

AUGUST–
NOVEMBER
2004



Fight test crewmember participates in a Lean Rapid Improvement Event at Warner Robins Air Logistics Center. He shares a Warfighter's perspective during creation of Value Stream Map for new aircraft maintenance flow.

RECOMMENDATIONS ON COACHING STRATEGIES FOR IMPLEMENTING LEAN

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The U.S. defense industry has more than a decade of experience implementing Lean process improvement methodologies to create value and eliminate waste in manufacturing and operations. While Lean implementation approaches differ, commercial companies and military commands consistently use highly skilled sensei, or *coaches* to help provide the discipline and structure needed to implement rapid and continuous change. This report documents key elements of coaching strategies from Lean implementations at 13 U.S. defense companies and military commands. The research indicates that differences in coaching strategies impact whether an organization will succeed in implementing Lean.

The U.S. defense industry has more than a decade of experience implementing Lean process improvement methodologies to create value and eliminate waste. Since the late 1990s, over a dozen Department of Defense (DoD) organizations have introduced Lean to systematically streamline operations and reduce costs. While Lean implementation approaches differ, private companies and military commands consistently use highly skilled sensei, or *coaches* to help provide the discipline and structure needed to implement rapid and continuous process improvement. Ten specific recommendations concerning coaching strategies to effectively implement Lean in defense organizations are included here.

The five fundamental principles of Lean listed below are described in the book titled *Lean Thinking*, by James Womack and Daniel Jones (Womack & Jones, 1996).

1. Specify Value in the Terms of the Customer.
2. Identify the Value Stream.
3. Make the Process Flow.
4. Pull Value from the Customer.
5. Pursue Perfection.

These Lean principles originated in Japan with automobile production practices developed at Toyota in the 1950s. Decades later commercial manufacturing companies around the world began adopting these five principles. More recently, U.S. defense industry began introducing Lean in their production and maintenance facilities. While shop floor operations continue to be the initial focus of commercial Lean implementations, some companies have extended the application of these Lean principles to additional processes. The U.S. defense aerospace industry has numerous examples of applying Lean structured improvement methodology to system life-cycle processes including design, material management, repair, and overhaul.

While DoD primarily relies on contractors to design and produce defense systems, many DoD organizations are responsible for system life-cycle processes such as material management, repair, and overhaul. Management of defense system acquisition and sustainment processes is a core competency of the material commands within each of the military services and several defense agencies. Figure 1 highlights how Lean principles have migrated from Japanese automobile manufacturing to defense system life-cycle processes to integrated defense system management.

Among the first DoD aerospace system management organizations to experiment with implementing Lean on a large scale was Warner Robins Air Logistics Center (WR-ALC). Air Force Major General Haines, then Commander of WR-ALC, highlighted that the center saved millions of dollars on labor, material, and tools by applying

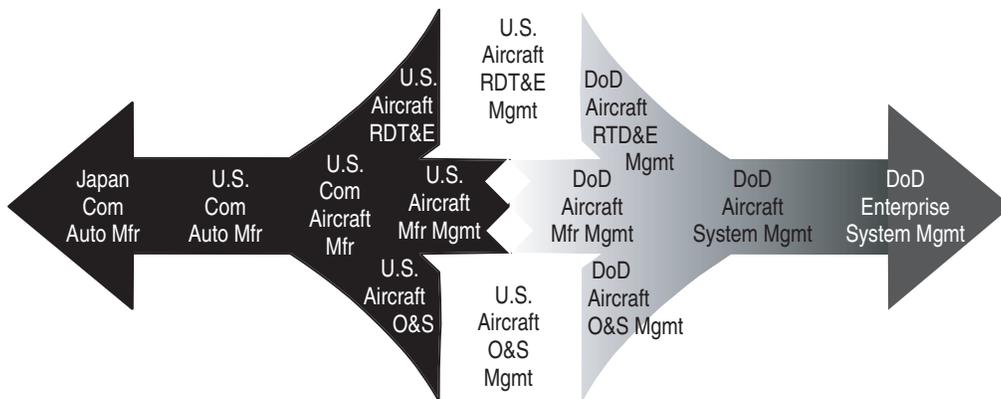


FIGURE 1. MIGRATION OF LEAN PRINCIPLES

Lean to depot-level repair of aircraft components. His successor, Major General Wetekam, expanded the centers Lean implementation to other weapon system sustainment processes. WR-ALC has significantly reduced the time to overhaul fighter and cargo aircraft. The other logistics centers within Air Force Materiel Command have also enhanced organizational performance by introducing Lean structured process improvement methodology (McCormack, 2002a).

Army Material Command (AMC) has also demonstrated improvements by introducing Lean to sustainment processes including maintenance and supply. In 2002, General Kern, Commander of AMC, expanded upon the Lean implementation at Red River Army Depot (RRAD). He launched a campaign to educate and train the AMC workforce about Lean principles and practices and provided funding for coaches at Army depots throughout the country (Hermes, 2002; McCormack, 2002a).

The U.S. Navy has applied Lean to the Intermediate Aircraft Maintenance Division at Naval Air Station Lemoore. The organization reduced the number of F-18 aircraft without engines from 26–28 per month to zero, and now a balance of engines is on hand to support the fleet (Jaynes, 2002).

“Defense systems management organizations are applying Lean structured, disciplined methodology for team-based process improvement to significantly boost performance.”

In 2003, Air Force Materiel Command (AFMC) piloted the application of the Lean principles to joint DoD and defense processes. Three AFMC program offices within the Aeronautical Systems Center collaborated with their prime contractors to use Lean tools and practices to reduce time to accomplish flight-testing, contract modifications, and contract closeout. Defense systems management organizations are applying Lean structured, disciplined methodology for team-based process improvement to significantly boost performance.

Each of these early Lean implementations by military commands share common traits and continue to expand. All DoD organizations employed external coaches to help introduce Lean principles and practices. During the same period, other organizations, including a military command, have attempted to implement Lean using only internal coaches and failed. This poses a key question concerning coaches. Richard McCormack asked military leaders involved with implementing Lean the question, “Can an organization like yours initiate a Lean implementation on its own or do you need help doing it?” Their answers are published in his book titled *Lean Machines: Learning From the Leaders of The Next Industrial Revolution* (Hermes, 2002; McCormack, 2002a).

Major General Haines, Commander, WR-ALC: “You need help doing it and we have one of the best, we’re using...Consultants. This was one of our learning experiences.... Our objective is to let them teach us for a year or so and by then we should have our own people who are ready to start running with it internally.”

Lieutenant Colonel Frank Hart, Commander RRAD: “You need to read “Lean Thinking”, then find yourself a firm like...that is on site on the ground and part of your team. If you think you can read the book and attend the seminar and do it yourself, you won’t achieve it. You have to hire experienced mentors who have truly walked the walk—been in an organization that has implemented it.”

During 2003, the Defense Acquisition University (DAU) Research Fellows investigated key elements of coaching strategy needed to successfully implement Lean in defense systems management organizations. While Lean principles and tools are fairly consistently defined, we found that coaching strategies for implementing Lean varied, and were not as well documented. Our study compared coaching strategies by organization size, mission, domain, and implementation phase. Through our research, we distilled that defense system management organizations should address the following six questions when building a coaching strategy for implementing Lean.

1. What is the scope of *responsibilities* for coaching staff to implement Lean?
2. What are the *credentials* needed to select coaches to implement Lean?
3. What is the *mix* of external and internal coaches needed to implement Lean?
4. What *tools* do coaches need to have knowledge/experience of to implement Lean?
5. What *performance measures* are needed to manage coaches implementing Lean?
6. What are the *incentives* coaches need to implement Lean?

Our research indicates that Lean—a structured, disciplined methodology for process improvement—can be applied to defense life-cycle system management activities. Although the Lean principles and tools are fairly formalized and straight forward, the strategies for implementing Lean vary. We analyzed and compared coaching strategies that companies and military services have employed to implement Lean in their organizations. The focus of the research was primarily on U.S. defense aerospace organizations. We found that different coaching strategies are needed during Introduction, Growth, and Sustainment phases of a Lean implementation.

DEFINITIONS AND SCOPE OF STUDY

Defense system management organizations were categorized by three dimensions: *size*, *domain*, and *mission*, which are independent variables in this study. The specific measures used to determine these domains are described below.

Size: *The number of people in an organization implementing Lean.* For the purpose of this research, a Small organization has less than 1,000 employees, Medium has between 1,000 and 5,000 employees, and Large has over 5,000 employees.

Domain: *The organization's primary business (DoD, Defense, or Other).*

Mission: *The primary emphasis of the organization with regard to the spectrum of defense system management activities.* For this research, the term *acquisition* refers to system development and demonstration work efforts plus production & deployment work efforts. Figure 2 depicts the life-cycle of systems management activities, as defined in DoD Instruction 5000.2, "Operation of the Defense Acquisition System."

People Interviewed: We interviewed over 50 people in organizations who were implementing or who had implemented Lean in organizations. Table 1 summarizes the organizations interviewed and their characteristics in terms of size, domain, and mission.

In addition to these formal interviews, we interviewed and observed other Lean practitioners from the following organizations or at the listed events.

- Lean Aerospace Initiative (LAI) is a non-profit consortium that provided coaches for introduction of Lean in three Aeronautical System Center (ASC) program offices. The LAI coaches were observed during program training of the Global Hawk program members in Rancho Bernardo, California in January 2003, and Value-Stream Mapping of the Global Hawk and F-22 aircraft programs in Dayton, Ohio in February 2003.
- Simpler Consulting Inc. is a private company that currently provides coaches to numerous DoD organizations including the Army, Navy, Air Force, and DoD headquarters staff. Simpler coaches were directly observed at Warner Robins Air Logistics Center and Corpus Christi Army Depot.

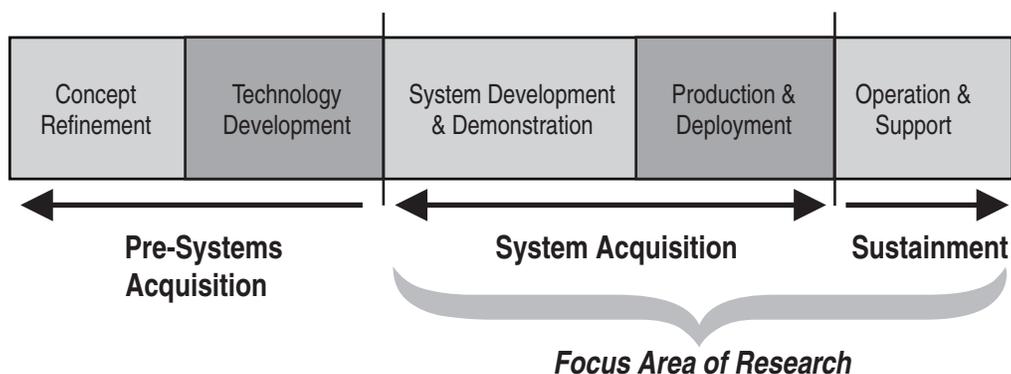


FIGURE 2. DEFENSE SYSTEMS MANAGEMENT ACTIVITIES

TABLE 1. ORGANIZATIONS INTERVIEWED

Organizations Interviewed	Parent Organization	Size	Domain	Mission
Corpus Christi Army Depot	Army Materiel Command	2,900	DoD	Sustainment
Aeronautical Systems Center	Air Force Materiel Command	9,300	DoD	Systems Acquisition
F-18 Engine AIMD	Strike Fighter Wing U.S. Pacific Fleet	700	DoD	Sustainment
Talley Defense Systems	Talley Defense Systems	200	Defense Industry	Acquisition & Sustainment
Metronics-Xomed	Medtonix	275	Other Industry	Acquisition & Sustainment
Northrop Grumman Air Combat Systems	Northrop Grumman	3,000	Defense Industry	Acquisition & Sustainment
Textron Systems	Textron Inc.	2,100	Defense Industry	Acquisition & Sustainment
Warner Robins Air Logistics Center	Air Force Materiel Command	13,000	DoD	Sustainment
Boeing Integrated Systems (Army Systems – LongbowApache)	The Boeing Company	4,000	Defense Industry	Acquisition & Sustainment
Lockheed Martin Aeronautics	Lockheed Martin Corporation	26,000	Defense Industry	Acquisition & Sustainment
Parker Aerospace	Parker-Hannifan Corporation	3,600	Defense Industry	Acquisition & Sustainment
Raytheon, Space & Airborne Systems	Raytheon	9,300	Defense Industry	Acquisition & Sustainment
Air Mobility Command	U.S. Air Force	147,000	DoD	Sustainment

- Lockheed Martin Commercial Systems Engineering is a private company that provides coaches and training for Lockheed Martin companies located in the eastern United States plus other American industries and government agencies. Lockheed Martin coaches were directly observed during training conducted at the companies training facility in Mount Laurel, New Jersey in June 2003.
- Raytheon Learning Institute is a training organization within Raytheon Corporation that provides Six Sigma Expert training within the organization. Raytheon coaches were directly observed during training conducted at Babson College, Massachusetts from July through September 2003.
- MainStream Management LLC, is a private company that provides coaches to guide Lean culture change activities currently supporting depot activities at Hill Air Force

Base, Utah. MainStream coaches were interviewed in June 2003 and directly observed at Hill Air Force Base in October 2003.

- Lean Shipbuilding and Repair Forum 2, Seattle, Washington, April 2003.
- LAI Annual Plenary Conference, Dayton, Ohio, March 2003.
- International Lean Manufacturing Conference, Lexington, Kentucky, May 2003.
- Lean Enterprise Institute (LEI) Value Stream Mapping training, Philadelphia, Pennsylvania, May 2003.
- Georgia International Lean Symposium, Warner Robins, Georgia, June 2003.

Lean Implementation Phase: Just as the defense system management spectrum is divided into several phases, Lean implementation can be divided into different phases based on workforce participation in Lean Events. While many leadership activities (like building and maintaining employee interest) are vital throughout an implementation, others require special attention during a specific phase. We used a 3-phase framework for implementing Lean to describe the application of the six coaching strategy elements. Figure 3 depicts these Lean Implementation Phases based on workforce participation in Lean events as we describe them in our research.

Research Hypothesis: If implementation of Lean is to be successfully introduced, grown, and sustained in defense system management organizations, then a robust coaching strategy is required.

Recommendations: The following are our top ten recommendations concerning coaching strategies to effectively implement Lean in defense organizations. These recommendations are based upon over 50 interviews with U.S. defense industry and DoD organizations that are implementing Lean. Findings are included from direct observation of 13 companies and military commands that are introducing, growing, or sustaining Lean. We believe these distilled experiences can help increase the probability that defense organizations can successfully implement Lean in system acquisition and sustainment processes.

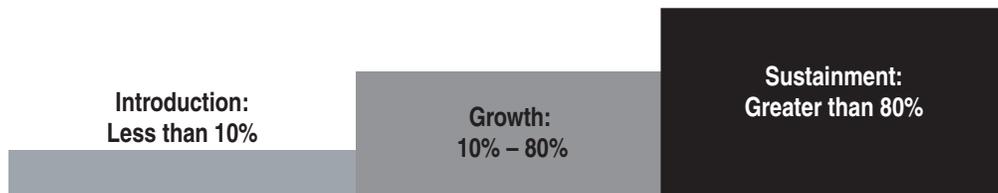


FIGURE 3. LEAN IMPLEMENTATION PHASES

COACH RESPONSIBILITIES

Establish several levels of coaches with different degrees of responsibilities. Organizations should also define the responsibilities and time commitment expected for both internal and external coaches to support Lean Implementations. The following three levels of coach responsibilities were used by several defense contractors and are suggested for medium and large organizations.

- **Level I Coach:** Serve part-time. Facilitate discrete, narrowly focused, Lean process improvement events.
- **Level II Coach:** Serve full-time. Scope, plan, conduct, follow-up, and assess Lean process improvement events. Lead multiple events or more complex projects. Train and mentor Level I coaches. Develop specialized tools and techniques that target organization's priority needs.
- **Level III Coach:** Serve full-time. Scope, plan, conduct, follow-up, and assess multiple or integrated Lean process improvement events and events of greater complexity. Train and mentor Level I and Level II coaches. Provide training in specialized tools and techniques. Advise senior leadership on alignment of projects with organization's strategic objectives.

***“Require minimum Lean coaching credentials
when hiring external coaches.”***

COACH CREDENTIALS

Require minimum Lean coaching credentials when hiring external coaches. All of the organizations studied that succeeded in maturing beyond the Introduction Phase used external coaches. Credential standards should include combination of relevant experience coaching Lean implementations in organizations within a similar environment (such as commercial, government, or non-profit) and mission area (such as manufacturing, maintenance/repair/overhaul, or supply-chain management). The credential standards should also specify minimum depth of Lean coaching experience (such as number of process improvement events or projects) and proof of results in improving performance of organizations (such as cost or time reduction).

A Defense organization, with over 8 years experience implementing Lean, has created evaluation criteria for qualification of external coaches. The rating system is available to dozens of subordinate companies, including many with defense system

acquisition and sustainment missions. Individual companies or business units within this corporation are expected to hire their external coaches from the approved list of consulting companies. Primary coaching credentials monitored are experience, results, and cost. Experience in specific environments, including manufacturing, material management, supply-chain management, and administrative domains highlighted. The Website describes experience and indicates relative cost for consultant services. Monetary savings are tracked for each external consultant or consultant's company, but not available on the Website.

“Primary coaching credentials monitored are experience, results, and cost.”

A large DoD organization has established minimum qualifications for personnel hired as external coaches. The contract they issued states these minimum qualification standards.

The following six criteria are documented as required for *Sensei's providing services* in the Statement of Work used by this organization.

1. General Manager with profit and loss responsibilities leading a Lean conversion.
2. Demonstrated World Class results while leading the conversion.
3. Ability to communicate—lead and teach at all levels of organization.
4. In depth knowledge of Toyota Production System tools.
5. Change management skills.
6. Twenty (20) full cycles of Lean implementation, including value stream analysis, Kaizen, formal Lean training and alignment/assessments.

Select and Certify internal coaches to an organizational standard. This coach selection standard should include previous job performance, participation in Lean activities, and personal traits (such as confidence, communication skills and inclination toward innovation). The internal coach certification standard should include a combination of formal training, experience coaching Lean activities, and auditable results. Medium and large organizations should consider establishing formal certification standards for multiple levels of internal coaches. Suggested certification standards for three coach levels are described below.

- **Level I Coach:** 2–5 days of classroom training and experience facilitating at least one rapid process improvement event that achieves measurable results.
- **Level II Coach:** 2–6 weeks of additional formal training. 1–2 years experience planning and executing Lean process improvement events and completion of at least one complex project. Experience mentoring Level I coaches is also highly desirable. Review of credentials by board of Level III coaches may include an interview or exam.
- **Level III Coach:** Extensive experience planning and executing Lean implementations at multiple levels within multiple organizations. Experience should include breadth of Lean activities to introduction, growth, and sustainment phases, including coaching of highly complex projects. Additional specialized training and experience mentoring Level II coaches is also highly desirable. Review of credentials by senior leaders may include interviews.

COACH MIX

Match mix of internal and external coaches to the Lean Implementation phase. Organizations should employ both internal and external coaches in all three Lean Implementation Phases. Figure 4 depicts a recommended mix of external and internal coaches by Lean implementation phase. Both coach mix and roles should be modified as the implementation progresses from introduction to growth and sustainment phases.

- **Introduction Phase:** Focus on using highly experienced coaches that can provide quick and visible successes. Highly experienced coaches increase the probability

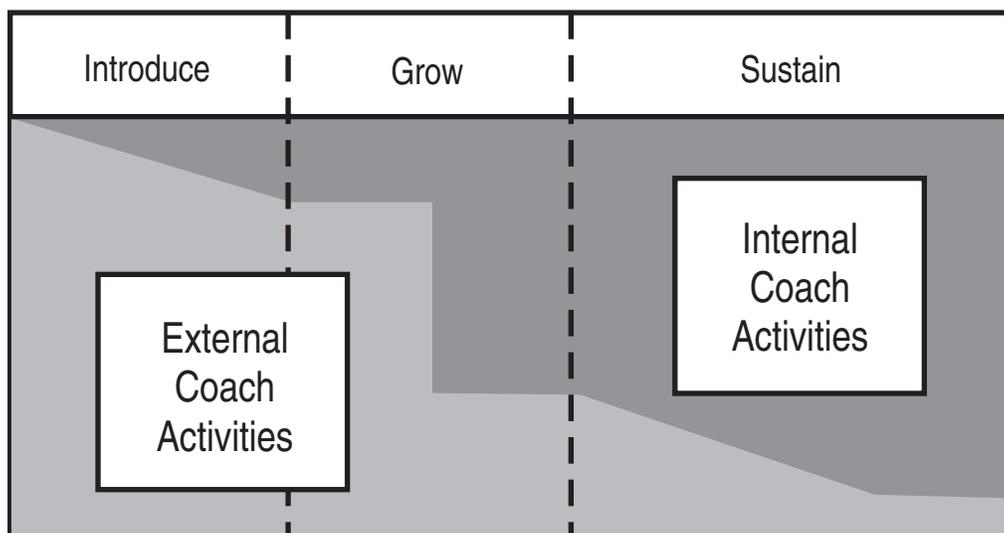


FIGURE 4. RECOMMENDED COACH MIX BY PHASE

of achieving early successes by ensuring events are properly scoped and planned and involve the correct people. Typically, highly experienced coaches do not reside in an organization that is just beginning to implement Lean; therefore, they must be obtained from external sources. Leverage the credibility of experienced coaches in having “been there and done that” in a similar organization to help overcome resistance implementing continuous process improvement.

- **Growth Phase:** Focus on using highly experienced coaches to build and develop an organization’s internal coaching capability. During the early Growth Phase, the majority of will probably be external resources; however, in this phase, emphasize the capacity to train and develop coaches using internal resources.

“Typically, highly experienced coaches do not reside in an organization that is just beginning to implement Lean; therefore, they must be obtained from external sources.”

- **Sustainment Phase:** Focus on conducting the majority of Lean activities using internal coaches but continue to employ external coaches to provide specialized support or an outside source of observation.

Assign coaches to the appropriate reporting chain based on the Lean Implementation Phase. During the Implementation Phase coaches should report directly to the corporate Lean champion (a senior executive or leader with a vested interest in the success of the Lean Transformation activities). During the growth and sustainment phases, maintain this reporting relationship as a training center for Lean experts within the parent organization, but move experienced coaches into the line organizations.

COACH TOOLS

Select a standard set of primary tools for coaches to use for planning, executing and evaluating routine process improvement events. This set of tools can be augmented with highly specialized tools such as Six Sigma statistical process control when required.

Each of the following primary coaching tools is a key ingredient to enable Lean teams to systematically achieve rapid and continuous process improvement.



LAI
LEAN
AEROSPACE
INITIATIVE

Contract for Change

We, the Leadership, pledge to support the Lean transformation through the following actions:

- We will write and communicate a vision and strategy for the area that makes the Lean Transformation
- We shall appoint a “Core Team” that will figure out the specific approach to Lean for this area
- We shall participate in the Value Stream Analysis by attending the daily or weekly outbriefs, reaching consensus on major opportunities and improvement approaches and finally signing the contract for change
- We shall lead the improvement process through our work on the Steering committee and shall assign appropriate resources to ensure that the transformation is successful

web.mit.edu/lean
Source: Raytheon

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FIGURE 5. SAMPLE CONTRACT FOR CHANGE

- **Planning tools:** Sign formal *Change Contracts* that describe desired outcomes, resources and specific roles (see Figure 5). The absence of change contracts in large organizations reduces the likelihood of implementations continuing beyond the introduction phase. After initial successes, organizations should employ more rigorous method to select and prioritize processes to apply Lean.

During event preparation, coaches worked closely with process managers and event leaders to develop a change contract. In medium and large organizations, coaches frequently used change contracts to clarify management expectations and secure commitment of needed resources.

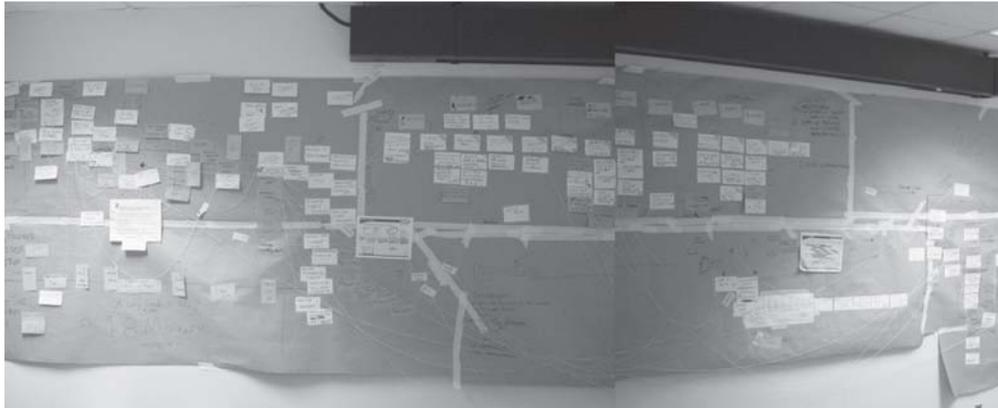


FIGURE 6. GLOBAL HAWK TIER I ENTERPRISE VSM

Change contracts served as charters for process improvement teams by clarifying expected outcomes, resources and establishing responsibilities for event leaders and participants. Change contracts in larger organizations were often signed by senior management to help communicate commitment to employees. In smaller organizations, the use of change contracts and other formal communication tools was less frequently observed.

- **Execution tools:** Use *Value Stream Mapping* (VSM) to help organizations make fact-based decisions throughout process improvement activities in each implementation phase. VSM can also help with selection and prioritization of process improvement events and more complex improvement projects. VSM is described in the book titled *Learning to See* by Mike Rother and John Shook (1999). The photo below (Figure 6) illustrates a Value Stream Map created by the Global Hawk System Program Office detailing their Tier I Enterprise.
- **Evaluation tools:** Asses benefits and costs of implementing Lean during all three phases. Larger organizations should establish a common method for determining Return On Investment (ROI) and cost savings for Lean events. While commercial industry may be able to link ROI directly to profit, DoD can compare investment with savings in resources including budget, manpower, material, and schedule.
- ROI was tracked in nearly all organizations implementing Lean. This was a consistent overarching objective for beginning and continuing a Lean journey. Investment cost was the cost hiring any external coaches plus the cost of time and materials for participants in an event from within the organization. The return was the amount that was booked to the bottom line (additional profit) as the result of the event. In most organizations, this bottom line saving was only the amount that could be booked during the fiscal year that the costs were incurred. Cost avoidances, both near- and long-term were tracked, but were not always credited as a true savings as a result of a Lean activity.

- External coaches were often measured based on return on investment. Expectations for booked savings were set for many internal coaches, but were not found to consistently be used as a measure of individual coach's performance. ROI was often used as an overall organization incentive, linking team rewards and recognition to the organization's contribution to the bottom line.

Communicate, Communicate, and Communicate with employees, managers, unions, and other process stakeholders. Medium and large size organizations have a stronger need to employ more sophisticated communication tools.

“Tailor Lean coach measurements to motivate key strategic outcomes.”

The following example is a powerful communication tool, from a worldwide defense industry leader, that highlights leadership vision, workforce incentive, and action plan. The corporate Lean champion published a letter to employees that clearly described why the organization was implementing Lean and a timed phased strategy. The three-page color letter described 20 building blocks for changing the company's culture to continuous process improvement. Included were targets for full-time *Lean managers*, minimum annual participation in 5-day process improvement events, and Value Stream Mapping requirement for investments over \$250K. The letter was signed by the organizations Chief Operating Officer and mailed to the home of every employee.

COACH PERFORMANCE MEASURES

Measure key processes that support an organizations capability to implement Lean. For example, during growth phase, matching the number of coaches available to targets for number of process improvement events is critical. A generally employed rule of thumb is that 1 percent of an organization's workforce serves full-time Lean coaches during the transition from Growth to Sustainment. Other coach support processes that organizations may want to measure include selection/assignment, training/certification, employment/rotation, and retention/promotion of coaches. Tailor Lean coach measurements to motivate key strategic outcomes. Measurements should be continually reviewed and updated to ensure the outcomes being measured are motivating desired behaviors in the coaches, workforce, and managers being evaluated.

Assess coaches' effectiveness based upon a combination of measurable performance (such as planning and executing process improvement activities) and feedback from participants and organizational leaders. Supervisors of coaches should focus their assessment on those responsibilities relevant to the level of performance and on

expected outcomes of Lean activities. Coaches should be provided feedback on their effectiveness and value to the organization systematically following milestones, such as the completion of large complex projects.

CONCLUSION

We have highlighted the following nine important areas dealing with coaching strategies.

- **Establish** several levels of coaches with different degrees responsibilities.
- **Require** minimum Lean coaching credentials when hiring external coaches.
- **Select and Certify** internal coaches to an organizational standard.
- **Match** mix of internal and external coaches to the Lean Implementation phase.
- **Assign** coaches to appropriate reporting chain.
- **Select** a standard set of primary tools for coaches to use.
- **Communicate**, Communicate, and Communicate.
- **Measure** key processes that support Lean Implementation.
- **Assess** coaches' effectiveness.

As you continue through this special edition of the *Acquisition Review Journal*, bear in mind our **Number One Recommendation** that goes beyond coaching to encompass overall Lean Implementation Strategy: **Recognize** that implementing Lean methodology is an enabler for continuously improving organizational performance, not for achieving a one-time increase in performance. Organizations should not try to become Lean, but plan, execute, and evaluate Lean activities to continuously improve and provide stakeholders ever-increasing value.

DAU offers a variety of courses in our continuous learning center dealing with Lean and Six Sigma. These are available through the DAU Web site at www.dau.mil under continuous learning.

ACKNOWLEDGMENTS

The authors wish to thank Dr. Beryl Harman and Mr. William Motley from DAU, and Dr. Eric Rebentisch from MIT for guidance and advice during our research project.



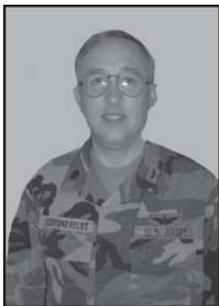
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