Lean Thinking Improves the Hydra-70 Rocket System

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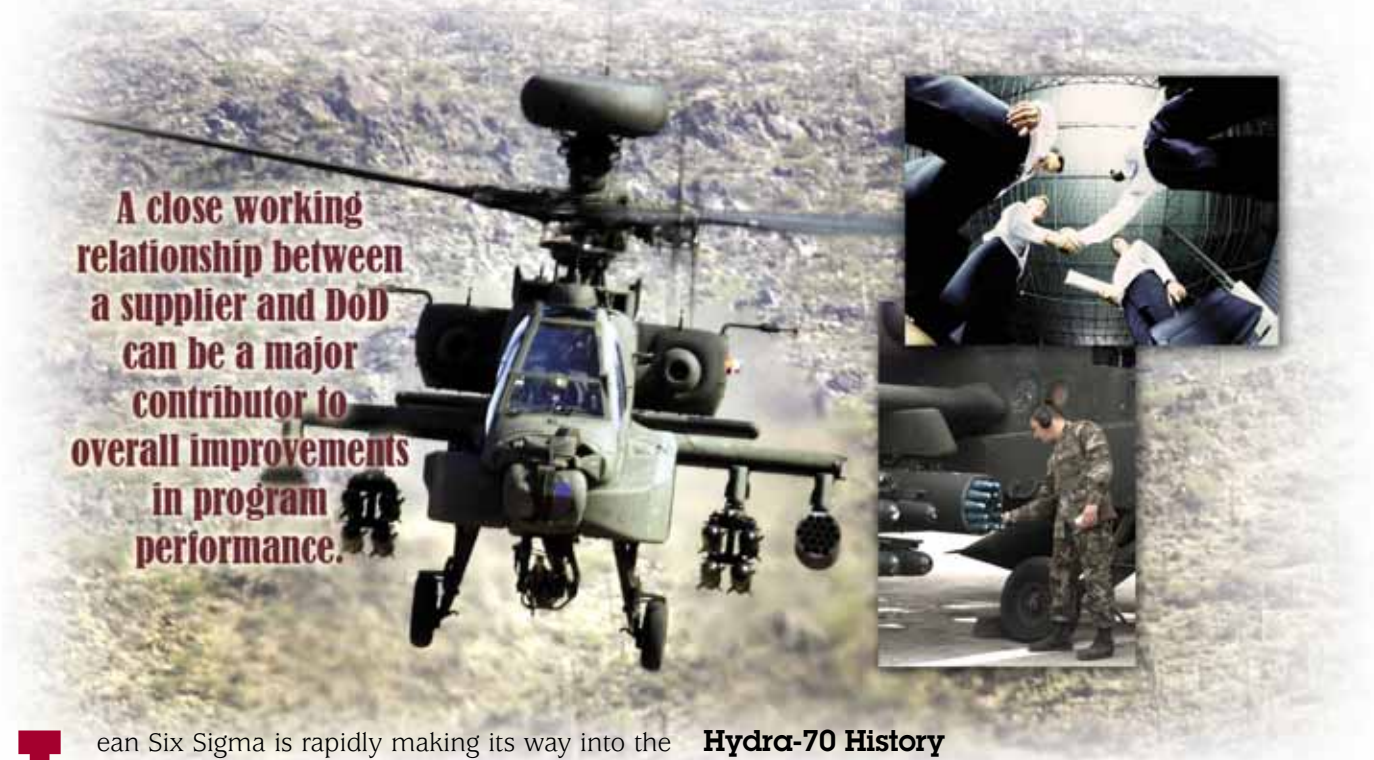

Lean Six Sigma is rapidly making its way into the mainstream of the defense industry. Lean thinking and principles are ultimately used to improve the efficiency and effectiveness of products and services provided to a customer. In short, Lean is the methodology of removing non-value-added steps from your business processes, and Six Sigma is the set of tools used to qualify the defects in your current processes and then quantify the level, amount, or return of those process improvements. Within the U.S. Army's Program Executive Office for Missiles and Space at Redstone Arsenal, Ala., Lean and Six Sigma are quickly becoming valuable tools in the cultural change unfolding within this extremely robust government organization. Specifically, the Joint Attack Munitions System (JAMS) Project Office saw the Hydra-70 System as a perfect candidate project to implement a Lean opportunity on one of the longest-running weapon systems.

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Hydra-70 History

The Hydra-70 Rocket System has been in production with the Army since the 1940s. The munitions system is used for both air-to-ground and ground-to-ground combat. It is capable of being launched from about 20 aviation platforms, from both fixed-wing and rotary-wing aircraft.

General Dynamics Armament and Technical Products is the prime contractor for the Hydra-70 Rocket System. Throughout the system's long and impressive history, it has gone through many component-improvement projects, and more are planned for the future. One specific change is to the system's MK 66 motor tube assembly. The motor tube assembly is manufactured by Gayston Corporation, a subcontractor to General Dynamics.

Since 1982, Gayston Corporation produced more than 4.5 million rocket motor tubes for the Army. Gayston's rocket motor tube production process requires more than 30 manufacturing and inspection steps, and all processes are performed within one facility. The process steps include diverse processes such as part lubrication, metal forming, heat treating, cleaning, machining, chromate conversion coating, and powder coating. Gayston began having trouble maintaining contract delivery schedules during the summer of 2006 as a result of significant equipment

downtime, increasing in-process losses, and production quality issues.

Lean Six Sigma Implementation

To address these critical Hydra-70 Rocket System production issues, Gayston, the JAMS Project Office, and General Dynamics embarked on a joint effort to improve the overall production throughput and quality of the MK 66 motor tube in early April 2007. All team members involved saw this was an opportunity to create a win-win situation for the rocket system and an opportunity to implement Lean and Six Sigma with a DoD supplier. The joint effort was initiated during a May 2007 site visit at the Gayston facility, with several follow-on events planned throughout the following months. Gayston requested a list of key process changes that would dramatically improve product quality, process quality, first-pass yield, total output per week, and on-time delivery.

Initial Assessment

The initial site visit was an opportunity to perform an overall assessment of Gayston's Hydra-70 motor tube production process. This allowed the team to determine whether Lean and/or Six Sigma would be beneficial to motor tube production improvements. The objectives set for the team were to:

- Improve Gayston's ability to meet objectives through Lean implementation
- Identify opportunities for improvement
- Obtain consensus on understanding the process and what is interrupting flow
- Create an improvement plan of action
- Improve reliability and producibility.

The team completed a walk-through of the manufacturing line and performed a quick Lean assessment. From this walk-through and assessment, several Lean approaches were recommended that specify the value of the process from a customer's perspective, identify the value stream through a value stream map for each process, eliminate waste, and continually pursue perfection. The main principle recommended from this assessment was to create a value stream map of the current, ideal, and future state of the motor tube production system. This map is a tool used by manufacturing facilities to understand flow of material and information as a product makes its way through the production process. This would assist Gayston, General Dynamics, and the government in developing an improvement strategy that would use several other Lean principles to support implementation of the improvement strategy. The principles include statistical process control (SPC), 5S, Takt time, and just-in-time (JIT) manufacturing.

SPC is the application of statistical methods to identify and control the variation in a process. The ability to determine the process capability through SPC and real-time process control with built-in quality would be beneficial to support the improvement strategy. Tactics known as 5S—which stands for the Japanese concept of housekeeping, involving sorting, straightening, sweeping, standardizing, and sustaining—were implemented throughout the plant. Takt time (the rate that a completed product needs to be completed to meet customer demand), JIT manufacturing (a planning system that optimizes the availability of materials at the manufacturing site to only what, when, and how much is necessary), and one-piece or continuous flow (the concept of moving one workpiece at a time between operations) were also found to be greatly beneficial to Gayston's improvement strategy. Although Gayston was in the process of rolling out its 5S program, which is one of the first steps to implementing a Lean workplace, management had not yet realized the impact that it would have on the overall production facility and how it was tied to Lean thinking. The concept of 5S requires one to clean, organize, develop, and sustain a productive work environment. It is one of the main foundations for visual management, which is another Lean principle that makes operation standards visual to workers so that they may follow them easily.

Gayston used visual management to arrange workstations in such a way that the status of that station could be determined at a glance. That gave the operator the ability to complete tasks faster using a standardized approach, paving the way for the team to move forward with the value stream map of the rocket motor process to determine if there were other areas of waste.

Applying Value Stream Mapping

A week-long value stream mapping event, hosted at Gayston, supported by General Dynamics, and led by the JAMS Project Office, was held in August 2007. Value stream mapping is a team-based, data-driven approach to diagnosing opportunities for improvement and developing consensus on an action plan to radically improve overall system effectiveness. It is different from process mapping, which is used in Six Sigma as a visual representation of how a product moves through a process clearly identifying inputs and outputs. The value stream map shows product/service flow, information flow, transportation, data collection, management controls, and where rework may occur.

The value stream mapping event provided training for all parties on how to create a value stream map, who should be included in the event, and what to look for in the process that could be considered waste. The scope, purpose, expectations, and customer value were determined for the event prior to any work starting. Once everyone was clear on what was expected, members from each organization were placed on sub-teams to collect the required data on flows. The value stream mapping exercise dissected the process and evaluated each process component of tube production from the management communication level

From Our Readers

Program/Project Manager: Makes the Differences Clear

The article "Project Manager and Program Manager: What's the Difference?" by Jeffrey Peisach and Timothy S. Kroecker [*Defense AT&L*, July-August 2008] is very well done. The boxes and columns make very clear the roles of each person. I've "been there done that" as the F-16 Armament project manager and the Modular Standoff Weapon program manager.

Alan Haberbusch
Col (Ret.), USAF

Socrates: Eventually You Have to Solve the Problem

Just wanted you to know how much I appreciated Maj. Dan Ward's piece on Socrates in Washington, D.C., for *Defense AT&L* magazine [July-August 2008]. I am retired, but I consult with lectures on leadership and program management.

I stress the dangers of relying on hard metrics when none of them solve the problems. Eventually *you* have to solve the problem, and vectors help you get there. There is also great power in failure if understood and interpreted properly.

Dan's article inspired me to read more about Socrates and, although Socrates talks about rules and principles, I have not found where he explained the difference. If this distinction is Dan's alone, he deserves even more credit.

Ed Armstrong
Consultant and LMC Program
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down to the production associate. This exercise proved to be eye-opening and provided data that were used later during value stream mapping.

Over the course of the week, the team generated hundreds of potential improvement ideas. These ideas were evaluated for ease of implementation, degree of impact and economic viability. A final list was compiled that contained the most practical and beneficial suggestions from the group. Each item on the list was then assigned to a team member. Team members from Gayston, JAM Project Office, and General Dynamics shared responsibility in assuring the items would be completed. Members from each organization then met on a weekly basis, either in person or by telephone, to determine the status of the action list and provide updates to the team.

The primary lesson of the value stream mapping was to identify whether an activity added value to the product or not. Any activity performed on the tube that did not add intrinsic value to the product was a potential for elimination. This exercise provided a completely different view of the total system from that previously held by Gayston, General Dynamics, or the JAMS Project Office. Unnecessary and redundant inspections, excessive and wasteful operator motion, inefficient material movement and handling, work stoppages, delayed prime contractor and JAMS Project Office approvals of changes were all areas that came to light during this evaluation. The current-state diagnosis provided a launching pad for improvement.

Another important lesson for Gayston was the inclusion of all levels of the organization in the mapping exercise. Management, quality and engineering personnel, production supervisors, and production associates were all a part of the evaluation in addition to the JAMS Project Office and General Dynamics participants. It assured a well-balanced, cross-functional approach and generated a sense of teaming that was not present in the program prior to the event. It also allowed the team an opportunity to see the issue from another vantage point. That actually assisted in some of the solutions to eliminate waste in the process.

Based on each sub-team's observations of equipment and the previously collected downtime data, Gayston's approach to equipment maintenance became a prominent subject for discussion during the event as several team members observed areas that could benefit from a more holistic maintenance system. This resulted in total productive maintenance becoming a part of the learning process during this exercise. TPM was the third Kaizen event (outside Lean and Six Sigma) that was held at Gayston to assist with improvements. Kaizen is Japanese for "continuous improvement" and is often used to mean team-based structured problem solving. TPM is a concept that brings maintenance (preventive, productive, and au-

tonomous) into focus through a structured approach to minimize downtime and increase uptime or utilization.

Gayston's Current Status with Lean Implementation

While the process of Lean implementation is never fully complete, a majority of the items listed on the original action plan from the value stream mapping event have been implemented. There were a total of eight original process improvements that were considered the top candidates to provide the most benefit to Gayston. The eight process changes were generated by Gayston based on the current processes that could be improved to assist with throughput issues. Of those, four are complete, and the remaining four are in different stages of approval and implementation. The completed four involve:

- A change in the slug length to reduce scrap
- Relocation of a draw operation to reduce material movement
- Reducing the hardness testing from 100 percent to sampling
- Eliminating a powder coat wipe-off station.

These completed events have allowed Gayston to reduce in-process loss, improve material flow, and apply labor to other areas in the process. Reductions and combinations of certain operations and inspection processes have also been instituted, which has resulted in reduced material movement and part handling. A number of improvements relative to material storage, operator motion, ergonomic issues, and product flow were implemented almost immediately. These initial improvements provided feedback to the team that this initiative was valuable and relevant at the floor level. Some of the more complicated process changes have required significant and coordinated technical input from Gayston, the JAMS Project Office, and General Dynamics. These process changes and validations are ongoing and have contributed significantly to overall part quality and production rate consistency.

One major component of the Lean approach that is still being implemented is the institution of process-wide TPM. Maintenance of critical pieces of equipment has already been transitioned to a TPM system, and the uptime and overall equipment effectiveness has improved as a result. TPM is being rolled out across the product line in concert with a company-wide implementation of 5S principles. Full implementation of TPM throughout the process is planned for 2011, at which time increased uptime, quality, and throughput improvements are expected.

Beyond the initial VSM event, the JAMS Project Office also provided technical expertise relative to statistical process control and made resources available that allowed Gayston to incorporate SPC as part of its in-house data collection system. This integration provides operators at key processes the use of statistics to control the process and is shifting problem detection from a reaction-based approach to a more preventive method. The focus of SPC has been to drive the decision making and process awareness down to the operator level by collecting and analyzing data in real time in a way that allows the floor level personnel to evaluate the quality of their own product.

Overall Streamlining Effect

The quantifiable effect on Gayston's performance as a result of this teaming effort across the supply chain has been significant. Gayston's overall delivery rate has increased by 64 percent over the course of the last 16 months. More important, in-process losses continue to decrease. Over the same time period, Gayston has recognized close to a 50 percent reduction in nonconforming material. While the improvements to date have been noteworthy, Gayston expects to see further reductions in nonconforming material and consequently higher delivery rates as the remaining items on the original action list are implemented.

Problem resolution and process improvement efforts have become more streamlined as a result of the close communication and cooperation among the team members of all organizations. This case study demonstrates that a close working relationship between a supplier and DoD can be a major contributor to overall improvements in program performance. It also demonstrates that the uses of Lean thinking and principles throughout the process can assist with improvement in more than just productivity. Attention to detail from the management level to the production associate level can assist in identifying waste in any management and production system. The benefits far outweigh the initial time required to participate and coordinate the event. It will change the mindset of the facility and the people.

The objective for our initial implementation was to improve Gayston's ability to meet requirements through Lean initiatives. We achieved increased delivery rate, decreased process loss, reduced non-conforming material, and improved machine uptime. This was all achieved through the use of Lean thinking and principles (value stream mapping, TPM, JIT, 5S, Kaizen, and visual management). Each of these principles assisted the team in identifying wastes that could be eliminated from manufacturing, management, and government administrative processes to improve productivity, quality, and on-time delivery. Together, we helped change the culture of Gayston Corporation and the way they look at their production and management processes.

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