

Acknowledgements

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Executive Summary

This field project paper titled, *Lean Enterprise Transformation (LET) in a Job Shop Environment* involves planning, teaching others, implementing and continuously improving organizational performance. The project case study is being delivered to a company headquartered in Paola, Kansas that has contracted with the not-for profit organization Mid-America Manufacturing Technology Center (MAMTC) to provide Lean Enterprise Transformation (LET) training, facilitating, coaching, implementation, and “hands-on” consulting services. The company, Taylor Forge Engineered Systems (TFES), Inc. designs and delivers very high quality engineer-to-order and make-to-order forgings, pipe fittings, and accessories for a variety of industries including gas, oil, and petrochemical. Lean Enterprise Transformation (LET) consulting services are being delivered to three TFES, Inc. Facilities located in Paola, Garnett, and Greeley, Kansas.

A preliminary LET Operations and Business Systems Assessment was conducted during June-July, 2005, by MAMTC Project Manager/Field Engineers. A 3rd party sub-contractor Integrated Manufacturing Solutions (IMS), Inc. coordinated the assessment of the Information Systems and Network Architecture portion of the overall LET Business and Operations Systems Assessment. Also, the overall project scope, timeline, deliverables, and completion process will be defined in greater detail within the body of this LET Field Project Paper and Work Plan and the defined “Triple Constraints.” At MAMTC, the project “Triple Constraints” focuses on the well defined project scope of work (SOW) that indicates the timeframe, project costs, and customer quality project performance specifications (PMBOK Guide 3rd Edition, 2004).

The two key senior executive leaders at TFES, Inc supporting the LET Project Work Plan & Timeline are the President and Vice President/General Manager. Both people have graciously allowed MAMTC to jointly document the TFES LET Project planning, training and “hands on”

implementation efforts throughout the duration of the Continuous Improvement Journey. Other key TFES personnel involved in the LET Project Core Leadership Team include: the Material and Production Inventory Control Manager at Paola, Kansas Facility, the Operations Manager for the Garnett & Greeley, Kansas Facilities, and the Plant Manager at the Paola, Kansas Facility, along with the many other TFES production and support personnel that made this field project a reality.

The overall purpose of this EMGT Masters Field Project Paper is to research, learn and share the experiences of developing and implementing this “real world” LET Job Shop Case Study. Also, sharing the trials, tribulations, successes, and lessons learned with all TFES and MAMTC employees involved in the LET Project Training & Implementation efforts, and other interested readers. Currently, the Core Leadership Team is in the process of creating a TFES, Inc. Lean Newsletter to share this Continuous Improvement Journey with others in both organizations. Both EMGT 823 textbooks: (a) Kerzner’s *Project Management 9th Edition*⁴ and (b) the *PMBOK Guide 3rd Edition* are utilized heavily in creating the template and structure, and for monitoring, and controlling this joint TFES and MAMTC LET Project Work Plan. The timeline for the joint MAMTC and TFES LET Field Project Work Plan and Job Shop Case Study has been subdivided and revised as follows: (1) Initial LET & Business System Assessment Project Scope of Work (SOW) from the June to July 2005 timeframe. (2) Overall LET Project SOW for the original contract has been lengthened from the October 2005 to the March 2007 timeframe.

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Chapter 1: Introduction

Lean Enterprise Transformation in a Job Shop Environment is the author's quest for integrating work experiences, with continuous learning and improving how to offer premier consulting products and services to customers. For the remainder of the Field Project Paper, TFES, Inc. for confidentiality purposes will be described as "the Job Shop" and MAMTC will be described as "the Partner." First, a brief description of the "Lean Enterprise Transformation in a Job Shop Environment" including definitions, project scope of work (SOW), and the purpose-why it was done. Also, the principle objectives of this University of Kansas Masters of Science in Engineering Management (MSEM) field project work are to: (1) Satisfy the EMGT 835 Field Project requirements for graduation with a MSEM degree. (2) Contribute and add to the *Body of Knowledge* at both KU Scholar Works, and the international Lean Enterprise Transformation (LET) community and implementation efforts in the thousands of small and medium manufacturing (SMM's) organizations.

Lean Enterprise will be defined by this author as, "an organizational leadership commitment, culture and environment that strives to continually improve performance through teamwork, and open minded thinking that focuses on short and long-term process and system improvements in all aspects of the company." In other words, a "Lean Enterprise Culture" describes a corporate culture; all the traditions, practices and language that are characteristic of an organization, and differentiate them from another type of organization. The *Lean Enterprise* includes all office and production areas of a company.

Transformation is defined in the *American Heritage 4th Edition Dictionary* as, "a marked change, as in appearance or character, usually for the better." The Japanese refer to *Kaikaku* as

long-term “radical change” as opposed to *Kaizen* which means “incremental short-term” improvements.

Job Shop is defined in *Lean Manufacturing for the Small Shop* as, “any operation not in the business of long run, proprietary, consistent, one-of-a-kind products.” Small job shops engineer and make-to-order most of the products and services that are produced for customers.

Environment is defined in the *American Heritage 4th Edition Dictionary* as, “the complex of social and cultural conditions affecting the nature of individuals, communities or organizations.”

Therefore, **Lean Enterprise Transformation (LET) in a Job Shop Environment** translates into the short-and long-term leadership commitment, to continuously improve organizational performance excellence, and the cultural conditions supporting the smaller customized engineer and make-to-order companies. The LET environment encompasses all production, operations and support functions of an organization.

The Initial Lean Enterprise Transformation (LET) and Business System Assessment Project Scope of Work (SOW) and the Partner Contract were delivered during the Summer of 2005. Please reference Appendix 3: The Job Shop LET & Business System Assessment and Partner Initial Project Scope of Work (SOW) Proposal & Contract, for additional details related to this specific project. The initial project SOW and time duration for the Job Shop LET & Business System Assessment was two weeks. The three primary Partner and 3rd Party Provider project deliverables for the assessment phase were the following documents: (a) Business System Assessment, (b) Network/Hardware Assessment, and (c) Lean Enterprise Assessment.

The Partner personnel provided the primary project manager roles and responsibilities, for all three of the initial project assessment categories listed above. In addition the Partner, sub-contracted with other third party providers for the majority of (b) the Information System and

Network/Hardware/Software Assessment portion of the overall Business Systems and Operations Assessment Project SOW. From the assessment results, the Overall LET Project SOW, cost estimates, and timeline were developed, signed and became the contract between the Job Shop and the Partner.

The actual longer-term project scopes of work developed from the initial assessment project were subdivided into two categories: (1) The Job Shop and Partner Project Contract titled, “Lean Enterprise Transformation (LET) Training & Implementation Consulting Services.” (2) A separate contract titled, “IMS Project for Research & Selection of Enterprise Resource Planning and Information System Upgrade Consulting Services,” with services provided by the outside 3rd parties already were identified. The overall planning, training, and delivery of this separate project scope of work (SOW) is being coordinated with the joint Job Shop and Partner LET Leadership Core Team and project management efforts.

1.1 Significance and History: The Overall Project Scope of Work Statement, Requirements and Expected Outcomes: (5.2.3.1, *PMBOK Guide*). The overall Job Shop and Partner jointly developed Project SOW for creating an improved teamwork environment and organizational culture is summarized as follows:

- (1) The general LET Project SOW Plan has been aligned with the customer’s strategic organizational objectives and desired outcomes. The overall planning and execution will be summarized in the “LET Executive Project Management Work Plan” shown above.
- (2) The LET Leadership Core Team defined, analyzed and implemented several Continuous Improvement (CI) suggestions; from the initial LET Project Information System & Network Architecture and Overall Business System Organizational Assessment Plan Findings and Recommendations.

- (3) The LET Project SOW assumptions and triple constraints that could potentially impact the overall project (a) scope, (b) time schedule, and (c) overall costs have been summarized.
- (4) The LET Leadership Core Team researched and created the detailed overall LET Project Work Breakdown Structure (WBS) Timeline and Implementation Plan.
- (5) Baseline Key Performance Measures (KPM's) were created for the new LET organizational structure and defined LET Project Work Plan deliverables to be gathered, monitored, and updated for Continuous Improvement (CI), monthly, quarterly, and as the project progresses in future years.
- (6) The LET Leadership Core Team planned and scheduled LET Project Review & Planning Meetings, and then analyzed baseline and Continuous Improvement KPM results in alignment with the LET Work Plan deliverables related to the contractual "Triple Constraints for the LET Project (a) scope of work, (b) time schedule, and (c) overall costs.
- (7) The LET Leadership Core Team refined and updated the LET Project Work Plans, strategies, and objectives per the Scope Verification and Change Control Process. Both the Job Shop and Partner LET Project Team Leaders and Members have agreed to continuously improve the organizational performance and excellence, by measuring and encouraging teamwork for accomplishing the new TFES KPM's.

The remainder of this paper focuses on the research, learning, and implementation experiences related to the work-related "hands-on" LET and Continuous Improvement Journey. The next section of this EMGT Field Project Paper is titled, *Chapter 2: Literature Review and Analysis Summary*. The author has condensed the entire research and literature review to provide the readers with some of the highlights of the complete research process over several months.

Chapter 2: Literature Review and Analysis Summary

The primary purpose of this section is to summarize the main points and supporting lessons learned from research in the “Complete Literature Review and Analysis” section that builds the foundation for the “Concepts, Methods, and Techniques” section that follows. The entire list of books, websites and articles used as research, reference and bibliography for the “Complete Literature Review and Analysis” is included in “Appendix 1.” First, the research books and commentary are listed in alphabetical order by author. Secondly, the journal and magazine articles are reviewed and organized with comments. Also, a complete book, article, websites bibliography and references are listed in the “References/Bibliography” section.

The primary lessons learned and discovered during the “Literature Review and Analysis Summary” include: (1) Small-and-Medium Sized Job Shops will utilize the LET Tools and Processes differently than larger corporations. (2) Custom Manufacturers are driven by actual engineer and make to customer order requirements, not forecasts. (3) Much more research has been done on larger high-volume and low-variety repetitive production related to Lean Manufacturing and Lean Enterprise concepts and topics, than on smaller job shop low-volume and high-variety environments. (4) Statistically, the Small Business Administration (SBA) data shows that over 99% of all manufacturing businesses employ less than 500 people. These companies are categorized as small-and-medium sized manufacturers (SMM’s). (5) A hybrid LET approach is required for both Job Shop and SMM’s environments. Many of the original LET Concepts, Methods and Techniques were developed for original equipment manufacturers (OEM). Smaller job shop environments require greater creativity and flexibility when training and applying the LET Concepts, Methods, and Techniques.

(6) A summary of two books and three articles is shown here as a sample of the extensive research done by the author during the Summer and Fall of 2006.

Bozonne, Vincent, *Speed to Market: Lean Manufacturing for Job Shops 2nd Edition*, (American Management Association, 2002).

An excellent book that compares and contrasts “Lean Enterprise Transformation” in a smaller job shop versus larger mass production environment. The author segregates the material into three distinct parts: (1) Part 1 reviews the following topic titles- Leapfrogging Lean, Process Thinking, Cutting Lead Time in Sales, Estimating and Pre-Production Areas, The Shop Floor, Continuous Improvement, and Implementation. (2) Part 2 reviews the following topic titles- When Scheduling is Out of Control, Hockey Stick Blues, The Thorny Issue of Job Shop Overhead, The Big Picture Perspective-Four Scenarios and What Business are You Really In? (3) Finally, in Part 3, Bozzone shares the “Tools of the Trade.”

In Part 1 titled *Speed to Market*, the author introduces the reader to what it takes during a small job shop Lean Enterprise Transformation to gain competitive advantages, and improve profitability. The author compares and contrasts how performance improvement and profitability in smaller job shops boils down reducing customer lead times, to improve profitability, and generate additional business with a variety of customers. Small job shops by design are much more creative and agile manufacturing entities than the larger multi-state or multi-country original equipment manufacturers (OEM’s). Furthermore, the author explores how smaller job shops can research positioning their companies to maximize potential opportunities with specific customers, in targeted market niches. Finally, the smaller job shops are often suppliers to the larger OEM’s. Therefore, SMM’s must learn to customize LET Concepts,

Methods, and Techniques to their business environments to meet the needs of their larger OEM customers in a timely manner.

Part 2 titled *Solution Strategies for Common Job Shop Problems* focuses on many of the key issues that prevent smaller job shops from meeting their business goals and objectives. The discussion of static versus dynamic planning and scheduling is a very real daily struggle for many smaller job shops. Also, the author adds some humor by introducing the term “*hockey stick*” to the small job shop jargon. The author’s definition of “*hockey stick*” is, a reoccurring monthly pattern found in many job shops “in which a great effort is expended during the last week of the month to ship as much as possible to make the numbers.” From personal experience, this phenomenon is not exclusive to small job shops. Many larger OEM’s experience the same end of the month, quarter, and year push to “make the numbers.” Also, the traditional cost accounting versus modern Lean Accounting Principles is briefly reviewed. Traditional overhead absorption and allocation methods need to be replaced by either customer usage charges based on frequency or dollar volumes of business for each customer.

In Part 3 titled *Tools of the Trade*, the author concludes by sharing some experiences, checklists, and lessons learned in Appendices A and B. Appendix “A” contains a questionnaire titled *Is This Your Shop?* A small job shop owner or general manager could use this questionnaire and the “Item Analysis” section to conduct an initial LET Self-Assessment of their business. Appendix “B” provides a *Detailed View of a Job Shop Business Process*. An example overall job shop flowchart is provided in Figure B-1 demonstrating a typical flow pattern through both the office and production work areas. Overall, *Speed to Market* is an excellent resource provided by the author Vincent Bozonne to assist small job shop owners in their LET and Continuous Improvement Journey.

Conner, Gary, *Lean Manufacturing for the Small Shop*, (Society of Manufacturing Engineers 2001).

Initially, the author compares and contrasts the similarities and differences between applying Lean in a small job shop environment versus larger manufacturers like Toyota or Ford Motor Companies. Conner addresses two major issues in this book: (1) All people must think about time all the time using a “Lean Management” approach. (2) *Lean Manufacturing for the Small Shop* is way overdue. The majority of the materials developed until about the last five years related to the Toyota Production System (TPS), Lean Manufacturing, Total Quality Management (TQM), Six Sigma, and many other Employee Involvement (EI) or Continuous Improvement Process (CIP). These philosophies have been created for and by people working for very large Original Equipment Manufacturers (OEM’s) like Toyota, Ford, Harley-Davidson, General Electric, and Motorola, which does not address over 99 percent of all manufacturing businesses in America employing less than 500 people (Reference Table 1-1 on page 2).

Also, Conner defines a small *job shop* as, “any operation not in the business of long run, proprietary, consistent, one-of-a-kind products.” The author of this field project would expand on that definition by adding that the majority of the small-and-medium sized job shops produce primarily to engineer and make-to-order contractual firm agreements with their customers. Furthermore, these smaller type job shops deal with high-variety and low-volume production requirements from numerous customers. Therefore, trying to force a large OEM type TPS or Lean Initiative down the throats of small and medium sized job shop suppliers just doesn’t work! A smaller job shop environment may require more of a hybrid approach for implementing lean. The utilization of both the Value Stream Mapping and Product-Quantity-Routing (PQR)

Analysis will help smaller job shops determine which of the Lean Tools & Techniques will work best in their work environment.

Furthermore, the author does an excellent job of exploring how to use many of the traditional Lean Tools & Techniques in the smaller and medium sized job shop environments. These Lean Tools and Concepts include: Value Stream Mapping (VSM), 5S & Visual Workplace, Product-Quantity-Routing (PQR) Analysis, Batch Size Reduction, Lead Time Reduction, Quality-at-the-Source, Setup Reduction, Standard Work, Jidoka (Autonomation), Poka Yoke (Mistake Proofing), Pull/Kanban Systems, and Kaizens or Continuous Improvement Events. A variety of examples and case studies from various small job shop type companies are used to relate these Lean Tools and Concepts to actual “hands on” applications.

Conner relates many of these Lean Concepts and Tools to “real world” application experiences in small and medium manufacturing (SMM) job shop type environments. For example, using effective story telling with Stan (SMM Owner) and Jan (Lean Guru) the author details how the employees of the fictional Jobbe Shoppe learn and apply the Lean Concepts and Tools. The employees learned that through training and application setup times could be reduced to where almost any shop order with a setup time of less than 10 minutes would be insignificant from an “old fashioned” economic order quantity (EOQ) perspective.

In conclusion, Conner demonstrates the majority of Lean Concepts and Tools can be effectively applied in a small to medium sized job shop environment. In Chapter 8 titled, *Managing Change*, the author challenges us to think deeper by exploring five critical “People Needs”: vision, skills, incentive, resources, and an action plan. In very simple terms, the author explains the “soft skills” and true Employee Involvement (EI) required for effective transition to a Lean Enterprise Job Shop Environment! Many of these “soft skills” are shared by the

Wisconsin Manufacturing Extension Partnership (WMEP) in their *Lean Culture* training and implementation efforts targeted at small, medium, and large organizations in the state of Wisconsin. WMEP is the equivalent of the Mid-America Manufacturing Technology Center (MAMTC) not-for profit organization in the State of Kansas.

Jones, Malcolm, *Three Perspectives on Lean*, (Superfactory, September 2006).

This article discusses three different perspectives related to the seminal work titled, *The Machine That Changed the World*, by James Womack and Daniel Jones in 1990, referring to the initial “Lean Americanization” of the Toyota Production System (TPS). The first perspective discusses how the book was initially based primarily in academic research and focused mainly on high-volume, low-variety, and repetitive manufacturing in the Original Equipment Manufacturers (OEM’s). The original Big Three automotive manufacturers were General Motors, Ford, and Chrysler. The initial debate was the founders of the Toyota Production System like Shigeo Shingo, Taichi Ohno, Sakichi and Kiichiro Toyoda focused primarily on waste elimination and non-stock production. The debate between Malcolm Jones the author of this article and the disciples of James Womack and Daniel Jones – *Lean Thinking* focuses on theory versus actual application of the “Lean Principles and Concepts.” The practical application versus the theoretical aspects of “Lean Enterprise Transformation” continues to rage around the world both on university campuses, think tanks, corporate boardrooms, and in production and service operations.

The second key perspective explored was the theory of demand amplification otherwise known as Systems Dynamic Research. This theory was originally documented in Professor Takahiro Fujimoto’s book titled, *The Evolution of a Manufacturing System at Toyota*. In this

original work, Professor Fujimoto identifies three key characteristics required in the Toyota Production System: (1) reliable standard methods, (2) reliable standard problem solving techniques, and (3) willingness to experiment in the true spirit of Kaizen (Continuous Improvement). These early views and discussions between Professor Fujimoto and others led to many world-wide companies becoming exposed to the benefits of “Lean Enterprise Transformation” regardless of organizational size.

The third perspective discussed was the concept of *Jidoka* that roughly translates from Japanese to English meaning “autonomation.” Autonomation is defined as, “transferring human intelligence to automated machinery or equipment to detect the production of a single defective part and immediately stopping the process while asking for help.” From a “value engineering” viewpoint the design purpose of autonomation is to eliminate the operator waiting waste of watching a machine rather than performing “value-added” work.

In conclusion, the concept of *jidoka* encourages interaction between people and equipment, and stresses a healthy “Respect for People” when redesigning processes or equipment. The integration of people, process and equipment cannot be over-emphasized. The concept of autonomation strives to allow a well-trained operator to run multiple machines. However, in high-variety and low volume situations in job shop environments, the time and effort required to achieve autonomation may be cost prohibitive. Therefore, this is just another example of how more advanced lean concepts like *Jidoka* must be customized for each company and situation. Smaller job shops must analyze their business, customers, markets, and suppliers and determine the custom LET and Continuous Improvement Concepts, Methods, and Techniques that work best for their company culture and business environment.

Tonkin, Lea A.P., *Northrop Grumman Newport News: Reaching Out to Suppliers*, (AME Target Magazine, Volume 22, Number 1, 2006), pages 51-56.

The author starts this article by explaining how the Northrop Grumman Newport News shipyard began planning the improvement of their supply chain. The main concept was to create “win-win” partnership relationships with small, medium, and large suppliers to the shipyards. Northrop Grumman initiated this process through a partnership created with the Virginia Philpott Manufacturing Extension Partnership (VPMEP). The VPMEP along with Old Dominion University had already provided initial Lean Overview training for over 7,500+ of about 25,000 employees of the Northrop Grumman Newport News shipyards utilizing a “Basic Lean Principles for the Job Shop” curriculum with simulation exercises. The Job Shop, a smaller supplier of Newport News have trained about 200 employees through October 2006, utilizing the same *Lean Principles for the Job Shop* training and simulation materials.

Furthermore, Tonkin outlines the more in-depth training and application required of both Newport News shipyard and the various sized supplier company employees progressing on their Lean Enterprise Transformation (LET) Journey. Also, part of the “Lean Culture” change involves more of a Value Stream focus as opposed to the old traditional departmental work center batch n’ queue focus. A Lean Qualification Evaluation Team (LQET) was jointly created between Newport News customers, suppliers, and employees to reach consensus on the required qualification criteria. A Value Stream Qualification Process was designed and insured all stakeholders agreed on the process flow and qualification criteria.

Finally, the author reviews the “Lessons Learned and Continuous Improvement Initiatives” that will be needed to strengthen the partnership between Northrop Grumman Newport News, the VPMEP, Suppliers, and Customers. Four key “Lessons Learned” were:

(1) It is essential to have strategic and standard criteria for the supplier selection process. (2) Need to communicate “What’s in it for me? (WIIFM)” to suppliers. (3) Suppliers need to have a broad range of lean knowledge. (4) Agility, as defined at Northrop Grumman is “the positive impact of reducing lead time and inventories while improving on-time delivery and quality,” is the key measure of success. Agile suppliers will need to learn and apply the lean principles and techniques to satisfy customers’ requirements, and deliver quality products and services, within the on-time delivery contract specifications.

Weeks, Brian, *Continuous Improvement Tools for Custom Manufacturers*, (WMEP Manufacturing Matters! Newsletter, Summer 2006).

The article provides several case study examples of how the Wisconsin Manufacturing Extension Partnership (WMEP) provides “value-added” Lean Enterprise and Continuous Improvement training and “hands-on” consulting services to small-and-medium sized low-volume and high-variety “job shop” type manufacturers. The principal Continuous Improvement Tools discussed in this article included: Data Collection, Capacity Planning, Supermarket/Pull Systems, 5S/Visual Management, Process Matrix, and Value Stream Mapping (VSM). In many smaller companies, resource constraints can include a lack of money, time, and skilled people to support a Lean Enterprise Transformation (LET) initiative. Therefore, these smaller companies oftentimes rely heavily on non-profit Manufacturing Extension Partnerships (MEP’s) like WMEP to provide training, knowledge sharing, coaching, and facilitating support.

The WMEP Manufacturing Specialists describe in detail not only the “Lean Concepts and Techniques”, but the dramatic benefits possible through effective cross-training and application of the tools defined above. For example, positive economic impact benefits shared from a

particular custom manufacturer, Sani-Matic located in Madison, Wisconsin included the following: (1) A 75 % Reduction in Work-in-Process (WIP) inventory costs; (2) 40 % Reduction in overall product lead times; (3) 40 % Reduction in labor costs; and (4) \$300,000 variety of cost savings. The proof is “Lean for Job Shops” does work and produces tangible economic benefits for those companies willing to challenge the status quo! Finally, at the “Lean Enterprise” organizational level greater cooperation and collaboration between sales, engineering, purchasing, manufacturing, and financial/accounting personnel can increase overall corporate performance excellence when training and implementation occurs, in a more “team-oriented” work environment.

Chapter 3: Field Project and Case Study Concepts, Methods and Techniques

Chapter 3 describes the concepts, methods, and techniques used for gathering relevant information and research data. Both secondary and primary research sources were utilized in developing this LET Field Project and Case Study Paper. The concepts, methods and techniques used in this field project and case study paper are focused more on small and medium sized manufacturers (SMM's). Research indicates some of the following facts related to SMM's: (1) SMM's are defined as companies with 500 or less employees. (2) SMM's provide 40 % of the total value of United States production; (3) SMM's consist of 8 million employees or 60 % of all U.S. manufacturing employment; and (4) 62,000 exporters with many more SMM's supplying other exporters. Also, these LET concepts, methods and techniques are customized to reflect the high-variety and low-volume job shop globally competitive environment faced by the Job Shop (Murphy, Engler and Jasinowski 2006).

The majority of the Job Shop business continues to be engineer-and-make-to-order per specific customer requirements. However, the energy industries like oil and gas have provided additional sales and production opportunities due to increased global demand, for the highly specialized heavy industrial pipes, fittings, accessories, and field installation services provided by the Job Shop. Therefore, the increased actual customer demand has led to the continued commitment by the owners and upper managers, to the LET Journey and implementation of a new Enterprise Resource Planning (ERP) hardware and software information system named Profit Key. Successful training, implementation and integration of both the LET and ERP Systems is very important to the future long-term strategic business objectives at the Job Shop. Therefore, the communication channels between the LET and ERP Systems Core Leadership Teams have been maintained to develop synergies and integration plans between the groups.

Every SMM's and job shop type organization is different in the start and progression of the long-term Lean Enterprise Transformation (LET) and Continuous Improvement Journey. However, each company and industry finds there is a sequence of general steps that seem to yield the best results when formulating the organization's overall LET Work Plan. The biggest challenge for the Job Shop is finding the right combination of external "change agents" and internal corporate champions to cultivate change and create the team-environment necessary to encourage significant organizational changes. *Building a Lean Culture 2nd Edition* developed by the Wisconsin Manufacturing Extension Partnership (WMEP) provides some valuable insight into how extensive the culture and change management principles are to the LET Continuous Improvement Process (CIP). Several research studies indicate that building a Lean Enterprise is about 20 % Technical and 80 % Cultural. (James Vatalaro, Productivity, Inc. and WMEP, 2002). Lean Culture will be listed as a topic for additional future research in Chapter 5 titled, "Future Research Recommendations."

For example, an effective method utilized by many types of smaller manufacturers and job shops focuses on how to reduce lead time to increase customer sales, and improve profitability. An analysis of the following job shop "Quotes to Cash" Conversion Process effectively illustrates how the "Seven Ways of Cutting Lead Time Improves Performance and Profitability," (Delta Dynamics 2005 Website Link). In essence, many small job shop type companies bid and ship orders quicker than the competition, and are rewarded with increased sales, a premium price for faster service, and improved cash flow. The smaller job shop environment produces value for customers, employees, and suppliers by trading productive time for dollars. Time is a very precious resource for SMM's in particular. These organizations are limited greatly by the "Triple Constraints" of Project Scope, Time and Cost. High quality project work is delivered to customers per

requirements of scope, cost and on-time delivery negotiated in the contract, (PMBOK Guide 3rd Edition, 2004).

Initially, the majority of a small-to-medium sized job shop company's employees must be trained and exposed to the basic principles of Lean. The *Lean Principles for the Job Shop* materials have been utilized for training about 200 employees at the Job Shop from October, 2005 to October, 2006. Also in early October 2005, the Job Shop's Vice President/General Manager and President of the Job Shop provided an initial Lean Overview and explanation of how these efforts are linked to the company's future vision and strategic business objectives. All employees at the Job Shop were provided with a basic understanding of how Lean Principles apply to their low-volume and high-variability globally competitive business environment. The goal is to have all 221 of the Job Shop's employees trained in the *Lean Principles for the Job Shop*, by December 31, 2006.

The next primary focus of the Job Shop's Lean Enterprise Transformation is Value Stream Mapping (VSM) which, through the action plan that is developed, can create dramatic changes quickly. Value Stream Mapping (VSM) is a logical first step in the Lean Enterprise journey, after a Lean Overview has been given to all employees, and begins in the first phase of the timeline shown below in, Table 1: LET General Phased Project Timeline. VSM is a superb tool for identifying, prioritizing and planning the projects and training that follows the basic Lean Overview training. At the Job Shop, VSM started on the manufacturing floor with the "Header Line" and then moved these principles and improvement tools into several front office areas.

The VSM Method consists of five primary elements: (1) Develop Product or Service Family Matrix, (2) Create Current State VSM as a Baseline, (3) Brainstorm Kaizens or Continuous

Improvement Events, (4) Design Future State VSM, and (5) Develop Future State Action Plan and Timeline. Effective VSM efforts provide a variety of Kaizens or Continuous Improvements that need to be prioritized, and resources planned to support the evolution from the Current to Future State VSM Action Plan & Timeline. Many small companies struggle to allocate resources, time, and money to facilitate the necessary improvements. In *Creating Mixed Model Value Streams*, author Kevin J. Duggan has created an important resource for SMM's creating VSM Current and Future State Maps, by mixed model product and service families. Also, Duggan's book analyzes the very real challenges faced by SMM's in dealing with high-variety product mixes, low-volume production quantities, shared resources, and information flows. (Duggan, 2002)

At the Job Shop, the VSM Current State indicates what other LET Concepts, Methods and Techniques are appropriate and necessary, for planning and implementing the prioritized Kaizens or Continuous Improvements. Initially, the Job Shop's "Header Line" at the Paola, Kansas Facility was chosen as the major product family for creating a VSM Current State Map.

As a result of the Job Shop "Header Line" Current State VSM efforts several potential Kaizen/Continuous Improvement Events were identified and have either been completed, or in-process or are behind schedule. Please reference Appendix 2: The Job Shop's LET Project Work Plan & Timeline for the latest progress and updates. The joint Job Shop and Partner LET Project Leadership Team has identified and prioritized two Office Area service families for the next VSM Training & Kaizen Sessions: (1) Request for Proposal Inquiry Phase and (2) Project Execution Phase 1 Process. The initial LET Concepts, Methods, and Techniques used to continuously improve the "Header Line" were 5S/Visual Workplace, Cellular/Flow Principles, Quick Changeover/Setup Reduction and Total Productive Maintenance (TPM).

Many small job shops start with the following LET Concepts and Methods: 5S/Visual Systems, Set-up Reduction, and possibly Cellular/Flow Work Areas, or Total Productive Maintenance (TPM) targeted to support the specific product or service family identified. However, the choice of which specific Lean Concepts, Methods, and Techniques to utilize depends greatly on each individual SMM. Job Shop environments require much greater creativity and flexibility than larger high-volume and low-variety repetitive manufacturing enterprises. As previously discussed, a combination of utilizing the VSM process and information flow improvement priorities, and the periodic use of the *Lean Assessment for Job Shops and Small Manufacturers* will provide very good base line and Continuous Improvement information. The Job Shop can utilize this information to measure progress toward both strategic and annual performance excellence goals and objectives.

A brief explanation of each element of a 5S/Visual Systems includes: (1) Sort for Organization, (2) Set-in-Order for Orderliness, (3) Shine for Cleanliness, (4) Standardize-properly maintain the Sort, Set-in-Order, and Shine activities, and (5) Sustain to maintain the good habits established during the first 4S's. The *5 Pillars of the Visual Workplace* were first conceived by Just-in-Time (JIT) expert Hiroyuki Hirano, In this seminal work, Hirano explains how the basics of the 5 Pillars System provides the foundation for fostering efficiency, maintenance, and continuous improvements throughout any organization, (Hirano, 1995). Also, as shown in the updated Appendix 2: TFES LET Project Work Plan & Timeline, a total of 30 General Housekeeping and 5S System Training & Pilot Work Area Kaizens have been initiated, over the past 11-12 months in both the Job Shop Kansas facilities production and office support work areas.

Visual Workplace Systems are defined and summarized as methods that are, “self-ordering, self-explaining, self-regulating, and self-improving for the work environment.” (Galsworth 2005). Visual Workplace methods and procedures should be flexible depending upon the type of job shop environment and implementation. Furthermore, visual techniques can be very common sense, simple and yet very creative to serve customers needs and employees improvement requirements. Visual communication in any size workplace makes vital information available and understandable at a glance, for all employees, customers, and suppliers. Visual Workplaces communicate effectively using a variety of visual techniques such as: *Kanban, Jidoka, Andon, and CEDAC*.

Brief explanations of each of these four Visual Workplace techniques are: (1) *Kanban* is a replenishment system utilizes either a card, space, or some other visual indicator. *Kanbans* are utilized between the Supplier, Production, and the Customer to streamline process and information flows. (2) *Jidoka* or Autonomation means “automation with a human touch.” *Jidoka* is an advanced LET technique that depends upon automated devices with human ingenuity, to obtain responses when equipment or systems are not operating properly. (3) *Andon* is defined as, a visual system that alerts people of problems in a process or piece of equipment. *Andon* is integrated with many of the other Lean Concepts and Methods including, but not limited to Total Productive Maintenance (TPM), Setup Reduction, and Standard Work. (4) *CEDAC* stands for “Cause-and-Effect Diagram with the Addition of Cards.” *CEDAC* was invented by Ryuji Fukada and the explanation of continual problem solving method was first described in the 1983 issue of *Managerial Engineering*. *CEDAC* is a multi-functional method utilized in many types of team brainstorming and problem solving activities yet today (Greif 1991).

Cellular/Flow Design Methods are intermediate LET techniques that build upon the 5S/Visual Workplace basics and provide the foundation for long-term Continuous Improvements.

Cellular and Flow Principles seek to streamline and create the best arrangement of people, equipment, materials, and methods to support actual customer demand for a mix of high-variety and low-volume products produced in small-and-medium sized job shops. Also, a Cellular Work Area promotes the “one-piece flow” concept and encourages the transformation to more of a team-oriented work force. One-Piece Flow is considered the state that exists when products or services move through sequential processes either one unit or one order at a time depending upon the actual customer’s *takt time* or demand rate. Properly designed Cellular Flow Work Areas give companies improved flexibility to meet and exceed customers’ orders for high-variety and low-volume production. Therefore, Cellular and Flow Concepts are well suited for the SMM’s job shop environment (Productivity Press, Inc. 1999).

Setup Reduction or Quick Changeover Methods are very important for SMM’s and job shops trying to satisfy multiple customers, in supplying a very high-variety of engineer and make-to-order products and services. The Single-Minute Exchange of Dies (SMED) methodology was originally created by Toyota’s Shigeo Shingo about 1983 as *A Revolution in Manufacturing: The SMED System*. Also, the 4-Step Changeover Improvement Process follows a similar continuous improvement cycle and improvement strategy like the Plan-Do-Check-Act (PDCA) method. The SMED System demonstrates how companies can meet customer needs in a timely manner, with less waste, by making products and services more cost effectively, and in smaller quantities or batch sizes. (Productivity Press, Inc. 1996).

Total Productive Maintenance (TPM) strives to increase overall equipment effectiveness (OEE), by focusing on minimizing the “six big losses”: (1) Equipment Breakdowns, (2) Setup Losses, (3) Minor Stoppages, (4) Reduced Speed, (5) Defects and Rework, and (6) Startup and Yield Losses-(TPM for Every Operator Productivity Press 1996). Maintenance activities for

operators and technicians are defined, scheduled, and planned on a regular basis to maintain and sustain critical pieces of equipment, in each job shop environment. The sphere of change must then be steadily widened to include the entire organization. Once the change is permanently in place within the business, begin looking up and downstream along the customer and supply chains. TPM is seen as a world-class manufacturing technique for optimizing the OEE of critical pieces of manufacturing equipment. (Productivity Press, Inc. 1996).

The Job Shop's LET Continuous Improvement Journey is starting the second year of planning, training and implementation activities. Basically, the majority of the Job Shop's employees have participated and been trained in either a LET Overview or the *Lean Principles for the Job Shop* all-day training and simulation exercises session. Therefore, the Job Shop is starting to realize some of the tangible and intangible LET economic impact benefits. Also, the LET Leadership Core Leadership Team members are analyzing and planning how to improve data collection and sharing of information related to the Key Performance Measures (KPM's). The majority of the data collection activities will be coordinating with the new ERP System implementation efforts. The ability to quantify and cost justify future LET Continuous Improvement initiatives will depend on the Core Team's skills and abilities selling the tangible economic benefits and any other intangible benefits to the Job Shop's owners and upper executives.

For example, the current KPM's being discussed at the Job Shop are Earned Hours, Throughput, On-Time Delivery, Quality and Safety measures. Each of these KPM's has to be base lined and properly aligned with the Job Shop's long-term strategic business plans and objectives. Factual historical data is available for the majority of these current KPM's but needs to be validated. However, future leading indicators may more accurately reflect the LET

and ERP System improvements. Validation criteria should be established for the combination of historical data and new KPM's being monitored and analyzed. A great deal of time has been spent between the Partner and Job Shop Core Team Leaders gathering base line data, analyzing and evaluating what KPM's will be properly aligned with the organization's long-term future strategic goals and objectives.

Hoshin Kanri or Policy Deployment is the LET equivalent of strategic planning. The Job Shop definitely needs to consider making this activity a priority for 2007 and beyond. The practice of *Hoshin Kanri or Policy Deployment* enables top SMM owners and upper executives to bridge the gap between corporate goals and company-wide deployment efforts. *Hoshin Kanri* consists of three main elements: (1) The alignment of all departmental or value stream, and individual project goals with corporate goals to eliminate duplication of efforts. (2) Effectively communicate roles and responsibilities to all organizational employees. (3) Utilize a "Balanced Scorecard" approach to closely monitor performance excellence using carefully designed KPM's (Akao 2004).

The LET Journey is on-going and never really ends if properly applied to the organizational culture and work environment. Therefore, the organizational leaders need to stay the course and maintain and sustain a long-term commitment and focus to LET and Continuous Improvement Plans. The *Lean Assessment for Job Shops and Small Manufacturers* would be an effective method for base lining and measuring the Job Shop's LET progress and Continuous Improvement efforts. The Job Shop Lean Core Team Leaders need to review and discuss using this Lean Assessment for evaluating progress and performance excellence efforts.

When leading a Lean Enterprise Transformation process, system, and organizational Continuous Improvement efforts, a longer period of time needs to be planned for training and implementation. Often, people in the organization need to be taught and absorb the importance of

all the various value added vs. non value-added activities that need to be identified, analyzed, baselined, and continuously improved. Typically, a significant period of experimentation by mid-level managers must occur before *Lean Thinking and Lean Culture* becomes automatic and a way-of-life in the transformed organization. Once this has happened, the Partner Lean Enterprise Transformation (LET) “change agent” can be most effective in leading, teaching, coaching and mentoring the Job Shop Leaders and Employees on their Continuous Improvement Journey.

The LET organization environmental and cultural changes require long-term leadership commitment and persistent support. In fact, as stated in Norman Bodek’s new book titled *Kaikaku: The Power and Magic of Lean*, “a great and radical transformation in organizational thinking, awareness, knowledge transfer, and fundamental changes in corporate policies, processes, actual business systems and practices” needs to occur (Bodek 2004). The Japanese word Kaikaku means long-term “radical change,” and challenges organizational leaders and managers to definitely change their way of thinking and doing business. The Lean Enterprise Transformation (LET) Journey never ends and requires on-going positive changes in thinking and behaving, to lead, maintain and sustain a long-term Continuous Improvement (CI) mentality and drive overall performance excellence growth.

The Job Shop and Partner LET Leaders will need to continually cultivate and encourage the desired lean thinking and behavior to truly realize all the benefits of evolving to a new “Lean Culture & Environment!” *Hoshin Planning or Policy Deployment* should be used during the Phase Four: Building Momentum stage of the LET Journey. Please reference Figure 4-1 on page 67 of *The Hitchhiker’s Guide to Lean* (Flinchbaugh and Carlino 2006) related to the 5 Phases of the Lean Transformation Roadmap for additional insight related to all five phases and the common elements (education, application, communication, and infrastructure) required during

each phase of the LET Journey. Many Job Shops vary by how long they spend during each of the 5 Phases of their Lean Enterprise Transformation (LET) and Continuous Improvement Journey. However, the lines can become blurred between the various phases during the LET Project planning, training, and implementation activities.

In general, the Table 1: LET General Phased Project Timeline illustrates the typical basic four phases, steps and approximate timeframe involved in planning and implementing a Lean Enterprise Transformation (LET), in a small job shop environment. An organization or business can progress more rapidly sometimes, if a “change agent” helps lead the transition during the initial two phases, continue cultivating internal champions, and has had previous LET training and implementation experience. However, the majority of successful LET training and implementation projects require joint commitment, leadership, and strong participation by both company and consultant employees. As time progresses, the Job Shop’s leaders and employees should become more involved in leading, maintaining and sustaining the LET and Continuous Improvement Journey, and the consultant’s role should diminish in both project scope and frequency of service support.

Table 1: LET General Phased Project Timeline.		
Phase No. & Broad Description	Broad Description of General Phase Steps	General Time Frame
1. Start the Lean Journey (Both Training & Implementation.)	A. Find external “Change Agent” or “Sensei” to lead and teach the organization at the start of the LET Journey! B. Start educating organization C. Identify burning platform D. Map “Value Streams” by product family E. Pick “Pilot Work Areas” for initial Training & Implementation efforts! F. Expand the Lean Scope of Work into more areas within the organization.	Six Months to 1 Year.
2. Create New Organizational Culture & Work Environment	G. Reorganize by “Product or Service Families.” H. Identify internal “Lean Champion (s)” and external “Lean Coaches and/or Change Agents!” I. Develop future growth strategies J. Convert/remove ‘CAVE’ people. (Note: Means <u>C</u>itizens <u>A</u>gainst <u>V</u>irtually <u>E</u>verything!) K. Instill a culture and new ways of thinking supportive of a “Continuous Improvement” work environment.	Six months to Three Years
3. Change Business Systems & Performance Plans.	L. Introduce “Lean Accounting” principles. M. Begin Pay-for-Performance Plans. N. Display simple “Visual Workplace” scoreboards. O. Expand “Lean Training & Implementation” efforts throughout the entire organization. P. Localize and specialize your tools and equipment	Three to Five Years
4. Continue the Lean Journey	Q. Continue teaching and applying “Lean Enterprise Principles” to your supply and customer chains. R. Develop global organizational strategy for long-term “Continuous Improvement” Plans!	Fifth Year & Beyond (Never Ends).
Source: The Partner’s LET Project Plan Outline.		

The following “Five Leadership Moves for Lean” will be necessary for successful LET and Continuous Improvement to occur at the Job Shop in the future, as documented on page 42 of *The Hitchhiker’s Guide to Lean* (Flinchbaugh and Carlino 2006):

1. Leaders must be Teachers.
2. Build Tension not Stress.
3. Eliminate Fear and Comfort.
4. Lead by Visible Participation not Proclamation.
5. Build Lean into Personal Practice.

Overall, Lean Leadership at all organizational levels is very important. The majority of people look to the corporate leaders to provide the vision and direction for traveling along the Lean Enterprise and Continuous Improvement Highway. However, without a general map and guidelines, many companies and employees become lost along the way of the Lean Enterprise Transformation Journey! Therefore, Lean Leaders must remain committed and persistent in the face of the negative “CAVE” people.

Remember that CAVE means Citizens Against Virtually Everything, and during the current Job Shop LET Project many of the “old-school” cave men and women have refused to change regardless of the Lean Enterprise and Continuous Improvement plans, logic and verifiable tangible and intangible benefits shown them. Thousands of global companies and millions of people have experienced numerous LET benefits, in the past 50+ years saving their companies billions of dollars, and providing real “value-added” activities, on-time delivery improvements, and increased satisfaction for their thousands of world-wide customers!

Chapter 4: Field Project Results and Continuous Improvement Ideas

The Job Shop has experienced the following estimated LET Economic Impact Benefits base upon the team efforts of all the Job Shop and Partner employees during the first year efforts from October 2005 to October 2006 utilizing a rolling 12 months average. The Job Shop LET Results will be summarized utilizing the five Key Performance Measures (KPM's) identified earlier in Chapter 3 as, Earned Hours, Throughput, On-Time Delivery, Quality and Safety company-wide measures. (1) The ratio of Earned Hours/Total Hours has improved from 59 % to 61 %. (2) The Throughput has increased by 33 % from 4 to 6 headers per day on average; (3) On-Time Delivery has improved from 77 % to 85 %. (4) Quality Performance improvements are estimated at 15 %; and (5) Safety incidents have been reduced by 10 %. based on OSHA record able and lost time data.

Long-term both Appendices 4 and 5 will be utilized for measuring the Continuous Improvements of the five KPM's listed above. The Partner organization uses the Economic Impact Assessment (EIA) for satisfying customer, state, and federal funding shareholders reporting requirements. In addition, the National Institute of Standards and Technology (NIST) Manufacturing Extension Partnership (MEP) federal funding partner requires additional reporting not found in the EIA customer survey. The EIA survey is completed with the Job Shop contact typically within 30 days after the project is completed. The NIST MEP's Minimally Accepted Impact Measures (MAIM) company survey is conducted 12 to 18 months after multiple projects have been completed with a Job Shop customer. The Partner's employees utilize the feedback from both the EIA and MAIM for two main purposes:

- (1) Meet the federal and state funding partners' reporting requirements; and
- (2) Gather feedback and continuously improve performance excellence for the customers.

In addition, a total of 206 of 227 Job Shop employees have been trained in the *Lean Principles for the Job Shop*. The remaining 19 employees will be trained by December 31, 2006. Overall workplace organization and cleanliness within both the production and office areas has been greatly improved in the past year. The combination of *5S System and Visual Workplace* training and implementation activities has made a huge impact on the organization of the workplace. The Job Shop employees have conducted over 30 Kaizen/Continuous Improvement activities over the past year. Lean Concepts, Methods, and Techniques implemented include: *Value Stream Mapping, 5S/Visual, Point-of-Use Storage (POUS), Quality-at-the-Source, Total Productive Maintenance (TPM), and Setup Reduction*. As all Job Shop employees train each other and improve the utilization of these and other Lean Concepts and Tools, the tangible and intangible benefits will continue growing in frequency and level of economic impacts. Overall, the level of employee involvement has improved drastically, and the best is yet to come.

Continuous Improvement Recommendations by the Partner to the Job Shop leaders of the LET Core Team have been numerous over the past year. Several are summarized: (1) Greater involvement by all levels of owners and executive management. The goal is to prevent recurrence of the “flavor-of-the-month” program that occurred with previous Continuous Improvement Process (CIP) training and implementation initiative approximately 10 years ago. (2) Spend two to three times the amount of time applying the Lean Concepts, Methods or Techniques taught to the Job Shop employees. The Job Shop work environment tends to focus on meeting customer orders, delivery dates, and at times neglects balancing and planning for long-term LET and Continuous Improvements, and falls back into the “fire fighting” crisis management mode. (3) Improve communication and effectiveness of team meetings, by insisting on an Agenda, Time Limits, and Action Items list. The Job Shop office environment has fallen into the trap of way too many

meetings. The meetings become lengthy, lack purpose and focus without the key items listed above. (4) Finally, the last major recommendation made here would be to finish what has been started. For instance, the Job Shop Appendix 2: LET Project Work Plan illustrates that many activities or smaller projects are started but falter and remain incomplete. The Job Shop Core Team Leaders must provide focus, direction and help prioritize the Kaizen/Continuous Improvement activities. An effective problem solving method would be helpful for resolving open issues during team meetings. Two potential problems solving methods are briefly discussed in the next paragraph.

The familiar quality and process improvement best practice initially created by Walter Shewhart's Plan-Do-Check-Act (PDCA) Cycle methodology, and popularized by W. Edwards Deming in Japan after World War II should be utilized in the development, analysis, base lining, and measuring Continuous Improvements, for the LET project activities. The PDCA method has been successfully used by many small, medium and large companies for team problem solving. Shewhart originally developed the PDCA Method while working at Bell Laboratories, Inc. in New York. Also known as, the *Shewhart Cycle* and it grew in popularity under the advocacy of Dr. W. Edwards Deming (Shewhart 1939).

The Job Shop could provide structure and help resolve many outstanding LET Kaizen/Continuous Improvement activities by training and utilizing the PDCA Method. LET Team meetings with structured agendas could utilize the PDCA Method for following up on the many Kaizens/Continuous Improvements identified and prioritized on each VSM Future State Map. A structured timeline and follow-up like Appendix 2: LET Project Work Plan would help the Job Shop maintain discipline and sustain the LET improvements realized the first year.

Another possible Continuous Improvement idea would be the application of the Joiner 7-Step Method for team problem solving and project management of the Job Shop LET. The 7 Steps of the Joiner Project Method are listed here from the *Team Handbook 2nd Edition*, and consist of the following systematic and disciplined framework for progressing through a project. (Scholtes, Joiner, Streibel 2001).

1. Define the Project Purpose and Scope of Work (SOW).
2. Identify the Current State Project Situation.
3. Root Cause Analysis of the Current State Project Situation.
4. Identify Alternative & Choose Best Solution (s) using PDCA Improvement Cycle.
5. Evaluate the Project Solution(s).
6. Standardize the Improved Project Solution(s).
7. Develop Future Plans for the Project Continuous Improvement Process (CIP).

The utilization of the Joiner 7-Step Method would be documented throughout the duration of the Job Shop and Partner LET Project. LET Leadership Core Team and Project Review meetings will continue to occur on a bi-weekly basis until the projected completion of the current TFES LET Project Work Plans by the end of March 2007.

In conclusion, the Job Shop leaders and employees need to plan, schedule, and complete the open Kaizens/Continuous Improvements utilizing a method like the LET Project Work Plan and Timeline. A focused effort by all Job Shop and Partner leaders and employees will need to be maintained and sustained, to realize the long-term benefits of the LET Continuous Improvement Journey. The bi-weekly LET Project Review and Leadership Core Team Meetings will continue

to be very important for maintaining focus and sustaining the momentum of the first year of LET training and implementation. Also, effective communication beyond these progress meetings will be critical for increasing the base of Job Shop employees actively involved, in the LET efforts.

Another example of the Job Shop Continuous Improvement efforts which could be used is the “Business Systems Review” method documented on pages 187-191, in Appendix C of the *Speed to Market Book* (Bozzone 2002). The Business Systems Review advocates greater Employee Involvement using a five-step approach for implementing Continuous Improvements. The “brown paper” method has been successfully applied and implemented by the Partner organization while assisting many other companies with LET training and implementation. This improvement procedure involves a roll of brown wrapping paper on a long wall, and then taping all forms used to run the Job Shop’s business onto the brown paper. After documenting all major business process steps, each step is reviewed and analyzed for Continuous Improvements. These problems or improvements are written either on Post-It Notes or directly onto the brown paper. Next, the performance expectations must be identified (both quantitative and qualitative). The final step involves the planning and implementation of all prioritized improvements.

In conclusion, the important long-term Job Shop 5 KPM’s: Earned Hours, Throughput, On-Time Delivery, Quality and Safety should be monitored weekly and results summarized monthly, quarterly, and annually. Then, first year base lined KPM’s could be analyzed and LET Continuous Improvement progress compared for future annual improvement trends. All Job Shop employees will focus their efforts in the direction of the Key Performance Measurements. Therefore, the Job Shop Core Leadership Team must be diligent about identifying, tracking, and continuously improving the company’s performance rewards and recognition based upon these 5 KPM’s. The Job Shop Leaders must always remember that a company gets the results that are measured.

Chapter 5: Future Research Recommendations

One particular area of additional research for future authors is *Lean Culture*. The Wisconsin Manufacturing Extension Partnership's (WMEP's) staff has invested over six years developing products and services supporting the integration of *Lean Culture* with the many other concepts, methods, and techniques involved in a Lean Enterprise Transformation (LET). From the actual case study experience between the Job Shop and the Partner, a lot of hard work still remains to truly change the organizational environment and culture to maintain and sustain the Continuous Improvements and Economic Impact Benefits realized during the first year of the LET training and implementation. *Creating a Lean Culture: Tools to Sustain Lean Conversions* explores the fact that old or new “work-related habits are just as difficult to change as personal habits.” (Mann 2005).

Transformational change requires a vision about the new organizational culture. Visions are about changing “What is” to “What can be” and inspire employees to pursue the cultural transformation. “Culture is to the organization as character is to the individual,” says Edgar H. Schein, the author of *Organizational Culture and Leadership 3rd Edition* (Schein 2004, page 212). Therefore, this author cannot overemphasize the importance of additional research related to *Lean Culture* being very important, especially for the future success of the many small-and-medium manufacturers (SMM's) that have limited resources to support LET Continuous Improvements. An overall “Lean Management System” perspective will be necessary to truly take LET training and implementation to the next level.

In fact, *Lean Management Systems* would be an excellent research topic for future graduate students. *Inside the Mind of Toyota: Management Principles for Enduring Growth*, authored by Satoshi Hino is a very good starting point for future researchers to explore in greater

depth the effective change to a “Lean Management System.” Toyota has found that “big company disease” is a by product of growth as an organization that can stifle creativity and flexibility as a bureaucracy is created to manage the increased size of the organization. Organizational flattening and restructuring is an essential Continuous Improvement Process (CIP) that is extremely necessary to revitalize any company during a major LET initiative. Therefore, small-and-medium sized manufacturers need to be wary of the bureaucratization and symptoms of declining employee morale that can occur if an organization grows too fast without a Lean Culture or Organizational Change Transformation Plan. Greater research into the long-term economic impact and benefits of a “Lean Management System” would be very valuable for future SMM’s and engineer and make-to-order job shops.

Teamwork or Team Building concepts will be an integral part of the LET and Continuous Improvements. In the E-zine Article titled, *Teamwork in the Workplace: a Definition* author Chris Stowell’s research summarizes three primary conditions required to attain higher levels of team performance: (1) Resources and Commitment; (2) Ownership and Heart; and (3) Learning. Teamwork within a workplace requires a great deal of patience, care and long-term commitment to fully realize tangible and intangible benefits of a LET and Continuous Improvement Journey. Cross functional teams of production and office support people will be required for greater Employee Involvement, effective use of team-problem solving methods, and sustainment of the initial benefits of any LET training and implementation plan. *Lean Culture* and teamwork are very natural partners. Therefore, a great deal of future additional research and exploration related to these topics will continue being very important for future generations of Lean Thinkers and Practitioners.

Lean Leadership will be another important area of research for future students, teachers, and authors. William Lareau's book titled, *Lean Leadership: From Chaos, to Carrots, to Commitment*, stresses that corporate leadership must provide a long-term strategic focus and direction for LET to be fully realized in any size organization. Job shops tend towards "command-and-control" type traditional leadership styles. Effective *Lean Leadership* requires long-term commitment and engagement from all organizational leaders. "Lip service" by leaders will not provide the necessary support to maintain and sustain a LET culture and environment. Therefore, today's Lean Leaders must focus on training and empowering employees to succeed and gain recognition for their efforts. Lack of long-term leadership commitment has been cited as one of the main reasons that many LET initiatives fail. As a result, the topic of *Lean Leadership* and future additional research will be critical to additional SMM's having greater LET success. The future leadership challenge emphasizes fully engaging all employees in achieving strategic business objectives and goals (Lareau 2000).

Hoshin Kanri Methods, Planning or Policy Deployment is another strategic planning and alignment area of LET and Continuous Improvement requiring additional future research. From the Japanese roots, *Hoshin* means "shining metal compass or pointing direction." The translation for *Kanri* is simply "management" (BMG Website 2006). The *Hoshin Kanri* strategic planning process aligns long-term business objectives and annual KPM's in a coordinated, top-down and bottom-up approach. Many SMM's realize that effective strategic planning is a key component of developing marketing strategies, new business products, and tactical plans for being successful. However, each SMM could benefit greatly from the disciplined *Hoshin Kanri* method to creating value for their customers. Several "world-class" larger organizations (i.e. Toyota Motor Corporation) have utilized the policy deployment principles of Eiji Toyoda in the 1950's

explaining the need to introduce Total Quality Control (TQC), “to make quality targets clearer and ensure that all employees understood these targets.” *Hoshin Kanri* was first piloted by Komatsu Seisakusho Company, Ltd. as a Deming Quality Award winner in 1964 (Hino 2006).

The entire body of knowledge related to Continuous Improvements and LET in SMM’s needs to be greatly expanded. Many smaller job shop owners become frustrated when LET efforts do not produce tangible results quicker. Oftentimes, the main reason for this lack of progress is the owner or upper management staff not clearly articulating the company’s vision, mission, and future LET and Continuous Improvement goals and objectives. Long-term commitment and patience is required, by both SMM owners and upper executives to ensure employees that the company owners and upper managers will remain persistent and steadfast, in the Continuous Improvement efforts. Lean Enterprise Transformation encourages open and honest communication, mutual trust and respect and must be ingrained into the new organizational *Lean Culture* to sustain proactive long-term success and profitability. Typical benefits for smaller job shops include improvements up to: Lead Time Reductions 50 %, Increased Capacity 20 %, Reduced Setup Times 75%, and Increased Inventory Turns 50% regardless of type of industry (Lean Advisors Website 2006).

In conclusion, the author of this LET Field Project and Case Study encourages other future researchers, students, and professors to further expand on this research, results and Continuous Improvement recommendations. The small-and-medium sized Job Shops definitely require more attention from the NIST MEP national program and other resources to provide advanced concepts, methods, and techniques for making them more effective and profitable. SMM’s will then be able to maintain, increase and sustain market share and competitive advantages, in the face of intense global competition.

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APPENDIX 1: Complete Literature and Analysis Review

A. Reference Books

Flinchbaugh, Jamie and Carlino, Andy, *The Hitchhiker's Guide to Lean: Lessons from the Road*, (Society of Manufacturing Engineers, 2006).

First, the authors share lessons learned from years of experience implementing Lean Enterprise in a variety of industries. One of the major points emphasized early in this book was distinguishing the difference between leadership versus management within organizations. From the authors' perspective management "maintains the status quo" while *leadership* "changes things, moves them forward, and produces different results."

Lean Enterprise Transformation (LET) challenges the status quo and strives for continuous improvement looking for open minded leadership and creative processes and system solutions for the future growth of any organization small, medium or large.

Also, Flinchbaugh and Carlino divide their entire book into ten sections with about five major topics discussed under each section. For example the theme of, *Section 1- Think First: Five Principles of Lean*, explores the following main elements; (1) Direct observation of work, activities, connections, and flows; (2) Systematic waste elimination; (3) Establishment high agreement (standardization) of what and how to deal with selecting priorities and methods for continuous improvement; (4) Systematic method for problem solving like Plan-Do-Check-Act (PDCA) or the 5 Whys; and (5) Creating a Learning Organization.

The authors review additional important sections dealing with topics ranging from, People Need Leadership not Management, to 5 Phases of Lean Enterprise Transformation Roadmap, and finally conclude the book with Conversations from the Road. The final section

allows the authors and some of their customers from a variety of industries to share Lean Enterprise Transformation successes and pitfalls with the readers. The companies and people interviewed represent a cross section of both small job shops, medium and larger organizations in the following diverse industries: lead smelting, energy operating systems, electronic controls, automotive and truck industries.

The five leaders from these various industries shared from their perspective the victories and frustrations as their companies progressed along the road of their Continuous Improvement Journey. Lessons learned included culture changes in both union and non-union environments as well as the need for persistence and patience when maintaining the Lean Enterprise Transformation (LET) Roadmap course. All five corporate leaders understood that the LET and Continuous Improvement path was a long-term strategic commitment not the “flavor-of-the-month” program for their organizational performance excellence efforts.

Henderson, Bruce A. and Larco, Jorge L., *Lean Transformation: How to Change Your Business into a Lean Enterprise*, (The Oaklea Press, October, 2002).

This *Lean Transformation* book allows readers to experience “real world” success stories as told by two lean practitioners that have both “walked-the-walk” not just “talk-the-talk” many times during their careers. Their global lean experience covers North and South America, Europe, India, China, and the Pacific Rim. The authors begin by examining “Lean Enterprise as a Business Strategy.” Both the Toyota Production System (TPS) and Dell Computer methodologies and success are overviewed. Dell Computer has been a phenomenal example of a Lean Enterprise System that expertly practices the “Pull & Kanban” methodology by producing

only to actual customer orders, and avoiding the retail loop by producing and delivering computers directly from the factory to the end customers. Dell Computer's have reduced their average order lead time to 4-5 days, leaving personal computer (PC) and laptop computer competitors like IBM, Hewlett-Packard, and Compaq scrambling to keep up with them.

Next, Henderson and Larco provide an overview of the "The Lean Factory" and their perspective on the "Six Fundamentals" of *Lean Transformation: Value Stream Mapping (VSM)*, The Toyota 5S System, Takt Time = Producing to Customer Demand, Install a Kanban/Pull Scheduling System, Reduce Setup Times and Batch Sizes, and Implement Cellular/Flow Layouts. Many of these lean implementation concepts and techniques tend to be more successful when introduced into a "pilot" work area prior to practicing these concepts company wide. This second main section of their *Lean Transformation* book becomes very lengthy and may become confusing to a person that has not had previous lean training and implementation experience. However, the information provided is very enlightening and useful if the reader reviews and applies some of the lean concepts discussed in this section.

The third section of their book *Lean Enterprise "Spreading Lean Throughout the Company"* highlights the need to many organizational production support areas like: Design and Process Engineering, Quality Assurance, Finance and Accounting, Human Resources, Sales and Marketing, Purchasing, etc. Once again, Henderson and Larco provide the readers with an easy to follow lean philosophy that encourages cross functional teamwork between traditional departments, in order to satisfy customers' specifications and demands in a timely manner. The fact that both Henderson and Larco have engineering educations and backgrounds has allowed them to share unique perspectives on improvement methodologies like Design for Manufacturability (DFM), and Right Sizing of Equipment. Also, they both challenge traditional

standard cost accounting methods by briefly discussing Lean Cost Accounting and the need for Refocusing Performance Measurement Systems.

Finally, the last section titled, “Sustaining the Change” explores how to continue moving the corporate *Lean Transformation* forward. The authors cite what they consider to be “Five Key Factors” for a Lean Enterprise Transformation Success: (1) A Strategic Vision, (2) Strong Line Management, (3) Expert Training and Support, (4) Aggressive Performance Targets, and (5) Impatience by Management to see the company move forward and deliver tangible results. However, Henderson and Larco warn that management needs to be realistic in their expectations, and willing to support and commit to the Lean Enterprise Transformation for the long-term. Lean Enterprise and Continuous Improvement is a life-long journey not a “silver bullet” or “quick fix” method for process and system improvements.

The Appendix contains an example of a “Lean Assessment Radar Chart” that rates and analyzes a company based on valuation ratings and comments for the following eight categories: (1) Workplace Safety, Order and Cleanliness, (2) Just-in Time Production, (3) Six Sigma Quality, (4) Empowered Teams, (5) Visual Management, (6) Continuous Pursuit of Perfection, (7) Overall Company Organization and Management Style, and (8) Company services. Typically, the valuation rating is scored on a one (Non-Existent or Poor) to five (World-Class or Excellent) scale. The categories may change but the assessment tool is valid for obtaining both baseline and continuous improvement measures.

Keyte, Beau and Locher, Drew, *The Complete Lean Enterprise: Value Stream Mapping for Administrative and Office Processes*, (Productivity Press, Inc. 2004).

The authors challenge their readers to expand on the basics of “Value Stream Mapping” (VSM) first documented in *Learning to See*, by Mike Rother and John Shook. The Lean Enterprise version of VSM strives to look into customers, internal corporate offices, and suppliers’ value streams for improving overall organizational performance. First, the authors discuss “Applying Value Stream Mapping Throughout the Enterprise” at a very high philosophical level and relate VSM to Shewhart’s Plan-Do-Check-Act (PDCA) Cycle for Continuous Improvement.

Next, Keyte and Locher examine, explain, and define how to map “Office Value Streams” and “Identifying Office Waste.” The basics of how to do Value Stream Mapping are reviewed. Also, a discussion of maintaining a “big picture” perspective when developing Current and Future State product and service family maps is highlighted. In conclusion, a review of defining “value” in the customer’s eyes and the standard “Eight Sources of Waste” is related to the office environment with examples provided.

The next section of the book utilizes a fictional ABC Design Company to demonstrate how to create a baseline Current State Value Stream Map (VSM), for a “Lean Transformation in the Production Area.” Also, the customer and supplier data, and information flow, and material flow documentation is developed. Step-by-step instructions are utilized for developing the Current State VSM, and selecting the key shop floor process metrics for analyzing performance. Finally, the sequential creation of the Current State Map for ABC Design is complete.

The next section of the book consists of brainstorming, improving, and creating the ABC Design Future State VSM. This improvement process begins with “Thinking Lean at the Functional Level.” All size companies need to consider two important points when improving their Current State VSM: (1) Do not jeopardize customers when trying to improve processes and

eliminate waste. (2) Utilize additional “Lean Tools and Concepts” to determine the *root causes* not the *symptoms* of the waste defined during the Current State VSM development and improvement brainstorming activities. The authors explore and suggest how to avoid potential pitfalls through the development of questions to be asked by then following major organization functional office support categories: Sales, Marketing, Operations, Order Processing, New Product Design, Inventory Control, Purchasing and Inventory Management, Scheduling and Production Control, Quality Management, Cost and General Accounting, and Human Resources.

Then, the next section of the book review explores the section titled “Designing ABC’s Future State” exploring the specific steps required in creating the improved ideal Future State VSM. In reality, several iterations of any particular Future State VSM could be developed and improved upon over time.

Finally, the section titled, “Achieving the Future State” summarize how to analyze and plan the implementation of a Future State VSM. Three Critical Success Factors (CSF’s) are listed for how a “Lean Enterprise Transformation” is achieved: (1) Organizational Leaders must understand and embrace lean concepts. (2) Value Stream Managers must be given the time and resources required to implement the Future State VSM. (3) Key Team Leaders must develop detailed *Kaizen* or short-term Continuous Improvement implementation plans. Furthermore, the Future State Value Stream Design must be properly aligned with the organizational strategic business objectives. Also, the Future State VSM Implementation Work Plan should be broken up into “loops” for coordinating the planning and execution efforts. For example, in this particular case study two “Office Improvement Loops” exist: (a) Post-Approval and (b) Order Entry Loops. *Kaizen* or Continuous Improvement activities must be prioritized within each of these two

improvement loops to maximize time utilization and target the greatest organizational returns for the time and effort invested.

Three *Kaizen* priorities were created for each of the Post-Approval and Order Entry Loops, and overall objectives and goals created for achieving these Future State VSM improvements. Then, a timeline and more detailed activities were created for the Future State VSM Implementation Work Plan. Many companies that I have worked with use either MS Project or Excel to develop a Gantt chart for project management purposes.

Mann, David, *Creating a Lean Culture: Tools to Sustain a Lean Conversion*, (Productivity Press 1995).

The theme of this book is the development of a “Lean Management System” to support the efforts typically applied by the Lean or Toyota Production System (TPS) concepts and tools to the manufacturing operations, within a company. The author, David Mann in the first part of his book explores what he describes as the, “Principle Elements of Lean Management.” In detail, the author describes each element and their key characteristics: Leader Standard Work, Visual Controls, Daily Accountability Process, and Discipline. The author shares many “real world” examples of how various tools and methods can be utilized to create and sustain a “Lean Culture” during a conversion from batch-and-queue to a leaner “Pull System” environment. Many of these specific concepts like “Visual Controls” work well in both smaller job-shop and larger production organizations.

For example, a “Case Study: A Tale of Two Networks” describes how “Visual Controls” can be designed to improve performance excellence for tracking both production and Information Technology (IT) processes. The author explains that a problematic computer system

can actually be converted into simple and visual system for tracking and monitoring production through the implementation of a “visual reorder tracking board” designed by the work area supervisor with input from the operators. The moral of this case study was the Keep it Simple Stupid (KISS) Principle that simplified the performance measurement process and eliminated the redundancy and inaccuracy of the previous computer system.

Also, Mann promotes the “Lean Management” philosophy with a three-part statement of process focus summarized as, “Go to the place, look at the process, and talk with the people.” This simple yet profound statement is at the heart of many of the Employee Involvement (EI) and Continuous Improvement Process (CIP) systems. Any process in any environment (job shop or mass production) needs to be observed, base lined, and improvements brainstormed with the people who do the work daily, before real process or continuous improvement can be realized!

In the “Daily Accountability Process” section, the author completes the analysis of the first part of the book by providing the analogy that daily accountability is the “steering wheel” for driving the conversion and transformation to a Lean Culture and Management environment. Mann details his “Three Tiers of Daily Meetings” approach to stress the importance of communication necessary during a Lean Culture conversion. Furthermore, the emphasis is that these daily meetings should be brief, standup, in location, and stay on agenda and timeframe of less than 15 minutes per meeting. A combination of the daily meetings and the visual communication boards establish the discipline needed to effectively plan, monitor, and improve both production and office support processes.

The second part of this book is titled, “Supporting Elements of Lean Management” and the author begins this section by discussing that learning “Lean Management” principles and application techniques is a very important aspect of each Lean Leader’s personal transformation.

For example, an effective “sensei” or lean teacher helps new leaders apply concepts learned during reading, training simulation sessions, and workshops. Also, a leader working with a sensei is similar to an internship or apprenticeship. The relationship between teacher and student must be very open allowing a two-way flow of communication to mutually benefit both people as they strive to learn and improve themselves and their organization.

Next, Mann explains the concept of “Gemba Walking” as a regularly scheduled visit where the work is happening between the sensei and student. Furthermore, the “gemba walk” is a very disciplined and effective method for developing and following up on expectations when properly utilized. Lean Management advocates gemba walking for creating a “Lean Culture” environment and building the skill sets and involvement levels of an organization’s employees. Remember, that when executive level ownership and leadership supports and embraces a lean journey, your organization has a much better chance for success!

In the section titled, “Leading a Lean Operation”, the author explores “Eight Leadership Behaviors to Learn” when experiencing a Lean Enterprise Transformation. These 8 Leadership Behavior Attributes are: (1) Passion for Lean, (2) Disciplined Adherence to Process Accountability, (3) Project Management Orientation, (4) Lean Thinking, (5) Ownership, (6) Tension Between Applied and Technical Details, (7) Balance Between Production and Management Systems, and (8) Effective Relationships With Support Groups. Mann finishes this chapter by emphasizing that many support groups like accounting, engineering, human resources, maintenance, production control and scheduling, quality, and safety must all be included in the conversion process to a Lean Culture and Management System.

In the section titled, “Solving Problems and Improving Processes-Rapidly,” Mann explores the need for developing a standard problem solving and root cause analysis method

related to process improvement within a “Lean Management System.” The author advocates selecting a seven or eight step problem solving approach, and properly training employees how to utilize this method. Plans for identifying and categorizing short, medium, and long-term improvements are discussed. A Lean Management System will need to create priorities for these various improvements and completion of these improvements will depend upon available resources, task duration, and how they are properly managed. The author presents an interesting perspective as to how improvement activities need to be managed. Creating and following a few guidelines is stressed, and criteria developed through the effective use of case study examples. Specifically, the A-3 (11” x 17”) one-page Project Plan form developed many years ago by Toyota is discussed as a very effective mid and long-term problem solving technique. Finally, the author finishes this section, by reviewing the “Rapid Response System” concept. Once again, two case studies compare and contrast the need to establish a method for responding quickly when converting work areas during the lean conversion process. Leaders and managers need to be properly aligned to support the lean process flow and layout changes.

In the section titled, “People-Predictable Interruptions and Source of Ideas,” the author explores how important the roles and responsibilities of people are to the success of any Lean Management System. Several topics and other lean workplace tools reviewed include: Attendance Matrix, Labor and Rotation Plans, Skills and Training Matrices, Encouraging Participation – The Idea System, and A Visual Improvement Suggestion 7-Step Process. Finally, the author shares some suggestions on dealing with issues like: What if Production People Don’t Buy into Lean? A 5-Point Checklist for Responding to Low Performers, Human Resources Policy Issues in Lean Management, and Resolving People Issues to Support Lean Production and Lean Management Systems.

In the section titled, “Sustain What You Implement,” the author concludes that this book on Lean Culture by challenging readers to establish individual goals and personal accountability for maintaining and sustaining the efforts of their Lean Management System. The reliance on Leaders “Standard Work” will help reinforce discipline and sustain success long after the lean conversion has occurred. Also, the Lean Leader must maintain “Visual Controls” by following up with employees to make sure these lean implementation tools are being monitored and maintained. Next, the Lean Leader must continue utilizing “Gemba Walks” for going to the work place, observing and improving the process. The author discusses how Lean Leaders can keep themselves honest by open and frank learning discussions with both internal and external Lean Senseis (Teachers). Finally, Mann summarizes the use of “Lean Management System Assessments” for analyzing progress towards attaining perfection in your company’s Continuous Improvement Journey!

Maskell, Brian H., *New Performance Measures*, (Productivity Press 1994).

This book is one of the early works of author Brian Maskell and became the baseline of much of the “Lean Accounting” literature that has grown exponentially in the past ten years. The book is only about 50 pages but provides very accurate predictions as to what organizational leaders and managers need to learn and change in their companies. Lean Enterprise or World-Class Manufacturers realize that traditional live-by-the quarter and die-by-the quarter financial and accounting performance measures are antiquated and need to be modernized for the 21st Century’s globally competitive environment.

Maskell, in the first section of the book, explains *Why are New Performance Measures Needed?* The main reason is that customers and employees demand these changes. The

expectations for higher quality, innovation, teamwork, flexibility, and better on-time delivery drives the necessity for changing the old traditional financial and cost accounting performance measurements. Secondly, the author states what the *Characteristics of the New Performance Measures* are: aligned to business strategies, primarily non-financial type measures, change over time, and must be simple and easy for all employees and customers to use and understand.

In the next section, Maskell shares *Examples of New Performance Measures at Work*. He states that, “measuring every customer’s satisfaction is important.”

Many of the small and medium sized job shop environments are excellent at making sure that their customer’s are satisfied, or they do not receive additional orders. Also, the author explores several examples of non-financial type Delivery Performance, Customer Service, Innovation, Productivity, Flexibility, Quality, and finishes this chapter with a review of modern Financial Performance Measures.

Finally, in the section titled, *Implementing New Performance Measures*, the author summarizes the major reasons why and how these performance measures will occur within an organization. The emphasis is that corporate Key Performance Measures (KPM’s) must be properly aligned with the company’s world-class goals. Also, the bigger the scope of the change in performance measures, then the transition plan needs to be carefully planned, communicated and executed. A “6 Step Approach” details and summarizes the following planned steps for the implementation of *New Performance Measures*: (1)-Write a Strategy, (2) List the Key Strategic Issues, (3) Validate the Key Strategic Issues, (4) Develop the New Performance Measures, (5) Pilot the New Performance Measures, and (6) Expand the New Measures throughout the entire Plant or Company. In conclusion, the need for *New Performance Measures* is still very great today, even approximately 12 years after Brian Maskell’s first book challenged the status quo in

the traditional financial and cost accounting kingdoms of manufacturing and other businesses. Today, the field of “Lean Accounting” has grown immensely. However, many small, medium, and large organizations have still not learned and applied the knowledge of how to implement “Lean Accounting” and more focused and accurate Key Performance Measures (KPM’s) to achieve greater performance and profitability in their companies!

Miller, William B. and Schenk, Vicki L., *All I Need to Know About Manufacturing I Learned in Joe’s Garage: World Class Manufacturing Made Simple*, (Bayrock Press 2000).

This book compares and contrasts traditional manufacturing versus more modern lean concepts and techniques through telling the story of how a corporate vice president of manufacturing Joe solicited the help of several co-workers and friends to design and build shelves in the garage at home. The *Planning to Build Shelves* section illustrates how confusing that information, in the form of drawings and a detailed bill of material, provided by both design and manufacturing engineering, can be for production personnel. Also, a Japanese worker named Ralph Morita continually asks probing questions that help expose Joe and many of the workers open their minds to potential “Lean Improvements” to the shelf building process.

The *How to Build Shelves* section begins with the evaluation of inventory, in the form of a large pile of different sizes and types of lumber in Joe’s backyard that will be used to build the garage shelves. Once again, Ralph inquires why there is so much material and over processing waste occurring in filling out paperwork to document usage and scrap lumber utilized for building the shelves. Also, the narrator of this story Sandy is a manufacturing engineer that works for Joe’s traditional batch n’ queue gear manufacturing company Garrett Gear Company. Sandy and Ralph are constantly discussing and brainstorming possible improvements to the

shelve building process that would support smaller batch sizes and more of a cellular manufacturing philosophy.

The *Getting Ready to Build Shelves* section demonstrates how the concept of *Kaizen* should be utilized for incremental short-term process and design improvements. Also, Ralph and Sandy become involved in a lively debate over the advantages and disadvantages of any information or computer system trying to plan, schedule, and monitor production performance. In essence, the discussion becomes a lesson on world class competition between Joe and Sandy's Garrett Gear and Ralph's Yamachi Gear companies. Garrett's old school traditional manufacturing practices versus Yamachi's more modern approach utilizing the Toyota Production System (TPS) or Lean Enterprise Transformation (LET) best practices in a smaller job shop environment.

During the *Building Shelves* section, the actual work starts and stops in large batches according to the computerized schedule produced by Joe's eldest son Joe Junior. However, before very long, several quality defects appear due to a lack of adequate training and tooling. Sandy and Ralph become involved in improving this specific process utilizing a technique *poka yoke* that literally means "mistake or error proofing." Furthermore, Junior inundates the shelve building process with additional "non-value added" schedule changes that adds complexity and confusion for the production workers. This book section concludes with Ralph and Sandy debating the pros and cons of investing in spare tools, after one of the drills breaks down during a drilling operation. The merits of *Just-in-Time* one-piece flow methods versus a high-lead time and high-inventory factory environment is the final argument for the time being.

The section titled, *Inspecting Shelves* provides a very interesting comparison between a Lean "Quality-at-the-Source" operator inspection and the "old school" Quality Control (QC)

philosophy of inspection and rejection of materials or products “after-built.” Quality is defined as conformance to “customer specifications” and must be the most important focus of the production process. A brief explanation of Total Quality Management (TQM) stresses that everyone in any company is responsible for improving quality.

The section titled *First Assembly* Joe, Ralph and Sandy demonstrate how many “old school” manufacturing uses firefighting as a way-of-life to provide quick fixes to common problems encountered as the shelve building process progresses into the sub and final assembly stages. Ralph discusses the concept of *jidoka* meaning provide immediate feedback quickly when defects occur and determine how to correct defects in process, product, equipment or humans so that they do not reoccur in the future. This chapter concluded with Sandy and Ralph discussing how to meet customer demand for building shelves, by implementing a lower-inventory and shorter-lead time approach.

Finally, the last book section titled, *Assembly Again* and *Going Home* emphasize the following critical points about how management tries to motivate workers to produce to meet schedule at all costs: (1) Negative and mean pushing of workers does not inspire increased productivity and efficiency. (2) The “old school” win at any costs mentality can be very demotivating to the majority of a workforce particularly when trying to produce under extreme pressure from management. In order to continuously improve, an organization must learn how to let go of the past, in order to improve at present and into the future!

B. Reference Articles

Ehrlrich, Betsi Harris, *Service with a Smile: Lean Solutions Extend Beyond the Factory Floor*, (Industrial Engineer Magazine August 2006), pages 40-44.

The article begins by briefly reviewing the history of Lean Manufacturing from the days of the Ford Motor Company's River Rouge Plant visited by the Toyota Motor Company's Taichi Ohno back in 1949, to the discussion of Frederick Taylor's *Scientific Management Approach*, and how most of these initial process improvement methods focused primarily on manufacturing and the shop floor. Also, the author compares and contrasts the more traditional "Mass Servicing" example of high volume calls being handled by semi-skilled customer care workers, to the "Lean Servicing" roadmap example challenging the myths that lean principles cannot be applied in a transactional business environment. The necessity for Standard Work becomes very apparent for performing the many high volume customer-to-employee encounters that occur within a transactional services delivery environment.

Furthermore, Ehrlich presents a creative alternative "customer-centric work cells" for focusing "Lean Servicing" strategies resulting in faster customer service response times and increased revenue and profits for an organization that plans and implements this lean improvement concept. Value Stream Mapping all the primary and secondary processes and information flow activities for each of the "Lean Service" families will identify opportunities and priorities for continuous improvements!

This article concludes with some "Examples of Lean Servicing" that illustrate how possible issues and symptoms can be identified, analyzed, brainstorm alternatives, and improvements implemented. Finally, Ehrlich challenges the readers of this article to follow the

hallmark of lean in “eliminating waste by producing to customer demand as rapidly as possible.”

In conclusion, the author references several modern day companies like Dell, Wal-Mart, and Tesco that practice daily the “Lean Servicing” concepts highlighted in this article.

Flinchbaugh, Jamie W. and Tracey, Dr. Monica W., *How Human Resource Departments Can Help Lean Transformation*, (AME Target Magazine, Volume 22, Number 3 2006).

The authors research and explore a variety of creative methods for traditional Human Resources departments to become educated and support corporate efforts related to Lean Enterprise Transformation (LET). Flinchbaugh and Tracey’s research indicates that five key variables help predict successful lean transformation: (1) Development of lean teams to support transformation efforts. (2) The calculation and communication of metrics to all levels of employees. (3) Creating stronger communication between all organizational members and barriers. (4) Communication with all employees regarding their roles and responsibilities, and (5) The acknowledgement and celebration of successes along the lean transformation journey.

Also, the authors designed two surveys as part of the extensive literature review for this article. The first survey was geared towards employees working under direct supervision. The second survey was designed towards supervisors and managers responsible for lean practices within their areas of responsibility. In fact, the authors’ literature review identified six specific areas that would warrant further research through conducting surveys: (1) Demographics, (2) Work Environment, (3) Innovation, Tools, and Technology, (4) Lean Implementation, (5) Communication, and (6) Rewards and Benefits of Lean Implementation.

Survey data was gathered based upon 64 questions for the employee survey, and 66 questions for the supervisor and manager survey. A total of 72 different company sites or locations, 154 employees, and 72 managers completed the two surveys.

Finally, the general research findings and recommendations were categorized as follows around the same five variables: (1) Development of Lean Teams as a supporting structure indicates an environment that encourages common language, principles, and tools. Also, a common corporate vision and direction is necessary to reach common lean goals and metrics. Visual work and open communication are also important for exposing problems and correcting them in a timely manner. (2) Calculation and Communication of Metrics shows how organizations keep score of their LET baseline and continuous improvement progress. Several key criteria are needed for developing Lean Key Performance Measures (KPM's). First, KPM's must be "owned" by those people who own the process. Second, KPM's must be forward looking. Third, management must support and determine who should review KPM's. Finally and most importantly, the KPM's must be leading indicators in a steady and consistent direction towards the future Lean ideal state.

(3) Communication Across Boundaries mean in a lean environment communication must be vertical, horizontal, and a two-way flow of information. The challenge for both managers and employees is strengthening communication channels between people at all levels of the organization. (4) Communications to Employees Regarding Their Roles means organizational leaders are tasked with making sure all employees understand their roles and responsibilities under the evolving lean cultural change environment. (5) Acknowledgement and Celebration of Successes means management is responsible for communicating to all employees that the Lean Enterprise Transformation (LET) is a never ending Continuous Improvement Journey!

Corporate leaders must clearly define expectations, milestones, communicate progress towards achievement of Lean KPM's, and determine appropriate ways to celebrate successes along the Continuous Improvement journey.

Final recommendations for Human Resources departments provided by Flinchbaugh and Tracey included: Create a Lean Culture, Develop Recruitment Criteria, Lean Personal Characteristics Needed, and Pay/Recognition and Performance Structure were listed as five predictors from this research study would require additional research to validate the initial data gathered and findings shared in this article.

Seeliger, John, Awalegaonkar, Ketan, and Lampiris, Christopher, *So You Want to Get Lean Kaizen or Kaikaku?*, (Mercer Management Consulting 2006), pages 1-8.

The authors from the Mercer Management Consulting organization compare and contrast how to utilize two different approaches to operational improvement that have been used for many years first in Japan and secondly throughout the world over the past twenty-five plus years. The first "lean" approach is called *Kaizen* that roughly translates to short-term focused "continuous incremental improvement." Normally, *Kaizens* or Continuous Improvement Events should occur after a Value Stream Map (VSM) has been developed for a specific product or service family. After a Current State VSM has been created, a brainstorming process should be conducted to enumerate potential *Kaizens* or Continuous Improvements, before creating an ideal Future State VSM.

On the other hand, a *Kaikaku* translates to a more long-term "radical improvement or change," and tends to be more of a lean transformation type process. *Kaikakus* are started by examining customers' priorities and is linked directly to an organization's strategic planning

efforts. For example, a company may decide to enter an entirely new market or product/service family that has never been produced before to strategically diversify their business. *Kaikakus* tend to take longer to implement, consist of a larger project scope, require more people be involved, are strategic in nature, create economic impact benefits and results which will be greater than those realized during short-term *Kaizen* or Continuous Improvement Events.

The authors stress that organizations need to be “weighing the tradeoffs” between utilizing either the *Kaizen* or *Kaikaku* improvement strategy depending upon the duration, resources required and scope of the process or system being improved. Advantages and disadvantages of each approach are highlighted within this article. *Kaizen* success depends on managers addressing several key issues: linking islands of excellence, moving quickly up the learning curve, increasing system inventories, and sustaining the effort. On the other hand, the *Kaikaku* strategy for improvement requires a much greater commitment of both time and resources including but not limited to these key issues identified: ensuring dedicated resources, committing capital, and providing long-term follow-up planning and implementation support.

Finally, the authors conclude this article by exploring *Kaikaku in Practice*. A case study involving an aviation maintenance, repair, and overhaul (MRO) provider. A three phased approach is utilized to catalyze the “Lean Enterprise Transformation (LET)” as follows: Phase 1- included the Diagnostic, Planning, and Lean Design stages by several team-defined value streams.

Phase 2- Lean Implementation involved major physical changes to the MRO process flow and layout. Specific product families and dedicated “work cells” were designed to transform the process flow and layout from traditional departments to value streams. Standard work content was developed by working closely with the workers in those particular value streams. Also, any

issues related to resistance to change were discussed with the people affected, and further addressed through employee participation, targeted education, and joint problem-solving efforts.

Finally, Phase 3-Lean Transformation Support was provided by redefining the organizational structure into office product teams that helped better align support personnel. Also, new enlightened key performance measures were introduced through the evolution to quality, cost, delivery, and safety (QCDS) visual boards. The results from this MRO *Kaikaku* were phenomenal- sustained a 39 % labor productivity improvement, reduced work-in-process (WIP) inventory by 85 %, an overall 91 % in lead time, a 68 % reduction in floor space used, and 74 % improvement in throughput.

Tischler, Len, *Bringing Lean to the Office*, (ASQ Quality Progress July 2006), pages 32-38.

The author, Len Tischler explores the opportunities that exist to implement Lean in the office environment. Many of his examples of learning and applying “Lean Office” practices are at the university campus rather than a manufacturing environment. Therefore, he brings a fresh perspective to the traditional approach to “Lean Thinking” by involving and challenging a team of college students to streamline processes in the university’s admissions office.

First, the author as teacher (sensei) and the college students begin by learning the three main principles behind “Lean Theory:” (1) Ask customers what they perceive as value in the services provided. (2) Reduce “non-value added” waste in the admissions system streamlining process flow. (3) Streamlined process flow equates to less waste, less work-in-process (WIP), simplified flow, higher quality, and happier customers (students).

Next, Tischler provides his students with an overview of several models of Lean Implementation: (1) *Lean Thinking*, by James Womack and Daniel Jones focuses on five parts: Value, Value Stream, Flow, Pull, and Perfection. (2) *Value Stream Management*, by Don Tapping, Tom Shuker, and Tom Luyster stresses three stages for implementing lean: Demand, Flow, and Leveling. Either of these approaches can be implemented in a smaller job shop office environment that deals with high variability and low volume products and services. Then, this section of the author's article summarizes the three expected outcomes of lean implementation: Better Processes, Better Working Conditions, and Meeting the Organization's Needs and Purpose.

Next, the author and students begin analyzing the "Faculty Calling Process: Current Value Stream." Initially, the Value Stream Mapping (VSM) indicates the Current State of this office process has a total of 3 value-added and 10 non-value added steps, with 12 waiting delays identified between steps. Overall, the response time was about two to three weeks from when a potential student placed an inquiry phone call to when the admissions representative received information about the inquiry. After brainstorming and analysis, the author and students created a new "Inquiry System: The Ideal State Value Stream" for the process and reduced the inquiry lead time to less than one day by streamlining the process and information flow dramatically and eliminating much of the non-value added and previous waiting time.

Finally, the author and students conclude this article by sharing how the VSM process was used to improve the university's admissions and processing of student applications. The admissions process was streamlined from 88 to 5 steps, and allowed students to gain visibility as to where each of their applications were in the university's information technology system.

Tonkin, Lea A.P., *Steelcase: Learning How to Implement Customer-Focused, Enterprise-Wide Lean*, (AME Target Magazine, Volume 22, Number 3, July 2006), pages 35-42.

The author, Lea A.P. Tonkin in this Steelcase Grand Rapids, Michigan corporate case study explores how to build momentum and employee involvement by extending “Lean Thinking” to the office and administrative areas of the organization, after successful implementation has been initiated in many of the production areas.

As with many long-term continuous improvement plans, the “Senior Leadership” at Steelcase needed to be properly educated and trained on the demands and commitment required for “enterprise-wide lean.” At Steelcase, a senior executive steering team named the Lean Action Committee (LAC) was created. The LAC members’ roles and responsibilities included selection of internal Office Lean Consulting Team (OLCT) people, monthly meetings with Lean Project Teams (LPT’s), and gemba walks (where the action is) with the lean consultants and Steelcase employees.

Also, the LAC group developed the necessary corporate structure to maintain support and sustain successful Lean Kaizen (short- term incremental) and long-term Continuous Improvement Initiatives at Steelcase. 10-Step Lean Project Phases were created to provide a standard approach for: Preparation, Training, Current and Future State Development, Planning, Implementation, Kaizens, Progress Checks, Documentation, and Communication. The primary “Lean Analysis” technique utilized with both the Steelcase LAC and OLCT groups is Value Stream Mapping (VSM). VSM designs the current and future state maps for any particular product or service family identified by the Steelcase LAC or OLCT groups.

The author strongly emphasizes the Toyota Production System (TPS), the Japanese baseline for much of the Lean Manufacturing and Enterprise development from the late 1980’s to

present, advocates that companies ask themselves three key questions: (1)What is the process? (2) How can you tell if the process is working? (3) What’s the process to develop the answers? Obviously, these three TPS questions indicate the importance of identifying and improving processes, and not pointing fingers at people. Furthermore, by opening our eyes and focusing on the processes and systems, people are able to see both the “value-added” and “non-value added” processes. “Value-added” activities are those that internal and external customers are willing to pay for. On the other hand, the eight categories of “non-value added” wastes needed to be identified and eliminated.

Finally, Tonkin concludes the Steelcase “Office Lean” Case Study with some helpful insights. First, the discussion of how Steelcase employees created a Solutions Fulfillment Team (SFT), base lined and improved the performance utilizing the Value Stream Mapping (VSM) methodology. Improvement results included the elimination of many unnecessary e-mails, excess movement of people, and related wastes. Next, Tonkin shares the perspective on selecting “pilot areas” to work on and then spread best practices learned to other office work areas. Additional “Lessons Learned” that were shared included: focusing on cultural change to improve customer service, being patient with each other as they learn and practice lean concepts together, and finally, gaining traction throughout the organization requires a lot of tough work and persistence.

Appendix 2: TFES, Inc. LET Project Work Plan & Timeline

Appendix 3: The Job Shop and Partner LET and Business System Assessment Scope of Work (SOW) Statement.

I. PROJECT GENERAL INFORMATION

Name of Client: The Job Shop.	Date of Project Scope of Work: June 13, 2005
Project Name: Lean Enterprise Transformation and Business System Initial Assessment	
The Partner Sr. Field Eng./Project Manager:	The Job Shop Project Manager: (VP & General Mgr.)

II. PROJECT SCOPE OF WORK (SOW) INFORMATION

A. Project Requirements: The Integrated Manufacturing Solutions (IMS) project team will complete a comprehensive assessment of The Job Shop's current business system (Profit Key) and its technical support/networking capabilities. This assessment will validate that Profit Key will meet its current and expected needs. In the event that Profit Key does not meet these needs, alternative solutions or courses of action will be recommended. The technical support assessment will determine gaps in the capability and reliability of The job Shop's business system architecture versus what will be necessary to support an integrated corporate-wide business system and communications network. The Partner project team will complete a Lean Enterprise assessment at all three production locations and will determine how and where Lean Enterprise will support and promote the company's strategic business objectives for cost, quality, throughput and growth. This assessment will include the order design, development and delivery functions and activities. The Partner will provide a cost-justified roll-out program for a corporate-wide Lean Enterprise Transformation (LET).

B. Project Schedules and Milestones: The project will be completed over 2-week duration. An attached work plan provides details of specific project tasks and the sequencing of those tasks. Integration of assessment findings will be a key milestone. This will ensure that if there is not a seamless integration between business system, technical support and lean initiatives the company will be provided a contingency plan. A presentation of findings and recommendations will be completed and appropriate next steps will be determined.

C. Project Tasks , Consulting Services, and Work Products: We will deliver the following work products upon the completion of this assessment:

1. Validation that Profit Key will meet the needs of the job Shop (or a recommendation for another course of action).
2. On-site web executed demo of Profit Key.
3. Network design (wide area, local area and wireless network designs for 3 facilities).
4. On-site Lean Overview (4-hour session to precede on-site lean assessments).
5. Lean Enterprise Assessment and ratings (3 facilities).
6. Summary of findings including tangible/intangible benefits with rough cut ROI for project roll-out.

D. The Job Shop Project Resources: (V.P./General Manager) – plan 10-15 hours over the course of the project; selected production and engineering personnel for interviews and on-site observations – plan ½ - 1 hour for each interviewee; selected system users for interviews and on-site observations – plan 1-2 hour group/individual interviews.

E. The Partner Project Resources: Sr.Field Engineer/Project Manager, Additional Field Engineers as Needed, IMS Software Consultant/Implementer, and IMS Network Consultant.

F. Estimated Project Costs: The Project SOW will be completed over 2-week duration and will require 130-154 man-hours of effort. The cost to complete this project and deliver the work products outlined above will range \$12,160-\$14,440, not to exceed \$14,440.

G. Estimated Project Benefits: Upon completion of this project, the Job Shop will have complete system architecture and network designs for its 3 plants. It will have confidence that Profit Key will be an effective solution for its business system and information management needs (or recommended alternatives). It will have a systematic lean roll-out program with critical gaps and corrective actions identified for follow through. Actual Project Benefits will be documented using the Partner Economic Impact Assessment (EIA) Survey, at the end of the project.

III. PROJECT AUTHORIZED APPROVALS

The Job Shop	The Partner
Signature:	Signature:
Printed Name:	Printed Name:
Title:: Vice President/General Manager	Title:: Sr. Field Engineer/Project Manager
Date:: June 13, 2005	Date: June 13, 2005

Appendix 4: The Partner Economic Impact Assessment (EIA)

As a result of the Partner Project Services delivered the Job Shop realized the following benefits:

SALES & MARKETING

				If yes, how much?
1. Will the company experience increased sales? (8)	Yes	No		\$
2. Did the services you received lead you to retain sales that would have otherwise been lost? (10)	Yes	No		\$
3. Over the past 12 months, were sales per employee higher than they would have been without MAMTC services? (13)	Yes	No		

COSTS

4. Did the company experience any cost savings in: (12)				If yes, how much?
a. Inventory – How much less inventory?	Yes	No		\$
b. Materials – How much material cost savings?	Yes	No		\$
c. Labor – How much labor savings were realized from improved resource utilization?	Yes	No		\$
Labor – How much labor savings from not hiring additional staff?		Yes	No	\$
d. Energy – How much energy cost savings?		Yes	No	\$
e. Overhead – How much overhead cost savings?	Yes	No		\$
f. Other Cost Savings – How much cost savings in other areas?	Yes	No		\$

CAPITAL INVESTMENTS

				If yes, how much?
Will the company experience:				
5. Increased investment (14)				
a. Plant or equipment?	Yes	No		\$
b. Information systems or software?		Yes	No	\$
c. Workforce practices or employee skills?	Yes	No		\$
d. Other areas of business?	Yes	No		\$
6. Did your establishment avoid any unnecessary investments? (15)	Yes	No		\$
7. Did your establishment save on any investments that were made? (16)		Yes	No	\$

EMPLOYMENT

8. Did the services you received directly lead you to many? create any jobs?(9)	Yes	No		#	If yes, how
9. Did the services you received lead you to retain any jobs? (11)	Yes	No		#	

OVERALL PERFORMANCE

10. Has your establishment experienced Improved profit margin? (7a)	Yes	No		
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OTHER

11. On a scale of 1-5, how satisfied are you with the overall quality of MAMTC's services?
(1) Very Dissatisfied (2) Dissatisfied (3) Neutral (4) Satisfied (5) Very Satisfied
12. On a scale of 1-5, how satisfied are you that MAMTC delivered what was promised in the original or amended Scope of Work?
(1) Very Dissatisfied (2) Dissatisfied (3) Neutral (4) Satisfied (5) Very Satisfied
13. Referral of any other business that could benefit from MAMTC services?
Company Name _____
Contact Name _____ Phone No. _____

Appendix 5: * NIST MEP's ** MAIM Federal Survey

***NIST MEP** = National Institute of Standards and Technology.

****MAIM** = Minimal Acceptable Impact Measures.

1. First, we would like to ask you a few questions regarding actions and changes your establishment undertook over the past 12 months, as a direct result of services you received from [**CENTER NAME**]. Did the services you received lead you to take actions (**READ LIST**)?

	<u>Yes</u>	<u>No</u>	<u>DK</u>	<u>Refused</u>
A. That you would otherwise not have taken	1	2	8	9 NA
B. More quickly than you would have otherwise	1	2	8	9 NA
C. At lower cost than you would have had otherwise	1	2	8	9 NA

2. **As a direct result of services you received**, has your establishment experienced any of the following changes **over the past 12 months** in these areas of **Manufacturing Systems**?

A. Reduced lead time.....	1	2	8	9 NA
B. Reduced work in process inventory.....	1	2	8	9 NA
C. Reduced defect rate	1	2	8	9 NA
D. Increased inventory turns	1	2	8	9 NA

3. **As a direct result of services you received**, has your establishment experienced any of the following changes **over the past 12 months** in these areas of **Marketing and Sales**?

	<u>Yes</u>	<u>No</u>	<u>DK</u>	<u>Refused</u>
A. Improved understanding of customers, markets, or competitors	1	2	8	9 NA
B. Improved customer development or retention	1	2	8	9 NA
C. Entry into new or better markets.....	1	2	8	9 NA

4. **As a direct result of services you received**, has your establishment experienced any of the following changes **over the past 12 months** in these areas of **Human Resources**?

	<u>Yes</u>	<u>No</u>	<u>DK</u>	<u>Refused</u>
A. Improved employee skills	1	2	8	9 NA
B. Reduced employee turnover.....	1	2	8	9 NA
C. Improved work environment for employees.....	1	2	8	9 NA

5. **As a direct result of services you received**, has your establishment experienced any of the following changes **over the past 12 months** in these areas of **Information Systems**?

	<u>Yes</u>	<u>No</u>	<u>DK</u>	<u>Refused</u>
A. Achieved greater integration with the information systems of your customers or suppliers	1	2	8	9 NA
B. Improved e-commerce capabilities	1	2	8	9 NA
C. Improved use or selection of Information Systems or software	1	2	8	9 NA

6. **As a direct result of services you received**, has your establishment experienced any of the following changes **over the past 12 months** in these areas of **Management Systems**?

	<u>Yes</u>	<u>No</u>	<u>DK</u>	<u>Refused</u>
A. Improved environmental management systems (e.g., (ISO 14000)	1	2	8	9 NA
B. Achieved quality certification (e.g., ISO 9000)....	1	2	8	9 NA
C. Improved business or strategic planning	1	2	8	9 NA

7. **As a direct result of services you received**, has your establishment experienced any of the following changes **over the past 12 months** in these areas of **Overall Performance**?

	<u>Yes</u>	<u>No</u>	<u>DK</u>	<u>Refused</u>
A. Improved profit margin	1	2	8	9 NA
B. Increased revenue or cash flow	1	2	8	9 NA
C. Improved customer satisfaction	1	2	8	9 NA
D. Increased market share.....	1	2	8	9 NA

I am now going to ask you a few questions regarding differences in your **sales** over the past 12 months.

8. Did the services you received directly lead to an increase in **sales** at your establishment over the past 12 months?

- 1 Yes
- 2 No **(GO TO Q.9)**
- 8 Don't Know **(GO TO Q.9)**
- 9 Refused **(GO TO Q.9)**

B. What was the dollar amount of the sales increase? (IF NEEDED: PLEASE TAKE YOUR BEST GUESS.)

- 1) \$ _____ **(GO TO 8B1 – REPORT DOLLAR VALUE)**
- 2) _____% **(GO TO 8B2 – REPORT PERCENT THEN GO TO Q.8C)**
- 8) Don't Know **(if DK, ask could you please give your best dollar estimate \$ _____)?**
- 9) Refused **(GO TO Q.9)**

C. That is a percentage of what total sales amount over the past 12 months?"

- 1 \$ _____
- 8 Don't Know ? **(if DK, ask could you please give your best dollar estimate \$ _____)?**
- 9 Refused

9. Did the services you received directly lead you to create any jobs over the past 12 months?

- 1 Yes
- 2 No **(GO TO Q.10)**
- 8 Don't Know **(GO TO Q.10)**
- 9 Refused **(GO TO Q.10)**

D. How many jobs were created? (PLEASE TAKE YOUR BEST GUESS)

- _____
- 1 _____
 - 8 Don't Know
 - 9 Refused

10. Did the services you received directly lead your establishment to retain sales that otherwise would have been lost?

- 1 Yes
- 2 No (**GO TO Q.11**)
- 8 Don't Know (**GO TO 11**)
- 9 Refused (**GO TO 11**)

B. What was the dollar amount of the retained sales? (IF NEEDED: PLEASE TAKE YOUR BEST GUESS.)

- 2) \$ _____ (**GO TO 10B1 – REPORT DOLLAR VALUE**)
- 2) _____% (**GO TO 10B2 – REPORT PERCENT THEN GO TO**

Q.10C)

- 10) Don't Know (if **DK**, ask could you please give your best dollar estimate \$ _____)?
- 11) Refused (**GO TO Q.10D**)

C. That is a percentage of what total sales amount over the past 12 months?"

- 1 \$ _____
- 8 Don't Know ? (if **DK**, ask could you please give your best dollar estimate \$ _____)?
- 9 Refused

11. Did the services you received lead you to retain any jobs over the past 12 months?

- 1 **Yes** (CONTINUE)
- 2 No (**SKIP TO Q.12**)
- 8 Don't Know (**SKIP TO Q.12**)
- 9 Refused (**SKIP TO Q.12**)

11A1. How many jobs were retained? (IF NEEDED: PLEASE TAKE YOUR BEST GUESS.)

- 1 _____
- 8 Don't Know
- 9 Refused

12. Did the services you received directly result in **cost savings** in labor, materials, energy, overhead, or other areas over what would have been spent in the past 12 months?

- 1 Yes
- 2 No (**GO TO Q.13**)
- 8 Don't Know (**GO TO Q.13**)
- 9 Refused (**GO TO Q.13**)

A. What was the dollar value of these **cost savings**?

- 1 \$ _____ (**GO TO 12A1 – REPORT DOLLAR THEN GO TO Q.13**)
- 2 _____% (**GO TO 12A2 – REPORT PERCENT THEN GO TO Q.12B**)
- 8 Don't Know (**if DK, ask could you please give your best dollar estimate \$_____**)?
(**GO TO Q.9C**)
- 9 Refused

B. That is a percentage of what **total cost** dollar amount?

- 1 \$ _____
- 8 Don't Know (**if DK, ask for their best dollar estimate \$_____**)
- 9 Refused (**GO TO Q.13**)

13. **Thinking again of the past 12 months, were sales per employee higher than they would have been without services?**

- 1 Yes
- 2 No
- 8 Don't Know
- 9 Refused

NO LONGER A SKIP AFTER THIS QUESTION.

Now we would like to turn your attention to your investments during the past 12 months.

14. As a result of the services you received has your establishment *increased* its investments over the past 12 months in :(READ LIST).

	<u>Yes</u>	<u>No</u>	<u>DK</u>	<u>Refused</u>	
a. Plant or Equipment.....	1	2	8	9	[if 14a=yes, ask Q.14a1 then Q.14b]
b. Information Systems or Software.....	1	2	8	9	[if 14b=yes, ask Q.14b1 then Q.14c]
c. Workforce Practices or Employee Skills.....	1	2	8	9	[if 14c=yes, then ask Q.14c1]
d. Any other areas of business	1	2	8	9	(if 14d=yes, ask Q.14d1)

14a1. By how much did you increase investments in Plant or equipment? (IF NEEDED, PLEASE TAKE YOUR BEST GUESS.)

- 1 \$_____
- 8 Don't Know
- 9 Refused

14b1. By how much did you increase investments in Information Systems or Software? (IF NEEDED, PLEASE TAKE YOUR BEST GUESS.)

- 1 \$_____
- 8 Don't Know
- 9 Refused

14c1. By how much did you increase investments in Workforce practices or employee skills? (IF NEEDED, PLEASE TAKE YOUR BEST GUESS.) (For PA clients, go to Q.PA6: if not a PA client, go to Q.14d)

- 1 \$_____
- 8 Don't Know
- 9 Refused

14d1. By how much did you increase investments in other areas of business? (IF NEEDED, PLEASE TAKE YOUR BEST GUESS.)

- 1 \$_____
- 8 Don't Know
- 9 Refused

15. As a result of the services you received, did your establishment **avoid any unnecessary investments** over the past 12 months?

- 1 Yes
- 2 No **(GO TO Q.16)**
- 8 Don't Know **(GO TO Q.16)**
- 9 Refused **(GO TO Q.16)**

A. How much did you save? (IF NEEDED: PLEASE TAKE YOUR BEST GUESS)

- 1 \$_____
- 8 Don't Know
- 9 Refused

16. As a result of the services you received, did your establishment **save on any investments** that were made over the past 12 months?

- 1 Yes
- 2 No **(GO TO 17)**
- 8 Don't Know **GO TO 17)**
- 9 Refused **(GO TO 17)**

16A. **How much was saved?** (IF NEEDED: PLEASE TAKE YOUR BEST GUESS.)

- 1 \$_____ **(GO TO 16A1 – REPORT DOLLAR)**
- 2 _____% **(GO TO 16A2 – REPORT PERCENT THEN GO TO 16B)**
- 8 Don't Know **(if DK, ask could you please give your best dollar estimate \$_____?)(GO TO 17)**
- 9 Refused **(GO TO 17)**

16B. **This is a percent of what total investment?**

- 1 \$_____
- 8 Don't Know? **(if DK, ask could you please give your best dollar estimate?)**
- 9 Refused

17. Is your establishment more competitive as a result of the services you received?

- 1 Yes
- 2 No
- 8 Don't Know
- 9 Refused

18. Did the services you received have any other effects on your establishment during the past 12 months?

- 1 Yes
- 2 No **(GO TO 18)**
- 8 Don't Know **(GO TO 18)**
- 9 Refused **(GO TO 18)**

18A. Would you please describe these effects. _____

Now I would like to ask you questions on your overall satisfaction with the services you received.

19. How satisfied is your company with the quality of services you received?
[READ LIST] CHANGE MADE 7/21/03.

- 5 Very Satisfied
- 4 Satisfied
- 3 Neutral
- 2 Dissatisfied
- 1 Very Dissatisfied
- 8 Don't Know
- 9 Refused

19a. I recorded your response as **[FILL IN NUMBER AND RESPONSE OPTION FROM Q.18]**. Is this correct?

- 1 YES
- 2 NO if no, read Q.19 again.

20. Would you use this program's services again in the future? Would you say you (READ LIST)? [PLEASE CONFIRM RESPONSE].

- | | | | |
|----------------------------|----------------------|----------------------------|------------|
| 5 <input type="checkbox"/> | Definitely Would | 8 <input type="checkbox"/> | Don't Know |
| 4 <input type="checkbox"/> | Probably Would | 9 <input type="checkbox"/> | Refused |
| 3 <input type="checkbox"/> | Might or Might Not | | |
| 2 <input type="checkbox"/> | Probably Would Not | | |
| 1 <input type="checkbox"/> | Definitely Would Not | | |

(Added 1/13/2004) (Adjusted 4/20/04) (Adjusted again 7/20/05)

21. What do you think will be your single biggest business challenge next year?

INTERVIEWER: TYPE "None" IF THE RESPONDENT DOESN'T SEE ANY

CHALLENGES FOR NEXT YEAR.

22. For analytic purposes, we would like to verify who completed this survey.

What is your job title? _____

23. What is your name? _____

INTERVIEWER NOTE: IF YOU KNOW RESPONDENT'S NAME, SAYING "AND YOU ARE _____ " IS FINE.

We have completed the survey. We're wondering if you would like to leave a recorded message that CENTER would listen to. You may want to mention what has gone particularly well or what could be improved in your workings with CENTER or anything else you would like to mention. Would you like to leave this message?

IF Yes, ADDED 10/18/05 **Please mention to the respondent to list their name and their company name.** RECORDING STARTS. Please mention anything you'd like to leave in this recording for CENTER. If No go to END.

END. These are all the questions I have for you. Thank you very much for your participation and have a good day.