# Integrating Lean Six Sigma and AIRSpeed within the NAVAIR 4.1 Organizational Improvement Efforts

White Paper

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## *White Paper Overview*

This white paper will provide an overview of Lean, Six Sigma and Theory of Constraints (hereafter referred to as LSS) concepts, including discussion of applications and outcomes. Consideration for success in applying the tools of Lean and Six Sigma, including the "demand function" and "support capacity" are provided. Comparisons to the High Performance Organization (HPO) (Pickering) improvement efforts within NAVAIR 4.1 Competency are also included. The final section will discuss implications to NAVAIR 4.1 work and will discuss ties to other initiatives. Potential applications and a discussion of "will it work?" are summarized. Efforts have been taken to minimize overlap with the standard AIRSpeed Powerpoint available briefings.

Fundamentally, Lean, Six Sigma and Theory of Constraints (LSS) fit within the framework of the HPO Diagnostic Change Model (DCM) and successful LSS implementation requires many of the HPO elements to have been completed. LSS, done alone, leaves many "gaps" or assumptions that need to be verified. LSS works well in the HPO deployment stages after doing much of the HPO DCM in groups and in the organization. Doing both HPO and LSS are better than just doing either approach.

## *Background*

### Naval Aviation Activities

NAVAIR, specifically through the 3.0 Competency and Depots, along with other Navy Commands affiliated with Naval Aviation, recently embarked on an improvement process entitled "Enterprise AIRSpeed," as a variation of Naval Aviation Readiness Integrated Improvement Program (NAVRIIP) AIRSpeed. AIRSpeed was created under the auspices of VADM Mike Malone, Commander, Naval Air Forces, in response to the Chief of Naval Operations (CNO) mandated "…Fleet Response Plan (FRP) to support emerging Fleet and contingency operations in the Global War on Terrorism."

The following basic information concerning the process methodologies is copied directly from the NAVRIIP website:

> Enterprise AIR*Speed* integrates best business practices, which includes *Basic and Advanced Theory of Constraints, Lean and Six Sigma*. The program emphasizes continuous process improvement to the Naval Aviation culture.
>
> The three process improvement tools are:
>
> Theory of Constraints: TOC is a set of tools that examines the entire system for continuous process improvement based on the belief that any organization has *at least* (usually multiple constraints and identifying even one usually surfaces others after that one is corrected) (emphasis and explanation added) one constraint and that any improvements on non-constraints may not yield as significant Return on investment as working on the constraint.

*Basic Theory of Constraints (BTOC)* is a process improvement tool under AIR*Speed* that is applied at aircraft intermediate maintenance departments, aviation supply departments and Marine air logistics squadrons.

The primary concept underlining *Advanced Theory of Constraints (ATOC)* is the application of market-demand pull supply-chain management. In the current system, components and parts are "pushed" to the end users. In the aircraft intermediate maintenance activity's, components are inducted regardless of whether they are required. In the "pull" system, actual flight-line demand (operational requirements) and the time it takes to reliably replenish (TRR) dictates inventory buffer levels and times to induct components into the repair process. Note the similarity to Lean's "pull concept (words added).

Lean: A focus on the removal of waste, which is defined as anything not necessary (no value added) to produce the product or service. Note that lead acknowledges some no value added but required steps in any process, but these should be challenged (words added). Lean is a process improvement strategy that facilitates an organization's ability to make everything, everyday in the exact quantity required, with no defects. The goal is to achieve perfection through the total elimination of waste in the value stream. Lean uses incremental improvement to constantly expose waste to balance operational and standard workflows. Most notable corporate (words added) examples are the supply chains established by Toyota and Honda.

Six Sigma: A strategy based on the assumption that the outcome of the entire process will be improved by reducing the variation of multiple elements. It is a process improvement strategy that uses quality improvement as the method for business improvement. Six Sigma is uniquely driven by close understanding of customer needs, disciplined use of facts, data, statistical analysis, and diligent attention to managing, improving, and reinventing business processes. Process improvements focus on variation reduction to produce highly repeatable processes that create customer satisfaction. Six Sigma measures variability in relation to a total population of numbers.

See the NAVRIIP Website (http://www.airpac.navy.mil/navriip/) for further background and historical details.

Appendix A provides a more detailed explanation of Theory of Constraints, Lean and Six Sigma as well as specific implementation considerations.

## NAVAIR Activities

NAVAIR is also implementing a version of AIRSpeed throughout the organization. The early implementation of AIRSpeed within NAVAIR differs slightly from Enterprise AIRSpeed based on less emphasis on the Theory of Constraints (TOC) body of knowledge, but does emphasize Lean and Six Sigma. NAVAIR is utilizing a different contractor for training and consulting. Enterprise AIRSpeed has a multi-million dollar per year contract with the Thomas Group, while the NAVAIR AIRSpeed long-term support in currently in the RFP process. The first wave of executive training for NAVAIR senior managers utilized an ad hoc, two-day version of Lean and

Six Sigma concepts presented by TKI, Inc and two-days of GE's Change Acceleration Program (CAP). A reference text, *Lean Six Sigma for Service* by Michael L. George (2003) was provided during the training, but was not heavily referenced.

Distinctions in contractors, training and texts become important when comparing various "flavors" of Lean, Six Sigma and Theory of Constraints, especially when considering the content and process of "Black Belt Training" utilized to "certify" people in the knowledge, skills and abilities for utilizing the concepts in process improvement. Ensuring consistency across organizations helps to avoid confusion, helps ensure crisp communication across organization, and helps to avoid the appearance of confusion and the "*flavor of the month*." For those not enthused by the LSS approach or changes, consistency helps remove people's excuse to do nothing…especially when people are not trained to understand just follow. Note that NAVAIR may well have Navy or Marine Corps individuals who have been exposed to the NAVRIIP version of AIRSpeed which may vary from the NAVAIR version of AIRSpeed.

## NAVAIR 4.1 Context of Improvement Activities

The NAVAIR 4.1 Competency, Systems Engineering, has been actively involved in improving organizational performance starting with Business Process Reengineering (BPR) targeted at Software Development in the late 1990's. As an enabler to the "change management" needs associated with BPR, NAVAIR 4.1 initiated the utilization of the "Higher Performance Organization (HPO) Diagnostic/ Change Model" developed by Dr. John Pickering of the Commonwealth Centers for High Performance Organizations (CCHPO) (Pickering, ASTD). Key individuals who had previously been involved with software process improvement were organized into an Enterprise Team known as the People, Process and Product Resource ($P^3R$) group. $P^3R$, along with the Software Resource Center (SRC) Enterprise Team, is charged with the coordination and activities involved with organizational improvement initiated from the Software BPR throughout NAVAIR 4.1 Systems Engineering.

A parallel effort to standardize and document best practices for Systems Engineering has been on-going within 4.1 at NAWCAD since the late 1990's. A Systems Engineering Guide (SE Guide), Systems Engineering Technical Review Instructions (SETR), and Risk Management checklists have been developed and distributed. Efforts are now on-going to train and potentially certify new and existing systems engineers in the best practices.

NAVAIR 4.1 System Engineering went "national" three years ago in order to better coordinate geographically separated "business units" between the depots, Pax River, MD, Pt. Mugu, CA and China Lake, CA. A leadership team (LT) and management team (MIT) were created as a structure to support the improvement initiatives and meeting periodically to focus on strategic (SAT) and tactical (MIT) activities.

Recently, the 4.1 SAT, has focused efforts on three separate "lines of business" within NAVAIR 4.1, each with their own focus and key products and services. Implementation of AIRSpeed might, and probably should, be different for these three areas.

- Software Development

- Fleet Depots
- Systems Engineering

NAVAIR 4.1 and the SRC has sponsored software improvement efforts applying Personal Software Process (PSP), Team Software Process (TSP) and Software Engineering Institute (SEI) Capability Maturity Model (CMM) evaluations and certifications among the various Integrated Product Teams (IPTs) and Software Support Activities (SSAs). A number of SSAs have now reached level 4 certification within the CMM structure and a few IPTs are pursuing Capability Maturity Model Integrated (CMMI) certification which is more inclusive of organizational constructs than CMM.

$P^3R$, working with the IPT and Competency Leaders, has coordinated a variety of 4 or 5 day "TeamWay Workshops" focused on helping intact groups improve their performance by better understanding themselves at the individual level, understanding the basics of high performance teams and by applying elements of the HPO model to their specific organizations. Based on size, many IPTs conducted multiple sessions with a final, short, "joint session" summarizing activities and developing joint "next steps." $P^3R$ also has conducted a number of "process modeling" sessions with various groups aimed at better understanding and improving their processes, most often within their own groups or organizations.

NAVAIR 4.1 is also in the process of establishing a performance measurement system across all the lines of business.

The 41 LT is currently evaluating strategies and tactics in support of the NAVAIR AIRSpeed efforts and this white paper is in support of those efforts. Decisions will need to be made concerning whether some "improvement efforts" need to be changed or dropped in order to accommodate the differences under LSS activities.

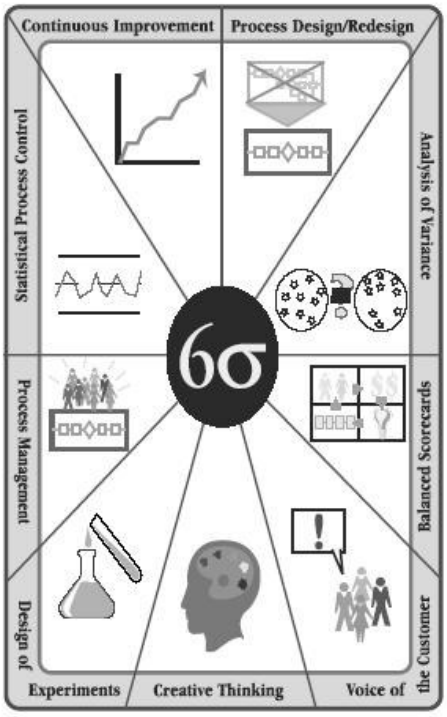
Appendix B provides a more detailed comparison of the HPO approach and the Lean, Six Sigma and Theory of Constraints (TOC) tools associated with AIRSpeed.

## *Applications and Outcomes*

### General Summary

There is an inherent danger in the labels associated with Lean, Six Sigma and Theory of Constraints (hereafter referred to as LSS), in that the terminology is "loose" with regards to the specific content, activities and tools associated with each "flavor" utilized in different organizations. All LSS activities, tools and content are not created equally, nor are they equally suitable to different situations. Skilled practitioners of process improvement, whether under "lean", six sigma, or TOC, often similar approaches and tools, many going back to the "old" 7 tools of quality used in Total Quality Leadership/ Total Quality Management (TQL/TQM).

For example, GE is known as a company that has worked on applying Six Sigma. When the details of their applications are reviewed, it becomes clear that the term "Six Sigma" is actually much more inclusive of organizational level efforts than the *normal* set of six sigma tools would involve. The figure below is extracted from The Six Sigma Way: *How GE, Motorola, and Other Top Companies Are Honing Their Performance by* Peter S. Pande, et al (2000 McGraw Hill). Furthermore, GE has embedded six sigma tools within their overall culture and management processes for strategy, reward and recognition in a long-term continuation of improvement "phases" started under GE's Chief Executive Officer, Jack Welch. Welch first laid-off hundreds of thousands of people in an attempt to reduce the "bloat" he found when he took over GE in the early 1980's. Much later in his tenure, Welch realized that additional improvement efforts were needed and he "borrowed" the corporate best practice of Lean Sigma and integrated it with all the other improvement initiatives he had been working on, in different, but consistent phases, within the GE company for 20 years.




If all the pieces of "six sigma" are worked, including Continuous Improvement, Process Design/ Redesign, Analysis of Variance, Balanced Scorecards, Voice of the Customer, Creative Thinking, Design of Experiments and Statistical Process Control, the organization has clearly moved beyond the specific six sigma tools into more of a general management systems approach. When looking even further into the details of the GE approach, clear differences emerge between the "flavors" in use across the GE business units and even within companies within the GE business units.

In general, however, absent the full organizational approach, LSS is generally considered to have specific weaknesses. Nave (2002) identifies the following major obstacles to the improvement methodologies:

- They address management theory as a secondary or tertiary issue.
- They don't address policies, either formal or informal.
- They don't address how managers are measured and rewarded for process improvements.
- They don't address the organization's values.

## LSS and HPO Comparison and NAVAIR 4.1 Impacts

Even more specifically, in comparison to the HPO framework, there is significant overlap between key pieces of the HPO and LSS approach. See Appendix B for a more specific review

and for a color-coded comparison of LSS against the "Big Sheet" summary of the HPO Diagnostic Change Model.

In general, keeping in mind the caveat about understanding the flavor of LSS that is being analyzed, there are numerous "assumptions" that LSS seems to assume are in place in the organization.

The following section explores Lean Six Sigma (LSS) assumptions and distinctions with the HPO Diagnostic Change Model and their potential application to NAVAIR 4.1. Each section will review an assumption or distinction and then discuss the potential application to NAVAIR 4.1.

a. LSS works best in organizations with a definite "process focus," as it assumes some form of process focused organization and often refers to "core business processes". LSS often recommends working on those key processes that cut across organizational pieces or recommends that there be a key "process owner" for the process being improved that delivers key products.

   *NAVAIR 4.1 impact*:
   With the separate structure of PEOs and Competencies, complications will exist working on any processes that NAVAIR 4.1 doesn't completely "own." Even for the processes that NAVAIR 4.1 is involved in and has generated "guidance" for, the voluntary nature of compliance with the guidance, as is often the norm within NAVAIR, will be a limiting factor. Most of the "process focus" is within Integrated Product Teams (IPTs).

   As an example, at a recent 4.1 SAT meeting, the SRC was tasked with having an evaluation conducted of various key Systems Engineering processes in the SE Guide. The SRC contracted with an outside vendor, Natural SPI in June 2004, to evaluate the NAVAIR AIR-4.1 System Engineering standard processes against CMMI level 3 and 4 requirements, and to report findings. In a well-written report, Natural SPI concluded, in part, (page 10 of 17):

   > Assuming that these processes are presented to the typical user in a structure and format similar to how they were received by NSPI, the AIR-4.1 standard set of processes would be very difficult to adopt and implement. People, particularly technically-oriented people, tend to need some structure to their work. People need a starting point and an ending point, or they at least need to know where in a set of processes their work begins and ends. *The AIR-4.1 set of processes are analogous to looking at a spider web and trying to figure out where it starts.* (emphasis added) This collection of processes has no obvious or intuitive hierarchy, flow, structure, or map. System engineering projects all have life cycles which have a beginning and end, and observable phases usually demarked by milestones. A typical project lead or engineering would find it virtually impossible to look at the AIR-4.1 processes and make a reasonable determination of which process to use and when.
   >
   > There is one artifact – the NAVAIR System Engineering Guide (SE Guide.pdf) that does provide a very good overarching description of generic system engineering processes (see 4.2, Process Asset Strengths), yet this document's applicability to any

particular NAVAIR unit is unclear. In fact, a paragraph on page 3 clearly states that conformance with and use of this Guide is "voluntary" by NAVAIR organizations.

In their report, Natural SPI recommended (pp. 16 and 17):
1. Define the system engineering business goals. An organization's goals will usually support or align with the higher level organizational goals or strategy (e.g., NAVAIR strategy or goals).
2. Define the goals for system engineering process improvement, and identify which of these goals align with and support the business goals defined in recommendation 1.
3. Determine the measures, indicators, and other information that would enable leadership to quantitatively and qualitatively understand progress toward the goals defined in recommendation 2.
4. Define and plan the improvement actions that need to be implemented that will yield processes and/or work products that will be measurable by the measures defined in recommendation 3.
5. Implement the improvement actions planned in recommendation 4. Collect the measures to determine progress toward the goals defined in recommendation 2.
6. Collect new and revised process assets and work products that result from implementing the improvement actions, and map them to the practices in the CMMI. Track and record process improvement progress against the plan defined in recommendation 4, and report results to relevant stakeholders.

Significant work needs to be done on the "process focus" orientation for NAVAIR so that LSS applications will be successful and the Natural SPI recommendations need to be considered; LSS will look for potential "projects" to have Black Belts work for their certification and the Natural SPI recommendations might make a good project.

b. <u>The HPO framework ensures the "work of leadership" is done early in the improvement process</u>; one piece of this "work of leadership" is ensuring a specific Leadership Philosophy is adopted and specifies at least a System 3 (consultative) approach for day to day operations and System 4 (participative) for the longer-term work where consensus and buy-in is important. LSS assumes that workers are actively engaged and interested in improving the performance of the organization or their processes. Only in limited portions of the literature associated with LSS, and often in a supplemental "change management" section is the emphasis on employees discussed (see GE Change Acceleration Process for example).

   LSS emphasizes the "technical" portion of the work or processes and neglects the "social" or people portion of the work and LSS either assumes the people part will just happen or that other management processes address the people part. The assumption concerning all of the "work of leadership" needs to be verified. TOC, for example, is sometimes positioned as a tool when management does not even want the people who own the process involved (see Appendix A and Nave (2002)).

   *NAVAIR 4.1 impact:*

There is something of an "*autocratic paradox*" embedded in implementing LSS; the mandate is clearly being driven from the hierarchy without much consultation. The PowerPoint "briefings" prepared to date have all painted the "business case" without much discussion or understanding of the impact on individuals within the organization. While "change in an organization cannot be lead from low in the organization, the business of carrying out the change cannot be accomplished without the energy and participation of all those involved at all levels" (Stilmar conversation).

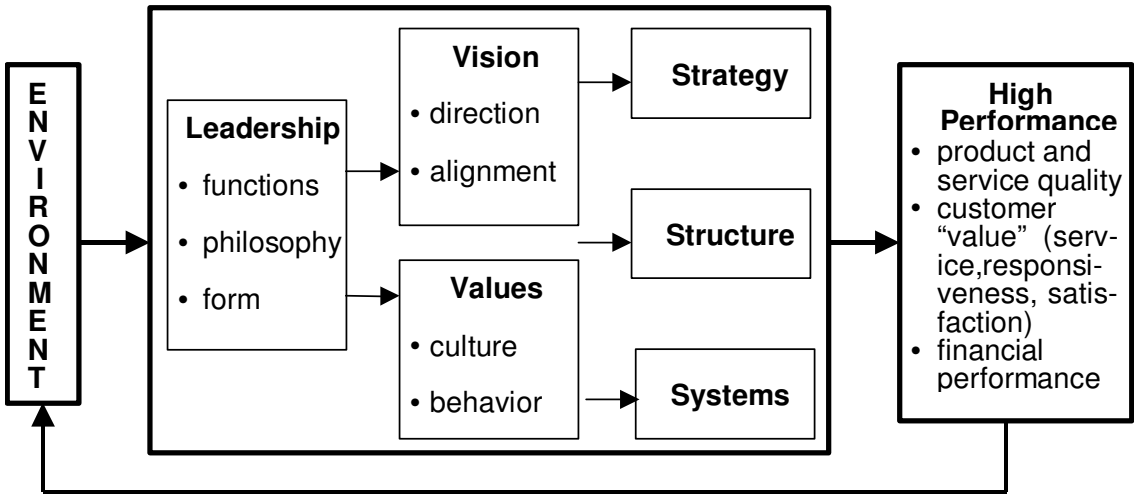
Understanding, and presenting, the "What's in it for me" (WIIFM) needs to be recognized and worked. *Lean Six Sigma for Service* (George 2003) in Chapter 7, *Phase 2: Engagement (Creating Pull)* (pp. 197-199), summarizes WIIFM and the change management emphasis as:

> Like most companies, … one spent nearly all its improvement budget on the people directly involved in deployment, the newly formed cadre of Champions and Black Belts. Only a small fraction of time and effort was spent communicating with others and explaining the what, why and "what's in it for me" (WIIFM) to those not directly involved. This strategy essentially ignores the fact that any changes made as a result of Lean Six Sigma would have to be sustained by those who live that job every day, and who aren't part of the Lean Six Sigma infrastructure. A *sustainable* Lean Six Sigma initiative needs to engage *both* those directly involved and non-direct resources in the effort.
>
> By narrowly defining who it designated as "involved" in the Lean Six Sigma initiative, the company described above limited what it could achieve—and overlooked some resources that could have made valuable contributions. Companies who follow this path often have some initial success, emanating from projects that represent low-hanging fruit or that are supported by a small but vocal minority. But results typically tail off quickly and are hard to revive"
>
> Table (p. 199)
> "This ain't your grandfather's change management
> Traditional approaches to introducing Lean Six Sigma or other initiatives have stressed a traditional form of "change management." You're supposed to identify everyone involved in or affected by an effort and classify them as resistor or supporter, or something in-between…then come up with strategies to "overcome resistance." The approach to change management described in these chapters (George 2003) is very different. While no change of any significance is going to be implemented without any resistance, you can avoid much of the resistance that occurs when changes are implemented from the top by
> - Fully understanding your organization (through the (a) readiness assessment
> - Engaging people in shaping the initiative in ways that support their personal goals (as well as those of your organization)
> - Making sure Lean Six Sigma resources are devoted to priority problems
> - Positioning Lean Six Sigma resources (Black Belts, etc) as support for line management
> - Recognizing that resistance to change is a way that people defend current good performance; what Lean Six Sigma offers is the opportunity for great performance
> - Training all top managers, creating enthusiasm rather than compliance

c. LSS builds upon the Total Quality Leadership (TQL) framework and is in the natural "flow" from the basics of quality tools (See Appendix A for more details). Understanding the distinctions and comparisons is important to successful implementation of LSS (and any other improvement methodology).

*NAVAIR 4.1 impact:*
While this is a critical need for the NAVAIR level, NAVAIR 4.1 managers and supervisors need to understand the TQL "lessons learned." Recall that the HPO approach positions itself as "pre-TQL" as discussed in Figure 1 and Box 3 of the "Lessons Learned from Charleston Naval Shipyard" as summarized below:

**FIGURE 1 : The CCHPO High-Performance Organization Change Model** *




* A version of this model was published in John W. Pickering and Robert E. Matson, "Why Executive Development Programs (Alone) Don't Work," *Training and Development,* (ASTD, May 1992), p. 92.

Although broader than Total Quality Leadership (TQL) in scope, HPO is related to – indeed, encompasses – TQL. Thus, in order not to add another set of terms to an already crowded change nomenclature and to take advantage of TQL's acceptance and support in the Navy, language from the Navy's Total Quality Leadership program was used to label Charleston's Leadership Change Teams.

TQL and HPO are, of course, very closely related. In fact, the HPO Change Process can be seen as the first step of TQL – perhaps even "*pre-TQL*." Where HPO begins with leadership (functions, philosophy, and form) and then proceeds to vision/ values and strategy/structure/systems, TQL – as applied in many organizations – begins with vision and guiding principles and goes directly to work processes/systems. Not "*getting leadership right first*" often results in a mechanical, "techniques only" approach to TQL being laid on top of a control-oriented, centralized, hierarchical, autocratic

> management system. Without properly understanding the mindset and organizational changes required by the philosophical underpinning TQL, such organizations will at best achieve no long term gain and may find they have succeeded in significantly increasing the cynicism and hostility of their workforces. W. Edwards Deming, of course, knew all this. None o his "fourteen points" deal with "techniques." Rather, buried in the points is a focus on getting the leadership "philosophy" right first.

Note that one could simply substitute LSS for the TQL terms in the paragraph above and the points would still be appropriate.

Recall that Pickering "discovered – (while working with Charleston Naval Shipyard that)… many top managers in both the public and private sectors -- that most managers do not know the management literature. He found that ***what managers needed most was a clear, concise conceptual model that synthesized what is in the literature about building high-performance organizations into a diagnostic tool that they could put to practical use in understanding their own organizations*** (Pickering "Lessons Learned from Charleston Naval Shipyard" p. 8 of 33).

> The *Six Sigma Way* (Pande 2000) summarizes the pitfalls of TQL in the following table. In order to ensure successful LSS implementation all of the solutions need to be verified and implemented.

| TQM Pitfall | Six Sigma Solution |
|---|---|
| **Lack of Integration** | **Links to the Business and Personal "Bottom Line"** |
| **Leadership Apathy** | **Leadership at the Vanguard** |
| **A Fuzzy Concept** | **A Consistently Repeated, Simple Message** |
| **An Unclear Goal** | **Setting a No-Nonsense, Ambitious Goal** |
| **Purist Attitudes and Technical Zealotry** | **Adapting Tools and Degree of Rigor to the Circumstances** |
| **Failure to Break Down Internal Barriers** | **Priority on Cross Functional Process Management** |
| **Incremental vs. Exponential Change** | **Incremental Exponential Change** |
| **Ineffective Training** | **Blackbelts, Greenbelts, Master Blackbelts** |
| **Focus on Product Quality** | **Attention to All Business Processes** |

d. LSS doesn't discuss much need for "systems alignment" and focuses on the product processes. There are a number of organizational systems that need alignment to initiate, support and sustain LSS efforts. For example;

- Reward systems aligned? (among others)
- Staffing systems aligned? (how we acquire/ place talent)
- Development systems aligned? (how we build competence/capability)
- Measures systems aligned? (How we track performance; desired behavior)
- Organization Design?(how we organize to support the change initiative)
- Information Systems (How we utilize technology (IT, NMCI, etc))
- Resource Allocation Systems (e.g., budget, finance, strategy, etc)
-

In the long-run, long-lasting, effective change acceleration requires a thorough examination and realignment of key organizational systems and structures.

*NAVAIR 4.1 impact:*
This is an area where more of the impact must be at the NAVAIR level as so many of the "systems" discussed above are outside the control of NAVAIR 4.1. For those systems where NAVAIR 4.1 has "ownership" or significant influence, work is needed to ensure alignment.

e. Every "flavor" of LSS has some form of steering committees that helps ensure the integration and choice of process improvement activities. There is little discussion about the need for balance between "thinking" and "doing" similar to the "parallel" organization concepts from HPO.

*NAVAIR 4.1 impact:*
Within the strategic (SAT) and tactical (MIT) leadership team framework, NAVAIR 4.1 needs to ensure that there is a high level of involvement in the selection, boundary setting and implementation of any LSS process related work. NAVAIR will have to consider

what to "start and stop" doing with any overlaps in descriptions or purposes of the leadership and management teams that have been established.

In general, LSS seems to work best on "larger," cross-organizational processes where the "whole system and all stakeholders" can be captured in one room on one "customer value map." With the complicated organizational structures and funding mechanisms with NAVAIR, it's critical that the right selection criteria be used for applying LSS to the appropriate process and to ensure all the "right players" are actively engaged. The normal practice of "anyone can say no, but no one approves," needs to be countered. Groups engaged in LSS process improvement need to clearly understand all know constraints and boundary conditions and should not fall into the trap of having their recommendations disapproved by the hierarchy; the right members from the hierarchy need to be involved throughout the improvement process.

f. LSS assumes the presence of a clear and agreed to vision and vision elements.

*NAVAIR 4.1 impact:*
With ADM Massenburg's Vision and Goals so clearly stated and emphasized, this might seem like a non-problem area. However, there appears to be much "flexibility" in applying "their interpretation" to the stated vision and goals and care needs to be taken to ensure the "alignment" of any LSS process improvement activities to the NAVAIR 4.1 vision and the NAVAIR vision. Stilmar (personal discussion) succinctly describes the needed sequence for alignment as:

> …an obligation of each level to interpret what the top level vision and goals mean in specific terms of what to do on 'Monday AM." That work is hard and cannot be skipped by any level or the process breaks down. More and more rigid goals from the top are not the solution. It is each level understanding and making sense of the goals and expressing them in operative terms for themselves that is essential. Yet the top goals are necessary (but not sufficient).

g. LSS emphasizes process metrics over organizational performance measures.

*NAVAIR 4.1 impact*:
With the recent emphasis on performance measures, including the early development of a "balanced scorecard approach" across the three NAVAIR 4.1 "lines of business," this work needs to be continued to help ensure that the right processes are being selected for improvement.

h. LSS rarely describes or discusses organizational values (not described at all).

*NAVAIR 4.1 impact;*

With it's stated organizational values, NAVAIR 4.1 needs to ensure that the values are being followed and supported at all times and that process improvement activities don't violate any of the values.

i. LSS assumes an organization structure that supports and doesn't compete; this is usually accomplished by having a "process owner" responsible for all aspects of the process that results in a specific process. Process teams need management that gives clear direction and support as well as providing appreciation and evaluation of their work.

*NAVAIR 4.1 impact:*
This area is a big potential problem for NAVAIR in general and NAVAIR 4.1 in particular. Without the organizational separation between IPTs and Competencies, and the separate flow of funds that goes with the organizational distinctions, significant pressure will exist if all "parties" are not involved with all process improvement activities. Some processes that the competency might want to "fix" will not be as important to the IPTs and vice versa. This potential problem highlights the need for agreement on the right processes to be worked on by LSS efforts. Most of the PowerPoint briefings acknowledge the need to generate criteria and the need to work on "high-return, low-cost" process improvement, but seldom go beyond that statement.

Lean Six Sigma: A Fusion of Pan-Pacific Process Improvement (Upton, p. 16) provides guidance on project selection that seems appropriate for NAVAIR 4.1:

> In conjunction with the focus of efforts, project identification should take the Lean approach of having both strategic and popular identifications. There is definitely a place, especially during the first 6-18 months, for popularly identified projects. These can be more quickly identified and work begun on them, giving early wins and building the enthusiasm for the implementation effort. When combined with a Lean Six Sigma approach to project management that uses Kaizen events to enable quick completion, this effect is multiplied.
>
> While these initial projects are being accomplished, the organization should use a strategic-level integration model such as the Malcolm Baldrige National Quality Award (MBNQA) criteria along with systemic, strategic tools such as Value Stream Mapping to identify projects more strategically. These should come to dominate the project portfolio, but should never completely eliminate "pop-ups" and "popular" projects.
>
> (See http://www.isixsigma.com/library/downloads/LeanSixSigma.pdf for more details)

j. LSS assumes an agreement, or at least an understanding of "customers" wants/needs/expectations and often doesn't distinguish between beneficiaries that consume a product or service and the food chain supplying the funding. This is a specific example of the difference in private and public sector organizations and their attempts to apply LSS. While there are a few public sector examples in the literature (i.e. Ft. Wayne, IN in George 2003), most are private sector organizations. Enterprise AIRSpeed has been having success in the depots, so the distinction, while important, can be overcome.

*NAVAIR 4.1 impact:*
NAVAIR 4.1 spent significant effort on the HPO Strategic Customer Value Analysis (SCVA) and NAVAIR 4.1 needs to continue and complete the process to ensure that all flavors of the customer's wants/needs/expectations are understood, at all levels of the organization, and are being met, which dictates the need for correct performance measures..

Steering groups need to be aware that the beneficiaries are not always the people who supply the funding or do the work of process improvement and therefore must often become strongly involved to champion a "enterprise wide" (i.e. Navy) systems view that is counter to budget driven processes.

k. <u>One of the LSS distinctions, in comparison to the HPO Diagnostic Change Model, is the emphasis on "time" as a critical element</u> of the tradeoffs between quality, financial performance and customer "value." Understanding and applying the emphasis on "time" might well help an overall improvement emphasis.

*NAVAIR 4.1 impact:*
George (2003) provides an emphasis on time in discussing the handful of terms essential for understanding lean (pp. 26-28). Having NAVAIR 4.1 examples would help the translation of LSS efforts to the individuals in the organization.

For example, lead time is defined as amount of work-in-process (WIP) over average completion rate which is straightforward. The definition of WIP provides opportunity for application, and George describes WIP as also meaning "Things in Process" or TIP. Those things can be customer requests, checks, phone calls, reports, etc.—any work that is officially in the process and isn't yet complete. Gaining understanding of the data associated with the numerator and denominator provided opportunity for performance measures. Whenever you have WIP, George notes (p. 27), you have work …"waiting to be worked on" or "in queue" which is the time it sits around waiting. Understanding queuing theory helps processes flow more smoothly (think about cash register lines). Understanding WIP is the key to process "pull" (another lean principle) and is the basis of designing the system such that an element only enters the process (input) when a complete element leaves the system.

l. <u>LSS doesn't distinguish between "leadership and management"</u> and doesn't spend any time describing the context for how the roles of technical workers have changed overtime. The HPO DCM develops the "Networked Talent Model" to help explain how leadership and management are now expected of people at all levels of the organization. Kotter (1990) for example, also distinguishes between "leaders and managers, while emphasizing the need for both: one without the other is likely to produce poor results. He says that:

> managing is primarily concerned with "consistently producing key results

expected by stakeholders," while leading involves:

- Establishing direction—developing both a vision of the future and strategies for producing the changes needed to achieve that vision.
- Aligning people—communicating the vision by words and deeds to all those whose cooperation may be needed to achieve the vision.
- Motivating and inspiring—helping people energize themselves to overcome political, bureaucratic, and resource barriers to change.

On a project, particularly a larger project, the project manager is generally expected to be the project's leader as well. Leadership is not, however, limited to the project manager: it may be demonstrated by many different individuals at many different times during the project. Leadership must be demonstrated at all levels of the project (project leadership, technical leadership, and team leadership).

*NAVAIR 4.1 impact:*
NAVAIR 4.1 needs to continue to emphasize the changes in technical worker roles, including changes to the performance elements in the annual performance appraisals. Longer-term, changes to the National Security Personnel System (NSPS) will make the distinctions clearer, but the NSPS is a long way from being implemented.

m. The LSS area notes that a critical focus area has to be "change interventions" (managing change) but is often assumed in the approaches (or at least not actively described).

*NAVAIR 4.1 impact:*
This is a potential area where NAVIR 4.1 can operate independently of NAVAIR by ensuring managers, supervisors, and employees have a good understanding of change theory. Those that have attended HPO training understand the basics, but there is much more that could and should be included. See also element b above.

Kotter (1996), for example, provides a proven and powerful 8-step methodology for leading change implementation in organizations.

1. Establishing a Sense of Urgency
    a. Examining the market and competitive realities
    b. Identify and discussing crises, potential crises, or major opportunities

2. Creating the Guiding Coalition
    a. Putting together a group with enough power to lead the change
    b. Getting the group to work together like a team

3. Developing a Vision and Strategy
    a. Creating a vision to help direct the change effort

b. Developing strategies for achieving that vision

4. Communicating the Change Vision
    a. Using every vehicle possible to constantly communicate the new vision and strategies
    b. Having the guiding coalition role model the behavior expected of employees

5. Empowering Broad-Based Action
    a. Getting rid of obstacles
    b. Changing systems or structures that undermine the change vision
    c. Encouraging risk taking and nontraditional ideas, activities, and actions

6. Generating Short-Term Wins
    a. Planning for visible improvements in performance, or "wins"
    b. Creating those wins
    c. Visibly recognizing and rewarding people who make the wins possible

7. Consolidating Gains and Producing More Change
    a. Using increased credibility to change all systems, structures, and policies that don't fit together and don't fit the transformation vision
    b. Hiring, promoting, and developing people who can implement the change vision
    c. Reinvigorating the process with new projects, themes, and change agents

8. Anchoring New Approaches in the Culture
    a. Creating better performance through customer- and productivity-oriented behavior, more and better leadership, and more effective management
    b. Articulating the connections between new behaviors and organizational success
    c. Developing means to ensure leadership development and succession

Kotter emphasizes that there is great importance in the sequence for the 8 steps for leading change, stating:

> Successful change of any magnitude goes through all eight stages, usually in the sequence shown. Although one normally operates in multiple phases at once, skipping even a single step or getting too far ahead with a solid base almost always creates problems.
>
> Normally, people skip steps because they are feeling pressures to produce. They also invent new sequences because some seemingly reasonable logic dictates a choice. After getting well into the urgency phase (#1), all change

efforts end up operating in multiple stages at once, but initiating action in any order other than that shown…rarely works well (pp. 24-25).

## *Conclusions*

Lean Six Sigma and Theory of Constraints, depending on the specifics utilized by the vendor providing training and support, is a robust set of process improvement tools. When used in conjunction with strong "change management" tools, especially in those areas that have worked with the High Performance Organization Diagnostic Change Model (Pickering) (HPO DCM) and when used on the right processes with the right players, significant improvement in organizational performance and process improvement can be expected and accomplished.

Fundamentally, Lean, Six Sigma and Theory of Constraints (LSS) fit within the framework of the HPO Diagnostic Change Model (DCM) and successful LSS implementation requires many of the HPO elements to have been completed. LSS, done alone, leaves many "gaps" or assumptions that need to be verified. LSS works well in the HPO deployment stages after doing much of the HPO DCM in groups and in the organization. Doing both HPO and LSS are better than just doing either approach.

In conclusion, there are some key areas to keep in mind in the transition to the operating phase of LSS.

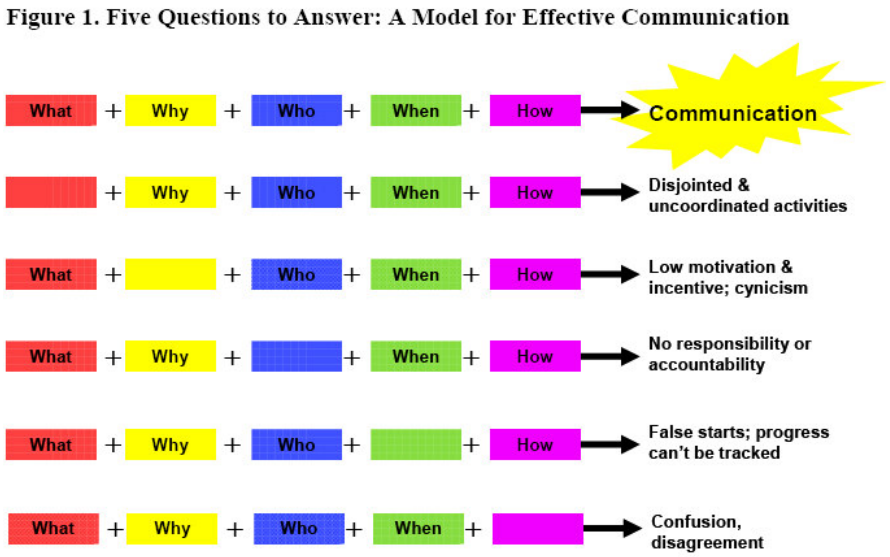
1. Implementation of AIRSpeed LSS should be focused differently in the three NAVAIR 4.1 business areas and presented and packaged within an aligned leadership approach.
    a. Software-Take credit for and accelerate psp/tsp/cmm/cmmi efforts
    b. Systems Engineering- need a strategy (i.e. there is a NFSWG issue on deploying software across the SYSCOMs aboard aircraft; this might make an ideal NAVAIR wide process focus)
    c. Depots-ride the NAVRIIP and Enterprise AIRSpeed efforts where possible; identify those NAVAIR intensive process

2. Communicating "What's In It For Me" has to occur throughout the entire organization to ensure engagement, understanding and dialogue. Much like Admiral Massenburg has done with his "elevator speech" for his vision and goals, each manager and supervisor needs to develop their face-to-face conversation concerning the implementation of NAVAIR AIRSpeed.

    West (2000) provides a "Model for Effective Communication" and the elements of this approach need to be completed for individuals, supervisors and managers and then shared widely in broadly in a "dialogue" or "conversation" format. Recall that the AIRSpeed work is being done in the context of people in NAVAIR hearing about Reductions In

Force (RIFs), the CNO wanting money returned and that NAVAIR is "bloated." Understandably, people will be most concerned with the personal impact of any improvement process upon their work, jobs and careers. This area cannot be over-emphasized.

**Figure 1. Five Questions to Answer: A Model for Effective Communication**




West, M. and Sullivan, T., The Language of Change, SEPG 2000, Seattle, WA.

3. Project manage the improvement activities; when the decision is made to apply LSS "tools and techniques," an appropriate POAM (or equivalent Work Breakdown Structure) must be developed and reviewed within the context of the Management Implement Team (MIT) as the way that business is being accomplished.

4. A thorough review of existing 4.1 "improvement initiatives" and activities must be rapidly conducted and decisions made as to "keep, change or eliminate" those necessary to balance any additional efforts attuned to NAVAIRSpeed. Thoughtful consideration must be taken to avoid "just piling on" any new activities that are needed.

5. Careful consideration must be given to staffing Blackbelts (change agents) and selection of projects for the Blackbelts to complete their certifications. Attention must be provided to ensuring that some of the projects address things that are highly relevant to all levels of the organization.

6. There are many "lessons learned" from other organizations that have successfully (that is they claim a huge return on investment) and these lessons should be understood by NAVAIR and NAVAIR 4.1. Devane (2004) has 28 lessons learned and recommends they not be condensed; he summarizes nine lessons learned for both the Transformation and Operations Phases as follows: (see pp. 75-84 for the complete list)

(Note HPO in this lessons learned is slightly different than Higher Performing Organiztions (Pickering) and relates more to High Performance Teams (HPT) in an appropriate team culture.

The nine key lessons learned that apply to both the "Transformation and Operations phase are

a. *There is a natural tendency to focus on the "gee whiz" nature of the new problem-solving tools that the Six Sigma discipline provides*. From the start leaders need to focus people's efforts on the application of the tools and how they help support company strategy and contribute financially—not on the nifty tables and charts the tools produce.

b. *Dispel the notion that all decisions require group participation.* This common misperception needs to be addressed early in the transformation. Although the HPO element of an LSS/HPO does help construct a more participative environment, all decisions do *not* require group participation, and in fact should not have group participation. The "everybody in-the-pool!" philosophy needs to be replaced with intelligent event invitations that consider the objectives of the event and the perspectives required for a high quality decision.

c. *Executives must visibly support the new environment continually or it will fail to yield the desired results.* Visible support includes conducting town hall meetings about the changes, celebrating victories in the new environment, and publicly rewarding and punishing people as appropriate to reinforce the desired results orientation and behaviors.

d. *Only hire external consultants who will build internal capability.* Unless an organization can pull off a massive raid of Black Belts and HPO design experts from an existing LSS/HPO, it is likely it will require external assistance. It is important that any consultants hired be training internal personnel from the first day they are on site to the day that they leave. In addition, strive to have internal Black Belts lead projects instead of external consultants so that internal capability is built up and consultant dependence is decreased. Otherwise, an organization has only funded an expensive temporary fix and built no internal capacity.

e. *Develop and publicize the method for disseminating strategy to the organization.* Getting the strategy out to the entire organization is essential. Everyone must know what the strategy is so they can support it through local goal setting and execution as well as through process improvement efforts. Strategic information flows downward so that local goal setting can support that strategy. Performance and inputs for strategy flow upward. Leaders have to ensure easy upward and downward flow. It is important to point out to the workforce that a person can simultaneously be on a standing HPT within the organizational structure and also on an ad hoc process improvement team formed to address a specific process issue. It is also important to note that in the *initial* redesign to HPTs, the HPT goal-setting process precedes the Manager goal-setting process. HPTs set their initial goals based on the organization's strategies, objectives, and goals. Subsequent HPT redesigns need to be aligned with the manager and organization goals.

*f. Create and support a learning-rich environment to accelerate the transformation and yield better business results.* Research and personal experience show that organizations that actively support learning and inquiry

can change significantly faster and more effectively than those organizations that do not.

g. *What top leaders say really matters.* During the transformation, the workforce evaluates how serious the organization is about the proposed changes by listening and watching top leaders. After the transition is over, top leaders must continue reinforcing what is important. One of the reasons Six Sigma has gained such dramatic results at Raytheon is that whenever CEO Dan Burnham gives a speech within the first ten minutes he mentions Six Sigma. This sends a powerful message to the workforce about what is important.

g. *Information dissemination and two-way dialogue at all levels of the organization are essential to a successful implementation.* All too often the only communication attempts are one-way. While slightly better than no communication, these fail to engage people and do not respond to unique questions they may have.

i. *Actively manage the organization's culture.* Culture needs to be managed just as much, if not more, than day-to-day technical tasks. The transformation to an LSS/HPO requires substantial changes to an organization's culture. As John Lupienski, the head of quality for one of Motorola's most successful quality plants in 2001 and 2002, once said, "When strategy and culture clash, culture always wins." Paying adequate attention to culture pays big dividends in any large-scale change effort.

## *Appendix A—Lean Six Sigma Principles and Perspective*

Note- this sections combines portions of three articles (Upton, Nave and Robustelli) relating or discussing Lean, Six Sigma and the Theory of Constraints. Portions have been rearranged to present a historical perspective, a comparison of the approaches and some thoughts on "what's next."

### Roots of Lean Six Sigma (Upton 2004)

The end of the 20th and beginning of the 21st century has seen increasing and continuing pressure from customers and competitors for greater value from their purchases whether based on higher quality, faster delivery, or lower cost (or some combination) in both manufactured products and services. In many industries, this has encouraged companies to adopt Six Sigma as their process improvement approach. Perhaps the most well known of these are Motorola, GE, and Honeywell.

In other industries, this has driven companies to adopt Lean as a method of improving speed to customer and overall cost. This is especially true in the automotive and aerospace industries. What is becoming increasingly obvious, however, is that a combined approach shows far more potential than either alone.

Many of us, however, have heard this all before, during the TQM era in these and other companies and industries. In most cases, however, TQM failed to live up to its potential. Is there any way that Lean, Six Sigma, or the Lean Six Sigma amalgam can avoid the deathtraps that compromised so many promising TQM implementations?

Total Quality Management (TQM) has roots that can be traced into ancient times but is usually identified with the establishment of product standards and statistical methods. With the additions of Juran, Deming, and a host of Japanese thinkers, the Statistical Process Control of the early 20th century became the TQM of the later 20th century. Lean has roots stretching back to the beginning of mass production. Generally, many of the ideas of Henry Ford and the TQM contributors, as interpreted and applied by Taiichi Ohno of Toyota and as documented by Womack & Jones are seen as the basis of Lean thinking. Six Sigma began when Smith applied more statistical rigor to TQM and became the organizational powerhouse when Welch and Bossidy developed the organizational infrastructure elements that characterize its modern implementation.

Lean Six Sigma is an integration of Lean Enterprise and Six Sigma that has been created independently and with greater and lesser degrees of success on numerous occasions.

This historical development is summarized in figure 1 (following).

One interesting thing about both Lean and Six Sigma, however, is their common TQM roots. The question of why Lean Six Sigma would work where TQM failed is important, especially since

many of the TQM failures were in organizations and industries that are currently attempting implementations of either or both of these or an integrated Lean Six
Sigma effort.

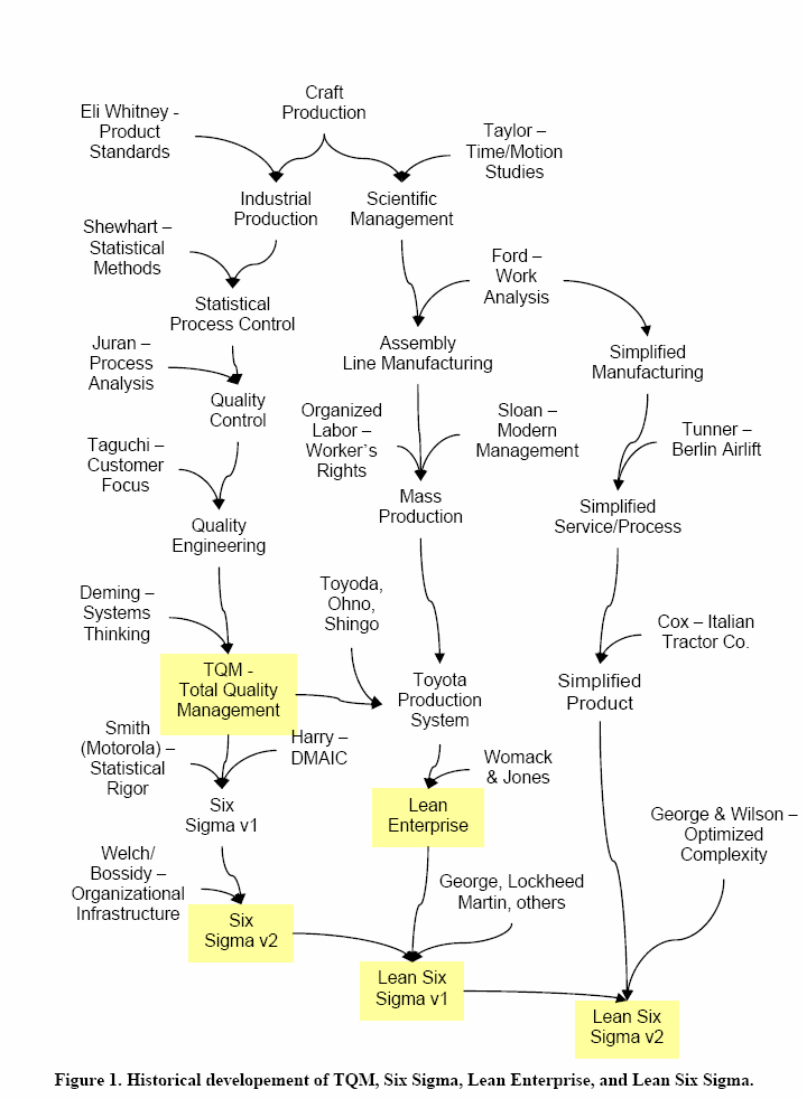



**Figure 1. Historical developement of TQM, Six Sigma, Lean Enterprise, and Lean Six Sigma.**

## Comparisons Lean, Six Sigma, and Theory of Constraints (Nave 2002)

The basics of the three improvement methodologies are reviewed and Nave (2002) presents a model to help understand their concepts and effects and similarities and differences. Table 2 describes the essence of each methodology.

### Six Sigma

Six Sigma claims that focusing on reduction of variation will solve process and business problems. By using a set of statistical tools to understand the fluctuation of a process, management can begin to predict the expected outcome of that process. If the outcome is not

satisfactory, associated tools can be used to further understand the elements influencing that process.

Through a rigid and structured investigation methodology, the process elements are more completely understood. The assumption is the outcome of the entire process will be improved by reducing the variation of multiple elements.

Six Sigma includes five steps: define, measure, analyze, improve and control (commonly known as DMAIC):
• **Define.** Practitioners begin by defining the process. They ask who the customers are and what their problems are. They identify the key characteristics important to the customer along with the processes that support those key characteristics. They then identify existing output conditions along with the process elements.
• **Measure.** Next the focus is on measuring the process. Key characteristics are categorized, measurement systems are verified and data are collected.
• **Analyze.** Once data are collected, it is analyzed. The intent is to convert the raw data into information that provides insights into the process. These insights include identifying the fundamental and most important causes of the defects or problems.
• **Improve.** The fourth step is to improve the process. Solutions to the problem are developed, and changes are made to the process. Results of process changes are seen in the measurements. In this step, the company can judge whether the changes are beneficial, or if another set of changes is necessary.
• **Control.** If the process is performing at a desired and predictable level, it is put under control. This last step is the sustaining portion of the Six Sigma improvements methodology. The process is monitored to assure no unexpected changes occur.

Focusing on the primary area of variation reduction the business produces other secondary effects, too. Quality is improved. Process investigation produces the re-evaluation of the value added status of many elements. Some elements are modified, while others are discontinued. Elements are refined and improved. Mistakes and opportunities for mistakes are reduced.

Some elements discovered during the Six Sigma product or service investigation constrain the flow of products or services through the system. Flow is defined as the time from the input of raw material to the output of a salable item. Improvement of a process that was restricting flow results in reduced variation, better quality and improvement in the volume of the process output. Thus the organization has less money tied up in in-process inventory. The time from paying for input material to seeing a profit is reduced, and the organization can respond to customer needs more quickly.

Six Sigma is founded on two main assumptions. First, people in an organization understand and appreciate the fact that numbers can represent features and characteristics of a process. They appreciate that a deeper understanding of data and data analysis can be used to produce improvements, and graphical representations of data can provide new and different perspectives of the process. Analytical types, such as engineers and scientists, generally respect this approach.

Another assumption is that through the reduction of variation of all the processes, the overall performance of the organization will be improved. But while it is hard to argue against improvement, the economic reality of business is we want the most improvement for the least investment. Improving all of an organization's individual processes could actually have a detrimental effect on the company's ability to satisfy the customer's needs and provide product and services at the right time at the lowest cost. The realized savings to the system might be less than the cost of all the

So, an organization that improves things just because it can may be improving the wrong things for the business.

**Lean Thinking**

Lean thinking is sometimes called lean manufacturing, the Toyota production system or other names. Lean focuses on the removal of waste, which is defined as anything not necessary to produce the product or service.

One common measure is touch time—the amount of time the product is actually being worked on, or touched, by the worker. Frequently, lean's focus is manifested in an emphasis on flow.

There are five essential steps in lean:
1. Identify which features create value.
2. Identify the sequence of activities called the value
3. Make the activities flow.
4. Let the customer pull product or service through the process.
5. Perfect the process.

**Identify value.** The determination of which features create value in the product is made from the internal and external customer standpoints. Value is expressed in terms of how the specific product meets the customer's needs, at a specific price, at a specific time. Specific products or services are evaluated on which features add value. The value determination can be from the perspective of the ultimate customer or a subsequent process.

**Identify the value stream.** Once value is identified, activities that contribute value are identified. The entire sequence of activities is called the value stream. Then a determination is made as to whether activities that do not contribute value to the product or service are necessary. Necessary operations are defined as being a prerequisite to other value added activities or being an essential part of the business. An example of a nonvalue added but necessary process is payroll. After all, people need to be paid. Finally the impact necessary, nonvalue added activities have on the process is reduced to a minimum. All other nonvalue added activities are transitioned out of the process.

**Improve flow.** Once value added activities and necessary nonvalue activities are identified, improvement efforts are directed toward making the activities flow. Flow is the uninterrupted movement of product or service through the system to the customer.

Major inhibitors of flow are work in queue, batch processing and transportation. These buffers slow the time from product or service initiation to delivery. Buffers also tie up money that can be used elsewhere in the organization and cover up the effects of system restraints and other wasted activities.

**Allow customer pull.** After waste is removed and flow established, efforts turn to letting the customer pull product or service through the process. The company must make the process responsive to providing the product or service only when the customer needs it— not before, not after.

**Work toward perfection.** This effort is the repeated and constant attempt to remove nonvalue activity, improve flow and satisfy customer deliver needs.

While lean focuses on removing waste and improving flow, it too has some secondary effects. Quality is improved. The product spends less time in process, reducing the chances of damage or obsolescence. Simplification of processes results in reduction of variation. As the company looks at all the activities in the value stream, the system constraint is removed, and performance is improved.

The lean methodology also makes some assumptions:
• People value the visual effect of flow.
• Waste is the main restriction to profitability.
• Many small improvements in rapid succession are more beneficial than analytical study.
•Process interaction effects will be resolved through value stream refinement. People in operations appreciate this approach. Lean involves many people in the value stream.

Transitioning to flow thinking causes vast changes in how people perceive their roles in the organization and their relationships to the product.

**Theory of constraints (TOC)**

TOC focuses on system improvement. A system is defined as a series of interdependent processes. An analogy for a system is the chain: a group of interdependent links working together toward the overall goal. The constraint is a weak link.

The performance of the entire chain is limited by the strength of the weakest link. In manufacturing processes, TOC concentrates on the process that slows the speed of product through the system.

TOC consists of five steps:
1. Identify the constraint.
2. Exploit the constraint.
3. Subordinate other processes to the constraint.
4. Elevate the constraint.
5. Repeat the cycle.

**Identify**. The constraint is identified through various methods. The amount of work in queue ahead of a process operation is a classic indicator. Another example is where products are processed in batches. There are usually multiple constraints and identifying even one constraint usually surfaces others after that initial constraint is corrected, thus the needed for repeated analysis.

**Exploit.** Once the constraint is identified, the improvement programs: that many programs use a process is improved or otherwise supported to mass, one size fits all approach to improvement. With achieve its utmost capacity without major expensive the mass approach, a company hopes that by refining upgrades or changes. In other words, the constraint is exploited.

**Subordinate**. When the constraining process is working at maximum capacity, the speeds of other subordinate processes are paced to the speed or capacity of the constraint. Some processes will sacrifice individual productivity for the benefit of the entire system. Subordinate processes are usually found ahead of the constraint in the value stream. Processes after the constraint are not a major concern—they are probably already producing under capacity because they have to wait on the constraining process.

**Elevate.** If the output of the overall system is not satisfactory, further improvement is required. The company may now contemplate major changes to the constraint. Changes can involve capital improvement, reorganization or other major expenditures of time or money. This is called elevating the constraint or taking whatever action is necessary to eliminate it.

**Repeat.** Once the first constraint is broken, another part of the system or process chain becomes the new constraint. Now is the time to repeat the cycle of improvement. The performance of the entire system is re-evaluated by searching for the new constraint process, exploiting the process, subordinating and elevating.

By focusing on constraints, this methodology produces positive effects on the flow time of the product or service through the system. Reduction of waste in the constraint increases throughput and improves throughput time. When the constraint is improved, variation is reduced, and quality is improved.

Constraint focus does not require intimate knowledge of data analysis or that a large number of people understand the elements of the system. Understanding by a few people with the power to change things is all that is necessary. The effort can be localized with minimum involvement of the workforce.

TOC overcomes one criticism of most process improvement programs: that many programs use a mass, one size fits all approach to improvement. With the mass approach, a company hopes that by refining and improving each process individually and independently to maximum output, the entire system output will improve. TOC methodology operates on several assumptions:

As in the case of lean, the organization places a value on the speed at which its product or service travels through the system.

- Speed and volume are the main determinants of the success.

- Current processes are essential to produce the desired output
- The product or service design is stable.

Value added workers do not need to have an in-depth understanding of this improvement methodology. Suggestions by the workforce are not considered vital for successful implementation of the theory of constraints. Organizations with hierarchical structure and centralized knowledge value this approach.

**Comparing the three methods**

There are some commonalities and general criticisms of all improvement models. In addition, all process improvement theories and methodologies make a few of the same assumptions. The main points of each methodology are summarized in Table 2.

Improvement methodologies begin by taking the product or service configuration at face value and improving the processes or system. They assume the following:

• The design of product or service is essentially correct.
• The design of the product or service is the most economical.
• Customer needs are satisfied with that design.
• The current product configuration fulfills the functional requirements of the market and customer.
• The management structure supports and nourishes change.

These assumptions may not be valid and require exploration.

After extensive refinement of the existing processes or systems, many improvement methodologies begin to look at the product or service design. However, each views the design through its theory and tools.

Quality function deployment and value management are two techniques used to help connect the product or service design to customer needs. Both bring marketing, finance, operations, design, customer and suppliers together to systematically explore how the product performs the function the customer needs.

An interesting part of this investigation is that cost can be associated with function. When marketing and customers know the cost of specific features, they make informed choices about the configuration of the product or services.

Table 2- Comparison of Improvement Programs

| Program | Six Sigma | Lean thinking | Theory of constraints |
|---|---|---|---|
| **Theory** | Reduce variation | Remove waste | Manage constraints |
| **Application guidelines** | 1. Define. 2. Measure. 3. Analyze. 4. Improve. 5. Control. | 1. Identify value. 2. Identify value stream. 3. Flow. 4. Pull. 5. Perfection. | 1. Identify constraint. 2. Exploit constraint. 3. Subordinate processes. 4. Elevate constraint. 5. Repeat cycle. |
| **Focus** | Problem focused | Flow focused | System constraints |
| **Assumptions** | A problem exists. Figures and numbers are valued. System output improves if variation in all processes is reduced. | Waste removal will improve business performance. Many small improvements are better than systems analysis. | Emphasis on speed and volume. Uses existing systems. Process interdependence. |
| **Primary effect** | Uniform process output | Reduced flow time | Fast throughput |
| **Secondary effects** | Less waste. Fast throughput. Less inventory. Fluctuation — performance measures for managers. Improved quality. | Less variation. Uniform output. Less inventory. New accounting system.<br><br>Flow — performance measure for managers. Improved quality. | Less inventory/waste. Throughput cost accounting. Throughput — performance measurement system. Improved quality. |
| **Criticisms** | System interaction not considered. Processes improved independently. | Statistical or system analysis not valued. | Minimal worker input. Data analysis not valued. |

## Beyond Six Sigma (Robustelli 2003)

Most companies don't have the benefit of an up-and-running management system that optimizes all of its people, processes, products, services, transactions, tools and technologies. This keeps them from implementing Six Sigma effectively and deriving a consistent benefit from it. Instead, the DMAIC process is turned loose on every possible process. Expensive Black Belts are deployed to fix lower-order problems. Six Sigma becomes the only "legitimate" mechanism of change, rendering all other tools inferior.

In such cases, the initiative is no more than a big hammer--the default choice for every nail in need of driving. No big-picture management schematic connects a diverse set of human, technological and process-related factors. Therefore, when the Six Sigma initiative falters, it's blamed because it alone stands as "the way we do business."

Instead of rushing to implement Six Sigma, a wise company begins with more fundamental management-system building blocks, such as process mapping, value analysis and basic improvement activities. Only then does it develop a more sophisticated process management

system that helps it identify and improve chronic, hidden performance problems. Further, an introspective analysis and diagnosis of performance gaps, relative to customer requirements and the company's inherent capabilities, dictates its choice of methods and tools.

## Thoughts on Implementing Lean, Six Sigma and Theories of Constraints

The *Six Sigma Way* (Pande 2000, pp. 379-382) summarizes change implementation recommendations as the Twelve Keys to Success:

**1. Tie Six Sigma Efforts to Business Strategy and Priorities**
Even if your first efforts focus on fairly narrow problems, their impact on key business needs should be clear. Show how projects and other activities link to customers, core processes, and competitiveness whenever possible.

**2. Position Six Sigma as an Improved Way to Manage for Today**
The methods and tools of Six Sigma make sense for successful organizations in the 21st century. They're a product of lessons learned by enlightened companies and managers, which address the challenges of rapid change, intense competition, and increasingly demanding customers.

**3. Keep the Message Simple and Clear**
Beware of alienating people with strange terms and jargon that create "classes" in a Six Sigma environment. While new vocabulary and skills are obviously part of the Six Sigma discipline, the core of the system and your company's vision for Six Sigma should be accessible and meaningful to everyone.

**4. Develop Your Own Path to Six Sigma**
Your themes, priorities, projects, training, structure—all should be decided based on what works best for you. Think about it: Why should there be a rigid formula for an approach to create a more flexible, responsive organization?

**5. Focus on Short-Term Results**
The proof is in the power of what Six Sigma can do to make your organization more competitive and profitable and your customers more loyal and delighted. Develop and push forward a plan that will make initial achievements concrete in the first four to six months.

**6. Focus on Long-Term Growth and Development**
Balance the push for early results with the recognition that those gains must lay the foundation for the real power of Six Sigma: creation of a more responsive, customer-focused, resilient, and successful company for the *long term.*

**7. Publicize Results, Admit Setbacks, and Learn from Both**
Don't expect—or claim—that Six Sigma works perfectly in your company. Recognize and celebrate successes, but pay equal attention to challenges and disappointments. Be ready to continuously improve—and even redesign—your Six Sigma processes as you progress.

**8. Make an Investment to Make It Happen**
Without time, support, and—yes—money, the habits and existing processes in your business won't change much. The results are likely to bring a quick return on investment, but first you have to *make* the investment.

**9. Use Six Sigma Tools Wisely**
No single tool or discipline in the Six Sigma system can create happier customers or improve profits. Statistics can answer questions, but can't deliver outstanding service. Creative ideas may hold potential, but without processes to develop and deliver them, they're just dreams.
Your success in Six Sigma will depend on applying all the methods, in the right balance, to maximize your results. And using the *simplest* tool that works—not the most complex—should be highly valued.

**10. Link Customers, Process, Data, and Innovation to Build the Six Sigma System**
These are the core elements of the Six Sigma approach. When you understand your markets, your operations, and can use measures and creativity to maximize value and performance, that's the *potent combination that can make life miserable for your competitors.*

**11. Make Top Leaders Responsible and Accountable**

Until senior managers—of the corporation, business unit, or even department—accept Six Sigma as part of their jobs (or have it *made* part of their jobs), the true importance of the initiative will be in doubt—and the energy behind it will be weakened.

**12. Make Learning an Ongoing Activity**

A few months of training, however intensive, won't cement all the new knowledge and skills needed to sustain Six Sigma. Over time, you should look outside the Six Sigma discipline for other methods and ideas that complement the tools we've reviewed in this book.

**BONUS—Make Six Sigma FUN!**

Yes, this stuff about business survival, competition, and measurement is serious, sometimes confusing, even a bit scary. But the Six Sigma Way opens the door to new ideas, new ways of thinking, and a new breath of success. Putting humor into it and having a good time with Six Sigma will only *raise* your chances for success: Any time people enjoy something, they almost automatically put more energy and enthusiasm into it.

## *Appendix B- HPO and LSS Comparisons*

### HPO Overview (Pickering)

Recall that the 3-day seminar, **Building High-Performance Organizations In The Twenty-First Century**, is concerned with the **theory and practice of large-scale organizational change**. It assumes that: (1) after years of observation, seminar participants are "experts" on their own organizations, but (2) they may not have been exposed to an extensive organizational theory background and so need a framework (a diagnostic change model and analytical approach) to structure and amplify their knowledge and suggest how to use it to effect change, and (3) they want to be part of a positive change process continually driving their organizations toward becoming "higher performing organizations" (defined as *simultaneously* delivering product and service quality, outstanding "customer value," and sound financial performance—"Pick 3").

The organizational change approach that forms the basis of the seminar seeks to "cast a net" over what has been learned from the past 100 years of academic theory and practical applications and to synthesize that knowledge base into a change model explaining why some organizations are high-performers but many are not. The seminar *does not* attempt to "tell an organization what's wrong with it" or to deliver a "cookbook" of what to do to improve it. Rather, the seminar introduces a series of "lenses" through which participants can view their own organizations and decide for themselves what changes may be necessary to improve its performance.

Work in the seminar begins by asking the question "how did their group get like this as an organization?" This question begins the HPO diagnostic process; and it is critical to understand how organizations got to be as they are, so that groups can decide what to keep from our "inherited past" and what needs to be changed. Depending on when the organization was formed, support systems and work processes of our organization may date from an earlier era; and while they may have been sufficient in that earlier period, they will not be capable of taking us into the future. This "context setting" is concluded by examining the skills needed to function in the future and by looking at how organizations might have to change support systems to achieve these new skills.

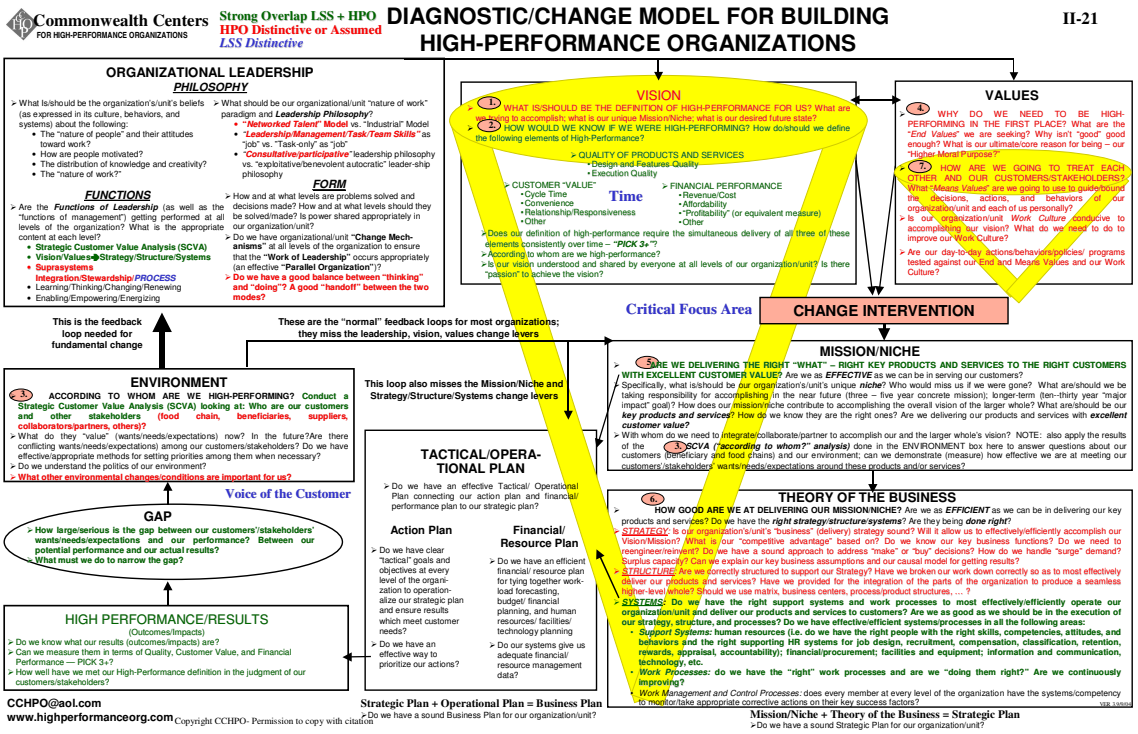
Focus is then turn to asking such "outcome-oriented" questions as: "What is high-performance for us?" "How would we know if we were high-performance?" "According to whom are we high-performance?" and "Why do we want to be high-performing in the first place?" but then groups also look inside the organization to ask "What are the *change levers* available to help us move the organization toward higher-performance?" "Are we doing the right 'what'?" "How good are we at it" and "How do we treat each other and our customers?"

Because this seminar is based on a change approach and materials designed for use by "intact" work teams over a relatively long period of time, the seminar does not try to cover all parts of the change model in detail. Rather, it begins with a thorough *overview* of the model's six interdependent change levers and then focuses time primarily on the first "lever:" the *critical nature of organizational leadership.* Experience has shown that unless an organization gets leadership "right" nothing else "downstream" in the model matters.

Organizational leadership in the HPO model will not be defined the same as "individual leadership" in most management courses. Rather, for us, leadership will be defined as consisting of three parts: (1) a belief set -- *a leadership philosophy* -- about the nature of people and their attitudes toward work, about how people are motivated, about the distribution of knowledge and

creativity and how we make decisions, and about how we see the nature of work; (2) a set of functions -- *the "work of leadership"* -- that must be performed at all levels of an organization if the organization is to become high-performance; ; and (3) a new set of "forms" -- *formal and informal ways to share power* -- required to get the work of leadership done. In the process of exploring organizational leadership, participants discover the need for a fundamental *"mental mind-set" or "paradigm" shift* by everyone in the organization -- moving our "mental view of organizations" from the older, steeply hierarchical, autocratic, control-oriented industrial model to a more inclusive, less-hierarchical, team-based "networked talent model."

The other five change levers -- vision, values, strategy, structure, and systems -- will be discussed as outgrowths of this first lever, but less thoroughly. Participants in the seminar will be asked to help direct the flow of the material presented to best meet their needs. Participants use applied examples of *how* the model is being used by teams in actual client organizations to help guide their change efforts. A key assumption of the HPO model and change process is that participants must gain the theory/practice-based "profound knowledge" and skills to diagnose their own organizations in order to begin identifying opportunities for introducing positive change. Although some discussion of implementation techniques (e.g., self-directed teams, re-engineering, TQM, etc.) will be included in the seminar, the majority of class discussion will center on the theoretical principles, which must be mastered in order to make any of these techniques work.



## Summary of Comparisons

Comparisons of the distinctions and differences between the HPO Diagnostic Change Model and Lean Six Sigma (LSS) are color coded above and summarized below.

- There is significant overlap between key pieces of the hpo and lss approach
- There are numerous "assumptions" that LSS seems to assume (again function of "flavor")
    - Process focused organization
    - S3/S4 Leadership Philosophy
    - Reward systems aligned (among others)
        - Staffing (how we acquire/ place talent)
        - Development (how we build competence/capability)
        - Measures and Rewards (How we track performance; desired behavior)
        - How we use information to build and sustain momentum
        - Organization Design (how we organize to support the change initiative)
        - Information Systems (How we utilize technology (IT, NMCI, etc))
        - Resource Allocation Systems (e.g., budget, finance, strategy, etc)
        - "Long-lasting, Effective Change Acceleration requires a thorough examination and realignment of key organizational systems and structures."
    - Where is the balance between "thinking" and "doing"
    - Clear and agreed to vision and vision elements
    - Performance measures in place to help id processes to improve
    - Values (not described at all)
    - Organization structure that supports not competes
    - Agreement on customers wants/needs/expectations
    - Understanding of external requirements and changes

- LSS Distinctive- add "voice of the customer" and the element of "time" to Pick 3+
- Critical Focus Area has to be "change interventions" (managing change) but is often assumed in the approaches (or at least not actively described)

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