

Lean Thinking Benefits VIRGINIA Class Program Office

Dave Miskimens

The VIRGINIA Class Program Office, which oversees the design, construction, and delivery of the VIRGINIA class of submarines—the United States' newest class of attack submarines—has been “Leaning” forward in its thinking to reduce the costs of building a nuclear-powered submarine for the past two years. The Program Office, which began integrating Lean Six Sigma strategies into every aspect of the construction process, is reaping the benefits as it sees the costs go down.

“Lean [Six Sigma] is a tool that provides a way to organize an attack and go after cost reduction,” said Rear Adm. Dave Johnson, former program manager of the VIRGINIA Class Program Office. “With Lean strategies in place, we are seeing real cost savings today within the program. Some \$15 million per ship can be attributed to lean savings in government furnished equipment.”

Miskimens, a member of the Senior Executive Service, serves as the Technical Director for Team Submarine. He is the former deputy program manager for the VIRGINIA Class Submarine Program Office.



Embracing the Methodology

Lean methodology is about speed, efficiency, and quality. Six Sigma emphasizes the need to recognize opportunities and eliminate defects through data-driven decisions, and it incorporates a comprehensive set of quality tools under a powerful framework for effective problem solving. Lean Six Sigma combines these strategies, eliminating non-value-added activities, improving cycle times, controlling variation of redesigned processes, and maintaining high repeatability. The key tenet of Six Sigma is its problem-solving framework called DMAIC, which stands for **D**efine, **M**easure, **A**nalyze, **I**mprove, and **C**ontrol.

While improvement processes, tools, and techniques have been around since the 1980s, Lean Six Sigma is a relatively new methodology being embraced by the Department of Defense and the Navy. Formally introduced within Naval Sea Systems Command in 2004,

the methodology of Lean Six Sigma was adopted by the VIRGINIA Class Program Office two years later.

“To be successful, you have to make Lean a core part of your business practices,” said Johnson. “You need to have a goal and be able to invest in the right people and time to ensure that your Lean journey keeps rolling for the future.”

The catalyst for integrating Lean Six Sigma strategies as a means of reducing overall submarine construction costs was the goal established by the then-Chief of Naval Operations Adm. Michael Mullen in the spring of 2006 to build two submarines for \$4 billion in fiscal year 2005 dollars by 2012.

Lean Training

Since adopting Lean initiatives as a core business practice in the program office, 75 percent of

the VIRGINIA Class Program Office staff have some level of Lean training. Many have obtained yellow, green, and black belts that demonstrate their skills and knowledge in Lean Six Sigma. Training in Lean Six Sigma can be a one-day or a six-week course, depending on the level the person is attaining. For the most part, Lean training consists of both textbook knowledge of the subject matter (methodologies, tools, principles, and related topics such as leadership and change management) as well as real-world, successful application of Lean methodology and tools by actively participating in a number of Lean Six Sigma projects. The training also includes hands-on exercises that may be translated into real-world applications.

"It was the best training I've received in my 26 years of government service," said Steve Lose, the Command, Control, Communications, and Intelligence design manager responsible for combat systems and overall systems integration of the non-propulsion electronic systems (NPES) on VIRGINIA Class submarines. "It was exercise-based and gave you a set of principles to follow. The class was an eye-opener, as I learned how to do things more efficiently." Lose added that he learned to develop a process structure for business practices, and identified methods of improvement for the structure.

Lose was one of the program office's first staff members to take the Lean champions training at the Norfolk Naval Base in Norfolk, Va., nearly two years ago. Since then, he has been incorporating Lean strategies to the NPES.

Lean Planning

For the VIRGINIA Class Program Office, the journey toward integrating Lean initiatives began when the first executive planning session was held in October 2006.

"Our first EPS focused on addressing cost reduction and the construction span, which allowed us to focus on the areas where both the government and the shipbuilders' responsibilities intersected," said George Drakeley, the Lean Six Sigma point person and special assistant for acquisition for the program office. "There was a lot of good effort put into this session and [it] got some great results. It was this first event that started the whole drumbeat for Lean [in the VIRGINIA Class Program Office]."

The first EPS meeting included senior executives from the two VIRGINIA Class shipbuilders, General Dynamics' Electric Boat and Northrop Grumman Newport News; the supervisors of shipbuilding, conversion, and repair from Groton, Conn., and Newport News, Va.; key program managers from the VIRGINIA Class Program Office; and other naval officials. Together, group members identified areas for improvement, such as technical authority and sonar, where costs savings could be realized either by reducing program requirements or the construction span. The areas identified then became a value stream, which involves all the actions (both value-

added and non-value-added) currently required to build a nuclear submarine from design to launch from both a Navy perspective and the shipbuilder perspective.

As part of the two-day session, the group mapped a high-level current state-of-the-construction process and discussed what the future state should be. That allowed the EPS group to visually understand the flow of materials and processes throughout the build cycle to recognize wastes, focusing mainly on the areas in which the Navy's and the shipbuilders' responsibilities intersect. Lean Six Sigma process maps are low-tech, created on a wall with butcher paper, Post-it® notes, and markers.

"The results from the 2006 EPS have guided our efforts," said Johnson. "Had we not done this, we would not be where we are today, within our \$2 billion goal."

Lean Application

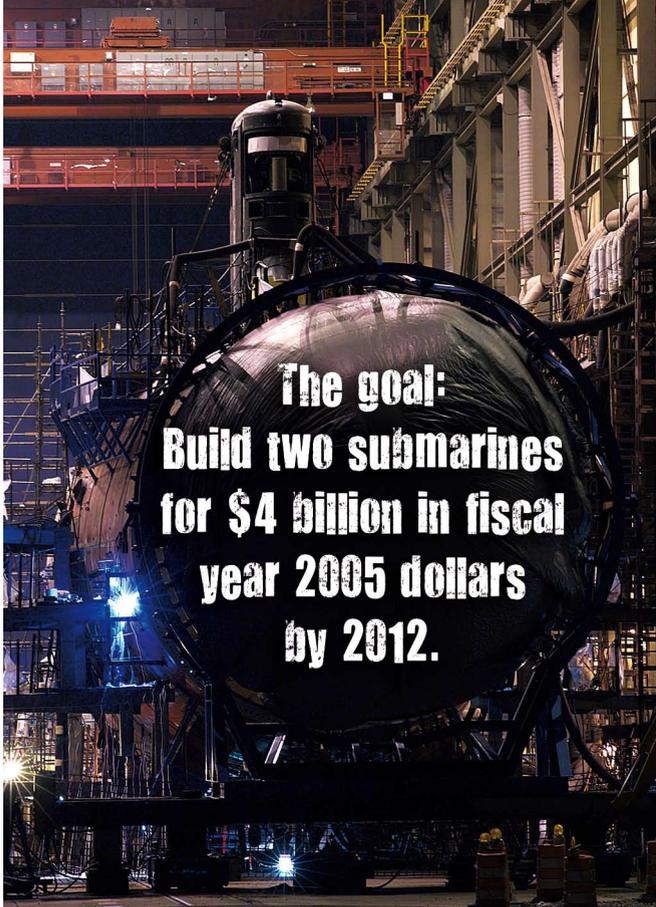
By the end of the EPS, the group selected 14 value streams, ranging from integration touch points to engineering reports to electronic support measures to the NPES integration strategy. While the majority of the identified value streams focused on the government-furnished equipment, the shipbuilders were challenged to develop their own Lean initiatives for shipbuilding and technical integration work.

"We tried working a dovetailed approach in which we identified items where the shipbuilder could look for cost reduction and where the government should look in reducing costs," said Johnson. "In certain situations where there was a cross boundary for the shipbuilder and the government, it then became a joint process for improvement."

Two months after the EPS ended, in December 2006, Lose held his own value stream analysis to identify areas for process improvement in the NPES. The Lean event included representatives from other team submarine program offices and Navy departments as well as representatives from the shipbuilders, Electric Boat and Northrop Grumman.

"We got all of the stakeholders together and mapped the value stream for the system delivery, installation, test and integration, and certification process," said Lose. "We had just completed our off-hull testing ... and the on-hull testing with [the USS] HAWAII, so everything was fresh in our minds. We came out of this event with a clearer set of actions of what we needed to do to improve our process and lower costs."

During the event, Lose and the other participants mapped the NPES current state process, identified areas for improvement, and then mapped two potential future states. The event resulted in improvement initiatives ranging from subsystem procurements to ship module construction. One of the areas identified as "non-value-added" was phased delivery of software. That was occurring in multiple subsystem



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areas where the initial software delivered by a subsystem required one or, in some cases, multiple updates through the course of the off-hull and on-hull (dockside) test periods. The magnitude, disruption, and cost impact caused by these phased deliveries was not concisely quantified until the value stream with all of the pertinent stakeholders was mapped. An improvement event was defined to work with all the system providers to develop specific delivery entrance criteria defining the elements of system maturity so that all stakeholders clearly understood what was required prior to system delivery.

“Just mapping that value stream and going through the Lean process helped identify what was value-added and non-value-added. All of the waste that had been built into the process over the years was amazing to me,” continued Lose.

Further Lean Initiatives

Lose held another Lean review with the participating acquisition resource managers and vendors to develop entry criteria for delivering subsystems—the secondary systems that are provided to the shipyards by vendors and integrated into the overall submarine system.

“What we found to be the root problem was that many of the subsystems [that] were being delivered were either incomplete or immature,” said Lose. “So, we came up with a specific list of criteria that the subsystems needed to meet and started working with the individual vendors who develop and produce these subsystems to get them to reduce costs and be more complete upon delivery. That reduced rework,

risk, and delay, and provided much more mature systems to the shipyards.”

Another NPES value stream that was “Leaned” was the common submarine radio room. A value stream analysis was conducted to identify process improvement opportunities in the development, installation, and test processes for the shipboard radio room. The common submarine radio room backfitted modernization has been aligned with the VIRGINIA Block III contract new construction delivery schedule, allowing a reduction in VIRGINIA Class-unique non-recurring costs. Savings were achieved in software development, system engineering, system integration/testing/certification, and technical documentation and logistics products. Those improvements will help to reduce rework, risk, and delays, and provide a cost avoidance of more than \$20 million over multiple ships.

“The NPES value stream is a perfect example between what is being done today and what the future state should be,” said Johnson. “It is almost the most obvious area where I see cost reduction and progress because it is the government’s part and is directly managed as part of the VIRGINIA Class process. The shipbuilder piece is a little less obvious.”

As the drumbeat of Lean is being heard on the Navy side, it can also be heard throughout the shipyards as the shipbuilders are conducting their own Lean events which are contributing to the reduction of costs and construction span. For the past five years, Electric Boat has been applying Lean Six Sigma tools to the entire submarine design, test, and repair process. In 2006, Electric Boat completed 131 Lean Six Sigma projects that produced a net savings of some \$16.2 million and has some 200 projects still in process.

To show off its Lean initiatives and strategies, Northrop Grumman Newport News invited Johnson, Lose, Drakeley, and other Navy officials along with Electric Boat representatives to their facilities. One of the Lean strategies that Northrop Grumman demonstrated was their ability to improve production in the installation of a high-efficiency inlet door. Originally, the number of times that the door was uninstalled throughout the build cycle would usually reach nearly 20. By using a value stream analysis to show where there was wasted time and effort, Northrop Grumman was able to cut the installation and re-installation of that high-efficiency inlet door down to two times, resulting in an 80-percent reduction in manhours.

“Lean is often common sense,” said Johnson. “People can look at what you are doing and decide what is a value-added step, and if [it is] not, remove it. The high-efficiency inlet door installation process improvement proves that.”

Continual Lean Application

Recently, one of the more important Lean events held by the VIRGINIA Class Program Office was the value stream analy-