lower levels were disappointed because their contributions might not be recognized and upper management would be compensated for the gains employees had made. One interviewee who had had his third business unit manager in six years said that management turnover had had a tremendous impact on employee morale. Another business unit whose manager became operations manager and later, plant manager, also experienced the feeling that the initiative had regressed from being very close to a cultural change under their former manager. Employees expected management to promote and talk repeatedly about the initiative if it is in fact so important. If not, perceived lapses in support might signal to employees that the initiative is losing favor with management.

Other examples of regression may have been due to the movement of people within and across business units. In January 2001, Company C had offered a voluntary separation package because they anticipated that the workload would decrease. The following March, when the schedule accelerated, there were not enough people. They still had obligations to the customer so CI leads went back on machines and new people were bought into the cells. Allowing for the learning curve of the new workers meant that they were not up to speed until September 2001. Pulling CI leads off of their CI work also did not reinforce long term goals because it gave the perception that the CI initiative was not that important.

Another example of slippage attributed to absorbing new personnel was in a particular cell where they had moved machines to reduce set up time on a process from 1.9 to 1.2 hours. As of their last report, it had climbed back up to 1.5 hours, but no one had been tasked to investigate the reason. Another interviewee noted that new people bring in a different attitude and the movement of people across cells had influenced his business unit's ability to maintain momentum.

Part of the regressive actions may be due to a misunderstanding between what Company C says CI does and what people perceive about the meaning of the initiative. Many latch onto the cleanliness, neatness, and maintenance aspects of it, but, because they do not place much importance on those characteristics, it lessens the value of CI in their eyes. Some do not see the connection to improving workflow. These people may only see the initiative in light of being asked to do more with fewer resources and at the same pay. This attitude is reinforced when kaizen results are not implemented and the reasons are not fully explained or understood by employees. They think that their good ideas are not appreciated.

The discipline required to maintain the machines and keep the work area clean spills over into the discipline needed to practice CI principles. This discipline is exercised when using CI tools to design the work flow, putting tools and equipment in their proper places, tracking metrics and producing action plans, and holding people accountable. There was only a small amount of evidence of misplaced equipment and action plans missing from a bulletin board.

6.9 Resistance

The estimates given by the interviewees for the amount of resistance they observed in their organizations ranged from five to fifteen percent of the workforce. Some reported that, at first, everyone was resistant because people tend to fear change, even if for the better, and because time constraints placed extra pressure on everyone. Three interviewees thought that resistors tended to be older workers with seniority at the plant, although many workers with over twenty years of experience were CI leads or were otherwise supportive of the initiative. It was observed by some interviewees that new employees accepted the initiative and its requirements as the normal way in which business is now conducted.

One respondent felt that the majority of the workers did not think the initiative was effective. Another respondent described the breakdown of employees as 10% leaders, 80% followers, and the 10% who will never change. Some CI leads let the last group go instead of expending energy trying to change the most recalcitrant people. If the changes are implemented, the resistors will have to at least work to them.

In order to address expected resistance to the changes, a number of strategies were followed. These strategies could be classified into those addressing culture, mitigating resistant behaviors, management emphasis, and actions taken towards regressive tendencies. They are interconnected and many approaches contain aspects of more than one category.

6.9.1 Culture and Resistance

There was resistance due to employee's perceptions about the applicability of CI and Japanese manufacturing and management practices to aerospace products. Some saw it as "just painting lines", doing preventive maintenance, and producing charts on

productivity. Even an employee that stated, "CI is the way of life now," misunderstood the benefits of CI and saw the emphasis on maintenance and not work flow.

This kind of resistance may be most pronounced in a particular business unit that manufactures more difficult parts. These parts are at the rear of the engine where it is hot and the materials are harder, the machineabilty is low, and the tolerances are tight. They resist the very concept of cellular manufacturing. They feel their work is more complicated than that of other cells. The old way was described as the village concept, where lathe, milling, welding, and grinding were separate. To them, requiring an operator to run two machines simultaneously leads to mistakes and produces parts of lower quality. One employee thought the old system worked better and that cleanliness could have been implemented without having to co-locate the machines. The advice by consultants to limit the travel time of parts was considered irrelevant, as there are people who are dedicated to move parts and the cost is not high.

The foundation of the culture that is engrained in this community are the skills that many of the employees have learned from their fathers and grandfathers. It is difficult to convince some that another way might be better. People get comfortable with old ways and become creatures of habit. They want to come in and do their job. Some characterize themselves as the kind of people who look for better ways to do things. Those in maintenance, for instance, have either been trained or are inherently inclined to fix things. The difficulty is explaining that if the process is done differently, the repair might last 20 years.

Cross training is another aspect of cellular manufacturing that went against the grain of some who were resistant. People prefer to specialize on certain machines and become extremely proficient at their specialties. One interviewee who writes work instructions said he must now be much more specific because the average operator may be less proficient on a machine due to cross training. This paradigm has removed the pride that employees felt for their specific proficiencies. It has not been replaced with an understanding of what might be necessary for the common good.

An understanding of the cultural biases of the employees and an effort to establish credibility was considered by choosing CI leads from among the most experienced and well-regarded workers. In some cases, the effort backfired because the requirements that make having a dedicated CI lead necessary also remove that employee from production or maintenance work completely or for a significant amount of time. Some of these CI leads and even some metric champions face animosity because others do not think they are pulling their weight. In the case of a champion working a project to improve a particular metric, other employees may think that if the champion is to be compensated in proportion to the savings from an improvement, the champion should do the work without them.

The most serious attacks on the culture have been the demands of the global economy. Pressures to make outsourcing decisions and maintain a competitive stature have made improvement initiatives necessary even to retain the jobs that still exist. There has been

some effort to transfer mostly lower technology parts, but when international partnerships are producing a system, all of the partners negotiate a share in the manufacture. One CI lead said, " People think they're owed job security and a paycheck. People need more training in world politics and business and [they] will realize their jobs are in jeopardy."

6.9.2 Mitigating Resistant Behaviors

Many who display resistance either are reluctant to try the new way at all or have lost faith in the company's acceptance of new ideas. There can be wasted credibility if a process was not justified and employees felt they made an effort to jump through hoops for nothing. The increase in non-production jobs to coordinate CI activities must also be explained as an investment toward eventual improvements.

One example of reconciling initial resistance was an exercise by a Process Implementation Team (PIT) to improve the 50% yield from a process by using mistake proofing to ensure the part went into the fixture the same way every time. The operator was very reluctant, but a person from the CI Office convinced him to try it for one month. After two months, the operator was asking why it was taking them so long to put it on the other two identical machines. The most reluctant operator became an active promoter. When employees have seen or experienced for themselves the good results of a change, they are very accepting.

Other efforts to preclude resistance were to include more people in kaizens and to get key operators involved. Key operators have the respect of their peers and, if they buy in, others will follow. CI leads also tried to be empathetic and addressed the concerns of employees. When preventive maintenance was introduced as an operator duty, maintenance workers perceived that move as taking away their responsibilities. They were persuaded and motivated when they were told that they were needed for more complicated repairs and not for changing oil and greasing the machinery.

Many resist because they do not understand *why* a change might be necessary or why a change they suggested was not implemented. In the first case, it helped to show charts to explain graphically what mechanisms were behind the improvement. This approach showed trust in their judgment. It might also be necessary to explain to unfamiliar employees in more detail when a successful change is deployed from one cell to another. Employees also expected that the results of a kaizen be implemented and were disappointed if told that there was no money for the equipment or tool. A couple of interviewees said that time constraints had limited the follow through needed to explain to employees the reasons why their ideas were not implemented. Taking time in individual instances to explain would actually improve acceptance in the longer term.

6.9.3 Management Emphasis

The emphasis management places on the initiative sends signals to employees about whether it is worthwhile. Tactics include monetary incentives that tie compensation to performance improvements realized through the use of CI. Management's commitment

to the initiative is also displayed by their actions of support and the resources and time they provide towards the initiative's accomplishment. Providing resources to document and publicize savings shows a commitment to share successes.

The most common point made about contending with resistance was about monetary incentives. Six interviewees mentioned that the unclear tie between CI and compensation was a barrier. Seeing real money in their paychecks was a solid experience. There are mechanisms to reward ideas, such as $100 towards catalogue purchases and raises for metric champions in proportion to the savings realized, up to a maximum of one dollar an hour. These incentives work when they are timely and the reward follows closely behind the action.

One employee said that he did not receive an award he thought he deserved until he complained. When he tried to submit a co-worker for an award, his supervisor was reluctant to make others jealous by singling out one individual. To the interviewee, that was a poor excuse for many reasons. The savings were documented in the machine's logbook, the reward could be confidential if included on a pay stub, and human resources had advertised that they had available funds for the purpose. This inconsistency was also true for cost champions. One cost champion said he had received a raise and another said that he had still not seen increased compensation after a year.

Company C has a gain sharing program whereby all employees share in some portion of the plant-wide savings at year-end. One CI lead said that some people do not always see or believe the tie to CI, even though it is communicated as the reason. These employees seem to think of CI as cleaning and painting more than as an improvement mechanism. They might see CI as another in a long line of initiatives and are weary of them. Another interviewee said that the people he encountered do recognize that their end-of-year performance gains are due to CI.

Another concern of employees was that upper management would receive an unfair share of the savings they created, while lower level workers seemed to be doing more work for the same pay. One CI lead said that, although the performance appraisal for hourly employees lists CI metrics, the appraisal is not linked to compensation. His opinion was that their motivation was not monetary, but in trying to find easier ways to do their work. Another interviewee thought that, in order to move toward a cultural change, there should be a more direct link between CI performance and the performance appraisals of business unit managers.

In order for CI to be successful, management must show its support for the initiative and not appear resistant. Some interviewees reported that their business unit managers and supervisors were behind them, even when the workers were resistant. One CI lead said that, although CI supports grassroots efforts and soliciting ideas from workers, it cannot only go in that direction and that there also needs to be some weight given to management ideas. In a very small number of cases, management support took the form of a threat of disciplinary action against employees to persuade them to participate in CI.

Sometimes management priorities are such that CI must be relegated to a lower importance. When parts are overdue, production comes before everything, including CI. The first line supervisors have the direct responsibility for production or for maintaining machines. One CI lead said that is why his business unit manager I able to support CI more than his supervisor. Sometimes people feel like they are spinning because the emphasis goes from hot to cold. Workers also receive conflicting views when they do not fully understand management's motivations. For instance, they may be told to reduce floor space, but then are reprimanded when the work area looks crowded and cluttered. The floor space reductions must be matched with inventory and WIP reductions and not a selective use of LEAN principles. Another inconsistency that was voiced was the perception that CI leads would be rotated every six months, but many have been in their positions for five years because the job carries it's own personality traits and skill sets developed over that period of time. Others complained about a shortage of manufacturing engineers who could expedite process changes. Dismissing the applicability of cellular manufacturing for a particular cell may be an unreasonable complaint against management.

Another item that does not get as much emphasis as possible is the commitment and motivation to document savings and declare small victories. The most common reason given was a lack of time. If there were incentives to share best practices, it would be done more and the workers involved and CI would get greater recognition. The corporate-wide system is sometimes cumbersome to use and is reserved for only the highest savings. A simpler plant-wide system might provide an avenue for recognition.

6.9.4 Actions Taken Toward Regressive Tendencies

There are physical barriers to regression. The CI bulletin boards that display the award status of the cell and the metrics against which they are judged are professional looking, prominently displayed and well maintained. The co-location of large machines and the painting of lines are semi-permanent, in that they would take enormous effort to move or ignore.

The principles have also taken hold. One CI lead said that CI had taught him understanding and patience. When management requires that the employees hold to standards that has resulted in tangible benefits. One example was when this non-union plant lost work to the headquarters plant because headquarters had promised a certain amount of work to the union. When the headquarters plant could not do the work, Company C eventually got it back and CI contributed to how effectively they could accomplish it and showed that if they held to a standard, they would be rewarded.

6.10 Continuing Evolution

The CI initiative has had a tremendous beneficial affect on Company C. An interviewee used the words engraved, irreversible, and necessary to describe the initiative. Most thought it had been good for Company C and that they are on an upswing. One acknowledged that they had probably not done a good job taking pictures to record the

transformation. Although there is not yet a uniform culture across all cells or business units, the plant is moving forward in its implementation and goals. They plan to move 33 cells into the next award category in the coming year, including seven to the blue ribbon level.

What has helped sustain the benefits are the customer scorecard showing customer feedback, teaming and shared responsibility, enthusiastic CI leads, and the credibility that comes from CI leads placing themselves on the factory floor. The plant is better organized, cleaner, and safer. The continuous improvement mentality is allowing them to shrink tolerances and produce even better products, and close gaps in performance between shifts.

They would like to get back to the impressive standing they held in 1999 when all of the cells at Company C were red ribbon. The first cell in the entire company to receive a blue ribbon was at this plant, and in August 2002, when there were 19 blue ribbon cells corporate-wide, three were at this plant. They have added a fourth since then. The progression from red to blue is not linear and requires a significantly greater achievement. In one comparison between a blue and red cell supported by the same CI lead, the blue cell had buy-in from everyone. The other cell had a weaker manager, was more protective of their processes and watched the CI lead very carefully.

Company C personnel are also trying to get authorization to do their own qualifying and yellow ribbon audits and to conduct CI lead training modules in house with their own extensive expertise. In one business unit, it is now more difficult to take a CI lead off of CI duties to accommodate schedule increases and requires the approval of the business unit manager. There is a general understanding that if processes are to be changed, management must invest the resources to design improvements in order to move forward.

7.0 Analysis

In order to learn how, or if, the circumstances in the preceding case studies can be applied to other organizational change situations, a comparison of the salient characteristics is necessary and may enlighten those planning new implementations. This analysis will examine the different approaches to leadership involvement, training methods, and communications and documentation as three categorical variables, and the connection of these approaches to the results and degree of success encountered in each case. Since success requires overcoming the resistance encountered during implementation, the strategies taken to reconcile resistance are also of interest.

7.1 Identifying Characteristics

Although the four case studies are different in many ways, common themes exist in many of their defining features. Table 7.1 summarizes the identifying characteristics of the case studies. The greatest similarity is that all of the change initiatives were introduced in a crisis situation. These organizations invested in the training and manpower resources needed to deploy the initiatives only when the costs of doing nothing became too high or the consequences of not improving would be the loss of business.

Table 7.1: Summary of Case Study Identifying Features

Case	Unit of Analysis	Approximate # of People Directly Affected	Change Initiative	Start of Initiative	Initiating Circumstances
A1	Skin Fabrication Directorate	800	LEAN Manufacturing	April 1999	High Costs
A2	Supplier Management Directorate	50	Material Flow Optimization	August 1998	High Costs
B	Electrical Harness Cell	30	LEAN Manufacturing	February 1999	Outsourcing Pressures
C	Engine Part Plant	1400	CI (LEAN-like proprietary program)	1996	Threat of Plant Closure

The unit in Table 7.1 is the unit of application of the change initiative. They can be classified according to functional area, technology level, or complexity of operations. The description of the functional area may be useful for determining if this comparison is applicable in other situations in different functional areas. LEAN activities have typically been concentrated in manufacturing environments, but many companies are attempting to leverage their success with improvement programs by applying similar principles to business processes other than production. Both cases A1 and B are in manufacturing units. Case A2 applies to a business process in purchasing and inventory

control. Case C is an entire plant and, although the initial emphasis was on manufacturing, the initiative was extended to the support and process cells.

Information about the technology level of each case may also be useful when considering their applications to other situations. It may also have some bearing on the environment of acceptance for change initiatives. Some employees may view LEAN-like principles as more useful for less sophisticated products produced in large quantities than for those in the aerospace industry. Both case A1 and case C involve the manufacture of high technology parts. The company in case C produces precision machined parts for high performance products and some cells manufacture more difficult parts that have tighter tolerances or that must withstand high heat. Case A1 includes the stretching, chemical milling, and etching of skin panels, which are expensive processes. Case B is an assembly process and, although the final system is complex, the highest technology required in the cell is the testing for continuity. Case A2 deals with expediters and the technological means are the telephone, e-mail, and the web, as well as parts databases.

The level of complexity of operations refers to how the unit is interconnected to other organizations and how many requirements it must handle and from whom. This may influence the speed of diffusion because there may be more parties or sub-organizations with differing interests that need to be convinced to adopt the initiative. If there are more organizations involved, the success or failure of the initiative may have a wider impact. Cases A1, A2, and C produce parts for or support multiple product lines. The directorate in case A1 is an internal supplier to all of the major product lines in the division. The directorate in case A2 also provides division-wide support and must coordinate purchasing with external suppliers, internal contracting, and corporate supplier management. I would consider cases A1 and A2 very close in level of complexity, but rank A2 higher because of the numerous external contacts. In case C, the unit studied was the entire plant. Their staff has to answer to the program offices at the headquarters company. Case B assembles many different harnesses, but for only one program. Table 7.2 provides a rank order as a comparison for the organizations.

Table 7.2: Technology Level and Operations Complexity of Case Studies

Rank (Highest to Lowest)	Technology Level	Complexity of Operations
1	C	C
2	A1	A2
3	B	A1
4	A2	B

7.2 Success and Regression

The units in the case studies all had some degree of dramatic success compared with their previous states. These successes and their attendant savings allowed them to reverse the trends that placed them in their initial predicaments. Table 7.3 lists the success measures and areas of savings for the cases. The reductions highlighted in success measures contributed to the financial savings. All of the case studies showed significant savings in

labor, material, or process time. In all of the case studies, the savings reduced the unit cost and were committed in their budgets or business plans in order to establish accountability. This allowed them to keep work they might have lost or to bring in more work with the same size workforce.

Table 7.3: Success Measures and Savings

Case	Success Measures	Area of Savings
A1	• Shortages reduced by 98% • Rework and Repair Costs reduced by 25% • Scrap Costs reduced by 42% • Cycle Time from 44 to 21 days • Employee Satisfaction improved by 14 points • Part number consolidation	• Material Costs • Overtime reduction • Headcount reduction due to lower rates and natural attrition
A2	• Part Numbers per buyer increased from 225 to 450 • Part number reduction from kitting • Supplier consolidation • Lower inventory • Fewer shortages • Half the planners and buyers	• Smaller, more efficient workforce • Material Holding Costs
B	• Labor Hours reduced 73% • Operator travel distance reduced 94% • Parts travel distance reduced 51% • Square Footage usage reduced 34% • Turnaround on changes from 2 weeks to one day	• Labor Hours
C	• Many high level CI Awards Won at this plant (3 out of 19 corporate-wide blue ribbons) • More organized and cleaner work environment • Rework reduction • Scrap reduction • 5% Reduction in equipment downtime • Travel time reduction • Inventory reduction • Set up time reduction; Standard run procedures; Tooling (one example saved $3.5 million over three years) • Square footage reduction • Improved Safety • Improved Customer Satisfaction	• Labor Hours; natural attrition and movement within company • Raw material costs

The degree of regression to former practices or processes is also a measure of how successfully the initiatives have been diffused into the organizations. Regression is defined as a full or partial return to the old method or process or a full or partial

discontinuance of changes adopted during the initiative implementation. The characteristics of the regression also provide some observations about how it may have been prevented and different perspectives within the organizations about the extent of regression. Table 7.4 summarizes the characteristics of regression in each case study. In none of the cases studies did there seem to be any formal measurement mechanism in place to compare degree of regression against decreases in success measures. Some regression was considered realistic and understandable, as long as they were achieving their objectives, even without full compliance to new procedures.

The characteristics of regression have been placed in three categories. Indications of regression are those that are evident from observation or that were mentioned as examples in interviews. The prevailing perceptions given by interviewees related to regression are also described. In case B, high employee turnover had resulted in some regression as rehires who had only been familiar with the old method were trained to use the new procedures and work within the changed environment. Information about management turnover was also included because that could influence the emphasis placed on adopting the initiative and the amount of resources dedicated to implementing it. Some of the sub-organizations in case C experienced regression due to frequent management changes because different managers placed a different priority on the initiative.

The strongest defenses against regression were not supporting the old process or making permanent or semi-permanent physical changes to the work area. In case A2, the process was so completely changed that purchasers could not use the old method. The rest of the initiative was still being deployed and there was some variation in how well employees understood the other sub-initiatives. In case B, the harness cell was reconfigured so differently from how it had been before that employees would have to learn and use the new method. The improved work flow was such that employees preferred it to how it had been before once they learned the new rules and vocabulary of cellular manufacturing.

In both A1 and C, there was some disagreement among interviewees as to the extent and significance of regression. In case A1, lower production rates allowed a reversion to a hot list, which a manager viewed as a placebo. Some employees thought that they were doing work in much the same way as before, but with fewer people. In case C, some employees misunderstood the emphasis placed on a clean and organized work area as not contributing to improved work flow.

Table 7.4: Characteristics of Regression in the Case Studies

Case	Indications	Employee Perceptions	Contribution of Personnel Turnover
A1	• Discontinuance of Kanban cards • Reversion to Hot List (placebo or lower rates?) • Regression allowed if improvement not effective	• Different responses within organization • Perception that product produced the same way with fewer people • Shifted focus after Kaizen • Satisfaction with improvements in metrics regardless of whether LEAN is the reason	• Not mentioned as a factor (80% of workforce trained in LEAN)
A2	• None reported (New process is the only one available) • Lack of visibility of some electronic capabilities	• Min/max described as "how we operate"	• Not mentioned as a factor
B	• Very few: Some signal lights not used; awaiting repair for when cell is moved	• Not using the old process because it does not exist on this program anymore	• Learning curve for rehires; high employee turnover
C	• Progress monitored constantly; disagreement over how well slippage was tracked and resolved	• Number of cells at each CI award level are increasing • Some misunderstanding of principles of cellular manufacturing; perception that emphasis is on cleanliness, not work flow • Waning enthusiasm since launch and dramatic gains made at the beginning	• High management turnover contributed to perceptions about changing importance of initiative • Voluntary separation offered in January 2001 contributed to employee turnover and new hire learning curve

7.3 Resistance and Reconciliation

The resistance against the initiatives encountered in the companies studied also offers observations of how effective certain strategies were at reconciling resistors, achieving acceptance, and redirecting people's energy toward productivity improvement. Table 7.5 compares the attributes of the resistance in terms of the resistors and how they exhibited their resistance.

Table 7.5: Characteristics of the Resistors and Resistance

Case	Characteristics of Resistors			Characteristics of Resistance
	% of Workforce	Age and Experience	Specific Interests	
A1	• Estimates of 5%-30%	• Some newer, some senior	• Lower level mgrs with competing expectations • Shop employees worried about job loss	• Unwilling to participate in LEAN classes • Apathy • Working around system
A2	• Within Directorate: 50%	• Tended to be of higher seniority; wanted more control over suppliers	• Outside suppliers: Added work; Loss of status; Stricter measurement • Contracting: Emphasis on lower unit cost and not other qualities of supplier • Internal Customers and Suppliers: Make/Buy; contractual barriers to moving work	• Complaints, worry • Aversion to changing practices • Uncooperative behavior
B	• Very Few	• Usually from those near retirement	• All were aware that every job was on the line	• Disbelief • Unwilling to take direction
C	• Estimates of 5% to 15%	• Tended to have high seniority	• Some who produced more difficult parts thought that cellular manufacturing was not adaptable	• Uncooperative behavior • Complaints that cellular manufacturing was not applicable to their product

There was not always agreement about what kinds of people offered the most resistance. Although many interviewees said that the resistors tended to be those with over 20 years of experience and preferred to keep the status quo, many employees with high seniority were tapped to lead the initiative and were very effective. Many years of experience may be a common trait among resistors, but is not a predictor of resistant behavior. On the other hand, newer employees seemed to have come of age in a world of constant change and are generally accepting of initiatives in the workplace. Most of the resistance was characterized by uncooperative behavior and complaints and did not jeopardize the implementation of the initiatives. Only a few exceptional cases required the movement of individuals or threat of disciplinary action.

I classified reconciliation strategies into four categories. They included consideration of cultural issues, mitigating resistant behavior, management emphasis, and actions taken towards regressive tendencies. The strategies are interconnected and many approaches contain aspects of more than one category, although they are listed under the heading for which they are most relevant. Cultural issues are those that define the inherent characteristics of the company and its workforce. The culture is influenced by company history, relationships with unions, and the particular personalities that shaped the structure of the organization. Practices that attempt to mitigate resistant behavior are those that stress openness, inclusiveness, and participation. The incentives, monetary and otherwise, and other resources and support that management provides for the initiative implementation are items listed under management emphasis. Companies also take actions and proactively implement policies to counter regressive tendencies. Figure 7.1 contains an illustration in which I use a brick wall as a metaphor for resistance and depict the relationships with the strategies mentioned above.

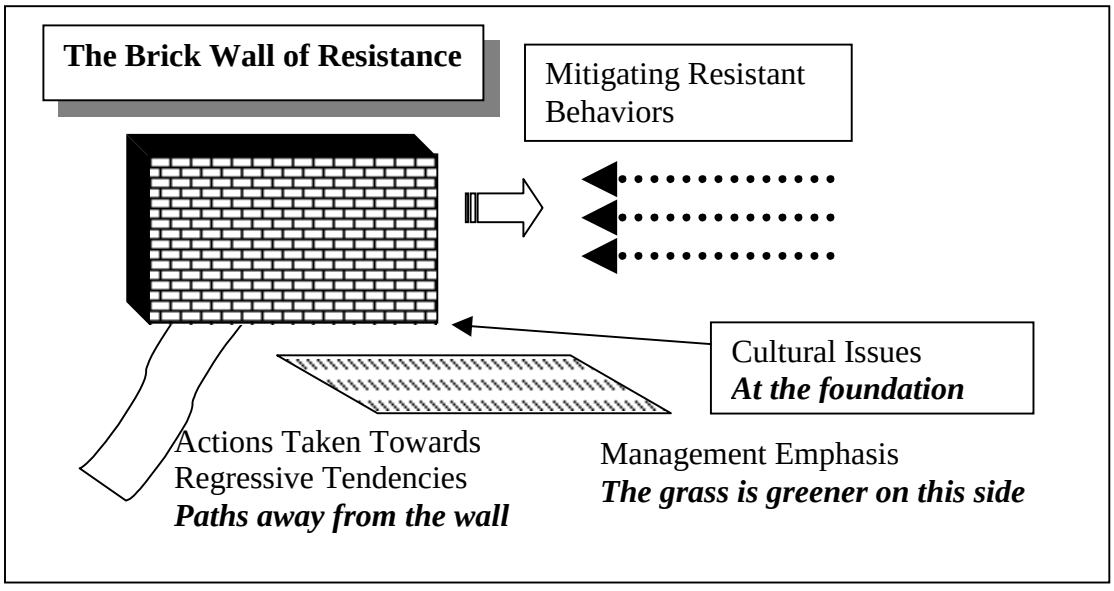

Figure 7.1: Reconciliation Strategies to Counter Resistance

Table 7.6 summarizes the strategies used by the organizations to address the issue of resistance and reconcile resistors. The approach that interviewees found most effective or which predominated the responses for each case is in bold face. Items that caused problems or were not addressed or resolved are italicized. The reconciliation strategies included addressing cultural issues, mitigating resistant behavior, choices or efforts management made about placing emphasis on the initiative, and actions taken toward the tendency to regress.

Cultural issues included union rule considerations, easing fear of leaking proprietary information by sharing production schedules with external suppliers, and using the combined knowledge and skills embedded in the workforce. These strategies addressed deeply embedded paradigms that might have prevented the adoption of the initiative. In case A1, the union had to be brought into discussions early because cellular manufacturing and point-of-use delivery would require an acknowledgement that job descriptions might be changed or merged. The long held belief that sharing schedule information might jeopardize competitive posture and should be closely guarded had to be overcome in case A2. Consulting experienced and respected employees and including them in key positions related to the implementation was followed in all of the cases, but was considered even more crucial in cases B and C.

Participation in kaizen events in the manufacturing cases and broadening the pool for the solicitation of ideas were ways to mitigate resistant behaviors. In case B, the environment that was created provided openness to new ideas and the expression of this environment was described as contagious because all members of the organization felt that their ideas were welcomed. Key operators and subject matter experts were enlisted as idea sources and to validate new methods in the case studies. Presumably, these experts had a better understanding of the existing process and what needed to be accomplished so that they could both make sound choices about what attempts were feasible and added credibility by their support once a particular path was chosen.

Monetary incentives tied to the performance of individuals or the organization was the most effective way in which management could motivate employees. Most interviewees could better appreciate the financial advantages to the company caused by the initiative if their own financial outlook was improved. Although an understanding that the fiscal strength and stability of the company would enable it to provide and maintain jobs was important, most people felt that they should be sharing in the gains to which they were contributing. The objectives of the initiative were also clearer and more well-defined when employees could link the organizational and personal outcomes.

Those organizations with the most dramatic redesign or in which the older process was no longer supported precluded the greatest avenues for regression. In cases B and C the workspaces had been reorganized and heavy equipment had been moved so that the work flow could not easily revert to the old procedures. The older inventory process was no longer supported by the supplier management directorate in case A2 and all inventory levels were set and purchases were made based on the new system. The LEAN vocabulary was so ingrained in the minds of many of the employees in case A1 because

of the company's commitment to training and kaizens, that even the regressions that were noted were explained using LEAN concepts.

Table 7.6: Reconciliation Strategies

Case	Cultural Issues	Mitigating Resistant Behaviors
A1	• Cumulative work experience emphasized in training • **Consideration of union issues** • Tough talk: "Get onboard or get out of the way."	• Nurturing a core group of respected workers • Peer pressure • **Kaizen participation** • Using negative comments as an opportunity for explanation
A2	• "Not invented here" countered with success stories • Natural attrition: movement to other jobs or companies, lay offs • Assignment of resistors to successful suppliers • **Allowing information to be shared with suppliers** • Written testimonials from suppliers	• Involved most enthusiastic employees • **Included input of SME's** • Electronic communications and B-to-B • Team member interaction with shop personnel
B	• **Mature and knowledgeable workforce was able to overcome initial hesitancy** • Ownership and trust	• Implemented ideas quickly • **Openness to ideas was contagious**
C	• **CI leads chosen from among experienced and respected employees** • Some employees do not think cellular manufacturing applies to their product • Skills passed through generations; attachment to tradition • Cross training requires more specific work instructions to counter decreased specialization	• Persuading resistors to try the new method for trial periods • Kaizen participation • **Key operator participation** • Showing data to justify change • Many times there was no time to provide feedback to employees to explain decisions

Legend:
Boldface = Approaches that interviewees found most effective or which predominated the responses for each case.
Italicized = Items that caused problems or were not addressed or resolved.

Table 7.6 (continued): Reconciliation Strategies

Case	Management Emphasis	Actions Taken Towards Regressive Tendencies
A1	• Mgmt must teach LEAN classes • Visibility of initiative with upper mgmt • **Specific goals on performance appraisals tied to initiative and merit increases**	• **Visibility of new vocabulary** • Digital imaging • Warn workers not to be impatient or have unreasonable expectation
A2	• Open door communication with mgmt • **Initiative goals tied to performance appraisals** • Director involvement in issues with contracting	• Passed off processes after development • **Old process no longer supported**
B	• Union support • **Merit increases based upon improvements** • Only project that received such support • *Did not raise labor grade to counter employee movement*	• Documenting standards • **Drastic redesign of process** (Old process does not exist on this program anymore.)
C	• *Unclear tie between CI performance, employee appraisals, and compensation* • $100 awards to reward ideas that result in savings • **Gain Sharing for all employees at year-end based on company performance** • Metric champion raises • *High management turnover sometimes caused confusion about priorities among workforce* • Not enough time given to document all projects	• Prominent CI bulletin boards • **Redesign of cells and movement of heavy equipment** • Rewarded with a return of previously lost work • Held to standards

Legend:
Boldface = Approaches that interviewees found most effective or which predominated the responses for each case.
Italicized = Items that caused problems or were not addressed or resolved.

7.4 Testing the Hypotheses and Drawing Conclusions

To extract lessons from the case studies, I return to the hypotheses in Section 1.3. The hypotheses relate a number of concepts that emerge from the data. These concepts are leadership, training, and communications and documentation. In order to relate these concepts, I used classification procedures and axial coding as described by Strauss and Corbin.[21] Since qualitative analysis is interpretive in nature, the researcher formulates the explanatory scheme from the concepts defined by the data and their relationships to each other. The data were not numerical, but can be analyzed by looking at the properties and dimensions of sub-categories and understanding how they are linked. The properties of the variables can be scaled from low to high. Two by two matrices showing the relationship between the independent and dependent variables will be used to visualize the relationships.

7.4.1 Leadership

Hypothesis 1. If lower level leadership is more committed to the initiative, there will be less regression, even if measures were not taken to make the changes to the process irreversible.

The first hypothesis relates the concept of leadership to the concept of regression. It further specifies lower level leadership as a sub-category. The measure of lower level leadership commitment in the case studies was the interview question that asked who the interviewee considered to be the champion for the initiative. The champions were visible supporters of the initiative who provided resources for implementation and were actively engaged in the process. It was observed that lower level leadership had more visibility with the operational employees whose cooperation is necessary to make the change initiative a reality. Figure 7.2 contains a composite of all of the champion plots from the case studies and offers a side-by-side comparison of the strength of lower level leadership.

[21] Strauss, Anselm and Corbin, Juliet, *Basics of Qualitative Research, Techniques and Procedures for Developing Grounded Theory* (Thousand Oaks, California, Sage Publications, 1998)

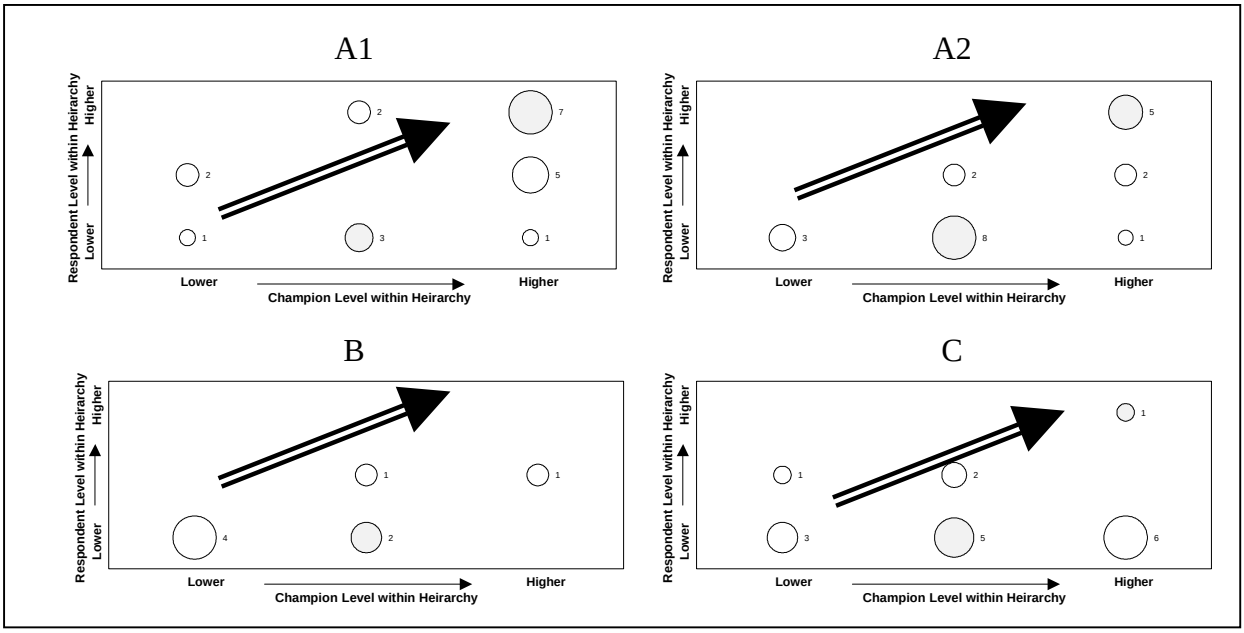

Figure 7.2: Composite of Champion Plots for All Case Studies

In Figure 7.2, the horizontal axes refer to the relative position in the organization's hierarchy of those named as champions. The relative position of the respondents is shown on the vertical axis. The size of the circle indicates the number of times a champion at a particular level was named by interviewees at any of three levels. For instance, in case A1, seven champions at a high level within the hierarchy were named by higher level interviewees. A high respondent may not necessarily be a high champion because the axes are scaled to those within the same category of respondent or champion.

In case A1, the champions named by lower level respondents were concentrated in the middle. Middle and higher level respondents tended to name high level champions. In case A2, the champions named by lower level respondents were also concentrated in the middle. Respondents at the highest level only named high level champions. In case B, lower level champions predominated, but there were no high level respondents. Champions at the middle and higher levels within the plant dominated the responses in case C for lower level respondents.

The trend depicted by the arrows is that people tended to recognize the leadership of their more immediate supervisors or of higher managers more closely associated with their organizations. If people had only named their immediate supervisors, you would expect all of the points to be along the diagonal. The most populated areas tended to be below the diagonals and the upper diagonals were very sparse or empty. The dispersion of the data within the lower diagonals shows that people were looking to higher levels for visible champions, but they were not ignoring the leaders at lower levels or those in the middle.

According to Rogers[22], people are influenced by peers or from those in adopter categories not too far distant from their own. This would indicate that leadership is required throughout the organization. Opinion leaders play a significant role in influencing their peers and are found in every adopter category. That means accessibility to opinion leaders who support the initiative must be encouraged. The opinion leaders who affect opinions cannot be much higher in status than those they wish to influence. People need reinforcement and validation from peers or near-peers. High level champions may influence the opinions of their subordinates, but need an group of lower and middle level opinion leaders situated throughout the organization who can directly control the actual implementation, assess its effectiveness, and adjust their actions and those of their own subordinates.

Since the initiatives must be diffused and accepted by the lower level employees in order to function as intended, I will concentrate on the observations about these interviewees. Very rarely will lower level leaders be named as champions by their superiors. For lower level respondents in all of the cases, lower to middle level champions predominated. Case C showed high visibility of the high level champions at the lower levels because the initial implementation was so closely tied to the general manager of the plant who first motivated the entire plant and reversed a downward trend.

The amount of lower level leadership visibly committed to the initiative was measured using the champion data collected from respondents. The percentages of lower level and middle level champions named by lower level respondents, and the percentage of lower level respondents named by all respondents were calculated. Since the level within the hierarchy was relative, the middle level champions named by lower level respondents may not have been extremely high within the organization. Since the focus was on lower level leadership, the middle level champions were also included, but the score was weighted at 20% as compared with the 40% weighting for the other two measures. The cases were ranked in each category and assigned a score based upon rank. Rank 1 earned four points, rank 2, three points, rank 3, two points, and rank 4, one point. The scores were summed to obtain a cumulative score as shown in Table 7.7.

Table 7.7: Leadership Scores

Case	Named by Lower Level Respondents				Named by All Respondents		Cumu-lative Score
	% of Champions in Lower	Score 40% wgt	% of Champions in Middle	Score 20% wgt	% of Champions in Lower	Score 40% wgt	
A1	20	1	60	3	14	2	1.8
A2	25	3	67	4	14	2	2.8
B	67	4	33	1	50	4	3.4
C	21	2	36	2	22	3	2.4

[22] Supra 7

It is also necessary to scale the degree of regression in each case. The degree of regression was assessed as a combination of the amount of regression evident from observation and interviews, the severity of the consequences and whether actions were taken to reverse or prevent them, and the level of agreement among the interviewees as to whether any regression had occurred. The cases were rated from very low to very high in these categories, a score was assigned to the rating, and the scores were summed, as shown in Table 7.8. Information gathered in the case studies and highlighted in Table 7.4 was used to determine these scores. A very low amount or evidence of regression received the highest score. In the consequences category, a firm attitude and effective actions taken to reverse or prevent regression received a higher score. Disagreement amongst interviewees about whether there was regression or the extent of the regression indicated that the changes had not been fully embedded without some slippage and the case was scored lower than a case in which employees spoke consistently about how a new process was actually practiced. Figure 7.3 depicts the plot relating the scores for lower level leadership and degree of regression. The upper end of the scale for degree of regression is labeled low because lower regression is better and the most desirable conditions on both scales should intersect at the top right.

Table 7.8: Degree of Regression Scores

Case	Amount of Regression	Score	Consequences	Score	Agreement	Score	Cumulative Score
A1	Medium	3	Medium	3	Low	2	8
A2	Low	4	Medium	3	High	4	11
B	Very Low	5	High	4	High	4	13
C	Medium	3	Very High	5	Low	2	10

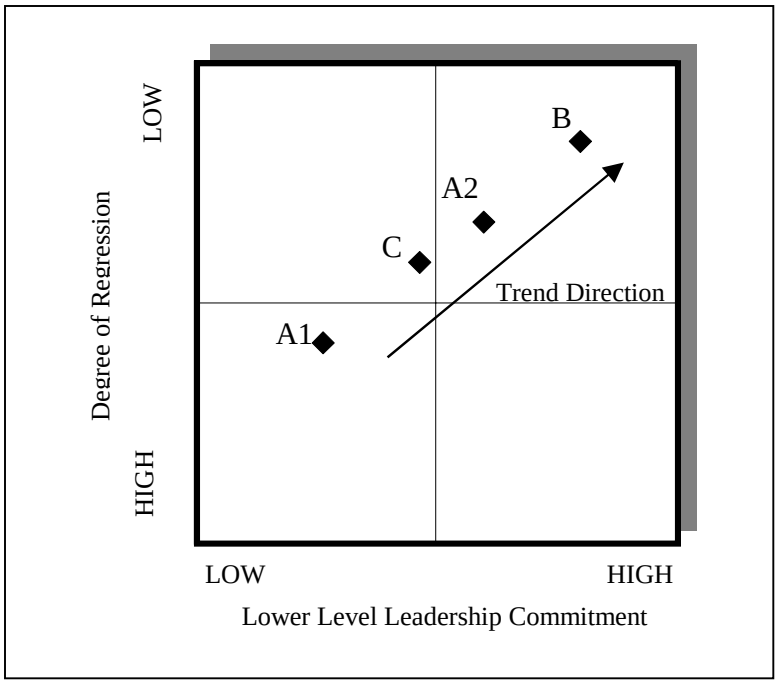

Figure 7.3: Lower Level Leadership vs. Degree of Regression

The data support the first part of hypothesis 1 and the commitment of lower level leadership is positively correlated with less regression in these cases because the trend moves toward the upper right. The qualifying phrase, "even if measures were not taken to make the changes to the process irreversible", is not fully supported. Cases A2 and B exhibited the least regression, but they also took the strongest actions against regression by not supporting or removing the old processes. Loss of support for the old method or drastically changing the physical layout may be a better indicator than lower level leadership commitment for reducing regression.

7.4.2 Training, Communication, and Documentation

The other concepts that may be related to the diffusion of change initiatives are workforce training and communication and documentation practices. Data were collected on formal training methods, the functional mix of project teams, time devoted to initiative implementation and maintenance, idea sources, avenues of communication, best practice documentation, and the adoption of the initiative throughout the wider organization. Training, informational communication, and the documentation of savings and best practices are related. The results of formal training sessions and kaizens are often documented and distributed in some way to interested parties. The documentation itself can be used as a means of communicating highlights of the initiative. All three categories together contribute to organizational learning. They provide the subject matter, a supportive environment for learning, and the context in which it is used. The evidence of this learning can be seen by how effectively these practices were adopted across the organization and how widespread the adoption was.

Rogers also noted that personal contact was more important than mass communications for diffusion. A larger number of trained employees who are well-versed in the advantages of the initiative are needed to promote it. Their personal influence can also help to counteract selective exposure, perception, and retention, whereby people filter the mass produced information they receive and tend to only seek and retain that which already supports their own opinions. An interaction effect can occur when there is a large enough number of adopters to network with others who may still be resistant. This effect speeds adoption by individuals. A learning organization, where more individuals can use the principles from training, can benefit from the interaction effect.

The particular items or approaches used in training, documentation, and communication for each case study can be found in Tables 7.9 through 7.12. The number of items listed under each category is not a determinant of how well each was achieved because it is dependent on who was interviewed and the methods they thought worthy of mention. Some training methods, such as information sheets, are also documentation and can be used for communication. Other examples that fit into multiple categories are cascade training, websites, and articles. The arrow indicates that training, documentation, and communication contribute to the adoption of the initiative.

Table 7.9: Training, Communications, Documentation, and Adoption in Case A1

Training	LEAN Classes Kaizen Events
Documentation	Kaizen Reports Baldridge Criteria Award
Communications	Crew Meetings Mgmt Talks All-Hands Meetings Celebrations Company Publications Memos Across Shops and Shifts

Adoption of Practices Across the Company	High: LEAN Projects in All Manufacturing Units, but not Many Process Units

In case A1, the primary training means were formalized classes and kaizen events. Company A had a formal LEAN umbrella organization to coordinate and support training, facilitation, and implementation. The manufacturing initiatives, in general, made large investments in training. Face-to-face communications, especially crew meetings, were described as the primary means to share information with employees. LEAN practices were widely used throughout the company in its manufacturing units and to some extent within process organizations.

The TIP sheets used in case A2 served as training devices, formal documentation of procedures, and as communication means. The training was less formal than that done in manufacturing units and was sometimes geared specifically to the individuals who were to implement the new procedures. The adoption was evaluated as medium to high because Phase II of the initiative was still undergoing implementation, although the min/max phase was almost universally adopted.

Formal training was more intense at the beginning of the implementation in case B. Newer employees, hired since the implementation, were trained on the job. The members of the crew took great initiative in documenting their practices and creating their own records. The tours given to visitors have made the greatest impressions toward communicating the success of the initiative. Although other aircraft program electrical cells have not adopted LEAN practices as completely as this cell, some ideas, such as pegboards and toolcarts, have been widely adopted by other organizations.

In case C, the headquarters CI office provided formal training to CI leads. The CI leads, in turn, facilitated kaizens and led the CI implementation and adoption with the help of the local CI umbrella organization. Although the corporate-wide documentation database was described as not very user-friendly, the success metrics and cell standings were prominently displayed on standardized CI bulletin boards at each cell or department. All

sub-organizations, including support and process cells used, practiced, and were evaluated on CI, displaying a highly widespread adoption of the initiative.

Table 7.10: Training, Communications, Documentation, and Adoption in Case A2

Training	TIP Sheets OJT One-on-One Cascade Training Mentoring, Coaching Spontaneous Training
Documentation	TIP Sheets Data Documentation Internal Website Official Notices
Communications	TIP Sheets All-Hands Meetings Meetings between Initiative Integration Off & Mgmt IIO at Staff Meetings Weekly Meetings with Operations Quality Councils Internet

Adoption of Practices Across the Company	Medium to High: All Internal Customers Must Set Min/Max Levels

Table 7.11: Training, Communications, Documentation, and Adoption in Case B

Training	Classes for Initial Project Team OJT One-on-One
Documentation	Book for Electrical Dept. Crew Members' Notebooks Memorandum for Red Line Process
Communications	Article in Magazine and Company Website Tours of Cell Meetings with Upper Mgmt

Adoption of Practices Across the Company	Medium: Held Up as Example, but Only Some Practices Widely Accepted

Table 7.12: Training, Communications, Documentation, and Adoption in Case C

Training	Modules Training for CI Leads Kaizens Cross-Training on Equipment
Documentation	CI Award Levels Corporate-wide Savings Database CI Office Process Delay Database Change Form from Operators to ME's
Communications	CI Bulletin Boards Regular Meetings, Meetings with HQ CI Lead contact with CI Off and HQ Electronic Gauging Articles Hand-offs between Shifts

Adoption of Practices Across the Company	High: All Cells Use CI, Including Support and Process Cells

The cases were evaluated with regard to the training given to the workforce to prepare them for the initiative and to teach them to use the tools necessary for implementation. The factors considered were the percentage of the workforce trained and the completeness of the subject matter. The cases were also evaluated on the formal documentation made available to the workforce that they could then use to share best practices and provide information on proven ideas and changes. The scores are shown in Table 7.13. Rank alone was insufficient for scoring, as some of the cases were very close in some aspects. Grades of very low, low, medium, high, and very high were used.

Table 7.13: Training and Documentation Scores

	Formal Training			Availability of Documentation		
Case	Rank	Grade	Score	Rank	Grade	Score
A1	1	High to Very High	4.5	4	Medium	3
A2	4	Low	2	2	Medium to High	3.5
B	3	Medium	3	1	High	4
C	2	High	4	3	Medium to High	3.5

The diffusion of the initiative is also a function of the functional mix of the project teams, the various sources from which ideas were solicited, and the level of effort devoted to implementing and maintaining the initiative. Table 7.14 provides a synopsis of these areas for each case. Training and broad solicitation of ideas are also linked by their affect

on the preparedness of the workforce. Better preparation may enable the buy-in required to engage the workforce in the initiative.

Hypotheses 2 and 3 relate training and documentation practices to diffusion and integration of the initiative.

Hypothesis 2. Training a larger part of the workforce leads to the employees having a greater ability to integrate, diffuse, and initiate change.

Hypothesis 3. Having a formal best practices or lessons learned documentation available to all results in better diffusion and less regression.

The degree of diffusion was determined using a cumulative score for four areas. The cases were placed in rank order for the adoption of practices across the company, the functional mix of project teams, idea sources, and the time devoted to the initiative. Rank 1 earned four points, rank 2, three points, rank 3, two points, and rank 4, one point. The adoption of practices across the company was weighted twice as much because it was a more direct observation of diffusion. Diversity of idea sources can compensate for less diversity on project teams. The project team mix for cases B and C were too close to differentiate by a separate ranking. Table 7.15 contains the ranking for each area and the cumulative score.

Table 7.14: Functional Mix of Project Teams, Idea Sources, and Level of Effort

Case	Functional Mix of Product Teams	Idea Sources	Time Devoted to Implementation	Time Devoted to Change Initiative
A1	• Crew Members • Manufacturing Management • Coalitions of 2 to 3 leads	• Management in Directorate • Product Line Managers • Supervisors • Lead Mechanics • Crew Members	• Mission Statement: 66% of FTE • 5 Full-time for 4 months in one area	• Mgmt: 25% to 30% • Floor: <10%
A2	• Buyers Assigned to Shops • Subject Matter Experts	• Initiative Integration Office Members • Users (Buyers) in Directorate • Suppliers • Manufacturing Shops	• 9 People Full-time from IIO for 1 ½ Years	• IIO: 100% • Mgmt: 30% to 50% • Employees Not On Project Teams: Very Little
B	• Crew Members • Supervisor • Planning • Engineering • LEAN facilitators	• Crew Members • Specialists and Planners Assigned to Cell • Engineering • LEAN Staff	• 15 People on Team for One Year • 5 FTE's for One Year • 5 FTE's for 6 Months	• Mgmt: 25% to 50% • Crew: Continuous Improvement Part of Job
C	• Crew Members • Key Operators • Designers • Manufacturing Engineers • CI Leads	• Crew Members • CI Leads • Engineering • Approval by Mgmt or ME's	• >20 CI leads Had 4 Weeks of Training	• CI Office and Some Leads: 100% • Eng. Tech: 50% • Cell Ldr: 35% • Floor: 2% to 5%

Table 7.15: Diffusion Scores

Case	Adoption Across the Company	Functional Mix	Idea Sources	Level of Effort	Cumulative Score
A1	2	1	2	4	14
A2	3	3	1	3	12
B	4	2	4	2	9
C	1	2	3	1	17

The amount and extent of formal training and the availability of best practices documentation were ranked in a similar fashion and graded very low, low, medium, high, or very high in order to compare these variables with the degree of diffusion. Communication means that fit the training or documentation categories were folded into those areas so they would not be overlooked. The plots relating formal training to diffusion, availability of documentation to diffusion, and documentation to regression can be found in Figures 7.4, 7.5, and 7.6, respectively.

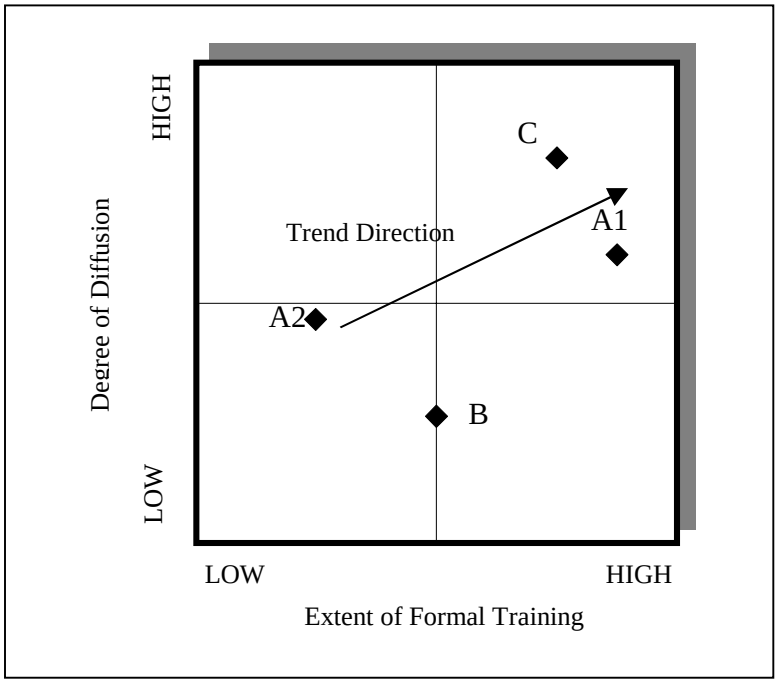

Figure 7.4: Extent of Formal Training vs. Degree of Diffusion

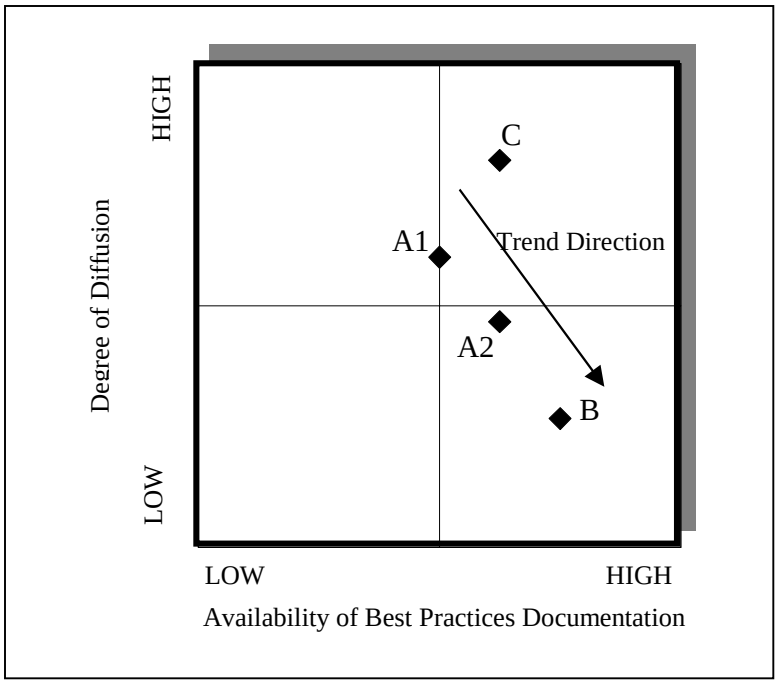

Figure 7.5: Availability of Best Practices Documentation vs. Degree of Diffusion

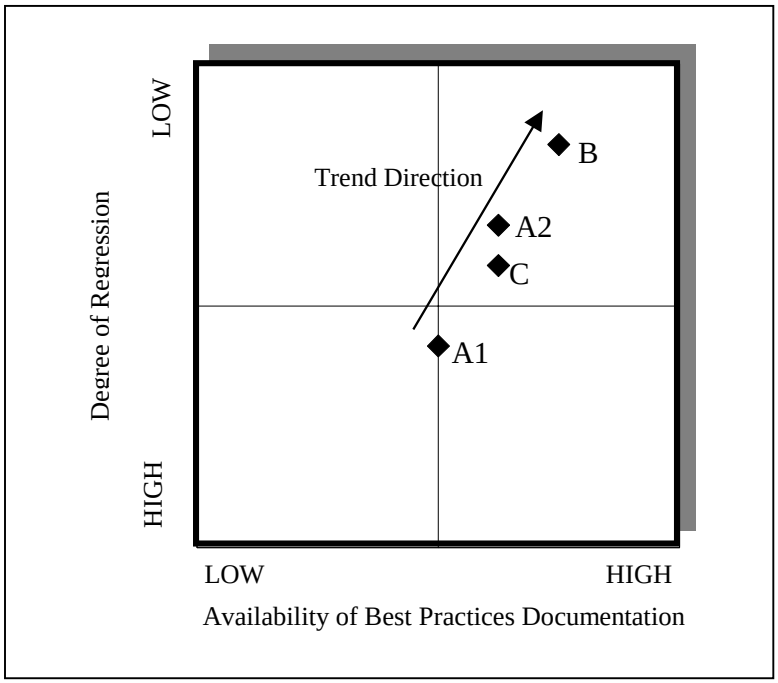

Figure 7.6: Availability of Best Practices Documentation vs. Degree of Regression

The second hypothesis seems to be supported by the trend of the four data points in Figure 7.4. Case A2 was able to achieve a moderate amount of diffusion without formal training for a large part of the workforce. Case B had intensive formal training for the initial team, but utilizes on-the-job training for incoming new hires. They publicize their gains to the plant, but training a larger part of the company workforce is not under their purview. Although the trend seems to go towards the upper right, the data points show a wider dispersion. Cases A1 and C seem to exhibit some similarities not shared by the experiences of cases A2 and B. Cases A1 and C invested a great deal in training, and the training and its planning and coordination were more formalized than in the other two cases. Cases A2 and B used a just-in-time model for their training. In case A2, an implementation team developed the new procedures and then brought in the employees who would be using the specific procedures. In case B, the implementation was a crash course in LEAN for everyone involved.

Hypothesis 3 must be examined in two parts. The first part relates the availability of formal best practices documentation to greater diffusion. The trend of the four points appears to go toward the lower right in Figure 7.5. This would indicate that the availability of formal best practice documentation does not necessarily correspond to greater diffusion of the initiative. The availability of formal documentation does correspond to less regression because the trend in Figure 7.6 goes to the upper right, supporting the hypothesis.

The steep trend in Figure 7.5 bears further examination because all of the cases had a medium to high degree of availability of documentation, but did not experience the same degree of diffusion. The experiences in cases A1 and C seem to support the hypothesis, but those in cases A2 and B do not support it. For instance, case B made formal documentation available for their entire workforce and some crew members create their own notebooks. This information is not used throughout other electrical cells and is particular to their operation. The differences between cases A1 and C, on the one hand, and A2 and B, on the other, may be explained by the more formal environment of the initiative in cases A1 and C. They have company-wide umbrella organizations that can act as visible reminders, clearinghouses, and advertisers of the initiatives and the documentation associated with it. The initiatives in cases A2 and B did not have high enough visibility and people may not have searched or have known to search for the documentation.

7.5 Summary of Key Findings

The information about lower level leadership, workforce training, and the availability of documentation related to improvement initiatives was collected and evaluated in the four case studies above. The relationship between these factors and regression from the initial gains of the initiative and the extent of the diffusion of the initiative was considered. The following relationships were illustrated by the trend of the four data points in each comparison:

- Stronger and more committed leadership for the initiative at lower levels corresponds to lower amounts of regression, supporting H1.

- The greater the percentage of the workforce that has received formal training, the greater the initiative was diffused throughout the organization, supporting H2.

- The availability of formal best practice documentation or documentation about the successes experienced by the organizations using the initiative does not necessarily lead to better diffusion or adoption of the practices, counter to H3.

- The availability of formal best practice documentation or documentation about the successes experienced by the organizations using the initiative does seem to correspond with less regression in the organizations that have implemented the initiative, supporting H3.

The implications for the decisions that corporations must make regarding fostering and nurturing leadership, training the workforce, and providing resources for documentation will be examined in the next chapter. All of these areas of emphasis require decisions by management that influence staffing and funding priorities. Those who make the decision to embark on a large-scale project such as a major change initiative must take these factors into account when trying to obtain the best outcome from the initiative.

8.0 Recommendations for Corporate Policy

During a time of intense global competition between fewer players, and the pressures that ensue from this struggle to maintain and increase market share, companies have chosen initiatives that are designed to increase their efficiency and productivity and place them in a more advantageous competitive position. Finding strategies to diffuse these initiatives more rapidly will enable companies to reap the benefits of the initiatives sooner and for longer periods.

At the beginning of this thesis, I posed four key research questions and corollary questions that pertain to the general question. I will review these questions and attempt to answer them with the data collected and observations made during the four case studies. These key research questions further prompted the hypotheses and I will review the findings and make recommendations for corporate policy that may contribute to the adoption and diffusion of change initiatives. The study has many implications for how companies should promote leadership support for the innovations they chose to implement, how to train and communicate to the workforce, and ways to document and make information about best practices available. The recommended approaches may result in better diffusion of the initiative throughout the organization and a lower likelihood of regression to former practices.

8.1 Introduction and Implementation of Change Initiatives

In the first question, I asked how change initiatives are introduced and implemented. I also asked about the mechanisms by which organizations decide change is necessary and choose a philosophy to follow or emulate. I wanted to determine what functional part of the organization acts as a promoter and how the organization as a whole is structured with regard to its eventual achievement of its stated goals.

In all of these case studies, the change initiative was implemented to counter a crisis situation. In cases B and C, it would have meant the loss of the business and the jobs involved. In cases A1 and A2, the high costs resulting from the baseline processes would have made the division less competitive. The organization in case A1 was an internal supplier and its problems affected all of the programs to which the division contributed. Case A2 dealt with the entire division's inventory, and so also affected every program. From this small sample, it seems that companies tend to feel the need to quickly adopt a change initiative in a specific situation when the survival of the organization is at stake, or when costs balloon so high that the competitive outlook appears bleak.

This would indicate that it might prove difficult to initiate a change program in the absence of a crisis. If a situation short of a crisis also warrants changes because the costs of doing nothing may be only moderately high, the crisis condition in which employees and management may be more likely to accept the possibility of change might not be present. In the absence of a crisis, it may even be more difficult for management to recognize that early changes might be necessary in order to prevent more serious problems later. Management at all levels should actually seek opportunities for change in

less troubled business units and upper management should support reasonable change efforts after weighing the priorities of these suggestions.

In all of the cases, the companies either had an improvement program in place or adopted a company-wide program that an outside supplier or consultant had found successful. The particular initiative that the company would follow was chosen at the very top levels. The companies found adequate information for existing programs and chose from among them based on the positive experiences of their contacts. They did not feel the need to invent entirely new programs. If there are individuals or groups who would like to introduce an extremely innovative or unfamiliar initiative, they would need influence with those at very high levels in order to have their program enacted.

The organizations under study adapted the vocabulary and toolsets of these already established programs to their own particular challenges. They were not the organizations that originally chose a method for the entire company to follow or that introduced a completely new method, but used the improvement mechanisms already recognized by the company executives. In case A1, a major external supplier's positive experience with LEAN catalyzed the organization's choice of LEAN and the company was able to use established instructional materials and adapt them for their use. Company C used Japanese consultants to establish a corporate-wide improvement program. Case study B also utilized LEAN principles and improvement tools that had been widely recognized throughout the company and had been incorporated into training programs. The directorate in case A2 also started with widely understood industry practices, such as min/max, and then improved upon the corporate standard and created their own initiative, Material Flow Optimization, that encapsulated all of the smaller initiatives into one program.

All of the companies in these case studies had umbrella organizations in place to provide facilitators, initial training, coordination, and expertise on improvement programs. These umbrella organizations acted as clearinghouses for ideas and reporting and advertising successes. Company A has the Company A Production System Promotion Office. Case A2 used its own Initiative Integration Office, but MFO was still an enabler for LEAN in other departments. The electrical cell in case study B also called upon the LEAN department for help with its implementation. Company C has a CI Office that supports CI and the CI leads plant-wide, as well as a counterpart CI office at the headquarters level.

These organizations used existing improvement programs already in existence in their companies. Those at the executive levels had already chosen the guiding principles that the company would follow. The organizations that implemented these initiatives were able to be creative within their own organizations during and after the implementation, even if they were not designing their own unique initiatives. The one exception in this study that did create its own initiative was case A2, in which many smaller improvement projects were rolled into their MFO initiative. This initiative was not fully deployed at the time that the case study was conducted and, although their min/max initiative showed success, I cannot conclude how well MFO as a whole would have performed.

This case study was also a business process improvement in supplier management. Since most other mature improvement initiatives have been in manufacturing, those planning the MFO initiative had less historical precedents from which to borrow. This indicates that organizations that are not using the centralized change initiative defined by the company can still create their own organic initiative. They can form their own internal change organization and capitalize on the change environment that already exists in the company due to the more mature manufacturing change initiatives. These smaller change organizations can be effective because they are closer to the people and tasks involved in the implementation of the initiative.

The umbrella organizations in the companies were also key contributors to the initiatives. The respect and authority they command within the company may determine how much direct involvement personnel from these organizations have in the implementations or how much guidance is sought by the implementing organizations. The umbrella organizations were not the focus of this study, but could constitute an interesting follow up for future study. There has been a proliferation of these improvement organizations in many companies and their contributions to the success of change initiative implementations may be important. Some companies have a more monolithic and centralized approach, while others disperse the responsibility for directing and coordinating change activities, even when they have a central office available for guidance.

Central organizations were effective in the mature change settings in manufacturing. They provide clarity of purpose and a standard set of principles and tools from which to start. In business process changes, the absence of a company-wide organization for change was not a hindrance because small organic organizations specific to the business unit can begin to create new initiatives on their own even if they have not seen as many successful precedents. Smaller, decentralized change organizations that act outside or beyond the purview of the central organization can also be helpful for creating programs that meet the specific needs of their organization, rather than trying to artificially apply a standard to their problems just because it is a standard. The value of central organization that provides a change clearinghouse remains, but does not limit the actions of the smaller organizations. In case B, in which the request to enact change was a grass roots effort, a stronger central organization might have been helpful if it had identified this opportunity for upper management in the first place.

8.2 Attaining Senior Management Endorsement and Employee Cooperation

The second set of research questions asks how organizations actually attain senior management endorsement as well as employee cooperation and empowerment. Are the particular people entrusted to implement or promote change placed in influential positions? To what extent are the job security concerns of employees allayed? Does management recognize differences in performance when change initiatives are attempted but not fully incorporated into the organization's culture and when they are truly successful?

This set of questions touches upon a variety of topics that were explored by this study, namely leadership issues, resistance to change among the workforce, and linking success measures to the adoption of the change initiative. The main question deals with the fact that senior management and the rest of the workforce may have different priorities when deciding if a change initiative is in their interests. These interests may never be perfectly compatible. Senior management is responsible for increasing profits and keeping the company on a competitive footing and the productivity improvements introduced by a change initiative can cut costs dramatically and allow savings that can be used to grow the business. Some of the resistance from the workforce may be due to the recognition that much of these cost savings will be due to labor reductions which may affect them directly. The health of the company in general and its ability to provide any jobs at all may depend on cutting costs, including jobs, to keep up with competitors. One interviewee at Company C thought that people should be better educated about world political and economic issues so that they would understand the factors that company management must consider.

One reason for this lack of trust among the workforce may be the nature of LEAN-type initiatives in the first place. In these initiatives there is a great deal of emphasis placed on eliminating waste. Operators may feel threatened because it is usually tasks that they perform that might be labeled as waste in order to improve productivity. If they are the employees that actually produce the product, they may find these efforts disingenuous if similar examinations are not made of the work done by managers. Confounding this issue is that many operational employees may not know or understand what managers do and that as managers move farther up the hierarchy, they may not understand what operators do.

Anxiety about job security may help explain why many resistors tended to be senior employees, although, it should be noted, not all senior employees were resistors. Newer employees were raised, educated, and trained in an environment of constant change and come to their jobs expecting to have to participate in change initiatives that allow the company to adapt to a changing competitive environment. In all of the case studies, management engaged the senior and experienced workers. In case A1, the director communicated with the union early in the implementation about job descriptions and praised and valued work experience during LEAN classes and kaizens. In case C, experienced employees were chosen as CI leads, metric champions, or key operators who validated new procedures. The cell in case B used its experienced and knowledgeable workforce to its advantage because these workers knew how to build the product and, once they could overcome their initial hesitancy, they produced an explosion of new ideas. The directorate in case A2 used subject matter experts to formulate the new procedures.

It is evident from these case studies, that senior, experienced employees are key to the acceptance and implementation of the initiative. I recommend that management proactively seek these experienced employees and utilize them on planning teams and pilot teams that are testing and implementing the initiative. Ideally, there should be a mix

of employees, but an assumption about perceived resistance due to initial hesitancy should not automatically preclude the inclusion of an individual. Those who were non-believers initially may prove to be excellent examples and will help to convince their coworkers by providing more legitimacy.

The strides made in these organizations were significant when measured by cost savings. In some situations where slower production schedules allowed some regression to older, less efficient practices, the interviewees tended to claim that these regressions did not jeopardize the initiative, nor did they significantly reduce the savings that were realized. I did not observe any mechanisms through which higher management could distinguish between lapses in the initiative implementation that might reduce savings or other factors. Management was satisfied if the organization attained or exceeded its performance objectives, regardless of whether the changes were fully enforced. It was certainly recognized that these savings might not have been possible without the change initiative, but the initiative was only a means and its full adoption and institutionalization was not an end in itself.

Those entrusted with implementing the initiatives were sometimes chosen because they were well respected for their competence by both higher authorities and the employees below them. These were not authoritarian figures, but people who were both technically proficient and firm in their beliefs about the improvement capabilities of their organizations and who could create an inclusive and trusting environment in which subordinates could feel comfortable contributing ideas. When upper management chooses leaders to implement critical improvement programs, they not only look for those with proven technical competency, but those who engender trust by consistently applying standards and acting in support of the program so that the beliefs they profess match their actions. The director in case A1 was specifically assigned to this directorate because people at the executive level had confidence in him and thought he had the appropriate combination of skills and manner to tackle the problems in Skin Fabrication. The general manager at Company C could have taken retirement, but he cared about what happened at the plant and stayed and contributed personally to the efforts that reversed the situation, rather than leave the problem for others.

The success of the initiative does not only depend upon the vision and objectives of the highest levels within the hierarchy. The executives must be able to harness the energy and creativity of the managers and supervisors who have more direct influence on the employees who must adopt the change initiative in the manufacturing or business process units. Some of the focus of the preceding case studies was on the perceived champions for the initiatives who provided resources and encouragement to the employees implementing the initiative. In particular, the connection between leadership commitment at the lower levels and less regression was the subject of the first hypothesis I proposed. The trend of the data supported the hypothesis that stated, in part, that if lower level leadership is more committed to the initiative, there will be less regression. The data, plotted in Figure 7.3, compares scores for degree of regression and the concentration of lower level leadership named as champions in the four cases. A high

level champion cannot be effective at implementing an initiative in the absence of supporters among junior management.

8.3 Incentives to Promote Leadership throughout the Organization

When a company chooses to introduce and implement a major change initiative, the initiative usually has the enthusiastic support of at least the head of the company and perhaps a few of the president's, CEO's, or general manager's inner circle of management. In order to implement this initiative down to the operational levels and fully incorporate the principles of the initiative within the processes used by the company, senior management must attain the active support of all levels of management and a large portion of the workforce. Attempts can certainly be made to force the initiative by dictate, but this would only result in a shallow acceptance of the initiative and the appearance on the surface that changes have been implemented. The general workforce, their immediate supervisors, and middle management also must feel that they contribute and that by accepting the initiative they are improving matters for the company and their positions in it.

The case studies indicated that better commitment by lower level leadership was positively correlated with fewer and less severe instances of regression. Enacting measures to create a more irreversible change may be an even stronger defense against regression, but the importance of leadership support should not be underestimated. It would be shortsighted to only take these irreversibility measures because, although it will prevent the regression in a specific situation, it will do nothing to cultivate the leaders who may continue to seek improvements or later diffuse these ideas as they move to different positions.

Many times, talented individuals tend to be promoted and moved throughout the organization, which tends to have a detrimental impact on management continuity. Thus, having depth of leadership where support comes from many directions can help ensure that the initiative survives management turnover and the vagaries of individual personalities. This leadership may be displayed by those in positions such as middle management and supervisors, but also by lead mechanics or other individuals with influence among their co-workers. One recommendation is to determine minimum time-in-grade provisions for positions of lower and middle management to enable these leaders to have real impact before they are moved and the focus is lost. These provisions must be required across the board so that there are no differences in advancement that could hinder careers or make certain positions less desirable.

Rogers[23] makes two points that are particularly relevant to this discussion. One is that non-material ideas are more difficult to diffuse than changes that produce material gains. The other is that, since innovators tend to be viewed as deviants by others in their social system, it is better to seek the acceptance of opinion leaders to assist in the diffusion of an

[23] Supra 7

idea. Innovators may not be the best change agents, but opinion leaders are found in every adopter category.

The connection of these ideas to this study is that many of these change initiatives are trying to diffuse principles and ideas to apply to processes, rather than the adoption of a particular finite system or tangible item. In this way, the change initiatives resemble non-material ideas, even if their implementation is intended to produce material gains for the company through greater productivity and increased profits. The challenge is promoting a change in methods and outlook that translate into material gains. Employees must be given information so that they can recognize how the gains are connected to the initiative. Another recommendation is that in those companies with year-end gain sharing, clear reports accompany the pay showing the percentage that each improvement program has made to this very real benefit.

The analysis in the preceding chapter showed that lower level leadership commitment was positively correlated with less regression to former practices. One part of fighting regression would be to provide consistent leadership at the lower levels. The choice and retention of effective leaders should be a point of management emphasis. In the case studies, a common strategy to reconcile resistors that fell under the area of management emphasis was to tie monetary incentives to the performance objectives. Meeting the performance objectives, in turn, relied on the proper use of the initiative. In situations when monetary incentives were not clearly connected to the accomplishment of the objectives employees may not have understood that the company's and their personal financial gain may have been due in large part to the adoption of the initiative. Upper management needs pay mechanisms to motivate the lower level leadership to fully adopt the initiative and lower level managers need these mechanisms to motivate their subordinates to deploy and maintain changes.

This recommendation involves the common theme sounded about monetary incentives as instrumental in advancing practices the company wishes to be adopted. Companies already have a performance appraisal system for individual performance, compensation and bonus plans, and many ways to measure the financial results of the initiatives. The gains made by organizational units and individual employees who utilize the principles and methods of the initiative should be tied to their performance objectives for all levels of employees. Higher scores on appraisals should in turn result in monetary compensation as merit increases or bonuses, if management is serious about promoting the initiative and ensuring its acceptance and proper use. Employees must see a tangible connection between the implementation of the initiative, the financial health of the company and their job security and material gains. Showing the benefits of the initiative in the concrete manner of pay and awards will deflect the cynicism created by the perception that those in upper management are the main beneficiaries of the improvements and cost reductions and that they are not subject to the negative consequences in the way that general employees may be.

A second recommendation addresses the choice of individuals as champions for the initiative at different levels of leadership. Opinion leaders at many levels should be

nurtured and subject to the performance incentives used to promote the initiative. Support for these leaders would take the form of placing them in influential positions and publicizing the active support they receive from upper management. There must be depth of leadership to counter high management turnover. If the initiative depends upon the personalities and influence of only a few individuals, it will not survive their departure, even if they leave due to promotions resulting from their superior implementation of the initiative. Although generous monetary incentives may make it more attractive for organizational leaders to stay in their positions longer, leaders below the organization's direct managers should also be nurtured. The time-in-grade provisions discussed above would act to slow management turnover.

Employees at the operational level are more likely to respond to leaders closer in the hierarchy to their own positions. Since their acceptance is crucial to the institutionalization of the initiative, the lower level leaders with whom they make the most contact must not be ignored. Although innovative people are required to generate ideas and cultivate unconventional methods, the initiative cannot diffuse without the help of opinion leaders who have the respect and trust of their fellow workers.

It is sometimes difficult to reduce the savings realized from these initiatives by using some savings to provide financial incentives, but it may be in the long-term interest of retaining the institutional learning and momentum. In case B, for instance, many of the initial implementers left for a different department because the other jobs were rated at a higher labor grade. Perhaps more would have stayed if their jobs in the current electrical cell had been upgraded. It is difficult to decide to deploy savings towards human resource development rather than adding these savings in their entirety to the bottom line. Another recommendation is for management to predetermine a percentage of the actual savings that they will agree to invest in human resources in the organization.

8.4 Training the Workforce to Enable Diffusion

This study also enabled the comparison of different approaches to training the workforce about the initiative. The spectrum ran from trying to include almost every employee in formal training to using a small core to define the new processes and providing specific training to the rest of the workforce only when they would need to start using the new procedures. The issue of training and deploying the new practices is also important because the training usually requires large investments of time and resources and removing people from production for a period of time.

Although the trend of the case studies showed a positive correlation between the extent of formal training in the initiative and a higher degree of diffusion, the individual cases showed mixed results. The two cases that invested a great deal in training a large part of the workforce about general principles and specific applications of the initiatives, cases A1 and C, also showed the greatest degree of diffusion. Cases A2 and B used a just-in-time model for their training. In case A2, an implementation team developed the new procedures and then brought in the employees who would be using the specific procedures. In case B, the implementation was a crash course in LEAN for everyone

involved. The emphasis was to extinguish the local fire first and to worry about diffusion throughout the company later. In case A2, they were implementing a brand new initiative without the example of previous experiences in that business practice as models. The desired diffusion would be in the gains realized from new practices, not a diffusion of the changed procedures themselves.

When companies attempt to train the vast majority of the workforce, the curricula tend to be more formalized in order for most workers to gain both general information necessary to understand the initiative and knowledge about the specific tools needed to practice the initiative. In some cases, where the deployment is more centralized, it is not necessary for every employee to receive classes in every tool if they have no foreseeable application for this tool. If employees receive training related to initiatives in measured doses, they will exhibit less weariness and cynicism created by the perception that they must learn about a program that may appear very similar to previous initiatives.

The recommendation for training combines the best features of the approaches used in the case studies. All employees should be trained in the fundamental principles and methods of the initiative, but training in specific tools and procedures should be reserved until needed by the individuals who are to be taught. A well-trained workforce is necessary for employees to become rational decision-makers by understanding the basic tenets of the initiative. Unnecessary instruction in the minutiae of the initiative may bore those who may never use the tools and may contribute to the sense of weariness that can be caused by introducing initiatives in various guises that appear to be the same thing under different names. It may only be perceived as more bureaucracy and less as a helpful instrument for improvement.

The employees should also be provided with some overview of how this initiative fits into the evolution of improvement programs they have already experienced at the company and why this one might be different or better suited to achieve company goals. Employees who are grounded in the basics of the initiative's principles can participate in kaizens and similar activities and use their skills, experience, and common sense to improve the processes they know well. This is also supported by Rogers[24] in his recommendation that change agents concentrate their efforts on promoting the competence of those in the social system, rather than promoting a specific or tangible innovation. This will enable potential adopters to better evaluate any innovation they encounter and eventually change the norms of the social system. It will go beyond the short-term victory of gaining acceptance for a particular innovation and create the general conditions needed for acceptance of good new ideas.

8.5 Barriers to Complete and Lasting Change in Large, Complex Organizations

This set of research questions asks about the nature of misunderstandings between the professed long-term goals of upper management and the perception by operational members of the organization. Is communication enough to seal the breach? How do

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organizations deploy resource savings from change efforts? If change is considered beneficial in the current environment, why is it sometimes so difficult for large organizations, which have been successful at their endeavors in the past, to change even in their best interests?

The stated goals of upper management when they decide to adopt a change initiative is usually to cut costs and increase profits, make the company more competitive, and develop capabilities that allow the company to be more nimble in a changing market environment. Employees may understand the business imperatives of the change, but what they may experience personally are job cuts, merging more tasks into one job description, or lowering the skills required to do particular jobs through automation or repetition. It is no wonder that it is difficult to engender the trust needed to align these interests. Most interviewees in the case studies had little insight into where savings are redeployed other than thinking that they were added back into the bottom line of the programs. If some is reinvested back into enlarging the capabilities of organizations, it is not widely known. Furthermore, the reinvestments referred to in the interviews tended to be capital investments, not in human resources. In case study B, the cell was able to add two lines to their original four, and there were numerous examples of equipment purchases in cases A1 and C. In case C, the gain-sharing program that provided year-end bonuses due to savings was directly due to improvements made using the change initiative, but employees were not always consciously aware of the connection.

The perceptions about the effectiveness of communications are also widely different. In some cases, those in management or in lead implementation positions thought that the initiative was well communicated and understood. This perception was not always shared by those at the operational level. This may be due to the greater and deeper understanding that people have for programs in which they are heavily involved on a daily basis. They may forget that these issues are not high on the agenda of others. In case A2, although MFO had not been fully deployed, some interviewees were confused about what sub-initiatives were considered part of the overall initiative. In case C, for instance, operators did not always receive feedback from engineering about the status of their ideas. The most common explanation given for this disconnect between the amount of feedback provided and what employees thought was necessary was lack of time.

There are many diverse interests to satisfy in large, complex companies. These interests are not only different but have varying amounts of influence on the course of events. One way to view the overall direction of the company with regard to its complete adoption of the initiative is for executives to ask whether the reward system, compensation practices, and communications means are aligned with the stated objectives for performance improvements. The view of the entire company was beyond the scope of this study. Most organizations have shining examples of their successes with change initiatives, but may still struggle to adopt these practices uniformly across the entire enterprise. Perhaps if these victories occurred in parallel, the successes of the higher achieving sub-organizations can be diffused simultaneously and reinforce each other. This requires not only simultaneous initiative implementations, but also equivalent and consistent emphasis placed on all of these implementations. Juggling numerous

initiatives may be a challenge, but employees should be informed from the start that not all improvements can be exceptional. They may be more accepting because the expectations will be high, but not unreasonable and they are less apt to suffer disappointment and become demoralized.

8.6 Communicating and Documenting Best Practices and Successes

The workforce can also be engaged through the formal documentation and intelligent communication of the successes of the initiative and proven methods to achieve them. The interviewees involved in this study were proud of the many accomplishments they achieved, even when they were not publicized. Occasionally, the importance of documentation was overlooked or the documentation that existed was underutilized. In some situations, employees did not receive feedback when their ideas were not implemented. A lack of time was the usual reason for these oversights. Of the many duties that are required of those in leadership, feedback and documentation may have been given less emphasis. The justifications for not using an idea may have been very reasonable, but uninformed employees may have thought that their contributions did not warrant recognition.

The data in the preceding chapter showed that better availability of best practices documentation was positively correlated with less regression. The availability of documentation did not seem to increase diffusion of the initiative in the organizations studied. Taking measures to prevent regression in the first place will allow managers to concentrate on diffusion issues without having to do constant battle with regressive tendencies.

I would also suggest that training, communications, and documentation are intersecting mechanisms for diffusion. Many companies make large investments in training, but perhaps these areas should be better balanced. If an uneven share of resources was spent on communications at the expense of training and documentation, there would be less content to communicate. Similarly, if training was not documented and the results were not communicated, the benefits of the training might end as soon as the class was completed.

The last recommendation would be to provide incentives or imperatives within job descriptions for more successes to be documented and broadcast. Companies have had some success with small awards programs that enable employees to share the gains from their ideas. Supervisors and managers should be encouraged by the incentives linked to their own appraisals to highlight the contributions of others in this way so that the norm would be idea creation, not jealousy of a rare individual who was compensated. This will go a long way toward repairing goodwill and gaining the trust of participants. Management should recognize the need for the time to document and promote the achievements that have been made. This recognition should be made tangible by supporting the documentation efforts in performance objectives and the incentives tied to the performance. Other sub-organizations can benefit from these lessons and, through

their participation, the originating organization may eventually benefit themselves from the experiences of others.

8.7 In Organizations with a History of Change Initiatives, What Mechanisms to Maintain Momentum are Evident?

Are the change initiatives self-reinforcing? Are limiting factors that counteract initial advances recognized? Are fundamental or only symptomatic causes in the system identified and addressed? How is the evolution through multiple change initiatives or programs characterized?

All of the interviewees were asked how the initiative stood at the current time and if they saw it evolving. Some with a higher-level understanding of the strategy could answer this question more specifically. One way to learn whether these initiatives have become self-reinforcing would be a future study of multiple years of objectives and how they have changed over time during the life of the change initiative.

Through experience with these change initiatives, these companies have learned to identify both the fundamental and symptomatic causes for resistance to diffusion. Removing these barriers, however, has been better accomplished in smaller sub-organizations. The most recalcitrant resistors are generally removed or silenced. Waste in individual processes is identified and improvement actions are taken. Employees are generally free to ask the question, "Is this the smart way of doing this?" or "How can we improve this method?" Most of the problems described as low-hanging fruit have been examined and resolved. Since the lifetime of these initiatives is years, management has an opportunity to capitalize on these successes and create the environment in which it will be completely engrained before moving to a succeeding stage when new initiatives may be introduced. If the initiative has proven successful in one part of a company the seeds should be planted early for it to generate improvements throughout. Introducing new initiatives before the current one has taken root risks alienating the workforce as they are forced to shift gears and start supporting what they may view as a new flavor-of-the month. One idea for further study would address the last question about the extent to which the evolution through multiple change initiatives or programs may be influenced more by the experiences and agendas of those in management or by particularities in the company history.

8.8 Summary of Recommendations and Ideas for Further Research

The recommendations for corporate policy makers were based upon the data gathered in four case studies. The major areas of interest were leadership, training, and communications and their connection to less regression and greater diffusion. The recommendations are as follows:

Leadership and Incentives
These recommendations address the retention and positioning of leaders throughout the organization and the incentives necessary for stimulating the adoption of the initiative.

- Use minimum time-in-grade provisions for positions of lower and middle management to enable these leaders to have real impact before they are moved and the focus is lost. Apply the provisions across the board so that there are no differences in advancement that could hinder careers or make certain positions less desirable.

- The gains made by organizational units and individual employees who utilize the principles and methods of the initiative should be tied to their performance objectives. Higher scores on appraisals should in turn result in monetary compensation as merit increases and bonuses. Employees must see a tangible connection between the implementation of the initiative, the financial health of the company and their job security and material gains.

- Opinion leaders at many levels should be nurtured and subject to the performance incentives used to promote the initiative. Support for these leaders would take the form of placing them in influential positions and publicizing the active support they receive from upper management. There must be depth of leadership to counter high management turnover. Employees at the operational level are more likely to respond to leaders closer in the hierarchy to their own positions.

Training the Workforce
The data supported hypothesis 2 which maintained that training a larger part of the workforce led to employees having a greater ability to integrate, diffuse, and initiate change. The following recommendation balances the need for training and the costs involved in achieving it.

- All employees should be trained in the fundamental principles and methods of the initiative, but training in specific tools and procedures should be reserved until needed by the individuals who are to be taught. Unnecessary instruction in the minutiae of the initiative may bore those who may never use the tools and may contribute to the sense of weariness that can be caused by introducing initiatives in various guises that appear to be the same thing under different names.

Communications and Documentation
Wide availability of documentation about the initiative and its practices helped to prevent regression. In addition, effective communications played an important role in enabling employees to see the correlation between initiative successes and personal and professional benefits.

- In those companies with year-end gain sharing, accompany the pay with clear reports showing the percentage that each improvement program has made to the benefit.

- Provide incentives or imperatives within job descriptions for more successes to be documented and broadcast. Supervisors and managers should be encouraged by the incentives linked to their own appraisals to highlight the contributions of others in this way so that the norm would be idea creation, not jealousy of a rare individual who was compensated.

Management Policies and Organizational Structure
These recommendations deal with choices of management emphasis and organizational models that could help foster trust and assist in smoother implementations.

- Management at all levels should proactively seek opportunities for change even in less troubled business units, and upper management should support reasonable change efforts after weighing the priorities of these suggestions.

- Smaller, organic change offices in sub-organizations can be used where there are less mature change histories from which to build models. These organizations are effective because they are closer to the people and tasks involved in the implementation of the initiative. They can complement the central change organization and can capitalize on the change environment that already exists in the company due to the more mature manufacturing change initiatives.

- Management should proactively seek experienced employees to assign to planning teams and pilot teams that are testing and implementing the initiative. An assumption about perceived resistance due to initial hesitancy should not automatically preclude the inclusion of an individual because non-believers can help to convince their coworkers and provide legitimacy.

- Management should predetermine a percentage of the actual savings and apply it to investments in human resources in the organization.

This study also highlighted many ideas for further study that were outside the scope of this research.

- Examine how companies capitalize on localized successes to deploy the initiatives across the entire organization. Are the reward and compensation systems and the communications means really aligned with the stated objectives for performance improvements?

- How is the evolution through multiple change initiatives or programs characterized in companies with long histories of change initiatives? How does prior experience with initiatives affect the choice of new initiatives? To what extent is the evolution through multiple change initiatives or programs influenced by the experiences and agendas of those in management or by particularities in the company history.

These recommendations are based on data showing the interaction between performance incentives and lessening resistance and the roles played by leadership, training,

documentation, and communications in diffusing the adoption of change initiatives and their associated ideas. In addition to the challenges of producing highly technical and complex products in a competitive global marketplace, aerospace companies must also contend with the same cultural and social barriers encountered by any large organization. More complete and simultaneous deployment of the compounded learning that organizations have already experienced would allow companies to make better use of the lifespan of a change initiative and the enthusiasm displayed towards the initiative.

APPENDIX

Change Management Questionnaire
(for research use during interviews)

1. In what part of the organization do you work?

2. What is your supervisory level? To whom do you report? Who reports to you?

3. In what change initiatives have you been involved directly within the last five years?

4. What functional group within the company was the umbrella organization for the above change initiative(s)?

5. Who was the high-level champion for the change initiative who might have provided funding or other support for the initiative?

6. Where did the specific idea(s) for the change originate? (Which person, functional area, and/or department?)

7. Were the persons who originated the idea(s) sufficiently knowledgeable about the process they were attempting to change?

8. Did you experience any direct affects to your job from these change initiatives? Did this include new training, a new job description, or process or procedure changes?

9. Was the process change your primary function during that time period? What percentage of your time was devoted to the change initiative?

10. How many man-hours or different functions were involved in the change process?

11. Over how long a period of time did the change process occur?

12. How were major change initiatives communicated to employees? (frequency, scope)

13. Were there any cost savings attributed to the changes? How were they documented?

14. What level of the corporation determined where cost savings would be redirected?

15. How were those cost savings used? (lay-offs, outsourcing, reinvestment in new capital equipment or training)

16. Was there any resistance to the change initiative or process change? By whom? How severe?

17. Did this resistance jeopardize the whole initiative? If the initiative went through, what steps were taken to reconcile or convince the resistors?

18. Is the changed process still in place? Has it continued to change in any way? Please describe.

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