Lean Enterprise Integration: A New Framework for Small Businesses

by

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ABSTRACT

Abstract

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by Thomas A. Seitz

Thesis Supervisor: Prof. Deborah J. Nightingale, Professor of Practice of Aeronautics and Astronautics and Engineering Systems

This thesis presents a novel lean enterprise framework for small businesses that partner with, or supply to, large lean enterprise businesses. The background of the lean paradigm is explored and the special needs of small business suppliers are considered with respect to the conventional lean enterprise model. A specific theory of "natural leanness" is explored to explain the apparent lean behavior of a small business in the absence of formal lean architecture. Causal loop diagrams explore the self-limiting behavior of natural lean, and lean enterprise tools are evaluated for use by small businesses to prevent self-limiting behavior. This thesis identifies and describes existing lean tools that may be used by lean small businesses without modification: These include the Lean Enterprise Model (LEM), Transition To Lean (TTL) Roadmaps and Value Stream Mapping (VSM). Other lean tools are modified to meet the specific operational needs of the small business supplier. Specifically, a Stakeholder Needs Analysis Tool (SNAT) and Small Business Lean Enterprise Self Assessment Tool are synthesized from similar lean tools. Two completely new tools are introduced to aid the small business in the lean transformation; the first is a Dependency Structure Matrix (DSM) technique to infer stakeholder values from enumerated needs. The second tool is the use of a Throughput Accounting system to measure the progress of a lean transformation against the goals of the organization. The resulting collection of tools enables the small business to leverage existing lean strengths without adding undue overhead, yet sets forth a framework of operation that prevents self-limiting behavior. The thesis concludes by summarizing the holistic small business "lean" framework, and identifying avenues of future research opportunities resulting from this study.

ACKNOWLEDGEMENTS

Leon Trotsky once said:

> "Archimedes promised to move the Earth if they would give him a point of support…However, if they offered him the needed point of support, it would have turned out that he had neither the lever nor the power to bring it into action".

At the onset of this thesis, I found myself in Archimedes' predicament: wanting to "move the earth", but not empowered to do so without some significant help. I would not have been able to create a framework for small business lean without the *support* from the people listed here, the *leverage* of the depth and breadth of knowledge of the Lean Aerospace Initiative at MIT, and the *power* of my friends and family. My sincere appreciation to Professor Deborah Nightingale for the patience, guidance, and insight she provided to this project.

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INTRODUCTION

Chapter Summary

Chapter 1 contains a brief background of the history of the lean movement in North America, and attempts to explain why the lean manufacturing paradigm did not "save" industry as was expected. The lean enterprise is explored as a holistic vision to improve value stream operations. The special needs of small business suppliers to large, "lean companies" is introduced. The difficulties of small supplier companies are explained, and the proposal to create a new framework for small business lean is introduced. The thesis goals and layout are also presented

1.1 Background: Lean roots in the United States

Todd Phillips[1] wrote that "The first thing you learn about lean …is that it's a journey you set out upon, toward a destination you'll never quite reach." Subsequent to the publication of the book *The Machine that Changed the World (Womack, Jones et al. 1990)*, the idea of "lean" has been the subject of intense and enthusiastic scrutiny in North American business, particularly in large manufacturing firms. In its early days, lean was a concept applied primarily to the manufacturing plant, and consisted of looking for waste, and establishing "pull" systems throughout the factory. At the time, "lean" was seen as a way to emulate the Japanese automakers, and was touted as the way to "save" American industry. As it turns out, lean manufacturing did not "save" American industry. What lean *did* accomplish was to allow North American industry to "catch up" to the impressive gains and efficiencies of their Asian industrial counterparts. The manufacturing process got much better, but the industries themselves remained entrenched in their "mass production" mindset. As an enterprise tool, "lean" had the same lackluster impact that similar popular "management fads" had. It appeared that "lean manufacturing" was insufficient, or at least, was no better than TQM, quality circles, or numerous other management fads of its time at providing sustained competitive advantage.

1.1.1 Lean and the Enterprise-Level Lean Vision

So why is it that "lean" did not work as expected? It turns out that the reason is simple: lean is *not merely a manufacturing tool,* nor is it a promise of success. It is not a single idea that can be "turned on" and used to create an overnight change in a business. In essence, "lean" is about working smarter to achieve greater value to the organization and

[1] *Todd Phillips, "Lean Manufacturing", Advanced Manufacturing Magazine, Jan 2000.*

the stakeholders that contribute to, or benefit from the operations of the organization. In the words of Taiichi Ohno[2], the father of lean manufacturing at Toyota:

> "The Toyota production system is not just a production system. I am confident it will reveal its strength as a management system adapted to today's era of global markets and high-level information systems."

The ideas of lean do not begin and end on the manufacturing floor; they extend to all systems and subsystems that interact with the company. This includes, but is not limited to, suppliers, customers, stockholders, etc. Lean *manufacturing* is only a small part of the "lean paradigm". The problem with earlier attempts by American industry to employ "lean" was that it simply did not expand the concept of lean beyond the manufacturing floor. For lean to work, it needs to be a *cultural value* shared by all stakeholders in the organization. For lean to be effective, a **lean enterprise** is required. As stated at MIT's LAI website[3]:

> "Lean is about people and processes efficiently delivering value to every stakeholder. This means achieving lean capability at the enterprise level… Creating lean enterprise value goes well beyond figuring out better ways to do the job right — it's also about doing the right job. Creating value means delivering what customers want and need, returns on investments that shareholders expect, and job satisfaction and lifetime learning that workers deserve. It is sharing the total benefits with suppliers so that they can continue operating as full partners in good times and bad. And it is delivering value to society that reflects its broader desires and concerns. "

Lean must be adopted as a *predispositional* culture in the organization, and needs to be internalized by the organization, from the lowest-level employee to highest-ranking executive. In short, a lean enterprise requires belief, observation, reflection, planning and action. In a lean enterprise, the focus and tools change the nature of the way the company does business, as summarized in Table 1.

In 1993, researchers at the Massachusetts Institute of Technology (MIT), in conjunction with the U.S. Air Force formed a team to help address the issues of rising costs

[2] Ro, Y. 2002. Organizational Process Improvement, Vol. 2003: University of Michigan Engineering Department.

[3] MIT/LAI. 2003. Lean Aerospace Initiative Website, Vol. 2003.

and military industrial overcapacity. The partnership was called the Lean Aerospace Initiative (LAI). The members of the LAI understood that lean principles had to be adopted across the entire spectrum of industry operations, and the goal of the LAI was to help "focus understanding and application of lean, enterprise, and value by ….generating, consolidating, and deploying knowledge around lean principles and practices in industry.[4]"

Table 1 - The Lean Enterprise vs. Mass Production

AREAS AFFECTED	MASS PRODUCTION	LEAN ENTERPRISE
Business strategy	Product-out strategy focused on exploiting economies of scale of stable product designs and non-unique technologies.	Customer focused strategy focused on identifying and exploiting shifting competitive advantage
Organizational structure	Hierarchical structures that encourage following orders and discourage the flow of vital information that highlights defects, operator errors, equipment abnormalities, and organizational deficiencies.	Flat structures that encourage initiative and encourage the flow of vital information that highlights defects, operator errors, equipment abnormalities, and organizational deficiencies.
Operational capability	Dumb tools that assume an extreme division of labour, the following of orders, and no problem solving skills.	Product flow from suppliers to producers to customers. Smart tools that assume standardized work, strength in problem identification, hypothesis generation, and experimentation.
Source: Jackson [5]		

Over the last nine years, the LAI has begun the arduous work of transforming large, industrial partner companies. Through the adoption of lean values and practices, companies have been able to rebuild their infrastructure and policies, and are starting to realize significant increase in profitability and operational efficiency.

[4] MIT/LAI. 2003. Lean Aerospace Initiative Website, Vol. 2003.

[5] Jackson, D. T. 1999. ***Beyond the Pilot Project: an essay on becoming lean.*** Paper presented at the 4th Annual Best of North America Conference, St. Louis, Missouri.

1.1.2 The Supplier Conundrum

After a large company's *internal* lean enterprise has been established, the exogenous elements of the lean enterprise need to be developed. Suppliers and development partners *must* be included. Therein lays a problem. While it is difficult enough to plan and execute a lean transformation *within* the company, it is much more difficult to bring suppliers into the "lean enterprise". The process involves first creating a value stream map of the supply chain and looking for key suppliers that need to be "incorporated" into the lean enterprise. Next comes establishing a real or metaphorical strategic partnership with the supplier. This is completely contrary to the "arm's length" relationship many large companies have with its suppliers. It is critical that the suppliers understand, and commit to a lean transformation. This is often attempted through education or coercion. While internal "lean transformation" is difficult, the incorporation of external supply chain partners is even more troublesome. *Internal* transformation of a company may be guided by that company's lean vision, and is facilitated by tools like the Lean Enterprise Self Assessment Tool (LESAT), and Lean Roadmaps. *External* transformation of suppliers requires that the lean company strategically partner with its suppliers and essentially "teach them" how to become lean.

Since "lean" is more of a philosophy than a prescription, the external (supplier) company must, under the tutelage of the "parent" company, establish its own lean vision and a strategy for its implementation. If the external supplier/partner is relatively large, it is possible that its operations and infrastructure are compatible with the procuring/parent companies systems and the large external supplier can adopt and use the same tools as the parent company in its transformation to lean. In many cases, a large supplier/partner is likely to be aware of wasteful practices that exist within its operation, and with a little encouragement from the parent company, the transformation to lean can be managed.

1.1.3 The Small Business Supplier in Particular

In the case of *small* business suppliers (less than 100 persons), the lean transformation is more problematic. Small businesses suppliers tend to have little formal infrastructure (IT networks, data managers, formal policies, etc.), and the small company's infrastructure is almost certainly incapable of interfacing with the larger "parent" company's "lean" system. Many small business suppliers have not even heard of lean, let alone developed a vision for a lean enterprise system. As such, the lean vernacular and lean tools can be confusing to the small company. In fact, a small business might resist a lean transformation "push" from a large company due solely from the communication boundary gaps created by a "lean" company imposing a "required lean transformation" on its smaller supplier. Unlike the larger supplier/partner, who is probably aware of waste and opportunity for improvement, the small business supplier/partner enjoys a "natural leanness" by virtue of its small size and flat organizational structure. The fact that the small business has a degree of "natural" leanness is both good and bad. It is *good* in the sense that the very fundamental philosophy of lean is already a part of the working culture within the small company. It is *bad* in the sense that its leanness comes more from its small size than from conscious operation. Furthermore, because waste is not readily apparent, demonstrating the value of a formal lean transformation to a small business may be much more difficult compared to that of a large business. In fact, much of the research conducted by the LAI has focused on developing tools and techniques for lean transformation in a large business, and relatively little work has been done in the area of small business lean.

1.2 Thesis Objectives

The objective of this thesis is to create a new lean enterprise framework for a small business that partners or supplies to large lean enterprise businesses. This thesis will report on the lean tools available to small businesses, and where necessary, modify those tools to

meet the specific operational needs of the small business supplier. If the tools needed by small business do not exist, this thesis will attempt to create the needed tools.

1.3 Thesis Approach

This document will investigate the disparities between the lean value propositions used for a large company and those of a small business supplier. For the purposes of this thesis, a small supplier company will be defined as a company of less than 100 employees that supplies goods or services to a large, lean organization. From the investigation, a framework for a "small business lean" model will be developed. Through an interview process of stakeholders within the small business supplier value chain, a mental model for small business operations will be developed. From the model, a framework for the specific needs of small business will be created. The first step in the creation of a "small business lean framework" will be to consider the explicit needs of a small business with respect to the lean paradigm. The unique operational considerations of small businesses will be identified and evaluated for its impact on the contemporary model of a lean enterprise (ostensibly developed for large businesses). Specifically, the tools available from the Lean Aerospace Initiative will be identified and contrasted against the specific needs of a small business. The tools and processes will be categorized in three categories:

1) Acceptable for use without Modification
2) Acceptable for use after Modification
3) Unacceptable or unaccounted for– New Tools are required to meet small business needs.

The collection of tools will represent the framework for "small business lean". When used accordingly, the small business supplier will be able to mesh with the operational needs of the large lean enterprise. The framework will be based upon the growing knowledge and momentum in the Lean Aerospace Initiative (LAI).

A small supplier company (Payload Systems, Incorporated) will be used as a case study for a majority of the framework creation. A second company (Etenna) will be used to verify the validity of novel frameworks created from the Payload Systems study. Additional methods and approaches will be described within the specific sections of this document. Once framework elements have been developed, those same companies will be used to evaluate its effectiveness.

1.4 Thesis Layout

Chapter 2 presents the backgrounds and operational environment of the two companies considered in this study. Chapter 3 identifies the small business model resulting from the study. In particular, the instantiation of a small business "natural lean" will be discussed. In addition, existing lean tools will be evaluated and their relative effectiveness in the context of small business lean will be discussed. The lean tools will be categorized and explored in subsequent chapters. Chapter 4 will discuss the lean enterprise tools that may be used by small businesses without modification. Chapter 5 will present existing lean tools that require modification to enhance their effective use by the small business supplier. Specifically, it will describe modifications to stakeholder needs analysis and a modified Lean Enterprise Self Assessment Tool for Small Business (SB-LESAT). Chapter 6 will identify new tools that are needed by small business. In this chapter, a novel method for identifying stakeholder value as well as an accounting method that meets the needs of small business lean measurements will be discussed. Chapter 7 will conclude the thesis by reflecting on the results of this paper, and describing the way the elements combine to form the "small business lean" framework. Also included in this chapter will be the identification of several possible avenues of future research in this area.

CHAPTER 2 -
COMPANY BACKGROUNDS

Chapter Summary

Chapter 2 describes the background of both Payload Systems and Etenna. Particular attention is paid to the companies' operational strategy and customer base, as well as the particular competitive environment as it relates to operational issues and problems. Each company's high-level strategic plan for the future is also discussed, with reference to the company's exposure to lean concepts or lean enterprise structures.

2.1 Payload Systems, Incorporated

Payload Systems Incorporated (PSI) is a small engineering and design firm located in Cambridge, MA. It was founded in 1984 to provide engineering in support of spaceflight research, with a particular focus on manned spaceflight. Since that time, the company has developed a reputation for providing top-quality, high-value science, technology, and design services to a wide range of customers, both commercial and governmental, including several international clients. The company has a strong tradition of customer needs identification and satisfaction, and that tradition is reflected in its success – PSI can claim that in 18 years of flying dozens of spaceflight experiments and other hardware, not a single experiment has experienced an unrecoverable failure once on orbit. In spite of its small size, Payload Systems can claim several "firsts": It was the first US company to place a commercial payload onboard Mir space station; it was the first US Payload Specialist; and it developed the first complex payload on-board the International Space Station.

Payload Systems has approximately 30 full-time, part-time, and consultant employees, all located in their Cambridge facilities. 90% of the employees are technical (engineers, technicians, and scientists). About half of these have advanced degrees. The company has approximately 2.5 M$ in revenue per year.

Payload Customers

Traditionally, the typical Payload Systems client is a researcher in a university that has already performed ground studies and experiments on an innovative technology or scientific theory that now required experimentation in space. Payload Systems works with the researcher and helps him/her obtain funding for the space-component of their experiment. Typically, this funding comes from one of the national space or defense agencies, e.g., NASA, USAF, NASDA (Japan), ESA (Europe), etc. Working closely with the researchers, Payload Systems designs and fabricates the experiment or hardware so that it

meets all the unique requirements of the spaceflight environment (in addition to meeting the scientific objectives). Payload is also responsible for astronaut training, launch support, mission control operations, and data and hardware recovery.

More recently, Payload Systems has expanded their expertise to become a first-tier contractor to NASA, and a first-tier subcontractor to Boeing (the company responsible for the fabrication of the International Space Station). This has led Payload to significantly upgrade their processes and capabilities to deal with the additional requirements that these new roles demand, particularly in the fields of safety, verification, and quality assurance. Since Boeing is a lean enterprise, PSI is aware that they will eventually be required to adopt the lean paradigm. The CEO of Payload Systems has begun actively researching "lean" at the Lean Aerospace Initiative, and has become a student of lean principles, but as we will see in the next chapter, there are many roadblocks on the path to lean.

PSI divides its expertise and services into the following four categories:

> ***Experiment Support***, which includes flight systems design, flight systems test protocol development, flight systems certification, payload integration, crew training, ground processing, and mission support
>
> ***Flight Systems Development***. This focuses on the design and fabrication of the hardware and software itself.
>
> ***Ground Test Support***. Payload Systems takes part in extensive ground research, and assists dozens of investigators in preparation for and performance of parabolic flight proof-testing and data collection on the NASA/JSC KC-135, providing many of these clients with the preliminary results necessary to commence preparation for spaceflight.
>
> ***Technology Innovation And Special Projects -*** Payload Systems provides technical guidance and/or conducts ground and preflight research and/or development projects in support of their clients' science and technology needs. These projects range from a few weeks to a few years in duration, and span fields from plant growth to telerobotics.

Payload's Competitive Environment

Payload Systems' major competitors are other small aerospace firms, or firms with small aerospace enterprises, such as SHOT Technologies, Hernandez Engineering, and Veridian Inc. However, because of declining space budgets, Payload Systems often finds

itself competing against much larger firms, such as Lockheed Martin and TRW. PSI's competitive advantage, compared to these larger companies (in addition to its lower overhead costs and flexibility), is the fact that the PSI is a certified Small Disadvantaged Business (SDB), which allows prime contractors to meet their SDB subcontracting goals while obtaining value for their end-products.

In this thesis, we will broadly consider the entire PSI organization, but we will focus the bulk of detailed analysis on PSI's Cell Culture Unit project, since it accounts for the majority of the revenue at the company.

Payload's External Environment, and Miscellaneous Issues and Problems

Payload Systems survived and grew in the 90's, an era that saw declining budgets and major consolidation in the aerospace industry. Its niche of providing support to small researchers at universities, as well as its proximity to the Massachusetts Institute of Technology and its network of relationships with researchers at other universities allowed it to broaden the services that it provided, while maintaining profitability and retaining good employees.

Presently, the main problem facing the company is its reliance on a single major customer (NASA) for over 60% of its revenues. This is not a long-term sustainable situation. The company is caught in a "Catch-22": it needs to spend resources broadening its customer base, but its customers also need more resources devoted to their products. Devoting more resources to business development might compromise performance on existing contracts, but not doing so ensures that the company will not survive beyond the end of those same existing contracts.

Payload Systems' goal is to provide value-added space-related hardware and services for researchers and organizations. However, the company recognizes that because of the declining national space budgets, it must seek parallel activities that can provide a

different revenue source. Ideally, these will come from spin-off activities related to the company's main business area. To this end, the company participates in the Small Business Innovative Research (SBIR) Program, which provides up to $1 M for innovative technology research related to a government or agency need. The goal is to develop a technology to the point of "proving its commercial viability". Payload has had several SBIR programs in the past, but as yet, none have led to commercial products.

More recently, Payload has funded the development of several biology-related technologies, derived from its work on the NASA Cell Culture Unit, developed for the International Space Station. However, internal resources are limited, and the company does not have experience in seeking out outside sources of funding. Identifying and securing new income streams remains a difficult challenge for PSI.

The final significant challenge that the company faces is the fact that its major customer, NASA, is a very large bureaucracy that is not very accepting of change in its hardware development process. They are very much "set in their ways". At the same time, there is a large turn-over in personnel in the agency, which project management switching every few years, which in turn leads to significant duplication of effort as the direction of the projects changes in response to the new personnel. And of course, this is done while under the uncertainties of the Federal budget process. For this reason, customer relations and interface is a major concern.

Payload's Strategic Plan

The goal of the company is to continue being a high-quality, low-cost, innovative developer of spaceflight hardware, while at the same time using the capabilities and expertise to branch out into other non-space areas. It's ideal business mix would be 40% large projects (such as the Cell Culture Unit), 30% small experiment payloads, and 30% commercial (non-government funded) projects. This would (hopefully) give it the flexibility and stability to survive changes in space budgets and economic conditions.

2.2 Etenna

Etenna is a small commercial supplier of antenna technology and electromagnetic testing services to large telecommunications corporations. Etenna was formed in 2001 as a spin-off from the Titan Corporation (NYSE: TTN), as a commercialization effort resulting from Titan's government-funded defense research and development. Located in Laurel, Maryland, Etenna employs approximately 40 employees. Etenna is one of the few "telecom startup" companies remaining after the telecommunications shakeout in the early 2000's. The reason for Etenna's survival stems from the company's narrow focus on core competency and the satisfaction of specific customer needs.

Etenna designs and produces antennas for commercial applications ranging from mobile phones to 802.11 and Bluetooth™ wireless devices. Employing Etenna's proprietary antenna technologies, the large telecommunication partner company significantly improves the size, performance and cost of its wireless devices and equipment. Etenna's main technology product and process lines make use of patented Artificial Magnetic Conductor (AMC) technology to enable high antenna performance and isolation in an attractive form factor for wireless products.

Backed by a team of researchers and design engineers, Etenna's intellectual property (IP) portfolio includes more than 30 issued or pending patents. The Titan Corporation, Archery Capital, and ECentury Capital are primary investors in the company.

Currently, Etenna is working with strategic market partners that require high performance, multi-mode, multi-frequency antennas. Etenna's current Frequency Selective Surface (FSS) technology supports these requirements, and allows the antennas to actually be smaller than standard antennas. The FSS technology creates "slow wave structures", which allow the dimensions of the antenna to be reduced, creating miniature, low profile antennas. By implementing engineered materials and patterns into mobile handsets, original

equipment manufacturers (OEMs), original design manufacturers (ODMs), carriers and suppliers benefit from the ideal combination of high performance, small form factor and reduced production cost. Etenna's uniquely engineered materials and patterns pioneer a new approach to equipment design because the company understands that the antenna—the component no wireless device can be without—has to be flexible and insensitive to its environment, allowing seamless integration into consumer electronics.

Etenna Customers

Etenna primarily seeks non-defense applications of its antenna technologies. Companies like Microsoft and Intel are the ideal customer, as are the larger telecommunications firms like MCI, Sprint, etc.

Etenna's External Environment, Issues, and Problems

Etenna faces several challenges to its viability and growth. The first challenge is the market for telecommunications products. In the last few years, the telecommunications industry has suffered significant economic hardship. Large telecommunications companies have generally scaled back their ambitious plans for rapid new technology development, or have dramatically reduced R&D spending[6], which constitutes the heart of the Etenna Business model. With the reduction in overall spending, investors have become more conservative, demanding firm deadlines and tangible proof of the company's viability. While Etenna is performing slightly better than their business plan, they clearly understand the threat of failure, and comprehend that a single mistake or setback could destroy the company.

The current economic environment for the telecommunication industry has led to a changing landscape in the competitive environment also. While Etenna has fewer

[6] McGarty, T. 2002. The Imminent Collapse of the Telecommunications Industry?, Vol. 2003: © Copyright, The Merton Group, 2002,.

competitors (many having gone bankrupt), the remaining competition is fierce. Technology breakthroughs by a small company like Etenna usually result in a fairly large, profitable product life cycle. In the "new" environment of fierce competition, technological advances are short-lived, or worse yet, the competition eats into the life cycle by developing products quickly that satisfy the same market niche[7]. Even though the product development and introduction costs remain more or less constant, the effect of competition is to reduce the actual profit area of the product life cycle. If the product life cycle profit does not exceed the product development costs, the company will lose money. In Etenna's case, the mistake would destroy the company. The model for this behavior is shown in Figure 1. To deal with the competitive landscape, Etenna' plans to create new value for the customer, while containing the product development costs. Etenna solicits company joint ventures that allow them to utilize the intellect of its staff, without committing to large volume production. Etenna designs, builds and tests "prototypes" based on customer needs. If the prototype is successful, Etenna outsources contracts to build the first limited production run, where proprietary knowledge is retained by Etenna, and operating margins are high. If the customer is satisfied with the limited production run

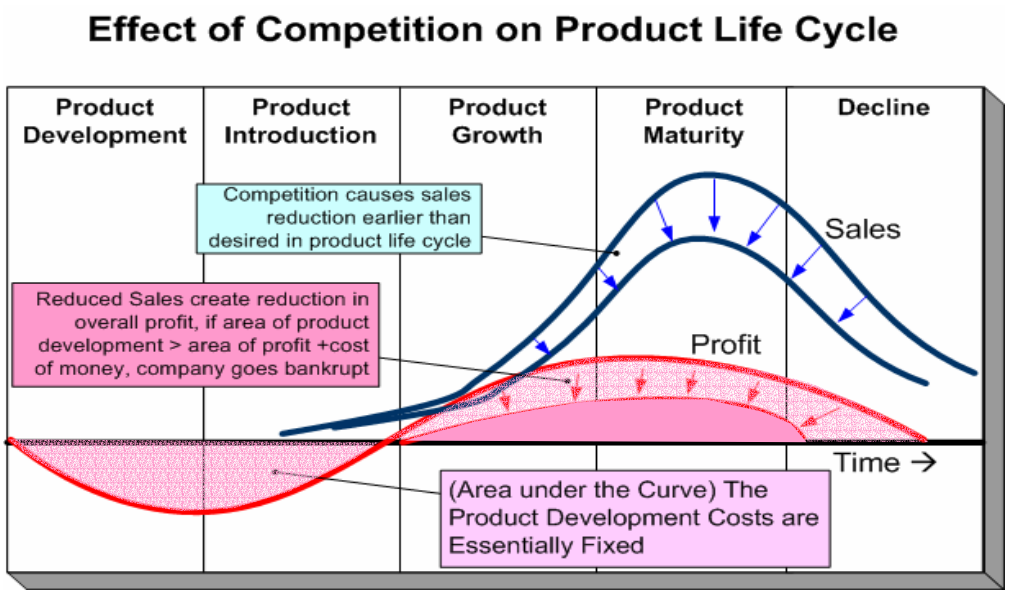


Figure 1 - Effect of Competition on the Product Life Cycle

[7] Messinger, P. 1995. ***The marketing paradigm: a guide for general managers $9 Q***. Cincinnati: South-West Pub. Co.

product, the manufacturing responsibilities are turned over to the larger partner firm, or Etenna contracts to continue manufacturing the product using outsourced manufacturing capabilities. According to Mr. Greg Mendolia, the Vice President of Marketing at Etenna, this affords Etenna the ability to provide competitive pricing through outsourced manufacturing, while protecting them from carrying the capital expense of a large manufacturing facility. Although Etenna will earn a steady income from its licensing of product and process technology, most of its income will be realized by direct compensation from the customer for the product development and limited production run profits. Knowledge, in essence, is the product Etenna sells to the larger customer.

Etenna's Strategic Plan

As part of its long-term growth, Etenna plans to expand its focus from design and product development to include production support. To this end, they selected a new CEO, Steve Grossman to lead the transformation of Etenna. He is tasked with architecting partnerships with large companies to develop commercial products. Recently, Etenna and Intel have partnered to incorporate 802.11a/b and Bluetooth antennae into Intel's future products. The two companies say they have been working together for almost a year to apply Etenna's artificial magnetic conductor to Intel's reference design mobile platforms.

While the strategic partnering association with Intel is good for the Etenna's short-term viability, it understands that there are some significant challenges ahead. First of all, While Intel is not officially pursuing a lean transformation it is attempting to streamline its strategic partnerships with small business suppliers. Intel is clearly intending that its suppliers begin a serious consideration of price and quality. Fortunately, Etenna has been built around the business and operational ideals of price and quality, and can successfully compete without any change to their operational paradigm. For Etenna, clearly there is no

stated desire to explore lean initiatives as a strategic advantage unless it can be demonstrated that it will improve the company's already impressive operational efficiency.

Chapter Conclusions

Armed with an understanding of the backgrounds of the two "case study" companies, we may begin to better understand how their organizational structure and operating philosophy play a significant role in the working culture of a small business supplier. While both companies are technical in nature, they supply technical products to two completely different kinds of customers. Payload supplies (directly or indirectly) to large, bureaucratic government organizations, while Etenna provides technology to commercial industries, where the operational dynamics are very different. Despite these differences, the two companies share some amazingly similar lean behavior. In the next chapter we will explore the shared "natural leanness" of both companies, and will present a "mental model" of small business leanness.

CHAPTER 3 –
LEAN IDENTIFICATION

Chapter Summary

Chapter 3 describes the "state of enterprise operations" observed by the small business supplier. A correlation is drawn between the way small business operates and certain principles within the lean paradigm. It is postulated that small business enjoys a certain degree of "natural lean" operation by virtue of its flat structure and facilitated communication. The special needs of small businesses are also discussed, and lean enterprise tools are evaluated against the small business needs for their applicability to a small business lean enterprise.

Identification of Lean in a Small Business Context

Conversations with upper management from both case companies revealed several consistencies in operation. While there were certainly differences in the implementation of the companies' operations and goals, there were some very strong themes that dominated the conversation. We will explore these themes to help build an understanding of "Lean" from the perspective of the small supplier company.

3.1 "Natural" Leanness

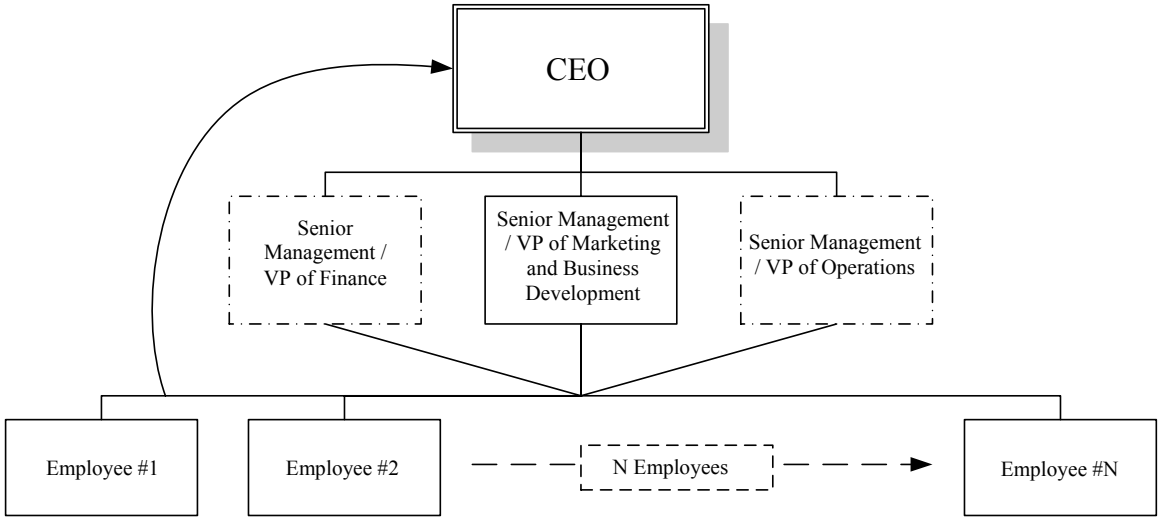


Figure 2 - Organizational Structure of Typical Small Business Suppliers

3.1.1 Lean structure

Payload Systems and Etenna have not made a formal transition to "lean", yet their operations and management views benefit from the efficiency inherent in a small group. Since the company is run by very few individual leaders, communication of the company "vision" is achieved through interpersonal exchange and direct observation of leadership behavior. Since there are very few people in the organization, the communication of

companies' objectives may occur in a single staff meeting or email broadcast. The lack of complex and layered management leads to direct access to the senior leadership by even the lowest levels of the organization. Each employee may witness personally the social, political, and cultural examples set by leadership. This allows executive management to "walk the talk" – their examples of operational vision are directly observable by each employee. In a large organization, this kind of direct two-way communication and observation is difficult (or impossible) to achieve.

The small business structure further enables resource management. The executive management of both companies know all of their respective employees, as well as their capabilities and limitations. This allows them to manage resource allocation without significant complication. As shown in Figure 2, the organizational structure in the small business is very flat, and very flexible. The employees at the bottom of the structure may interact with all levels of management, and vice versa. The CEO in a small company can, and often does, interact regularly with employees in the lower ranks of the organization, and the entire power structure is can change according to the immediate needs of the company. In Payload Systems, for example, different people can become group leaders for projects, depending on their skills. While the group leader manages the group, it is only a temporary situation, and somebody else might manage a different project. The structure is malleable to the demands of the situation. This flexibility stands in sharp contrast to that of a large business organization. Since a large business has many employees, there is almost no way for the executive management to know all the operations and resources within the company at any given time. The large company needs established procedures and structures to accomplish the company objectives. Interaction between the lowest and highest ranks in a large organization is often limited or nonexistent, and communication lags are common. Clearly, the small size of the small business is the source of its advantage.

In many ways, a small business operates like a benevolent dictatorship:

- **Centralized Power**: There is a limited, easily visible source of responsibility for the organization, usually a single owner, CEO, or small group of executive management
- **Employee Empowerment:** Because the upper management is aware of each employee's strengths and weaknesses, the leadership of a small business often delegates responsibility with the complete autonomy to accomplish the assigned task.
- R**educed Complexity of Interaction:** The limited number of people and management layers in a small company makes it possible for a small company to operate without layers of bureaucracy typically required in a larger company. Procurement in a small company, for example, can be accomplished with one or two phone calls, in large companies simple procurement can take weeks or months to process.
- **Streamlined Communication:** Due to the greatly reduced complexity of interactions in a small business (if for no other reason than by the limited number of people) communication of information from top-down or from bottom-up is rapid.
- **Rapid Decision Making:** Rapid information flow leads to rapid communication and the ability to make quick decisions. Further, it is easy to communicate those decisions both up and down the management chain.
- **Clear Vision:** It is relatively easy for the leadership of a small company to communicate its management vision. It is also easy for the company leaders to enforce that vision, and monitor its progress.
- **Every opinion can be considered.** There are few people in the organization, and few impediments to dialogue. If desired, mangers in the small business can poll and understand everyone's opinion. A majority opinion will not necessarily prevent the communication of a minority opinion.

If we are to understand the reason the small business benefits from a "natural leanness" due to its size and resultant organizational structure, we can adopt Swansburg's principles for organizational management[8]. According to Swansburg's model, an organization is nothing more than the grouping of activities for the purpose of achieving objectives. Management is defined as the means of coordinating appropriate activities with other units vertically and horizontally, which are responsible for accomplishing the company's organizational objectives. Table 2 illustrates the application of seven of Swansburg's attributes of organization in both a traditional large business and typical small business.

[8] Swansburg, R., & Swansburg, R. 2002. ***Introduction to Management and Leadership for Nurse Managers*** (2nd ed.).Chapter 14, 2002.

Table 2 - Application of Swansburg's Organizational Attributes to Small and Large Business Structures

Component of an Organization	Typical Large Business Structure	Typical Small Business Structure	Impact on "Natural" Leanness
Bureaucracy	Highly structured organization with little to no participation by the governed	A less organized structure, with active participation by the governed	Much of the source of small company natural leanness stems from lack of bureaucracy
Role theory	With multiple management layers employees often receive inconsistent expectations or information about their place in the organization, leading to stress, dissatisfaction, and ineffective performance	With fewer layers, expectations are clearly communicated, and information flows easily, facilitates lower stress and dissatisfaction about role in company.	The lean enabler for organizational efficiency
Organizational development	The large organization is more difficult to change – slower to alter the work environment to make it more conducive to worker satisfaction and productivity	The lack of overhead structure allows for rapid changes in work environment	The lack of structure provides agility in small business to change course as needed.
Autonomy	Not necessarily a function of size. The lean organization will empower employees with self-definition, self-regulation, and self-governance. In a large company, this must be developed culturally. In a small company, it is likely to be a required feature for survival.		In a small company autonomy is developed naturally.
Accountability	Less accountability in a traditional organization (easier to hide in a structure of many people)	Nowhere to hide, Each employee answers for their own actions (credit of blame).	Might be a zero-net-gain feature of small business. People that thrive on attention might do well in a small business, but it could subdue the introvert.
Adhocracy	In a large company structure, it is difficult to manage small groups of a fleeting nature. Adhocracy requires specific attention and documented processes, which adds to bureaucracy.	Simple teams or task forces are organized to accomplish goals and are then disbanded and new ones are formed to accomplish new goals.	The agility to form and shape the small business structure affords it a sense of natural lean, without additional bureaucratic overhead.
Communication	In a large company structure, it is difficult to manage information flow, and delays inevitably occur without adherence to lean enterprise principles	Fundamentally small size facilitates rapid communication up and down management chain.	The key to efficient operations is communication, as will be discussed in the next section of this chapter

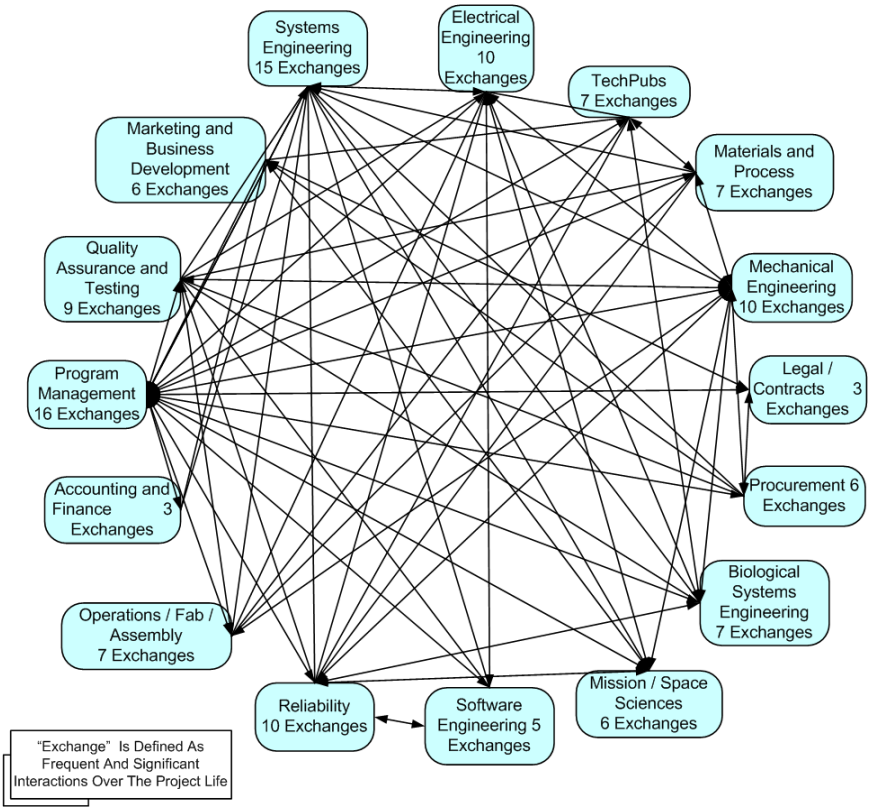
From the table, we can see that the small business contains the attributes of a well-managed organization *by virtue of its size* alone. The small business does not require particular management "will" or conscious managerial overhead to maintain certain aspects of a lean enterprise. The ad hoc nature of the small organizational structure is a definite

benefit to the operational efficiency of the small business. This is particularly true of commercial small business. In an interview with Greg Mendolia, of Etenna, the ability to know what each employee is working on at any given time is crucial to Etenna's success. Resource management and asset allocation occurs in real time, and information flow can be achieved in a single staff meeting or email routing. This type of lean structure is possible in a large company as well, but it is not naturally developed. In fact, one of the goals of a lean enterprise is to emulate the kind of leanness that comes naturally for a small company. The focus of lean principles and tools is to provide a large company with the tools needed to allow them to operate effectively.

3.1.2 Lean Communication

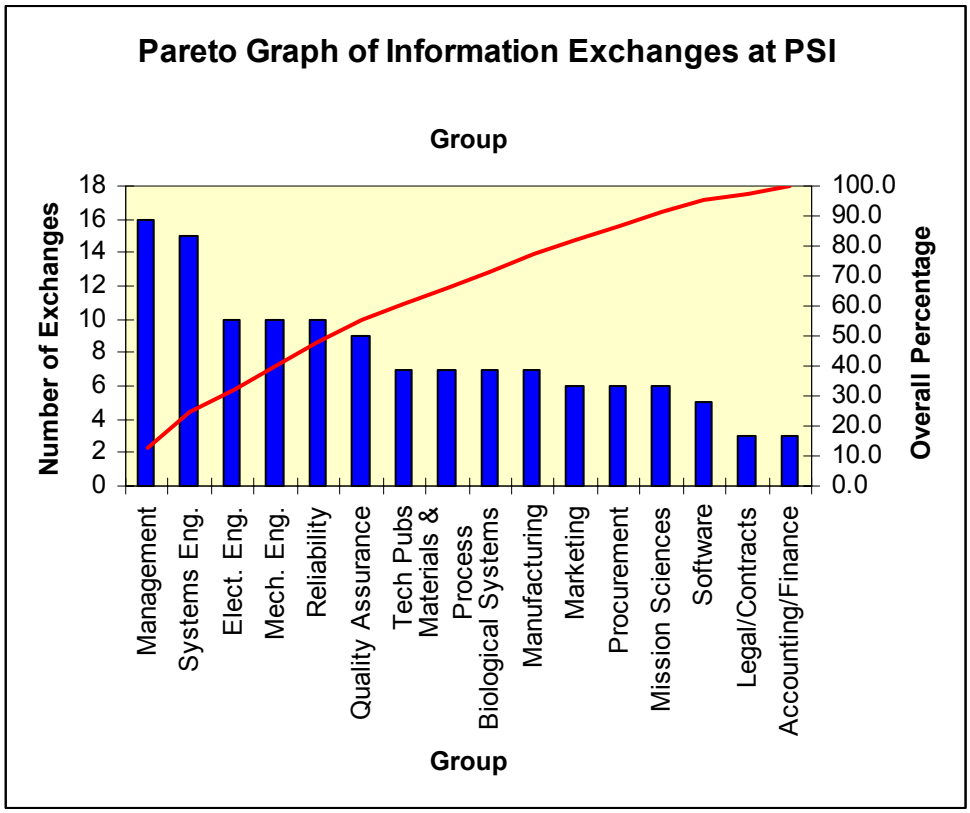
The facilitating process to the naturally lean structure in a small company is the ability to communicate. In PSI and Etenna, information flows efficiently, and leadership vision is relatively apparent to the entire staff. Leadership vision can be communicated effectively in a single staff meeting. Executive management visibility occurs through direct communication and employee observation of management behavior.

Figure 3 - Network Information Flow Diagram at Payload Systems



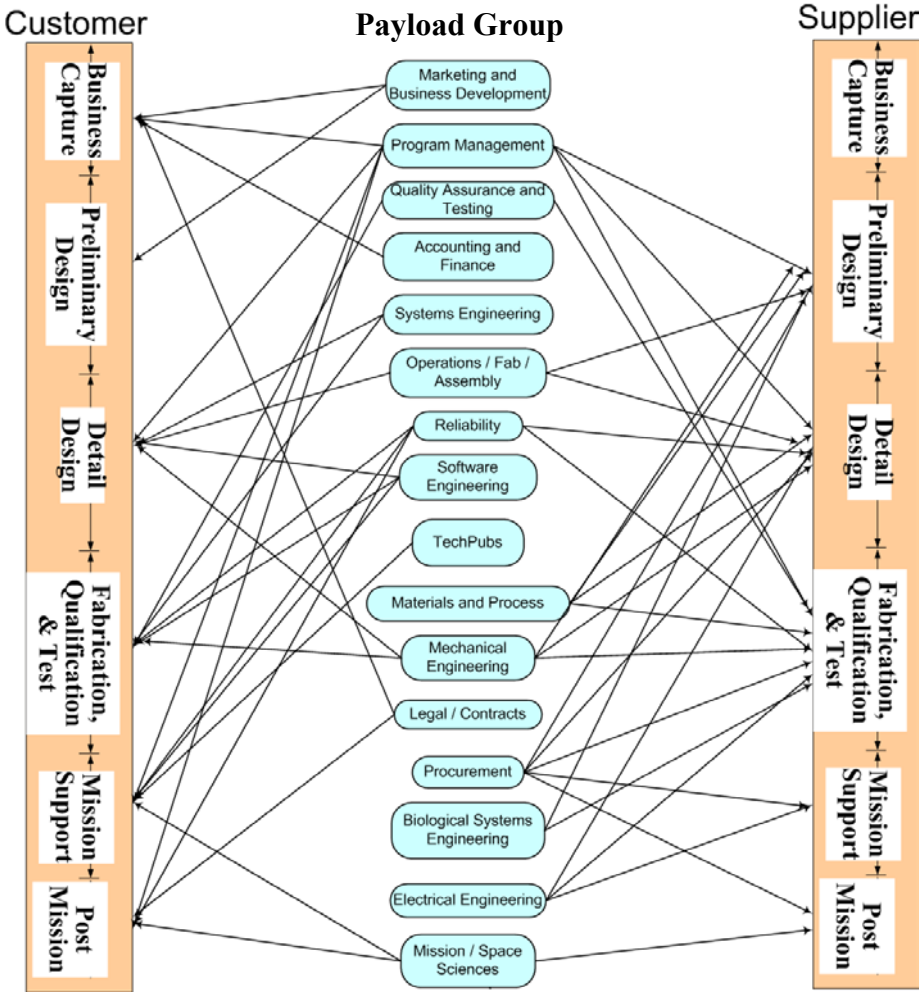
While it may be argued that PSI is organized by functional silos, the size of any given silo is one or two persons, so no large communication barrier is created. In fact, when we map the typical interactions of the different functions in the course of a typical project, we see a very balanced flow. The network flow diagram (Figure 3) describes the number of significant interactions between (internal) groups throughout the course of a typical development project. The number of significant interactions was established through the interview process with the individuals at PSI. Each group representative was asked to draw the number of significant interactions they gave or received from a different group during the course of a typical development project. When all the groups had responded, a network flow diagram was established to map the nature of the interactions. The completed network flow diagram represents the significant information exchanges within the groups, and is believed to represent the typical information flow structure at PSI. From the diagram, we see a fairly balanced flow of

Figure 4 - Pareto Graph of Information Exchanges at PSI



information within the company. Plotting the number of interactions in a Pareto diagram, we may analyze the frequency of interactions by group (Figure 4). As shown in the figure, the largest percentages of information exchanges are made to or from Management and Systems Engineering. Since these functions provide control and coordination, it makes sense that they should be highest. The striking thing about the Pareto chart is the relative flatness of the other levels. The information exchange at the engineering levels is not lopsided: no single group dominates the exchanges. Contracts and Finance make up the lowest portion of information exchanges, but that is expected, since they tend to provide a support function to the other groups (at Payload, if the project goes as planned, their input is typically needed only in the very beginning or very end of a project). It should be noted at this point that we have only discussed *significant* or *formal* information exchanges at PSI, since those were measurable. Informal information exchanges happen so frequently and casually at PSI, that the informal exchanges would be difficult to document. Based on

Figure 5 – Network Flow of Payload External Information Exchange by Group Function and Project Phase (CCU)



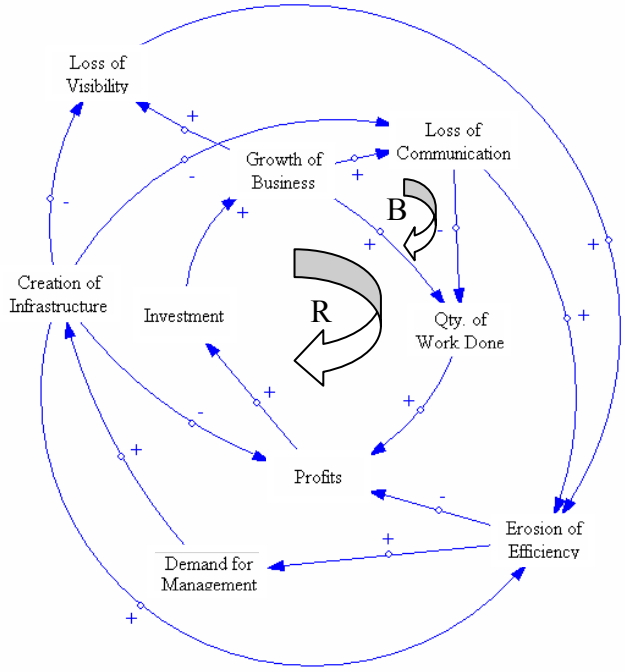
conversations with personnel at PSI, the formal exchanges are fairly indicative of the informal exchanges, but on a much higher frequency scale.

The balanced and free-flow of information at Payload and Etenna may be the single greatest enabler to the natural lean process. Immediate feedback is provided through lively communication, and waste is eliminated through the adherence to a common vision that occurs through the focused exchange of information when it is needed. When we look for communication outside the company (Figure 5), we see a similar balanced flow. At Payload Systems, there is no formal policy concerning contact of customer or supplier. The individual workers are empowered to talk to either group directly. If a particular group needs to talk to a customer counterpart, they call directly, and do not require an intermediary to "channel" customer contact. This results in just-in-time delivery of information, and represents a goal of the lean vision. This "naturally lean" communication flow is not the result of a carefully crafted strategy; it is a function of necessity. PSI cannot afford the overhead to spend "filtering" its employee's conversations, so individuals are provided *de facto* authority to gather and disseminate information as needed. Of course, more formal exchanges do take place at regular intervals (Design Reviews, Safety Reviews, etc.), and in those cases, leadership representation is provided as the communication interface. Nevertheless, the normal state of operation in the small business is to provide or request information directly to or from the corresponding responsible party without formal structure.

At Etenna, communication is equally uninhibited. Each employee is trusted to "represent" the company externally, and every employee is expected to provide or request whatever information is necessary for the individuals to complete their objectives.

3.1.3 Self-Limiting Problems with Natural Leanness

Figure 6 - Causal Loop Diagram of "Natural Leanness"



There are two immediate "downsides" to the natural lean structure of a small business. Both negative consequences of natural lean behavior limit future company growth. The first is a structural need to manage ever-increasing complexity as the company grows. The second is a dilution of knowledge that occurs over time, or as the company expands.

As a small company becomes more successful due to its naturally lean behavior, it will tend to grow and expand. Growth will require additional employees and further capital investment. As the company grows, the *ad hoc* management structure loses sight of all the employees and resources. Since no preexisting "engineered" management infrastructure exists to deal with the additional burden, management quickly loses visibility of operations and resources. Simultaneously, communication is hampered, and the company reduces its operational efficiency. Waste, or muda, becomes more difficult to identify and eliminate, particularly since personnel are working harder than ever to make up for the lost efficiency. The company struggles to regain visibility and improve communication through the creation of overhead (policies, procedures, training). The additional overhead does improve visibility and communication, but also decreases profit. This causal loop cycle of this behavior is illustrated in Figure 6. As the company grows, the very thing that made it lean (lack of structure) becomes the impediment to future growth. Without a preexisting lean plan, the company will undergo several cycles of the kind of cycle

represented by the causal loop diagram. The key for a "small business framework for lean" must include a method to introduce the benefits of lean, without adding undue overhead.

The second self-limiting feature of the small business "natural lean" behavior is the knowledge dilution that takes place as the company grows. While communication is efficient in a small business, there are (generally) few formal processes in place to record lessons learned. In the small company, individual employees may keep notebooks or journals, but there is no generally acceptable format, and almost no way to retrieve the information without consulting the originator of the document. As such, knowledge is primarily passed from one person to another, without a common, shared knowledge repository. For a small business, this is effective, and may be appropriate for a given short time period. However, when that same small company gets older, and persons with key knowledge leave the company, the informal document / verbal method of knowledge transfer is incompatible with the needs of the larger organization. Knowledge dissemination in a large company is broadly dispersed, and an individual contact may be insufficient to adequately transfer knowledge to the entire set of appropriate people within the larger company. When knowledge is not properly captured or documented in a way that future generations can access that information, it is lost over time (especially when the responsible individuals leave the company). As the company grows larger, there is an increased likelihood that lessons learned will be lost, and mistakes will be duplicated, adding waste and inefficiency to a system that previously thrived on "naturally lean" behavior.

3.2 Small Business Needs

In the previous section, we looked at the common elements that comprise a "natural leanness" within a small company. We will now turn our attention to the specific needs identified by the small business. Understanding the way small business needs may differ from larger businesses will help us understand what elements of the lean "toolbox" are

applicable for small business. It will also help us identify area where specific improvements are needed.

3.2.1 Meeting Payrolls and Leveling Cash Flow

Senior management in PSI and Etenna both remarked in conversation that one of their biggest concerns with respect to day-to-day operations was in planning cash flow to meet future payroll obligations. This does not imply that either company is insolvent. Instead, it reflects the way cash flow occurs in small business. As a supplier to large businesses, payload receives lump payments at preordained milestones in its product design and development process. Some of PSI's customers, DOD and NASA, tend to have large variations in planned vs. actual payment schedules. This often occurs during new contract start-ups, or at fiscal year changeovers. For example, in FY2003 the Department of Defense did not get an approved budget until January, even though the fiscal year started in October, 2002. The resultant lag in budget leads to large uncertainties about payment cycles for some of PSI's projects. The result of this type of payment schedule fluctuation is a kind of "economic bullwhip" effect[9]. An unmanaged cash flow is not inherently stable. Demand for cash-on-hand to meet payroll obligations increases as the time between payments increases. The company must curtail investments and store cash safety stocks against the possibility of disruption. Hiring, training, capital improvements all are delayed until the large cash influx, at which time they proceed. As multiple projects stockpile cash reserves against potential disruption, less cash is available for other programs. As the projects stretch out, small changes in payment scheduling can result in large variations in cash-in-hand. Eventually, the financial system oscillates in large swings in a "feast or famine" mode of planning and execution. In times of "famine" meeting payroll is problematic, and executive management must decide whether to withdraw money from

[9] Based on the concepts presented by Lee, e. a. 1997. The Bullwhip Effect in Supply Chains. ***Sloan Management Review***(Spring): 93-102., pp 93-102.

other programs, cash reserve "safety stocks", or borrow against future payments. The cost of money, and ensuing overhead resulting managing this economic bullwhip ultimately results in increased overall costs and reduced service.

Large companies are not immune to the economic bullwhip effect, but they tend to have many large contracts that fluctuate in the same manner. With a diverse source of incoming cash flow, "feasts" and "famines" can cancel each other out, resulting in a smoothed cash flow. In this regard, the small business needs for smooth cash flow are much more significant than that for large enterprises, and cash flow management becomes an emergent need somewhat unique to small business suppliers.

To improve the cash flow for the small business, and lower overall systems costs, strategic partnerships are required. Teaming with a large partner company may open avenues of altered payment structures that provide smoothing of the payment cycle. Shorter payment cycles of smaller payments would greatly reduce the economic burden on the small supplier, and lower overall costs.

3.2.2 Meaningful Strategic Partnership

Supply chain management is a conundrum for a small supplier company the size of PSI or Etenna. Payload, for example builds complex scientific product that require supplies in small quantities spread out over several months or years. The lack of volume therefore does not offer much incentive for "teaming" with PSI's suppliers. In fact, most of PSI's supply chain needs are satisfied through catalog-type shops like Grainger, VWR Scientific, etc. In these cases, the procurement group or individual simply looks up the desired part and orders it directly. The transaction is rapid and uncomplicated, and any change to "partner" with these companies might actually create waste by introducing complexity where none is needed. Despite this, there are areas where strategic partnering can be beneficial.

Payload's CEO, Javier de Luis, points out that supply chain optimization has been ongoing for subcontracted services at PSI, and the company has dramatically reduced the number of small machine shops it uses to provide specialty machining. Payload has elected to partner with more expensive, but more capable, shops that can better satisfy the company's needs. The CEO further speculates that additional waste elimination could occur if this number is reduced even further to allow for direct interaction with the supply chain stakeholder(s). For example, a *single* specialist at a machine shop would represent a *single* point of contact, and allow for a more common context for conversation and communication of needs. It is still uncertain whether PSI could provide enough volume of work to justify a "teaming" relationship, as opposed to the current "arms-length" transaction.

None of the supply chain at Etenna is currently included in a strategic partnership. Etenna outsources manufacturing and testing to the lowest bidder. This is indicative of the type of competitive environment Etenna operates. Supplies are commercial in nature, and procured in large quantities. Etenna purposefully designs with interchangeability of manufacturing in mind. Any capable electronics manufacturing company can build Etenna's product. Therefore, any company or country with the lowest price is selected. Controlling final cost is the key to surviving the telecommunications world, where a few cents per unit can distinguish between profitability and bankruptcy. To remain nimble and competitive, Etenna chooses not to create long-term strategic partnerships with the companies it provides service. While the details of Etenna's partnership with Intel are proprietary, Mr. Mendolia mentioned that Etenna desires a contract-for-service relationship with Intel, freeing the company to pursue Intel's competitors. The difference between Etenna and Payload Systems in this case is clock speed. The term "clock speed" (Fine, 1998) refers to the rates at which companies and industries evolve. Industrial clock speed is measured by the rate of change in product development, process creation, and organization renewal. The telecommunication industry is an example of an extremely rapid clock speed. Research and

development of NASA payloads is on the other end of the spectrum, and exhibits much slower clock speeds. It is not that Etenna does not develop strategic partnerships with its customers or supply chain, it is that the lifespan of those partnerships is much shorter lived. Several months or a year of partnership at Etenna have the same general implications that a multiyear partnership might have with Payload Systems.

It is therefore a specific need of the small business to develop strategic partnerships within the context of the clock speed of the company. Lean tools must be created that allow for rapid measurement of lean value from a strategic partnership, but must be flexible enough to accommodate long term strategic partnerships as well.

3.2.3 Meaningful Measurements of Progress

The current accounting system and financing activities at PSI and Etenna are "right sized" to fit the needs of the small business. Even so, both companies realize that the accounting measurement system is incapable of providing a clear picture of profitability. Worse yet, the accounting information does not provide the ability to make necessary managerial decisions. PSI is attempting to change its accounting system to more accurately capture value. They are reviewing activity-based accounting, and other methods to improve the direct access of financial information to aid in the decision-making process. As a company, Etenna is still very young, and is still establishing its policies and procedures, and is not actively pursuing alternate measurement systems, but acknowledges that "it would be great if there were a system that told me if I was making good decisions."

A common theme recurs in conversations with both companies: A single bad decision can destroy the company. Small businesses need to understand their decision making within the context of a meaningful accounting measurement system. For example, Mr. Mendolia states that he would welcome the lean paradigm if it meant a real increase in

profits for his organization, but stipulates that there would need to be a way that he could measure its effectiveness in real time.

3.3 Evaluation of Existing Lean Tools

While lean "philosophy" establishes the vision that drives progress towards a lean transformation, lean "tools" enable and measure that progress. Several enabling tools exist within the lean paradigm, but most were developed for use by large companies that do not necessarily enjoy a state of "natural leanness" that is inherent in small companies. Moreover, the strategic, political, and cultural differences observed in a large company may not apply to those of a small business supplier. Before a small business "lean framework" can be effective, a review of the available enabling and measuring tools is required.

There are three possibilities when reviewing existing lean tools:

1) The tool is acceptable without modification.
2) The tool requires modification to tailor it for the special needs and structures of a small business supplier.
3) Existing tools are insufficient or nonexistent and need to be created to meet additional small business needs.

The first step, then, is to review the existing lean tools. Several lean tools were taken to Payload Systems for evaluation. Based upon the specific needs of the organization, and the lessons learned from previous interviews, the lean tools were evaluated for application to small business needs. Tools that were deemed acceptable for use without modification included the **Enterprise and Production Operations Transition-To-Lean Roadmaps** (LAI, 2000), and the **value stream mapping** process. The **Lean Enterprise Self Assessment Tool** (LESAT) (Nightingale et al., 2001) was recognized as potentially valuable, but in need of modification to address the special needs of the small business as well as provide less dependence upon lean vernacular. The **Stakeholder needs**

performance matrix was also identified as a tool that is potentially useful, but in need of modification to improve its value for use by small business. Two additional tools were identified as specific needs for the small business supplier. The first is a way to **analyze customer value** without investing in a large marketing program. The second is a **measurement system** capable of capturing progress against lean goals, as well as assist in the decision making process. We will discuss each of these topics in the upcoming chapters, and include their adaptation to small business supplier needs.

CHAPTER 4 –

LEAN TOOLS THAT CAN BE USED BY SMALL BUSINESS WITHOUT MODIFICATION

Chapter Summary

Chapter 4 provides a summary of lean tools that are acceptable for use by small business suppliers without modification. As they currently exist, these tools contain sufficient content for small business use without substantial additional training in "lean theory" or taxonomy. Further, these tools provide clear benefits to the small business supplier, regardless of their state of "leanness". The tools identified within this category are the Lean Enterprise Model, the Enterprise and Production Operations Transition-To-Lean (TTL) Road maps, and the Value Stream Mapping Process.

As discussed in the previous chapter, there are lean tools available to the small business supplier that may be used "as-is" to assist the business identify and eliminate waste, and operate more efficiently. These tools were evaluated at Payload Systems through interviews with senior management, and there was good general agreement that these tools were both self-explanatory and of immediate value to the lean small business supplier. Since no modification was required for their immediate assimilation into a small business culture, no attempt will be made by this thesis to alter the tools in any way. Instead, a brief description of each tool is provided to illustrate the direct benefit to the small business supplier.

Figure 7 - LEM Overarching Principles

Human-oriented Practices

- Promote lean leadership at all levels
  Align and involve all stakeholders to achieve the enterprise's lean vision.
- Relationships based on mutual trust and commitment
  Establish stable and ongoing relationships within the extended enterprise encompassing both customers and suppliers.
- Make decisions at lowest appropriate level
  Design the organizational structure and management systems to accelerate and enhance decisionmaking at the point of knowledge, application, and need.
- Optimize capability and utilization of people
  Ensure that properly trained people are available when needed.
- Continuous focus on the customer
  Proactively understand and respond to the needs of internal and external customers.
- Nurture a learning environment
  Provide for development and growth of both organizations' and individuals' support for attaining lean enterprise goals.

Process-oriented Practices

- Assure seamless information flow
  Provide processes for seamless and timely transfer of, and access to, pertinent information.
- Implement integrated product and process development (IPPD)
  Create products through an integrated team effort of people and organizations that are knowledgeable about and responsible for all phases of the product's lifecycle, from concept definition through development, production deployment, operations and support, and final disposal.
- Ensure process capability and maturation
  Establish and maintain processes capable of consistently designing and producing the key characteristics of the product or service.
- Maintain challenges to existing processes
  Ensure a culture and systems that use quantitative measurement and analysis to improve processes continuously.
- Identify and optimize enterprise flow
  Optimize the flow of products and services, either affecting or within the process, from concept design through point of use.
- Maintain stability in changing environment
  Establish strategies to maintain program stability in a changing, customer-driven environment.

4.1 Lean Enterprise Model

The Lean Enterprise Model (LEM) is a "large business" framework designed to serve as a catalyst for change in the defense aircraft industry. But the LEM appears have a similar value to the small business supplier. In essence, the LEM encompasses lean enterprise principles and practices. Currently available only to LAI consortium members, the LEM serves as a reference to help companies better understand the concepts of lean as they pertain to their own organizations and

processes[10]. The LEM is intended to provide insights about where a company might direct lean efforts in the future. There are twelve Fundamental practices described in the Lean Enterprise Model. The practices themselves form the "lean paradigm". Figure 7 contains the twelve overarching principles of the LEM. While it is not the purpose of this thesis to describe these practices in detail, a general summary of the practices is provided below. Further information regarding the LEM can be obtained by contacting the Massachusetts Institute of Technology Lean Aerospace Initiative.

4.1.1 LEM Practices and Their Relevance to Small Business Suppliers

Identify And Optimize Enterprise Flow –The goal of this practice is optimization of the flow of products and services from concept design through point of use. This includes both upstream and downstream influences on the product or service. The metrics used to measure progress against this goal is time, from the actual flow time to the total product development cycle time (from concept to launch). As lean practices pick up momentum in the company, and waste is eliminated, the time required to deliver value will also be reduced. This process is facilitated through the use of engineering models and simulation, process flow management, Work-in-process inventory reduction, and reduction in flow paths. This practice applies universally to both large and small businesses, and as such, does not require modification.

Assure Seamless Information Flow – Process and product flow improvements must occur with corresponding improvements in information flow. The importance of efficient information flow was discussed in Chapter 3. It turns out to be a *required* element for the LEM, which stipulates that a company must "Provide processes for seamless and

[10] Nightingale, D. 2003. Lean Aerospace Initiative.

timely transfer of and access to pertinent information." Metrics for progress in this area deal with use of common tools, like databases, and sharing information with customers and suppliers. Information retrieval time will also be reduced as this practice ensues, and provides a further measure of lean progress. Facilitating this practice are common usage databases, information links to strategic partners and removal of bureaucratic communication systems. This practice directly addresses one of the self-limiting behaviors of "natural leanness" – the loss of knowledge as the company grows. With an established common process for archiving and retrieving information, the small company is able to grow without repeating past mistakes.

Optimize Capability And Utilization Of People - This practice ensures that properly trained people are available when needed. In essence, this practice describes the value of a learning organization combined with sound resource management. A measurement of progress against this practice is an increase in output per employee at the same, or increased, number of training hours per employee. This practice is facilitated by employee education and training programs. Since this practice has obvious and direct implications for both large and small businesses, it is universally applicable to small business suppliers without modification.

Make Decisions At Lowest Possible Level – the goal of this practice is to enhance decision making at the point of knowledge, application, and need. In other words, this practice empowers employees with the authority to make decisions within their realm of responsibility. Delegation facilitates this practice, as does employee and management training to understand the responsibilities of the decision maker. Small businesses already enjoy an advantage in this area due to their "natural leanness" as described in Chapter 3.

Implement Integrated Product And Process Development – In this practice, interdisciplinary teams are integrated that are knowledgeable of, and responsible for, all phases of the product's life cycle. The integrated teams work together to minimize product development time, reduce the number of changes made after design release, and improve overall efficiency and operation. Suppliers and customers are often key members of these IPTs. This practice is enabled through systems engineering practices, strategy sessions, and is facilitated by active communication. This practice has two implications for small businesses, the first is reinforcing a process that occurs naturally in the small business (integrated process development); the second is the creation of opportunities to secure membership in large partner companies' IPTs. With membership in the large procuring company's IPT, the small company can be more proactive to customer needs, and have input to key design decisions that affect the enterprise. The customer's design benefits from direct supplier involvement, the supplier benefits from increased awareness of requirements (with the ability to modify those requirements before the final design is committed).

Develop Relationships Based On Mutual Trust And Commitment - The goal of this practice is to establish stable cooperative relationships with strategic suppliers and customers. The key to this practice is to establish common grounds of "win-win" relationships within the cooperative relationships that serve both company's best interests. In this practice, benefits from the lean transformation are shared with the partner companies. For example, cost savings of supplier is passed on to customer in the form of lower prices. It is important to note that this partnering relationship should first start within the company, between management and labor. When mutual trust and commitment is established internally, external partnering may begin. Progress in this practice is measured by a marked reduction in "arms-length" supplier relationships in favor of a smaller number of more significant partners. Since this practice directly addresses the small business

supplier's need for more meaningful partnership with large customer companies, it is acceptable for use without modification.

Continuously Focus On The Customer – In this practice, a lean company attempts to proactively understand and respond to the needs of the internal and external customers. Stakeholder needs become the driving force within the company. The implications of this practice are the same for both large and small businesses alike, and the practice is therefore acceptable without modification. In fact, this element is so important, additional tools are suggested in chapters 5 and 6 to help provide measurement against company progress in this area.

Promote Lean Leadership At All Levels – The essence of this practice is to achieve a common understanding and vision of lean operation. The vision must start within the company, and when established, extend to upstream and downstream partners. The establishment of real managerial and employee training and incentives as well as good communication plays a vital role in facilitating this practice. The key is to foster a lean culture within the company by setting leadership examples and conducting day-to-day business in a manner that is consistent with the company's lean objectives. This practice states explicitly what is generally implicit in a small business operation. As the small company grows, its need to explicitly address this topic becomes increasingly important, and therefore, this practice is acceptable without modification.

Challenge Existing Processes – This practice is a cultural reflection of the lean mentality. The key to this practice is to challenge assumptions and models about the "best" way to do business. In the lean paradigm, employees and management are continuously looking for ways to improve value and eliminate waste. Root causes are sought for problems and actions are undertaken to eliminate their recurrence. Measurements of

efficiency and progress against lean objectives are keys to this practice. Throughput Accounting (Described in Chapter 6) is one method to facilitate this practice, other methods include training and education, periodic process reviews, process failure-proofing, and good bottoms-up communication. The implications of this practice are the same for both large and small businesses alike, and the practice is therefore acceptable without modification.

Nurture A Learning Environment – Continuous improvement occurs through continuous learning. The development and growth of organizations and individuals is the key to attaining lean enterprise goals. Employees must sustain their competitive advantage through continuous learning. This process includes learning from others within the company by communicating "lessons learned", or through pier reviews of projects or cases. Cross-training, educational encouragement and reward systems aligned to incentivize learning are examples of enablers for this practice. Since there is a tendency in both small businesses and small businesses to focus on the immediate tactics of a business process, it is easy to overlook the importance of continuous growth. This practice is essential for all businesses, and is acceptable for small business without change.

Ensure Process Capability And Maturation - The goal of this practice is to establish and maintain processes centered on capabilities. Failure to understand and plan to a product or process capability invites poor results and waste generation. To understand capability, a measurement system is needed. Statistical process control, documented standard practices, and continuous improvement interact to provide a sense of a product's capabilities. Since process control requires capability measurement, and ultimately is linked to quality and customer satisfaction, this practice applies equally to small businesses or large ones, and is therefore included in the small business framework.

Maximize Stability In A Changing Environment – Earlier in this chapter, we considered the "economic bullwhip effect" of financial instability. The need to establish stability in design, product flow, and management is equally important. The purpose of this last practice is to create an environment where products are "pulled" through the system in a planned and stable manner. Demand must be managed and planned to stabilize flow. Financial, managerial, and product safety stocks must be used judiciously to allow for stability in the face of a continuously changing competitive landscape. Since stability is particularly important in small business (fewer programs to balance feast of famine events), it is acceptable as a practice without modification.

4.1.2 Limitations to the LEM

The LEM provides taxonomy of lean practices, metrics and supporting data. The LEM serves as a tool to guide both industry and government LAI consortium members along their journey towards "lean". By design; however, the LEM does not provide information on "how-to" become lean. Nor does it provide guidance on the appropriate order or sequence in which to effectively implement the lean practices. The transition to lean roadmap is required to help with the "what to" and guides the "how to" aspects of a lean transformation. We will describe this tool in the next section.

4.2 Transition to lean (TTL)

To facilitate the "what-to" and the "how-to" processes in the context of a lean transformation, Transition-to-Lean (TTL) modules have been developed by the LAI. The TTL modules include both an enterprise level and a (production) operations level model of lean implementation steps for a company to follow. While this section will only describe the fundamental aspects of the TTL, the TTL itself is very detailed, and the reader is encouraged to contact LAI for more information.

The Enterprise and Production Operation TTL models allow a user company to create a path to follow to become lean. A precedence model is created, with descriptions of specific actions required to enable each element of the diagram. Precedence diagrams represent the priority and sequence of activities to be performed when implementing lean practices. These diagrams provide a roadmap, and serve as a tool for organizing lean principles. Where the LEM merely describes the practices, the TTL sequences and prioritizes the specific steps necessary to accomplish the LEM practices. Descriptions are developed for each precedence activity in the diagram. According to Professor Debbie Nightingale[11], LAI Director at MIT:

> *"These descriptions comprise some or all of the following elements:*
>
> *1) Discussion of what each box or node means, including definition of terms;*
>
> *2) Recommendations on industry "best practice" in implementing the activity;*
>
> *3) Examination of potential implications of the practice; and,*
>
> *4) Review of alternative approaches. Figure 1 below identifies the TTL product vision."*

The TTL Product vision is provided as illustration of these points in Figure 8. The output of the TTL process is a tangible plan that plots the course of the lean transformation within the company. Since each company is different, no two TTL roadmaps will ever look exactly alike.

[11] Nightingale, D. 2003. Lean Aerospace Initiative.

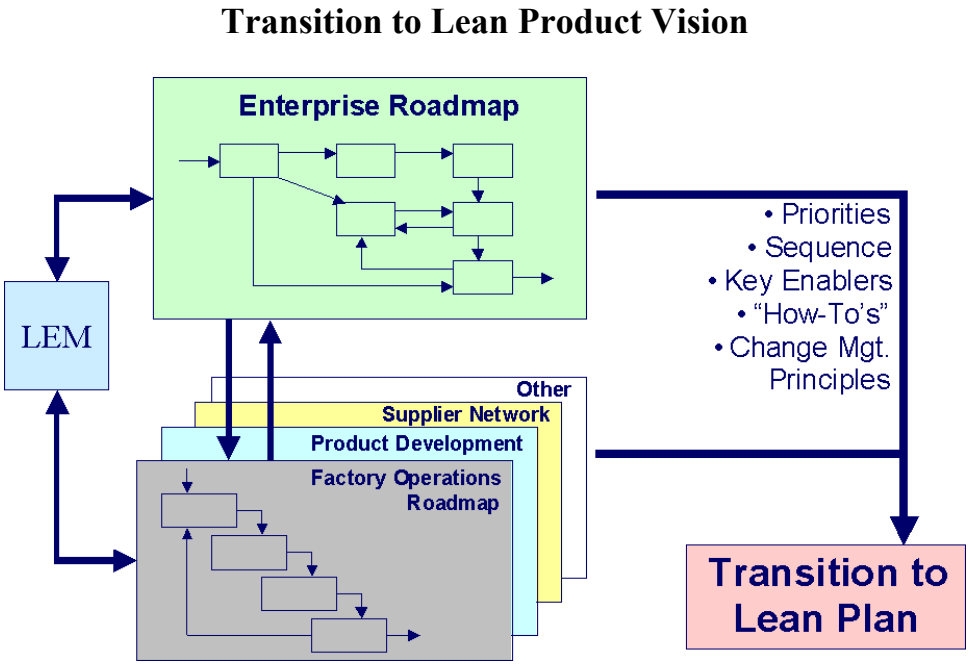


Figure 8 - Transition To Lean Product Vision

(Source: Deborah Nightingale, Director, Lean Aerospace Initiative, Massachusetts Institute of Technology, Cambridge, Mass, 1998)

As shown in Figure 8, many elements external to the company are considered to create a company's roadmap. In fact, the TTL usually consists of two or more products. For example, there may be an enterprise-level TTL that addresses the strategic and cultural transformation of the company, and a second one that addresses the production operations in more detail. Depending on the sources of value or waste within the company, TTL roadmaps may provide the most benefit when a narrowly focused TTL is guided by an overarching enterprise level TTL. An example of an operations roadmap for a typical production process is included in Figure 10. This specific set of steps was guided by a broader enterprise-level TTL roadmap, as shown in Figure 9.

The TTL is currently available to through the LAI website (http://lean.mit.edu), and it remains a valuable tool for small business suppliers to use to develop a sound strategy for

transition to lean. To facilitate the transition to lean, the LAI consortium has published a guide that describes a detailed process of creating a transition to lean. The Enterprise TTL Guide is made up of three volumes that provide a set of materials allowing the user to understand and navigate through the Transition To Lean Roadmap at increasingly deeper levels of detail. It is not the purpose of this paper to describe the specific details of use of this tool, but a summary of the volumes is provided below, and the reader is encouraged to consult the Lean Aerospace Institute Consortium for more details.

Volume 1 - This volume contains an "executive overview" of the lean paradigm, and invites the Enterprise Leader and Lean Change Agents to understand the compelling 'whats and whys" of the lean vision and the fundamentals of the lean transformation.

Volume 2 - The Transition-to-Lean Roadmap described in this volume provides the next level of description and detail in understanding the nature and scope of the tasks required to complete each of the primary activities that make up the dynamic roadmap.

Volume 3 - The Roadmap Explorations described in this volume provide an in-depth exposition (using a common template) of each of the twenty-two tasks identified within "roadmap addressing".

Each of these volumes combine to provide important and detailed processes for the small (or large) business to re-architect its structure and operations in a way that ultimately provides *more value* for all stakeholders. The TTL was easily understood by senior management at Payload Systems, and since the tools already contain the flexibility to adapt to small business needs, the tool was acceptable for use without modification.

Figure 9 - LAI's Enterprise Level TTL Roadmap

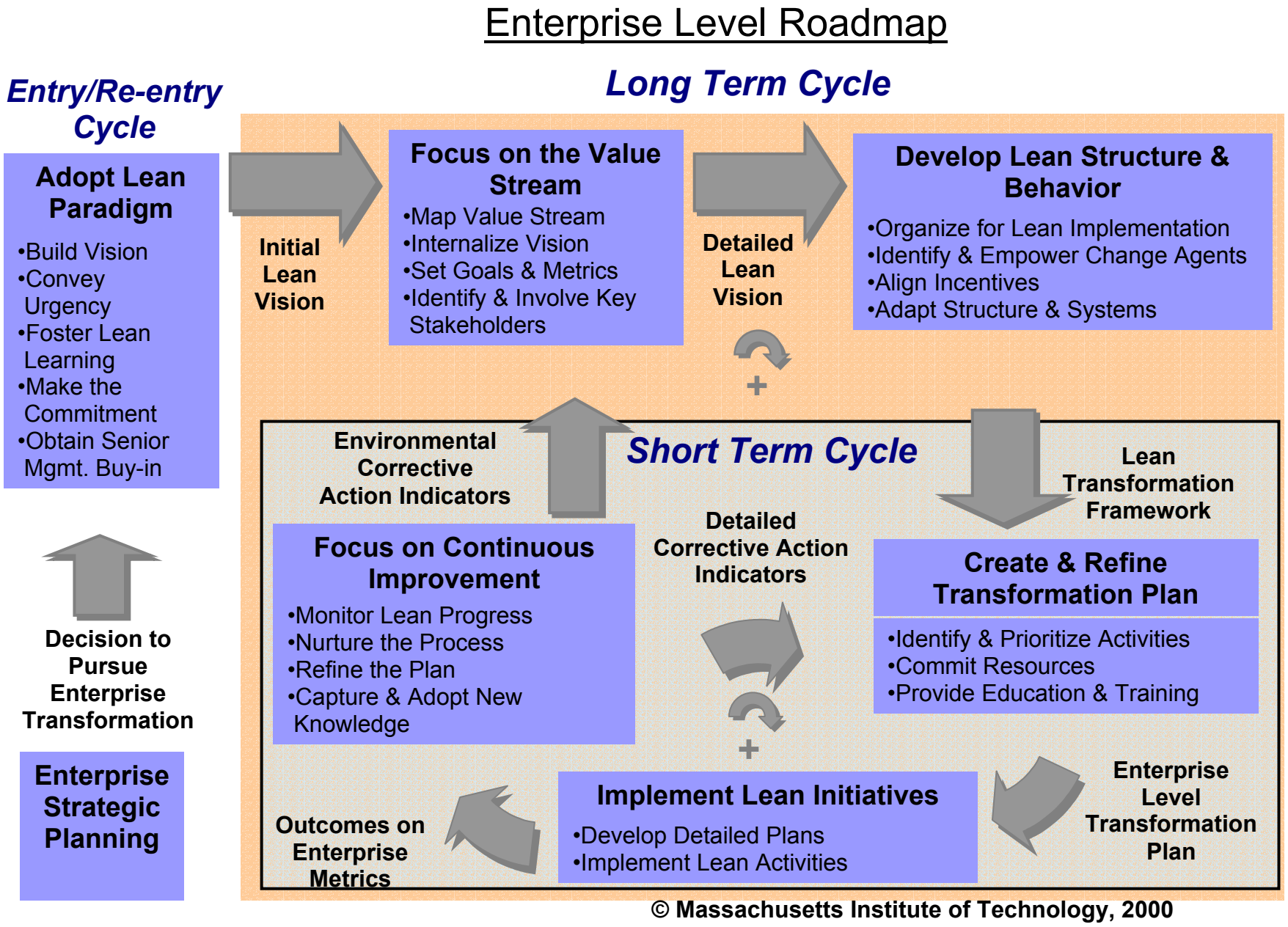
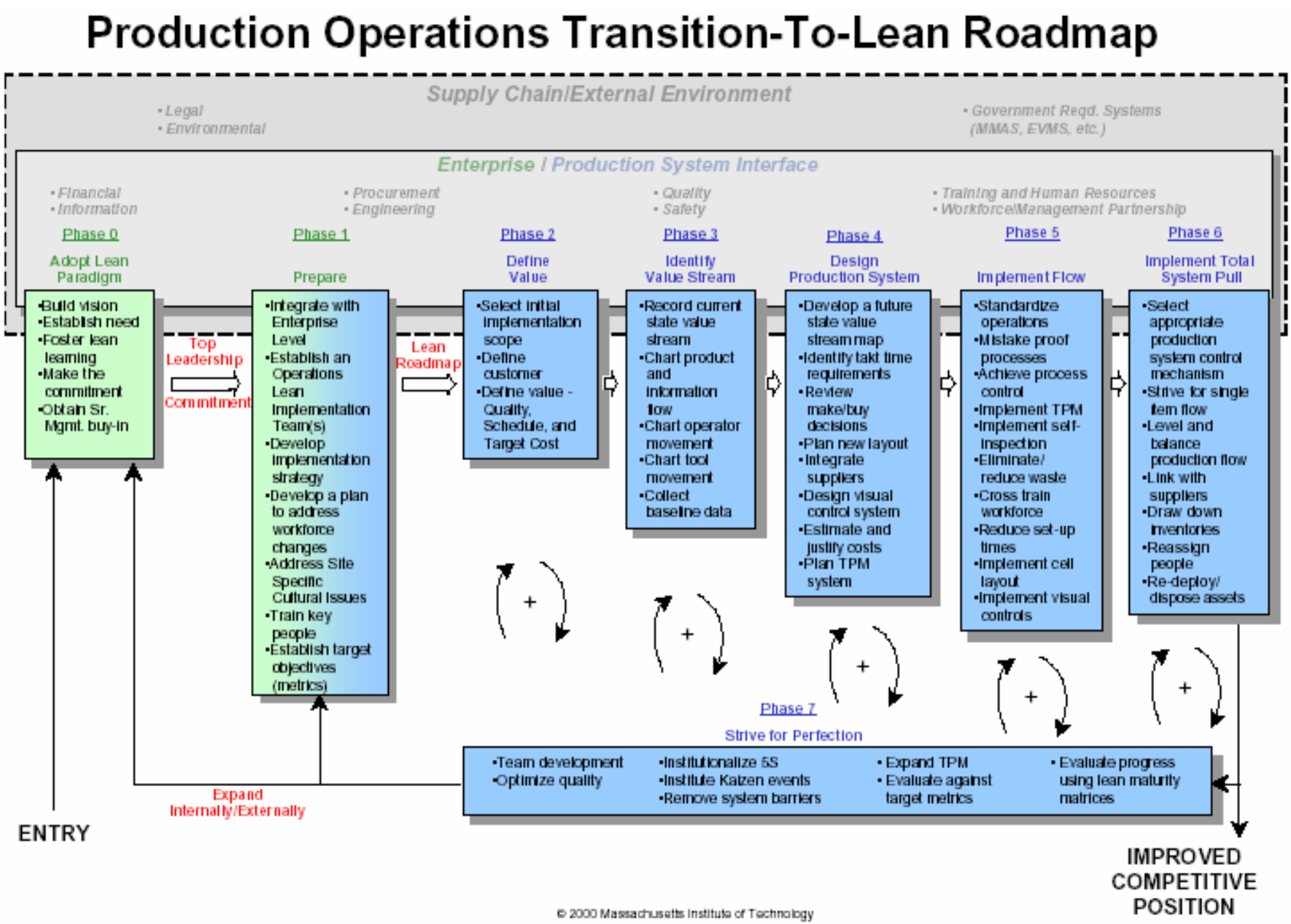


Figure 10 - LAI's Production Operations TTL Roadmap



4.3 Value stream mapping

A lean transformation requires a thorough assessment of the current situation, a meaningful model for improvement and a plan to get there. A value stream map (VSM) meets those needs. A VSM is a compilation of all the steps and actions required to bring a product from early concept through product delivery. In its basic form, the VSM displays the essential elements that a product or service contains to enable it to transition from raw material into to customer delivery and usage. The goal of a VSM is to graphically identify and eliminate the waste in the process. Typically, a product or service contains three types of elements:

1) Value added (what the customer is willing to pay for)

2) Necessary, but non-value added (elements that the customer does is not necessarily willing to pay for, but are required for the product or service to exist)

3) Non value added, also known as muda or waste; any activity that does not add value to the final product.

Value stream mapping involves mapping out two value streams. The first is an illustration of the current state ("Current State Map"), the second is a map of where the company wishes to be in the future ("Future State map"). Mapping out the activities in a value stream includes recording the specific process steps, with cycle times, down times, in-process inventory, material moves, and information flow paths. The result of the process is to help visualize the current state of the process activities and provide a guide to the future desired state.

There are several good texts describing value stream mapping (references 3, 21, 27 in the bibliography). The process used for small business VSM is identical to the processes described by these reference materials. An example of value stream mapping for PSI's cell culture unit is included in Figure 56 (shown on page 183).

CHAPTER 5 –
LEAN TOOLS THAT REQUIRE MODIFICATION FOR USE BY SMALL BUSINESS SUPPLIERS.

Chapter Summary

Chapter 5 provides a summary of lean tools that are acceptable for use by small business suppliers when modified to fit their special needs. As they currently exist, these tools are limited in their ability to provide maximum value to the small business due to their use of language, or reference to large business operations. In many cases, the size and operation of a small business do not permit the use of these tools without support of market research, or immersive training in "lean theory" and taxonomy. When modified, these tools provide clear benefits to the small business supplier, regardless of their state of "leanness". The tools identified within this category are the Customer Needs Identification Matrix and the Lean Enterprise Self Assessment Tool.

Lean Tools that Require Modification for use by Small business Suppliers.

In the previous chapter, tools were identified that can be used directly by small business suppliers without modification. Since these tools were essentially self-contained, defining terms as needed, and providing clear correlation of value within the small business context, they required no alteration for small business use. Within the Lean Aerospace Initiative, additional tools exist with the potential to be of equal value to the small business, but the utilization of these tools is impaired by their current constitution. For example the existing lean "supplier needs identification tool" does not provide the objective ranking and performance measurement capability needed by a small business, without an influx of marketing information. Since the small business does not generally have the kind of operational overhead required to support market research, a modification to the tool is needed to provide additional value, while keeping intact the intent of the tool. In the second case, the tool presumes the structure of a large organization, and further presumes a fairly active knowledge of lean concepts and taxonomy. Since small businesses are generally less familiar with lean concepts and vernacular, the tool is made more accessible, and has been rewritten to match the operational structure of a small business supplier.

5.1 Stakeholder Needs Analysis Tool.

5.1.1 Background: The tool as it currently exists

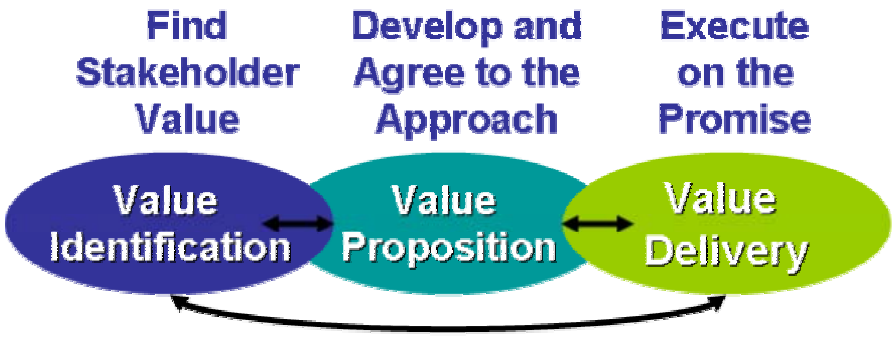
As stated in the Introduction, stakeholder value plays a large role in establishing a company's lean vision and goals. Murman et al[12] defines stakeholder value as:

> *"How various stakeholders find particular worth, utility, benefit, or reward in exchange for their respective contributions to the enterprise."*

[12] Murman, E., Allen, T., Bozdogan, K., Cutcher-Gershenfeld, J., McManus, H., Nightingale, D., Rebentisch, E., Shields, T., Stahl, F., Walton, M., Warmkessel, J., Weiss, S., & Windall, S. 2002. ***Lean Enterprise Value : Insights from MIT's Lean Aerospace Initiative***. New York: Palgrave.

Nightingale[13] describes the dynamic and iterative process of capturing stakeholder needs by representing it as shown by Figure 11:

Figure 11 - Value Roles in the Lean Paradigm



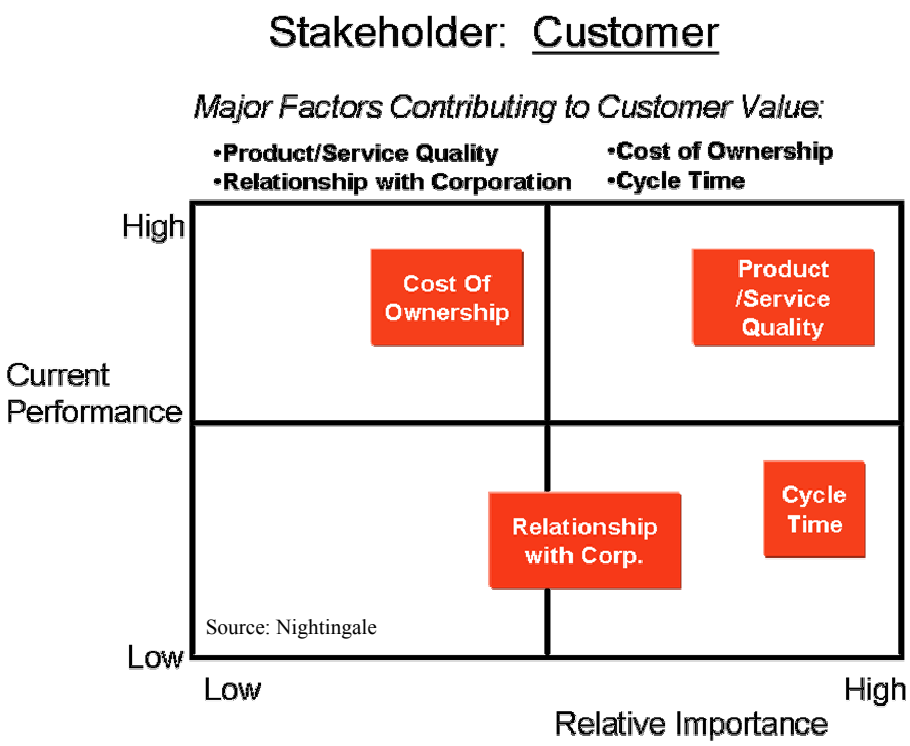
As illustrated, the first step in providing value to the customer is to find out who the stakeholders are, and what they value. In a large company, marketing groups exist to help identify the company stakeholders and can provide insight into the customer needs and values. Often, the large company is able to conduct extensive market research to accurately characterize the large company's stakeholders, and what they value. In a small company, this is usually not the case. Stakeholders may be relatively easy to identify, given the completion of the value stream map, but understanding the stakeholder *values* may be difficult. Further, it may be difficult to assess which values are more important to concentrate on, and which values are currently being satisfied by the small company.

One of the tools available to large businesses for the identification of needs is a "stakeholder needs and values map". This tool helps the user define and model its efficacy of its needs fulfillment against the relative importance of that need to each prospective stakeholder. The process is relatively straightforward. For each stakeholder, the needs of that stakeholder are listed. For each need, the relative importance of the need is assessed, as well as the company's estimate of how well they satisfy that company's need. Each stakeholder's needs are plotted against the company's satisfaction estimate, in a quadrant

[13] Nightingale. 2002. Value and Enterprise Stakeholders: MIT.

box diagram as shown in the example below. By comparing the current performance vs. the relative importance matrix, the company can decide which needs it must improve. In the case of the example shown below (Figure 12), the stakeholder was identified as the "Customer". The customer needs in order of importance are as follows: (High) Product and Service quality, (Rapid) Cycle time, (Good) relationship with the corporation, and (reasonable) Cost of ownership. These needs form the horizontal coordinates for the chart. The vertical coordinates for the chart are supplied by the company's perspective of its relative current performance satisfying the customer's needs. The company judges that it performs well against the customer's need for Reasonable Cost of Ownership and Good Product and Service quality. The company also judges that it is not adequately performing well against the customer's need for Good Relationship with the Corporation and Rapid Cycle Time.

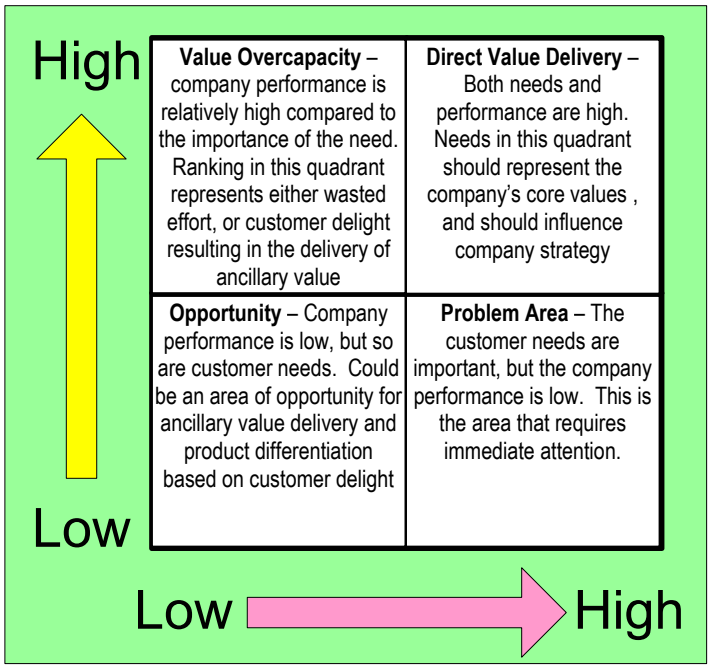
Figure 12 - Customer Needs Delivery Evaluation Matrix



The current embodiment of this tool allows the user to rank the products relative to each other in quadrants. As shown in Figure 12, the ranking of each need in its specific quadrant creates an opportunity for company strategy. The lower right hand quadrant of the chart represents the most important needs with the lowest current performance. This quadrant identifies the group of needs the user's

company may wish to develop first along its journey to "lean". The upper right hand quadrant of the chart identifies which needs are both important and "well delivered" by the company. The upper left quadrant represents a kind of "value delivery overcapacity" – meaning that they are delivering high value against a rather lowly ranked customer need. This quadrant could be interpreted two ways: 1) the area could represent wasted effort (working to deliver high performance at the expense of other, more important needs); and, 2) It may represent a particular "niche" that the company serves, delivering value to the customer that differentiates its products and services from its competition. This quadrant must be studied closely by the company to determine whether the area represents additional resources for further value delivery against higher priority needs, or some kind of latent, but defining "ancillary value[14]". The lower left hand quadrant of the chart represents the areas where the relative importance of the need is low, and the corresponding value delivery by the company is also relatively low. How the user decides what to do with this information depends largely on the company vision. For a company that is largely delivering value to its customers (no needs in the lower right hand quadrant), the lower left quadrant could represent an area to develop strategic advantage. The lower left could signify product differentiation, and possible competitive advantage. For a company that is not delivering performance in the important areas, the lower left hand

Figure 13 - Needs Performance Quadrants in Existing Tool



[14] Utterback, J. M. 1996. ***Mastering the dynamics of innovation***. Boston, Mass.: Harvard Business School Press.

column could be an area that should be ignored until the "more urgent" needs are addressed. As a company becomes leaner, the left side of the quadrant chart will provide a source of strategic opportunity.

With relatively good marketing or customer research data, ranking the needs against one another and navigating the company's lean transformation in the area of value delivery can be accomplished effectively using this technique.

5.1.2 Limitations of the tool as it currently exists

There are two limitations of this tool as it pertains to use by a small business supplier. The first is simply one of resources, the small business does not generally have a large enough (overhead) budget to support a massive program to improve all the needs that do not fit into the upper right hand quadrant. The second problem is that the tool does not quantify the relative differences between needs in the same category. If the number of identified customer needs is small, ranking is relatively easy and intuitive. If many needs are present, or many needs exist at the same relative importance, it may be difficult to rank the needs without comprehensive marketing data. For the small business to employ this tool more effectively, some method of quantifying and ranking satisfaction (performance) against the stakeholder needs must be identified. The following section outlines a modification to the quadrant tool for use by small business. After the tool has been developed, we will then use it to evaluate the performance of one of our case study small business suppliers.

5.1.3 The Small Business Needs Performance Index[15]

A simple modification of the needs quadrant chart permits us to easily convert the needs analysis tool to a quantifiable tool for use by small business. First, we change the

[15] Based on an idea first reported by: Clark, N., Grossi, I., de Luis, J., & Seitz, T. 2002. Integrating the Lean Enterprise - Part B: 17. Cambridge: MIT.

evaluation of current performance and relative importance to relative ranking on a one-to-ten scale. We then establish the following relationships of interest:

CP = Current Performance. (1)

For each need, we determine the company's relative current performance against that need, on a scale of 1 to 10.

RI = Relative Importance. (2)

For each need, we determine the company's assessment of the relative importance of that need. In the modeling of importance, we may substitute the company's *desired performance* in place of relative importance. We may now calculate the two performance indices that will help the small company understand how and where to prioritize improvement efforts. The first measure is simply the ratio of current performance to relative importance. We call this the performance ratio:

NPR = Needs Performance Ratio = CP/RI (3)

Charting the Performance Ratio

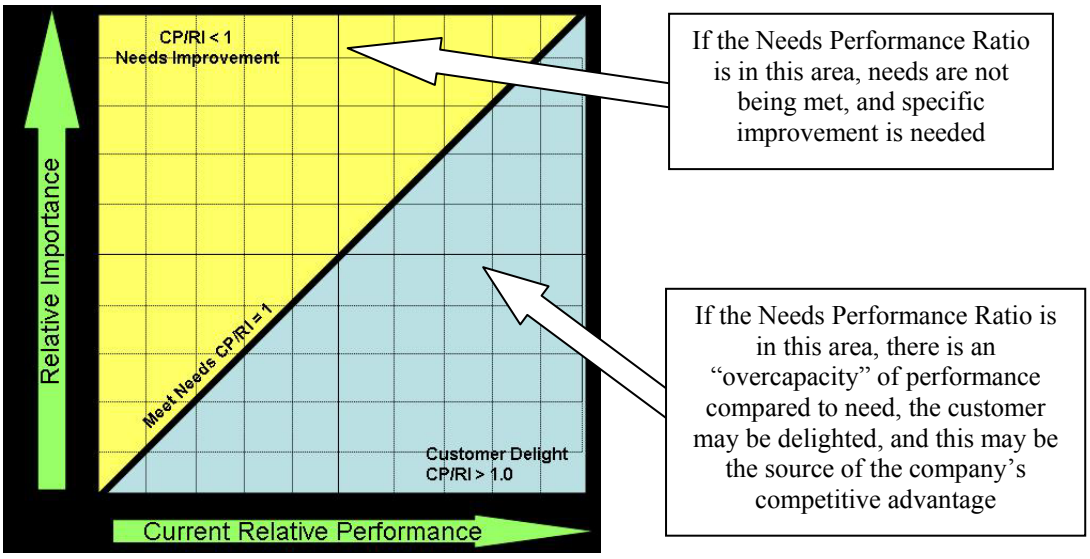
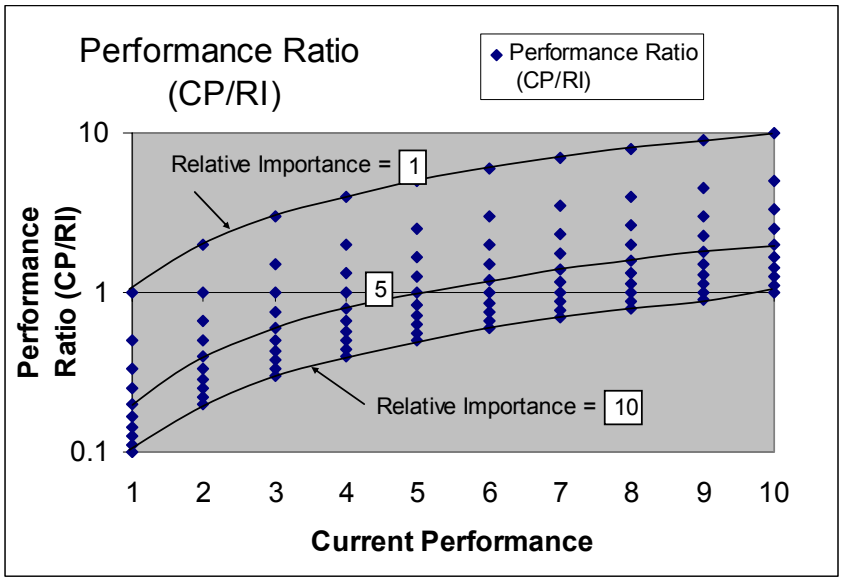


Figure 14- Needs Performance Index Chart

If the needs performance ratio is equal to one, the small supplier is performing at the customer's expectation level, and in general is delivering value to the customer. If the ratio is above one, the supplier is exceeding the customer's expectation, and is operating in the realm of customer delight. However, if the Performance Ratio is less than one, the supplier is not meeting the needs of the customer, and should look for opportunities to improve. A graphic representation of this relationship is shown in Figure 14.

In effect, the Needs Performance Ratio is nothing more than the relative comparison of performance to customer satisfaction. Meeting performance expectations delivers minimum acceptable value to customer (performance roughly commensurate with the importance of the need), and this ratio results in a NPR of one. A ratio of greater than one is a measure of "value delivery" overcapacity, as described in the earlier section, and should be evaluated against the company's strategic vision (e.g. is it waste, or ancillary value delivery?). If the CP/RI is less than one, the elements with the lowest values should be analyzed against the company's strategic vision. Depending on the relative importance of the need, the company may decide to invest in a specific improvement plan. In the case of a low relative need, with a low NPR, the company may decide to eliminate that need from consideration for the time being. On a scale of one-to-ten, the possible values of NPR can be calculated and plotted. The relationship between performance, importance and NPR is shown in the Figure 15. The use of a log scale for the performance ratio helps illustrate the contribution of low

Figure 15 - Performance Ratio vs. Current Performance



performance against high needs. As can be seen in the figure, a NPR above one occurs when importance is low, and performance is high. Using this measure, the highest possible score is a 10, and the lowest possible score is 0.1. The use of the one to ten scale on either axis results in a one hundred data point matrix of possible responses, allowing for better resolution of ranking than the previous two by two matrix, which only provides a four point data matrix. The higher resolution of ranking allow for a better ability to prioritize future actions by providing distinctions between needs that are grouped closely together in a quadrant.

This is particularly useful for determining *which* needs a small company may need to begin work to improve in any given area. The numeric ranking allows for a quantification of the need and performance, and allows for rapid discrimination and prioritization of needs. The smaller the NPR value, the greater the division between the company's current performance and its relative performance, and the more a company should explore actions to resolve the discrepancy between importance and performance. Once a small supplier company has embarked on the lean transition, it will need to periodically review these rankings. As the company eliminates waste and improves its value-added performance, it is likely that the under-capacity gaps will shrink, and the small supplier may even differentiate itself from its competition by delighting the customer in these areas and providing overcapacity against needs. The basic simplicity of the Needs Performance Ratio makes it an attractive tool for small businesses to use.

5.1.4 The Small Business Weighted Needs Index

While the Needs Performance Ratio value is a good indicator of value delivery, it may not be a *complete* picture of needs ranking. The problem with the NPR as a single measure of performance is that it does not take into account the relative importance of the need: it merely provides a ratio of need and performance. It is logical to assume that the higher the

importance of a particular need, the more important the radial distance from the "customer satisfaction line" becomes. Therefore, a relative importance weighting calculation must be developed. In this case, the author recommends the use of the Weighted Needs Index.

WNI = weighted needs index = $\{|(CP-RI)|*RI\}$ (4)

Like the Needs Performance Ratio, the calculation is rather simple, allowing its calculation at very low levels in the supplier organization. Unlike the Needs Performance Ratio, the relationship is not direct. As the relative importance of the need increases, the Weighted Needs Index is leveraged, and gaps between current performance and relative importance result in large WNI values.

Figure 16 - Weighted Needs Index Vs. Relative and Current Performance

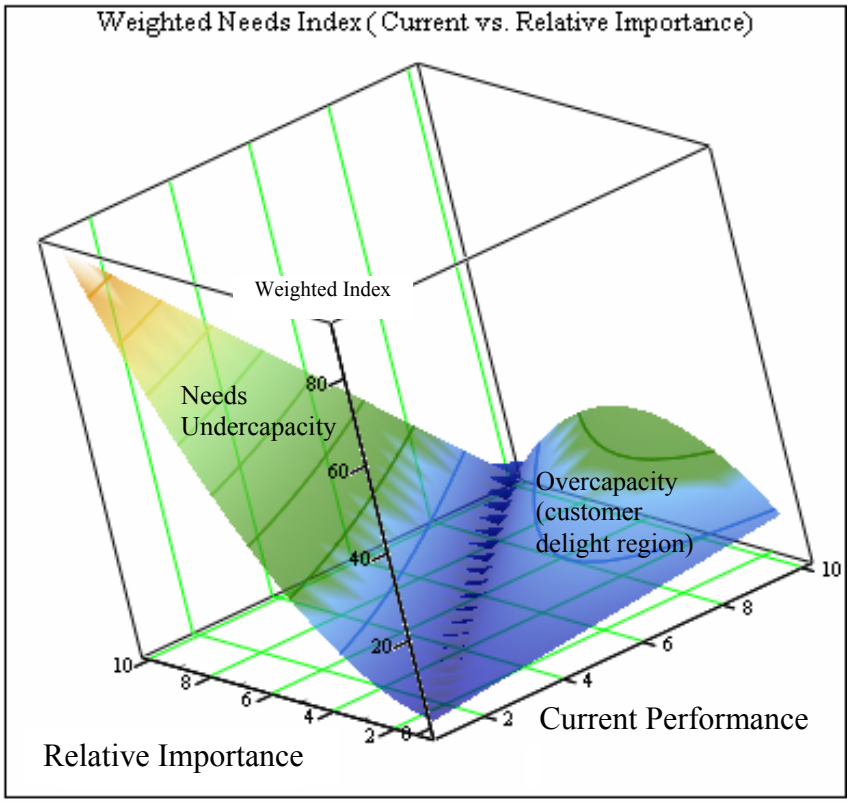


Figure 16 illustrates the relationship between current performance, relative importance, and the Weighted Needs Index. The surface created by the plot of the

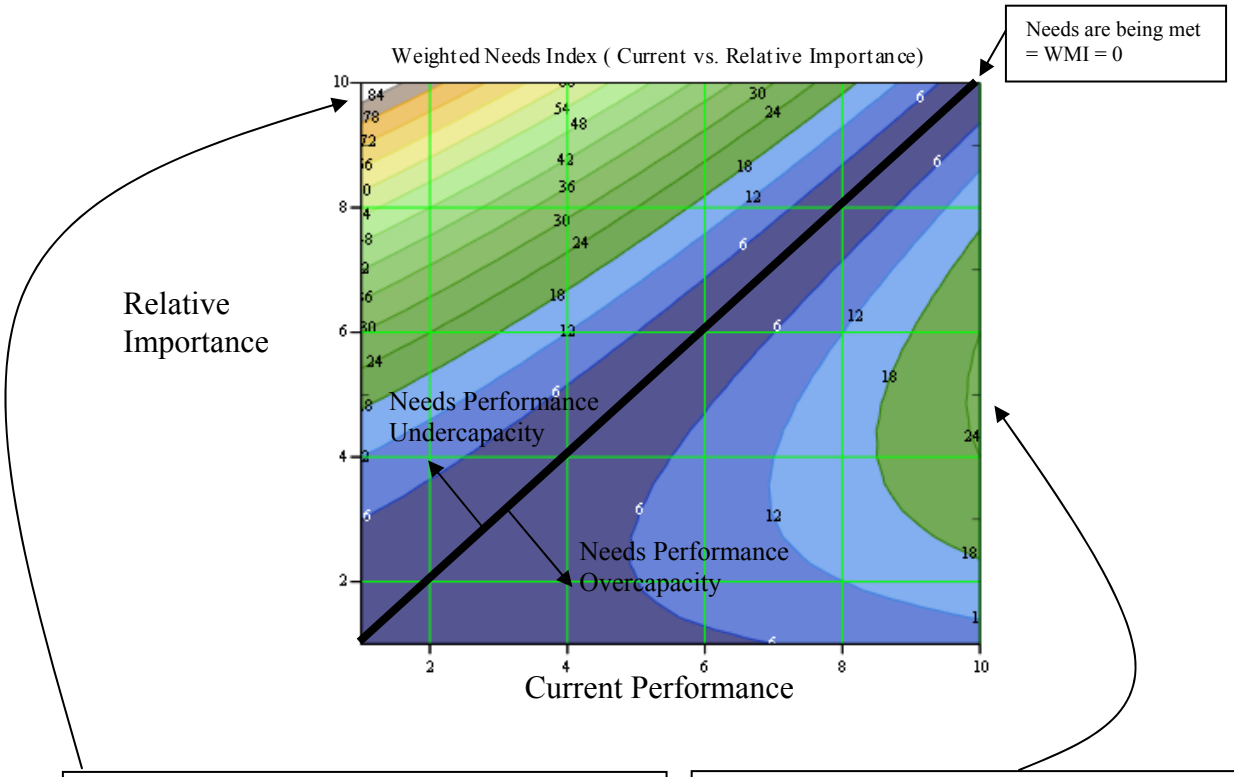
Weighted Needs Index provides insight about strategic planning for the small supplier company. For example, when the needs are weighted relative to their performance, the effect of an overcapacity at a lower level does not have the same magnitude impact as the needs performance ratio. This makes sense on an intuitive level: Having overcapacity in an area that is not very important may delight the customer in that area, but only when all the other needs are being met. The contour plot shows the entire range of possible values for WNI. In the plot, the left hand side of the surface represents performance that is equal to, or less than the need (no overcapacity of the performance with respect to need). The highest value is 90, which represents a current performance of 1 against a relative importance of 10, and signals the company to immediately begin an evaluation of their performance against this need. The line at bottom of the surface (which separates the two surfaces) represents the minimum satisfaction of customer needs. In the WNI scoring, this represents the lowest possible value of zero, and means that the needs are being met, signaling that the company does not need to be immediately concerned. The right hand side of the surface represents possible WNI values resulting from needs satisfaction overcapacity (the region of ancillary value delivery and possible customer delight). In the presence of a performance overcapacity, the small business needs to evaluate situations to determine if the practice of overcapacity is wasteful, and so the values are greater than zero. Unlike undercapacity, however, gaps between need and performance do not leverage high values of WNI. As shown by the plot, having overcapacity when the relative importance of the need is small is does not provide a WNI that exceeds 24. There are two reasons for this. First, as the relative importance of the need increases, the maximum gap between need and performance must decrease[16], so the magnitude of possible overcapacity is lowered. Second, since the company is exceeding its performance against relative need, it does not

[16] This is simply due to the 1-10 scale provided to performance and importance, the maximum gap in overcapacity would occur when the relative importance of a need is 1 and the performance against that need is a 10, for a gap of 9, if performance remains the same, but the importance is raised to a five, the gap is reduced to a 5, and the corresponding WNI changes.

spark the same kind of alert (i.e. high WNI value) than underperformance would spark. Of course, at some point, producing excess ancillary customer value is counterproductive, and exceeding customer need may be considered wasteful. For example, in the antenna surfaces Etenna produces, the customer may value a surface finish of 500 microns. Meeting this need exactly as the customer values would give a WNI score of zero (indicating that Etenna should spend very little time analyzing this need if it has any other WNI undercapcities. If Etenna was able to provide its customer with a finish of 200 microns, the customer may be delighted, since it may reduce surface wave scattering. But at some point, the product antenna performance is insensitive to further improvement and the customer may not be any happier with a surface finish of 50 microns than they were with 200 microns. If it costs Etenna additional time or money to produce a finish of 50 microns, and the customer is ambivalent to the change, the overcapacity is waste. To help capture this condition, the WNI value increases rapidly in the presence of a performance overcapacity, and as the gap between importance and performance increases in the presence of an overcapacity, the WNI values level off because the importance of the need must decrease with higher overcapacity gaps. The highest possible WNI value in the presence of an overcapacity is 25: a current performance at 10 against a relative importance of a 5. A two dimensional contour plot of this relationship is provided in Figure 17.

To facilitate use by the small supplier, an Excel Spreadsheet Workbook was created to be used by supplier conducting the needs identification. This tool will be provided to the LAI for incorporation into their lean tools collection. A copy of the spreadsheet data entry and calculation sheet format is shown in Figure 18.

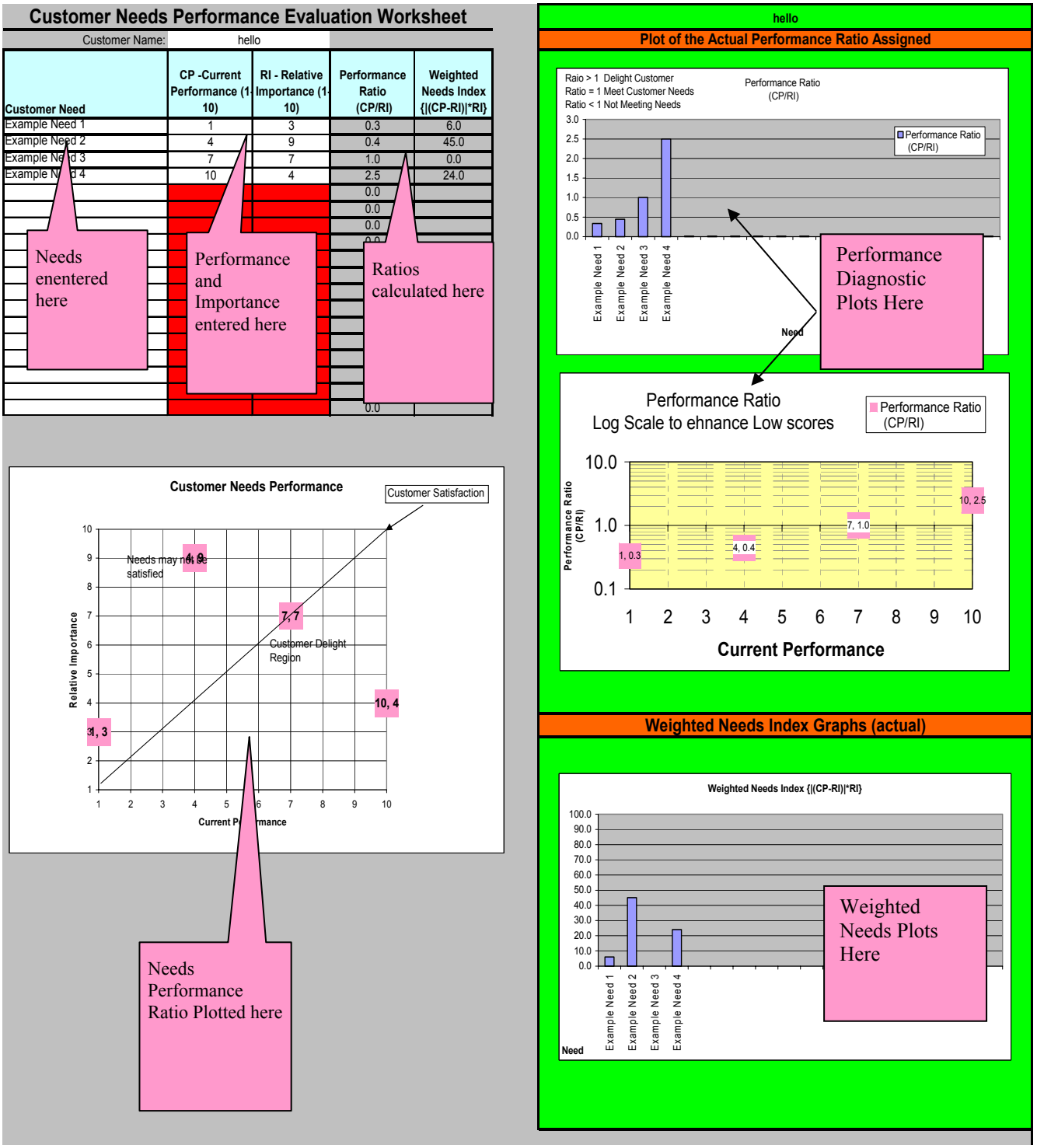
Figure 17 - Weighted Needs Index Contour Plot



Notes: A needs overcapcity produces a rapidly increasing WNI if the need is relatively important, but overcapacity gaps greater than 5 are caused by relative importance's less than 5, so greater gaps can only be caused by less important needs, and the WNI never exceeds 25 in the presence of an overcapacity

Notes: A needs undercapacity produces a rapidly increasing WNI as the gap increases from zero to nine. At an undercapacity gap of nine, the relative importance of the need is ranked a ten, but the current performance is a one.

Figure 18 - Excel Workbook Created to Identify Needs Performance Factors



5.1.5 Testing the Tool – Use of the Needs Analysis Tool at Payload Systems

As stated earlier, the small business is at a disadvantage when assessing the customer needs and values. In the small business, there is typically only a small, often overworked, marketing and sales group. The resources for customer research are extremely limited. This is the case with Payload Systems. To best identify stakeholder needs within the Payload Systems enterprise, we first examine the four types of services that the company provides:

1. Partnership with Principal Investigator
2. Operational Hardware Development
3. Facility Developer
4. Research and Development

Each of these services and its end customer is described below. The description of the customer resulted from the identification of the needs each customer has in the pursuit of that service. Following the customer/service descriptions is a series of tables that describe the results of the analyses using the newly created needs identification tools.

Service 1. Partnership with Principal Investigator

In this service, a researcher, usually at a university, desires to develop an experiment for use on-board the International Space Station (ISS) or Space Shuttle. Typically, the researcher has already conducted quite an extensive series of ground tests, along with perhaps some short-term microgravity experiments on-board the NASA KC-135 microgravity parabolic aircraft or drop-towers. The researcher's objective is to obtain data from the experiment performed under the unique conditions of the space environment. He or she is unfamiliar with the details and complexities of designing and building hardware for spaceflight, and therefore is interested in teaming up with Payload Systems to carry out the hardware design and development.

Payload Systems typically teams with the researcher at the point in the program where a proposal is being put together to submit to a funding agency (NASA, DoD, etc.). The proposing team thereby brings both scientific strength, in the form of the researchers and the ground test data he has already obtained, and operational strength, due to the presence of Payload Systems and the company's history in developing spaceflight hardware. If successful, the researcher takes on the role of *Principal Investigator* (PI), and Payload Systems is a subcontractor to the PI's institution.

Requirements and specifications for this kind of project are usually rather ill defined and can change as the researcher refines experimental procedures. One of the challenges posed by this project is to align the academic research environment with the milestone-driven NASA integration schedule. The most important challenge, however, is to ensure that the ultimate scientific objectives are not lost in the transition from a ground experiment to an operational payload. It is very common for experiment developers to lose sight of what the ultimate scientific objective of the payload is, and end-up with functioning hardware that does not produce any useful data.

In this type of project, the end customer is clearly the PI. The main goal of the hardware being developed is to deliver value, in the form of sound experimental data or scientific knowledge, to the PI. From Payload Systems' perspective, the PI's institution is the contractual organization that is funding development. However, normally the PI's institution itself is obtaining the funds from NASA or another government agency, which are stakeholders in the project as well.

Service 2. Operational Hardware Development

In this type of project, Payload Systems is tasked with developing hardware that will fulfill an operational purpose in a space system. For example, in a recent project the company designed and developed a pressure relief valve for use on board the ISS. This

hardware is not designed for any experimental or scientific purpose; rather, there is a specified set of operational requirements that the design must meet.

Contracts for these projects are obtained in open competition, either directly from a NASA field center or from one or the large aerospace firms that act as a primary contractor for a particular program. Requirements and specifications are usually very well defined, though not necessarily accurate. In other words, these contracts have signed requirements documents, but the requirements themselves may not be consistent or cost-effective with the ultimate function of the hardware being developed.

The end customer for an operational hardware development project is the organization that issued the contract (typically NASA or one of it's primary contractors), which will be referred to as the primary contractor. This primary contractor develops the specifications and will ultimately have to accept the hardware. Payload Systems plays the role of supplier in this type of project.

Service 3. Facility Developer

This type of project requires Payload Systems to develop facility-class hardware for use in space, and often times also requires hardware components for use in ground testing. Projects in this category are unique in that the organization that is funding the project and developing the initial specifications is not the end-user. Normally, the hardware that is developed for these purposes is made available to scientists who use it for their own experiments, just as they would use any other piece of laboratory hardware like an incubator, centrifuge, etc.

These contracts are usually won in open-competition. The funding agency (typically NASA or DoD), releases a Request for Proposals (RFP), which is accompanied by substantial technical specifications. If successful in its bid, Payload Systems becomes responsible for all aspects of the hardware design and development, from the drafting of the hardware and

software requirements to the final mission operations and support. Payload Systems is also responsible for technical and scientific verification of the hardware, and it usually teams with consultants and subcontractors in various technical and scientific fields in order to obtain this expertise.

The major challenges in these types of development efforts are due to the fact that the end-user is not represented in the contract structure. The contracting agency is supposed to be acting in the end user's best interests, but often the two parties' goals diverge. In addition, these contracts, which tend to be large scale, are more subject to the vagrancies of the federal budget process, often resulting in significant program delays and redirection.

In these projects, the role of the customer is somewhat murky. The funding agency is clearly a stakeholder. But is it the real customer? After much debate, the real customer was defined as the end-user scientist or researcher that will be utilizing the hardware. The needs of this customer are essentially those of the principal investigator.

Service 4. Research and Development

Payload Systems does not have the resources to fund extensive internal R&D activities. Therefore, most technical research is conducted under the auspices of the US Small Business Innovative Research (SBIR) program. This program releases research synopses several times a year, and small companies can respond to them with innovative proposals. They are funded at a low level for Phase I ($100K), but can obtain more substantial funding ($750K) if they are selected for Phase II. The first phase is purely a paper-study, with no hardware development. Phase II ends with a prototype hardware developed and tested. The goal of the SBIR program is to provide "seed" money to allow development of those proposals demonstrating the ability to meet some government technical need. Development continues to the point where the company can then seek private capital funding.

Funding agencies for the SBIR program can range from NASA to the Department of Transportation. Some funding agencies provide significant oversight and technical monitoring, while others desire only to see the final reports.

At first glance, the customers in these types of contracts appear to be the funding agencies themselves. However, it became evident in conversations with PSI employees that the real customer is actually Payload Systems itself. Ultimately, an SBIR project needs to yield new business opportunities for the company. Otherwise, the project's value is quite limited, since it consumes resources from other programs that might be more promising in the long term.

5.1.6 Using the Modified Tool:

After the stakeholders were identified, their needs were determined by two methods. The first method was to converse with Dr. Javier de Luis, the CEO of Payload Systems, and make educated guesses about the various stakeholder needs. While this may lack a certain deterministic rigor, Dr. de Luis' experience and common sense led to a very comprehensive list of needs. The second technique used to identify needs was to look at the stakeholders in the value stream and determine their needs by the stakeholder's relative position in the value stream map. When the needs were compiled, they were placed into the newly created customer needs spreadsheet. Dr. de Luis was then asked to rank his company's performance to, and relative importance of the specified need. The results were then calculated and compiled, and are summarized in Table 3 - Stakeholder Needs Summary Table. The table lists the stakeholders in the Payload System enterprise, and illustrates which of the four types of service contribute value to each stakeholder. The table also references the corresponding Value Comparison Table associated with each stakeholder. The most significant need identified by either method is highlighted in the Value Comparison.

Table 3 - Stakeholder Needs Summary Table

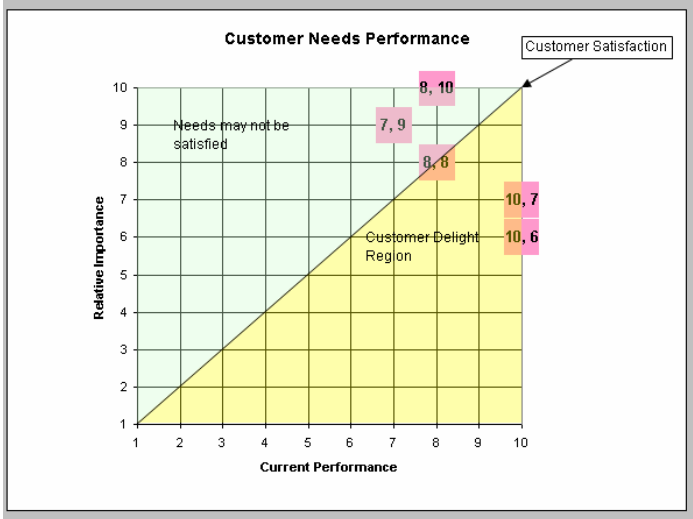
Stakeholder	Service Valued by Stakeholder				Reference to Corresponding Value Comparison Table
	1	2	3	4	
Principal Investigator	✓		✓		Table 4 - PSI Stakeholder Needs Evaluation: Principal Investigator
Funding Agent	✓		✓	✓	Table 5 - PSI Stakeholder Needs Evaluation: Funding Agent
Primary Contractor		✓			Table 6 – PSI Stakeholder Needs Evaluation: Primary Contractor
Taxpayer (Society)	✓		✓	✓	Table 7 – PSI Stakeholder Needs Evaluation: Taxpayer (Society)
Primary Shareholder (Owner)	✓	✓	✓	✓	Table 8 – PSI Stakeholder Needs Evaluation: Primary Shareholder/Owner
Employees	✓	✓	✓	✓	Table 9 – PSI Stakeholder Needs Evaluation: Employees
Suppliers	✓	✓	✓		Table 10 – PSI Stakeholder Needs Evaluation: Suppliers
Astronauts	✓		✓		Table 11 – PSI Stakeholder Needs Evaluation: Astronauts
Payload Systems				✓	Table 12 – PSI Stakeholder Needs Evaluation: Payload Systems (as an enterprise)
Technical Community	✓		✓	✓	Table 13 – PSI Stakeholder Needs Evaluation: The Technical Community

Table 4 – PSI Stakeholder Needs Evaluation: Principal Investigator

Customer Needs Performance Evaluation Worksheet

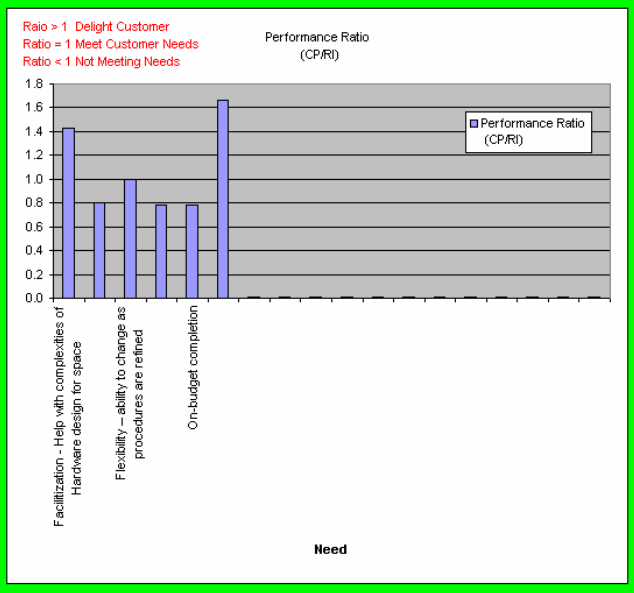
Customer Name: **Principal Investigator**

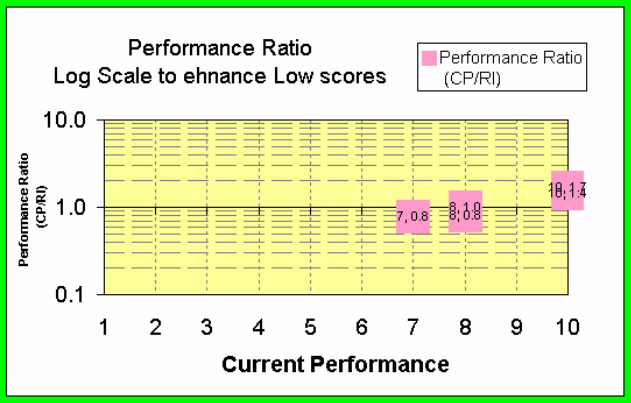
Customer Need	CP -Current Performance (1-10)	RI - Relative Importance (1-10)	Performance Ratio (CP/RI)	Weighted Needs Index {|(CP-RI)|*RI}
Facilitization - Help with complexities of Hardware design for space	10	7	1.4	21.0
Ability to run Experiment as planned with sound experimental data	8	10	0.8	20.0
Flexibility – ability to change as procedures are refined	8	8	1.0	0.0
On-time completion	7	9	0.8	18.0
On-budget completion	7	9	0.8	18.0
Additional vigilance for end objective	10	6	1.7	24.0



Principal Investigator

Plot of the Actual Performance Ratio Assigned





Weighted Needs Index Graphs (actual)

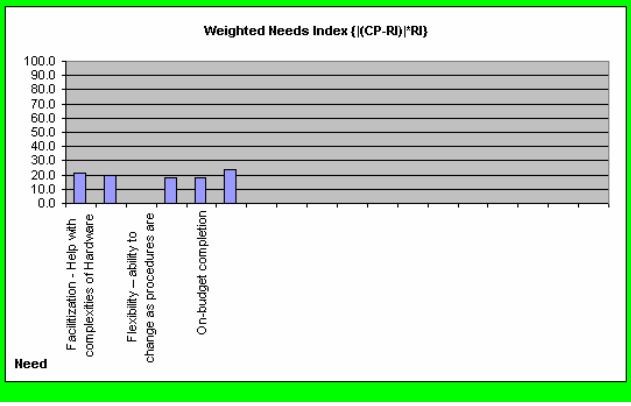
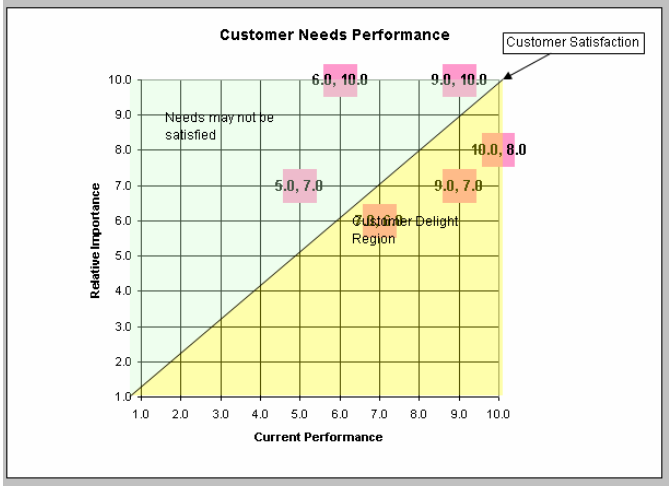


Table 5 – PSI Stakeholder Needs Evaluation: Funding Agent

Customer Needs Performance Evaluation Worksheet

Customer Name: **Funding Agent**

Customer Need	CP -Current Performance (1-10)	RI - Relative Importance (1-10)	Performance Ratio (CP/RI)	Weighted Needs Index {|(CP-RI)|*RI}
Maintaining Cost to Plan	6.0	10.0	0.6	40.0
Maintaining Schedule to Plan	7.0	6.0	1.2	6.0
Provide "VOC" (voice of customer)	9.0	10.0	0.9	10.0
Public Relations from effort	5.0	7.0	0.7	14.0
Create "seed" technology	9.0	7.0	1.3	14.0
Flexibility and Adaptability	10.0	8.0	1.3	16.0
Communication	6.0	10.0	0.6	40.0



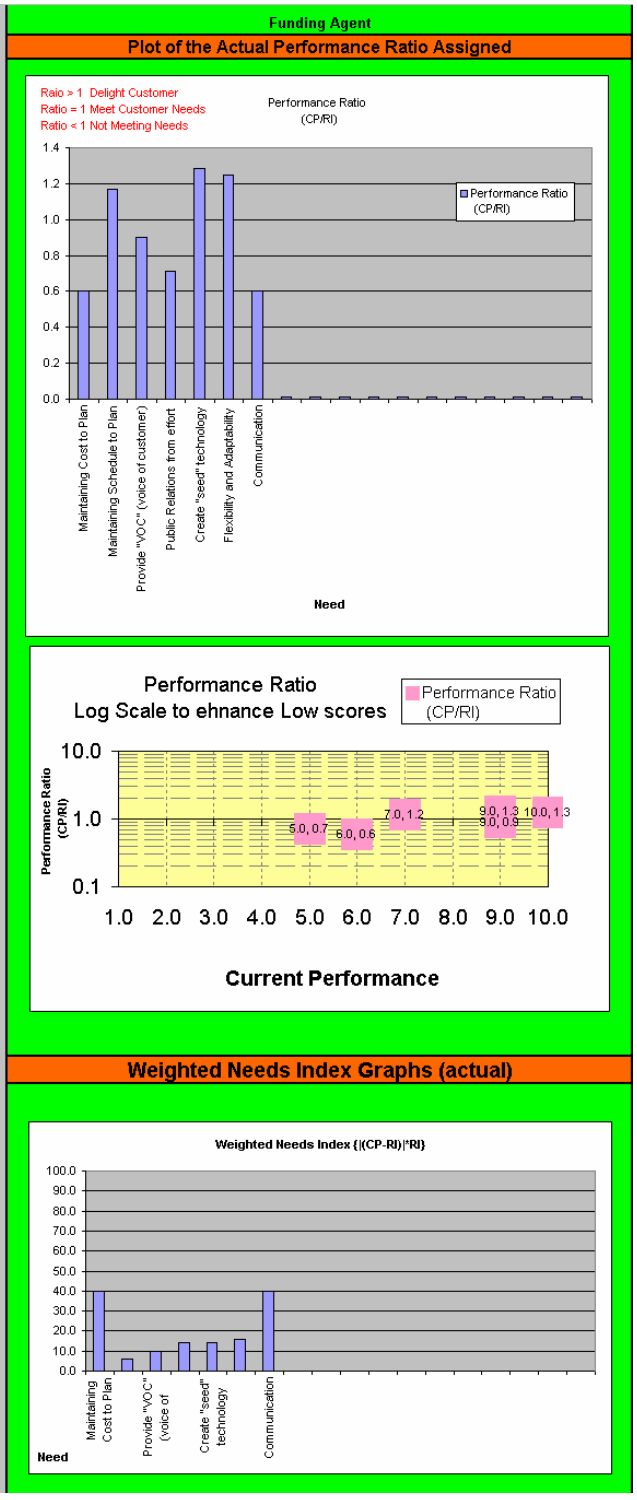
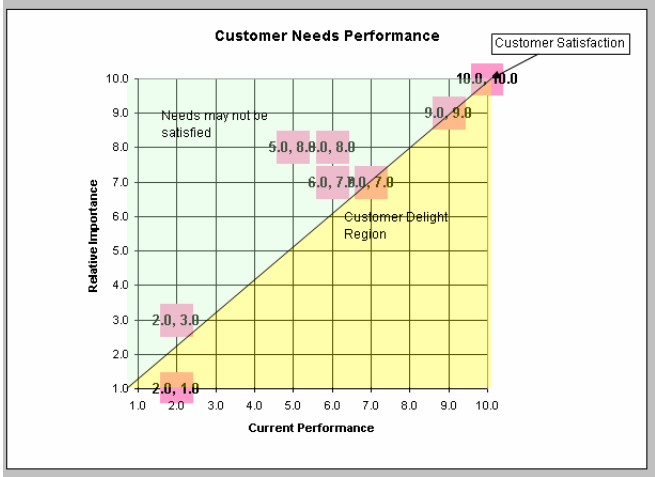


Table 6 – PSI Stakeholder Needs Evaluation: Primary Contractor

Customer Needs Performance Evaluation Worksheet

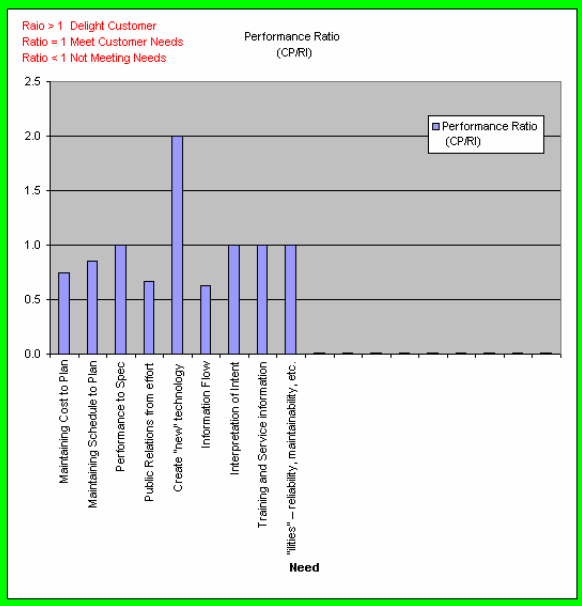
Customer Name: **Primary Contractor**

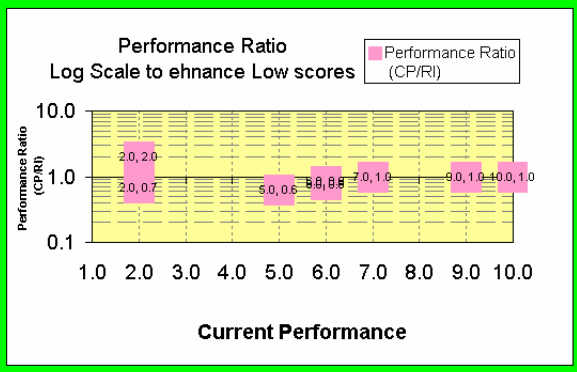
Customer Need	CP -Current Performance (1-10)	RI - Relative Importance (1-10)	Performance Ratio (CP/RI)	Weighted Needs Index {|(CP-RI)|*RI}
Maintaining Cost to Plan	6.0	8.0	0.8	16.0
Maintaining Schedule to Plan	6.0	7.0	0.9	7.0
Performance to Spec	10.0	10.0	1.0	0.0
Public Relations from effort	2.0	3.0	0.7	3.0
Create "new" technology	2.0	1.0	2.0	1.0
Information Flow	5.0	8.0	0.6	24.0
Interpretation of Intent	10.0	10.0	1.0	0.0
Training and Service information	9.0	9.0	1.0	0.0
"ilities" – reliability, maintainability, etc.	7.0	7.0	1.0	0.0



Primary Contractor

Plot of the Actual Performance Ratio Assigned





Weighted Needs Index Graphs (actual)

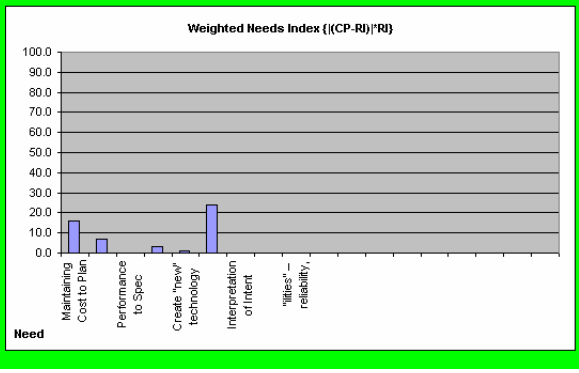
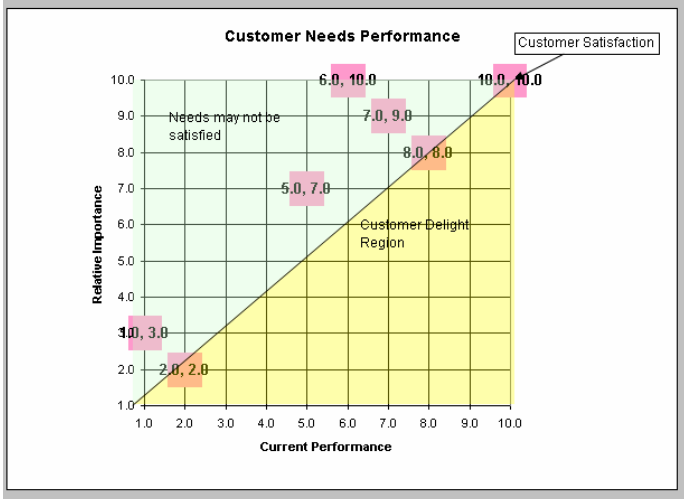


Table 7 – PSI Stakeholder Needs Evaluation: Taxpayer (Society)

Customer Needs Performance Evaluation Worksheet

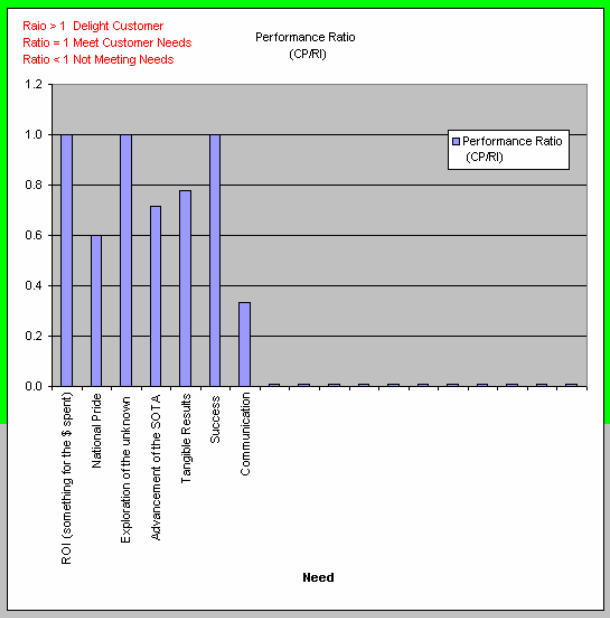
Customer Name: **Taxpayers**

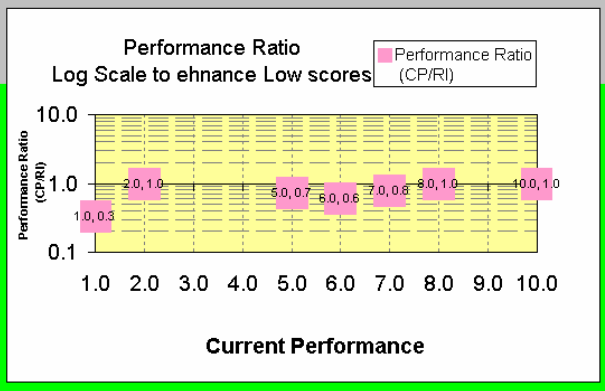
Customer Need	CP -Current Performance (1-10)	RI - Relative Importance (1-10)	Performance Ratio (CP/RI)	Weighted Needs Index {|(CP-RI)|*RI}
ROI (something for the $ spent)	2.0	2.0	1.0	0.0
National Pride	6.0	10.0	0.6	40.0
Exploration of the unknown	8.0	8.0	1.0	0.0
Advancement of the SOTA	5.0	7.0	0.7	14.0
Tangible Results	7.0	9.0	0.8	18.0
Success	10.0	10.0	1.0	0.0
Communication	1.0	3.0	0.3	6.0



Taxpayers

Plot of the Actual Performance Ratio Assigned





Weighted Needs Index Graphs (actual)

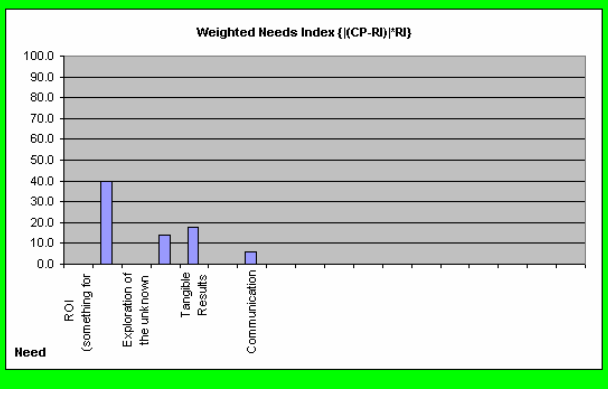
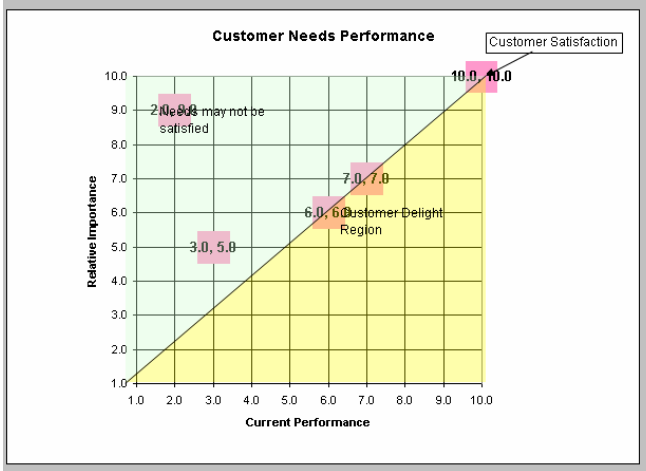


Table 8 – PSI Stakeholder Needs Evaluation: Primary Shareholder/Owner

Customer Needs Performance Evaluation Worksheet

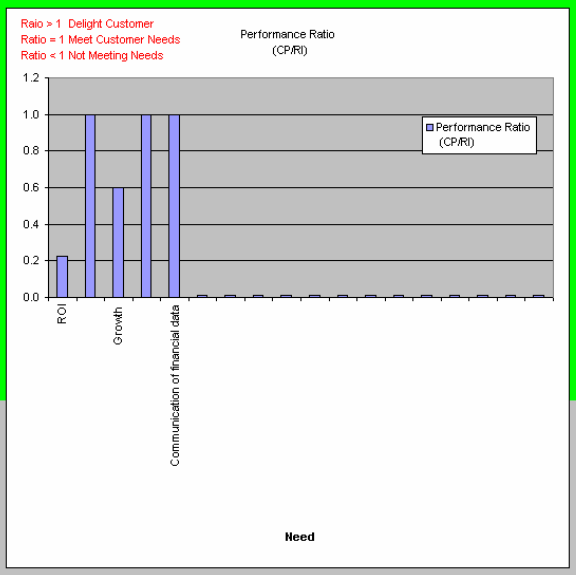
Customer Name: Owner

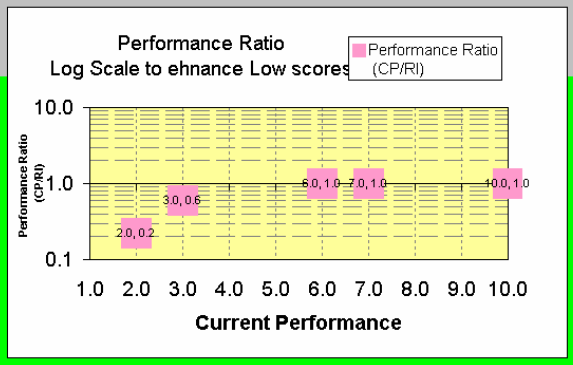
Customer Need	CP -Current Performance (1-10)	RI - Relative Importance (1-10)	Performance Ratio (CP/RI)	Weighted Needs Index {|(CP-RI)|*RI}
ROI	2.0	9.0	0.2	63.0
Preservation of Value (stable or increasing retained earnings)	7.0	7.0	1.0	0.0
Growth	3.0	5.0	0.6	10.0
Maintenance of Reputation	10.0	10.0	1.0	0.0
Communication of financial data	6.0	6.0	1.0	0.0



Owner

Plot of the Actual Performance Ratio Assigned





Weighted Needs Index Graphs (actual)

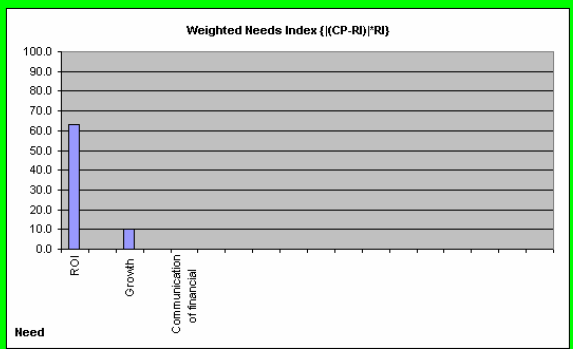
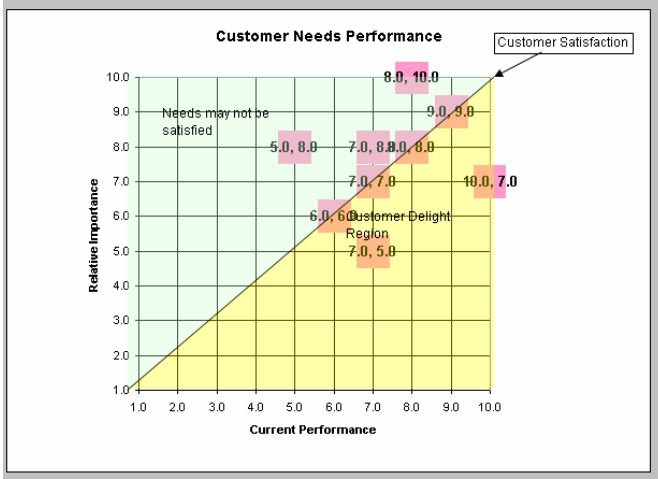


Table 9 – PSI Stakeholder Needs Evaluation: Employees

Customer Needs Performance Evaluation Worksheet

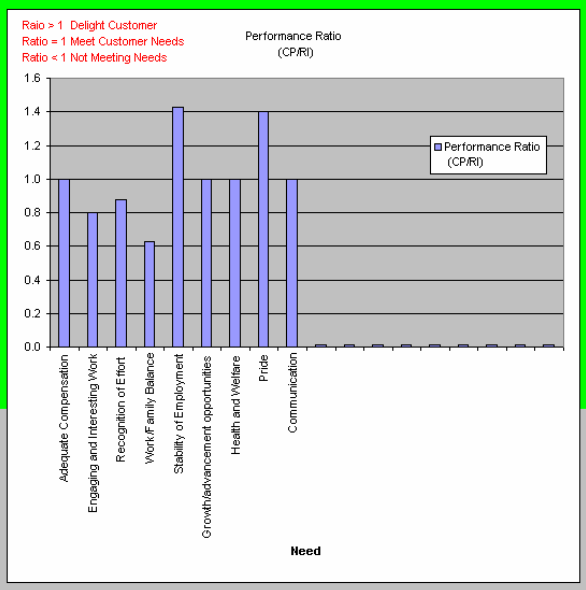
Customer Name: Employees

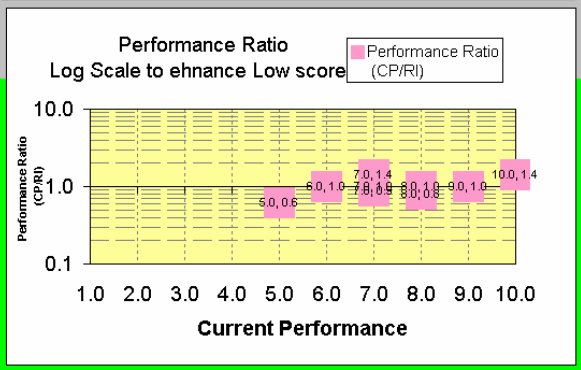
Customer Need	CP -Current Performance (1-10)	RI - Relative Importance (1-10)	Performance Ratio (CP/RI)	Weighted Needs Index {|(CP-RI)|*RI}
Adequate Compensation	8.0	8.0	1.0	0.0
Engaging and Interesting Work	8.0	10.0	0.8	20.0
Recognition of Effort	7.0	8.0	0.9	8.0
Work/Family Balance	5.0	8.0	0.6	24.0
Stability of Employment	10.0	7.0	1.4	21.0
Growth/advancement opportunities	7.0	7.0	1.0	0.0
Health and Welfare	9.0	9.0	1.0	0.0
Pride	7.0	5.0	1.4	10.0
Communication	6.0	6.0	1.0	0.0



Employees

Plot of the Actual Performance Ratio Assigned





Weighted Needs Index Graphs (actual)

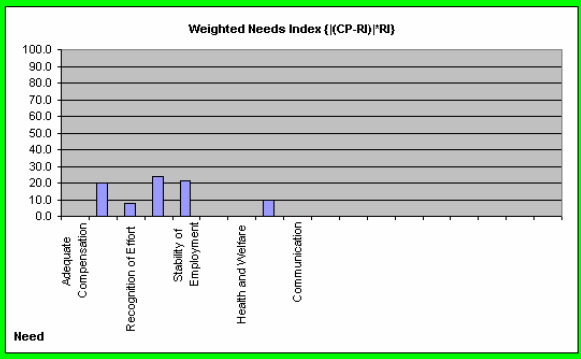
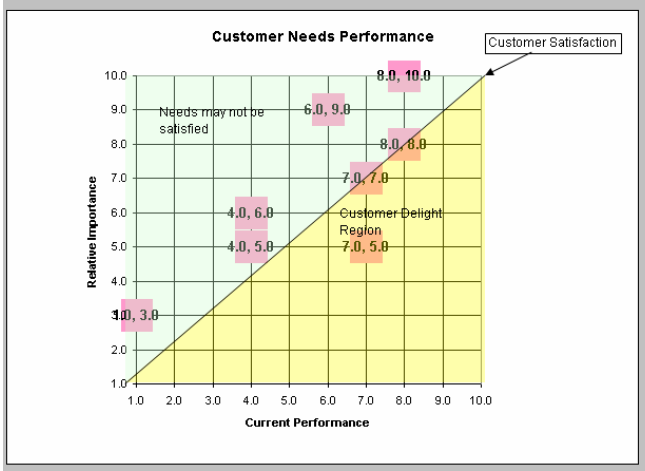


Table 10 – PSI Stakeholder Needs Evaluation: Suppliers

Customer Needs Performance Evaluation Worksheet

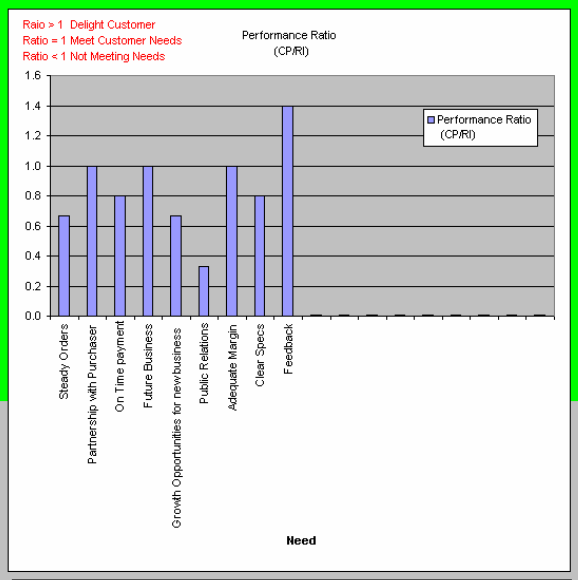
Customer Name: **Suppliers**

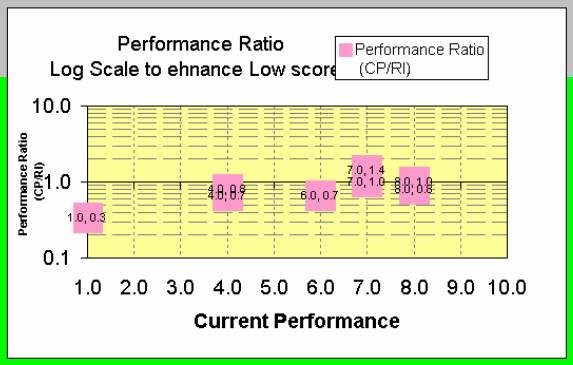
Customer Need	CP -Current Performance (1-10)	RI - Relative Importance (1-10)	Performance Ratio (CP/RI)	Weighted Needs Index {|(CP-RI)|*RI}
Steady Orders	6.0	9.0	0.7	27.0
Partnership with Purchaser	7.0	7.0	1.0	0.0
On Time payment	8.0	10.0	0.8	20.0
Future Business	8.0	8.0	1.0	0.0
Growth Opportunities for new business	4.0	6.0	0.7	12.0
Public Relations	1.0	3.0	0.3	6.0
Adequate Margin	7.0	7.0	1.0	0.0
Clear Specs	4.0	5.0	0.8	5.0
Feedback	7.0	5.0	1.4	10.0



Suppliers

Plot of the Actual Performance Ratio Assigned





Weighted Needs Index Graphs (actual)

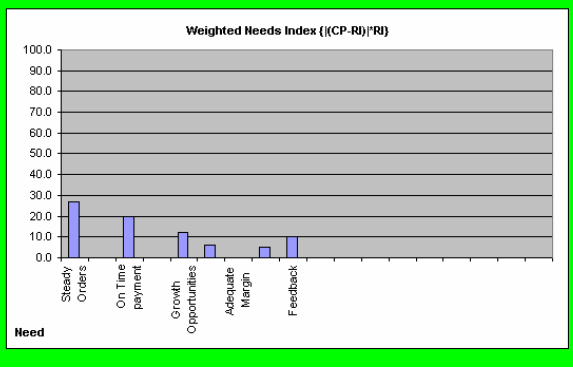
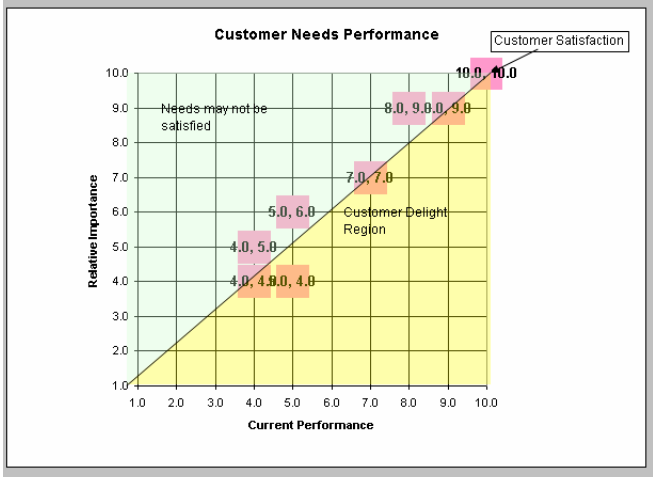


Table 11 – PSI Stakeholder Needs Evaluation: Astronauts

Customer Needs Performance Evaluation Worksheet

Customer Name: Astronauts

Customer Need	CP -Current Performance (1-10)	RI - Relative Importance (1-10)	Performance Ratio (CP/RI)	Weighted Needs Index {|(CP-RI)|*RI}
Safety – Safe Products	10.0	10.0	1.0	0.0
Fulfilling Experiments	7.0	7.0	1.0	0.0
Clear Procedures	5.0	6.0	0.8	6.0
Good GSE / Training Hardware	5.0	4.0	1.3	4.0
Don't waste time	8.0	9.0	0.9	9.0
Performance of System	9.0	9.0	1.0	0.0
PR	4.0	5.0	0.8	5.0
Credibility	4.0	4.0	1.0	0.0



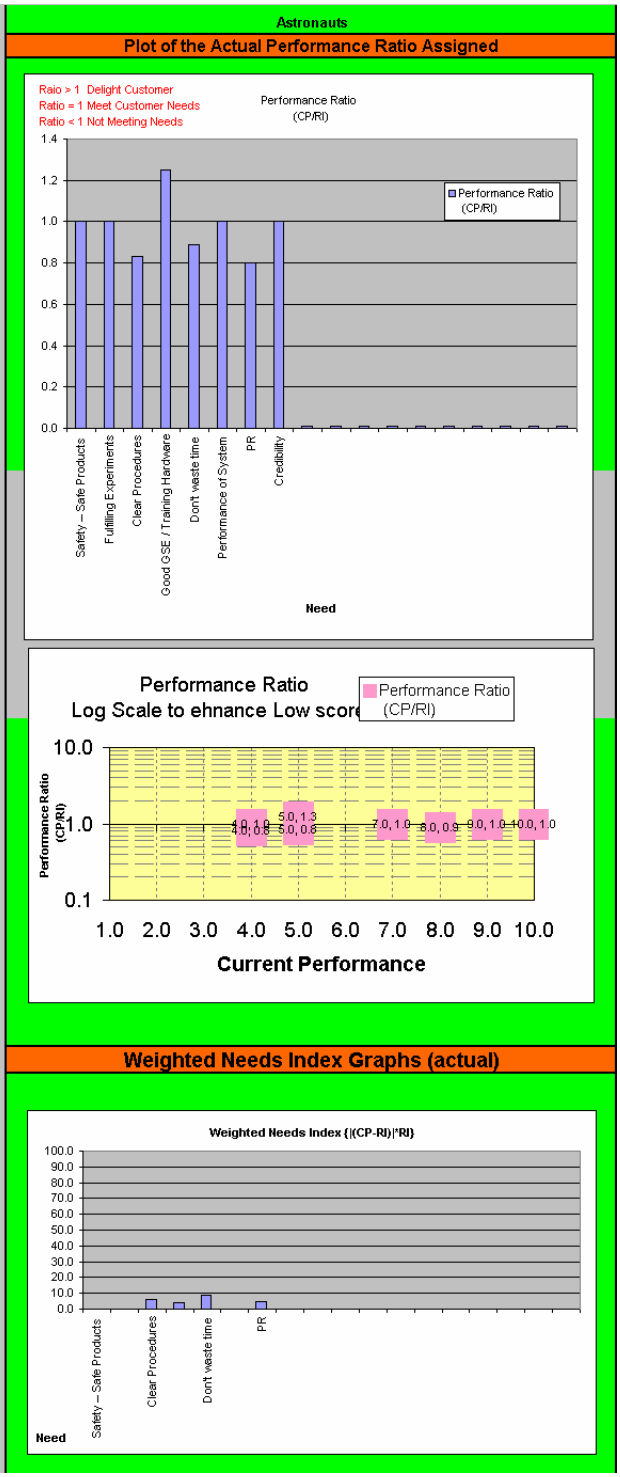
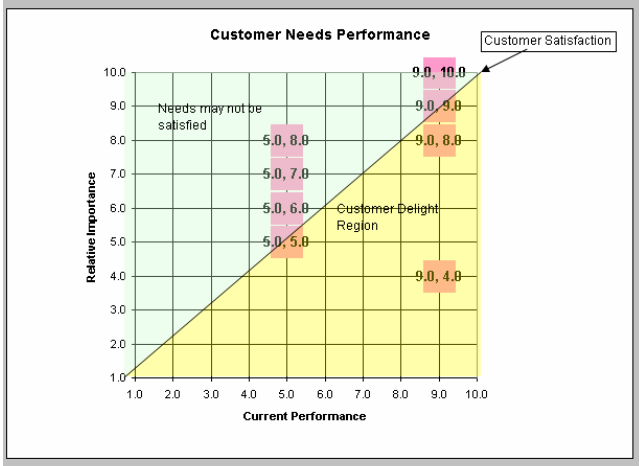


Table 12 – PSI Stakeholder Needs Evaluation: Payload Systems (as an enterprise)

Customer Needs Performance Evaluation Worksheet

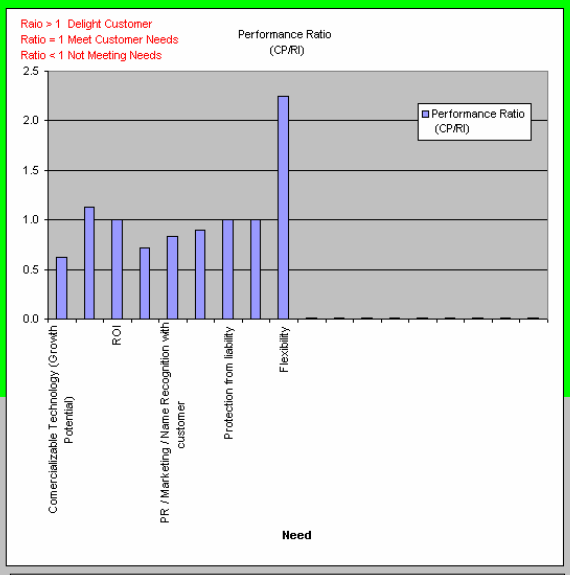
Customer Name: PSI

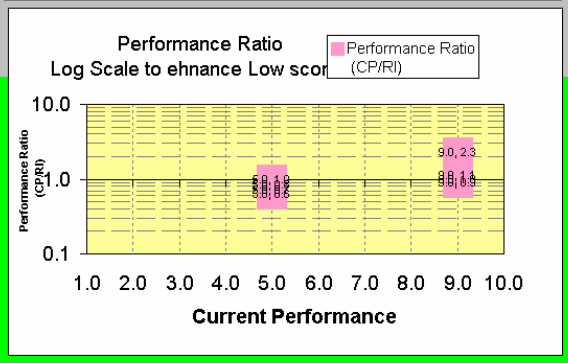
Customer Need	CP -Current Performance (1-10)	RI - Relative Importance (1-10)	Performance Ratio (CP/RI)	Weighted Needs Index {|(CP-RI)|*RI}
Comercializable Technology (Growth Potential)	5.0	8.0	0.6	24.0
Engaging Projects for Workforce	9.0	8.0	1.1	8.0
ROI	9.0	9.0	1.0	0.0
Capacity Utilization	5.0	7.0	0.7	14.0
PR / Marketing / Name Recognition with customer	5.0	6.0	0.8	6.0
Reputation	9.0	10.0	0.9	10.0
Protection from liability	5.0	5.0	1.0	0.0
Solvency	9.0	9.0	1.0	0.0
Flexibility	9.0	4.0	2.3	20.0



PSI

Plot of the Actual Performance Ratio Assigned





Weighted Needs Index Graphs (actual)

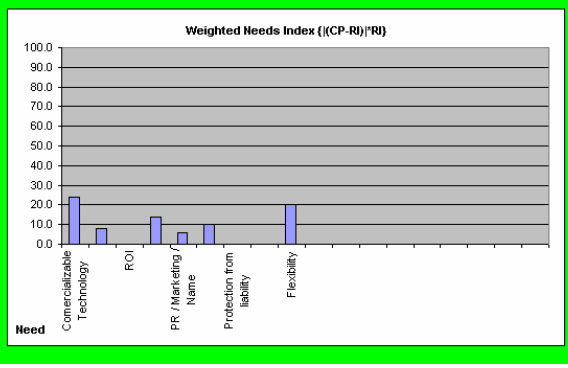
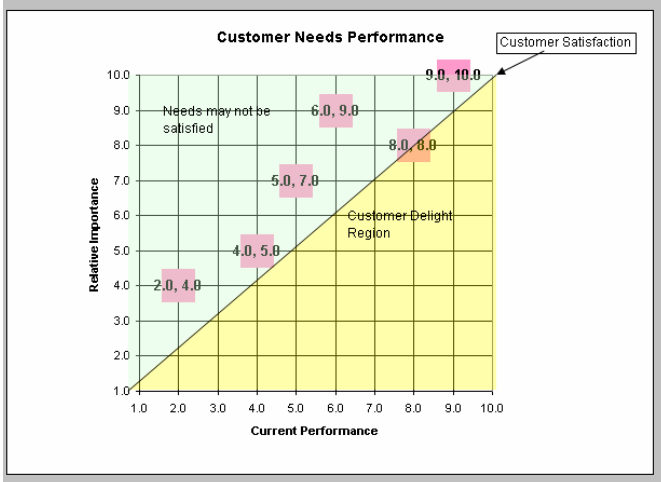


Table 13 – PSI Stakeholder Needs Evaluation: The Technical Community

Customer Needs Performance Evaluation Worksheet

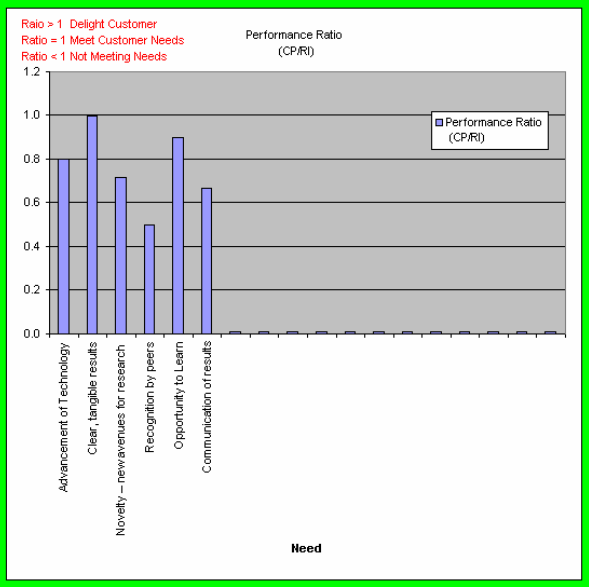
Customer Name: **Technical Community**

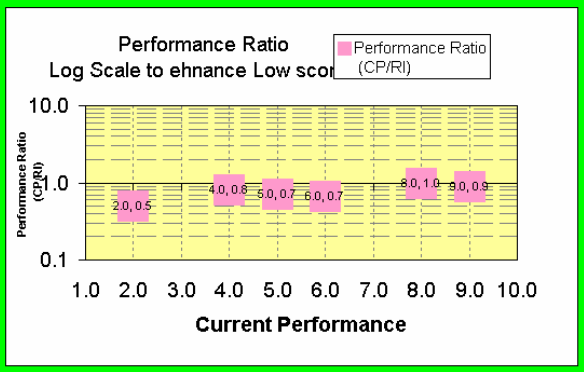
Customer Need	CP -Current Performance (1-10)	RI - Relative Importance (1-10)	Performance Ratio (CP/RI)	Weighted Needs Index {|(CP-RI)|*RI}
Advancement of Technology	4.0	5.0	0.8	5.0
Clear, tangible results	8.0	8.0	1.0	0.0
Novelty – new avenues for research	5.0	7.0	0.7	14.0
Recognition by peers	2.0	4.0	0.5	8.0
Opportunity to Learn	9.0	10.0	0.9	10.0
Communication of results	6.0	9.0	0.7	27.0



Technical Community

Plot of the Actual Performance Ratio Assigned





Weighted Needs Index Graphs (actual)

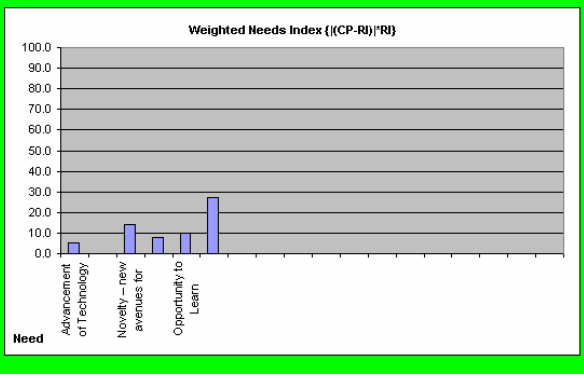


Table 14 - Summary of PSI Stakeholder Needs

Customer	Largest Need Identified by Needs Performance Ratio (Smallest NPR)	Largest Need Identified By Weighted Needs Index (Largest WNI)	Comment
Principal Investigator	0.8 - Ability to run Experiment, flexibility, on-time/on-budget	24.0 - Additional vigilance for end objective	WNI provides insight into a area of need where gap is large and need is high
Funding Agent	0.6 – Maintain Cost to Plan, and Communication	40 - Same as NPR	Since both measures identify the same needs, these are definitely areas for Payload to explore
Primary Contractor	0.6 – Information Flow	24.0 – Same as NPR	Since both measures identify the same needs, Payload should explore. But WNI is lower than funding agent, so may not be top priority
Taxpayer (Society)	0.3 - Communication	40 – National Pride	National Pride is difficult to deliver, but communications can always be improved.
Primary Shareholder (Owner)	0.2 - ROI	63 - ROI	Maximizing ROI seems to be the biggest driver here, and is the highest weighted score. This might be the first place to improve value delivery.
Employees	0.6 – Work/Family Balance	24 – Work/Family Balance	Since both measures identify this need, it may be considered the first item for improvement with respect to employee needs improvement.
Suppliers	0.3 – Public Relations	27 – Steady Orders	Since the supplier's public relations are difficult to control, smoothed order flow may be the fertile ground to begin supplier relations improvements.
Astronauts	0.8 – clear procedures, and Public Relations	9.0 – Don't waste the astronaut's time	Both needs may reflect a greater need for experiments that are understandable and work as planned.
Payload Systems	0.6 – Growth-Potential Technology	24.0 – same as NPR	Payload as a company needs to focus on growth (which may be achieved through a lean transformation)
Technical Community	0.5 – Recognition by Peers	27.0 – Communication of Results	Better communication can lead to better peer recognition. Recommend Payload conduct "training" of staff in the preparation of technical papers

5.1.7 Analysis of Results

A summary table of the customer needs analysis is included in Table 14. There are several instances where the Needs Performance Ratio and the Weighted Needs index identified the same need as most important relative to performance improvement. The NPR identifies the need as the *largest gap* between performance and importance, and the WNI identifies the gap as large, *with a correspondingly high level of importance*. In this case, there is little doubt that this is the area to concentrate efforts to improve performance. When both the NPR and WNI identify the same need, we are likely to have discovered that stakeholder's "needs bottleneck". This condition is analogous to Goldratt's[17] theory of constraints, where the identification and improvement of bottlenecks plays allows for subsequent operational efficiency (the theory of constraints will be explored more thoroughly in the next chapter). Whether it is measured by the needs performance ratio, or the weighted needs index, the need is likely to be the item that defines or limits company performance. With a "needs bottleneck", working to improve any other subordinate need is wasteful, since it does not improve upon the condition needing the most attention.

In the case that where NPR and WNI provide *different* results, there may not be an obvious a constraining condition, or there may be several needs that must be improved upon in order to deliver additional value to the customer. When the two measurement indices resulted in the identification of different needs, a conversation with Payload Systems ensued. It turned out that the different perspectives provided by the different results allowed for rich debate on the meaning of the results. Payload suggested that the weighted needs index acts to "globally" identify needs that are important for improved performance. In other words, the WNI can be used to compare overall needs across the range of stakeholders, and identifies those needs that are globally more important, while the NPR

[17] Goldratt, E. M., & Cox, J. 1994. ***The goal : a process of ongoing improvement*** (2nd rev. ed.). Great Barrington, MA: North River Press.

identifies needs that are only important within the context of a given stakeholder. While this is not necessarily the intent of the stakeholder needs analysis tool (SNAT), developing methods to "normalize" the results across the different stakeholders would provide a good method for inter-stakeholder comparison, and this topic could prove valuable in future SNAT research.

5.1.8 Limitations of the SNAT

It should be noted that the SNAT is a tool that provides a supplier's *perspective* of current performance against stakeholder needs. The value of the tool depends upon the quality and depth of thought used in the identification of stakeholders, their needs, and a realistic and objective reflection of company performance against those needs. The SNAT is not a "stand-alone" document, in the sense that it is better utilized when included as part of a multi-tool approach to lean. Before using the SNAT, it is helpful to have previously used the LEM to help frame and define the company vision with respect to lean. It is also helpful to have previously conducted a "current state" value stream map of the company, to understand the important stakeholders, and their needs.

Since the SNAT is relatively inexpensive to use, and provides quantitative data, there is a temptation to treat the results of a SNAT study as conclusive. The value of the SNAT is in its ability to provide *perspective*, not absolute numbers. The one-to-ten ranking scale is subject to vast interpretive differences between different users, or different time spans. An individual's perspective of "importance" and "performance" ultimately comes down to a user's opinion and intuition (which varies). The variation is not necessarily important in assessment of needs, since it is the relative performance of the company against a stakeholder's multiple needs that is significant. If quantifiable numbers are required, expensive, and time-consuming market research is required.

5.2 Lean Enterprise Self Assessment Tool for Small Business

5.2.1 Background: The tool as it currently exists

The Lean Enterprise Self Assessment Tool, or LESAT(Nightingale et al., 2001), was developed by the Lean Aerospace Initiative at the Massachusetts Institute of Technology, in conjunction with a large number of industry consortium partners. The tool was developed to allow individuals within an organization to identify and rank those factors which are most important to the successful transition to lean. With input from the leaders of many large industrial aerospace companies, the LAI team created a very useful tool for a company to measure its global progress along the path of lean transformation. The LESAT is essentially a maturity matrix survey form, providing a framework for identifying strengths and weaknesses of an individual or company with respect to the lean paradigm. Especially useful in the LESAT are rankings of "current" and "desired" states, allowing users to custom fit their lean vision to the needs of the company.

The LESAT contains three major sections, reflecting the pillars of a Lean Transformation. Figure 19 illustrates these sections as pillars supporting (enabling) the transition to lean. The assessment itself is founded on the lean principles already discussed in this paper. As the figure illustrates, any single pillar that is weak jeopardizes the integrity of the structure. The LESAT architecture stems from this vision of the lean transformation. The first section is the lean transformational leadership, and addresses the processes and leadership attributes

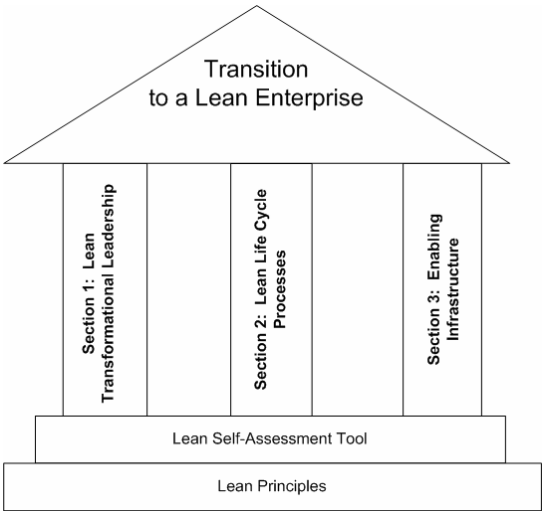


Figure 19 - LESAT In Relation To the Lean Paradigm

that nourish the transformation to lean principles and practices. The life cycle processes are operational in nature, and reflect the processes that surround a product or service from its early conception through its post-delivery support and ending in its eventual retirement. The enabling infrastructure identifies those processes that provide and manage the resources that enable lean operations.

While the three sections form the structure of the LESAT, there are several important elements contained within the sections. Section One roughly parallels the Transition to Lean Roadmap. Therefore, the elements within the first section of the LESAT describe and measure a logical sequence of primary activities associated with the Transition to Lean Roadmap. These are:

- Lean Transformational Leadership
- Enterprise Strategic Planning
- Adoption of the Lean Paradigm
- Focus on the Value Stream
- Development of Lean Structure and Behavior
- Creation of, and Refinement to, the Transformation Plan
- Implementation of Lean Initiatives
- Focus on Continuous Improvement

The LESAT contains examples and questions relating to the primary activities along the TTL roadmap, and the major tasks required to complete each of these primary activities. The goal of the LESAT in this section is to measure the status (current state vs. desired state) of the action steps necessary to initiate, sustain and continuously improve an enterprise transformation.

Section II of the LESAT measures the status of the company's product life cycle with respect to the lean paradigm. The product development process, from early conception to design, manufacturing distribution and service are included in this section. In a lean system, the barriers within the product life cycle processes are minimized so that waste is also minimized in an effort to maximize stakeholder value. The elements measured within section II are:

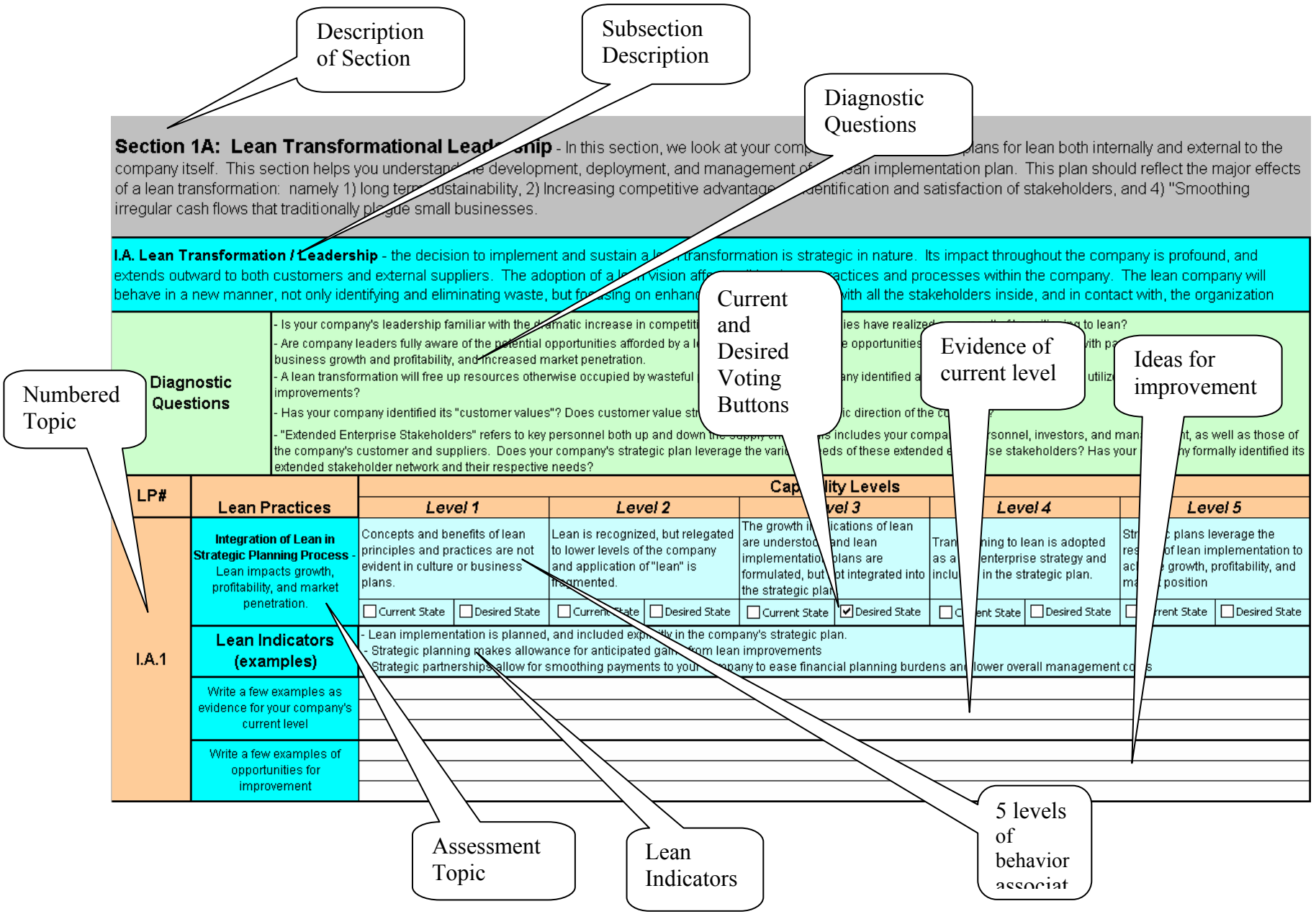
- Business Acquisitions
- Program Management
- Requirements Definition
- Product and Process Development
- Supply Chain Management
- Production Operations
- Product Distribution
- Product Service

Section Three of the LESAT measures individual or company performance with regard to the enterprise enabling infrastructure. The enabling infrastructures are those processes that *support* the leadership and operational processes. In other words, the enabling infrastructures are those processes which indirectly impact the stakeholder value of a product or service. In a value identification process, these items might be overlooked, or might be considered necessary, but it is difficult to determine if they are *value-added* elements. It is not until these processes are scrutinized for their ancillary benefit that their value-added status becomes clear. Information Technologies (IT) is an example of an enabling infrastructure. While it is difficult to say that a customer is "willing to pay for" a supplier company's IT network, it becomes apparent (when scrutinized) that efficient information flow is required for efficient processes. Since the customer is willing to pay for efficient processes (since it ultimately saves money), the IT network becomes a value-added support component. Enabling Infrastructure is broken down into two additional categories: Lean Organizational Enablers and Lean Process Enablers. The former provides necessary support for the management of the lean organization, and the latter supports the holistic product development process itself.

5.2.2 The LESAT Format

The general format of the LESAT is shown in Figure 20. At the top of the form is a description of the section, and the various goals of the matrix questions. This is intended to

Figure 20 - General Format of the LESAT



provide an overarching perspective to the subsequent questions. Immediately below the section description is the subsection description. In this description, a more specific set of the subsection goals. At this point the evaluation strategy unfolds, and the reader is encouraged to align his/her thinking along the lines of the description provided. To further develop the appropriate "mindset", a set of diagnostic questions are provided. This section contains leading questions, intending to reflect the lean vision of a company with specific emphasis on the subsection theme. Below the Diagnostic Questions come the specific survey topics themselves.

The specific survey topics are numbered for organizational ease in subsequent analysis. The survey topic header provides a brief description of the fundamental issue the survey topic reflects. Beneath the survey topic is a list of lean indicators. The lean indicators are those structural artifacts that illustrate the way a perfectly lean company would operate if they internalized and reflected the particular lean topic under consideration.

Next to the lean survey topic is a list of 5 levels of behavior or attitude associated with the various stages of progress along the lean transformation path. The enumerated levels are intended to provide sufficient information to an assessor to allow them to judge at what level their organization or group currently operates as well as provide an idea of the "ideal state" of the company's state when the foreseeable lean transformation is completed. As was pointed out in the very first sentence of this document, a lean transformation is never really over, so the desired state level reflects a medium to long-term goal, allowing the assessor to measure the gap between the current operational state of his/her company and the foreseeable desired state. Voting buttons are provided to allow the user to indicate current or desired states for any given survey topic.

Beneath the lean indicator examples is a space for the assessor to write down a few examples (evidence) that led him or her to the ranking he/she selected. This

helps maintain a record for comparison for future growth, and allows the user to communicate their ideas to other assessors.

Immediately beneath the evidence section is a space for the assessor to provide a few examples of opportunities for improvement. During the survey completion, an assessor's thoughts tend to become very focused on the subject matter. The act of marking current and desired states forces an awareness of gaps that may exist between the two states. Since the assessor's mind is focused on the topic, there is a chance at that moment that they may have substantive ideas for improvement (ways to close the gap). Before the user moves to the next topic, they are encouraged to record their ideas, so that they may avoid being forgotten in the course of further survey activities.

5.2.3 Limitations to the LESAT for Small Businesses

The LESAT is an important and powerful tool, and is an accepted standard in many large aerospace corporations. In fact, after surveying three small businesses to determine whether the LESAT applies to small business, only two limitations were noted. The first limitation that reduces the LESAT effectiveness is the language used in the assessment itself. The second limitation is that the LESAT does not contain reference to the identification of constraints or constraint-based decision making. The first limitation was identified in the initial stages of LESAT evaluation with the companies. The second limitation was not pointed out until much later, when discussing Throughput Accounting processes with several executives from the same small businesses.

The Language Barrier

Small businesses, or at least the three surveyed in this activity, tend to be naturally lean. As such, they have a very distinct vocabulary built around the service or products they provide. "Lean vocabulary" has been around large companies for at least a dozen years. The people that work in large industry speak a very precise

language for lean, assisted by an infrastructure that reinforces the language through lean training programs, symposiums, etc. In fact, much of the lean vernacular shares words and ideas with other productivity enhancement tools like Total Quality Management and Six Sigma. Large companies tend to internalize that lean vocabulary, so the LESAT is not difficult for persons within a large company to process. In a small company, the language of the enterprise is different. Many small company workers are not veterans of other "corporate efficiency programs", and have not picked up the "lean vocabulary", simply because the need to do so was not apparent. The first time the author mentioned the word "enterprise" to a manager at one of the survey companies, the manager responded: "Are you talking about old *Star Trek*, or that new one?" The question was meant as a joke, but points to an underlying communication boundary caused by vocabulary in the current LESAT. The first time a review copy of the (unmodified) LESAT was sent to one of the technicians at Etenna, he sent it back with a single Post-it note attached. Written on the Post-it note was the statement: "I don't know what any of this means". When the technician was asked for specifics, it was determined that the *concepts* embodied in the questions were all relevant and easily understood, but the way the questions were worded led to confusion, and the confusion became a distraction to the self-assessment process. After several hours of discussion, we came to the conclusion that the LESAT needed to be reworded in such a way to allow a small business (with at least a minimum of lean knowledge) to use the self assessment tool. Several other persons in Payload Systems, and a small integrated circuit manufacturer provided the similar responses: They all liked the concept of the LESAT; each respondent indicated that filling out the matrix forced a concentrated focus on lean concepts (and was universally seen as beneficial). However, each thought the LESAT form should be modified to make it more accessible for the language and structure of small business.

Lack of Constraint Identification

In Chapter 6, we will discuss the use of constraint based accounting systems, also known as Throughput Accounting. The details of this process are discussed elsewhere, but an additional section was needed to incorporate the process of identifying and subordinating decisions to the bottlenecks in the process.

5.2.4 The Change Process- A New Small Business LESAT

The first step in modifying the LESAT for use by small business was to first identify the elements that should not change. In this case, the basic structure itself needed to be kept intact. The conventional LESAT lists 54 lean principles split into three associated sections, and enjoys widespread use throughout the aerospace industry. Since the end objective of a lean framework for small business suppliers is to create a toolset that can be used by small business, but is compatible with the systems used by large business, it was crucial to preserve the conventional LESAT structure. In the interests of synergy with large business, it was decided that the question format of the LESAT and meaning of each lean practice would be left intact. It was determined that the descriptive wording would require change to facilitate more effective use by small business members. By keeping the structure and meaning the same, a large company can *directly* compare LESAT results (current state, desired state, and gaps) with the small business. Even though two different versions of the LESAT result from the activity, the substance of the data is identical. The concept of an equal, but distinct small business LESAT was discussed with Prof. Nightingale, one of the principle architects of the original LESAT. She concurred that it was important to keep the intent and meaning of the respective questions intact. She commented that at some point, the larger lean enterprises needs to develop strategic partnerships with even the smallest supplier, and a LESAT tailored for small business would be particularly useful if it interfaces seamlessly with the original LESAT.

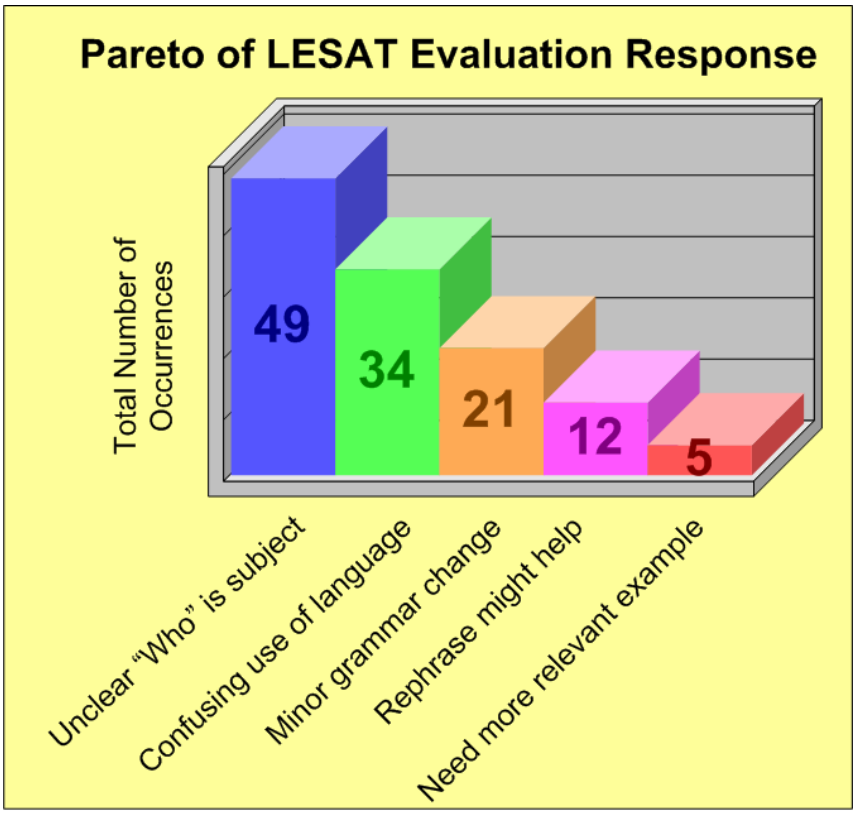
The first step in developing a LESAT especially tailored for small business was to identify where the roots of the communication problems originate. In particular, a study was undertaken to identify specific phrases that were most in need of change. A survey was sent to Payload Systems. In the survey, several senior management personnel were asked to review the existing LESAT and identify the sources of ambiguity or confusion. In the survey form, respondents identified the following sources of confusion:

Sentence fragments - It was difficult for the assessor to always determine which company was being analyzed. For example, in the original LESAT, item 1.B.1 Entitled "Learning and Education in 'Lean' for Enterprise Leadership" the description of Level 2 characteristics is reported as:

> "Leaders are actively seeking opportunities to learn about lean. There is an initial grasp of the extent of the paradigm shift in the enterprise"

The assessor was unclear about *whose* leaders were being discussed. Since the sentence contained the word "enterprise", the assessor was confused whether the leaders from the upstream portion and downstream portion of the value stream were included in this characterization. Further, the assessor was confused about the meaning of phrase "initial grasp of the extent of the paradigm shift". Response survey results concerning LESAT clarity were

Figure 21 - Pareto Chart of LESAT Survey-Identified Problems



predominated by questions concerning the focus of the five levels of behavior. Of these, most problems concerned "to whom the questions were addressed". In the survey; one assessor wrote:

> "The LESAT seems to ask many important questions that feel like they need to be answered. But, there are many cases where I am not certain who we are talking about: My company? My supplier companies? The company I supply to? or all of the above? The use of enterprise and extended enterprise is difficult to resolve. I feel uncomfortable guessing about this, and would appreciate more clarification in this area"

In the survey, **confusion about the focus of the question** was listed 49 times. While it must be stressed that a few survey forms is not necessarily sufficient to make sweeping judgments about the entirety of changes needed to a LESAT, a Pareto chart of the five major issues recorded and their number of occurrence is listed in Figure 21. The relative confusion described by the Pareto chart may have more to do with familiarity with the subject matter than with cryptic wording. To test this hypothesis, the same LESAT and survey tool were provided to the CEO of Payload Systems, a recent graduate of MIT's class in Lean Enterprise. He was able to complete the entire LESAT without similar problems. His familiarity with the subject matter provided insight that allowed him to understand both the expressed and implied meanings of the statements contained in the original LESAT. It appears that prior lean knowledge plays a significant role in an assessor's understanding of the original LESAT.

This exposes a predicament for the small business lean framework: Upper management may be very well versed in the lean paradigm, and the lean vision, and may have no problem with the concepts contained within the LESAT; but, the lower levels of the company may have only a superficial understanding of lean concepts. Since the LESAT is designed to identify opportunities for lean growth, the ability to correctly fill out the assessment is essential. Therefore, the LESAT for small business must first be rewritten to allow for accurate assessment from individuals that may possess a casual exposure to lean principles.

The next step in the process was to create the first draft of the Small Business Lean Self Assessment Tool (SB-LESAT), removing language that might be confusing, and rewording the intent of the statements to allow for understanding with a minimal understanding of lean principles. To extend the example cited earlier, the original LESAT, item 1.B.1 was originally written:

> "Leaders are actively seeking opportunities to learn about lean. There is an initial grasp of the extent of the paradigm shift in the enterprise"

It was changed to read:

> "Your company's leaders are actively seeking opportunities to learn about lean. There is a basic understanding of the value of a lean transformation within your company."

In the second statement, it is clear about *whose* leaders are the subject of the assessment. Also, the confusion about "paradigm shifts" is restated to a slightly less eloquent phrase about "understanding the value of a lean transformation". Like most translations, the two statements do not precisely reflect the same idea. The rephrased statement is broader, and therefore not as focused as the original. It is the author's hope, however, that the intent of the two statements is the same, and since the revised statement is more readily understood by someone with only a passing knowledge of lean taxonomy, it is speculated that the revised statement will provide a more accurate response from a small business surveyant.

Once the SB-LESAT was rewritten, it was sent back to one of the original surveyors at Payload Systems. This time, he had no problems with the text. However, this judgment is not necessarily conclusive, since the subject was possibly tainted from his earlier exposure to the tool. Therefore, a second source was recruited to test the SB-LESAT (using someone with only minimal exposure to Lean vernacular or the original LESAT). The second source came from a technician in the Etenna Corporation. The technician's exposure to lean was incidental, occurring several years earlier when he used to work in an aerospace company. The technician had never been to a lean class, or attended any lean workshops, but was

familiar with the concepts of waste elimination and customer value delivery. The technician was asked to complete the SB-LESAT and list comment or questions relating to the topics and mechanics of the survey. In this case, no structural confusion was noted, although there were several comments about ways in which the SB-LESAT could be reworded to improve its point. The SB-LESAT was subsequently changed, and sent back to Payload Systems and Etenna for evaluation. After several iterations the LESAT was proclaimed acceptable by both parties.

5.2.5 SB-LESAT in Detail

There were several changes to the original LESAT, mostly addressing the issues described in the Pareto chart. Table 15 (below) provides an example of the types of changes made. Appendix A contains a complete description of the changes made to the original LESAT, and provides rationale for those changes in the context of small business needs.

Table 15 - Representative Changes Made to Original LESAT

Problem Identified by Survey	*Original LESAT Phrasing*	*Small Business LESAT Phrasing*	*Comments*
Unclear "who" is the subject of the sentence	Benefits of lean implementation are beginning to influence the strategic planning process.	The benefits of the lean implementation are beginning to influence your company's strategic planning process.	"Your company" added to identify ownership.
Confusing use of language	"Leaders are actively seeking opportunities to learn about lean. There is an initial grasp of the extent of the paradigm shift in the enterprise"	"Your company's leaders are actively seeking opportunities to learn about lean. There is a basic understanding of the value of a lean transformation within your company."	Example previously discussed in body of this section. "your company" clarifies subject, and paradigm shift rephrased to understanding
Minor Grammar Change	Principal current value stream(s) are defined, allowing the identification of critical interactions. Significant opportunities for eliminating waste and creating value are identified and aligned with the strategic objectives.	The principal (current) value streams are identified and critical interactions of the value streams emerge. Significant opportunities for waste elimination and value creation are identified. These opportunities are aligned to the strategic objectives.	Added pronoun "The", and minor rewording. No substantive changes.

Continued on next page

Table 15 (Continued from previous page)

Problem Identified by Survey	Original LESAT Phrasing	Small Business LESAT Phrasing	Comments
Rephrase might Help	Forecasted improvements from lean implementation are incorporated into enterprise planning and budgeting decisions.	The forecasted improvements from planned and current lean implementation projects are incorporated into your company's planning and budgeting decisions.	Slight rewording to improve sentence flow.
Need More Relevant Example for Small Business Use	A formal process for readily capturing and communicating lessons learned is being applied. Employee contributions are actively sought.	Your company has a formal process for capturing and communicating lessons learned. The process is used consistently, and your company's personnel actively contribute to, and learn from these lessons. Mistakes are rarely duplicated.	Added an example of benefit from learning – mistake avoidance
Not Representative of Small Business Operation	Organizational environment and management system supports limited decision making at point of application and need.	Your company's organizational environment and management system supports limited decision-making at point of application and need. Employees clearly understand their responsibilities for decision making, and are empowered to make decisions within the scope of their application.	Additional description used to define the concepts within the description as a means to remove possible misinterpretation.
Additional Definition Needed	Limited enterprise-level resources are committed and often applied to the symptom rather than the root cause.	Limited enterprise-level resources are committed and often applied to the symptoms of a problem, rather than the elimination and prevention of the root causes. Once a problem is fixed, it is rarely studied for root cause elimination ("There just isn't time or budget!" is often quoted).	Additional description to illustrate level for enhanced small business understanding

When completed, the SB-LESAT contains 55 principles, one more than the original LESAT. As stated earlier, the addition of a Lean Practice to understand constraints was provided to illustrate the importance of bottleneck identification. The lower levels of this practice simply identify constraints on the production line, where the higher levels of performance extend constraint identification to the operational processes practices used by the company and its extended enterprise.

The additional lean practice is described below (Table 16). It is also included in the SB-LESAT , which is described in the next several pages.

Table 16 - New Lean Practice Relating to Constraints

Lean Practice	Subsection	Description
II.E.3	II.E.3	Production Constraints Identification - The limitations to the production process play a key role in the identification of future improvements
II.E.3	Level 1	Bottlenecks appear "randomly" in your production process, and significant resources are wasted waiting for work to finish "downstream" in the process.
II.E.3	Level 2	Some formal identification has been made for process bottlenecks, but no safety stock process exists to manage flow.
II.E.3	Level 3	Process bottlenecks have been identified, and appropriate safety stocks have been assigned to fully utilize bottlenecks. Large inventories of parts are still used, and Quality assurance is usually left to the "end" of the production process.
II.E.3	Level 4	All process improvement decisions are viewed in context with the process bottlenecks. Process improvement resources being allocated to lower inventory and improve flow.
II.E.3	Level 5	The understanding of constraints in the production process has been expanded to include suppliers and customers, a formal process for identification and elimination of SYSTEM bottlenecks exists, and is being used.
II.E.3	Lean Indicators (examples)	- With the exception of safety stocks at the bottleneck, work-in-process inventory (WIP) is drastically reduced. - Working on freeing up the constraint is the single biggest driver in new process improvement projects within your company. - A measurement system exists in your company to adequately capture the costs associated with WIP.

Figure 22 - SB-LESAT, Section 1A

Section 1A: Lean Transformational Leadership - In this section, we look at your company's implementation plans for lean both internally and external to the company itself. This section helps you understand the development, deployment, and management of the lean implementation plan. This plan should reflect the major effects of a lean transformation: namely 1) long term sustainability, 2) Increasing competitive advantage, 3) Identification and satisfaction of stakeholders, and 4) "Smoothing irregular cash flows that traditionally plague small businesses.

I.A. Lean Transformation / Leadership - the decision to implement and sustain a lean transformation is strategic in nature. Its impact throughout the company is profound, and extends outward to both customers and external suppliers. The adoption of a lean vision affects all business practices and processes within the company. The lean company will behave in a new manner, not only identifying and eliminating waste, but focusing on enhancing the relationships with all the stakeholders inside, and in contact with, the organization

Diagnostic Questions	- Is your company's leadership familiar with the dramatic increase in competitiveness that many companies have realized as a result of transitioning to lean? - Are company leaders fully aware of the potential opportunities afforded by a lean transformation? These opportunities include stabilized cash flow with partner companies, greater business growth and profitability, and increased market penetration. - A lean transformation will free up resources otherwise occupied by wasteful practices. Has your company identified a suitable strategy for growth to utilize resources freed up by improvements? - Has your company identified its "customer values"? Does customer value strongly influence the strategic direction of the company? - "Extended Enterprise Stakeholders" refers to key personnel both up and down the supply chain. This includes your company's personnel, investors, and management, as well as those of the company's customer and suppliers. Does your company's strategic plan leverage the various needs of these extended enterprise stakeholders? Has your company formally identified its extended stakeholder network and their respective needs?

LP#	Lean Practices	Capability Levels									
		Level 1		*Level 2*		*Level 3*		*Level 4*		*Level 5*	
I.A.1	**Integration of Lean in Strategic Planning Process** - Lean impacts growth, profitability, and market penetration.	Concepts and benefits of lean principles and practices are not evident in culture or business plans.		Lean is recognized, but relegated to lower levels of the company and application of "lean" is fragmented.		The growth implications of lean are understood and lean implementation plans are formulated, but not integrated into the strategic plan.		Transitioning to lean is adopted as a key enterprise strategy and included in the strategic plan.		Strategic plans leverage the results of lean implementation to achieve growth, profitability, and market position	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☑ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- Lean implementation is planned, and included explicitly in the company's strategic plan. - Strategic planning makes allowance for anticipated gains from lean improvements - Strategic partnerships allow for smoothing payments to your company to ease financial planning burdens and lower overall management costs									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										

Figure 22 (continued from previous page)

I.A.2	**Focus on Customer Value** - Customers create the requirements that "pull" value from the company's value stream and set the strategic direction of the company	Means of defining value to customers is informal and unstructured ☐ Current State ☐ Desired State	Structured process for defining customer value is applied to selected customers. ☐ Current State ☐ Desired State	How the company can best contribute to the customer's success is well-defined and incorporated into most of the company's projects and programs ☐ Current State ☐ Desired State	The customer definition of value strongly impacts your company's strategic direction. ☐ Current State ☐ Desired State	Competitiveness is enhanced as customer value becomes the predominant driving force throughout the extended enterprise. ☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Your company employs a formal process for determining customer needs and communicating those needs to the employees. - Your company understands what constitutes success in the "eye of the customer". - A formal process exists to measure and assess customer satisfaction. - Customer value and customer satisfaction strongly influence the way decisions are made in the company.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					
I.A.3	**The Extended Enterprise Picture** - Your customer and your suppliers represent different ends of your value stream. The value *streams* from your customer, through your company and to your suppliers, and so on…	Relations with customers and suppliers reflects a "We-Them" mentality ☐ Current State ☐ Desired State	Initial opportunities identified for establishing extended enterprise linkages. In other words, you have begun to look outside your company to the adjacent links in your supply chain (i.e. customer and key suppliers) ☐ Current State ☐ Desired State	Strategic planning process explicitly includes consideration of key stakeholders in the value stream. ☐ Current State ☐ Desired State	Your company collaborates with key suppliers in a strategic partnerships that serve your mutual needs and interests. This strategic partnership balances stakeholder values and improves working relationships with the key elements of the value stream ☐ Current State ☐ Desired State	Integration of the extended enterprise contributes to overall improvement in innovation, growth, increased profitability, and market position for the strategic partners. ☐ Current State ☐ Desired State
	Lean Indicators (examples)	- When your company conducts strategic planning, it is strongly influenced by stakeholder and customer value. - Your Company's strategic planning process looks outside the company itself, to the customer, partners, suppliers, and employees that make up the value stream, - Your company accepts some risk when planning supplier, customer, or partner activities and responsibilities, some of the risk is also shared by those same groups.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 23 - SB-LESAT, Section 1B

Section 1B: Lean Transformational Leadership (continued) - In this section, we continue to look at your company's implementation plans for lean both internally and external to the company itself. This section helps you understand the development, deployment, and management of the lean implementation plan. This plan should reflect the major effects of a lean transformation: namely 1) long term sustainability, 2) Increasing competitive advantage, 3) Identification and satisfaction of stakeholders, and 4) "Smoothing irregular cash flows that traditionally plague small businesses.

I.B. Adopting the Lean Vision - While the small business may be "naturally lean", to increase profitability requires a deeper understanding of lean principles and a formal vision for its implementation. Transitioning to Lean requires a significant change to the business model of the enterprise. It is imperative that the enterprise leadership understands and buys into the lean vision, since they will be required to create a vision for doing business, behaving and seeing value in fundamentally different ways.

Diagnostic Questions	- Do your company's leaders / senior management and "visionaries" understand the lean paradigm at the enterprise level? - Does your company's leadership enthusiastically support a transformation to lean? Do they "walk the talk"? - Has a common vision of lean been communicated throughout your company? Has it been communicated to your customers? Your suppliers? The extended enterprise? lean"?

LP#	Lean Practices	Capability Levels									
		Level 1		*Level 2*		*Level 3*		*Level 4*		*Level 5*	
I.B.1	**Learning and Education in "Lean" as it relates to your company's leadership** - "Unlearning" the old ways of doing business, and internalizing the lean paradigm.	Little interest in learning lean principles is evident among your company's leadership. Lean is treated as "just another method".		Your company's leaders are actively seeking opportunities to learn about lean. There is a basic understanding of the value of a lean transformation.		Your company's leaders are adopting lean learning and continuously applying lean principles across the internal operations of the company.		Your company's leadership contributes to the development and refinement of the body of knowledge about lean. In particular, they are able to adapt lean principles to the needs of your company.		Lessons learned from lean implementation are actively shared across the organization and within the extended enterprise.	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- A formal lean education process for the company leaders has been established. - A majority of your company's senior management have received significant exposure and education in lean principles, practice, and behavior. - Your company's leaders regularly apply and use "lessons learned" in lean.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										
I.B.2	**Senior Management Commitment** - Is your company's senior management leading the Lean Vision *personally*?	The level of commitment among the company's senior management is variable - some endorse, while some may actively resist.		The senior management buys into your company's group "vision". Those leaders / managers who will not adapt are replaced.		"Lean" is integral to the objectives of group and company-wide meetings. Senior managers personally and visibly lead the lean transition.		Senior leaders in your company are championing the transformation to lean. They clearly "believe" in lean, and are fairly relentless in their pursuit of lean in your company.		The leadership championing described in level 4 is extended outside the company to the extended stakeholder network.	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- There is a uniform, consensus commitment support within your company's leadership to transition to lean. - Your leadership seems excited and impatient to begin the lean transformation. - Management provides support and recognition for positive action towards a lean transformation, as well as for "lean acts" that improve the company's profitability.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										

Figure 23 (continued from previous page)

I.B.3	**Lean Enterprise Vision** - Does your company have a new "mental model" of the enterprise?	Senior Management and company leaders have varying visions of "lean", ranging from none to well-defined.		Senior Management and Company leaders adopt a common vision of "lean".		Your company's "lean vision" has been communicated and is understood by you, and most of the employees		A common vision of lean is shared by the extended enterprise. This means both inside and outside the company, and extends to key customers and suppliers.		The enterprise stakeholders have internalized the lean vision, and are an active part of achieving it. Lean has become operating philosophy, not just a "program" requirement.	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- The role that lean plays in achieving the vision is clearly defined. - Your company's lean vision has been communicated to all levels and has extensive buy-in by most employees. - Your company's lean vision incorporates a new mental model of how the company would act and behave according to lean principles and practices. - Your Company's lean vision is compatible with, and compliments the lean vision of your customers and key suppliers.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										
I.B.4	**A Sense of Urgency** - Your company's transformation to lean is organic, forming an integral element of a whole, and is seen as an urgent priority.	Looking at your company's competition and competitive environment identifies competitive threats and need for (change) actions.		Your Company's senior leadership has developed an urgent and compelling case for the lean transformation.		The urgent and compelling case for lean transformation has been communicated to everyone, and the organization rallies behind it.		Your company's urgent and compelling case for lean is expanded to, and accepted by, key suppliers.		Your company's urgent and compelling case for lean is expanded to and accepted throughout the extended enterprise.	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- A compelling business case for lean has been developed and communicated. - The implications and time scales of the lean vision have been translated for each area of the extended enterprise (Including both customer and supplier value chains). - The lean transformation progress is integral to leadership discussions, decisions, and program events. - Customer value and customer satisfaction strongly influence the way decisions are made in the company.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										

Figure 24 - SB-LESAT, Section IC

Section 1C: Lean Transformational Leadership (continued)- In this section, we continue to look at your company's implementation plans for lean both internally and external to the company itself. This section helps you understand the development, deployment, and management of the lean implementation plan. This plan should reflect the major effects of a lean transformation: namely 1) long term sustainability, 2) Increasing competitive advantage, 3) Identification and satisfaction of stakeholders, and 4) "Smoothing irregular cash flows that traditionally plague small businesses.

I.C. Focus on the Value Stream - Creation of value and elimination of waste internal and external to the company becomes the driving force for the company and extended enterprise. The current means of delivering customer value are determined, followed by improving the value stream by minimizing waste. Lean metrics are specified and stakeholder involvement in the extended enterprise is clarified.

Diagnostic Questions	
	- Is a formal process utilized to explicitly determine "value" to the customer?
	- Have the value streams of all stakeholders been mapped? Integrated? Balanced against the needs of your company and the overall extended enterprise?
	- Does your company understand how material and information flow throughout various elements of the enterprise?
	- Has a system of balanced performance measures been established that reflect progress toward strategic *lean* business objectives?
	- Are enabling infrastructure (IT, procedures, organizational structure, rewards, etc.) processes being aligned to the value stream flow?
	- Does your company, and everyone within it, clearly understand how it delivers value to the customer?

LP#	Lean Practices	Capability Levels				
		Level 1	*Level 2*	*Level 3*	*Level 4*	*Level 5*
I.C.1	**Understanding the Current Value Stream** - Assessing how customer value is delivered (both upstream and downstream in the value chain).	The documented process flow differs from the actual flow. There is an initial understanding of the need for formal mapping and further analysis.	Key stakeholders and what they value are identified. Present processes are mapped and initial analysis is underway.	The principal (current) value streams are identified, and critical interactions of the value streams emerge. Significant opportunities for waste elimination and value creation are identified. These opportunities are aligned to the strategic objectives.	The value stream elements are understood with depth and breadth of knowledge. Supporting processes and their interdependencies across the company are exposed and understood.	The (updated) value streams and their interdependencies are evaluated across the extended value stream (customers, suppliers and stakeholders).
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- A formal process has been established for identifying customer and stakeholder value.. - The practice and language of value stream mapping is recognized as an important part of an iterative improvement process. - Current value stream maps of major customers/product lines have been mapped, and hand-off points and interfaces are clearly defined.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					
I.C.2	**Enterprise Flow** - Re-evaluating "economies of scale" assumptions, and adopting "single piece flow" of materials as well as information.	Material and information flows are disjointed and "optimized" process-by-process. "Pushing" the product or information through the system is the flow mentality.	Some primary information or process flow paths have been overhauled to overcome significant barriers to the flow.	Primary flow paths are simplified and aligned to the value stream(s), which allows information and material to flow as required.	Material and information flow seamlessly throughout the company, "pulled" by the need for the product, process, or information.	Material and information flow seamlessly and responsively throughout the extended enterprise, both up and downstream in the value stream.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Information flows have been rationalized to assure interoperability among enterprise elements. - Material flow paths have been simplified and shortened to enhance flow. Work in Process (WIP) inventories are reduced. - Information and material flows are responsive to the actual stakeholder needs.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 24 (continued from previous page)

I.C.3	**Designing the Future Value Stream** - Integrating your company's value stream to meet the extended enterprise vision	Management in your company understands that the present processes do not meet the future lean enterprise objectives. ☐ Current State ☐ Desired State	A general understanding of the stakeholder requirements has lead to the ability to weigh and balance relative needs. A concept for future (new) value stream design has been developed based on those balanced needs. ☐ Current State ☐ Desired State	Future value stream(s) are developed, which encompass future enterprise goals and satisfy stakeholder intents and requirements. ☐ Current State ☐ Desired State	Future value stream(s) are refined to accommodate a changing environment. The value stream is not static, but identifies and is able to respond to changes in the competitive landscape. ☐ Current State ☐ Desired State	Future value stream(s) are refined to dynamically accommodate a changing environment across the extended enterprise. ☐ Current State ☐ Desired State
	Lean Indicators (examples)	- A formal process has been established to identify how the enterprise can best deliver value to customers and stakeholders. - The future value stream(s) reflect new and improved ways to increase value and minimize non-value added activity. - Future value stream(s) designs have been generated for the primary value stream(s) and their supporting processes.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					
I.C.4	**Performance Measurement** - Since performance measurement tends to drive individual behavior, and ultimately the company's culture, has your company's performance measurements been aligned to adequately measure progress towards a lean enterprise?	Performance measures are ad hoc, inconsistent and focused on function of the individual or area, rather than the value stream. ☐ Current State ☐ Desired State	Baseline performance measures are established to stimulate progress towards the lean future state and are visible throughout the company. ☐ Current State ☐ Desired State	Performance measurement systems use a minimal and balanced set of measures based upon strategic objectives and aligning the individual, group, operational, and company lean objectives ☐ Current State ☐ Desired State	Measurement systems and target setting pulls performance improvement throughout the company. In other words, the measurement system incentivizes and rewards lean progress. ☐ Current State ☐ Desired State	A common target setting and measurement process pulls performance improvements across the extended enterprise. In this case, the entire value stream is improved. ☐ Current State ☐ Desired State
	Lean Indicators (examples)	- A balanced and minimal set of performance measures are used to track the lean implementation progress. - The performance metrics keep the lean implementation process aligned toward your company's strategic objectives. - The performance measures used assure that the individual, group, company, and extended enterprise metrics are aligned . - Waste elimination, value creation and customer satisfaction strongly influence the performance measures.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 25 - SB-LESAT, Section ID

Section 1D: Lean Transformational Leadership (continued)- In this section, we continue to look at your company's implementation plans for lean both internally and external to the company itself. This section helps you understand the development, deployment, and management of the lean implementation plan. This plan should reflect the major effects of a lean transformation: namely 1) long term sustainability, 2) Increasing competitive advantage, 3) Identification and satisfaction of stakeholders, and 4) "Smoothing irregular cash flows that traditionally plague small businesses.

I.D. Develop Lean Structure and Behavior - Your Company's infrastructure must be assessed and modified prior to launching a lean initiative as well as throughout the lean transformation. Your company's organizational structure, incentives, policies, business systems, and operational processes must be aligned and coordinated to elicit the behavior required for successful implementation of lean principles and practices.

Diagnostic Questions	
	- Has an organizational structure been implemented that focuses on core processes along the customer value stream? - Is your company's organizational structure designed for flexibility and responsiveness to changes in the external or competitive environment? - Are your company's relationships with internal and external stakeholders based on mutual respect and trust? - Are your company's policies and procedures updated to promote and encourage lean behavior? - Are people with a clear vision and commitment to lean transformation (i.e. "lean change agents") positioned and empowered to provide guidance and leadership for the lean transformation? - Has decision making in your company been delegated to the lowest practical level? - Is prudent risk-taking encouraged by your company? How is failure dealt with?

LP#	Lean Practices	Capability Levels				
		Level 1	*Level 2*	*Level 3*	*Level 4*	*Level 5*
I.D.1	**Enterprise Organizational Orientation** - An assessment of how well your company is organized to support value delivery.	Your company operates as "functional silos" - that is, groups do not interact much, and your company is essentially organized to operate as separate functional units.	Initial efforts are underway to identify functional barriers and understand their full implications.	Your company operates as a partially deployed cross-functional organization. Where many of the functional barriers are removed and process are aligned with the company's strategic objectives and value stream(s).	Extensive cross-functional processes are implemented across the company. Functional units now serve as knowledge centers for skill retention.	Cross-functional, process-based orientation is aligned across the extended enterprise. Knowledge and skills are shared by upstream and downstream stakeholders for extended value creation.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Functional barriers have been minimized. - There is extensive use of cross-functional processes across the company. - Career progression potential exists across both processes and functions.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					
I.D.2	**Relationships Based on Mutual Trust** - "win-win" vs. "we-they" attitude, enterprise value is created when stakeholders trust and respect each other.	Relationships in your company tend to be determined by organizational role, resulting in a "we-they" perspective.	The selective application of "lean" perspective results in breaking down some of the organizational barriers and the development of mutual trust between groups and individuals within the company.	Stable and cooperative relationships exist across the company; cooperative relations are established with some enterprise partners	Mutual respect and trust exists across the extended enterprise with equitable sharing of benefits from continuous improvement initiatives.	The upstream and downstream stakeholders modify their operational behavior so as to enhance the extended enterprise's performance ("win-win").
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Communication barriers based on organizational position have been significantly reduced.. - Stable and cooperative relationships exist among most enterprise stakeholders. - There is an almost palpable sense of "team" when interacting with customers or suppliers, it is understood by all that "we are all in this together".				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 25 (continued from previous page)

I.D.3	**Open and Timely Communication** - Information is exchanged when it is needed and has the most positive impact on stakeholder value.	Information flow is largely one-way, often top-down, and is limited. The information flow typically lags, which tends to escalate the magnitude of problems to the point that they are much more difficult to solve.	☐ Current State ☐ Desired State	Basic communication mechanisms are employed, but are not uniform; your company's communication strategy is under development.	☐ Current State ☐ Desired State	Your company's leaders are accessible and visible, developing two-way communications in open, concise and timely form.	☐ Current State ☐ Desired State	The communication processes are undergoing continuous refinement, and information is accessible and freely exchanged, or can be pulled as required. Most employees know how and where to access the information they need.	☐ Current State ☐ Desired State	Your company has a comprehensive system of two-way communication that is employed throughout the extended enterprise. Information is freely exchanged as needed with all stakeholders.	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Open and timely communications exist among stakeholders, i.e. regular meetings with employees, newsletters, central data repositories. - Technology has been leveraged to speed communication flow and accessibility, while filtering unnecessary communications. - Employee input is valued, and plays a key part in decision making. - All personnel in your company know where, and how, to get the information they need to do their job.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										
I.D.4	**Employee Empowerment** - Does your company enable decision making at its lowest possible level?	Decision making in your company is largely centralized, and occurs in a hierarchical structure with limited delegation of authority. Lower levels have very little input into the decision making process.	☐ Current State ☐ Desired State	Your company realized it needs to enable appropriate lower-level decision making. Structure and training is being put in place to enable lower level decision making empowerment.	☐ Current State ☐ Desired State	Your company's organizational environment and management system supports limited decision-making at point of application and need. Employees clearly understand their responsibilities for decision making, and are empowered to make decisions within the scope of their application.	☐ Current State ☐ Desired State	Decision making processes are continually refined to promote increased accountability and decision-making ownership at point of use.	☐ Current State ☐ Desired State	Decision making across the extended enterprise is delegated to the point of application. Suppliers and Customers are an integral part of the decision making process, and are trusted and empowered to make decisions at their point of use that impacts the overall enterprise as well as your company.	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Managers and supervisors serve as mentors and educators, promoting lower-level decision making. - The extent and types of empowerment are tailored to match the environment and people that are influenced by, and responsible for, the decision. - Empowerment enables swift and effective decision making closest to the point of use. - Lower level decisions are communicated to the appropriate stakeholders.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										

Figure 25 (continued from previous page)

I.D.5	**Incentive Alignment** - Reward the behavior you want.	There is a sporadic use of incentives and an awareness that some incentives discourage lean behavior/	Incentives that reward and encourage lean behavior are deployed in some areas, but not others.	Executive compensation and employee incentives are linked directly to attainment of lean objectives	Incentive systems successfully contribute to achievement and sustainability of lean objectives.	Lean incentives are deployed, with measurable success across the extended enterprise.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Incentives include a balance of monetary and non-monetary rewards and recognition to encourage lean activity. - Incentives are based on performance measures that encourage lean activity.. - Incentives encourage local improvements that will benefit multiple processes or value stream performances. - Incentives ultimately "pull" the lean behavior needed to sustain the lean enterprise.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					
I.D.6	**Innovation Encouragement** - A lean transformation requires that you move form risk aversion to prudent risk rewarding.	Innovation initiatives are sporadic and ad hoc; security, stability, and risk aversion drive most decision making.	Initial efforts are underway to develop systems, processes and procedures for fostering innovation.	Innovation initiatives are underway in selected areas; measures for assessing impact are in use.	Innovation initiatives are flourishing across the enterprise; prudent risk taking is encouraged and rewarded.	Comprehensive innovation program is implemented and positive results are recognized across the extended enterprise.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- The review process for suggestions has been streamlined and gives clear visibility of the progress of each suggestion. - Suggestion programs have been properly incentivized to give recognition to originators of innovative ideas. - Risk is understood, not avoided. Prudent risk taking is seen as a core strength of your company, not a liability. - Innovations can be measured against the company's lean vision, and the value of the innovation is considered in relation to its impact on the values stream.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 25 (continued from previous page)

I.D.7	**Lean Change agents** - To implement and sustain change, lean visionaries or champions are empowered as change agents to inspire and drive change.	Change agents are sporadically distributed in your company, but without clear change authority.	Your company has identified the role of the change agent, and is developing the organizational infrastructure to support a network of change agents.	There is formal identification and definition of the change agent's role in the organization. They are empowered to make the necessary changes. Further, they are tasked to delegate their responsibilities as well as implement a program of education and training for new change agents.	Change becomes self-generating, initiated by employees, management, as well as change agents.	Your company's change agents are a critical resources for lean knowledge, skill and experience within the extended enterprise. Their skills and knowledge are shared with the extended enterprise to help improve the value to the extended enterprise.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Lean change agents have been designated and empowered in your company, with a mandate to increase value and eliminate waste. - Lean change agents operate throughout all areas of your company and cross-transfer knowledge gained and lean implementation experience to other areas of your organization. - A process for mentoring and developing new change agents has been established. - Each individual in your company feels a personal responsibility and authority to make positive change occur in their position.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 26 - SB-LESAT, Section IE

Section 1E: Lean Transformational Leadership (continued)- In this section, we continue to look at your company's implementation plans for lean both internally and external to the company itself. This section helps you understand the development, deployment, and management of the lean implementation plan. This plan should reflect the major effects of a lean transformation: namely 1) long term sustainability, 2) Increasing competitive advantage, 3) Identification and satisfaction of stakeholders, and 4) "Smoothing irregular cash flows that traditionally plague small businesses.

I.E. Create and Refine Your Company's Transformation plan - In this section, you will evaluate how completely your organization has identified, prioritize and sequence a comprehensive set of lean initiatives that collectively constitute the plan for achieving the desired lean transformation.

Diagnostic Questions	- Is the enterprise-level lean transformation plan prioritized and aligned with the company's strategic business objectives? - Have adequate resources been provided to facilitate the lean transformation? - Does the current education and training program adequately support your company's strategic direction(s) and lean transformation? - Have "lessons learned" and "best practices" been effectively incorporated within the lean transformation planning?

LP#	Lean Practices	Capability Levels									
		Level 1		*Level 2*		*Level 3*		*Level 4*		*Level 5*	
I.E.1	**Enterprise-Level Lean Transformation Plan** - Charting the transformational course across the extended enterprise.	There is no formal lean transformation plan. Or there is a loosely defined plan with little priority or coordination established at the enterprise level.		While there is not necessarily a formal lean transformation plan, your company has identified the requisite lean implementation projects. These projects are prioritized to meet long and short-term strategic objectives		Your company has created a formal lean enterprise improvement plan(s), and it is coordinated and prioritized across the company's value stream(s), with a timeline for expected and measurable results.		The lean transformation plan is being executed in your company, and is continuously refined through learning from implementation results and changing strategic requirements.		The dynamic lean transformation plan balances mutual benefits of the stakeholders across the extended enterprise.	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- A process is in place to incorporate lessons learned from transition-to-lean activities into the enterprise-level lean transformation plan. - The milestone targets of the lean transformation plan are broken down by section and deployed across the company. - Your transformation plans balance long-term and short-term stakeholder objectives for the best "value chain" solution. Cost savings and value improvements are shared across the enterprise.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										

Figure 26 (continued from previous page)

I.E.2	**Commit Resources for Lean Improvements** - create a reasonable and adequate resource provision for lean.	There are little or no resources provided in your lean transformation plan and budgeted by your company for process improvement or waste elimination	Limited enterprise-level resources are committed and often applied to the symptoms of a problem, rather than the elimination and prevention of the root causes. Once a problem is fixed, it is rarely studied for root cause elimination ("There just isn't time or budget!" is often quoted).	Resources in your company are allocated as required for the execution of the lean transformation plan and prioritized across the value stream.	A pre-planned amount of company resources is provided for lean initiatives, access to the resources requires minimal justification, as long as it is within the strategic transformation objectives.	A pool of earmarked resources is provided for lean initiatives across the extended enterprise. A formal plan is in place to share the costs and benefits from the lean transformation throughout the extended enterprise.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Resources are committed to support the level and speed of the lean transformation required within your company. - Sufficient time to build on lean improvements through personal contribution is given at all levels. - The procedure to apply for lean improvement resources has been simplified, and gives priority to improvements that benefit multiple areas.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					
I.E.3	**Provide Education and Training** - Just-in-time learning. Ensuring a common understanding of the lean vision and the company's implementation plan, as well as the employee's role in the transformation.	There is little coordination of education and training programs within your company to facilitate lean change.	Your company's education and training program covers a minimum set of skills required to support the lean transformation plan.	Your company's education and training program is comprised of a balanced and sequenced set of elements to support the coordinated transformation plan.	Education and training at all levels is periodically reviewed to check alignment and suitability to the lean transformation plan. Employee knowledge is enriched through professional development education and training, which strengthens their value as individuals within the company	Your company's education and training program supports the upcoming needs of the extended enterprise transformation plan.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Education and training programs, including refreshers, are provided on a just-in-time basis. - Education and training has a balanced and sequenced set of elements to support the lean transformation plan. - The application of lean principles learned in training and education is formally appraised. - Employees are trained not only in "lean", but in areas that increase their knowledge, and further develop their skills and abilities. This, in turn, reinforces lean behavior.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 27 - SB-LESAT, Section IF

Section 1F: Lean Transformational Leadership (continued)- In this section, we continue to look at your company's implementation plans for lean both internally and external to the company itself. This section helps you understand the development, deployment, and management of the lean implementation plan. This plan should reflect the major effects of a lean transformation: namely 1) long term sustainability, 2) Increasing competitive advantage, 3) Identification and satisfaction of stakeholders, and 4) "Smoothing irregular cash flows that traditionally plague small businesses.

I.F. Implement Lean Initiatives - In this section, you will evaluate how completely your organization has flowed the company-level lean transformation plan and lean vision into specific actions, programs and projects. You will also determine how thoroughly theses projects are executed within each organizational process area and determine how they are re-integrated at the enterprise level.

Diagnostic Questions	- Has the enterprise-level lean transformation plan been translated into detailed execution projects? - Has a uniform system been established to track the progress of the lean initiatives with respect to the overall plan? - Do lean initiative plans contain a feedback mechanism for revision? How are lessons learned incorporated into the plan? - How flexible is the plan? How often is it reviewed? What is it measured against? How do you know progress is being made?

LP#	Lean Practices	Capability Levels				
		Level 1	*Level 2*	*Level 3*	*Level 4*	*Level 5*
I.F.1	**The Development of Detailed Plans Based on the Company's "Enterprise Plan"** - The coordination of lean improvements up and down the organizational structure.	Local improvements in process are generally optimized for individual areas and employees cannot clearly see the links between localized improvements and the enterprise goals.	Key goals of the company's lean transformation plan are understood by most employees. Process owners are involved in developing detailed plans that link to the goals and strategic objectives of the enterprise plan	Detailed lean implementation plans supporting the enterprise level plan are developed and coordinated across processes or business elements within the company.	Interdependencies between groups are identified, and the detailed plans are refined to accommodate t the interdependency. The resultant plan is then integrated across the enterprise. Best practices are shared across the entire	Implementation plans from the extended enterprise are coordinated with, and support, your company's lean transformation plan
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Detailed implementation plans are aligned to milestone targets of your company's enterprise level plan - A process is in place to incorporate lessons learned in detailed implementation plans, and the enterprise level plan is adjusted as necessary. - Detailed improvement plans are coordinated throughout the enterprise where shared implications exist.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					
I.F.2	**Tracking Detailed Implementation** - Assessing actual outcomes against the goals.	Results of process improvements are observed, but not quantified.	A process is under development at your company to permit tracking and quantification of progress of the detailed lean implementation. Data from some projects are being reviewed.	A project management process has been implemented to track the progress of detailed lean projects against their planned milestones. Feedback on progress is provided to your company's leaders so that appropriate enterprise-level corrective action can be initiated.	The project management process can readily assess detailed plans and can accommodate revisions mandated by changes to the enterprise level lean transformation plan. Information form this process flows up to company leadership and down to the employees as needed	The project management process is deployed across the extended enterprise to enable real-time tracking against the extended enterprise goals and values.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Lean initiatives are coordinated and tracked, with the individual results "rolled up" and assessed against enterprise level milestones and targets. - The responsibility and accountability for improvement success is assigned locally to enable fast corrective action on deviations from the plan. - Changes to processes and value stream maps(s) are documented and updated regularly.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 28 - SB-LESAT, Section IG

Section 1G: Lean Transformational Leadership (continued)- In this section, we continue to look at your company's implementation plans for lean both internally and external to the company itself. This section helps you understand the development, deployment, and management of the lean implementation plan. This plan should reflect the major effects of a lean transformation: namely 1) long term sustainability, 2) Increasing competitive advantage, 3) Identification and satisfaction of stakeholders, and 4) "Smoothing irregular cash flows that traditionally plague small businesses.

I.G. Focus on Continuous Improvement - The successful execution of your company's lean implementation plan forms the basis for future improvement. The improvement process is monitored and nurtured. Lessons learned are captured, and improved performance becomes a driving force for future strategic planning by company leadership.

Diagnostic Questions	- Are guidelines for continuous improvement sufficiently developed for an effective company-wide transformation to lean? - Is your company's organizational structure designed for flexibility and responsiveness to changes in the external or competitive environment? - Are your company's employees being challenged to sustain existing improvements and develop new improvements? - Is your company's leadership actively involved in monitoring the progress of the lean implementation plan at all levels? - Is appropriate support and encouragement being provided to all employees involved in the lean transformation? - Are lessons learned being captured in a consistent, systematic manner? Are they accessible to the decision makers in your company when needed? - Are lean implementation results impacting strategic planning?

LP#	Lean Practices	Capability Levels									
		Level 1		*Level 2*		*Level 3*		*Level 4*		*Level 5*	
I.G.1	**Structured Continuous Improvement Process** - Uniformity in how we get better.	Improvement initiatives in your company are ad hoc, and are usually a reaction to some event. Proactive improvements are rarely undertaken, or the initiatives themselves are not data driven.		An formal improvement process for your company is broadly defined, and is being selectively applied.		Your company has a systemic, structured methodology for continuous improvement. Your improvement programs are centered around the principles of value creation, and its implementation is developed and deployed across many areas.		our company has a structured continuous improvement process that is deployed at all levels across the company. All of your initiatives use a structured value analysis to target improvements.		Your company's structured continuous improvement process is fully ingrained in your company, and is applied cooperatively outside the company to the extended enterprise.	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- A consistent improvement and transformation approach is implemented, and sustains the improvements made. - The continuous improvement process challenges people to tackle the root cause of waste or inefficiency, rather than the symptom. - Lean principles are being applied to most of your company's systems and processes, and learning from past "lessons" and developing new insight..									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										
I.G.2	**Monitoring Lean Progress** - Assessing progress toward achieving enterprise objectives	Your company's leaders are not actively involved in the progress review of the overall lean implementation plan.		Your company's lean implementation plan progress is reviewed against high-level milestones and success criteria, for some projects but not others.		A formal methodology is used by your company leadership to analyze the overall progress across all lean implementation projects. Current plans are adjusted based on learning from lean implementations.		Results of your company's implementation projects are aggregated to permit reallocation of resources and to ensure on-going alignment with strategic objectives.		Senior managers monitor lean progress upstream and downstream in the value chain (throughout the extended enterprise). Results are impacting future strategic planning of your company, its suppliers and its customers.	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- The lean transformation progress is judged by its aggregate benefits, not just the individual or localized improvements. - Your company's leaders actively participate in monitoring the implementation progress, and routinely and address deficiencies within the transformation plan. - Lean progress reviews are conducted, documented, and disseminated to the necessary groups and personnel.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										

Figure 28 (continued from previous page)

I.G.3	**Nurturing the Process** - Assuring executive level involvement	There is growing awareness that successful lean implementation is highly dependent upon senior management support and encouragement.	Some senior management are providing encouragement, support and recognition, but it is not consistent across the entire company.	Company leaders seek to identify and remove barriers to the lean implementation. Teams and individuals who successfully implement lean practices are recognized and rewarded.	Senior managers across the entire enterprise are highly visible in their involvement, support and encouragement of the lean initiative. An enthusiastic atmosphere is evident.	Senior executives and managers champion and nurture a culture of continuous improvement in the extended enterprise.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Leaders in your company actively support the lean initiatives, and are ensuring the success of those initiatives. - Your leadership recognizes and rewards positive actions and efforts made by groups and individuals in the lean transformation process. It is common to recognize and reward significant efforts, even if improvements are not fully successful. - Employee input is valued by senior leadership, and plays a key part in adjusting the lean implementation plan. - All personnel in your company know the company's lean strategy, and are informed about any changes to the implementation plan.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					
I.G.4	**Capturing Lessons Learned** - Ensuring that successes lead to more success, and that failure is not duplicated.	Lessons learned from improvement activities in your company are not documented, and reside only in the memories of the participants.	Lessons learned in your company are documented and maintained in paper files, design notebooks, etc., but are difficult to find and utilize.	Your company has a formal process for capturing and *communicating* lessons learned. The process is used consistently, and your company's personnel actively contribute to, and learn from these lessons. Mistakes are rarely duplicated.	Lessons learned in your company are consistently captured, communicated regularly, and used in a structured manner. An company-wide knowledge base is created. All employees routinely use the knowledge base to learn and store valuable information.	A formal knowledge management process is adopted by your company that is compatible with the extended enterprise. Lessons learned in your company are routinely and explicitly incorporated into the formulation of new lean initiatives. Where appropriate, these insights are shared with strategic partners.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Your company's "best" practices, suggestions, and lessons learned are maintained in a clear/concise standard format. - A formal process has been established company-wide for capturing and reusing lessons learned. - The company's "lessons learned" are periodically reviewed and updated or eliminated to maintain the relevance of the information kept. - Everybody in your company knows how to access and use your company's knowledge base to make use of the information contained within.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 28 (continued from previous page)

I.G.5	**Impacting Enterprise Strategic Planning** - Results lead to strategic opportunities	The results of your company's lean implementation are not fed back to its strategic planning process.		The benefits of the lean implementation are beginning to influence your company's strategic planning process.		Your company's senior management considers the potential impact of performance improvement initiatives in its assessment of new business opportunities.		The forecasted improvements from planned and current lean implementation projects are incorporated into your company's planning and budgeting decisions.		Your company's senior management integrates the forecasted future results of lean implementation in its assessment of new business opportunities and potential competitive/market impact.	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- Your company's business results reflect the improvements resulting from its lean implementation. - Your company's strategic planning makes allowances for the anticipated gains from lean improvements. - The gains realized from your company's lean implementation are leveraged to achieve growth, profitability, market position, and employment stability. - Your company's lean implementation plan has resulted in improved relations with your customers and suppliers, allowing better forecasting of future business and demand leveling.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										

Figure 29 - SB-LESAT, Section IIA

Section II: Life Cycle Processes: Life cycle processes are defined by the processes that act upon a product - from its initial conception through its operational support and ultimate disposal. The degree which your company is successful in making these processes lean is a measure of your company's efficiency. This section helps you determine whether your company is performing at the required level to: define customer requirements; develop products and processes; manage supply chains; produce and service the product; and provide post delivery support.

II.A. Business Acquisition and Program Management - To be successful in a (globally) competitive environment, companies must develop and manage partnerships with their customers and be able to rapidly re-configure and align their competencies among their suppliers and partners in order to deliver the best life-cycle value to its customers.

Diagnostic Questions	
	- Are new business opportunities arising from the gains made in the lean transformation?
	- Does customer feedback and customer usage data drive new business process developments at your company?
	- Have you developed an understanding or partnership with your suppliers and customers to distribute assets throughout the extended enterprise in order to increase value at minimal cost?
	- Are the program risks and your company's resource requirements balanced to assure optimal product "flow" through its life cycle?
	- Are skills and resources drawn from across the extended enterprise to enhance program development efforts? In other words, are you free to "borrow" resources as needed from your suppliers or customers to help you with the product or process development effort? Does your company freely share its resources with its strategic partners?

LP#	Lean Practices	Capability Levels				
		Level 1	*Level 2*	*Level 3*	*Level 4*	*Level 5*
II.A.1	**Utilize Lean Capability for Business Growth** - Exploiting new business opportunities arising from the resources freed up by the lean transformation.	Business improvement initiatives are ad hoc and are focused on operational efficiency. Very little thought given to "system" efficiency.	Improvement gains provide resources to facilitate future improvements. Potential business opportunities from applying lean thinking across core competencies are recognized and plans have been developed to utilize them.	Benefits sustained from applying lean thinking within your company are used to improve the stability of the current business and/or win new business	Your company knows how to measure and exploit its enhanced lean capabilities, and combines its lean resources with its customer knowledge throughout the company to leverage opportunities for competitive advantage.	Your company's strategic plan dynamically incorporates the capabilities of extended enterprise (supplier and customer) as well as key stakeholder interests to identify and leverage competitive opportunities.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Reduced cost, increased quality and faster response times gained from lean efforts are used to maintain new business. - The ability to improve and refine processes quickly is used extensively to respond to changing customer requirements. - A process is used to scan the competitive environment to exploit opportunities arising from the enhanced capabilities of the lean enterprise.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 29 (continued from previous page)

II.A.2	**Optimize the Capability and Utilization of Assets** - Using your people, equipment, facilities, etc., to their fullest. Lean enables business growth through the redeployment of assets to value-added activities.	The utilization of people and material assets within your company is optimized within groups, departments, or functions, and there rarely coordination with outside groups.	There is evidence of ad hoc cooperation between functional units to eliminate waste and share resources.	An company-wide "enterprise" approach provides a consistent and balanced asset allocation across your company's value stream, but may not include growth strategy.	As a result of the application of lean concepts and techniques, assets are freed up to be applied across the enterprise to support current and growth activities.	The ability exists to easily and quickly shift or divest resources to new opportunities, there is a company-wide understanding of the resource measurement and utilization policy, and the system works to provide agile resource management to the company "strategy portfolio".
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Assets freed from lean implementation are readily redeployed. - The workforce and its knowledge is nurtured, reallocated, and maintained wherever possible. - Available assets and resources are coordinated throughout the company to leverage resources to their most-value added usage.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					
II.A.3	**Provide Capability to Manage Your Performance to Risk, Cost, and Schedule**- Success requires an understanding risk while still encouraging prudent risk taking. In other words, "lean" presupposes effective risk management.	Programs are managed and staffed as independent entities. Risk assessment is done at the local level, and usually is viewed as local impact on cost, performance or schedule.	There is a management system to monitor and control program performance and staffing. Regular reviews focus on cost, schedule, and performance of individual programs. Information is communicated "up" the management chain.	Program reviews within your company assess risk within individual programs and staffing is adjusted as necessary to mitigate risk. Risk information is shared to leaders throughout the company.	The programs are reviewed assessing the risk across the portfolio of programs within the company with appropriate reallocation of resources to mitigate the cost, schedule, performance, and customer satisfaction risks associated with the "big picture" risk.	Risk abatement processes are used to optimize performance of the portfolio of programs within your company. Everyone knows their role in the process, and the system works like it is supposed to.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Your company's programs and process reviews have a "portfolio" approach to achieve company-wide balance or priorities and interests. - A risk management process is fully integrated across the enterprise, every knows how to use it, and does. - A formal process for measuring performance to cost, schedule, risk, and customer satisfaction exists.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 29 (continued from previous page)

II.A.4	**Allocate Resources for Program Development Efforts** - Teaming with key members of your value chain for greater success.	Program management efforts rely on your company's functional units for the allocation of the required skills.		Your company has begun to look beyond the functional unit to allocate resources. Some, but not all of the necessary skills are deployed across program boundaries.		Some of the skilled resources are routinely shared across your company's programs. Formal methods are being developed for determining team makeup and the assignment of necessary skills.		Your company's resources and skills are routinely balanced and shared across the portfolio of programs within your company. Resource sharing is part of your company's "culture".		Your company shares resources with its suppliers and customers as necessary. A strong sense of "team" with your extended enterprise partners has created "virtual" organizations as needed from the extended enterprise. This extended enterprise lowers everyone's costs by providing partners with the skills and resources necessary to execute the development effort(s).	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- A process is defined and used to ensure that cross-disciplinary skills are represented on teams - Resources and skills are easily and quickly shifted or divested to balance requirements across all program development efforts. - A strong sense of teamwork exists with your value chain partners, and you share resources freely, as pulled by program needs.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										

Figure 30 - SB-LESAT, Section IIB

Section II: Life Cycle Processes (Continued): Life cycle processes are defined by the processes that act upon a product - from its initial conception through its operational support and ultimate disposal. The degree which your company is successful in making these processes lean is a measure of your company's efficiency. This section helps you determine whether your company is performing at the required level to: define customer requirements; develop products and processes; manage supply chains; produce and service the product; and provide post delivery support.

II.B. Requirements Definition - Customer needs and values must be assessed continuously and translated into practical requirement statements that form the basis for your company's product and process development activities.

Diagnostic Questions	- Are the customer's needs continually evaluated in determining product and process requirements? - Does customer feedback and customer usage data drive new business process developments at your company? - Is a data collection and customer feedback process defined and deployed at your company? - Is product life cycle data used in determining requirements and subsequent specifications? - Are product and process capability data matched to design criteria?

LP#	Lean Practices	Capability Levels				
		Level 1	*Level 2*	*Level 3*	*Level 4*	*Level 5*
II.B.1	**Establish a Requirement Definition Process to Optimize Lifecycle Value** - Stakeholder "pull" vs. technology or product "push"	Requirements are defined internally based on past experience, rather than on a formal requirements definition process.	A requirements definition process, which balances cost, schedule, and performance is partially developed and deployed at your company. It has been documented, and is under active review.	Your company has a requirements definition process that leverages value chain capabilities (i.e. intelligently capitalizes on the strengths of your company and its extended enterprise) and focuses on overall life cycle implementations.	Your company has an iterative requirements definition process that spans the value chain, resulting in a minimal set of requirements that balances cost and performance with company and stakeholder needs.	The requirements process is a strategic advantage for your company and its extended enterprise. The use of your requirements process contributes to increased responsiveness and leads to new business opportunities.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- There is a process in place to determine the clear and concise product life cycle requirements, with acceptable ranges for the requirements. - The process ensures a balanced representation from all disciplines across your company and throughout the value chain - Structured methods are used by your company and its strategic partners to elicit and gather needs from different stakeholders and customers.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 30 (continued from previous page)

II.B.2	**Utilize Extended Enterprise Data to Optimize Future Requirements Definition** - Closed-loop processes are in place to capture operational performance data.	Warranty claims and deficiency reports represent the primary source of data that is collected and analyzed for impact to present requirements for your company's products and processes.	A proactive process is being developed by your company to collect product usage data as the basis for future requirements.	Data are collected on usage, maintenance, disposal and future needs from across the present value chain and fed into future design solutions and requirement definitions.	Your company's requirements definition process allows real time access, collection and dissemination of data from across the extended enterprise for analysis by stakeholders for future use.	The requirements definition process is established across your company's extended enterprise to actively seek data on needs, usage, and process capability. The data populate a data repository that can be mined for future requirements.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Customer feedback is actively sought and provided as input to the requirements definition process. - A database of usage, maintenance, and disposal data is maintained and extensively used to establish future requirements definitions. - Enhanced knowledge of customer and stakeholder requirements and desires is used to leverage future requirements.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 31 - SB-LESAT, Section IIC

Section II: Life Cycle Processes (continued): Life cycle processes are defined by the processes that act upon a product - from its initial conception through its operational support and ultimate disposal. The degree which your company is successful in making these processes lean is a measure of your company's efficiency. This section helps you determine whether your company is performing at the required level to: define customer requirements; develop products and processes; manage supply chains; produce and service the product; and provide post delivery support.

II.C. Develop Product and Process - Product and Process design decisions must be based upon value quantification and tradeoffs that incorporate inputs from the affected stakeholders.

Diagnostic Questions	
	- Is the product development process formalized and understood?
	- Are customers and other life cycle stakeholders regularly involved in product and process development?
	- Are downstream stakeholder issues in design and development considered and incorporated as early as possible in the process?
	- Have most of the unnecessary iterations in the development cycle been removed?
	- Are products and processes being developed concurrently? Do they align with your company's strategic lean initiatives?

LP#	Lean Practices	Capability Levels				
		Level 1	*Level 2*	*Level 3*	*Level 4*	*Level 5*
II.C.1	**Incorporate *Customer Value* in the Design of Products and Processes** - Understanding customer value allows continuous improvement of both products and processes	In your company, customer inputs are captured only at the beginning of the development	Customer inputs are considered quantitatively in your company through top-level customer liaison and occasional customer reviews.	The customer's) are formally represented on your company's integrated product development teams (IPT). Feedback mechanisms exist in the product development process to understand and minimize design iterations.	The customer's) are actively involved with the IPT at multiple levels, and jointly improve the effectiveness and quality of the products and processes designed in your company.	The customer's) are routinely involved with IPT and are valued team members. Sharing of benefits is well-established; value quantification and sharing as well as requirement tradeoffs are a continuous and automatic part of the process.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Customer inputs are sought and used actively throughout the development process. - Designs satisfy customer value requirements, without unnecessary functionality - A "teaming" sense exists with your customer to better define and refine requirements during the product development process, costs are shared by the team as emergent properties develop				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 31 (continued from previous page)

II.C.2	**Incorporate "Downstream" Values into Product and Process Design** - Understanding downstream stakeholders (manufacturing, support, etc.) allows value to flow seamlessly to the customer.	Manufacturing issues are considered late in the product development process. This often results in producibility problems or unnecessary production costs.	Manufacturing and assembly issues are considered early in the projects, but in an ad hoc manner. Supplier and cost considerations are limited.	Multi-functional teams include some downstream disciplines as well as your company's key suppliers.	Priorities of downstream stakeholders are quantified as early as possible in design, and used for process evaluation and improvement.	Downstream stakeholder's values in the extended enterprise are quantified, and balanced via tradeoffs, and are a continuous part of the product development process.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- There is early consideration and incorporation of downstream stakeholders issues throughout the design development. - The scope of considerations integrated into designs has been extended to include manufacturing, assembly, test, serviceability, and cost implications. - Products are easier to produce and have lower life cycle costs as a result of "downstream value" consideration.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					
II.C.3	**Integrate Product and Process Development** - Breaking down functional groups ("silos") enables communication and value flow within your company and along the value chain.	Development is performed in functional organizations, and is not integrated in cross-functional teams.	Multidisciplinary development or IPTs are used to a limited extent.	Multidisciplinary development is used extensively; metrics are established for process evaluation.	Multidisciplinary techniques are deployed for most programs and product development efforts, metrics are used for process evaluation and improvements.	Product and process definition is seamlessly integrated both internally and with upstream and downstream stakeholders.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Resources and skills are balance across projects and programs. There is extensive sharing and re-use of knowledge. - Suitability and timing of design information is released, and is matched to the requirements of subsequent processes. - A general understanding of diversity exists within your company. That diversity is treasured, and forms the basis for rich multidisciplinary team constitution. Divergent thinking is encouraged, and often leads to creative results.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 32 - SB-LESAT, Section IID

Section II: Life Cycle Processes (continued): Life cycle processes are defined by the processes that act upon a product - from its initial conception through its operational support and ultimate disposal. The degree which your company is successful in making these processes lean is a measure of your company's efficiency. This section helps you determine whether your company is performing at the required level to: define customer requirements; develop products and processes; manage supply chains; produce and service the product; and provide post delivery support.

II.D. Manage Supply Chain - Internal Company skills (core competencies) are aligned with those of suppliers such that the customer value chain is optimized throughout the extended enterprise.

Diagnostic Questions	
	- Have the number of suppliers been reduced to a level that can be effectively managed?
	- Do contractual requirements enable supplier flexibility and adoption to both expected and emergent changes?
	- Have the bottlenecks and constraints throughout the extended enterprise been identified? Do you know what they are?
	- Are supplier partnerships and strategic alliances established to strengthen the competitive advantage? Are both members of the team strengthened as a result of the alliance?
	- Are in-house capabilities balanced with supplier capabilities? Is there overlap? Can it be eliminated?

LP#	Lean Practices	Capability Levels									
		Level 1		*Level 2*		*Level 3*		*Level 4*		*Level 5*	
II.D.1	**Defined and Develop Supplier Network** - Skills, capabilities and core competencies are aligned across the supplier network	Your company uses a large number of direct suppliers. There is little evidence of a defined supplier strategy and limited knowledge of the relationships within the supplier network		Your company has reduced the number of key suppliers it interacts with. The supplier base has been rationalized to focus on key suppliers with high impact on strategic objectives.		Your company's supplier network is established, based on a strategic analysis of the value creation process. The analysis includes both internal company value creation, as well as value creation from various suppliers.		Strategic outsourcing and make-buy decisions focus on achieving an optimal combination of core competencies both within the company and across the supplier network.		Your company's supplier network is defined, developed, and integrated to ensure efficient creation of value for enterprise stakeholders over the entire product life cycle.	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- The supplier network is defined and developed concurrent with the strategic plan, and ensures the efficient creation of value for all enterprise stakeholders - Your supplier's expertise and capabilities compliment your company's needs for skills and capabilities; unnecessary overlap and duplication has been removed. - Your company's supplier network is flexible, and can quickly adapt to changing requirements and unanticipated disruptions.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										

Figure 32 (continued from previous page)

II.D.2	**Optimize Network-Wide Performance** - Partnering with key suppliers and optimizing processes to achieve customer value.	Supplier relationships are at "arm's length" and somewhat adversarial. Your Purchasing department manages a large number of short-term, lowest-bid contracts		Your company uses formal processes for supplier assessment and approval. Your company has established long-term purchase agreements with key suppliers that focus on cost reduction. Still, there is limited visibility into your supplier's business processes.		Your company has met with its key suppliers and mapped out common objectives, roles and responsibilities. These are established and communicated, and a few strategic alliances are in place. There is early involvement of key suppliers in your design and development decisions.		Your company's strategic alliances with its key suppliers emphasize a high degree of information sharing, risk sharing, and benefit sharing. Both your company's and your suppliers' production and delivery schedules are synchronized across the supplier network.		Supplier capabilities are dynamically optimized to ensure efficient value creation and building durable competitive advantage, creating flexibility and responsiveness to shifts in the marketplace.	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- Formal processes are in place for supplier assessment and approval - Roles and responsibilities are clearly defined in contractual relationships, and risk and reward shares are agreed upon. - Production and delivery are synchronized throughout the supplier base to ensure continuous flow and minimal waste.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										
II.D.3	**Foster Innovation and Knowledge-Sharing Throughout the Supplier Network** - Incentivizing innovation and technology transfer.	Your company is primarily focused on internal capabilities, with little cognizance of tacit (experience based) or explicit (formal) knowledge sharing across suppliers		Your company has adopted some internal processes to leverage supplier-based knowledge and innovation.		Your company involves key suppliers to develop technology roadmaps in pursuance of a common strategic vision. Your company shares metrics for continuous improvements with those key suppliers		A knowledge transfer mechanism is created for open and rapid access throughout the supplier network.		A mutually-beneficial arrangement has been established in your company to foster innovation across suppliers. A process for on-going communication of vision, strategy, metrics an knowledge implementation is in place.	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- Long-term collaborative relationships are established and maintained where possible - Processes to facilitate sharing and transfer for innovation, knowledge and technology are deployed. - A mutually beneficial continuous improvement process is established throughout the supplier network over the entire product life cycle.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										

Figure 33 - SB-LESAT, Section IIE

Section II: Life Cycle Processes (continued): Life cycle processes are defined by the processes that act upon a product - from its initial conception through its operational support and ultimate disposal. The degree which your company is successful in making these processes lean is a measure of your company's efficiency. This section helps you determine whether your company is performing at the required level to: define customer requirements; develop products and processes; manage supply chains; produce and service the product; and provide post delivery support.

II.E. Produce Product - The production system must be designed and managed according to lean principles and practices.

Diagnostic Questions	- Has enterprise strategy been aligned with manufacturing capability? - Is production knowledge and capability regarded as a strategic competitive advantage? - Are products "pulled" by actual customer demand, in real time? - Has the production process been ordered and adapted for flow? - Have the process bottlenecks been identified? Are inventories maintained at minimal levels throughout the production process?

LP#	Lean Practices	Capability Levels									
		Level 1		*Level 2*		*Level 3*		*Level 4*		*Level 5*	
II.E.1	**Utilize Production Knowledge and capabilities for Competitive Advantage** - Strategic leveraging of manufacturing capability	Production capability is not understood outside the manufacturing organization.		Production knowledge and capabilities are captured and used to influence manufacturing strategy, including make/buy decisions.		Production capabilities are understood and utilized across the company. Company strategy and manufacturing capabilities are aligned.		Manufacturing system design is integrated with strategic make/buy decisions across the company and is aligned with the company strategy to create competitive advantage.		Production knowledge is leveraged across the extended enterprise to generate strategic opportunities of value creation	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- Production capability constitutes a major consideration in enterprise-level long range strategic planning. - Knowledge of production capabilities are maintained and shared throughout the extended enterprise.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										

Figure 33 (continued from previous page)

II.E.2	**Establish and Maintain a Lean Production System** - Defect-free production pulled by the customer.	Your company's production system operates on a batch and queue schedule with high in-process inventory, with quality based on inspection rather than prevention.	Your production system operates with a batch and queue schedule with limited cellular or in-line layouts to improve flow.	Product flow paths are identified and key elements of the production process layout have been reordered, enhancing flow and reducing in-process inventory, with some suppliers delivering to point-of-use where appropriate.	Selected products within your company are produced using a "flow" system, pulled directly by a customer demand (takt time). Your key suppliers understand the takt time, and deliver materials to you just in time for production.	Work is segmented and organized along the value stream flows to achieve defect-free production upon demand through the implementation of pull form customer, through your key suppliers.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Your company's conversion to lean has freed up shop floor space, equipment, human resources, and capital for re-deployment - Your stock and inventory levels have been reduced in parallel with gains in your process stability and quality. - Production work is performed only when "pulled" from subsequent "customers" in the value chain.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					
II.E.3	**Production Constraints Identification** - The limitations to the production process play a key role in the identification of future improvements	Bottlenecks appear "randomly" in your production process, and significant resources are wasted waiting for work to finish "downstream" in the process.	Some formal identification has been made for process bottlenecks, but no safety stock process exists to manage flow.	Process bottlenecks have been identified, and appropriate safety stocks have been assigned to fully utilize bottlenecks. Large inventories of parts are still used, and Quality assurance is usually left to the "end" of the production process.	All process improvement decisions are viewed in context with the process bottlenecks. Process improvement resources being allocated to lower inventory and improve flow.	The understanding of constraints in the production process has been expanded to include suppliers and customers, a formal process for identification and elimination of SYSTEM bottlenecks exists, and is being used.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- With the exception of safety stocks at the bottleneck, work-in-process inventory (WIP) is drastically reduced. - Working on freeing up the constraint is the single biggest driver in new process improvement projects within your company. - A measurement system exists in your company to adequately capture the costs associated with WIP.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 34 - SB-LESAT, Section IIF

Section II: Life Cycle Processes (continued): Life cycle processes are defined by the processes that act upon a product - from its initial conception through its operational support and ultimate disposal. The degree which your company is successful in making these processes lean is a measure of your company's efficiency. This section helps you determine whether your company is performing at the required level to: define customer requirements; develop products and processes; manage supply chains; produce and service the product; and provide post delivery support.

II.F. Distribute and Service Product - On-time deliveries of defect-free products are complemented by superior post-delivery service, support, sustainability and customer association.

Diagnostic Questions	- In your company, are production schedules and capacity considered prior to making a sales/contract commitment? - Are product delivery data flowed throughout the value chain? - Does your company satisfy its customer maintenance requirements? Are customer rejects/returns treated as opportunities for learning? - Has the production process been sequenced and adapted for flow? - Are in-service usage data deployed to appropriate personnel in your company?

LP#	Lean Practices	Capability Levels									
		Level 1		*Level 2*		*Level 3*		*Level 4*		*Level 5*	
II.F.1	**Align Sales and Marketing Production** - Matching demand and capabilities	In your company, marketing pushes product sales and bids on to production with little consideration of the current production capacity.		Marketing provides production with some, but limited, visibility to current and future potential order base. However, the order base not purposefully aligned to the production capacity.		Products are supplied in smaller, more frequent batches, balancing orders to current production capacity. Most running orders are fully visible to production.		Your company matches real-time customer demand and delivery requirements with its production capabilities. Your company has an extensive knowledge base of customer preferences, and uses it to help provide production visibility.		Actual and future prospective orders are matched in real-time with production capabilities throughout the extended enterprise, including your suppliers and customers.	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- Sales or Bids are aligned to your current and future production capacity and capabilities. - There is a constant feedback and input between sales / marketing and the production elements of your company. - Sales and bids commit product delivery to real-time customer demand, without the use of "buffer" stocks of inventory buildup.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										

Figure 34 (continued from previous page)

II.F.2	**Distribute Product in a Lean Fashion** - the right product, produced in the right quantity, delivered at the right time.	Your company distributes form inventories by batch; the customer inspects the products upon receiving the shipment.	Your company distributes in smaller batch sizes, more frequently, in line with increased reliability (compared to pre-lean transformation). Your company has programs in place to reduce customer receiving inspection.	A pull system signals that stock is pulled directly from the production line, of from low-stock levels; some products are delivered directly to point of use with limited inspection.	Defect-free items are produced and delivered without receiving inspection to real-time customer usage; your company's customers are given access to databases for order status visibility.	Defect-free distribution on demand is achieved via the implementation of customer pull from the "end customer" through the entire extended enterprise (including raw material suppliers).
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Point of use delivery to customers with minimal receipt inspection has become standard practice in your company. - Your deliveries are synchronized to minimize goods in transit and transportation requirements. - Your company's delivery cycle is shorter and more reliable, compared to its prior (pre-lean) system.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					
II.F.3	**Enhance Value of Delivered Products and Services to Customers and the Enterprise** - Responding to the voice of the customer.	Your company's product support system reacts to customer needs, usually on-time and from inventory.	Your company's support system delivers products and services on time, but with disruptions to production flow and associated resources.	Your company's support system flow paths are identified, and are starting to be integrated with lean product development and production flows.	Your company has standardized customer and product support processes, which provides responsive information and product flow that is fully integrated with the development of production flows.	Customer needs for post-delivery products and services are anticipated in enterprise plans and fulfilled by adoption and extension of capabilities already provided.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Solutions to product and service issues are coordinated throughout your company and value chain to find fast, cost effective solutions. - Your customer and product support processes have been standardized and are regularly reviewed against customer feedback. - Disruptions to your design and production flows from support services have been minimized.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 34 (continued from previous page)

II.F.4	**Provide Post Delivery Service, Support and Sustainability** - Providing customer solutions.	A high level of spares is necessary because of unknown failure rates and long lead times for spare replenishment.	Your company has begun to collect data on failure trends, which permits both the determination of service interval points in preventative maintenance as well as a reduction of spare part levels.	The company as a whole is increasingly involved in addressing customer maintenance solutions. Spare levels are reduced through common platforms; root cause analyses are fed back into your product design process.	The enterprise is part of the customer's maintenance solution by ensuring availability through replacement of critical components before failure.	The enterprise has become part of the customer's business solution via warranting of product performance.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Customer feedback is proactively maintained and used to predict emerging service issues and enhance future designs. - Spares levels are reduced in-line with short predictable lead times for replacement spares.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 35 - SB-LESAT, Section IIIA

Section III: Enabling Infrastructure: To achieve a successful lean transformation, the enterprise infrastructure must support the implementation of lean principles, practices and behavior.

III.A. Lean Organizational Enablers- The support units of an enterprise must themselves become lean in executing their assigned function, but they must also redefine what they do such that they support lean implementation within the life cycle processes and the lean transformation and the leadership process.

Diagnostic Questions	- Do the finance and accounting measures used by your company support the implementation of lean? - How well have the financial and accounting systems been integrated with the non-financial measures of value creation? - Can stakeholders retrieve financial information as required? - Are human resource practices reviewed to assure that the intellectual capital matches the process needs? - Are the information technology systems compatible with your suppliers and customers?

LP#	Lean Practices	Capability Levels									
		Level 1		*Level 2*		*Level 3*		*Level 4*		*Level 5*	
III.A.1	**Financial System Supports Lean Transformation** - Lean requires appropriate financial data	Your company's financial system provides basic balance sheet and cost accounting data; there is little awareness and exploration of broader support roles for finance data.		Initial efforts are underway to adapt of modify financial systems to compensate for the inadequacies of the formal cost-accounting system.		Your company's finance system is overhauled to provide data and financial information to support and enable a lean transformation at any level.		Your company's financial system's scope is expanded to integrate with non-traditional measures of value creation (i.e. intellectual capital, balanced scorecard, throughput accounting, etc.)		Your financial systems provide seamless information exchange across the extended enterprise, with some direct measure on value creation for all stakeholders.	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- Financial measures that conflict with lean activity are no longer used as the sole measure of lean progress and lean performance. - The financial system handles a balanced set of financial and non-financial measures to assist managerial decision making. - The financial system has been overhauled to ensure fast and efficient processing of information as required.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										

Figure 35 (continued from previous page)

III.A.2	**Enterprise Stakeholders Pull Required Financial Information** - Data on Demand	Your company's financial information gives you a snapshot of past performance and is reported through regularly scheduled standardized reports. Specific requests for measures require extraordinary efforts.		Your company's finance actively provides traditional financial information in real-time to assist users in planning and programming activities.		Users are able to directly access and use financial information to make trade-off decisions.		Users are able to pull financial and other value creation information to support decision analysis in the format desired		Users across the extended enterprise generate and share timely financial and performance data. You have access to pertinent supply chain partner's information, they have access to yours, and it is shared (as needed) in real time.	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- Financial and performance measurement data can be accessed and used as needed in user-defined format. - Financial information can be extrapolated to forecast outcomes. - System provides up-to-date information on-demand and rationalizes information no longer used.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										
III.A.3	**Promulgate the Learning Organization** - Learning organizations create a flexible workforce	The human resources processes concentrate on recruiting, placement, and benefits. Personnel training is ad hoc, and is not aligned to organizational needs.		A well-defined personnel development process, aligned with organizational needs, is applied for selected employees.		Personnel development process is extended to all employees and incorporates the anticipated future needs of the lean enterprise. Resources and facilities are dedicated for learning.		A learning climate is promoted within the company through ready access to information and input to strategy and policy making. Opportunities for extending learning experiences are provided.		A learning climate is promoted throughout the extended enterprise by the sharing of capabilities knowledge, skills and best practice.	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- Intellectual capital is regarded as a corporate assets - Employees have individual training plans, which are aligned to the current and projected skill base requirement. - Employees actively capture and incorporate lessons learned into future training and practices.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										

Figure 35 (continued from previous page)

III.A.4	**Enable the Lean Enterprise with Information Systems and Tools** - Facilitate the flow of information and knowledge	The information infrastructure in your company consists mainly of stand-alone systems. The need for systems integration is recognized, but no improvement plan exists.	Elements of a common information infrastructure have been determined, and an implementation plan is under development. Maintenance of legacy systems consume most of your company's IT resources.	The information infrastructure has been formalized and is in use in selected locations. Legacy systems are used only when necessary.	An information infrastructure is deployed that supports seamless information exchange across the company.	Information systems between your company and those of your are fully interoperable and the pertinent information is easily accessible and usable across the to your customer and supplier/partners.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Compatible information systems and tools exist across the extended enterprise - Information Systems facilitate fast and effective transfer and retrieval of information required. - Information systems and tools compliment lean processes and practices and are easily adapted to accommodate change.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					
III.A.5	**Integration of Environmental Protection, Health and Safety into the Business** - Cleaner, healthier, safer	Your company complies with all known legal and regulatory requirements, and reacts if issues are identified.	Your company gives consideration to means of mitigating *conditions* that cause environmental, health, and safety issues.	A process is in place to proactively identify environmental health and safety risks, and manage them appropriately, with a preference for source prevention	Forward-thinking solutions to environmental health and safety risks are implemented early in the product / service design, and continues throughout the life cycle of the product or service.	Environmental health and safety risk prevention and mitigation is part of the natural way business is conducted across the extended enterprise, creating a sustainable "safe" environment, and creating a competitive advantage for your enterprise.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Health and safety issues are routinely addressed in employee driven improvement activities. - Processes and designs are proactively adapted to minimize environmental, health and safety issues at the source. - Designs meet current environmental regulations and are capable of easy adaptation to future requirements over the life cycle of the product.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

Figure 36 - SB-LESAT, Section IIIB

Section III: Enabling Infrastructure (continued): To achieve a successful lean transformation, the enterprise infrastructure must support the implementation of lean principles, practices and behavior.

II.B. Lean Process Enablers - A number of "enablers" can facilitate lean implementation by the consistent application of processes throughout the enterprise.

Diagnostic Questions	- Hs process standardization and knowledge re-use been imbedded in your company's policies and procedures? - Have the full benefits from process standardization been realized across your company? - Are common tools and systems used throughout your company? Your suppliers? Your customers? - Is process variation diligently reviewed and reduced in all processes throughout your company? - Has "Lean" become a vision shared by all employees in your company?

LP#	Lean Practices	Capability Levels									
		Level 1		*Level 2*		*Level 3*		*Level 4*		*Level 5*	
III.B.1	**Process Standardization** - Strive for consistency and re-use of knowledge.	Processes vary by program or product line, even for similar products.		Key processes in the organization have been identified that could benefit from standardization, with initial efforts underway.		Selected processes are standardized company-wide.		Process standardization and knowledge re-use is consistently employed within your company.		Interface processes between you and your suppliers and customers have been identified and standardized.	
		☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State	☐ Current State	☐ Desired State
	Lean Indicators (examples)	- The workforce plays a significant role in devising standard processes and practices, which are adhered to by all, and periodically updated. - Process improvements are documented in a concise and easy-to-understand format. The information is provided to key stakeholders as needed. - Processes are standardized where applicable throughout the extended enterprise.									
	Write a few examples as evidence for your company's current level										
	Write a few examples of opportunities for improvement										

Figure 36 (continued from previous page)

III.B.2	**Common Tools and Systems** - Assuring compatibility, reducing costs	Tools and systems vary by program of work center.	Your company has identified high leverage opportunities for common tools and systems, and initial deployment is underway in a few areas.	Plans are in place for achieving common tools and systems have been implemented to varying degrees across your company.	Common tools and systems have been fully implemented throughout your company.	Your tools and systems are fully compatible with those of your enterprise strategic partners and customers.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Policies have been established and deployed that require the use of common tools and systems throughout your company. - Common tools and systems provide easy access and re-use of knowledge across the product life cycle. - Company-wide use of common tools and systems provides enhanced compatibility between processes and aids employee transfer.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					
III.B.3	**Variation Reduction** - Reduce uncertainty by reducing variation	There is limited use of variation reduction tools and methods in your company.	There is evidence that sources of variation are being identified and analyzed within your company. Initial efforts are underway to reduce variability.	A formal approach that balances customer value and variation reduction is implemented in many parts of your company.	Considerable benefits are realized from reduced variation in process and practices across your organization.	Benefits of reduced variation are realized across the extended enterprise, from your suppliers to your customer.
		☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State	☐ Current State ☐ Desired State
	Lean Indicators (examples)	- Process ownership and visual displays of process variation enable quick and easy identification of adverse trends - High levels of process stability are maintained by utilizing mistake-proofing and root cause identification techniques. - Variation reductions achieved enable short predictable lead times for information and material flow.				
	Write a few examples as evidence for your company's current level					
	Write a few examples of opportunities for improvement					

5.2.6 SB-LESAT Future Research

A Microsoft Excel workbook encompassing the elements included in the SB-LESAT was created to facilitate data capture, based on suggestions from both participating companies. The Excel Workbook has been provided to the Lean Aerospace Initiative, and it is hoped that it will be provided to additional small businesses for further evaluation and refinement. Clearly, many more small businesses will be required to further refine the SB-LESAT to meet the needs of the vast small supplier base. This version of the SB-LESAT will provide a springboard for future improvements.

5.3 The Need for Additional Tools

The previous chapter (4) discussed the tools that are acceptable without modification. This chapter (5) discussed tools that are acceptable for small business supplier use after modifications are made to the tools. The LEM, TTL Roadmaps and VSM provide the "visionary" tools required to envision and architect a lean operation. The Stakeholder Needs Analysis Tool (SNAT) and SB-LESAT provide ways to measure certain levels of progress against the lean transformation. When these two sets of tools are combined, the beginning of a solid framework for small business lean begins to take shape. However, the framework is incomplete unless specific ways to tie the tools to stakeholder values are created. Furthermore, some method to measure the financial progress of the lean transformation is also needed. The next chapter (6) discusses two additional tools that help address these needs.

CHAPTER 6 –
NEW LEAN TOOLS FOR USE BY SMALL BUSINESS SUPPLIERS.

Chapter Summary

Chapter 6 provides a summary of new lean tools for use by small business suppliers. These tools were created to fit the special needs of the small business. The first tool described is a method to leverage the existing customer needs identification tool described in Chapter 5 to infer customer value without the expense of intensive market research. This tool utilizes the Dependency Structure Matrix to group interdependent needs. From the groupings of needs, the underlying customer values may be inferred. The second tool described is Throughput Accounting. Throughput Accounting provides the ability to quantify both the progress made against a lean transformation plan as well as quantifiable methods to aid decision making within the lean paradigm. Both of these tools provide clear benefits to the small business supplier, regardless of their state of "leanness".

As was discussed at the conclusion of the previous chapter, when the newly modified lean tools are combined with the existing acceptable (unmodified) lean tools, a powerful set of processes is created to assist a small business supplier interface with a lean company. While this combined set of tools is substantial, the set is missing some key elements that are specifically required to assist small businesses. In interviews with both subject companies (Etenna and Payload Systems), two recurrent themes predominated dominated the discussion.

The first is that small businesses cannot afford comprehensive market research. When the entire company contains less than 100 persons, it is unlikely to support a comprehensive market research department. But since stakeholder values play such an important role in guiding the lean transformation, how can a company identify customer values? According to Greg Mendolia of Etenna, purchasing market research from consulting companies usually is a waste of money, since it is either outdated, obvious, or does not capture all of the company's stakeholders.

A second theme that recurred in conversation is the need for a legitimate measurement system. Both companies were steadfast in their assertion that a lean transformation would not be undertaken unless it was either forced (and paid for) by a large business partner, or if "lean" provided a direct, and measurable increase in profitability. In fact, the small businesses surveyed require that the profitability of each lean decision be measured for return on investment, so that "bad" lean decisions could be avoided. In other words, the incentive for a naturally lean company to become lean exists only when a verifiable, measurable, monetary benefit results.

The first section in this chapter describes a novel low-cost method for inferring customer values. The subsequent second section describes the use of Throughput Accounting as a system to measure lean return on investment.

6.1 Inferred Stakeholder Value Identification through DSM

6.1.1 Background:

W.C. Johnson describes stakeholder value as a critical component in a successful business strategy. By extension, the *identification* of stakeholder values must be a "first step" in the company's plan to undertake a lean transformation. Johnson writes[18]:

> "The emerging value paradigm is not only a new way to think about marketing, but a new business imperative in the 21st century. It is the strategic driver that differentiates great companies from the pack. Value connotes many meanings - yet, it is always defined by the [stakeholders]."

There have been numerous marketing books written about delivering customer value, but little work describing *how* to determine what stakeholders *actually* value. Work by Arogyaswamy[19] and Ashbrook[20] and others provide important insight about the significance of properly identifying customer value. Their research describes how the development, design, production and delivery of products that satisfy customer are based on the conveyance of worth against the "customer's" underlying values. Unfortunately, the tools provided for identifying customer value are somewhat costly, consume large quantities of manpower, time, and rely on a highly sophisticated marketing group. These are all resources that are traditionally scarce in a small business. What is needed for small business is a process for identifying customer value without expending large quantities of time, money or personnel.

In September of 2002, a group of students at the Massachusetts Institute of Technology were assigned to identify stakeholder needs as part of a class in "Integrating the

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[18] Johnson, W. C., & Weinstein, A. 1999. ***Designing and Delivering Superior Customer Value: Concepts, Cases, and Applications***. Saint Lucie Press.

[19] Arogyaswamy, B., & Simmons, R. 1993. ***Value-directed management : organizations, customers, and quality***. Westport, Conn.: Quorum Books.

[20] Ashbrook, B. J. 1993. ***Quantifying customer value--an application of a partial least squares model in quality function deployment***. Unpublished Thesis M S --Massachusetts Institute of Technology Sloan School of Management 1993.

Lean Enterprise". The students[21] constructed a matrix of customers and ranked their relative needs, similar to the methods described in Chapter 5. It occurred to them at the time that various stakeholder needs were interactively coupled. In other words, two separate needs may interact to form a relationship that further defines the need. They reasoned that if they are able to assess the needs and performance on a numeric scale, then they should also be able to determine the relative interaction of one need to each other need within the context of an individual stakeholder. Some needs are reinforcing, and work to enhance another need. For example, communication needs facilitate good final design needs. Some interactions produce negative effects. For example, project flexibility needs often have an adverse effect on on-time project completion needs. Since the stakeholder's were already identified, and the stakeholder's needs were listed, the students decided to test whether they could be grouped by interactive effect. A Dependency Structure Matrix (sometimes called "Design Structure Matrix"), or DSM was selected to best group and illustrate the magnitude of the interaction. We will explore the use of this tool as it pertains to the identification of "latent" or inferred customer value for use by small business.

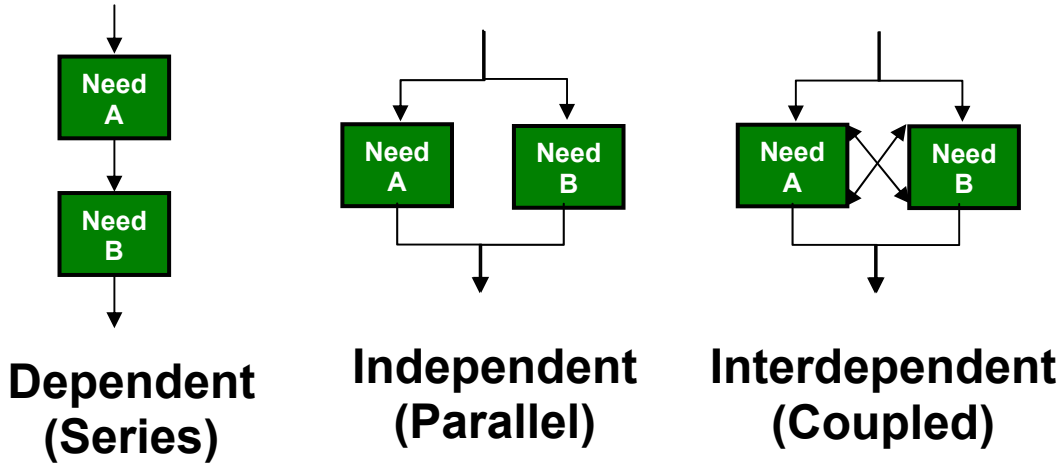
6.1.2 The Dependency Structure Matrix

As shown in Figure 37, there are three possible relationships between customer needs. One need may depend on another. For example, if a customer needs rapid delivery time, they also may need an efficient distribution system, but there is no need for the distribution system unless there is also a need for rapid delivery time. This type of task is called "dependent" or series based. Another relationship possible is independent, this occurs when one need has nothing to do with another need, but both are needed by the stakeholder. An example of this may be the need for rapid delivery time and a need for sound experimental data. This type of task is called "independent" or parallel dependency. A third relationship is where the two needs relate to each other, yet both are needed, and

[21] Clark, N., Grossi, I., de Luis, J., & Seitz, T. 2002. Integrating the Lean Enterprise - Part B: 17. Cambridge: MIT.

the partial realization of each need redefines the relationship between the two. This type of relationship is called "interdependent" or coupled. An example of this might be the customer needs of cost and performance. As performance increases, the cost may also increase. Many lean enterprise operations attempt to increase performance without a corresponding cost increase; the two are interrelated, but not necessarily linearly dependent upon each other.

Figure 37 - Types of Needs Relationships



The Dependency Structure Matrix is simply a way to represent the relationships of the needs interactions for a given customer. The process, based on the earlier works of Steward[22], and later work by Eppinger[23], describes the nature of the relationships through a matrix representation. For a needs-based DSM, the interactive component of a need may be determined and ranked on a relative scale and placed into a representative matrix as shown in Figure 39. The interaction strength between any two needs is ranked. Commercially available software allows for ranking between zero and nine, with the lowest number generally representing the strongest interaction (the user is not bound by this

[22] Steward, D. V. 1981. ***Systems analysis and management : structure, strategy, and design***. New York: PBI.

[23] Eppinger, S. D., & Sloan School of Management. 1990. ***Organizing the tasks in complex design projects***. Cambridge, Mass.: Alfred P. Sloan School of Management Massachusetts Institute of Technology.

convention, and other methods are available, but for the purpose of this discussion, we will use the 0-9 scale for interaction strength). If manual techniques are used to re-sequence the matrix, the user is free to develop almost any meaningful method of ranking.

6.1.2.1 The Process of Establishing Interaction Strengths

When all of the stakeholder needs are enumerated, a measure of relative interactive relationships between the needs is required. In Chapter 5, a method for determining performance against customer needs is presented. Assuming that this task is completed, the needs defined by that activity are leveraged to create an interaction matrix. To construct an interaction matrix, the specific needs for any stakeholder are listed down the vertical axis of the matrix (these make up the row headings of the subsequent DSM). Those same needs are also listed along the top horizontal axis of the matrix (making up the column headings of the subsequent DSM). Next, the user is asked to identify the interdependencies. Starting with the needs listed for each row, the user is asked to identify if that need contains a serial dependency on any given column need (e.g. "Is the need in row X dependent upon elements in Column Y?"). At this point, the relative scale of the ranking is not important, and the user may simply write "yes" or "no" to indicate dependencies. The next step in the process is to review the column needs. Starting with any given need listed in a column, the row needs corresponding to that column are assessed. In this step, the user is asked to list whether the need expressed in the column transfers any information to the row need that is vital for the row need's realization. This step provides confirmation that the row analysis was completed correctly, and both steps must provide identical results. If there is a discrepancy between the first and second steps, the user needs to evaluate the cause for the difference, and repeat the column and row review steps. The final stage of the process of interaction identification is to rank the magnitude of the interdependency. There are several methods possible to accomplish this task. To ensure consistency, the author recommends identifying whether the interaction is

positive or negative. A positive interaction is one where one need reinforces another. For example, if we consider two distinct needs "sufficient resources" and "on-time completion" we may understand positive reinforcement. In this case, "sufficient resources" are required to obtain "on time performance", and the two needs positively interact. A negative interaction is the case where one need is at odds with another. For example, if we consider the needs "on-time completion" and "project flexibility" we may understand an example of negative interaction. In this example, "project flexibility" generally hinders the ability to meet "on-time completion" needs, and the two interact negatively. Once the positive and negative natures of the interactions are understood, the magnitudes of the interactions are required. To ensure consistent use of the tool, the author recommends starting with the strongest interaction and the weakest interaction. The assessor then attempts to quantify the interaction magnitude on a scale of zero to nine. A nine represents the weakest (almost trivial) interaction, and a zero indicates a direct, strong interaction. The scale adjusts in ten increments between the two extremes, and the remaining interactive magnitudes are recorded. The key parts of this process are illustrated in Figure 38

Figure 38 - Process of Creating Needs Interaction Matrix

	A'	B'	C'	D'	E'
Need A					
Need B	(yes) +1		(yes) - 9		
Need C		(yes) +2			
Need D		(yes) -5			
Need E					

Process of Creating Needs Interaction Matrix:

- List all needs for a given stakeholder in rows
- Repeat needs heading for columns
- Evaluate dependencies
  - Are needs in row dependent on column need?
  - Do the columns provide valuable interaction with row needs? Do column needs provide inputs to row needs? (List yes or no). Resolve any inconsistencies.
- Identify Nature of interaction (+ or -)
- Find strongest and weakest interaction in matrix.
- Scale from zero to 9

The resultant Matrix is called the DSM. The as-constructed DSM provides a snapshot of the interactive nature of the needs, and has intrinsic value as a representation tool in, and of, itself. There is additional power to the DSM, however, because it allows us to sequence the needs based on the nature and strength of their relations with one another. The sequencing is called "partitioning", and follows a fairly straightforward process[24]. The steps involved in partitioning will be illustrated using the example data provided from Figure 39.

Figure 39 - Example Dependency Structure Matrix

	A'	B'	C'	D'	E'
A					
B	1		9		
C		2			
D		5			
E					

Interpretation:

Rows: Contain Dependencies of Serial Information

- B is dependent on A, C, & E.

Columns: Contains Inputs to Needs

- B transfers info to C & D.

Numeric Ranking Provides Strength of Interaction

- B is strongly dependent on A, and weakly interactive with C
- E has no meaningful interaction with any other needs
- A is not dependent on any needs, but provides important input to B

Partition Step 1: Arrange needs with empty rows first. In this case, row A and Row E are empty. These two rows are placed first in the matrix, as shown in Figure 40

Figure 40 - Step 1: DSM Re-Sequencing

	A'	B'	C'	D'	E'
A					
E					
B	1		9		
C		2			
D		5			

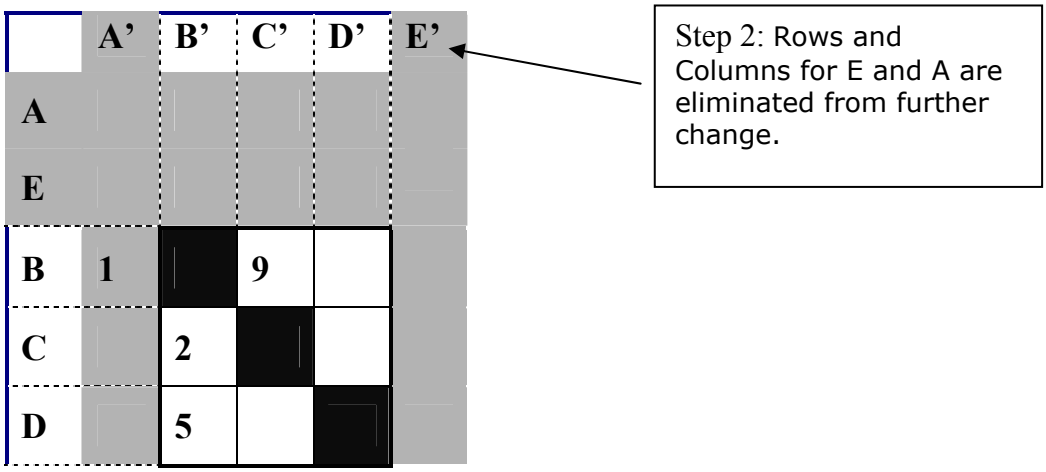
Step One: Row E moves up to 2nd Row, rows B, C, D move down

[24] Roemer, T. 2002. Tools For Innovation:The Design Structure Matrix. Cambridge: MIT.

Partition Step 2: Eliminate the empty rows and their corresponding columns for that need.

Figure 41 shows the elimination of Columns E and A.

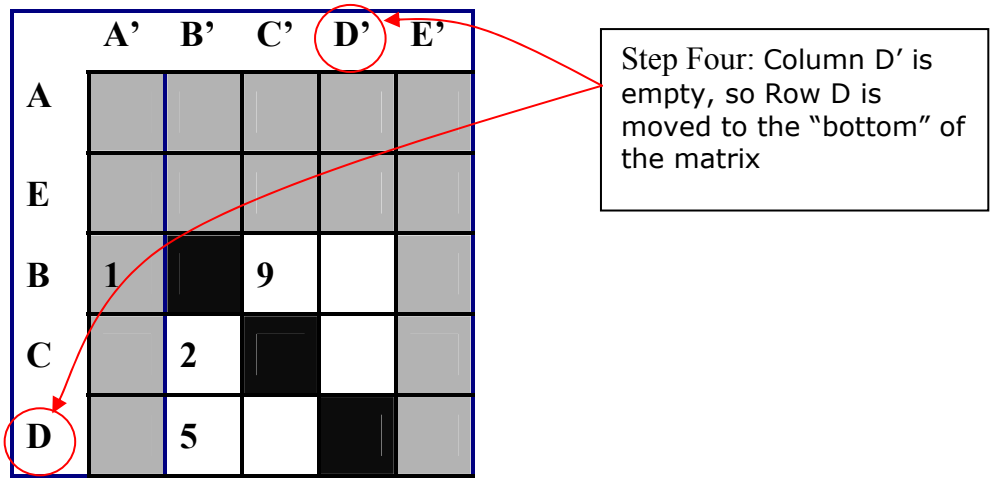
Figure 41 - Step Two in DSM Partitioning



Partition Step 3: Repeat (Go to step 1). If there are any additional empty rows resulting from the elimination of the columns, Steps 1 and 2 would be repeated until there remain no more empty rows. In this example, there are no additional empty rows, so we proceed to the next step.

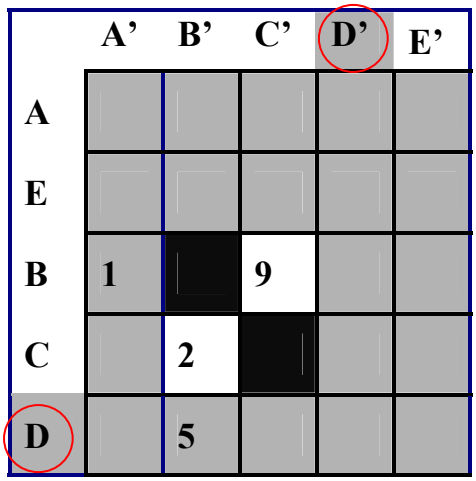
Partition Step 4: Schedule needs with empty columns last. In this example, Column D' is empty, and row D is moved to the bottom of the matrix

Figure 42 - Step Four in DSM Partitioning



Partition Step 5: Eliminate the corresponding row and column for that need from further consideration. Row and Column D' are eliminated from further consideration (Figure 43).

Figure 43- Step 5 in DSM Partitioning

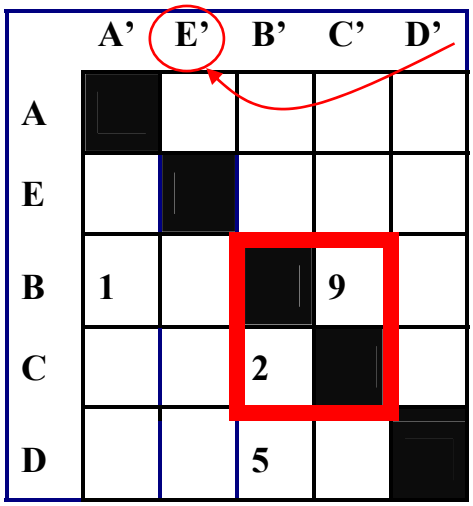


Step Five: Row D and Column D' is eliminated from future consideration

Partition Step 6: Repeat steps 4 and 5 as needed. In this case, there are no additional empty columns, so we move to step 7.

Partition Step 7: When step 6 is complete, all the remaining needs that are unmoved are *coupled*. At this point, the columns are moved to group them into blocks around the diagonal as shown in Figure 44

Figure 44 - Step 7 in DSM Partitioning



Step Seven: Column E' is moved next to column A' to align the diagonal blocks. B and C are the coupled needs

6.1.3 A Real Case: Payload Systems

It is important to note that the information resulting from the way the coupled groups form allows the user to infer the value from those coupled needs. Buried within the grouped blocks is the "customer value" implicit in this type of needs analysis.

Table 17 provides an example of an implicit value analysis. Payload Systems' Principal Investigator's needs were identified as outlined in Chapter 4. In this example, however, the needs were evaluated and ranked for their constructive or destructive interaction. The strength of the interaction was ranked on a scale of negative nine to nine, where a negative nine was considered a weak negative interaction, and a positive nine was considered a weak positive interaction. By placing the needs relationships into a DSM, and conducting partitioning[25], a clear image of the needs coupling can be established. Uncoupled needs can be seen as relatively independent – changing this need will not greatly impact other needs. Coupled needs, however, require close scrutiny, because changing a single coupled need can change the effects of the

Table 17 - Stakeholder Needs Interaction Matrix

Label	Stakeholder Need	Interaction (# vs. #) scale -10 to10
A	Facilitization - Help with complexities of Hardware design for space	A-B 10 A-C 10 A-D 7 A-E 7 A-F 7
B	Ability to run Experiment as planned with sound experimental data	B-A 10 B-C 10 B-D 2 B-E 4 B-F 7
C	Flexibility – ability to change as procedures are refined	C-A 10 C-B 10 C-D -4 C-E -5 C-F -7
D	On-time completion	D-A 10 D-B 10 D-C -4 D-E -8 D-F -2
E	On-budget completion	E-A 7 E-B 4 E-C -5 E-D -8 E-F 4
F	Additional vigilance for end objective	F-A 10 F-B 10 F-C 6 F-D 5 F-F 7

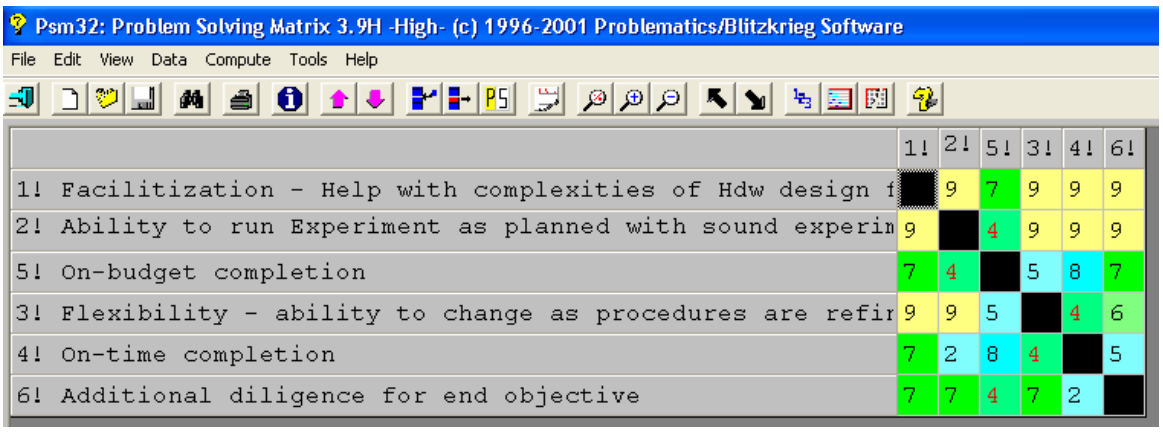
[25] Eppinger, S. D., & Sloan School of Management. 1990. ***Organizing the tasks in complex design projects***. Cambridge, Mass.: Alfred P. Sloan School of Management Massachusetts Institute of Technology, Eppinger, S. D., & Sloan School of Management. 1993. ***A model-based method for organizing tasks in product development***. Cambridge, MA: International Center for Research on the Management of Technology Sloan School of Management Massachusetts Institute of Technology, Williams, S., & Steward, D. V. 2003. PSM 32, 3.9H (High) ed.: Problematics / Blitzkrieg.

other needs.

The advantage of this type of analysis is that by using the *existing* needs data created for the Needs Worksheet tool, and a comprehensive set of stakeholder underlying values can be inferred.

Using the data from Table 17, we can place the interactive effects into Design structure Matrix Software, which eliminates the need for manual partitioning. In this case PSM32 from Blitzkrieg Software[26] was used. The data entered for the relationship table are assembled in the rather succinct layout of the DSM, as shown in Figure 45 Note that the DSM does not allow the input of negative numbers. Professor Steve Eppinger, from the Massachusetts Institute of Technology[27] explained that the absence of negative numbers in DSM software is due to the fact that most DSM interactions are interested in the *magnitude* of the interaction, not the actual positive or negative impact. Upon reflection, this makes sense, since we are attempting to model the grouping of the needs as an indication of latent value, not necessarily the effects of the grouping.

Figure 45 - DSM Structure of Needs Prior to Partitioning



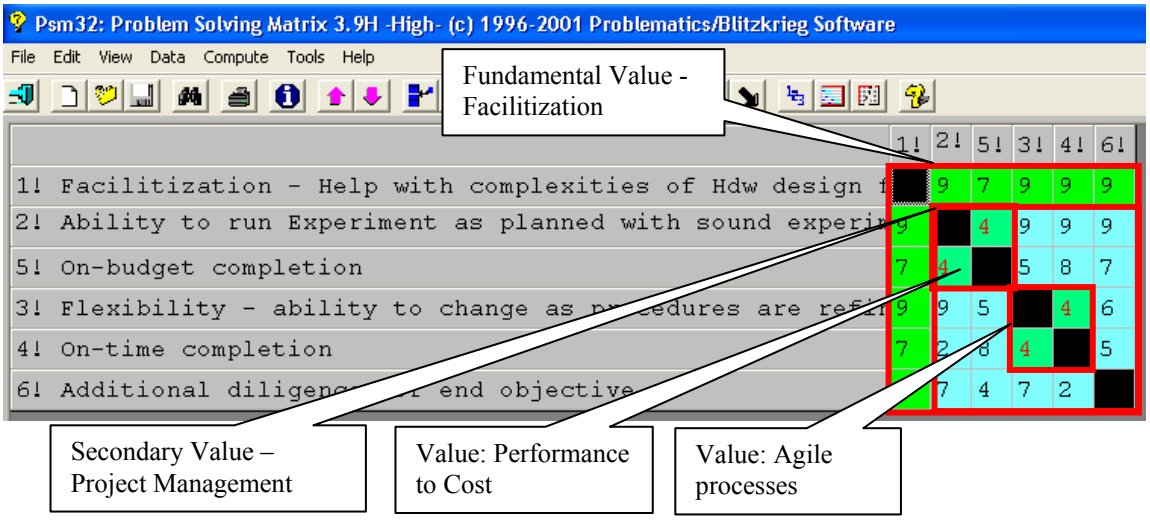
After partitioning (Figure 46), we easily see the "coupled" needs. In this case, when considering PSI's Principal Investigator stakeholder, facilitization is the key to value delivery

[26] Williams, S., & Steward, D. V. 2003. PSM 32, 3.9H (High) ed.: Problematics / Blitzkrieg.

[27] Eppinger, S. D. 2002. Conversation on Negative Values in DSM. In T. Seitz, N. Clark, J. d. Luis, & I. Grossi (Eds.). Cambridge.

based on needs. This is represented by the large coupled block that contains two smaller coupled blocks. It is the author's belief that the large coupled block provides the information necessary to infer the identification of a single aggregate need that dictates all other needs. This "overarching need" is an indication of a *fundamental customer value*. The other coupled needs within the large block point to additional customer values that fit within the span of influence of the fundamental overarching value. Since the need "facilitization" provides dominance over the grouping of all other needs, it becomes a fundamental customer value. The identification of "facilitization" is not surprising when one considers that Payload's primary source of business is helping Principle Investigators with the complexities of hardware design for space applications. Within the partitioned matrix are three other coupled needs that help us further identify customer value.

Figure 46 - Partitioned DSM, Showing Grouping of PSI Principal Investigator Needs



In Figure 46, we see another block of needs grouping rows and columns 2 through 6. Since all of these needs interrelate in a project management theme, we may infer a secondary customer value that fits under the overarching need of facilitization. We infer that Project Management is a secondary customer value. Within the Project Management block we see two additional sub-groupings of needs. The first is "the ability to run the experiment as planned with sound data" interacting with "On-budget completion". This

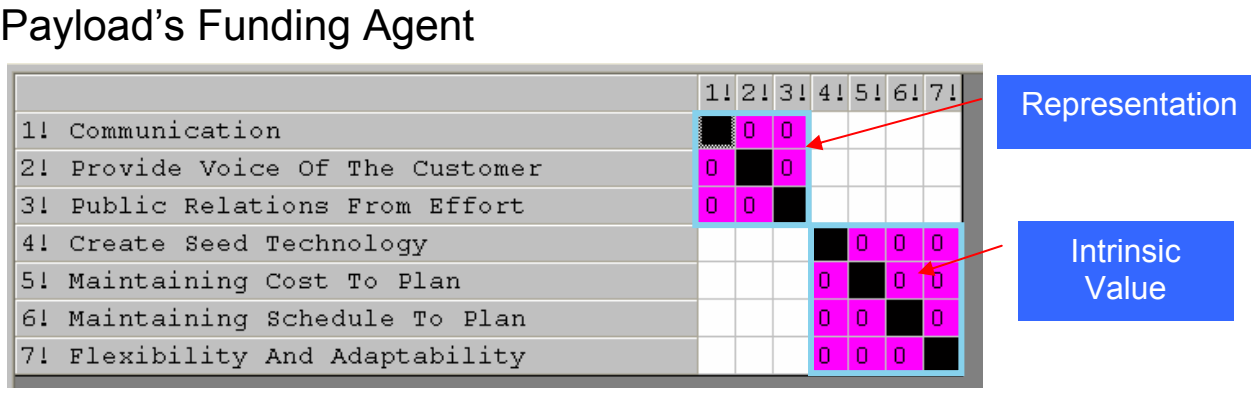
makes sense, since budget and performance are almost certainly linked. Reflecting on these coupled needs (with the staff at Payload) leads us to infer that the underlying customer value represented by this coupled interaction is "Performance to Cost". Similarly, we see a second grouping of needs within the project management context. The two needs "On-time Completion" and "flexibility" are clustered together. Again, this grouping makes sense *intuitively*, in this context, the interaction is negative, as flexibility almost certainly decreases the likelihood of on-time completion. The resultant grouping of these needs leads us to infer the customer's value: Agile processes (ones that can respond flexibly to changing needs, but still perform to schedule). Remember that we had earlier defined value as the way "*stakeholders find particular worth, utility, benefit, or reward in exchange for their respective contributions to the enterprise"*. Drawing inferences from the way needs are grouped allows us to explore the meaning of coupled needs. We look at the two needs, and the way they interact, and are able to define value based on an intuitive or logical thought model of the way a customer finds worth, utility or benefit as a result of that grouping. Another way of looking at the group is to ask "what is it about these grouped needs that provide a benefit to the customer that he or she would be willing to pay for?" Of course, the inferences drawn may not be entirely accurate, depending on the analyzer's understanding of the competitive market or specific stakeholder. It is the author's belief that when this tool is used in conjunction with the value stream map for a given product or process, the implied value is apparent. We will explore a more comprehensive value analysis in the next section.

6.1.4 Expanding the Test to the Payload Stakeholder Network

In Chapter 4, we identified the various Payload stakeholders and their needs. With this analysis already complete, we only need to describe how each stakeholder need interacts with another, and then place those needs in a matrix for subsequent partitioning and grouping. To evaluate the DSM tool on a broader scale, we expanded the DSM value

analysis to the entire stakeholder network. The author first constructed an interaction matrix, and then asked Dr. de Luis of Payload Systems to help describe the magnitude of the interactions between the given needs for each stakeholder. We placed those interaction magnitudes into the PSM software, and partitioned the resulting DSM. The results are shown graphically from Figure 47 to Figure 53. In each case, the coupled needs were identified, and the representative customer value was inferred by looking at the Payload values stream map and inferring the implied value from the partitioned groups. Also shown in the figures are the derived (or inferred) customer values associated with the particular coupling of the needs.

Figure 47 - Value DSM - Payload's Funding Agent



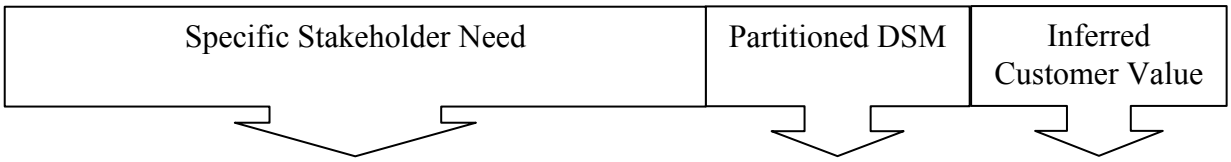


Figure 48 – Value DSM for Payload's Primary Contractor (e.g. NASA)

Payload's Primary Contractor

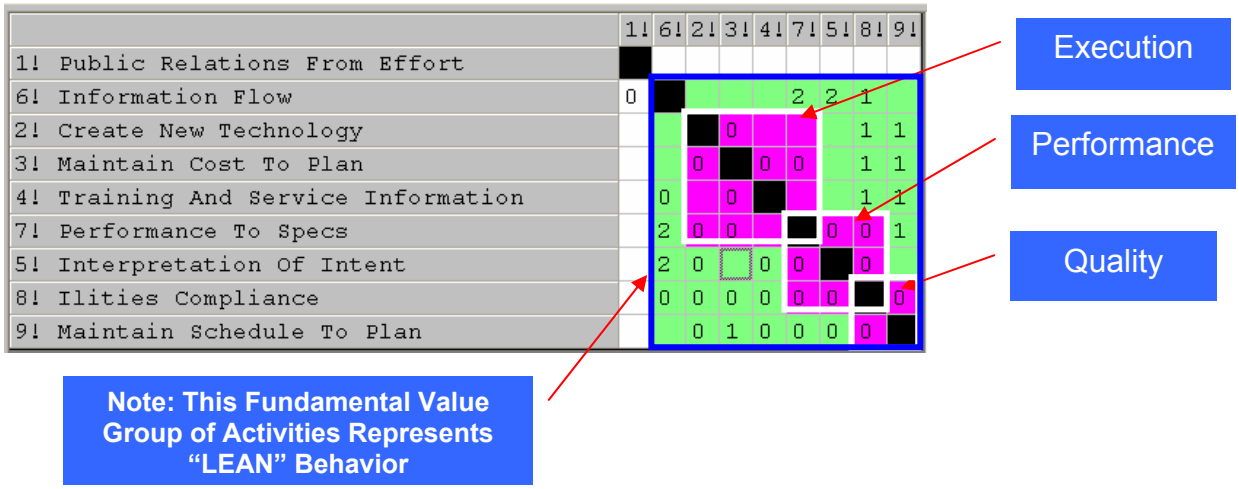


Figure 49 - Value DSM for Payload Shareholders

Payload Shareholders

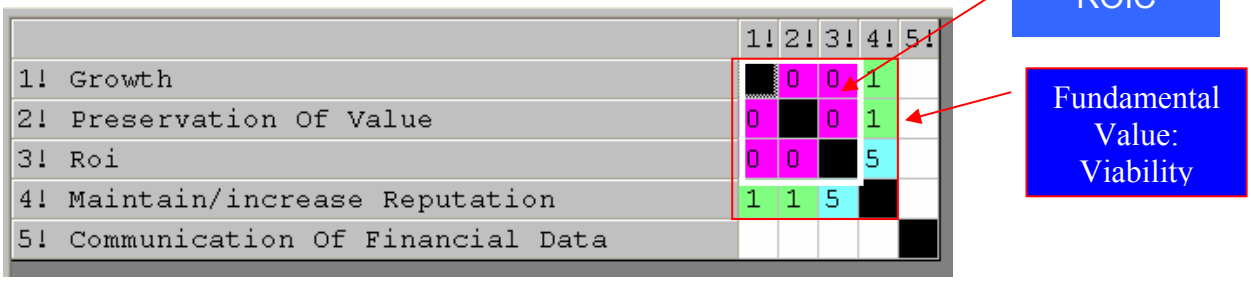
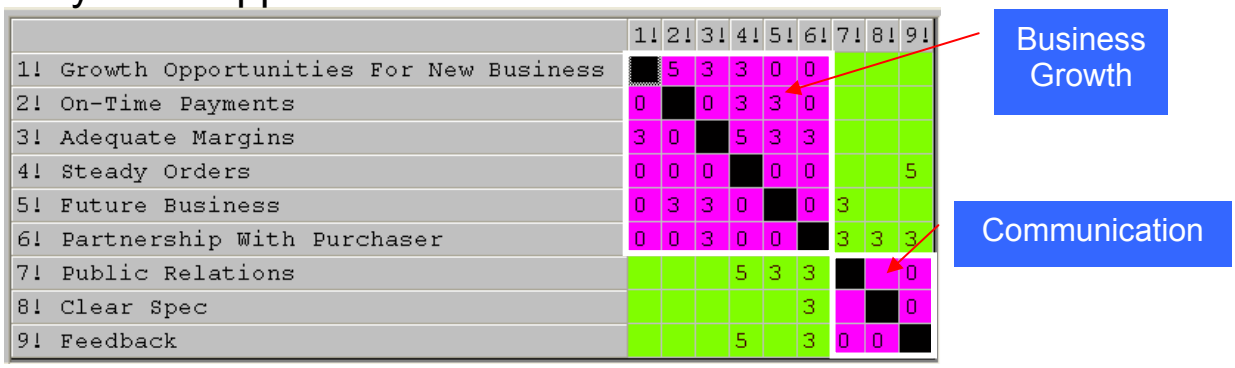


Figure 50 - Value DSM for Payload Suppliers

Payload Suppliers



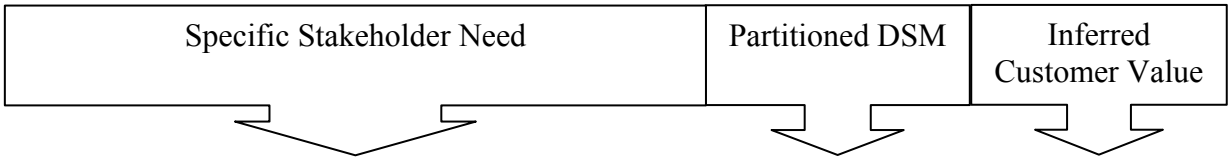


Figure 51 - Value DSM for Payload's Extended Customer (Astronauts)

Payload's Extended Customer: Astronauts

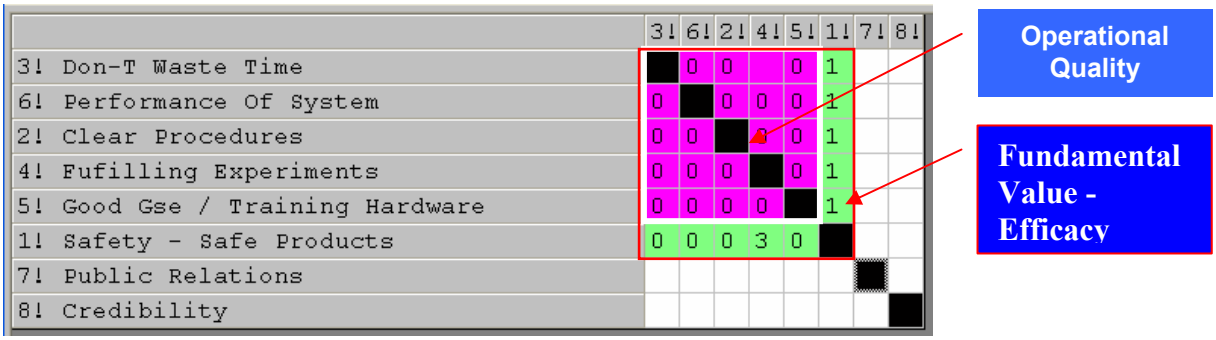


Figure 52 - Value DSM of US Taxpayers

Payload's Extended Customer: The U.S. Taxpayer

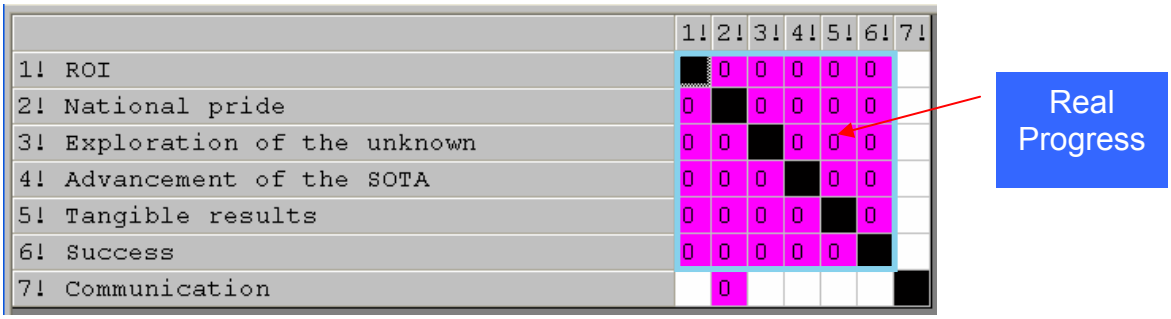
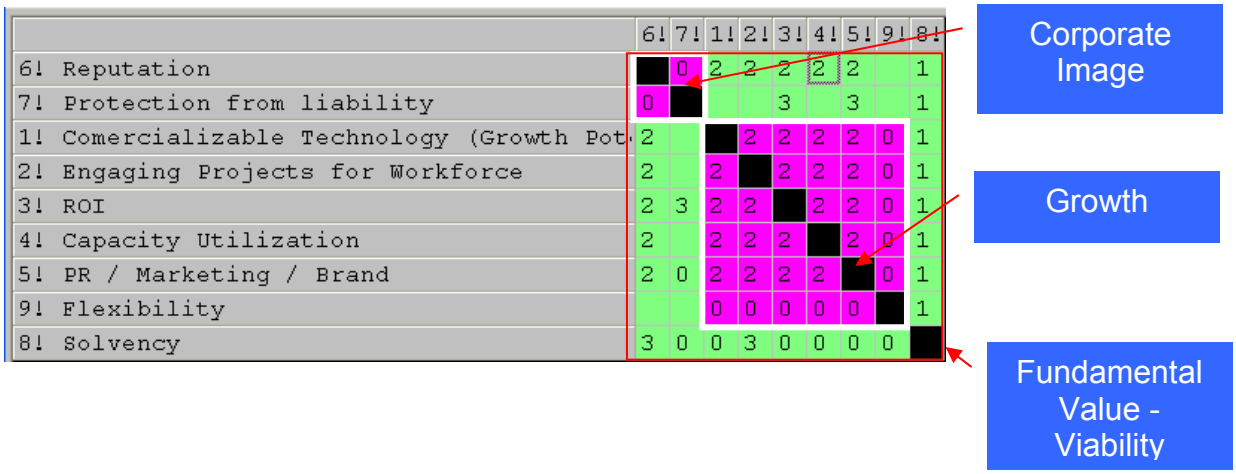


Figure 53 - Value DSM for Payload as a Business Entity

Payload Systems, The Company



6.1.5 Analysis of Results

A summary table of the customer values analysis is included below (Table 18).

Table 18 - Summary Table of Stakeholder Inferred Values

Payload Stakeholder	Stakeholder Inferred Values
Principal Investigator	**Agility and Performance to Cost**
Funding Agent	**Representation and Intrinsic Value**
Primary Contractor	**Execution, Performance, Quality = Lean Behavior**
Taxpayer	**Real Progress**
Shareholder	**Return on invested Capital + reputation = Viability**
Suppliers	**Business Growth and Communication**
Astronaut	**Operational Quality + Safety = Efficacy**
Payload Systems	**Growth + Corporate Image = Viability**

The use of DSM to infer customer values appears to have some merit. In some cases, the "primary" or "fundamental" values are too broad to be of any strategic value, but buried within the fundamental values are secondary values that provide insight into the stakeholder's envisioned makeup of that value. To determine whether this process has significant merit for lean planning will require further study beyond the scope of this document. However since the process itself is inexpensive, and can be done in a single afternoon, it provides a potentially powerful low-cost tool for small business. Senior Management at Payload Systems suggested that the DSM analysis of values could be added to the Customer Needs Worksheet. While this is a good idea, it too, remains the topic for future research.

6.2 Lean Accounting Measurement Tool

6.2.1 Background

In Chapter 3, a need for a method to "measure" progress against the lean transformation was identified. As was stated, the small business supplier cannot wait for quarterly accounting numbers to determine whether the lean transformation has improved cash flow, or reduced expenses and waste. Even if the company could wait, it is likely that accounting information would not be sufficient to express the gains made by the lean transformation. In other words: The accounting system itself may be incapable of providing numbers that are meaningful in measuring the lean transformation. How is it possible for a small business to know whether the "lean" transformation is working?

Conventional accounting does not necessarily help the decision making process. In the introduction of this paper, it was mentioned that a single bad decision can bankrupt the small business. Certainly, the elimination of waste and improved processes will make a measurable difference in the "bottom line", but that does not help the manager decide *a priori* which tasks to work on, and which tasks to subordinate to more important ones. Since there is no pre-ordained formula or cast-in-stone procedure to become lean, how does the small business manager make decisions, or select between two "lean" alternatives? How can the manager predict the effect of his decision on the lean paradigm?

It should be noted that the author is not advocating the elimination of the cost accounting system. Certainly, cost accounting provides a vital function in the economic operation of the business world (and cost accounting methods are required for financial reporting purposes). What is needed is an ***additional*** measure of performance that is specifically tailored to measuring the benefit of the lean transformation, as well as a tool to provide assistance in making decisions. While there may not be a "panacea" (a system that is capable of providing all the answers), there is a tool that can be used to greatly assist the

measurement of "lean" and provide a method to make decisions impacting lean a priori. That tool is called "Throughput Accounting", or sometimes "Theory Of Constraint accounting".

Noted researcher of managerial accounting systems, John Caspari[28] summarizes the need for Throughput Accounting:

> "But, what is an improvement? It seems that improvement is somehow related to an open-ended goal. Something that takes us closer to our goal would be an improvement. Something that does not get us closer to the goal, no matter how alluring, is not an improvement. The essential goal of a publicly held company must be to make more money--now and in the future…
>
> …Cost alone, no matter how refined the calculation, will not guide us reliably in the right direction. The more pronounced effect will always be in Throughput and the effects of constraints. The objective is to create a process of ongoing improvement relative to the goal. Bottom-line results shown on the income statement measure progress toward the goal for profit-oriented organizations. The purpose of the throughput accounting income statement is to assist in a process of ongoing improvement. The question that a throughput accounting income statement answers is, "have we established a process of ongoing improvement" rather than, "how much money did we make?" Note that traditional absorption costing, or even direct costing (which treats direct labor and a significant portion of overhead as variable), is not appropriate for measuring relatively short-term improvement relative to the goal. In the longer run the total income reported by all three methods will tend to balance, but the later two may provide misleading information for the shorter periods required to identify a robust improvement process."

In the preceding quotation, Caspari brings up two important concepts. The first is "constraints" and the second is Throughput. These two concepts must first be understood before the concept of Throughput Accounting can be properly described.

6.2.2 Constraints Defined

In his book, *The Goal*[29], Goldratt illustrates the concept of constraints in the example of scouts on a 10 mile hike. The scouts have an objective: To safely reach the prescribed

[28] Caspari, J. A. P. D., C.M.A. 2000. Can Throughput Accounting (or Constraints Accounting) Help You Get a Better Handle on Costs? ***JAC***(June 2000).

[29] Goldratt, E. M., & Cox, J. 1994. ***The goal : a process of ongoing improvement*** (2nd rev. ed.). Great Barrington, MA: North River Press.

destination with all the children in 5 hours. As is typical in a random sampling of people, the children have a variety of skills in hiking, some are fast, and some are slow. If the trail is narrow, and no scout can pass another, each time somebody in line stops to take a rest, etc. all the people in line behind that scout are forced to stop, or are provided with additional time to catch up. Meanwhile, the people in front are not limited by the person who has stopped, and they may keep going, creating a gap in the line. Eventually, the single line of hikers turns into a disparate group of clusters, with each cluster being constrained by a slower hiker in front. The clusters in front are forced to wait for the clusters behind to catch up, and the clusters in the back are demoralized, and move even slower. In Goldratt's story, the scout leader moves to the front of the line to maintain the pace. As the scouts set off again, the leader notices that the line clusters again. There is a group of people behind the pace-setting leader, but a cluster of boys lags behind a poor, chubby child named Herbie. Nobody likes being behind Herbie, because he is slow. So the scout master decides to place the fastest boy in the front of the line, followed by the next fastest, and so on, this places Herbie at the end of the line. As the scouts start down the trail again, the scoutmaster notices that the clustering has stopped, no boy is constrained by another. But, in a few minutes, the scoutmaster has lost sight of the leader, and the line extends farther and farther apart. Since this is not very safe, he asks the scouts to stop, and once again reform the line. This time, the scoutmaster concentrates on the *system constraint,* Herbie. It is clear that the group cannot make progress faster than the slowest member of the group. The scoutmaster talks to Herbie, and finds out that he is being slowed down by the weight of his backpack (in addition to being the slowest member of the team, he was also the overloaded). The scoutmaster removes some of the supplies from Herbie's pack, and distributes it to the faster hikers. He then places Herbie in the front of the line, and the scouts set out on the trail. To the scoutmaster's satisfaction, this time, the line stays tightly formed, all clustered behind Herbie. Furthermore, taking some of the load from Herbie has increased his speed, and the scouts meet their objectives.

The analogy of Herbie is a compelling one for processes within a company. When processes rely on several key elements linked in a serial operation, the process itself cannot function any faster or more efficiently than the weakest link in the chain: The "Herbie". Goldratt's book examines manufacturing operations that identify these bottlenecks (or throughput constraints). His book creates a simple plan for manufacturing operations to perform:

1) Identify the Constraint (Find the Herbies in the process)
2) Decide how to exploit the system's constraints. Strive to efficiently maximize the capacity at the constraint. In the hiking example, weight was taken off Herbie's pack, and Herbie was placed in front of the line.
3) Subordinate everything else to the preceding decision. It does not help to improve the capacity of non-constraints. In the hiking example, reducing the pack weight of the second-slowest boy would not have improved the overall line speed, unless Herbie's improved speed caused the next slowest boy to be the bottleneck.
4) Elevate the constraint. In the hiking example, Herbie was helped by the reduction in pack weight. Better fitting shoes, training, etc. might help eliminate Herbie as the constraint.
5) If the bottleneck has been eliminated, find the next constraint (go back to step 1). In our example, if Herbie improves his hiking speed, he may no longer be the bottleneck. The scoutmaster must be aware of any new bottlenecks that form.

Like Lean itself, the theory of Constraints can be applied *beyond* the manufacturing floor. In a business, even a small one, there are several processes occurring either in series or parallel. For example, marketing, product design and development, quality assurance, accounting and finance are ongoing processes in most small business. Like the hiking example, where different scouts have different hiking capabilities, small business processes all have capacity limitations. The failure to identify and exploit these process bottlenecks risks the same kind of disparate effect on customer service or profitability that was seen in the scout's hiking line before they addressed constraints. Cost overruns, delays, and dissatisfied customers are good indications that a company has failed to identify and plan for its process bottlenecks.

It is important to realize that capacity constraints of a system may not be endogenous, and in fact, the bottleneck may exist at the customer. For a better understanding of this, we must understand the concept of Throughput.

6.2.3 Throughput Defined

Throughput is defined[30] as "The rate at which a system generates money." It is essentially all the money that comes in to a company, minus what it paid its vendors. In his book on Throughput Accounting, Corbett stresses the fact that the company generally generates money through sales. This implies that increased production of a given product can only be considered an increase in throughput when there is a *corresponding* demand for, and subsequent sale of, that product. In the previous section, we mentioned that the customer may become a bottleneck. If the customer's need for a product is less than a company's production capacity, the *customer* is the bottleneck. The only way to increase throughput is to increase the customer's willingness to buy, or find alternate customers. Goldratt emphasizes[31] that Throughput can only be thought of as anything that brings "fresh money" into the company through sales, and cannot be attributed to any kind of internal company "money shuffling".

6.2.4 Throughput Accounting

Throughput Accounting (TA) is a mathematically simple accounting process. The basic purpose of Throughput Accounting is to provide real-time information to decision makers with respect to the progress of the lean transformation or evaluate the impact of any given process decision. Since we have already defined the "goal" of a company is to make money, both now, and in the future, the lean measurement tool should provide a way

[30] Corbett, T. 1998. ***Throughput accounting : TOC's management accounting system***. Great Barrington, MA: North River Press.

[31] Goldratt, E. M. 1990. ***The haystack syndrome : sifting information out of the data ocean***. Croton-on-Hudson, N.Y.: North River Press.

of identifying whether the company is moving closer to, or further away from its goal. The Throughput Accounting method addresses three simple questions:

1) How much money is being generated by our company?
2) How much money is being captured by our company?
3) How much money must we spend to operate the company?

Throughput Accounting (TA) attempts to quantify these questions, and in so doing, provides a yardstick for the lean transformation. Intuitively, as a company pursues a lean transformation (waste is eliminated, and resources are freed up to work on value-added activity), at the minimum, less money will be spent to operate the company. Keep in mind, however, that lean enterprise transformation does more than simply cut costs: It provides value to the enterprise by making the right product in the right quantities. In other words, the generation of marginal profits will also be higher, since products will be made that can actually be sold. One of the flaws of cost accounting systems is that it values inventory as an asset. In other words, the company can increase its value (on a cost accounting principle) simply by manufacturing and storing finished goods in a warehouse that nobody intends to purchase! The elimination of this kind of waste is paramount to the survival of small businesses. However, if the small business used cost accounting as a measure of performance to lean goals, they would be penalized for not creating excess inventory. Let us now consider the fundamental measures of Throughput Accounting.

To address the three simple *questions* we discussed, Throughput Accounting uses three simple *measures* to quantify lean progress:

1) Throughput (T) – As we have already discussed, this is the rate at which the system generates money (primarily through sales or investment).
2) Investment (I) – Investment is defined as all the money the system invests in purchasing items the system intends to sell.
3) Operating Expense (OE) – All the money the system spends to turn Investments (I) into Throughput (T)

From the list above, we see that three measures are required to determine how "lean" the company is operating. T, I, and OE are the three measures we may use to evaluate progress against lean objectives. We will discuss each of these measures in more detail.

6.2.4.1 Throughput (T)

T_u = Throughput_per_unit

P = Price_per_unit

TVC = total_variable_cost = the amount of cost that varies for every increase in the product's sale. In most cases, this is the raw material cos If commisions or rebates are applied, these also are place in the TVC. Note: Labor cost DOES NOT go here.

So, we may now calculate The throughput per unit

$$T_u = P - TVC$$

To understand the Throughput for any given product, we simply multiply the Throughput per unit by the quantity of units sold in a given period

TT_P = Total_throughput_per_product

q = Quantity_sold_in_the_given_period

$$TT_P = T_u \cdot q$$

A company's total throughput will simply be the sum of all the TTp's

$$\text{Total Company Throughput} = T = \sum_{n=1}^{\text{number\_of\_products}} TTp_n$$

Lean Ratios

T/OE – Indicates the fraction of Throughput to Operating Expense
T/I – Indicates progress made on Throughput per unit Operating Expense

The Lean Ratios provide a way to quickly analyze a company's progress along a journey towards lean transformation. Both ratios should increase as the company pursues its lean transformation.

Table 19 - Throughput Calculation Example

Row		Sports Drink	T-shirts	Sneakers	Notes
1	**Price (P)**	**5**	**15**	**50**	
2	Labor and overhead Cost per unit item	**1**	**7**	**30**	This value is not used to calculate TVC
3	Raw Materials Cost per Item	**1**	**2**	**5**	Adds to TVC
4	Sales Commission per item	**0**	**0.5**	**2**	Adds to TVC
5	**TVC**	**1**	**2.5**	**7**	Row 3+4
6	Quantity Manufactured in May (000s)	**12**	**9**	**50**	Not pertinent to throughput
7	Quantity Sold in May	**8**	**4**	**35**	This is "q"
8	**q** used for calculating throughput	**8**	**4**	**35**	Row 7 only
9	**Tu (P-TVC)**	**4**	**12.5**	**43**	Row 1-5
10	**TTp (Tu*q)**	**24,000**	**50,000**	**1,505,000**	Row 9x8
11	**Total Throughput**	**1,579,000**			**Sum of row 10 columns**

In Table 19, an example of Throughput calculation is provided. In this example, a small sporting goods supplier produces three products: Sports Drinks, T-shirts and Sneakers. The important key components used to make decisions about throughput are listed in rows 1 through 10. The first thing to note is that row 2, the labor cost per unit

item is not considered in the throughput calculation. In a cost accounting world, the number of units produced is divided by the number of hours used to create the product, and a labor cost per unit hour is calculated. In a cost accounting world, this number has real meaning. In the consideration of Throughput, however, the labor cost per unit is generally not considered. The reason is simple: The labor costs associated with producing the part are generally fixed. In most cases, the employees are not fired if they produce their quota of shoes or sports drinks. The overhead rate of labor and equipment (for the purpose of this discussion) is almost assuredly *fixed*. When the machines or labor are idle, *they still cost the same amount*. Whether they work or not, the relative costs do not change much. In a cost accounting world, increasing manufactured quantities will reduce the per unit labor cost. This seems like a good thing. In the case of Throughput Accounting, it is only a good thing if there is a *demand* for the product. Without it, throughput cannot increase. This is reflected in row six of the table, where the quantity of manufactured goods does not change the throughput calculation, only the number of goods sold produces a change to throughput.

6.2.4.2 Operating Expense (OE)

Operating expense is defined as all the money the system spends in turning investment into throughput. Intuitively, we may understand throughput as the amount of money we have to invest in a process to get the process moving (generating revenue). In the case of Throughput, we do not consider labor and overhead costs. In Operating expense, we do. Wages from the entire company, from the CEO to the custodians are considered part of the operating expense. Also included in the Operating Expense are rents, fuel and energy costs, etc. In other words, Operating Expense is all the other costs not considered in the Total Variable Costs (as discussed in Throughput).

A goal of the lean transformation is to increase the ratio of Throughput to Operating Expense. If T is increased for the same OE, there has been a measurable increase in lean

behavior. If T is fixed, the only way to increase the T/OE ratio is to lower operating expense. In a lean transformation, waste is identified, targeted and eliminated. This almost certainly results in a lower OE, and improves the T/OE ratio, even if no other improvements have been made! It is common for management to think of OE as a fixed number, in fact, most cost accounting systems calculate an overhead rate that is rarely recalculated. In Throughput Accounting, OE must be considered on a case-by-case basis.

6.2.4.3 Investment (I)

In Throughput Accounting, all the money that a company invests in purchasing items that a company intends to sell is considered Investment. This is similar to the conventional cost accounting term "assets", with one important difference: Throughput Accounting treats finished goods inventory and work in process (WIP) differently. For the Investment calculation, we ascribe the Investment value of WIP and finished goods inventory (FGI) as the *price we paid our vendors* for the material and purchased parts that went into the product. There is no additional value added by the "processing, storing or manufacturing" and the Investment number does not include the direct labor that went into the manufacturing of the part. The value given to WIP and FGI is reflected elsewhere, in the total variable cost, affecting Throughput, but not changing Investment costs. Note that increased quantities of finished goods or high levels of WIP will increase the overall TVC, and *LOWER* the Throughput as discussed in the previous section.

Other conventional "assets" are also included in the Investment number, building, land, computers, etc. Since these are real assets that can, and would, be sold in the case of the company's demise, they are considered part of the Investment. A goal of the lean transformation is to increase the ratio of Throughput to Investment. If T is increased for the same I, there has been a measurable increase in lean behavior. If T is fixed, the only way to increase the T/I ratio is to lower investment, typically through a reduction in WIP.

6.2.5 The Correlation between Throughput Accounting and Profit

Using the three values described above allows us to understand the impact of daily decisions on the company's net profit (NP) and return on investment (ROI)[32].

Net Profit = NP = T-OE

Return on Investment = ROI = (T-OE)/I

Where T = Total Throughput, ΣTT_p, OE = Total Operating Expense, and I = Total Investment.

With an understanding of T, OE, and I, a company is able to decide the impact of a decision or strategy move. For example, since the goal of a company is to make money, decisions that increase throughput or decrease operational expense will lead to an increase in Net profit. On an incremental level, this is also true. If a single decision increases the ratio of T/OE, it will increase the overall company's net profit.

Since virtually every decision has associated costs, the ROI (or incremental ROI) is very helpful. In this case, the incremental change in the net profit (T-OE) must increase a predetermined threshold (the company's ROI goal) with respect to the investment cost. If the NP is positive, and the ROI is above the company's ROI threshold, the decision to invest is a good one.

6.2.6 How to Use Throughput Accounting – a Lean Approach

Corbett's book on Throughput Accounting (see references) provides many practical examples of how to use this method. He provides an excellent analogy of a chain to explain the relation of Throughput Accounting to company decisions and operations. Like a chain that breaks at its one weakest link, every company system has a constraint. If the goal of the system is to make the chain stronger, concentrating efforts at improving anything but

[32] Corbett, T. 1998. ***Throughput accounting : TOC's management accounting system***. Great Barrington, MA: North River Press.

the weakest link is wasteful (Just as improving any hiker's speed other than Herbie would have been futile). The weakest link in the chain determines the maximum performance of the entire chain. A company's set of processes and activities are similar to a chain. To manage process/procedural constraints in a small business, requires a five-step process:

- **Step One:** The company must evaluate the system and identify the system's constraints.
- **Step Two:** Management must decide how to exploit the system's constraints. This decision will be determined by the nature of the constraint itself.
- **Step Three:** The company must subordinate everything else to the preceding decision.
- **Step Four:** The company must elevate the constraint.
- **Step Five:** If the company "breaks" the bottleneck, they must re-evaluate the value stream map, and identify a new constraint (repeat process).

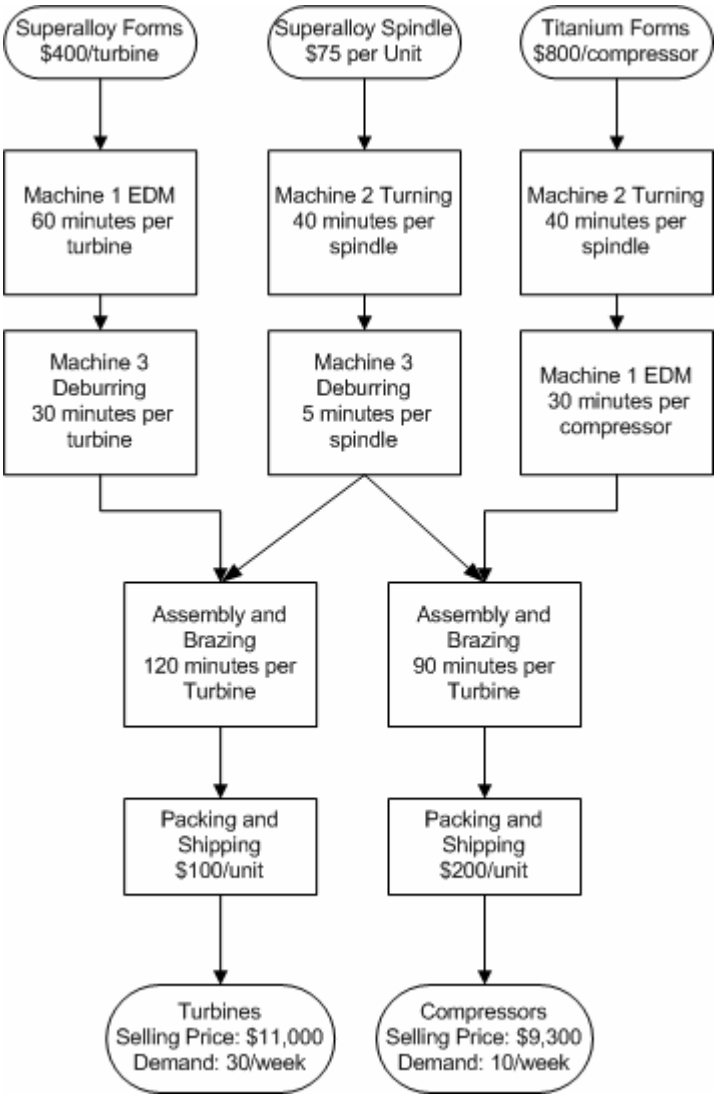
To demonstrate the five steps in the context of throughput accounting, we will adapt an example given by Swain and Bell[33]. Let us consider a fictitious small business that produces turbines and compressors for jet aircraft. We will name our company "Jet Parts 'R Us", or JPRU for short. JPRU has two main products, a titanium compressor blade assembly and a superalloy turbine. Both the compressor and the turbine are assembled from metallic preforms, machined and mated to a superalloy collar for subsequent delivery to a jet engine OEM.

[33] Swain, M., & Bell, J. 1999. ***The theory of constraints and throughput accounting*** (1.0 ed.). Boston, MA: Irwin/McGraw-Hill.

The relative costs and flows of the process are shown in Figure 54, (simplified for the purpose of our illustration). We will assume that the workers in JPRU are limited to a 40 hour week.

Three separate machines are required to process the two products. The company employs two machinists and one assembler (all are skilled technicians). The machinists are responsible for creating quality parts for the assembler to attach and braze the superalloy spindles to the machined parts.

Figure 54 - Product/Process Flow for JPRU



Each technician receive $25 (direct pay) per hour, or $1000/week. As part of its cost accounting program, JPRU allocates overhead (burden) rate at $15/hour per direct labor hour. Of the burden rate, only $8 is due to variable overhead. The weekly operating expense, excluding raw material cost, for JPRU is $6,000. The operating expense is made up of the following elements: $1000/week labor X 3 laborers = $3000; 120 labor hours x $15/hour overhead = $1800, and $1200 in selling and general administrative expenses.

Our first step in Throughput Accounting will be to identify the bottlenecks. You can see in Figure 54, that there are essentially four operations used by JPRU: three

machining and one assembly step. We now look at each step in the process, and ascribe the process time to the individual steps. In Table 20 we find that the assembly step becomes the constraint.

Table 20 - Capacity Requirements For JPRU Work Centers

Capacity Requirements for Each Work Center at JPRU							
	Product	Time (minutes)	Weekly Demand	Capacity Needed (Minutes)	Current Available Capacity (Minutes)	Leftover Capacity	Rank
EDM machine	Turbine	60	30	1800	2400	600	2
	Compressor	30	10	300	2400	2100	7
Turning machine	Turbine	40	30	1200	2400	1200	3
	Compressor	80	10	800	2400	1600	6
Deburring machine	Turbine	35	30	1050	2400	1350	4
	Compressor	5	10	50	2400	2350	8
Assembly	Turbine	120	30	3600	2400	-1200	1
	Compressor	90	10	900	2400	1500	5

Without consideration of any other capacity constraints, we see that the assembly of the turbine becomes the highest ranking bottleneck, requiring 1200 more minutes in a week than are available. Since there is only a single assembler, the problem is even worse: There is 4500 minutes of assembly required, and only 2400 minutes of available resource. Clearly, this is the constraint we are looking for. Making any changes to a process other than the bottleneck will not allow the company to increase its income. If an activity does not move the company closer to its goal to make money, it is waste (or "muda" to use the lean vernacular).

Table 21 - Comparison of GAAP and TA Results

Summary of Product Information Based on Capacity Analysis		
	Turbine	**Compressor**
Weekly Demand	30	10
Selling Price	$ 11,000	$ 9,300
Time		
EDM machine	60	30
Turning machine	40	80
Deburring machine	35	5
Assembly	120	90
total time	255	205
Raw Materials		
Superalloy Forms	$ 400	$ -
Superalloy Spindles	$ 75	$ 75
Titanium Forms	$ -	$ 800
Packaging	$ 100	$ 200
Total Materials	$ 575	$ 1,075
Direct Labor @ $25 / hour	$ 6,375	$ 5,125
Variable Overhead @ $15/hour	$ 3,825	$ 3,075
GAAP Accounting Process		
Contribution Margin (selling price-raw materials-direct labor-variable overhead)	$ 225	$ 25
Time on Constraint (assembly)	120	90
Contribution Margin per unit of Constraint	1.88	0.28
Production Priority by GAAP method	**Priority 1**	**Priority 2**
Throughput Accounting Process		
Throughput Value (T)	$ 10,425	$ 8,225
Time on Constraint	120	90
Throughput margin per unit of constr	86.88	91.39
Production Priority	**Priority 2**	**Priority 1**

Since we have identified the constraint, we may now move to step two, which is to exploit the constraint. With the bottleneck identified as the assembly process, we need to determine how to best exploit this constraint to maximize profitability. In other words, while we are undergoing attempts to remedy the situation, we need to decide which products to build in which quantities. Normally, a company would use a generally accepted accounting practice (GAAP) to calculate the traditional contribution margin of each of the two products, and then maximize production on the "most" profitable unit. This is a great idea, except contribution margin may lead the company to make the wrong decision. In Table 21, we compare the results of Throughput Accounting measurements and GAAP methods to calculated contribution margin. As described earlier, in Throughput Accounting the most important part of the overall process is the bottleneck operation. Neither a turbine nor a compressor can be delivered by the TPRU company without first passing through the bottleneck operation. The basic approach to maximum profit is to maximize the profit per unit constraint on the bottleneck operation. This simplifies calculations immensely. If we just looked at GAAP calculations for contribution margin (shown in the table), we would calculate that Turbines provide $1.88 income margin per unit assembly, and Compressors contribute a paltry 28 cents. The decision in a cost accounting world would be to maximize production on the Turbines. However, there are problems with this logic as we look at the situation in the context of Throughput. As we have stated earlier, the labor force is constant for the time span under consideration, and the overhead costs are also *fixed*. It does not matter *which* product is actually being worked on, the labor and overhead costs will not change. The only thing that will change is the cost of raw materials and the selling price of the units actually delivered. Looking at the margin in a throughput context allows us to understand that the margins for the two products are very similar, and that compressors contribute more income per unit constraint. If we maximize production of compressors, and then use the remaining time to build turbines, we will make more

money for the company, and avoid wasted effort. As we can see from Figure 55, had we used conventional accounting methods, we would have produced 20 turbines and would have had no time left to build compressors (note that this is still 10 turbines short of the customer's demand of 30 per week, and no deliveries to our compressor customer). The decision to make only turbines would have resulted in a net profit of $203,300. If we had considered Throughput Accounting to calculate margin, we would have elected to build all 10 of the required compressors, and would have had time to build 12.5 additional turbines. The resulting profit for any given week would have been $207,363, which is an additional $4,063 of pure profit (the additional income completely pays for the labor required to produce the parts!). Assuming the business does nothing other to address the bottleneck, they would realize an additional $211,276 annual profit simply by using Throughput Accounting methods.

Comparison of Bottom Line Profit Based on Decisions				
		GAAP Method		Throughput Accounting
Number of Units made in a week				
turbines		20		12.5
compressors		0		10
Income from Sales				
turbine income	$	220,000	$	137,500
compressor income	$	-	$	93,000
Costs				
Actual labor cost		4000		4000
Actual raw material cost	$	11,500	$	17,938
Selling & Administration		1200		1200
Profit				
net profit	$	203,300	$	207,363

Figure 55 - Comparison of TA method and GAAP methods

Once we have exploited the constraint by maximizing revenue through the bottleneck, we begin step three of our process, which is to subordinate everything else to the constraint. With the JPRU company producing 10 compressors and 12.5 turbines each week, it is not satisfying its customer demands for turbines. However, unless something is changed in the system, the only way JPRU can produce more turbines is to reduce the amount of compressors produced. We have already seen that this is not beneficial from an income perspective. As we saw in Table 21 - Comparison of GAAP and TA Results, JHRU must subordinate

the market demand for turbines to the profit potential of compressor production. The management at JPRU might be tempted to use idle time on machines 1 through 3 to build extra inventory or WIP. We have already discussed, that giving in to this temptation will not improve JPRU's bottom line. In fact, we can safely say that it would not be a LEAN decision. To make progress, and allow for more actual profit, JPRU must subordinate all subsequent decisions regarding this product mix to the constraint that limits revenue. To make *more* money, JPRU must move to the next step.

The next step in the Theory of Constraints accounting system is to Elevate the Constraint. In this context, "elevate" simply means to focus on the constraint, and figure out a way to reduce its impact. Lean tools like value stream process mapping, work "pull" through the factory, process leveling, and the 5 S's are indispensable. If the assembly point is a constraint, perhaps work flow could be reorganized to improve throughput. Maybe the JPRU technicians that finish with machining tasks could be educated in the assembly techniques. Maybe the use of smaller batch sizes could eliminate "batching" problems that prevent smooth flow through the factory. The ideas described in *Lean Thinking* (Womack & Jones, 1996) and *Lean Enterprise Value* (Murman et al., 2002; Murman, 2002) are critical to providing needed progress in elevating and eliminating constraints.

The fifth and final principle of Throughput Accounting is to repeat the process. As JPRU eliminates the constraint in assembly, a new constraint will take its place. The result is a never-ending process improvement cycle. In other words, the result is the adoption of the lean paradigm of constant improvement, and never-ending identification and elimination of waste.

6.2.7 Throughput Accounting and the Measurement of Lean Progress

Our examples to this point have emphasized Throughput. This is appropriate, since Throughput plays a vital role in understanding the progress of the lean transformation. We have briefly mentioned Investment and Operating Expense, and their relation to ROI and net profits. If we are to use Throughput Accounting as a tool for measuring the lean transformation, it is helpful to understand their relation to elements of the lean paradigm. There are five generally accepted principles of lean behavior. According to Womack, the five basic lean principles are: Specify the *value* of any given product, Identify the *value stream* for each product; Make value *flow* without interruptions: Let the customer *pull* value from the producer; and, Pursue *perfection*. In this section, we will evaluate these five elements of lean and illustrate ways that Throughput Accounting measures the corresponding element.

Lean Principle 1 -Specify the Value of any given Product or Process:

In the first step of the lean enterprise transformation, Womack suggests that a company specify all the activities that add value to a product or service. This is often phrased as "decide what it is about your product or service that a customer would be willing to pay for." When the value is identified, all other activities that do not contribute value are considered either waste or "necessary, but not important". The identified "waste" should be targeted for step-by-step removal. After wasteful activities have been removed, the company can focus on the necessary, but non value added activities to judge whether they can be further improved or eliminated. If we consider the fundamental relations of Throughput Accounting and activity, we may better gauge the definitions of value and waste. As discussed earlier, the three basic measures of "lean" are T, I, and OE. When asking the question of customer value, it is helpful to consider these three measures. To identify customer value in terms of Throughput, one may consider "What is it about this process step or service or function that the customer

would be cause the customer to increase or decrease its demand for this product? What is it about this step that allows us to increase our price for the product or enables us to lower our total variable cost (TVC)?" For investment I, we may look at the sequence step and ask: "Does this step have any impact on my investment? Is there something buried within this process that adds additional investment?" For operating expense (OE), we reflect on the step and look for ways in which the step increases or decreases our operating expense. In this case, two questions result from this reflection: The first is "Does this step cost our company more money?", and the second is "Will the customer be happy to pay the additional markup as a result of this impact on OE?"

While Throughput Accounting in this context does not address the exact monetary value of a given steps in the process, it adds additional rigor to the thought process used to identify value. Certainly, the elimination of waste is likely to be the greatest potential source of improvement in corporate performance and customer service. The real problem occurs in deciding "How" wasteful something is, and "how much" the customer would like to pay for something. Greg Mendolia, of Etenna commented on customer value, saying "The customer values everything, as long as it does not cost anything." The use of T, I , and OE to help reinforce the thought process adds the extra consideration of cost to the value perspective, and is therefore a useful tool.

Lean Principle 2 - Construct a Value Stream Map:

The Value Stream map is essentially a document that charts the product and process flow in the steps required to bring a product to the end user. A value stream map charts the progress of the upstream and downstream influences on the product. In our example of the fictitious JPRU company, the upstream processes for a turbine would include the ordering and delivery sequences of the titanium raw material billets, the manufacture of the billets, and may extend as far upstream as the mining and refining

operations associated with the titanium ore itself. The downstream processes would include shipping the finished turbines to the OEM customer, as well as their inclusion into (further downstream) the aircraft where the engine is installed. The midstream portions of the value stream would include all the steps and processes involved in producing the part from the titanium pre-form, and would extend through product shipping. This detailed analysis of the product flow provides two important "returns" on the effort: The first is a holistic understanding of the product and process flow. This, in turn helps the company understand how to better improve its own processes or flows to improve upstream or downstream processes, and reduce overall costs and cycle times. The second return value stream mapping provides is that it allows the company to understand where the waste occurs. The text *Learning to See* (Rother, Shook, & Lean Enterprise Institute., 1999) describes the process of value stream mapping. So how does value stream mapping fit into Throughput Accounting?

Value stream mapping can be used in conjunction with capability, demand and throughput as a means to identify system constraints. In the example of JPRU, we identified the assembly bottleneck in the midstream process flow by mapping the processes used to create both turbines and compressors. Along each stage of the process, the capacity was calculated and compared to the demand. A bottleneck was identified, and the throughput (T) was calculated for the bottleneck. A calculation of the marginal throughput ($/unit time on the constraint) was calculated to help us understand the "value" of time on the constraint. If the process is mapped for both upstream and downstream influences, additional capacity constraints may also be identified. The use of the Throughput Accounting method, allows the user to trade the respective values of revenue cost of the constraint, and decide which task to subordinate to the main bottleneck. Throughput Accounting and Value Stream Mapping work

symbiotically: The value stream map provides perspective to the process flow, and the Throughput calculations provide real cost "rigor" to the act of mapping the value stream.

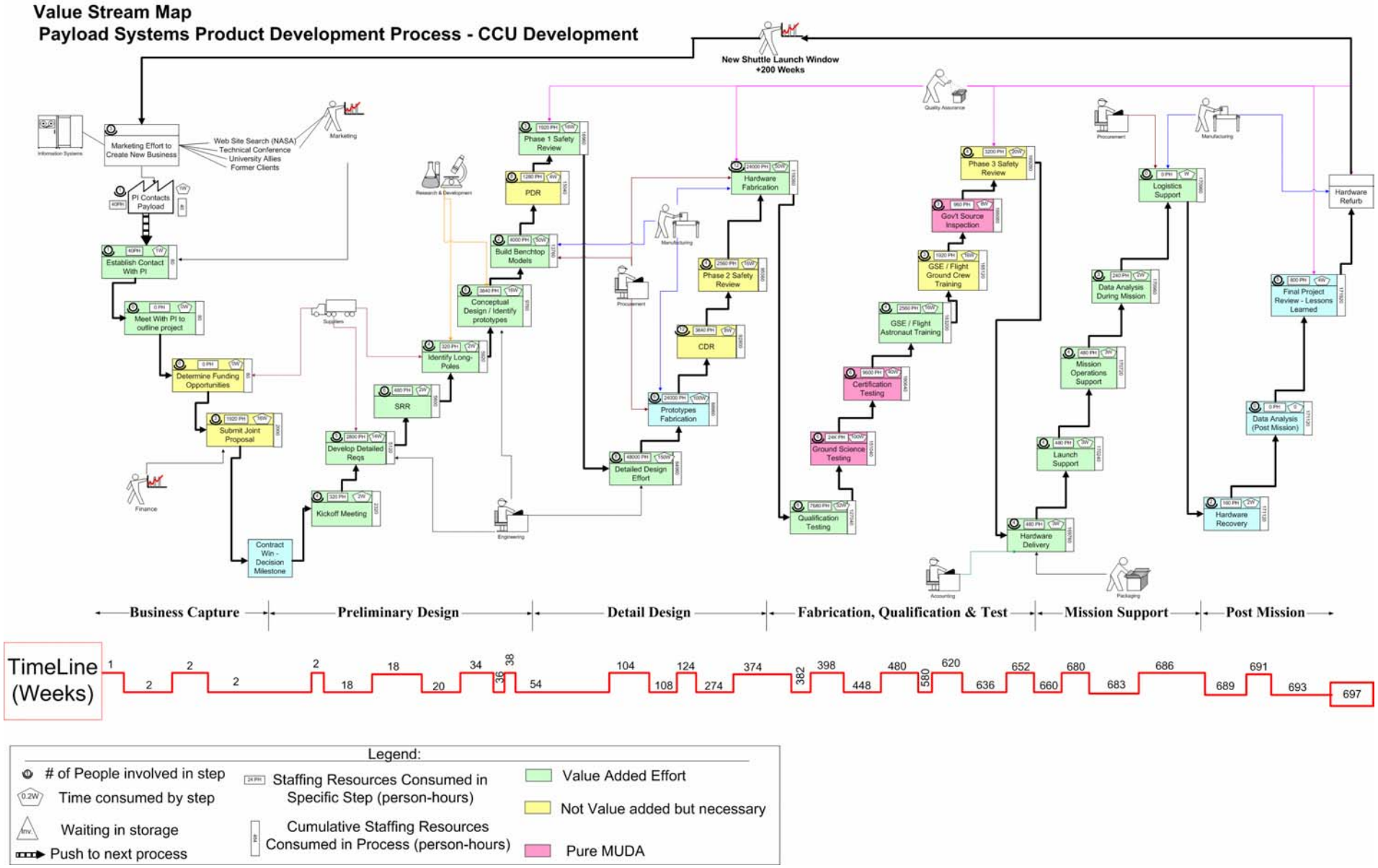
If we look at the value stream map for payload systems (Figure 56), there are many cases where waste is identified within the product development process. However, without a tool to "measure" the impact of the waste, how does the company know what process limits their ability to generate money, both now, and in the future? What is the constraint that prevents movement closer to the goal?. Like the JPRU example, the way we determine the most important constraint is by constructing a corresponding throughput chart. We list the items identified by the value stream map, and evaluate what each step provides relative to the constraints on manpower or time at Payload systems. The results are provided in Table 22. If we had never considered processes external to PSI, and instead focused on internal processes, we would discover that none of the processes payload uses are bottlenecks. In fact, when we look at the CCU project, it is clear that Payload has a significant overcapacity to produce CCUs. Even the highest ranked processes with respect to capacity demands (a tie between Critical Design Review and Hardware Fabrication) are comfortably under-stressed with regard to demand. This is a condition known as an *exogenous* constraint. The constraining factor with respect to CCU comes from outside the company. If we look closer at the Value Stream Map, we see that the entire CCU construction process relies on a 200 week shuttle launch window. It is the timing of the shuttle launch window that constrains Payload Systems from moving closer to their "goal" of making more money. Since the payload staff is a more or less fixed number of employees, and the company has a more or less fixed operating expense, working to improve any of its processes without first addressing the customer constraint would not generate any additional revenue for the company.

Table 22 - Bottleneck Analysis of Payload Cell Culture Unit

Weekly Demand	0.015	3 units/200 weeks					
Selling Price (Actual # is confidential, $10M used for illustration purposes)	10000000						
CCU ACTIVITY	***Time (weeks)***	***people hours required***	***People hours required per week***	**Capacity Needed (Minutes)**	**Current Available Capacity (Minutes)**	**Leftover Capacity**	**Rank**
Shuttle Launch Stimulates "buy"	200	0	0	1	2	1	**1**
PSI Contacts PI	1	40	40	2400	72000	69600	29
Establish Contact w/PI	1	40	40	2400	72000	69600	29
Submit Joint Proposal	16	1920	120	7200	72000	64800	22
Kickoff Meeting	2	320	160	9600	72000	62400	14
Develop Detailed Requirements	14	2800	200	12000	72000	60000	12
SRR	2	480	240	14400	72000	57600	6
Identify Long Poles	2	320	160	9600	72000	62400	14
Conceptual Design	16	3840	240	14400	72000	57600	6
Build Benchtop Models	50	4000	80	4800	72000	67200	27
Preliminary Design Review	4	1280	320	19200	72000	52800	4
Phase I Safety Review	16	1920	120	7200	72000	64800	22
Detailed Design Effort	150	48000	320	19200	72000	52800	4
Prototype Fabrication	100	24000	240	14400	72000	57600	6
Critical Design Review	8	3840	480	28800	72000	43200	2
Phase 2 Safety Review	16	2560	160	9600	72000	62400	14
Hardware Fabrication	50	24000	480	28800	72000	43200	2
Qualification Testing	32	7680	240	14400	72000	57600	6
Ground Science Testing	100	24000	240	14400	72000	57600	6
Certification Testing	40	9600	240	14400	72000	57600	6
GSE/Flight Astronaut Testing	16	2560	160	9600	72000	62400	14
GSE/Flight Ground Crew Training	16	1920	120	7200	72000	64800	22
Government Source Inspection	8	960	120	7200	72000	64800	22
Phase 3 Safety Review	20	3200	160	9600	72000	62400	14
Hardware Delivery	3	480	160	9600	72000	62400	14
Launch Support	3	480	160	9600	72000	62400	14
Mission Operations Support	3	480	160	9600	72000	62400	14
Data Analysis During Mission	2	240	120	7200	72000	64800	22
Logistics Support		0			72000	72000	31
Hardware Recovery	2	160	80	4800	72000	67200	27
Final Project Review	4	800	200	12000	72000	60000	12
Raw Material*	$775,000	$775,000					
Direct Labor* @ $38/hour	$6,532,960	$6,532,960					
Variable Overhead* @ $12/hour	$2,063,040	$2,063,040					
Throughput Value (T)	$9,225,000	$9,225,000					
Time on Constraint	3840	1					
	(CDR)	**(Launch Timing)**					
Throughput Margin	$2,402	$9,225,000					
Production Priority	2	1					

* Note: Numbers shown here are fabricated for illustrative purposes. The actual numbers are Confidential to Payload Systems, Inc.

Figure 56 - Value Stream Map of the CCU project at PSI



Indeed, if Payload Systems *only* worked on the CCU project, it could not generate any additional Throughput (T) without first removing the customer constraint. In real life, of course, Payload Systems has many other projects operating simultaneously, which requires additional utilization of its manpower – our example only looks at the CCU which accounts for little more than half of Payload's business. Additional projects being developed by Payload Systems accounts for the large amounts of overcapacity identified in throughput calculation. In fact, the additional projects consume the excess resources. Future work with Payload should create a value stream map and corresponding throughput calculation for ALL of the payload projects, by comparing all the product line with all the value stream maps, a holistic view of the company Total Throughput (ΣTT_p) could be identified. Note that if Throughput could not be increased, the only other way to generate additional Net Profit is to LOWER operational expense. Since $NP = T\text{-}OE$, decreasing OE would also put more money into Payload's pockets. This would also provide a similarly improved return on investment (*Return on Investment (T-OE)/I).*We have seen how the concepts of Throughput Accounting work with the first lean principle of Value Stream Mapping. We will now see how Throughput Accounting applies to step three – creating value flow through the enterprise.

Lean Principle 3 – Make Value Flow through the Enterprise.

In a lean enterprise, the points at which one process transfers a product or service to another point in the process is defined as an interface. The hand-offs at the interfaces, as well as the processes themselves must be made to occur with as little disruption as possible. In a manufacturing line, for example, flowing product means that there is little or no WIP waiting in front of any given process. Ignacio Grossi[34] described flow in the following manner:

[34] Grossi, I. 2003. Supplier Network Model. ***SDM Master's Thesis***. 158.

> *…"The interfaces between any two activities in the value stream – whether they are internal or external to the firm, must be minimized and streamlined in such a way that the product does not encounter any resistance (non-value added activities) in moving to the next step in the process."*

Creating flow involves arranging value adding steps and eliminating waste to remove obstacles that prohibit continuous material or information flow. In no single area is Throughput Accounting better in harmony with a lean principle than in the creation of flow. Throughput Accounting is the tool by which flow interruptions are identified, measured, and systematically eliminated. The example of "Jet Parts 'R Us" is essentially the method by which Throughput Accounting identifies flow irregularities and their associated cost. The theory of constraints in this case identifies bottlenecks as the impediments to flow based on customer demand. Throughput Accounting identifies the impact of the flow interruption, and prioritizes their solution based on the relative net profit associated with changes to the bottleneck status. The mechanics of throughput accounting does not reward the buildup of WIP and FGI, and penalizes non-lean behavior.

Lean Principle 4 – "Pull From the End Customer"

To accomplish customer "pull", a company must change its method of production from a large batch production to producing only what is demanded by the customer. This involves not only finished products but work in process throughout the entire value stream. The End customer must *pull* the products from the producer rather than the supplying customer to pushing products to the customers. In a Throughput Accounting sense, this step in the lean paradigm ensures that no unwanted inventories will be waiting for customers to buy them. As we discussed earlier in this section, conventional accounting rewards the creation of large finished goods inventories. Throughput accounting punishes the accumulation of inventory by increasing the operating expense for each unit that is produced but not sold. In the calculation of Throughput, the only way a company can increase net profit is to increase Throughput or lower Operating Expense. Correspondingly,

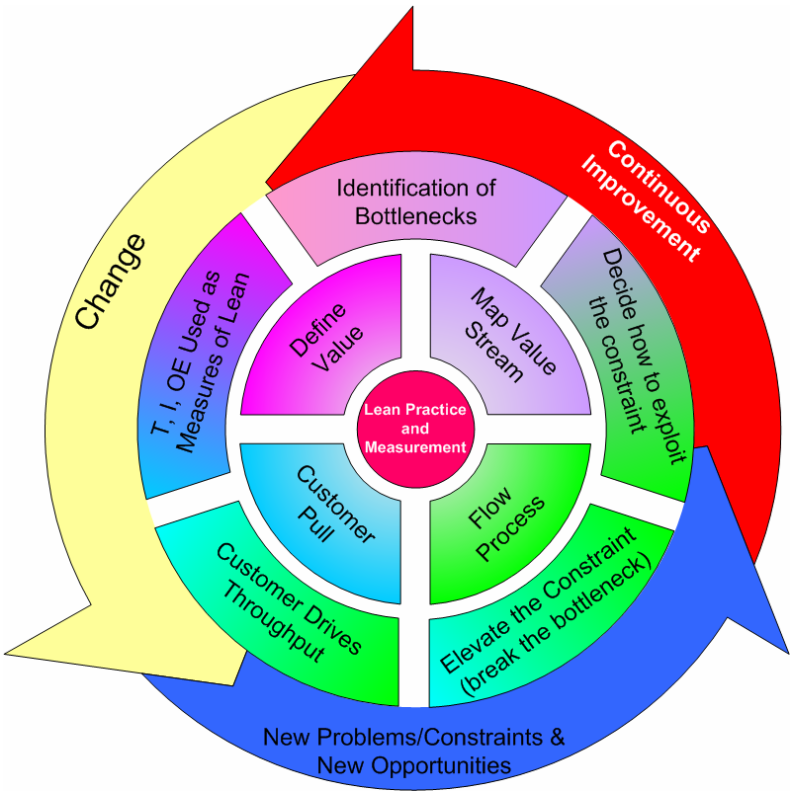
Throughput can only be increased if the price of the product increases (at the same or greater demand) or the customer demand increases (at the same or greater product price). The goal of throughput accounting is to incentivize customer "pull". As such, Throughput Accounting is an excellent tool for inducing this tenant of the lean paradigm.

Lean Principle 5 – "Pursuit of Perfection"

Perfection, in the Lean Vision occurs when every asset and every action adds value to the product or service for the customer. "Lean thinking" represents thinking about processes in the value stream as a path of sustained performance improvements instead of individual steps. The simultaneously uplifting and disheartening thing about lean is that it never ends. When a process is improved, there will always be a new task to improve, or a better method to deliver customer value. An enterprise is dynamic, and customer needs and values are always changing. As the company, market, customer, society ages, it changes and evolves. Each subtle change ripples along the value stream and redefines the processes and their interfaces. Each ripple creates new challenges and new opportunities for growth and increased net profit for the company. In a Throughput Accounting system, the last step in the accounting procedure is (after a constraint has been eliminated) to find and eliminate the next constraint. In fact, every company process has at least one constraint. The constraint is neither good nor bad, but it is always present. Just as the lean system evolves, so too does the Throughput Accounting system. Throughput Accounting always looks for the next opportunity to increase Throughput, Decrease Investment, or Lower Operating Expense. It is the accounting equivalent of the relentless search for, and elimination of, *muda.*

The relationship between the Lean Enterprise Vision and Throughput Accounting has now been established. The relationship is represented graphically in Figure 57. In this figure, the lean enterprise has two components, the lean process and the lean measurement system. The activities that drive the lean process make up the first layer of the Lean Enterprise System, value identification, value stream mapping, flow an pull represent the centering principles of the lean enterprise. Surrounding the principles is the lean measurement tool (Throughput Accounting)

Figure 57 - Throughput Accounting as a Compliment to the Lean Paradigm



Defining value in the lean principle is accomplished using T, I , and OE as guides, and provides a springboard for the identification of bottlenecks. Mapping the Value Stream is reinforced by the Throughput Accounting methods of bottleneck identification and exploitation of the constraint. The lean principle of flow is achieved by the Throughput Accounting technique of elevating the constraint. The lean principle of customer pull is achieved when the Throughput Accounting system identifies that the customer sales drives the throughput of the product. Surrounding and encompassing these two layers is the lean principle of continuous improvement leading to the never-ending identification of new constraints, leading to new challenges and opportunities for growth and greater customer satisfaction.

6.2.8 Potential Pitfalls of Throughput Accounting

Before concluding this section, it is important to point out some of the common misunderstandings of Throughput Accounting that can lead some companies to make the wrong decisions along its path to a lean enterprise. We will discuss these pitfalls in the context of lean, and advise the proper course of action to avoid these pitfalls.

6.2.8.1 Pitfall #1 – Excessive Budget Cuts.

If we consider our example of JPRU, where the assembly process was constraining product delivery we see a potential misapplication of Throughput Accounting. Since the three machines (EDM, Turning, Deburring) had excess capacity, it may be tempting for the JPRU management to make budget cuts within the machining operations. Cutting the capacity of non-bottleneck processes may be a good thing for the business, and budget cuts are a great way to lower OE and raise the company's net profit. However, laying off workers may not necessarily be the best application of Throughput Accounting. As co-workers get laid off, the remaining work force may become demoralized and may alter their work habits. As was stated earlier in this chapter, the enterprise is a dynamic thing, and needs to be considered as such. To increase the T/OE ratio, the company could decide to adjust throughput by adding additional capacity at the bottleneck, and increase sales. The net result might be to increase the net profit dramatically. There are many solutions to every problem. Budget cuts are relatively easy to enforce, and easy to understand, but it may prevent future growth, and needs to be considered in context with the company's growth strategy. Another way to improve throughput may be to eliminate the "problem" constraint. This is analogous to removing Herbie from the scout hike. Swain[35] points out in his example of the scout hike that Herbie is not necessarily a bad thing to have. In fact, every system has a Herbie. It is the Herbies of the world that provide regulation to process flow.

[35] Swain, M., & Bell, J. 1999. ***The theory of constraints and throughput accounting*** (1.0 ed.). Boston, MA: Irwin/McGraw-Hill.

Swain writes:

> *"…a company needs to identify a bottleneck to use as a focus for the rest of the organization. Herbie, our slow friend on the hiking trail, is not really a liability to the group's progress. By intelligently using him to establish pace, the wise hike leader is able to confidently predict the group's arrival time, and prevents the scouts from spreading out on the trail. Releasing non-bottleneck workers in order to reduce capacity can reduce the flexibility necessary in the enterprise to implement a TOC [Theory of Constraints] system."*

6.2.8.2 Pitfall #2 – Failure to "Rethink" Operating Expense.

Like cost accounting systems that may recalculate burden rates once a year, the failure to reconsider OE as it becomes lean can doom a company to make poor decisions. OE is not a fixed number, and changes frequently. One would expect that an ongoing transformation to lean would make consistent progress in lowering the OE. If OE is not recalculated, the Net Profits (*NP = T-OE)* will be artificially low, and the company will think it is losing ground in the lean transformation. Furthermore, since decisions to pursue various lean endeavors is likely to be predicated on the ROI calculation (*Return on Investment = (T-OE)/I),* an artificially high operating expense may push the ROI below the threshold of acceptability, and allow sources of waste to continue unabated.

6.2.8.3 Pitfall #3 – Lack of Focus on Non-Measurable Bottlenecks.

Larry Weiss, a Professor of Accounting at the Massachusetts Institute of Technology once stated[36]: "You get what you measure." His statement implies that creating any measurement system brings the peril of overemphasis on the elements that are measured, and a de-emphasis on things that are mot measured. In Throughput Accounting, particular emphasis is placed on bottleneck operations. This author maintains that this is generally a good thing. However, problems will occur when the measurement system does not include all the data. For example, our analysis of the CCU development at Payload systems is

[36] Lawrence Weiss, *Financial and Managerial Accounting Lecture*, MIT, Summer 2002.

incomplete. We never looked at the upstream processes at Payload, and larger bottlenecks may loom in the system that we did not account for. Had we neglected to consider the customer demand for CCUs in our analysis, we never would have found the appropriate bottleneck to increased Throughput in the CCU. You get what you measure. The value stream map provides a nice visual tool for checking the measurement system against the value stream, but the user is advised to continue to revisit the concept of constraints on a regular basis to make sure that a holistic view of the enterprise values is adequately represented in the Throughput model.

All the Pieces are in Place

This chapter adds two additional weapons to the small business lean armory. Lean vision is crafted from a thorough understanding of customer values. The values may now be easily and inexpensively identified through the use of the DSM technique described herein. The Throughput Accounting tool provides for rigorous measurement of the lean transformation, and aids lean decision making. The addition of these two tools now allows for the completion of the framework for small business lean. We will explore the instantiation of that framework in the conclusions of this document, and identify areas of future research in the next chapter.

CHAPTER 7 –
CONCLUSIONS AND RECCOMENDATIONS FOR FURTHER RESEARCH

Chapter Summary

Chapter 7 summarizes the conclusions drawn from the results of this thesis work and identifies areas for additional research needed to supplement the efforts described herein. With a framework now constructed for small business lean, the next step is to test and refine the research on a broader commercial level.

7.0 Conclusions

The cumulative result of this thesis is a "lean" framework for small business suppliers. In Chapter one, we reflect on the history of the lean enterprise, and explain why the narrow interpretation of lean principles (those confined to manufacturing operations) were insufficient to allow American Industry to regain its lost competitive advantage. The application of the lean vision must extend to a holistic consideration of the entire value stream of a company. It is not until lean principles are applied to the *extended enterprise* that real competitive advantage can be sustained. The specific needs of small businesses are introduced in Chapter 2. In the same way that "lean operations" are insufficient to capture the needs of a lean enterprise, existing lean tools (designed for large businesses) may be insufficient to meet the needs of the small business supplier.

Small business suppliers are unique in that they possess a "naturally" lean behavior. This behavior is more implicit than explicit, and represents the tacit instantiation of lean enterprise principles. However, this "natural leanness" does not contain the explicit infrastructure and systems architecture to sustain long-term growth, and the very elements that provide naturally lean behavior limits future growth. Without strategic partnering, small businesses suffer an "economic bullwhip" effect that creates cash flow problems, and specific lean enterprise vision and tools are needed to sustain success in the small business.

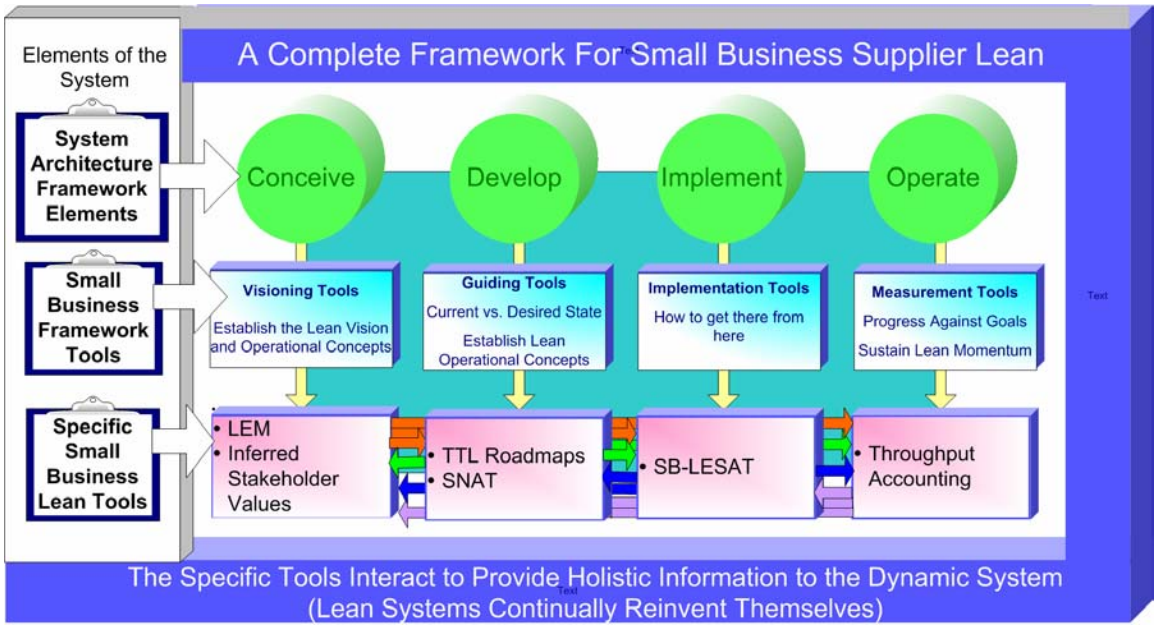
This thesis presents a new lean enterprise framework for small business that partner with, or supply to, large lean enterprise businesses. This thesis identifies and describes existing lean tools that may be used by lean small businesses without modification: These include Lean Enterprise Model (LEM), Transition To Lean (TTL) and Value Stream Mapping (VSM). The existing tools provide the essential components of the "small business lean vision" required to begin framing the small business architecture. Once the visionary tools are used, the small business requires specific tools to plan and measure the lean

transformation. The Stakeholder Needs Analysis Tool (SNAT) and Small Business Lean Enterprise Self Assessment Tool (SB-LESAT) are synthesized from existing lean tools to provide specific, measurable insight about the performance against the lean vision. The performance measures allow gap identification (current vs. desired). The SNAT is used by small businesses to identify performance to need, and the SB-LESAT is used to guide the company strategy by measuring gaps (current vs. desired) in specific areas of the lean paradigm. Through the understanding of the gap analysis, strategies can be updated or modified to reflect current needs.

Two completely new tools are introduced to add depth to the small business "lean" framework. The tools identified above (especially the value stream map and LESAT) are critically aligned to customer value, so its definition is imperative to the success of the lean transformation. The Dependency Structure Matrix (DSM) technique allows even the cash-strapped small company to infer stakeholder value from enumerated needs. This provides a "navigational compass" to the company's path along a lean transformation. The second tool is perhaps the most critical for the small business framework. Due to the significant and potentially catastrophic consequences of "bad decision making", a small business needs a formal accounting measurement system that quantifies both decision making and operational efficiency against lean transformation goals. Throughput Accounting is seen as a system that provides a relatively inexpensive method to measure lean progress, yet corresponds very well to the goals of a lean transformation.

The resulting collection of tools enables the small business to leverage existing lean strengths without adding undue overhead, yet sets forth a framework of operation that prevents self-limiting behavior. The novel framework for lean enterprise integration may be represented by the graphic in Figure 58.

Figure 58 - The Small Business Supplier Lean Framework



7.1 Future Research Opportunities Resulting From This Study.

This document provides a broad perspective of the lean paradigm in a small business context. As is the case of broadly focused studies, additional depth of investigation is needed to reinforce each of the elements. While this thesis provides the essential framework for the lean transformation and sustained operation of a small business supplier, there is much more work needed to fully substantiate the framework. In particular, the size and scope of the study must be expanded to include additional types of small businesses. The two businesses studied in the cases described by this thesis were both highly technical, with a limited manufacturing capability. The nuances of high rate manufacturing or service industries were not included in this framework. Additional research in these areas would broaden the applicability of the framework and provide further value to the tools. Other avenues of additional research include the six topics listed below.

7.1.1 Small Business Natural Leanness

The concept of "natural leanness" is introduced in this thesis. Based upon the operations of the two case study companies, the observed patterns of behavior fit with the mental model of a naturally occurring lean behavior. To substantiate this work, additional studies are needed encompassing a broader cross-section of small business suppliers. A broader research base would provide a deeper understanding in this area. Lean structure and communication are identified as the traits that comprise natural leanness. There may be other elements, as well as additional limitations to growth. A more focused, and statistically substantial study would provide insight into this area.

7.1.2 Strategic Partnering Considerations

The concept of the economic bullwhip is introduced in this thesis. It is expected that lean partnerships with large companies would allow small business to level cash flows and reduce the bullwhip effect. Additional studies are required to identify the nature of the strategic partnership that best suits the needs of the small business enterprise supplier. Details of knowledge sharing and re-use, cost sharing, and length of partnership need to be explored in greater detail. The clockspeed of the industry needs to be an important consideration in this partnership, and research into the relative clockspeeds of different small business suppliers may prove illuminating when further defining strategic partnering in the context of small business needs.

7.1.3 SNAT

Although it is based on an existing lean tool, the Stakeholder Needs Analysis Tool (SNAT) has only been tested on a single company. Additional testing on a broader range of small business suppliers may identify methods to improve the usefulness of this tool. Combining the SNAT with the DSM tool may streamline the needs and value inference process and remove waste associated with using two distinctly separate tools.

7.1.4 SB-LESAT

The original LESAT required months of development, with input from a variety of LAI stakeholders. The SB-LESAT requires review and input from many more small business suppliers before it can be accepted for widespread use within the lean enterprise.

7.1.5 Inferred Values through Needs DSM

The determination of customer values through needs analysis is presented in this thesis. The next step in the process is to test the results from the DSM technique by comparing the results to actual market research that identifies stakeholder needs. A statistical correlation between the DSM results and actual, researched values would provide an estimate of error that would help gauge the accuracy of the tool.

Throughput Accounting

There are many texts that reference or review Throughput Accounting as a managerial accounting tool; however, very little work has been done correlating Throughput Accounting to the lean paradigm. This thesis scratches the surface of this relationship. It is expected that the theory of constraints applies much more broadly to the operation and measurement of lean operations within the small business supplier. Of particular intresest would be to study the apparent "natural leanness" of a company with respect to Throughput Accounting measurements. Establishing the process for GAAP and Throughput Accounting systems co-existing within a small business organization requires further research as well.

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APPENDIX A

Specific Changes Made To LESAT

Included in this Appendix are the specific changes made to the original LESAT. Table 22 includes reference to the sections and lean practices, the original wording of the text, the modified wording, as well as comments describing the rationale behind the change in the context of small business needs.

Table 23 - Specific Changes Made to Original LESAT

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I	Section Description	Section I: Lean Transformation/Leadership. Definition: Develop, deploy, and manage lean implementation plans throughout the enterprise, leading to: (1)- long-term sustainability, (2)- acquiring competitive advantage and (3)- satisfaction of stakeholders; along with a continuous improvement in all three parameters.	Section I: Lean Transformational Leadership - In this section, we look at your company's implementation plans for lean both internally and external to the company itself. This section helps you understand the development, deployment, and management of the lean implementation plan. This plan should reflect the major effects of a lean transformation: namely 1) long term sustainability, 2) Increasing competitive advantage, 3) Identification and satisfaction of stakeholders, and 4) "Smoothing irregular cash flows that traditionally plague small businesses.	Essentially a change for improved clarity, supplemental description provided to aid persons less familiar with lean vernacular.
I.A	Subsection A description	I.A. – Lean Transformation/Leadership. The decision to pursue a lean transformation is strategic in nature. Its impact throughout the enterprise is profound and pervasive, affecting all business practices and processes. The lean enterprise will behave in a fundamentally new manner, significantly eliminating waste and enhancing relationships with all stakeholders	I.A. Lean Transformation / Leadership - the decision to implement and sustain a lean transformation is strategic in nature. Its impact throughout the company is profound, and extends outward to both customers and external suppliers. The adoption of a lean vision affects all business practices and processes within the company. The lean company will behave in a new manner, not only identifying and eliminating waste, but focusing on enhancing the relationships with all the stakeholders inside, and in contact with, the organization	Essentially a change for improved clarity, extended definition of enterprise and benefits of lean provided to aid persons less familiar with lean vernacular.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.A	Diagnostic Questions	• Are enterprise leaders familiar with the dramatic increases in competitiveness that many companies have realized as a result of transitioning to lean? • Are enterprise leaders fully aware of the potential opportunities (i.e. greater growth, profitability and market penetration) that can be realized within their own organization as a result of transitioning to lean? • Has a suitable strategy for growth been identified to utilize resources freed up by improvements? • Does "customer value" strongly influence the strategic direction? • Has full leverage of the extended enterprise stakeholders been incorporated into the strategic plan?	- Is your company's leadership familiar with the dramatic increase in competitiveness that many companies have realized as a result of transitioning to lean? - Are company leaders fully aware of the potential opportunities afforded by a lean transformation? These opportunities include stabilized cash flow with partner companies, greater business growth and profitability, and increased market penetration. - A lean transformation will free up resources otherwise occupied by wasteful practices. Has your company identified a suitable strategy for growth to utilize resources freed up by improvements? - Has your company identified its "customer values"? Does customer value strongly influence the strategic direction of the company? - "Extended Enterprise Stakeholders" refers to key personnel both up and down the supply chain. This includes your company's personnel, investors, and management, as well as those of the company's customer and suppliers. Does your company's strategic plan leverage the various needs of these extended enterprise stakeholders? Has your company formally identified its extended stakeholder network and their respective needs?	Questions specify whose company is the subject of the question. Additional descriptive language provided to help lead reader through concept of lean transformation.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.A.1	I.A.1	Integration of Lean in Strategic Planning Process - Lean impacts growth, profitability and market penetration	Integration of Lean in Strategic Planning Process - Lean impacts growth, profitability, and market penetration.	No change required
I.A.1	Level 1	Concepts and benefits of lean principles and practices are not evident in culture or business plans.	Concepts and benefits of lean principles and practices are not evident in culture or business plans.	No change required
I.A.1	Level 2	Lean is recognized, but relegated to lower levels of the enterprise and application is fragmented.	Lean is recognized, but relegated to lower levels of the company and application of "lean" is fragmented	No change required
I.A.1	Level 3	The growth implications of lean are understood and lean implementation plans are formulated, but not integrated into the strategic plan.	The growth implications of lean are understood and lean implementation plans are formulated, but not integrated into the strategic plan.	No change required
I.A.1	Level 4	Transitioning to lean is adopted as a key enterprise strategy and included in the strategic plan.	Transitioning to lean is adopted as a key enterprise strategy and included in the strategic plan.	No change required
I.A.1	Level 5	Strategic plans leverage the results of lean implementation to achieve growth, profitability and market position.	Strategic plans leverage the results of lean implementation to achieve growth, profitability, and market position	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.A.1	Lean Indicators (examples)	Lean implementation is included explicitly in the enterprise strategic plan. Strategic planning makes allowance for anticipated gains from lean improvements.	- Lean implementation is planned, and included explicitly in the company's strategic plan. - Strategic planning makes allowance for anticipated gains from lean improvements - Strategic partnerships allow for smoothing payments to your company to ease financial planning burdens and lower overall management costs	- Extended definition of enterprise. - Additional example provided to illustrate lean transformation addressing small business concern of payment smoothing (very important for small business suppliers in particular).
I.A.2	I.A.2	Focus on Customer Value -Customers pull value from enterprise value stream	Focus on Customer Value - Customers create the requirements that "pull" value from the company's value stream and set the strategic direction of the company	Additional text for clarity
I.A.2	Level 1	Means of defining value to customer(s) is informal and unstructured.	Means of defining value to customers is informal and unstructured	No substantive change
I.A.2	Level 2	Structured process for defining value is applied to selected customers.	Structured process for defining customer value is applied to selected customers.	No change required.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.A.2	Level 3	How the enterprise can best contribute to customer's success is well defined and incorporated into most projects/programs.	How the company can best contribute to the customer's success is well-defined and incorporated into most of the company's projects and programs	No substantive change
I.A.2	Level 4	Customer definition of value strongly influences the strategic direction.	The customer definition of value strongly impacts your company's strategic direction.	Additional clarification of whose company
I.A.2	Level 5	Competitiveness is enhanced, as customer value becomes the predominant driving force throughout the extended enterprise.	Competitiveness is enhanced as customer value becomes the predominant driving force throughout the extended enterprise	No change required.
I.A.2	Lean Indicators (examples)	• Enterprise employs a formal process for determining customer value. • The enterprise understands what constitutes success for its customers. • A formal process exists to measure and assess customer satisfaction. • Customer value strongly influences policies, practices and behavior.	- Your company employs a formal process for determining customer needs and communicating those needs to the employees. - Your company understands what constitutes success in the "eye of the customer". - A formal process exists to measure and assess customer satisfaction. - Customer value and customer satisfaction strongly influence the way decisions are made in the company.	Clarification of subject company, and slight rewording to simplify descriptions. No real substantive change

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.A.3	Leveraging the Extended Enterprise	Value stream extends from customer through the enterprise to suppliers	The Extended Enterprise Picture - Your customer and your suppliers represent different ends of your value stream. The value streams from your customer, through your company and to your suppliers, and so on…	Additional definition of terms to aid clarity
I.A.3	Level 1	Relations with customers and suppliers reflect a "We-They" mentality.	Relations with our customers and suppliers reflects a "We-Them" mentality	"our" customers used to define ownership
I.A.3	Level 2	Initial opportunities identified for establishing extended enterprise linkages.	Initial opportunities identified for establishing extended enterprise linkages. In other words, you have begun to look outside your company to the adjacent links in your supply chain (i.e. customer and key suppliers)	Additional definition added for clarity
I.A.3	Level 3	Strategic planning process explicitly includes consideration of key stakeholders in value streams.	Strategic planning process explicitly includes consideration of key stakeholders in the value stream.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.A.3	Level 4	Integration and balancing of stakeholder values are achieved via collaborative supplier relations and strategic partnering.	Your company collaborates with key suppliers in strategic partnerships that serve your mutual needs and interests. This strategic partnership balances stakeholder values and improves working relationships with the key elements of the value stream	Clarification of whose company and extended definition to aid clarity of subject
I.A.3	Level 5	Integration of the extended enterprise contributes to innovation, growth, increased profitability and market position.	Integration of the extended enterprise contributes to overall improvement in innovation, growth, increased profitability, and market position for the strategic partners.	Added "for the strategic partners" to clarify to whom benefit affects.
I.A.3	Lean Indicators (examples)	• Strategic planning is strongly influenced by stakeholder and customer value. • Strategic planning encompasses the total enterprise, including customer, alliances/partners, employees and suppliers. • Risk and responsibilities are apportioned when leveraging the extended enterprise suppliers and partners.	- When your company conducts strategic planning, it is strongly influenced by stakeholder and customer value. - Your Company's strategic planning process looks outside the company itself, to the customer, partners, suppliers, and employees that make up the value stream, - Your company accepts some risk when planning supplier, customer, or partner activities and responsibilities, some of the risk is also shared by those same groups.	Added specific mention of whose company to aid clarity. Added extended description to aid clarity.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.B	Subsection B description	I.B. Adopt Lean Paradigm - Transitioning to lean requires a significant modification to the business model of the enterprise. It is imperative that the enterprise leadership understands and buys into the lean paradigm since they will be required to create a vision for doing business, behaving and seeing value in fundamentally different ways.	I.B. Adopting the Lean Vision - While the small business may be "naturally lean", to increase profitability requires a deeper understanding of lean principles and a formal vision for its implementation. Transitioning to Lean requires a significant change to the business model of the enterprise. It is imperative that the enterprise leadership understands and buys into the lean vision, since they will be required to create a vision for doing business, behaving and seeing value in fundamentally different ways.	Reworded slightly to remove some of the large business vernacular. Added additional description for clarity.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.B	Diagnostic Questions	• Do enterprise leaders and senior managers understand the lean paradigm at the enterprise level? • Do all senior leaders and management enthusiastically support a transformation to lean? • Has a common vision of lean been communicated throughout the enterprise and within the extended enterprise? • Has a compelling case been developed for the Lean transformation?	- Do your company's leaders / senior management and "visionaries" understand the lean paradigm at the enterprise level? - Does your company's leadership enthusiastically support a transformation to lean? Do they "walk the talk"? - Has a common vision of lean been communicated throughout your company? Has it been communicated to your customers? Your suppliers? The extended enterprise? - Has your company made the decision to become lean out of a desire to improve profitability, efficiency and cash flow? Or is it simply responding to a customer requirement to "become lean"?	Defined enterprise relationships in text to aid clarity. Additional verbiage to illustrate intent of questions.
I.B.1	I.B.1	Learning and Education in “Lean” for Enterprise Leadership -“Unlearning” the old, learning the new	Learning and Education in "Lean" as it relates to your company's leadership - "Unlearning" the old ways of doing business, and internalizing the lean paradigm.	Slight change to reflect on lean paradigm from diagnostic questions.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.B.1	Level 1	Little interest in learning lean principles is evident among enterprise leadership.	Little interest in learning lean principles is evident among your company's leadership. Lean is treated as "just another method".	Additional reference to similar projects to increase empathy for project implementation.
I.B.1	Level 2	Leaders are actively seeking opportunities to learn about lean. There is an initial grasp of the extent of the paradigm shift for the enterprise.	Your company's leaders are actively seeking opportunities to learn about lean. There is a basic understanding of the value of a lean transformation.	Slight change of wording to enhance clarity for small business assessor.
I.B.1	Level 3	The leaders are adopting lean learning and continuously applying lean principles across the enterprise.	Your company's leaders are adopting lean learning and continuously applying lean principles across the internal operations of the company.	Slight change of wording to enhance clarity for small business assessor.
I.B.1	Level 4	Leaders contribute to the development / refinement of the body of knowledge about lean.	Your company's leadership contributes to the development and refinement of the body of knowledge about lean. In particular, they are able to adapt lean principles to the needs of your company.	Additional illustration of point to aid understanding.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.B.1	Level 5	Lessons learned in implementing lean are actively shared across the organization and within the extended enterprise.	Lessons learned from lean implementation are actively shared across the organization and within the extended enterprise.	No change required
I.B.1	Lean Indicators (examples)	• A formal lean education process for senior leaders has been established. • Leaders regularly apply and use lessons learned in "lean". • Majority of enterprise leaders have received significant exposure and education in lean principles, practices and behavior.	- A formal lean education process for the company leaders has been established. - A majority of your company's senior management have received significant exposure and education in lean principles, practice, and behavior. - Your company's leaders regularly apply and use "lessons learned" in lean.	Small change to add "your" company as subject of change.
I.B.2	I.B.2	Senior Management Commitment - Senior management leading it personally	Senior Management Commitment - Is your company's senior management leading the Lean Vision personally?	Added the words "Lean Vision" to remove ambiguity
I.B.2	Level 1	Level of commitment among senior leaders and management is variable – some endorse while others may actively resist.	The level of commitment among the company's senior management is variable - some endorse, while some may actively resist.	No change required.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.B.2	Level 2	Senior management buys into group commitment; senior leaders / managers who cannot or will not adapt are replaced.	The senior management buys into your company's group "vision". Those leaders / managers who will not adapt are replaced.	"your company" added
I.B.2	Level 3	"Lean" is integral to enterprise wide meetings, senior staff meetings, etc.; senior managers personally and visibly lead lean transition.	"Lean" is integral to the objectives of your group and your company. Your company's leaders personally and visibly lead the lean transformation.	Added "your" for clarity
I.B.2	Level 4	Senior leaders are championing the transformation to lean within the enterprise.	Senior leaders in your company are championing the transformation to lean. They clearly "believe" in lean, and are fairly relentless in their pursuit of lean in your company.	Added additional descriptive text to illustrate concept.
I.B.2	Level 5	Senior leaders and management mentor and foster lean champions internally and through the extended enterprise.	The leadership championing described in level 4 is extended outside the company to the extended stakeholder network.	Rephrased to remove ambiguity.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.B.2	Lean Indicators (examples)	• There is a consensus commitment supporting a transformation to lean. • Management provides support and recognition for positive actions • Senior management are champions in transforming the enterprise.	- There is a uniform, consensus commitment support within your company's leadership to transition to lean. - Your leadership seems excited and impatient to begin the lean transformation. - Management provides support and recognition for positive action towards a lean transformation, as well as for "lean acts" that improve the company's profitability."	Added reference to company profitability to drive home the value of the lean transformation.
I.B.3	I.B.3	Lean Enterprise Vision – New mental model of the enterprise	Lean Enterprise Vision - Does your company have a new "mental model" of the enterprise?	"your company" added.
I.B.3	Level 1	Senior leaders have varying visions of lean, from none to well-defined	Senior Management and company leaders have varying visions of "lean", ranging from none to well-defined.	No substantive changes
I.B.3	Level 2	Senior leaders adopt common vision of lean	Senior Management and Company leaders adopt a common vision of "lean".	No substantive changes, minor rewording to specifically address small business structure.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.B.3	Level 3	Lean vision has been communicated and is understood by most employees	Your company's "lean vision" has been communicated and is understood by you, and most of the employees	No substantive changes.
I.B.3	Level 4	Common vision of lean is shared by the extended enterprise	A common vision of lean is shared by the extended enterprise. This means both inside and outside the company, and extends to key customers and suppliers.	Additional verbiage to illustrate meaning of extended enterprise.
I.B.3	Level 5	Stakeholders have internalized the lean vision and are an active part of achieving it.	The enterprise stakeholders have internalized the lean vision, and are an active part of achieving it. Lean has become operating philosophy, not just a "program" requirement.	Additional explanation illustrating effect in small business.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.B.3	Lean Indicators (examples)	▪ The role that lean plays in achieving the vision is clearly defined. ▪ The vision has been communicated to all levels and has extensive buy-in by most employees. ▪ The vision incorporates a new mental model of how the company would act and behave according to lean principles and practices.	- The role that lean plays in achieving the vision is clearly defined. - Your company's lean vision has been communicated to all levels and has extensive buy-in by most employees. - Your company's lean vision incorporates a new mental model of how the company would act and behave according to lean principles and practices. - Your Company's lean vision is compatible with, and compliments the lean vision of your customers and key suppliers.	Added an additional example about compatibility with larger (big business) system. Ultimately the two systems must work together.
I.B.4	I.B.4	A Sense of Urgency The primary driving force for Lean	A Sense of Urgency - Your company's transformation to lean is organic, forming an integral element of a whole, and is seen as an urgent priority.	Additional description to remove ambiguity.
I.B.4	Level 1	Scan of environment identifies competitive threats and need for action.	Looking at your company's competition and competitive environment identifies competitive threats and need for (change) actions.	Additional description to remove ambiguity.
I.B.4	Level 2	Enterprise senior leaders develop an urgent and compelling case for the lean transformation.	Your Company's senior leadership has developed an urgent and compelling case for the lean transformation.	”your company” added.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.B.4	Level 3	Urgent and compelling case for lean transformation has been communicated and the organization rallies behind it.	The urgent and compelling case for lean transformation has been communicated to everyone, and the organization rallies behind it.	Added pronoun "The"
I.B.4	Level 4	Urgent and compelling case for lean is expanded to and accepted by key suppliers.	Your company's urgent and compelling case for lean is expanded to, and accepted by, key suppliers.	"your company" added.
I.B.4	Level 5	Urgent and compelling case for lean is expanded to and accepted throughout the extended enterprise.	Your company's urgent and compelling case for lean is expanded to and accepted throughout the extended enterprise.	"your company" added. Extended enterprise already defined, (so additional text not needed).

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.B.4	Lean Indicators (examples)	• A compelling business case for lean has been developed and communicated. • The implications and time scales of the vision have been translated for each area of the enterprise. • Lean transformation progress is integral to leadership discussions and events.	- A compelling business case for lean has been developed and communicated. - The implications and time scales of the lean vision have been translated for each area of the extended enterprise (Including both customer and supplier value chains). - The lean transformation progress is integral to leadership discussions, decisions, and program events. - Customer value and customer satisfaction strongly influence the way decisions are made in the company.	Added additional indicator to drive home the importance of customer value as a driving force in lean.
I.C	Subsection C description	I.C. Focus on the Value Stream - Value creation with minimal waste becomes the primary driving force of the enterprise. The current means of delivering customer value are documented, followed by improving the value stream by minimizing waste. Lean metrics are specified and stakeholder involvement clarified.	I.C. Focus on the Value Stream - Creation of value and elimination of waste internal and external to the company becomes the driving force for the company and extended enterprise. The current means of delivering customer value are determined, followed by improving the value stream by minimizing waste. Lean metrics are specified and stakeholder involvement in the extended enterprise is clarified.	Additional description of key concepts to remove ambiguity and improve small business understanding.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.C	Diagnostic Questions	• Is a formal process utilized to explicitly determine "value to the customer"? • Have the value streams of all stakeholders been mapped, integrated and balanced? • Does the enterprise understand how material and information flow throughout the various elements of the enterprise? • Are enabling infrastructure processes being aligned to value stream flow? • Does the enterprise understand clearly how it currently delivers value to customers? • Has a system of balanced performance measures been established that reflect progress towards strategic business objectives?	- Is a formal process utilized to explicitly determine "value" to the customer? - Have the value streams of all stakeholders been mapped? Integrated? Balanced against the needs of your company and the overall extended enterprise? - Does your company understand how material and information flow throughout various elements of the enterprise? - Has a system of balanced performance measures been established that reflect progress toward strategic lean business objectives? - Are enabling infrastructure (IT, procedures, organizational structure, rewards, etc.) processes being aligned to the value stream flow? - Does your company, and everyone within it, clearly understand how it delivers value to the customer?	Additional emphasis on customer value provided.
I.C.1	I.C.1	Understanding the Current Value Stream -How we now deliver value to customers	Understanding the Current Value Stream - Assessing how customer value is delivered (both upstream and downstream in the value chain).	Additional description of value stream (for clarity).

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.C.1	Level 1	The documented process flow differs from the actual flow. There is an initial understanding of the need for formal mapping and analysis.	The documented process flow differs from the actual flow. There is an initial understanding of the need for formal mapping and further analysis.	No change required
I.C.1	Level 2	Key stakeholders and what they value are identified. Present processes are mapped and initial analysis is underway.	Key stakeholders and what they value are identified. Present processes are mapped and initial analysis is underway.	No change required
I.C.1	Level 3	Principal current value stream(s) are defined, allowing the identification of critical interactions. Significant opportunities for eliminating waste and creating value are identified and aligned with the strategic objectives.	The principal (current) value streams are identified and critical interactions of the value streams emerge. Significant opportunities for waste elimination and value creation are identified. These opportunities are aligned to the strategic objectives.	Added pronoun "The", and minor rewording. No substantive changes.
I.C.1	Level 4	Depth and breadth of knowledge of value stream elements and supporting processes exposes interdependencies across the enterprise.	The value stream elements are understood with depth and breadth of knowledge. Supporting processes and their interdependencies across the company are exposed and understood.	Additional description to allow for understanding by a broaden range of small business users

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.C.1	Level 5	Updated value streams and their independencies are evaluated across the extended enterprise.	The (updated) value streams and their interdependencies are evaluated across the extended value stream (customers, suppliers and stakeholders).	Slight rewording, no significant changes
I.C.1	Lean Indicators (examples)	• A formal process has been established for identifying customer and stakeholder value. • The practice and language of value stream mapping is recognized as an important part of an iterative improvement process. • Current value streams of major customers/product lines have been mapped, and hand off points and interfaces clearly defined.	- A formal process has been established for identifying customer and stakeholder value.. - The practice and language of value stream mapping is recognized as an important part of an iterative improvement process. - Current value stream maps of major customers/product lines have been mapped, and hand-off points and interfaces are clearly defined.	No change required
I.C.2	I.C.2	Enterprise Flow -“Single piece flow” of materials and information	Enterprise Flow - Re-evaluating "economies of scale" assumptions, and adopting "single piece flow" of materials as well as information.	Additional description for clarity.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.C.2	Level 1	Material and information flows are disjointed and "optimized" process by process. "Push" mentality prevails.	Material and information flows are disjointed and "optimized" process-by-process. "Pushing" the product or information through the system is the current flow mentality.	Additional description for clarity.
I.C.2	Level 2	Some primary flow paths have been overhauled to overcome significant barriers to flow.	Some primary information or process flow paths have been overhauled to overcome significant barriers to the flow.	No significant change.
I.C.2	Level 3	Primary flow paths are simplified and aligned to the value stream(s), which allows information and material to flow as required.	Primary flow paths are simplified and aligned to the value stream(s), which allows information and material to flow as required.	No change required
I.C.2	Level 4	Material and information flow seamlessly throughout the enterprise.	Material and information flow seamlessly throughout the company, "pulled" by the need for the product, process, or information.	Additional description to illustrate lean concept.
I.C.2	Level 5	Material and information flow seamlessly and responsively throughout the extended enterprise.	Material and information flow seamlessly and responsively throughout the extended enterprise, both up and downstream in the value stream.	Additional description for clarity.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.C.2	Lean Indicators (examples)	• Information flows have been rationalized to assure interoperability among enterprise elements. • Material flow paths have been simplified and shortened to enhance flow. • Information and material flows are responsive to stakeholder needs.	- Information flows have been rationalized to assure interoperability among enterprise elements. - Material flow paths have been simplified and shortened to enhance flow. Work in Process (WIP) inventories are reduced. - Information and material flows are responsive to the actual stakeholder needs.	No change required.
I.C.3	I.C.3	Designing the Future Value Stream - Value stream to meet the enterprise vision	Designing the Future Value Stream - Integrating your company's value stream to meet the extended enterprise vision	Additional wording to add clarity
I.C.3	Level 1	Management understands that the present processes do not meet the future lean enterprise objectives.	Management in your company understands that the present processes do not meet the future lean enterprise objectives.	"your company" added to clarify.
I.C.3	Level 2	A concept for future value stream(s) design has been created based on balanced stakeholder requirements.	A general understanding of the stakeholder requirements has lead to the ability to weigh and balance relative needs. A concept for future (new) value stream design has been developed based on those balanced needs.	Additional description added to improve small business reader's understanding of the level.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.C.3	Level 3	Future value stream(s) are developed, which encompass future enterprise goals and satisfy stakeholder requirements.	Future value stream(s) are developed, which encompass future enterprise goals and satisfy stakeholder intents and requirements.	Subtle rewording. No significant change.
I.C.3	Level 4	Future value stream(s) are refined to accommodate a changing environment.	Future value stream(s) are refined to accommodate a changing environment. The value stream is not static, but identifies and is able to respond to changes in the competitive landscape.	Additional description added to improve small business reader's understanding of the level
I.C.3	Level 5	Future value stream(s) are refined to dynamically accommodate a changing environment across the extended enterprise.	Future value stream(s) are refined to dynamically accommodate a changing environment across the extended enterprise.	No change required.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.C.3	Lean Indicators (examples)	• A formal process has been established to identify how the enterprise can best deliver value to customers and stakeholders. • The future value stream(s) reflects new and improved ways to realize value and minimize non-value adding activities. • Future value stream(s) designs have been generated for the primary value stream(s) and their supporting processes.	- A formal process has been established to identify how the enterprise can best deliver value to customers and stakeholders. - The future value stream(s) reflect new and improved ways to increase value and minimize non-value added activity. - Future value stream(s) designs have been generated for the primary value stream(s) and their supporting processes.	No change required.
I.C.4	I.C.4	Performance Measures -Performance measures drive enterprise behavior	Performance Measurement - Since performance measurement tends to drive individual behavior, and ultimately the company's culture, has your company's performance measurements been aligned to adequately measure progress towards a lean enterprise?	Additional description added to improve small business reader's understanding of the lean concept.
I.C.4	Level 1	Performance measures are ad hoc, inconsistent and focused on functional areas rather than value streams.	Performance measures are ad hoc, inconsistent and focused on function of the individual or area, rather than the value stream.	No change required.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.C.4	Level 2	Baseline performance measures are established to stimulate progress towards the lean future state and are visible throughout the enterprise.	Baseline performance measures are established to stimulate progress towards the lean future state and are visible throughout the company.	Rephrasing of "enterprise" for small business understanding.
I.C.4	Level 3	Performance measurement system uses a minimal and balanced set of measures based on strategic objectives and aligning local with enterprise metrics.	Performance measurement systems use a minimal and balanced set of measures based upon strategic objectives and aligning the individual, group, operational, and company lean objectives	Additional description added to improve small business reader's understanding of the level
I.C.4	Level 4	Measurement systems and target setting pulls performance improvement throughout the enterprise.	Measurement systems and target setting pulls performance improvement throughout the company. In other words, the measurement system incentivizes and rewards lean progress.	Additional description added to improve small business reader's understanding of the level
I.C.4	Level 5	A common target setting and measurement process pulls performance improvement across the extended enterprise.	A common target setting and measurement process pulls performance improvements across the extended enterprise. In this case, the entire value stream is improved.	Specified the extent of the value stream for clarity.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.C.4	Lean Indicators (examples)	• A balanced and minimal set of performance measures are used to track lean implementation progress towards the strategic direction. • Performance measures used assure that local and enterprise measures are aligned.	- A balanced and minimal set of performance measures are used to track the lean implementation progress. - The performance metrics keep the lean implementation process aligned toward your company's strategic objectives. - The performance measures used assure that the individual, group, company, and extended enterprise metrics are aligned . - Waste elimination, value creation and customer satisfaction strongly influence the performance measures.	Two additional examples provided to further illustrate the point. Driving home the concepts of the lean paradigm.
I.D	Subsection D description	I.D. Develop Lean Structure and Behavior - Organization infrastructure must be assessed and modified prior to launching a lean initiative as well as throughout the transformation. Organizational structure, incentives, policies, business systems and processes must be aligned and coordinated to elicit the behavior required for successful implementation of lean principles and practices	I.D. Develop Lean Structure and Behavior - Your Company's infrastructure must be assessed and modified prior to launching a lean initiative as well as throughout the lean transformation. Your company's organizational structure, incentives, policies, business systems, and operational processes must be aligned and coordinated to elicit the behavior required for successful implementation of lean principles and practices.	"Your" company added to define who the subject addresses.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.D	Diagnostic Questions	• Has an organizational structure been implemented that focuses on core processes along the customer value stream? • Is organizational structure designed for flexibility and responsiveness to changes in the external environment? • Are relationships with stakeholders based on mutual respect and trust? • Have policies and procedures been revised to promote and encourage lean behavior? • Have incentives been developed which are consistent with the behavior desired? • Has decision-making been delegated to the lowest practical level? • Is prudent risk taking encouraged? • Are lean change agents positioned and empowered to provide guidance and leadership for the lean transformation?	- Has an organizational structure been implemented that focuses on core processes along the customer value stream? - Is your company's organizational structure designed for flexibility and responsiveness to changes in the external or competitive environment? - Are your company's relationships with internal and external stakeholders based on mutual respect and trust? - Are your company's policies and procedures updated to promote and encourage lean behavior? - Are people with a clear vision and commitment to lean transformation (i.e. "lean change agents") positioned and empowered to provide guidance and leadership for the lean transformation? - Has decision making in your company been delegated to the lowest practical level? - Is prudent risk-taking encouraged by your company? How is failure dealt with?	Subtle rewording for clarity, but no substantial change to this set of questions.
I.D.1	I.D.1	Enterprise Organizational Orientation - Organize to support value delivery	Enterprise Organizational Orientation - An assessment of how well your company is organized to support value delivery.	Reworded to improve small business understanding.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.D.1	Level 1	The enterprise operates as functional silos.	Your company operates as "functional silos" - that is, groups do not interact much, and your company is essentially organized to operate as separate functional units.	Additional definition provided to improve understanding.
I.D.1	Level 2	Initial efforts are underway to identify functional barriers and understand their full implications.	Initial efforts are underway to identify functional barriers and understand their full implications.	No change required.
I.D.1	Level 3	Partially deployed cross-functional organizational processes are aligned with enterprise value stream(s).	Your company operates as a partially deployed cross-functional organization. Where many of the functional barriers are removed and process are aligned with the company's strategic objectives and value stream(s).	Rephrased the example to allow for broader accessibility from small business backgrounds.
I.D.1	Level 4	Extensive cross-functional processes are implemented across the enterprise. Functional units now serve as knowledge centers for skill retention.	Extensive cross-functional processes are implemented across the company. Functional units now serve as knowledge centers for skill retention.	No change required.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.D.1	Level 5	Cross-functional, process based orientation is aligned across the extended enterprise.	Cross-functional, process-based orientation is aligned across the extended enterprise. Knowledge and skills are shared by upstream and downstream stakeholders for extended value creation.	Additional description added to improve small business reader's understanding of the level
I.D.1	Lean Indicators (examples)	• Functional barriers have been minimized. • There is extensive use of cross-functional processes across the enterprise. • Career progression potential exists across both processes and functions.	- Functional barriers have been minimized. - There is extensive use of cross-functional processes across the company. - Career progression potential exists across both processes and functions.	"Enterprise" removed, "company" inserted.
I.D.2	I.D.2	Relationships Based on Mutual Trust - "Win-win" vs. "we-they"	Relationships Based on Mutual Trust - "win-win" vs. "we-they" attitude, enterprise value is created when stakeholders trust and respect each other.	Additional description added to improve small business reader's understanding of the level
I.D.2	Level 1	Relationships tend to be determined by organizational role, resulting in a "we-they" perspective.	Relationships in your company tend to be determined by organizational role, resulting in a "we-they" perspective.	"Your company" added.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.D.2	Level 2	Selective application of enterprise perspective results in breaking down of organizational barriers and developing mutual trust.	The selective application of "lean" perspective results in breaking down some of the organizational barriers and the development of mutual trust between groups and individuals within the company.	Additional description added to improve small business reader's understanding of the level
I.D.2	Level 3	Stable and cooperative relationships exist across the enterprise; cooperative relations are established with some enterprise partners.	Stable and cooperative relationships exist across the company; cooperative relations are established with some enterprise partners	No change required.
I.D.2	Level 4	Mutual respect and trust exists across the extended enterprise with equitable sharing of benefits from continuous improvement initiatives.	Mutual respect and trust exists across the extended enterprise with equitable sharing of benefits from continuous improvement initiatives.	No change required.
I.D.2	Level 5	Stakeholders modify behavior so as to enhance extended enterprise performance (win-win).	The upstream and downstream stakeholders modify their operational behavior so as to enhance the extended enterprise's performance ("win-win").	Additional explanation of value stream members.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.D.2	Lean Indicators (examples)	• Communication barriers based upon organizational position have been significantly reduced. • Stable and cooperative relationships exist among most enterprise stakeholders.	- Communication barriers based on organizational position have been significantly reduced.. - Stable and cooperative relationships exist among most enterprise stakeholders. - There is an almost palpable sense of "team" when interacting with customers or suppliers, it is understood by all that "we are all in this together".	Additional example of teaming mentality to deepen assessor's understanding of lean strategic partnerships.
I.D.3	I.D.3	Open and Timely Communications - Information exchanged when required	Open and Timely Communication - Information is exchanged when it is needed and has the most positive impact on stakeholder value.	Additional illustration of value used in a lean context.
I.D.3	Level 1	Communication is largely top-down, limited and lagging.	Information flow is largely one-way, often top-down, and is limited. The information flow typically lags, which tends to escalate the magnitude of problems to the point that they are much more difficult to solve.	Additional description added to improve small business reader's understanding of the level
I.D.3	Level 2	Basic communication mechanisms are employed but are not uniform; communication strategy is under development.	Basic communication mechanisms are employed, but are not uniform; your company's communication strategy is under development.	"Your company" specified to remove ambiguity.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.D.3	Level 3	Enterprise leaders are accessible and visible, developing two-way communications in open, concise and timely form.	Your company's leaders are accessible and visible, developing two-way communications in open, concise and timely form.	No change required.
I.D.3	Level 4	Communication processes are undergoing continuous refinement and information is exchanged or can be pulled as required.	The communication processes are undergoing continuous refinement, and information is accessible and freely exchanged, or can be pulled as required. Most employees know how and where to access the information they need.	Additional description added to improve small business reader's understanding of the level
I.D.3	Level 5	Comprehensive system of two-way communication is employed throughout the extended enterprise.	Your company has a comprehensive system of two-way communication that is employed throughout the extended enterprise. Information is freely exchanged as needed with all stakeholders.	Additional description added to improve small business reader's understanding of the level

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.D.3	Lean Indicators (examples)	• Open and timely communications exist among stakeholders. i.e. regular meetings with employees, newsletters, etc. • Technology has been leveraged to speed communications flow and accessibility, while filtering unnecessary communications. • Employee input is valued and plays a key part in decision-making.	- Open and timely communications exist among stakeholders, i.e. regular meetings with employees, newsletters, central data repositories. - Technology has been leveraged to speed communication flow and accessibility, while filtering unnecessary communications. - Employee input is valued, and plays a key part in decision making. - All personnel in your company know where, and how, to get the information they need to do their job.	Additional example added to illustrate future lean state of information access.
I.D.4	I.D.4	Employee Empowerment -Decision-making at lowest possible level	Employee Empowerment - Does your company enable decision making at its lowest possible level?	No substantial change.
I.D.4	Level 1	Centralized decision-making occurs in a hierarchical structure with limited delegation of authority.	Decision making in your company is largely centralized, and occurs in a hierarchical structure with limited delegation of authority. Lower levels have very little input into the decision making process.	Additional description added to improve small business reader's understanding of the level

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.D.4	Level 2	Appropriate structure and training is being put in place to enable empowerment.	Your company realized it needs to enable appropriate lower-level decision making. Structure and training is being put in place to enable lower level decision making empowerment.	Additional description added to improve small business reader's understanding of the level
I.D.4	Level 3	Organizational environment and management system supports limited decision making at point of application and need.	Your company's organizational environment and management system supports limited decision-making at point of application and need. Employees clearly understand their responsibilities for decision making, and are empowered to make decisions within the scope of their application.	Additional description used to define the concepts within the description as a means to remove possible misinterpretation.
I.D.4	Level 4	Decision processes are continually refined to promote increased accountability and ownership at point of use.	Decision making processes are continually refined to promote increased accountability and decision-making ownership at point of use.	Slight rephrasing.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.D.4	Level 5	Decision-making across the extended enterprise is delegated to the point of application.	Decision making across the extended enterprise is delegated to the point of application. Suppliers and Customers are an integral part of the decision making process, and are trusted and empowered to make decisions at their point of use that impacts the overall enterprise as well as your company.	Additional description added to improve small business reader's understanding of the level
I.D.4	Lean Indicators (examples)	• Managers and supervisors serve as mentors and educators, promoting lower level decision-making. • The extent and types of empowerment are tailored to match the environment and people empowered. • Empowerment enables swift and effective decision-making closest to the point of use.	- Managers and supervisors serve as mentors and educators, promoting lower-level decision making. - The extent and types of empowerment are tailored to match the environment and people that are influenced by, and responsible for, the decision. - Empowerment enables swift and effective decision making closest to the point of use. - Lower level decisions are communicated to the appropriate stakeholders.	Additional indicator provided to illustrate two-way communication. Decisions are made at the lowest level, and communicated to the people that need to know.
I.D.5	I.D.5	Incentive Alignment -Reward the behavior you want	Incentive Alignment - Reward the behavior you want.	No change required.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.D.5	Level 1	There is sporadic use of incentives and an awareness that some incentives discourage lean behavior.	There is a sporadic use of incentives and an awareness that some incentives discourage lean behavior/	No change required.
I.D.5	Level 2	Incentives that reward and encourage lean behavior are deployed in some areas.	Incentives that reward and encourage lean behavior are deployed in some areas, but not others.	No change required
I.D.5	Level 3	Executive compensation and employee incentives are linked directly to attainment of lean objectives.	Executive compensation and employee incentives are linked directly to attainment of lean objectives	No change required
I.D.5	Level 4	Incentive systems successfully contribute to achievement and sustainability of lean objectives.	Incentive systems successfully contribute to achievement and sustainability of lean objectives.	No change required
I.D.5	Level 5	Lean incentives are deployed, with measurable success across the extended enterprise.	Lean incentives are deployed, with measurable success across the extended enterprise.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.D.5	Lean Indicators (examples)	• Incentives include a balance of money and non-monetary rewards / recognition to encourage lean activity. • Incentives are based on performance measures that encourage lean activity. • Incentives encourage local improvements that will benefit multiple processes or value steam performance.	- Incentives include a balance of monetary and non-monetary rewards and recognition to encourage lean activity. - Incentives are based on performance measures that encourage lean activity.. - Incentives encourage local improvements that will benefit multiple processes or value stream performances. - Incentives ultimately "pull" the lean behavior needed to sustain the lean enterprise.	Additional illustration of pull in relation to lean behavior.
I.D.6	I.D.6	Innovation Encouragement From risk aversion to risk rewarding	Innovation Encouragement - A lean transformation requires that you move form risk aversion to prudent risk rewarding.	Definition embedded in description for clarity.
I.D.6	Level 1	Innovation initiatives are sporadic and ad hoc; security, stability and risk aversion drive most decision-making.	Innovation initiatives are sporadic and ad hoc; security, stability, and risk aversion drive most decision making.	No change required
I.D.6	Level 2	Initial efforts are underway to develop systems, processes and procedures for fostering innovations.	Initial efforts are underway to develop systems, processes and procedures for fostering innovation.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.D.6	Level 3	Innovation initiatives are underway in selected areas; measures for assessing impact are in use.	Innovation initiatives are underway in selected areas; measures for assessing impact are in use.	No change required.
I.D.6	Level 4	Innovation initiatives are flourishing across the enterprise; prudent risk taking is encouraged and rewarded.	Innovation initiatives are flourishing across the enterprise; prudent risk taking is encouraged and rewarded.	No change required
I.D.6	Level 5	Comprehensive innovation program is implemented and positive results recognized across the extended enterprise.	Comprehensive innovation program is implemented and positive results are recognized across the extended enterprise.	No change required
I.D.6	Lean Indicators (examples)	• The review process for suggestions has been streamlined and gives clear visibility of the progress of each suggestion. • Suggestion programs have been properly incentivized to give recognition to originators of innovative ideas.	- The review process for suggestions has been streamlined and gives clear visibility of the progress of each suggestion. - Suggestion programs have been properly incentivized to give recognition to originators of innovative ideas. - Risk is understood, not avoided. Prudent risk taking is seen as a core strength of your company, not a liability. - Innovations can be measured against the company's lean vision, and the value of the innovation is considered in relation to its impact on the values stream.	Two additional indicators to include risk management discussed in level 1 and 2.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.D.7	I.D.7	Lean Change Agents -The inspiration and drivers of change	Lean Change agents - To implement and sustain change, lean visionaries or champions are empowered as change agents to inspire and drive change.	Definition included in description to aid clarity
I.D.7	Level 1	Change agents are sporadically distributed, but without change authority.	Change agents are sporadically distributed in your company, but without clear change authority.	"your company" added to define subject of level
I.D.7	Level 2	There is formal identification of change agents, along with role definition, authority delegation and program of education and training for change agents.	Your company has identified the role of the change agent, and is developing the organizational infrastructure to support a network of change agents.	Reworded to increase small business clarity
I.D.7	Level 3	Appropriately skilled change agents are assigned to key areas with the authority to effect changes.	There is formal identification and definition of the change agent's role in the organization. They are empowered to make the necessary changes. Further, they are tasked to delegate their responsibilities as well as implement a program of education and training for new change agents.	Extended illustration to help assessor understand level.
I.D.7	Level 4	Change becomes self-generating, initiated by employees as well as change agents.	Change becomes self-generating, initiated by employees, management, as well as change agents.	Added management to include in enterprise

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.D.7	Level 5	Change agents are providing a critical resource of lean knowledge, skill and experience in transforming the extended enterprise.	Your company's change agents are critical resources for lean knowledge, skill and experience within the extended enterprise. Their skills and knowledge are shared with the extended enterprise to help improve the value to the extended enterprise.	Additional illustration of level to aid small business understanding
I.D.7	Lean Indicators (examples)	• Lean change agents have been designated and empowered. • Lean change agents operate throughout all areas and cross-transfer lean implementation experience. • Process for developing "lean masters" and other change agents has been established.	- Lean change agents have been designated and empowered in your company, with a mandate to increase value and eliminate waste. - Lean change agents operate throughout all areas of your company and cross-transfer knowledge gained and lean implementation experience to other areas of your organization. - A process for mentoring and developing new change agents has been established. - Each individual in your company feels a personal responsibility and authority to make positive change occur in their position.	Added mentoring example as well as personal ownership of change.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
1E	Subsection E description	SECTION I.E. - Create And Refine Transformation Plan - Identify, prioritize and sequence a comprehensive set of lean initiatives that collectively constitute the plan for achieving the desired transformation.	I.E. Create And Refine Your Company's Transformation Plan - In this section, you will evaluate how completely your organization has identified, prioritize and sequence a comprehensive set of lean initiatives that collectively constitute the plan for achieving the desired lean transformation.	Additional description to aid clarity.
1E	Diagnostic Questions	• Is the enterprise level lean transformation plan prioritized and aligned with strategic business objectives? • Have adequate resources been provided to facilitate lean transformation? • Does the current education and training program adequately support the strategic direction(s) and lean transformation? • Have lessons learned and best practice been effectively incorporated within lean transformation planning?	- Is the enterprise-level lean transformation plan prioritized and aligned with the company's strategic business objectives? - Have adequate resources been provided to facilitate the lean transformation? - Does the current education and training program adequately support your company's strategic direction(s) and lean transformation? - Have "lessons learned" and "best practices" been effectively incorporated within the lean transformation planning?	"Your company" used to define subject of the question. No other substantive change.
I.E.1	I.E.1	Enterprise-Level Lean Transformation Plan -Charting the course across the extended enterprise	Enterprise-Level Lean Transformation Plan - Charting the transformational course across the extended enterprise.	No significant change.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.E.1	Level 1	Individual planning efforts are mostly bottom up initiatives with little priority or coordination established at enterprise level.	There is no formal lean transformation plan. Or there is a loosely defined plan with little priority or coordination established at the enterprise level.	Additional description to aid small business understanding.
I.E.1	Level 2	Enterprise-level view identifies lean implementation projects, which are prioritized to meet long and short-term strategic objectives.	While there is not necessarily a formal lean transformation plan, your company has identified the requisite lean implementation projects. These projects are prioritized to meet long and short-term strategic objectives	Additional description to aid small business understanding.
I.E.1	Level 3	Enterprise improvement plans are coordinated and prioritized across enterprise value stream(s), with a timeline for expected measurable results.	Your company has created a formal lean enterprise improvement plan(s), and it is coordinated and prioritized across the company's value stream(s), with a timeline for expected and measurable results.	"your company" replaces enterprise.
I.E.1	Level 4	Lean transformation plan is continuously refined through learning from implementation results and changing strategic requirements.	The lean transformation plan is being executed in your company, and is continuously refined through learning from implementation results and changing strategic requirements.	Additional description to aid small business understanding.
I.E.1	Level 5	Lean transformation plan balances mutual benefits of stakeholders across the extended enterprise.	The dynamic lean transformation plan balances mutual benefits of the stakeholders across the extended enterprise.	No significant change.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.E.1	Lean Indicators (examples)	• A process is in place to incorporate lessons learned into the enterprise-level lean transformation plan. • The milestone targets of the lean transformation plan are broken-down by section and deployed across the enterprise. • Plans balance long-term and short-term stakeholder objectives for the best overall solution.	- A process is in place to incorporate lessons learned from transition-to-lean activities into the enterprise-level lean transformation plan. - The milestone targets of the lean transformation plan are broken down by section and deployed across the company. - Your transformation plans balance long-term and short-term stakeholder objectives for the best "value chain" solution. Cost savings and value improvements are shared across the enterprise.	Added cost savings/sharing to illustrate equitable "win-win" available through lean.
I.E.2	I.E.2	Commit Resources for Lean Improvements -Resource provision for lean	Commit Resources for Lean Improvements - create a reasonable and adequate resource provision for lean.	Slight rewording for clarity.
I.E.2	Level 1	Little or no resources are provided for process improvement or waste elimination.	There are little or no resources provided in your lean transformation plan and budgeted by your company for process improvement or waste elimination	Slight rewording for clarity.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.E.2	Level 2	Limited enterprise-level resources are committed and often applied to the symptom rather than the root cause.	Limited enterprise-level resources are committed and often applied to the symptoms of a problem, rather than the elimination and prevention of the root causes. Once a problem is fixed, it is rarely studied for root cause elimination ("There just isn't time or budget!" is often quoted).	Additional description to illustrate level for enhanced small business understanding
I.E.2	Level 3	Resources are allocated as required for execution of the lean transformation plan and prioritized across the value stream.	Resources in your company are allocated as required for the execution of the lean transformation plan and prioritized across the value stream.	“your company” added as subject.
I.E.2	Level 4	A pool of earmarked resources is provided for lean initiatives with minimal justification required.	A pre-planned amount of company resources is provided for lean initiatives, access to the resources requires minimal justification, as long as it is within the strategic transformation objectives.	Rephrased for small business accessibility.
I.E.2	Level 5	A pool of earmarked resources is provided for lean initiatives across the extended enterprise.	A pool of earmarked resources is provided for lean initiatives across the extended enterprise. A formal plan is in place to share the costs and benefits from the lean transformation throughout the extended enterprise.	Added cost sharing benefits as sign of highest level

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.E.2	Lean Indicators (examples)	• Resources are committed to support the level and speed of lean transformation required. • Time to build on improvements by personal contribution is given at all levels. • The procedure to apply for improvement resources has been simplified, and gives priority to improvements that benefit multiple areas.	- Resources are committed to support the level and speed of the lean transformation required within your company. - Sufficient time to build on lean improvements through personal contribution is given at all levels. - The procedure to apply for lean improvement resources has been simplified, and gives priority to improvements that benefit multiple areas.	No significant changes/
I.E.3	I.E.3	Provide Education and Training -Just-in-time learning	Provide Education and Training - Just-in-time learning. Ensuring a common understanding of the lean vision and the company's implementation plan, as well as the employee's role in the transformation.	Additional description to illustrate concept for enhanced small business understanding
I.E.3	Level 1	There is little coordination of education and training programs to facilitate change.	There is little coordination of education and training programs within your company to facilitate lean change.	“your company” added to subject
I.E.3	Level 2	Education and training covers a set of skills required to support the lean transformation projects.	Your company's education and training program covers a minimum set of skills required to support lean transformation projects.	“your company” added to subject

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.E.3	Level 3	Education and training program is comprised of a balanced and sequenced set of elements to support the coordinated transformation plan.	Your company's education and training program is comprised of a balanced and sequenced set of elements to support the coordinated transformation plan.	"your company" added to subject
I.E.3	Level 4	Education and training at all levels is periodically reviewed to check alignment and suitability to the lean transformation plan.	Education and training at all levels is periodically reviewed to check alignment and suitability to the lean transformation plan. Employee knowledge is enriched through professional development education and training, which strengthens their value as individuals within the company.	Additional description to illustrate concept for enhanced small business understanding
I.E.3	Level 5	Education and training program supports the upcoming needs of the extended enterprise transformation plan.	Your company's education and training program supports the upcoming needs of the extended enterprise transformation plan.	"your company" added to subject

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.E.3	Lean Indicators (examples)	• Education and training programs, including refreshers, are provided on a just-in-time basis. • Education and training has a balanced and sequenced set of elements to support the lean transformation plan. • The application of lean principles learned in training and education is formally appraised.	- Education and training programs, including refreshers, are provided on a just-in-time basis. - Education and training has a balanced and sequenced set of elements to support the lean transformation plan. - The application of lean principles learned in training and education is formally appraised. - Employees are trained not only in "lean", but in areas that increase their knowledge, and further develop their skills and abilities. This, in turn, reinforces lean behavior.	Additional indicator added to show how growth of knowledge increases / reinforces lean behavior.
I.F	Subsection F description	I.F. - Implement Lean Initiatives -Flow down the enterprise-level plan into specific actions, programs and projects that are executed within each process organizational area and determine how they are integrated at the enterprise level.	I.F. Implement Lean Initiatives - In this section, you will evaluate how completely your organization has flowed the company-level lean transformation plan and lean vision into specific actions, programs and projects. You will also determine how thoroughly theses projects are executed within each organizational process area and determine how they are re-integrated at the enterprise level.	Additional description to illustrate concept for enhanced small business understanding

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.F	Diagnostic Questions	• Has the enterprise level lean transformation plan been translated into detailed execution projects? • Has a uniform system been established to track the progress of lean initiatives with respect to the overall plan? • Do lean initiative plans contain a feedback mechanism for revision and to share lessons learned?	- Has the enterprise-level lean transformation plan been translated into detailed execution projects? - Has a uniform system been established to track the progress of the lean initiatives with respect to the overall plan? - Do lean initiative plans contain a feedback mechanism for revision? - How are lessons learned incorporated into the plan? How flexible is the plan? How often is it reviewed? - What is it measured against? How do you know progress is being made?	Added questions to include measurement systems to address small business concern for rapid return on effort.
I.F.1	I.F.1	Development of Detailed Plans Based on Enterprise Plan -Coordinating lean improvements	The Development of Detailed Plans Based on the Company's "Enterprise Plan" - The coordination of lean improvements up and down the organizational structure.	Additional description to clarify intent of subject.
I.F.1	Level 1	Improvements are generally optimized for individual areas and employees can not clearly see the links between localized and enterprise goals.	Local improvements in process are generally optimized for individual areas and employees cannot clearly see the links between localized improvements and the enterprise goals.	Additional description to improve understanding.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.F.1	Level 2	Key goals of the enterprise lean transformation plan are understood by most employees. Process owners are involved in developing detailed plans linked to the goals/strategic objectives of the enterprise plan.	Key goals of the company's lean transformation plan are understood by most employees. Process owners are involved in developing detailed plans that link to the goals and strategic objectives of the enterprise plan	No change required.
I.F.1	Level 3	Detailed lean implementation plans supporting the enterprise level plan are developed and coordinated across processes.	Detailed lean implementation plans supporting the enterprise level plan are developed and coordinated across processes or business elements within the company.	No substantial changes.
I.F.1	Level 4	Detailed lean implementation plans accounting for any interdependencies are refined and integrated across the enterprise. Best practices are shared.	Interdependencies between groups are identified, and the detailed plans are refined to accommodate t the interdependency. The resultant plan is then integrated across the enterprise. Best practices are shared across the entire company.	Additional verbiage to improve small business understanding.
I.F.1	Level 5	Implementation plans from extended enterprise are coordinated with and support the lean transformation plan.	Implementation plans from the extended enterprise are coordinated with, and support, your company's lean transformation plan	No change required.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.F.1	Lean Indicators (examples)	• Detailed implementation plans are aligned to milestone targets of the enterprise-level plan. • A process is in place to incorporate lessons learned in detailed implementation plans. • Detailed improvement plans are coordinated throughout the enterprise where shared implications exist.	- Detailed implementation plans are aligned to milestone targets of your company's enterprise level plan - A process is in place to incorporate lessons learned in detailed implementation plans, and the enterprise level plan is adjusted as necessary. - Detailed improvement plans are coordinated throughout the enterprise where shared implications exist.	No significant changes.
I.F.2	I.F.2	Tracking Detailed Implementation - Assessing actual outcomes against goals	Tracking Detailed Implementation - Assessing actual outcomes against the goals.	No change required
I.F.2	Level 1	Results of process improvement initiatives are observed but not quantified.	Results of process improvement initiatives are observed, but not quantified.	No change required.
I.F.2	Level 2	Process is under development to permit tracking and quantification of progress of the detailed lean implementation. Data from some projects is being reviewed.	A process is under development at your company to permit tracking and quantification of progress of the detailed lean implementation. Data from some projects are being reviewed.	No change required.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.F.2	Level 3	There is a project management process implemented to track progress of detailed lean projects against milestones, with feedback provided to enterprise level. Appropriate corrective action is initiated within individual projects.	A project management process has been implemented to track the progress of detailed lean projects against their planned milestones. Feedback on progress is provided to your company's leaders so that appropriate enterprise-level corrective action can be initiated.	Reworded to address small business operations.
I.F.2	Level 4	The project management process can readily assess detailed plans and can accommodate revisions mandated by changes to the enterprise level lean transformation plan.	The project management process can readily assess detailed plans and can accommodate revisions mandated by changes to the enterprise level lean transformation plan. Information form this process flows up to company leadership and down to the employees as needed.	Additional definition embedded in description to aid assessor understanding.
I.F.2	Level 5	The project management process is deployed across the extended enterprise to enable real-time tracking.	The project management process is deployed across the extended enterprise to enable real-time tracking against the extended enterprise goals and values.	Additional description to clarify level

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.F.2	Lean Indicators (examples)	• Lean initiatives are coordinated and tracked, with the individual results “rolled up” and assessed against enterprise level milestones and targets. • The responsibility and accountability for improvement success is assigned locally to enable fast corrective action on deviations from the plan. • Changes to processes / value stream map(s) are documented and updated regularly.	- Lean initiatives are coordinated and tracked, with the individual results "rolled up" and assessed against enterprise level milestones and targets. - The responsibility and accountability for improvement success is assigned locally to enable fast corrective action on deviations from the plan. - Changes to processes and value stream maps(s) are documented and updated regularly.	No change required.
I.G	Subsection G description	I.G. - Focus On Continuous Improvement -Successful execution of lean implementation plan forms the basis for further improvement. The improvement process is monitored and nurtured, lessons learned are captured, and improved performance becomes a strong driving force for future strategic planning by enterprise executives.	I.G. Focus on Continuous Improvement - The successful execution of your company's lean implementation plan forms the basis for future improvement. The improvement process is monitored and nurtured. Lessons learned are captured, and improved performance becomes a driving force for future strategic planning by company leadership.	Reworded to improve small business understanding.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.G	Diagnostic Questions	• Are guidelines for continuous improvement sufficiently developed for effective facilitation of enterprise-wide transformation plans? • Are enterprise participants being challenged to build-on and sustain existing improvements? • Are senior managers actively involved in monitoring progress of lean implementation at all levels? • Is appropriate support and encouragement being provided to all participants in lean implementation? • Are lessons learned being captured in a consistent, systematic manner? • Are lean implementation results impacting strategic planning?	- Are guidelines for continuous improvement sufficiently developed for an effective company-wide transformation to lean? - Is your company's organizational structure designed for flexibility and responsiveness to changes in the external or competitive environment? - Are your company's employees being challenged to sustain existing improvements and develop new improvements? - Is your company's leadership actively involved in monitoring the progress of the lean implementation plan at all levels? - Is appropriate support and encouragement being provided to all employees involved in the lean transformation? - Are lessons learned being captured in a consistent, systematic manner? Are they accessible to the decision makers in your company when needed? - Do lean implementation results impact your company's strategic planning?	"Your company" replaces some occurrences of enterprise. Slight rewording for clarity.
I.G.1	I.G.1	Structured Continuous Improvement Processes -Uniformity in how we get better	Structured Continuous Improvement Process - Uniformity in how we get better.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.G.1	Level 1	Improvement initiatives are ad hoc and not data driven.	Improvement initiatives in your company are ad hoc, and are usually a reaction to some event. Proactive improvements are rarely undertaken, or the initiatives themselves are not data driven.	Additional definition embedded in description to aid assessor understanding.
I.G.1	Level 2	An improvement process for the enterprise is broadly defined and being selectively applied.	A formal improvement process for your company is broadly defined, and is being selectively applied.	"your company" added to subject
I.G.1	Level 3	Systematic, structured methodology for continuous improvement and value creation is developed and deployed across many areas.	Your company has a systemic, structured methodology for continuous improvement. Your improvement programs are centered on the principles of value creation, and its implementation is developed and deployed across many areas.	Additional definition embedded in description to aid assessor understanding.
I.G.1	Level 4	Structured continuous improvement process is deployed at all levels across the enterprise, using value analysis to target improvements.	Your company has a structured continuous improvement process that is deployed at all levels across the company. All of your initiatives use a structured value analysis to target improvements.	Additional text added to clarify description.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.G.1	Level 5	Structured continuous improvement process is fully ingrained throughout the extended enterprise.	Your company's structured continuous improvement process is fully ingrained in your company, and is applied cooperatively outside the company to the extended enterprise.	Additional description of extended enterprise to aid understanding.
I.G.1	Lean Indicators (examples)	• A consistent improvement/transformation approach is implemented, sustaining improvements gained. • The continuous improvement process challenges people to tackle the root cause, rather than the symptom. • Lean principles are being applied to most enterprise systems and processes, utilizing lessons learned.	- A consistent improvement and transformation approach is implemented, and sustains the improvements made. - The continuous improvement process challenges people to tackle the root cause of waste or inefficiency, rather than the symptom. - Lean principles are being applied to most of your company's systems and processes, and learning from past "lessons" and developing new insight..	Additional descriptive text added to illustrate examples.
I.G.2	I.G.2	Monitoring Lean Progress -Assessing progress toward achieving enterprise objectives	Monitoring Lean Progress - Assessing progress toward achieving enterprise objectives	No change required.
I.G.2	Level 1	Enterprise leaders are not actively involved in the review of overall lean implementation plan progress.	Your company's leaders are not actively involved in the progress review of the overall lean implementation plan.	“Your company” replaces “enterprise”

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.G.2	Level 2	Implementation plan progress is reviewed against enterprise level milestones and success criteria, for some projects.	Your company's lean implementation plan progress is reviewed against high-level milestones and success criteria, for some projects but not others.	"Your company" replaces "enterprise"
I.G.2	Level 3	A formal methodology is used by enterprise leaders to analyze the overall progress across all lean implementation projects. Current plans are adjusted based on learning from lean implementations.	A formal methodology is used by your company leadership to analyze the overall progress across all lean implementation projects. Current plans are adjusted based on learning from lean implementations.	"Your company" replaces "enterprise"
I.G.2	Level 4	Results of implementation projects are aggregated to permit reallocation of resources and to ensure on-going alignment with strategic objectives.	Results of your company's implementation projects are aggregated to permit reallocation of resources and to ensure on-going alignment with strategic objectives.	"Your company" added to identify subject of level.
I.G.2	Level 5	Senior managers monitor lean progress throughout the extended enterprise. Results are impacting future enterprise strategic planning.	Senior managers monitor lean progress upstream and downstream in the value chain (throughout the extended enterprise). Results are impacting future strategic planning of your company, its suppliers and its customers.	Additional description of enterprise to define extent in context of level.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.G.2	Lean Indicators (examples)	• Lean transformation progress is judged by the aggregate benefits, not individual or localized improvements. • Leaders actively participate in monitoring implementation progress and addressing deficiencies within the transformation plan. • Lean progress reviews are documented in a common format and disseminated.	- The lean transformation progress is judged by its aggregate benefits, not just the individual or localized improvements. - Your company's leaders actively participate in monitoring the implementation progress, and routinely and address deficiencies within the transformation plan. - Lean progress reviews are conducted, documented, and disseminated to the necessary groups and personnel.	"Your company" added to identify subject of indicators.
I.G.3	I.G.3	Nurturing the Process -Assure executive level involvement	Nurturing the Process - Assuring executive level involvement	Slight rewording
I.G.3	Level 1	There is growing awareness that successful lean implementation is highly dependent upon senior management support and encouragement.	There is growing awareness that successful lean implementation is highly dependent upon senior management support and encouragement.	No change required
I.G.3	Level 2	Some senior managers are providing encouragement, support and recognition, which is not consistent across the enterprise.	Some senior management provides encouragement, support and recognition, but it is not consistent across the entire company.	Slight rewording to active tense.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.G.3	Level 3	Managers seek to identify and remove barriers to lean implementation. Teams and individuals who successfully implement lean practices are recognized and rewarded.	Company leaders seek to identify and remove barriers to the lean implementation. Teams and individuals who successfully implement lean practices are recognized and rewarded.	Reworded to address flat structure in most small businesses
I.G.3	Level 4	Senior managers across the entire enterprise are highly visible in their involvement, support and encouragement of the lean initiative. An enthusiastic atmosphere is evident.	Senior managers across the entire enterprise are highly visible in their involvement, support and encouragement of the lean initiative. An enthusiastic atmosphere is evident.	No change required.
I.G.3	Level 5	Senior executives and managers champion and nurture a culture of continuous improvement in the extended enterprise.	Senior executives and managers champion and nurture a culture of continuous improvement in the extended enterprise.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.G.3	Lean Indicators (examples)	• Management actively supports and is involved in ensuring the success of improvements. • Positive actions and the effort taken are recognized and rewarded, even if improvements are not fully successful.	- Leaders in your company actively support the lean initiatives, and are ensuring the success of those initiatives. - Your leadership recognizes and rewards positive actions and efforts made by groups and individuals in the lean transformation process. It is common to recognize and reward significant efforts, even if improvements are not fully successful. - Employee input is valued by senior leadership, and plays a key part in adjusting the lean implementation plan. - All personnel in your company know the company's lean strategy, and are informed about any changes to the implementation plan.	Added informational components to indicators. Two way communication is essential for continuous improvement to thrive
I.G.4	I.G.4	Capturing Lessons – Learned: Ensuring that successes lead to more successes	Capturing Lessons Learned - Ensuring that successes lead to more success, and failure is not duplicated.	Added avoidance of repeated failure.
I.G.4	Level 1	Lessons learned from improvement activities are not documented, residing only in the memories of participants.	Lessons learned from improvement activities in your company are not documented, and reside only in the memories of the participants.	"Your company" added to clarify.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.G.4	Level 2	Lessons learned in some areas are documented and maintained in paper files, design rulebooks, etc.	Lessons learned in your company are documented and maintained in paper files, design notebooks, etc., but are difficult to find and utilize.	Slight rewording, no significant change.
I.G.4	Level 3	A formal process for readily capturing and communicating lessons learned is being applied. Employee contributions are actively sought.	Your company has a formal process for capturing and communicating lessons learned. The process is used consistently, and your company's personnel actively contribute to, and learn from these lessons. Mistakes are rarely duplicated.	Added an example of benefit from learning – mistake avoidance.
I.G.4	Level 4	Lessons learned are consistently captured, communicated and regularly used in a structured manner.	Lessons learned in your company are consistently captured, communicated regularly, and used in a structured manner. A company-wide knowledge base is created. All employees routinely use the knowledge base to learn and store valuable information.	Added a "use" element to the knowledge base to ensure explicit use of such.
I.G.4	Level 5	An enterprise knowledge base is created. A formal knowledge management process is adopted. Lessons learned are routinely and explicitly incorporated into the formulation of new lean initiatives.	A formal knowledge management process is adopted by your company that is compatible with the extended enterprise. Lessons learned in your company are routinely and explicitly incorporated into the formulation of new lean initiatives. Where appropriate, these insights are shared with strategic partners.	Added additional description to illustrate intent of level.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.G.4	Lean Indicators (examples)	• "Best" practice, suggestions and lessons learned are maintained in a concise and clear standard format. • A formal process has been established throughout the enterprise for capturing and reusing lessons learned. • Lessons learned are periodically reviewed to maintain relevance of information kept.	- Your company's "best" practices, suggestions, and lessons learned are maintained in a clear/concise standard format. - A formal process has been established company-wide for capturing and reusing lessons learned. - The company's "lessons learned" are periodically reviewed and updated or eliminated to maintain the relevance of the information kept. - Everybody in your company knows how to access and use your company's knowledge base to make use of the information contained within.	Added a test that everyone in company knows how to use the knowledge base system.
I.G.5	I.G.5	Impacting Enterprise Strategic Planning - Results lead to strategic opportunities	Impacting Enterprise Strategic Planning - Results lead to strategic opportunities	No change required.
I.G.5	Level 1	Results of lean implementation are not fed back to strategic planning process.	The results of your company's lean implementation are not fed back to its strategic planning process.	Slight rewording
I.G.5	Level 2	Benefits of lean implementation are beginning to influence the strategic planning process.	The benefits of the lean implementation are beginning to influence your company's strategic planning process.	"Your company" added to identify ownership.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.G.5	Level 3	Executive management considers potential impact of performance improvement initiatives in its assessment of new business opportunities.	Your company's senior management considers the potential impact of performance improvement initiatives in its assessment of new business opportunities.	Changed to reflect typical organizational structure in small business
I.G.5	Level 4	Forecasted improvements from lean implementation are incorporated into enterprise planning and budgeting decisions.	The forecasted improvements from planned and current lean implementation projects are incorporated into your company's planning and budgeting decisions.	Slight rewording to improve sentence flow.
I.G.5	Level 5	Executive management integrates forecasted future results of lean implementation in its assessment of new business opportunities and potential market impact.	Your company's senior management integrates the forecasted future results of lean implementation in its assessment of new business opportunities and potential competitive/market impact.	Changed to reflect typical organizational structure in small business

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
I.G.5	Lean Indicators (examples)	• Business results reflect improvements resulting from lean implementation. • Strategic planning makes allowance for anticipated gains from lean improvements. • Gains realized from lean implementation are leveraged to achieve growth, profitability, market position and employment stability.	- Your company's business results reflect the improvements resulting from its lean implementation. - Your company's strategic planning makes allowances for the anticipated gains from lean improvements. - The gains realized from your company's lean implementation are leveraged to achieve growth, profitability, market position, and employment stability. - Your company's lean implementation plan has resulted in improved relations with your customers and suppliers, allowing better forecasting of future business and demand leveling.	Added indicator to reflect "future vision" of lean relationship with value chain.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II	Section Description	Section II – Life Cycle Processes. Definition: Implement lean practices across life-cycle processes for defining customer requirements, designing products and processes, managing supply chains, producing the product, distributing product and services, and providing post delivery support.	Section II: Life Cycle Processes: Life cycle processes are defined by the processes that act upon a product - from its initial conception through its operational support and ultimate disposal. The degree which your company is successful in making these processes lean is a measure of your company's efficiency. This section helps you determine whether your company is performing at the required level to: define customer requirements; develop products and processes; manage supply chains; produce and service the product; and provide post delivery support.	Additional description used to illustrate theme of section.
II.A	Subsection A description	II.A. - Business Acquisition And Program Management - To be successful in the globally competitive environment of the twenty-first century, enterprises must develop and manage partnerships with their customers and be able to dynamically re-configure and align core competencies among suppliers, the enterprise and its partners in order to deliver best life cycle value to customers.	II.A. Business Acquisition and Program Management - To be successful in a (globally) competitive environment, companies must develop and manage partnerships with their customers and be able to rapidly re-configure and align their competencies among their suppliers and partners in order to deliver the best life-cycle value to its customers.	Additional description to aid understanding

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.A	Diagnostic Questions	• Are new business opportunities arising from lean enabled capabilities being fully exploited? • Does customer feedback and usage data drive new business process development? • Are assets allocated across the value stream in a consistent and balanced manner? • Are program risks and resource requirements balanced to assure optimal flow throughout the product life cycle? • Are skills and resources drawn from across the extended enterprise to enhance program	- Are new business opportunities arising from the gains made in the lean transformation? - Does customer feedback and customer usage data drive new business process developments at your company? - Have you developed an understanding or partnership with your suppliers and customers to distribute assets throughout the extended enterprise in order to increase value at minimal cost? - Are the program risks and your company's resource requirements balanced to assure optimal product "flow" through its life cycle? - Are skills and resources drawn from across the extended enterprise to enhance program development efforts? In other words, are you free to "borrow" resources as needed from your suppliers or customers to help you with the product or process development effort? Does your company freely share its resources with its strategic partners?	Added additional question concerning strategic partnerships to help small business understand importance.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.A.1	II.A.1	Leverage Lean Capability for Business Growth -Exploiting new business opportunities arising from lean enabled capabilities	Utilize Lean Capability for Business Growth - Exploiting new business opportunities arising from the resources freed up by the lean transformation.	Reworded for easier understanding
II.A.1	Level 1	Business improvement initiatives are ad hoc and are focused on operational efficiency.	Business improvement initiatives are ad hoc and are focused on operational efficiency. Very little thought given to "system" efficiency.	Additional reference to system efficiency
II.A.1	Level 2	Improvement gains provide resources to facilitate future improvements. Potential business opportunities from applying lean thinking across core competences are recognized and plans have been developed.	Improvement gains provide resources to facilitate future improvements. Potential business opportunities from applying lean thinking across core competencies are recognized and plans have been developed to utilize them.	Reworded slightly
II.A.1	Level 3	Benefits sustained from applying lean thinking within the enterprise are used to retain current business and/or win new business.	Benefits sustained from applying lean thinking within your company are used to improve the stability of the current business and/or win new business	“enterprise” exchanged for company to reflect small business structure

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.A.1	Level 4	There is full use of the enhanced capabilities and customer knowledge throughout the enterprise to leverage opportunities for competitive advantage.	Your company knows how to measure and exploit its enhanced lean capabilities, and combines its lean resources with its customer knowledge throughout the company to leverage opportunities for competitive advantage.	Reworded to illustrate coordination of knowledge
II.A.1	Level 5	The strategic plan dynamically incorporates extended enterprise capabilities and stakeholder interests to identify and leverage opportunities.	Your company's strategic plan dynamically incorporates the capabilities of extended enterprise (supplier and customer) as well as key stakeholder interests to identify and leverage competitive opportunities.	Additional description to aid understanding
II.A.1	Lean Indicators (examples)	• Reduced cost, increased quality and faster response times from waste eliminated are used to maintain or win new business. • The ability to improve and refine processes quickly is used extensively to respond to changing customer requirements. • A process is used to scan the competitive environment to exploit opportunities arising from the enhanced capabilities of the lean enterprise.	- Reduced cost, increased quality and faster response times gained from lean efforts are used to maintain new business. - The ability to improve and refine processes quickly is used extensively to respond to changing customer requirements. - A process is used to scan the competitive environment to exploit opportunities arising from the enhanced capabilities of the lean enterprise.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.A.2	II.A.2	Optimize the Capability and Utilization of Assets (People, equipment, facilities, etc.) - Lean enables business growth through the redeployment of assets	Optimize the Capability and Utilization of Assets - Using your people, equipment, facilities, etc., to their fullest. Lean enables business growth through the redeployment of assets to value-added activities.	Reworded slightly to enhance understanding
II.A.2	Level 1	Utilization of people and material assets is optimized within functional units.	The utilization of people and material assets within your company is optimized within groups, departments, or functions, and there rarely coordination with outside groups.	Additional definition embedded in description
II.A.2	Level 2	There is evidence of ad hoc cooperation between functional units to eliminate waste and share resources.	There is evidence of ad hoc cooperation between functional units to eliminate waste and share resources.	No change required
II.A.2	Level 3	An enterprise approach provides consistent and balanced asset allocation across the value stream.	A company-wide "enterprise" approach provides a consistent and balanced asset allocation across your company's value stream, but may not include growth strategy.	Extended explanation to differentiate from next level
II.A.2	Level 4	As a result of the application of lean concepts and techniques, assets are freed up to be applied across the enterprise to support current or growth activities.	As a result of the application of lean concepts and techniques, assets are freed up to be applied across the enterprise to support current and growth activities.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.A.2	Level 5	The ability exists to easily and quickly shift or divest resources to new opportunities.	The ability exists to easily and quickly shift or divest resources to new opportunities; there is a company-wide understanding of the resource measurement and utilization policy, and the system works to provide agile resource management to the company "strategy portfolio".	Additional description to illustrate extent of lean transformation
II.A.2	Lean Indicators (examples)	• Assets freed up from lean implementation are readily redeployed. • Workforce and its knowledge are nurtured, reallocated and maintained where possible. • Available assets and resources are coordinated throughout the enterprise to leverage resources to the maximum.	- Assets freed from lean implementation are readily redeployed. - The workforce and its knowledge is nurtured, reallocated, and maintained wherever possible. - Available assets and resources are coordinated throughout the company to leverage resources to their most-value added usage.	"enterprise" exchanged for company to reflect small business structure
II.A.3	II.A.3	Provide Capability to Manage Risk, Cost, Schedule and Performance - Success follows effective risk management	Provide Capability to Manage Your Performance to Risk, Cost, and Schedule- Success requires an understanding risk while still encouraging prudent risk taking. In other words, "lean" presupposes effective risk management.	Added lean tie-in

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.A.3	Level 1	Programs are managed and staffed as independent entities.	Programs are managed and staffed as independent entities. Risk assessment is done at the local level, and usually is viewed as local impact on cost, performance or schedule.	Additional description added to facilitate understanding
II.A.3	Level 2	There is a management system to monitor and control program performance and staffing. Regular reviews focus on cost, schedule and performance of individual programs.	There is a management system to monitor and control program performance and staffing. Regular reviews focus on cost, schedule, and performance of individual programs. Information is communicated "up" the management chain.	Added communication up the chain.
II.A.3	Level 3	Program reviews assess risk within individual programs and staffing is adjusted as necessary to mitigate risk.	Program reviews within your company assess risk within individual programs and staffing is adjusted as necessary to mitigate risk. Risk information is shared to leaders throughout the company.	Additional communication element added.
II.A.3	Level 4	The programs are reviewed assessing the risk across the portfolio of programs with appropriate reallocation of resources.	The programs are reviewed assessing the risk across the portfolio of programs within the company with appropriate reallocation of resources to mitigate the cost, schedule, performance, and customer satisfaction risks associated with the "big picture" risk.	Additional description provided to facilitate understanding

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.A.3	Level 5	Risk abatement processes are used to optimize performance of the portfolio of programs.	Risk abatement processes are used to optimize performance of the portfolio of programs within your company. Everyone knows their role in the process, and the system works like it is supposed to.	Added qualification of expressed knowledge
II.A.3	Lean Indicators (examples)	• Programs and process reviews have a portfolio approach to achieve enterprise balance. • A risk management process is fully integrated across the enterprise.	- Your company's programs and process reviews have a "portfolio" approach to achieve company-wide balance or priorities and interests. - A risk management process is fully integrated across the enterprise, every knows how to use it, and does. - A formal process for measuring performance to cost, schedule, risk, and customer satisfaction exists.	Added measurement system to indicator
II.A.4	II.A.4	Allocate Resources for Program Development Efforts -Teaming for success	Allocate Resources for Program Development Efforts - Teaming with key members of your value chain for greater success.	Reworded to reflect small business structure
II.A.4	Level 1	Program development efforts rely on functional units for allocation of the required skills.	Program management efforts rely on your company's functional units for the allocation of the required skills.	Added “your company” to provide subject

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.A.4	Level 2	Some but not all skills / resources necessary are dedicated and assigned to program development. Skilled resources are narrowly guarded within programs.	Your company has begun to look beyond the functional unit to allocate resources. Some, but not all of the necessary skills are deployed across program boundaries.	Reworded slightly to improve understanding
II.A.4	Level 3	Some of the skilled resources are routinely shared across programs. Formal methods are being developed for determining team makeup and assignment of necessary skills.	Some of the skilled resources are routinely shared across your company's programs. Formal methods are being developed for determining team makeup and the assignment of necessary skills.	Added “your company” to provide subject
II.A.4	Level 4	Resources and skills are routinely balanced and shared across the portfolio of programs.	Your company's resources and skills are routinely balanced and shared across the portfolio of programs within your company. Resource sharing is part of your company's "culture".	Added “your company” to provide subject Added culture measure.
II.A.4	Level 5	“Virtual organizations” are created as needed from the extended enterprise and provided with the skills and resources necessary to execute the development effort(s).	Your company shares resources with its suppliers and customers as necessary. A strong sense of "team" with your extended enterprise partners has created "virtual" organizations as needed from the extended enterprise. This extended enterprise lowers everyone's costs by providing partners with the skills and resources necessary to execute the development effort(s).	Additional description provided to aid small business comprehension.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.A.4	Lean Indicators (examples)	• A process is defined and used to ensure that cross-disciplinary skills are represented on teams. • Resources and skills are easily and quickly shifted or divested to balance requirements across all program development efforts.	- A process is defined and used to ensure that cross-disciplinary skills are represented on teams - Resources and skills are easily and quickly shifted or divested to balance requirements across all program development efforts. - A strong sense of teamwork exists with your value chain partners, and you share resources freely, as pulled by program needs.	Added teamwork indicator
II B	Subsection B description	II.B. - Requirements Definition- Customer needs and values must be assessed continuously and translated into requirement statements that form the basis for product and process design.	II.B. Requirements Definition - Customer needs and values must be assessed continuously and translated into practical requirement statements that form the basis for your company's product and process development activities.	Added “your company” to provide subject of description

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II B	Diagnostic Questions	• Are the customer's needs continually evaluated in determining product and process requirements? • Is a data collection and customer feedback process defined and deployed? • Is product life-cycle data used in determining requirements and subsequent specifications? • Are product and process capability data matched to design criteria?	- Are the customer's needs continually evaluated in determining product and process requirements? - Does customer feedback and customer usage data drive new business process developments at your company? - Is a data collection and customer feedback process defined and deployed at your company? - Is product life cycle data used in determining requirements and subsequent specifications? - Are product and process capability data matched to design criteria?	Added capability measure alignment to design criteria.
II.B.1	II.B.1	Establish a Requirement Definition Process to Optimize Lifecycle Value - Stakeholder pull vs. technology/product push	Establish a Requirement Definition Process to Optimize Lifecycle Value - Stakeholder "pull" vs. technology or product "push"	No substantive change
II.B.1	Level 1	Requirements are defined internally based on past experience, rather than on a formal requirements definition process.	Requirements are defined internally based on past experience, rather than on a formal requirements definition process.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.B.1	Level 2	Requirements definition process, which balances cost, schedule and performance, is partially developed, deployed and documented.	A requirements definition process, which balances cost, schedule, and performance is partially developed and deployed at your company. It has been documented, and is under active review.	Added review criteria for living document.
II.B.1	Level 3	Requirements definition process leverages value chain capabilities and focuses on overall life cycle implications.	Your company has a requirements definition process that leverages value chain capabilities (i.e. intelligently capitalizes on the strengths of your company and its extended enterprise) and focuses on overall life cycle implementations.	Additional description provided to facilitate understanding
II.B.1	Level 4	An iterative requirements definition process spans the value chain resulting in a minimal set of requirements that balances cost and performance.	Your company has an iterative requirements definition process that spans the value chain, resulting in a minimal set of requirements that balances cost and performance with company and stakeholder needs.	Added "your company" to provide subject
II.B.1	Level 5	The requirements process is a strategic advantage for the extended enterprise contributing to increased responsiveness and new business opportunities.	The requirements process is a strategic advantage for your company and its extended enterprise. The use of your requirements process contributes to increased responsiveness and leads to new business opportunities.	Reworded slightly - Added "your company" to provide subject

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.B.1	Lean Indicators (examples)	• There is a process in place to determine clear and concise product and life cycle requirements, with acceptable ranges. • The process ensures a balanced representation from all disciplines across the value chain. • Structured methods are used to elicit and gather needs from the different stakeholders/customers.	- There is a process in place to determine the clear and concise product life cycle requirements, with acceptable ranges for the requirements. - The process ensures a balanced representation from all disciplines across your company and throughout the value chain - Structured methods are used by your company and its strategic partners to elicit and gather needs from different stakeholders and customers.	Slight rewording for text flow.
II.B.2	II.B.2	Utilize Data from the Extended Enterprise to Optimize Future Requirement Definitions - Closed loop processes are in place to capture operational performance data	Utilize Extended Enterprise Data to Optimize Future Requirements Definition - Closed-loop processes are in place to capture operational performance data.	No change required
II.B.2	Level 1	Warranty claims and deficiency reports represent the primary source of data that is collected and analyzed for impacts to present requirements.	Warranty claims and deficiency reports represent the primary source of data that is collected and analyzed for impact to present requirements for your company's products and processes.	Additional reference to products and processes

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.B.2	Level 2	A proactive process is being developed to collect product usage data as the basis for future requirements.	A proactive process is being developed by your company to collect product usage data as the basis for future requirements.	Added "your company" to provide subject
II.B.2	Level 3	Data are collected on usage, maintenance, disposal and future needs from across the present value chain and fed into future design solutions and requirement definitions.	Data are collected on usage, maintenance, disposal and future needs from across the present value chain and fed into future design solutions and requirement definitions.	No change required
II.B.2	Level 4	Process allows real-time access, collection and dissemination of data from across the extended enterprise for analysis by stakeholders for future use.	Your company's requirements definition process allows real time access, collection and dissemination of data from across the extended enterprise for analysis by stakeholders for future use.	Added "your company" to provide subject
II.B.2	Level 5	The process is established across the extended enterprise to actively seek data on needs, usage and process capability to populate a data repository that can be mined for future requirements.	The requirements definition process is established across your company's extended enterprise to actively seek data on needs, usage, and process capability. The data populate a data repository that can be mined for future requirements.	Rephrased to enhance small business comprehension.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.B.2	Lean Indicators (examples)	• Customer feedback is actively sought and provided as input to the requirements definition process. • A database of usage, maintenance and disposal data is maintained and extensively used to establish future requirements definitions. • Enhanced knowledge of customer and stakeholder requirements and desires is used to leverage future requirements.	- Customer feedback is actively sought and provided as input to the requirements definition process. - A database of usage, maintenance, and disposal data is maintained and extensively used to establish future requirements definitions. - Enhanced knowledge of customer and stakeholder requirements and desires is used to leverage future requirements.	Slight rewording
II.C	Subsection C description	II.C. Develop Product and Process - Product and process design decisions must be based upon value quantifications and tradeoffs that incorporate inputs from affected stakeholders.	II.C. Develop Product and Process - Product and Process design decisions must be based upon value quantification and tradeoffs that incorporate inputs from the affected stakeholders.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.C	Diagnostic Questions	• Is the product development process formalized and understood? • Are customers and other lifecycle stakeholders regularly involved in product and process development? • Are downstream stakeholder issues in design and development considered and incorporated as early as possible in the process? • Have most of the unnecessary iterations in the development cycle been removed? • Has the development cycle been simplified and aligned to the critical path? • Are products and processes being developed concurrently?	- Is the product development process formalized and understood? - Are customers and other life cycle stakeholders regularly involved in product and process development? - Are downstream stakeholder issues in design and development considered and incorporated as early as possible in the process? - Have most of the unnecessary iterations in the development cycle been removed? - Are products and processes being developed concurrently? Do they align with your company's strategic lean initiatives?	Modest changes only,
II.C.1	II.C.1	Incorporate Customer Value into Design of Products and Processes - Understanding customer value allows continuous improvement of product and process	Incorporate Customer Value in the Design of Products and Processes - Understanding customer value allows continuous improvement of both products and processes	Slight rewording to remove slash "/"

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.C.1	Level 1	Customer inputs are captured only at the beginning of the development.	In your company, customer inputs are captured only at the beginning of the development	Added "your company" to provide subject
II.C.1	Level 2	Customer inputs are considered qualitatively through top-level liaison and occasional reviews.	Customer inputs are considered quantitatively in your company through top-level customer liaison and occasional customer reviews.	Added "your company" to provide subject
II.C.1	Level 3	The customer(s) are formally represented on Integrated Product Teams (IPT) and feedback mechanisms exist to facilitate timely design iterations.	The customer's) are formally represented on your company's integrated product development teams (IPT). Feedback mechanisms exist in the product development process to understand and minimize design iterations.	Reworded to enhance understanding
II.C.1	Level 4	The customer(s) are actively involved with the IPT at multiple levels to jointly improve the effectiveness and quality of the product and process design.	The customer's) are actively involved with the IPT at multiple levels, and jointly improve the effectiveness and quality of the products and processes designed in your company.	Added reference to company

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.C.1	Level 5	The customer(s) are routinely involved with IPT with effective, continuous communication. Sharing of benefits is well established; value quantification and tradeoffs are a continuous and automatic part of the process.	The customer(s) are routinely involved with IPT and are valued team members. Sharing of benefits is well-established; value quantification and sharing as well as requirement tradeoffs are a continuous and automatic part of the process.	Added additional appreciation of customer involvement
II.C.1	Lean Indicators (examples)	• Customer inputs are sought and used actively throughout the development process. • Designs satisfy customer value requirements, without unnecessary functionality.	- Customer inputs are sought and used actively throughout the development process. - Designs satisfy customer value requirements, without unnecessary functionality - A "teaming" sense exists with your customer to better define and refine requirements during the product development process, costs are shared by the team as emergent properties develop.	Added teaming indicator.
II.C.2	II.C.2	Incorporate Downstream Stakeholder Values (Manufacturing, Support, etc.) into Products and Processes - Understanding downstream stakeholders allows value to flow seamlessly to customer	Incorporate "Downstream" Values into Product and Process Design - Understanding downstream stakeholders (manufacturing, support, etc.) allows value to flow seamlessly to the customer.	Slight rewording

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.C.2	Level 1	Manufacturing issues are considered late in design.	Manufacturing issues are considered late in the product development process. This often results in producibility problems or unnecessary production costs.	Additional description provided to clarify point
II.C.2	Level 2	Manufacturing and assembly issues are considered earlier in projects, but in an ad hoc manner. Supplier and cost considerations are limited.	Manufacturing and assembly issues are considered early in the projects, but in an ad hoc manner. Supplier and cost considerations are limited.	No change required
II.C.2	Level 3	Multi-functional teams include some downstream disciplines and key suppliers.	Multi-functional teams include some downstream disciplines as well as your company's key suppliers.	Added "your company" to provide subject
II.C.2	Level 4	Priorities of downstream stakeholders are quantified as early as possible in design, and used for process evaluation and improvement.	Priorities of downstream stakeholders are quantified as early as possible in design, and used for process evaluation and improvement.	Slight rewording
II.C.2	Level 5	Downstream stakeholders' values in the extended enterprise are quantified, and balanced via tradeoffs, as a continuous part of the process.	Downstream stakeholder's values in the extended enterprise are quantified, and balanced via tradeoffs, and are a continuous part of the product development process.	Added reference to product development process

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.C.2	Lean Indicators (examples)	• There is early consideration and incorporation of downstream stakeholders issues throughout design development. • The scope of considerations integrated into designs has been extended to include manufacturing, assembly, serviceability and cost implications. • Products are easier to produce and have lower life-cycle costs.	- There is early consideration and incorporation of downstream stakeholders issues throughout the design development. - The scope of considerations integrated into designs has been extended to include manufacturing, assembly, test, serviceability, and cost implications. - Products are easier to produce and have lower life cycle costs as a result of "downstream value" consideration.	Slight modification to improve small business understanding
II.C.3	II.C.3	Integrate Product and Process Development - Breaking down of functional silos enables seamless communication and value flow	Integrate Product and Process Development - Breaking down functional groups ("silos") enables communication and value flow within your company and along the value chain.	Additional description of value chain
II.C.3	Level 1	Development is performed in functional organizations.	Development is performed in functional organizations, and is not integrated in cross-functional teams.	Additional illustration of point
II.C.3	Level 2	Multidisciplinary development is used to a limited extent.	Multidisciplinary development or IPTs are used to a limited extent.	Added IPT

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.C.3	Level 3	Multidisciplinary development is used extensively; metrics are established for process evaluation.	Multidisciplinary development is used extensively; metrics are established for process evaluation.	No change required
II.C.3	Level 4	Multidisciplinary techniques are deployed for most programs/product development efforts; metrics are used for process evaluation and improvement.	Multidisciplinary techniques are deployed for most programs and product development efforts, metrics are used for process evaluation and improvements.	No change required
II.C.3	Level 5	Product and process definition is seamlessly integrated both internally and with the upstream and downstream stakeholders.	Product and process definition is seamlessly integrated both internally and with upstream and downstream stakeholders.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.C.3	Lean Indicators (examples)	• Resources and skills are balanced across projects and programs, to aid maximum re-use and sharing of knowledge. • Suitability and timing of design information released, is matched to the requirements of subsequent processes.	- Resources and skills are balance across projects and programs. There is extensive sharing and re-use of knowledge. - Suitability and timing of design information is released, and is matched to the requirements of subsequent processes. - A general understanding of diversity exists within your company. That diversity is treasured, and forms the basis for rich multidisciplinary team constitution. Divergent thinking is encouraged, and often leads to creative results.	Added diversity appreciation as an indication of lean
II.D	Subsection D description	II.D. - Manage Supply Chain - Internal enterprise core competencies are aligned with those of suppliers such that the customer value chain is optimized throughout the extended enterprise.	II.D. Manage Supply Chain - Internal Company skills (core competencies) are aligned with those of suppliers such that the customer value chain is optimized throughout the extended enterprise.	Reworded to better suit small business vernacular

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.D	Diagnostic Questions	• Have the number of suppliers been reduced to a level that can be effectively managed? • Do contractual arrangements enable supplier flexibility and adaptation to both expected and unexpected changes? • Are in-house capabilities balanced with supplier capabilities to optimize network-wide performance? • Have opportunities for supply chain development been fully exploited? • Are constraints and bottlenecks throughout the extended enterprise identified and rapidly resolved to ensure continuous flow? • Are supplier partnerships and strategic alliances established to strengthen dynamic competitive advantage?	- Have the number of suppliers been reduced to a level that can be effectively managed? - Do contractual requirements enable supplier flexibility and adoption to both expected and emergent changes? - Have the bottlenecks and constraints throughout the extended enterprise been identified? Do you know what they are? - Are supplier partnerships and strategic alliances established to strengthen the competitive advantage? Are both members of the team strengthened as a result of the alliance? - Are in-house capabilities balanced with supplier capabilities? Is there overlap? Can it be eliminated?	Reworded slightly to tailor for small business understanding
II.D.1	II.D.1	Define and Develop Supplier Network - Core competencies aligned across supplier network	Defined and Develop Supplier Network - Skills, capabilities and core competencies are aligned across the supplier network	Defined core in context of description

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.D.1	Level 1	Large number of direct suppliers in a hierarchical structure. There is little evidence of a defined supplier strategy and limited knowledge of the relationships within the supplier network.	Your company uses a large number of direct suppliers. There is little evidence of a defined supplier strategy and limited knowledge of the relationships within the supplier network	Slight rewording
II.D.1	Level 2	The supplier base has been rationalized to focus on key suppliers with high impact on strategic objectives.	Your company has reduced/minimized the number of key suppliers it interacts with. The supplier base has been rationalized to focus on key suppliers with high impact on strategic objectives.	Added reduction in number of key suppliers
II.D.1	Level 3	Supplier network is defined based on strategic analysis of value creation processes internally and across suppliers.	Your company's supplier network is established, based on a strategic analysis of the value creation process. The analysis includes both internal company value creation, as well as value creation from various suppliers.	Added description of supply chain in context of level
II.D.1	Level 4	Strategic outsourcing and make-buy decisions focus on achieving an optimal combination of core competencies both within the enterprise and across the supplier network.	Strategic outsourcing and make-buy decisions focus on achieving an optimal combination of core competencies both within the company and across the supplier network.	Replaced “enterprise” with “company”

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.D.1	Level 5	Supplier network is defined, developed and integrated to ensure efficient creation of value for enterprise stakeholders over the entire product lifecycle.	Your company's supplier network is defined, developed, and integrated to ensure efficient creation of value for enterprise stakeholders over the entire product life cycle.	Replaced "enterprise" with "company"
II.D.1	Lean Indicators (examples)	• The supplier network is defined and developed in line with the strategic plan to ensure efficient creation of value for all enterprise stakeholders. • Supplier expertise and capabilities complement enterprise core competencies; unnecessary overlap and duplication has been removed. • Supplier network is flexible and can quickly adapt to changing requirements and unanticipated disruptions.	- The supplier network is defined and developed concurrent with the strategic plan, and ensures the efficient creation of value for all enterprise stakeholders - Your supplier's expertise and capabilities compliment your company's needs for skills and capabilities; unnecessary overlap and duplication has been removed. - Your company's supplier network is flexible, and can quickly adapt to changing requirements and unanticipated disruptions.	Slight rewording to improve clarity
II.D.2	I.D.2	Optimize Network-Wide Performance - Partnering with key suppliers and optimizing processes to achieve customer value	Optimize Network-Wide Performance - Partnering with key suppliers and optimizing processes to achieve customer value.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.D.2	Level 1	Supplier relationships are at arm's length and adversarial. Purchasing department manages a large number of short-term, lowest-bid contracts.	Supplier relationships are at "arm's length" and somewhat adversarial. Your Purchasing department manages a large number of short-term, lowest -bid contracts	Slight modification to improve understanding
II.D.2	Level 2	Formal processes are in place for supplier assessment and approval. Long-term purchase agreements focus on cost reduction. Limited visibility into supplier business processes.	Your company uses formal processes for supplier assessment and approval. Your company has established long-term purchase agreements with key suppliers that focus on cost reduction. Still, there is limited visibility into your supplier's business processes.	Added limitation to help differentiate next level
II.D.2	Level 3	Common objectives, roles and responsibilities are established and communicated, with a few supplier partnerships or strategic alliances in place. Early involvement of key suppliers in design and development.	Your company has met with its key suppliers and mapped out common objectives, roles and responsibilities. These are established and communicated, and a few strategic alliances are in place. There is early involvement of key suppliers in your design and development decisions.	Additional reference to mapping

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.D.2	Level 4	Strategic alliances with key suppliers emphasize a high degree of information- sharing, risk-sharing & benefit sharing. For others a differentiated set of strategies and practices are in place. Production and delivery are synchronized across the supplier network.	Your company's strategic alliances with its key suppliers emphasize a high degree of information sharing, risk sharing, and benefit sharing. Both your company's and your suppliers' production and delivery schedules are synchronized across the supplier network.	Slight rewording
II.D.2	Level 5	Supplier capabilities are dynamically optimized to ensure efficient value creation and building durable competitive advantage, creating flexibility and responsiveness to shifts in the marketplace.	Supplier capabilities are dynamically optimized to ensure efficient value creation and building durable competitive advantage, creating flexibility and responsiveness to shifts in the marketplace.	No significant change
II.D.2	Lean Indicators (examples)	• Formal processes are in place for supplier assessment and approval. • Roles and responsibilities are clearly defined in contractual relationships, and risk and reward shares agreed upon. • Production and delivery are synchronized throughout the supplier base to ensure continuous flow, with minimal waste.	- Formal processes are in place for supplier assessment and approval - Roles and responsibilities are clearly defined in contractual relationships, and risk and reward shares are agreed upon. - Production and delivery are synchronized throughout the supplier base to ensure continuous flow and minimal waste.	No significant change.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.D.3	II.D.3	Foster Innovation and Knowledge-Sharing Throughout the Supplier Network - Incentivizing innovation & technology transfer	Foster Innovation and Knowledge-Sharing Throughout the Supplier Network - Incentivizing innovation and technology transfer.	No change required
II.D.3	Level 1	Primary focus on internal capabilities, with little cognizance of tacit (experience-based) or explicit (formal) knowledge across suppliers.	Your company is primarily focused on internal capabilities, with little cognizance of tacit (experience based) or explicit (formal) knowledge sharing across suppliers	Added "your company" to focus attention
II.D.3	Level 2	Internal organizational structures and processes are established to leverage supplier-based knowledge and innovation.	Your company has adopted some internal processes to leverage supplier-based knowledge and innovation.	Added "your company" to focus attention
II.D.3	Level 3	Technology roadmaps include suppliers in pursuance of common strategic vision. Shared metrics for continuous improvement are utilized.	Your company involves key suppliers to develop technology roadmaps in pursuance of a common strategic vision. Your company shares metrics for continuous improvements with those key suppliers	Added "your company" to focus attention
II.D.3	Level 4	Knowledge transfer mechanism is created for open and rapid access throughout the supplier network.	A knowledge transfer mechanism is created for open and rapid access throughout the supplier network.	Slight rewording for clarity (added pronoun).

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.D.3	Level 5	Mutually-beneficial arrangements are established to foster innovation across suppliers. A process for on-going communication of needed changes in vision, strategy, metrics and implementation is in place.	A mutually-beneficial arrangement has been established in your company to foster innovation across suppliers. A process for on-going communication of vision, strategy, metrics and knowledge implementation is in place.	Added pronoun. Added "your company" to focus attention
II.D.3	Lean Indicators (examples)	• Long-term collaborative relationships are established and maintained where possible. • Processes to facilitate sharing and transfer of innovation, knowledge and technology are deployed. • A mutually beneficial continuous improvement process is established throughout the supplier network over the entire product lifecycle.	- Long-term collaborative relationships are established and maintained where possible - Processes to facilitate sharing and transfer for innovation, knowledge and technology are deployed. - A mutually beneficial continuous improvement process is established throughout the supplier network over the entire product life cycle.	No change required
II E	Subsection E description	II.E. - Produce Product - The production system must be designed and managed according to the principles and practices of the lean production paradigm.	II.E. Produce Product - The production system must be designed and managed according to lean principles and practices.	Removed reference to paradigm.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II E	Diagnostic Questions	• Is production knowledge and capability regarded as a strategic competitive advantage? • Has enterprise strategy been aligned with manufacturing capability? • Are products pulled in accordance with customer demand in real-time? • Have the production processes been ordered and adapted for flow? • Are inventories maintained at minimal levels throughout the production process?	- Has enterprise strategy been aligned with manufacturing capability? - Is production knowledge and capability regarded as a strategic competitive advantage? - Are products "pulled" by actual customer demand, in real time? - Has the production process been ordered and adapted for flow? - Have the process bottlenecks been identified? - Are inventories maintained at minimal levels throughout the production process?	Slight rewording to reflect emphasis on lean vernacular.
II.E.1	II.E.1	Utilize Production Knowledge and Capabilities for Competitive Advantage - Strategic leveraging of manufacturing capability	Utilize Production Knowledge and capabilities for Competitive Advantage - Strategic leveraging of manufacturing capability	No change required
II.E.1	Level 1	Production capability is not understood outside the manufacturing organization.	Production capability is not understood outside the manufacturing organization.	No change required
II.E.1	Level 2	Production knowledge and capabilities are captured and used to influence manufacturing strategy including make/buy decisions.	Production knowledge and capabilities are captured and used to influence manufacturing strategy, including make/buy decisions.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.E.1	Level 3	Production capabilities are understood and utilized across the enterprise. Enterprise strategy and manufacturing capabilities are aligned.	Production capabilities are understood and utilized across the company. Company strategy and manufacturing capabilities are aligned.	"enterprise" replaced with "company" to reflect small business structure
II.E.1	Level 4	Manufacturing system design is integrated with strategic make/buy decisions across the enterprise and aligned with enterprise strategy to create competitive advantage.	Manufacturing system design is integrated with strategic make/buy decisions across the company and is aligned with the company strategy to create competitive advantage.	Slight modification only
II.E.1	Level 5	Production knowledge is leveraged across the extended enterprise to generate strategic opportunities for value creation.	Production knowledge is leveraged across the extended enterprise to generate strategic opportunities of value creation	No change required
II.E.1	Lean Indicators (examples)	• Production capability constitutes a major consideration in enterprise level long-range, strategic planning. • Knowledge of production capabilities are maintained and shared throughout the extended enterprise.	- Production capability constitutes a major consideration in enterprise-level long range strategic planning. - Knowledge of production capabilities are maintained and shared throughout the extended enterprise.	No change required
II.E.2	II.E.2	Establish and Maintain a Lean Production System - Defect free production pulled by the customer	Establish and Maintain a Lean Production System - Defect-free production pulled by the customer.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.E.2	Level 1	Production system operates on a batch and queue schedule with high in-process inventory, with quality based on inspection rather than prevention.	Your company's production system operates on a batch and queue schedule with high in-process inventory, with quality based on inspection rather than prevention.	Added “your company” to focus attention
II.E.2	Level 2	Production system operates with a batch and queue schedule with limited cellular or in-line layouts to improve flow.	Your production system operates with a batch and queue schedule with limited cellular or in-line layouts to improve flow.	Added “your” to focus attention
II.E.2	Level 3	Product flow paths are identified and key elements of the layout have been reordered enhancing flow and reducing in-process inventory, with some suppliers delivering to point of use where appropriate.	Product flow paths are identified and key elements of the production process layout have been reordered, enhancing flow and reducing in-process inventory, with some suppliers delivering to point-of-use where appropriate.	No substantive change
II.E.2	Level 4	Selected products are produced using a flow system pulled directly by customer demand (take time), which includes key suppliers.	Selected products within your company are produced using a "flow" system, pulled directly by a customer demand (takt time). Your key suppliers understand the takt time, and deliver materials to you just in time for production.	Added upstream supplier focus

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.E.2	Level 5	Work is segmented and organized along the value stream flows to achieve defect free production upon demand through the implementation of pull from customer through material suppliers.	Work is segmented and organized along the value stream flows to achieve defect-free production upon demand through the implementation of pull form customer, through your key suppliers.	Slight rewording to reflect small business vernacular
II.E.2	Lean Indicators (examples)	• Conversion to lean has freed up floor space, equipment, human resources and capital for re-deployment. • Inventory levels have been reduced in line with gains made to process stability and variation reductions. • Work is performed only when "pulled" from subsequent "customers" in the value chain.	- Your company's conversion to lean has freed up shop floor space, equipment, human resources, and capital for re-deployment - Your stock and inventory levels have been reduced in parallel with gains in your process stability and quality. - Production work is performed only when "pulled" from subsequent "customers" in the value chain.	Minor rewording only.
II.E.3	II.E.3	NA	Production Constraints Identification - The limitations to the production process play a key role in the identification of future improvements	Added new subsection to reflect understanding of constraints
II.E.3	Level 1	NA	Bottlenecks appear "randomly" in your production process, and significant resources are wasted waiting for work to finish "downstream" in the process.	Failure to understand constraints appears like random failure

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.E.3	Level 2	NA	Some formal identification has been made for process bottlenecks, but no safety stock process exists to manage flow.	Safety stock WIP only in front of constraint.
II.E.3	Level 3	NA	Process bottlenecks have been identified, and appropriate safety stocks have been assigned to fully utilize bottlenecks. Large inventories of parts are still used, and Quality assurance is usually left to the "end" of the production process.	Some understanding, more needed
II.E.3	Level 4	NA	All process improvement decisions are viewed in context with the process bottlenecks. Process improvement resources being allocated to lower inventory and improve flow.	Expanding to enterprise
II.E.3	Level 5	NA	The understanding of constraints in the production process has been expanded to include suppliers and customers, a formal process for identification and elimination of SYSTEM bottlenecks exists, and is being used.	Extended enterprise use of constraint management

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.E.3	Lean Indicators (examples)	NA	- With the exception of safety stocks at the bottleneck, work-in-process inventory (WIP) is drastically reduced. - Working on freeing up the constraint is the single biggest driver in new process improvement projects within your company. - A measurement system exists in your company to adequately capture the costs associated with WIP.	Examples of lean use of constraint management
II F	Subsection F description	11.F. - Distribute And Service Product - On-time deliveries of defect free products are complemented by superior post delivery service, support and sustainability.	II.F. Distribute and Service Product - On-time deliveries of defect-free products are complemented by superior post-delivery service, support, sustainability and customer association.	Slight rewording for flow.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II F	Diagnostic Questions	• Are production schedules and capacity considered prior to making a sales/contract commitment? • Are product delivery data flowed throughout the value chain? • Does the organization satisfy customer maintenance requirements effectively? • Are in-service usage data deployed to appropriate personnel? • Are customer rejects/returns treated as opportunities?	- In your company, are production schedules and capacity considered prior to making a sales/contract commitment? - Are product delivery data flowed throughout the value chain? - Does your company satisfy its customer maintenance requirements? Are customer rejects/returns treated as opportunities for learning? - Has the production process been sequenced and adapted for flow? - Are in-service usage data deployed to appropriate personnel in your company?	Qualitative look at effectiveness added to bring "bottom line" perspective small business wants.
II.F.1	II.F.1	Align Sales and Marketing to Production - Matching demand and capabilities	Align Sales and Marketing Production - Matching demand and capabilities	No change required
II.F.1	Level 1	Marketing pushes product sales/bids with little consideration of current production capacity.	In your company, marketing pushes product sales and bids on to production with little consideration of the current production capacity.	Added "your company" to focus attention

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.F.1	Level 2	Marketing provides production with partial visibility to current and future potential order base. Order base not aligned to production capacity.	Marketing provides production with some, but limited, visibility to current and future potential order base. However, the order base not purposefully aligned to the production capacity.	Slight rewording for sentence flow
II.F.1	Level 3	Products are supplied in smaller more frequent batches, balancing orders to current production capacity. Most running orders are fully visible to production.	Products are supplied in smaller, more frequent batches, balancing orders to current production capacity. Most running orders are fully visible to production.	No change needed
II.F.1	Level 4	Matching real-time customer demand and delivery requirements with production capabilities, using extensive knowledge base of customer preferences.	Your company matches real-time customer demand and delivery requirements with its production capabilities. Your company has an extensive knowledge base of customer preferences, and uses it to help provide production visibility.	Added "your company" to focus attention
II.F.1	Level 5	Actual and future prospective orders are matched in real-time with production capabilities throughout the extended enterprise.	Actual and future prospective orders are matched in real-time with production capabilities throughout the extended enterprise, including your suppliers and customers.	Additional description of supply chain for clarity.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.F.1	Lean Indicators (examples)	• Sales / bids are aligned to current and future production capacity and capabilities. • There is constant feedback and input between sales/marketing and production elements across the enterprise. • Sales / bids commit product delivery to real-time customer demand, without the use of buffer stocks.	- Sales or Bids are aligned to your current and future production capacity and capabilities. - There is a constant feedback and input between sales / marketing and the production elements of your company. - Sales and bids commit product delivery to real-time customer demand, without the use of "buffer" stocks of inventory buildup.	Added "your" to focus attention
II.F.2	II.F.2	Distribute Product in Lean Fashion - - Right product, right quantity at the right time	Distribute Product in a Lean Fashion - the right product, produced in the right quantity, delivered at the right time.	Added delivery criteria.
II.F.2	Level 1	Distribute from inventories by batch; customer inspects products upon receipt.	Your company distributes form inventories by batch; the customer inspects the products upon receiving the shipment.	Added "your company" to focus attention
II.F.2	Level 2	Distribute in smaller batch sizes more frequently in line with increased reliability. There are programs in place to reduce customer receipt inspection.	Your company distributes in smaller batch sizes, more frequently, in line with increased reliability (compared to pre-lean transformation). Your company has programs in place to reduce customer receiving inspection.	Added "your company" to focus attention

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.F.2	Level 3	Product distribution from low stock levels is triggered by an internal pull system; some products are delivered directly to point of use with limited inspection.	A pull system signals that stock is pulled directly from the production line, of from low-stock levels; some products are delivered directly to point of use with limited inspection.	Reworded to enhance small business comprehension
II.F.2	Level 4	Defect free items are produced and delivered without receipt inspection to real-time customer usage; customers are given access to databases for order status visibility.	Defect-free items are produced and delivered without receiving inspection to real-time customer usage; your company's customers are given access to databases for order status visibility.	Added “your company” to focus attention
II.F.2	Level 5	Defect free distribution on demand is achieved via the implementation of customer pull from end customer through material suppliers.	Defect-free distribution on demand is achieved via the implementation of customer pull from the "end customer" through the entire extended enterprise (including raw material suppliers).	Additional clarification of extended enterprise

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.F.2	Lean Indicators (examples)	• Point of use delivery to customers with minimal receipt inspection has become standard practice. • Deliveries are synchronized to minimize goods in transit and transportation requirements. • Delivery cycle is shorter and more reliable.	- Point of use delivery to customers with minimal receipt inspection has become standard practice in your company. - Your deliveries are synchronized to minimize goods in transit and transportation requirements. - Your company's delivery cycle is shorter and more reliable, compared to its prior (pre-lean) system.	Added "your" to focus attention
II.F.3	II.F.3	Enhance Value of Delivered Products and Services to Customers and the Enterprise - Responding to the voice of the customer	Enhance Value of Delivered Products and Services to Customers and the Enterprise - Responding to the voice of the customer.	No change required
II.F.3	Level 1	Product support system reacts to customer needs, usually on-time and from inventory.	Your company's product support system reacts to customer needs, usually on-time and from inventory.	Added "your company" to focus attention
II.F.3	Level 2	Support system delivers products / services on time, but with disruptions to production flow and associated resources.	Your company's support system delivers products and services on time, but with disruptions to production flow and associated resources.	Added "your company" to focus attention

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.F.3	Level 3	Support system flow paths are identified and are beginning to be integrated with lean product development and production flows.	Your company's support system flow paths are identified, and are starting to be integrated with lean product development and production flows.	Slight restructure, added "your company" to focus attention
II.F.3	Level 4	Standardized customer and product support processes provide responsive information and product flow fully integrated with development and production flows.	Your company has standardized customer and product support processes, which provides responsive information and product flow that is fully integrated with the development of production flows.	Added "your company" to focus attention
II.F.3	Level 5	Customer needs for post-delivery products / services are anticipated in enterprise plans and fulfilled by adaptation and extension of capabilities already provided.	Customer needs for post-delivery products and services are anticipated in enterprise plans and fulfilled by adoption and extension of capabilities already provided.	Reworded slightly

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.F.3	Lean Indicators (examples)	• Solutions to product / service issues are coordinated throughout the extended enterprise to find fast, cost effective solutions. • Customer and product support processes have been standardized and are regularly reviewed against customer feedback. • Disruptions to design and production flow from support services has been minimized.	- Solutions to product and service issues are coordinated throughout your company and value chain to find fast, cost effective solutions. - Your customer and product support processes have been standardized and are regularly reviewed against customer feedback. - Disruptions to your design and production flows from support services have been minimized.	Added "your" to focus attention and specify subject of example.
II.F.4	II.F.4	Provide Post Delivery Service, Support and Sustainability - Providing customer solutions	Provide Post Delivery Service, Support and Sustainability - Providing customer solutions.	No change required
II.F.4	Level 1	High level of spares necessary because of unknown failure rates and long lead times for spare replenishment.	A high level of spares is necessary because of unknown failure rates and long lead times for spare replenishment.	No change required
II.F.4	Level 2	Collection of data on failure trends permits both determination of service interval points for preventative maintenance and a reduction of spare part levels.	Your company has begun to collect data on failure trends, which permits both the determination of service interval points in preventative maintenance as well as a reduction of spare part levels.	Added "your company" to focus attention

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
II.F.4	Level 3	The enterprise is increasingly involved in addressing customer maintenance solutions. Spare levels are reduced through common platforms; root cause analyses are fed back into product design.	The company as a whole is increasingly involved in addressing customer maintenance solutions. Spare levels are reduced through common platforms; root cause analyses are fed back into your product design process.	Replaced "enterprise" with "company" to reflect small business structure
II.F.4	Level 4	The enterprise is part of the customer's maintenance solution by ensuring availability through replacement of critical components before failure.	The enterprise is part of the customer's maintenance solution by ensuring availability through replacement of critical components before failure.	No change required
II.F.4	Level 5	The enterprise has become part of customer's business solution via warranting of product performance.	The enterprise has become part of the customer's business solution via warranting of product performance.	No change required.
II.F.4	Lean Indicators (examples)	• Customer feedback is proactively maintained and used to predict any emerging service issues and enhance future designs. • Spares levels are reduced in line with short predicable lead times for replacement spares.	- Customer feedback is proactively maintained and used to predict emerging service issues and enhance future designs. - Spares levels are reduced in-line with short predictable lead times for replacement spares.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
III	Section Description	Section III - Enabling Infrastructure - Definition: To achieve a successful lean transformation, the enterprise infrastructure must support the implementation of lean principles, practices and behavior.	Section III: Enabling Infrastructure: To achieve a successful lean transformation, the enterprise infrastructure must support the implementation of lean principles, practices and behavior.	No change required
III.A	Subsection A description	III. A. - Lean Organizational Enablers - The support units of an enterprise must themselves become lean in executing their assigned function, but they must also redefine what they do such that they support lean implementation within the life cycle processes and the lean transformation/leadership processes.	III.A. Lean Organizational Enablers- The support units of an enterprise must themselves become lean in executing their assigned function, but they must also redefine what they do such that they support lean implementation within the life cycle processes and the lean transformation and the leadership process.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
III.A	Diagnostic Questions	• Do the finance and accounting measures support the implementation of lean? • How well have the financial and accounting systems been integrated with non-financial measures of value creation? • Can stakeholders retrieve financial information as required? • Are human resource practices reviewed to assure that intellectual capital matches process needs? • Are the information technology systems compatible with stakeholder communications and analysis needs? • Do processes create the least amount of environmental hazards practical?	- Do the finance and accounting measures used by your company support the implementation of lean? - How well have the financial and accounting systems been integrated with the non-financial measures of value creation? - Can stakeholders retrieve financial information as required? - Are human resource practices reviewed to assure that the intellectual capital matches the process needs? - Are the information technology systems compatible with your suppliers and customers?	Removed hazard question. Its inclusion was confusing.
III.A.1	III.A.1	Financial System Supports Lean Transformation - Lean requires appropriate financial data	Financial System Supports Lean Transformation - Lean requires appropriate financial data	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
III.A.1	Level 1	Finance system provides basic balance sheet and cost accounting data; there is little awareness and exploration of broader support roles for finance.	Your company's financial system provides basic balance sheet and cost accounting data; there is little awareness and exploration of broader support roles for finance data.	Added "your company" to focus attention
III.A.1	Level 2	Initial efforts are underway to adapt or modify systems to compensate for the inadequacies of the formal financial system.	Initial efforts are underway to adapt or modify financial systems to compensate for the inadequacies of the formal cost-accounting system.	No change required
III.A.1	Level 3	Finance system is overhauled to provide data and financial information to support and enable a lean transformation at any level.	Your company's finance system is overhauled to provide data and financial information to support and enable a lean transformation at any level.	Added "your company" to focus attention
III.A.1	Level 4	Financial system scope is expanded to integrate with non-traditional measures of value creation (e.g., intellectual capital, balanced scorecard, etc.).	Your company's financial system's scope is expanded to integrate with non-traditional measures of value creation (i.e. intellectual capital, balanced scorecard, throughput accounting, etc.)	Added "your company" to focus attention
III.A.1	Level 5	Financial systems provide seamless information exchange across the extended enterprise, with emphasis on value creation for all stakeholders.	Your financial systems provide seamless information exchange across the extended enterprise, with some direct measure on value creation for all stakeholders.	Added "your" to focus attention

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
III.A.1	Lean Indicators (examples)	• Financial measures that conflict with lean activity are no longer used to measure progress and performance. • The financial system handles a balanced set of financial and non-financial measures to assist decision-making. • The financial system has been overhauled to ensure fast and efficient processing of information as required.	- Financial measures that conflict with lean activity are no longer used as the sole measure of lean progress and lean performance. - The financial system handles a balanced set of financial and non-financial measures to assist managerial decision making. - The financial system has been overhauled to ensure fast and efficient processing of information as required.	No change required
III.A.2	III.A.2	Enterprise Stakeholders Pull Required Financial Information - -Data on demand	Enterprise Stakeholders Pull Required Financial Information - Data on Demand	No change required
III.A.2	Level 1	Lagging financial information is reported through regularly scheduled standardized reports. Specific requests for measures require extraordinary effort.	Your company's financial information gives you a snapshot of past performance and is reported through regularly scheduled standardized reports. Specific requests for measures require extraordinary efforts.	Rephrased sentence for clarity
III.A.2	Level 2	Finance actively provides traditional financial information to assist users in planning and programming activities.	Your company's finance actively provides traditional financial information in real-time to assist users in planning and programming activities.	Added “your company” to focus attention

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
III.A.2	Level 3	Users are able to directly access and use financial information to make tradeoff decisions.	Users are able to directly access and use financial information to make trade-off decisions.	No change required
III.A.2	Level 4	Users are able to pull financial and other value creation information to support decision analysis in the format desired.	Users are able to pull financial and other value creation information to support decision analysis in the format desired	No change required
III.A.2	Level 5	Users across the extended enterprise generate and share timely financial and performance data. Data reflects extended enterprise results.	Users across the extended enterprise generate and share timely financial and performance data. You have access to pertinent supply chain partner's information, they have access to yours, and it is shared (as needed) in real time.	Additional description in text to illustrate level.
III.A.2	Lean Indicators (examples)	• Financial and performance measurement data can be accessed as needed in user-defined format. • Financial information can be extrapolated to forecast outcomes. • System provides up to date information on request and rationalizes information no longer used.	- Financial and performance measurement data can be accessed and used as needed in user-defined format. - Financial information can be extrapolated to forecast outcomes. - System provides up-to-date information on-demand and rationalizes information no longer used.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
III.A.3	III.A.3	Promulgate the Learning Organization - Learning Organizations create a flexible workforce	Promulgate the Learning Organization - Learning organizations create a flexible workforce	No change required
III.A.3	Level 1	The human resources processes concentrate on recruiting, placement and benefits. Personnel training is ad hoc and not aligned to organizational needs.	The human resources processes concentrate on recruiting, placement, and benefits. Personnel training is ad hoc, and is not aligned to organizational needs.	No change required
III.A.3	Level 2	A well-defined personnel development process, aligned with organizational needs, is applied for selected employees.	A well-defined personnel development process, aligned with organizational needs, is applied for selected employees.	No change required
III.A.3	Level 3	Personnel development process is extended to all employees and incorporates the anticipated future needs of the lean enterprise. Resources and facilities are dedicated for learning.	Personnel development process is extended to all employees and incorporates the anticipated future needs of the lean enterprise. Resources and facilities are dedicated for learning.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
III.A.3	Level 4	A learning climate is promoted within the enterprise through ready access to information and input to strategy/ policy making. Opportunities for extending learning experiences are provided.	A learning climate is promoted within the company through ready access to information and input to strategy and policy making. Opportunities for extending learning experiences are provided.	No change required
III.A.3	Level 5	A learning climate is promoted throughout the extended enterprise by the sharing of capabilities, knowledge, skills and best practice.	A learning climate is promoted throughout the extended enterprise by the sharing of capabilities knowledge, skills and best practice.	No change required
III.A.3	Lean Indicators (examples)	• Intellectual capital is regarded as a corporate asset. • Employees have individual training plans, which are aligned to the current and projected skill base requirements. • Employees actively capture and incorporate lessons learned into future training and practices.	- Intellectual capital is regarded as a corporate assets - Employees have individual training plans, which are aligned to the current and projected skill base requirement. - Employees actively capture and incorporate lessons learned into future training and practices.	No change required
III.A.4	III.A.4	Enable the Lean Enterprise with Information Systems and Tools - Facilitate the flow of information and knowledge	Enable the Lean Enterprise with Information Systems and Tools - Facilitate the flow of information and knowledge	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
III.A.4	Level 1	The information infrastructure consists mainly of stand-alone systems. The need for systems integration is recognized but no improvement plan exists.	The information infrastructure in your company consists mainly of stand-alone systems. The need for systems integration is recognized, but no improvement plan exists.	Added "your company" to focus attention
III.A.4	Level 2	Elements of a common information infrastructure have been determined, and an implementation plan is under development. Maintenance of legacy systems consumes most IT resources.	Elements of a common information infrastructure have been determined, and an implementation plan is under development. Maintenance of legacy systems consumes most of your company's IT resources.	No change required
III.A.4	Level 3	The information infrastructure has been formalized and is in use in selected locations. Legacy systems are rationalized and aligned across the value stream. An information infrastructure is deployed that supports seamless information exchange across the enterprise.	The information infrastructure has been formalized and is in use in selected locations. Legacy systems are used only when necessary.	Removed additional description to reflect simpler structure of small business
III.A.4	Level 4	Information systems are fully interoperable and the pertinent information is easily accessible and usable across the extended enterprise.	An information infrastructure is deployed that supports seamless information exchange across the company.	Added pronoun "an".

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
III.A.4	Level 5	Enable the Lean Enterprise with Information Systems and Tools - Facilitate the flow of information and knowledge	Information systems between your company and those of your partners are fully interoperable and the pertinent information is easily accessible and usable across the entire network.	Rephrased sentence for improved clarity
III.A.4	Lean Indicators (examples)	• Compatible information systems and tools exist across the extended enterprise. • Information systems facilitate fast and effective transfer and retrieval of information required. • Information systems and tools complement lean processes and practices and are easily adapted to accommodate change.	- Compatible information systems and tools exist across the extended enterprise - Information Systems facilitate fast and effective transfer and retrieval of information required. - Information systems and tools compliment lean processes and practices and are easily adapted to accommodate change.	No change required
III.A.5	III.A.5	Integration of Environmental Protection, Health and Safety into the Business - “Cleaner, healthier, safer”	Integration of Environmental Protection, Health and Safety into the Business - Cleaner, healthier, safer	No change required
III.A.5	Level 1	The enterprise complies with all known legal and regulatory requirements and reacts if issues are identified.	Your company complies with all known legal and regulatory requirements, and reacts if issues are identified.	Added “your company” to focus attention

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
III.A.5	Level 2	Consideration is given to means of mitigating conditions that cause environmental, health and safety issues.	Your company gives consideration to means of mitigating conditions that cause environmental, health, and safety issues.	Added "your company" to focus attention
III.A.5	Level 3	A process is in place to proactively identify Environmental protection, Health and Safety (EHS) risks and manage them appropriately, with a preference for source prevention.	A process is in place to proactively identify environmental health and safety risks, and manage them appropriately, with a preference for source prevention	Removed acronym for improved clarity
III.A.5	Level 4	Forward thinking solutions to potential life cycle EHS risks are implemented early in product (service) design and throughout the value stream.	Forward-thinking solutions to environmental health and safety risks are implemented early in the product / service design, and continue throughout the life cycle of the product or service.	Removed acronym for improved clarity
III.A.5	Level 5	EHS risk prevention and mitigation is part of the natural way business is conducted across the extended enterprise, creating a sustainable environment and creating a competitive advantage.	Environmental health and safety risk prevention and mitigation are part of the natural way business is conducted across the extended enterprise, creating a sustainable "safe" environment, and creating a competitive advantage for your enterprise.	Removed acronym for improved clarity

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
III.A.5	Lean Indicators (examples)	• Health and safety issues are routinely addressed in employee driven improvement activities. • Processes and designs are proactively adapted to minimize environmental, health and safety issues at source. • Designs meet current environmental regulations and are capable of easy adaptation to meet projected changes over the life cycle of the product.	- Health and safety issues are routinely addressed in employee driven improvement activities. - Processes and designs are proactively adapted to minimize environmental, health and safety issues at the source. - Designs meet current environmental regulations and are capable of easy adaptation to future requirements over the life cycle of the product.	No change required
III.B	Subsection B description	III.B. - Lean Process Enablers - A number of enablers can facilitate lean implementation via consistent application throughout the enterprise.	II.B. Lean Process Enablers - A number of "enablers" can facilitate lean implementation by the consistent application of processes throughout the enterprise.	No substantive change

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
III.B	Diagnostic Questions	• Have the full benefits from process standardization been realized across the enterprise? • Has process standardization and reuse been imbedded in enterprise policies and procedures? • Are common tools and systems used throughout the enterprise? • Is process variation continually reviewed and reduced in all processes throughout the enterprise?	- Hs process standardization and knowledge re-use been imbedded in your company's policies and procedures? - Have the full benefits from process standardization been realized across your company? - Are common tools and systems used throughout your company? Your suppliers? Your customers? - Is process variation diligently reviewed and reduced in all processes throughout your company? - Has "Lean" become a vision shared by all employees in your company?	Added lean vision component
III.B.1	III.B.1	Process Standardization - Strive for consistency and re-use	Process Standardization - Strive for consistency and re-use of knowledge.	Knowledge is the real resource being reused
III.B.1	Level 1	Processes vary by program or product line.	Processes vary by program or product line, even for similar products.	Additional description for clarity
III.B.1	Level 2	Key processes in the organization have been identified that could benefit from standardization, with initial efforts underway.	Key processes in the organization have been identified that could benefit from standardization, with initial efforts underway.	No change required

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
III.B.1	Level 3	Selected processes are standardized across the enterprise.	Selected processes are standardized company-wide.	Replaced enterprise with company to reflect small business structure
III.B.1	Level 4	Process standardization and reuse is consistently employed across the enterprise.	Process standardization and knowledge re-use is consistently employed within your company.	Slight rewording
III.B.1	Level 5	Extended enterprise interface processes have been standardized.	Interface processes between you and your suppliers and customers have been identified and standardized.	Rephrased to improve small business comprehension
III.B.1	Lean Indicators (examples)	• The workforce plays a significant role in devising standard processes and practices, which are adhered to and periodically updated. • Process improvements are documented in a concise and easy to use standard format and transferred. • Processes are standardized where applicable throughout the extended enterprise.	- The workforce plays a significant role in devising standard processes and practices, which are adhered to by all, and periodically updated. - Process improvements are documented in a concise and easy-to-understand format. The information is provided to key stakeholders as needed. - Processes are standardized where applicable throughout the extended enterprise.	Rephrased to improve small business comprehension

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
III.B.2	I.B.2	Common Tools and Systems - Assuring compatibility, reducing costs	Common Tools and Systems - Assuring compatibility, reducing costs	No change required
III.B.2	Level 1	Tools and systems vary by program or work center.	Tools and systems vary by program of work center.	No change required
III.B.2	Level 2	Have identified high leverage opportunities for common tools and systems; initial deployment in a few areas.	Your company has identified high leverage opportunities for common tools and systems, and initial deployment is underway in a few areas.	Added "your company" to illustrate focus.
III.B.2	Level 3	Plans are in place for achieving common tools and systems and have been implemented to varying degrees across the enterprise.	Plans are in place for achieving common tools and systems, and have been implemented to varying degrees across your company.	No change required
III.B.2	Level 4	Common tools and systems have been implemented throughout the enterprise.	Common tools and systems have been fully implemented throughout your company.	"fully" added to implemented
III.B.2	Level 5	Compatibility of tools and systems with those of enterprise partners in the extended enterprise.	Your tools and systems are fully compatible with those of your enterprise strategic partners and customers.	Added "your"

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
III.B.2	Lean Indicators (examples)	• Policies have been established and deployed that require the use of common tools and systems throughout the enterprise. • Common tools and systems provide easy access and reuse of knowledge across the product life cycle. • Enterprise-wide use of common tools and systems provides enhanced compatibility between processes and aids employee transfer.	- Policies have been established and deployed that require the use of common tools and systems throughout your company. - Common tools and systems provide easy access and re-use of knowledge across the product life cycle. - Company-wide use of common tools and systems provides enhanced compatibility between processes and aids employee transfer.	Replaced "enterprise" with company to reflect small business structure.
III.B.3	I.B.3	Variation Reduction - Reduce uncertainty by reducing variation	Variation Reduction - Reduce uncertainty by reducing variation	No change required
III.B.3	Level 1	There is limited use of variation reduction tools and methods. There is some evidence of variation understanding in parts of the organization.	There is limited use of variation reduction tools and methods in your company.	Removed additional illustration to reduce ambiguity (due to small business structure).
III.B.3	Level 2	There is evidence that sources of variation are being identified and analyzed. Initial efforts are underway to reduce variability.	There is evidence that sources of variation are being identified and analyzed within your company. Initial efforts are underway to reduce variability.	"Your company" added to focus perspective.

Section or Lean Practice	Description	Original LESAT Wording	SB-LESAT Wording	Changes made for SB-LESAT & Comments
III.B.3	Level 3	A formal approach that balances customer value and variation reduction is implemented in many parts of the enterprise.	A formal approach that balances customer value and variation reduction is implemented in many parts of your company.	Replaced "enterprise" with company to reflect small business structure
III.B.3	Level 4	Considerable benefits are realized from reduced variation in processes and practices across the enterprise.	Considerable benefits are realized from reduced variation in process and practices across your organization.	No change required
III.B.3	Level 5	Benefits of reduced variation are realized across the extended enterprise.	Benefits of reduced variation are realized across the extended enterprise, from your suppliers to your customer.	Alluded to supply chain
III.B.3	Lean Indicators (examples)	• Process ownership and visual displays of process variation enable quick and easy identification of adverse trends. • High levels of process stability are maintained by utilizing mistake proofing and root cause identification techniques to the fullest. • Variation reductions achieved enable short predicable lead times for information and material flow.	- Process ownership and visual displays of process variation enable quick and easy identification of adverse trends - High levels of process stability are maintained by utilizing mistake-proofing and root cause identification techniques. - Variation reductions achieved enable short predictable lead times for information and material flow.	No change required.