Raytheon Vision Systems and Raytheon Electronic Warfare Operations, Goleta, CA: Progress Along the Journey to Six Sigma, Lean Cultural Change

Targeting long-term and short-term progress through experts, customers, and suppliers.

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Start with Stakeholder Buy-In

"We started on this transition in 1999," said John Peyton, Six Sigma champion for Electronic Warfare Systems at Goleta. "Our management, including Dan Burnham, chairman and CEO, heard from consultants that it takes five to eight years to change a culture, and there is no doubt that it takes that long. Managers and others need to be convinced that there is a better way to work. Some employees have distrust. You can’t just say, 'You’re empowered to lean out your area — go and make changes.'"

Change management starts when you get buy-in from key stakeholders, according to Peyton. "You get together with people involved in a process such as our Towed Decoy program. Experts sit down with those affected in a work group, discuss the process being used and its challenges, then what we’re trying to do — about needed improvements in the process and what those lean changes mean for associates and the company. We often do ad hoc training. People need to understand and be a part of solutions, whether it is creating data, proposing alternative process steps, etc."

Six Sigma Cultural Change

Raytheon people envision Six Sigma as a means of improving all processes within the organization, and to help the company work more effectively with customers.
Six Sigma Guiding Principles

1. Specify value in the eyes of the customer.
2. Identify the value stream and eliminate waste/variation.
3. Make value flow at the pull of the customer.
4. Involve and empower employees.
5. Continuously improve knowledge in pursuit of perfection.

Figure 1.

Raytheon Goleta associates reported a variety of Six Sigma improvement projects. For example, a 2002 Towed Decoy project showed that manual recording of Decoy range test data worked, but was inefficient. The team developed a computerized data entry process for easier data collection and analysis and got the go-ahead from their program office.

Providing a sense of urgency to Decoy Six Sigma efforts, their customer, the Air Force, wanted production increased from 150 a month to 300. After assessing the entire production operations, an implementation team decided to focus on ISSM (Integrated Solid State Module). Their targets: better product flow, train and implement lean, cross-train personnel, reduce waste, effectively manage cycle time and waste, and reduce overtime. After documenting baseline operations, they worked with operators for early buy-in on needed improvements such as simplified time card entries and reduced ISSM paperwork. Among the changes they achieved together were single-piece flow, range charts usage, point-of-use parts storage, and a streamlined shop floor rearrangement.

Their collaborative efforts resulted in a 46 percent reduction in ISSM WIP, 45 percent decreased decy cycle time, assembly over-

and suppliers. Six Sigma guiding principles are shown in Figure 1.

This knowledge-based, bureaucracy-busting process relies on involvement by associates in every area of the organization. Training, tools, and common sense enable all employees to analyze and improve day-to-day operations by utilizing tools learned in training and used on their first project. Specialists are Green Belts trained in Six Sigma concepts and productivity skills (brainstorming and visual planning, etc.). They collaborate with others to improve processes within their work areas/functions, with projects generally lasting up to a month. Raytheon’s goal was to have 25,000 specialists trained by the end of 2002, and the company expected to exceed that number. Experts are Black Belts armed with multi-disciplined tool sets plus additional training and experience. They facilitate cross-functional improvement projects usually lasting at least three months.

How does Raytheon manage-
time decreased 51 percent, shipments consistently reached 300 monthly, added capacity was created, and more than 50 associates were trained in Six Sigma and lean principles and tools. Electronic Warfare Systems also achieved performance gains resulting from additional Six Sigma projects in other areas such as security clearance procedures and cost and schedule improvement.

**Raytheon Vision Systems Six Sigma**

At Raytheon Vision Systems (RVS) in Goleta, experts racked up significant performance gains through Six Sigma. Approximately 950 employees at RVS develop and manufacture infrared focal plan arrays (FPAs) and detective assemblies. An FPA is the retina within an imaging system. RVS’s multiple value streams include development, design, materials, wafer processing, and manufacturing.

Among the broad range of Six Sigma projects reported by RVS experts, variability reduction (VR) is a major theme. For example, VR in Thermal Products resulted in implementation of a pull (versus the old push) system, better yields (up 120 percent), reduced product costs, and other improvements. This was accomplished by first training the workforce and then using a variety of tools, including process observation and process mapping.

In RVS’s FPA assembly operation, Six Sigma projects led to a “visible factory,” daily production meetings, daily run rules, and other changes (Figure 3). In turn, they reported reduced WIP (down 50 percent), cycle time (WIP/throughput) decreased 50 percent, static cycle time (average WIP/average throughput) decreased 65 percent, and throughput rose 34 percent. The most important result was that customer satisfaction increased dramatically.

Additional Six Sigma projects in FPA hybrid assembly and other areas netted further performance improvements. Among their tools were logical and physical process
flow analysis, line analysis, baseline evaluations, surveys, affinity analysis, 5-whys (asking "why" five times when possible NVA processes were encountered), and visual planning. Posting metrics in work areas helped to encourage Six Sigma enthusiasm.

**Solid State Microwave: Predictability is the Name of the Game**

Using 5S visual management steps (sort, store, shine, standardize, and sustain) and other improvement tools, Goleta experts working with associates at Raytheon’s Solid State Microwave (SSM) facility in El Segundo, CA transformed their operation to meet customer demand that was nearly double their capacity in 2000. Challenged by excessive WIP and NVA steps contributing to bulky cycle times, they chose a leaner path. They established production tempo based on customer demand, with standard WIP for all cells.

Now associates use range charts to manage daily production. An Operator Certification Program (OCP) provided training in data collection and analysis, enabling operators to certify their own work (and eliminating the need for additional inspection). They’ve reduced direct labor costs, as dynamic cycle times decreased more than 50 percent and quality performance improved.

Even better predictability performance was targeted in 2002, driving higher yields, boosting capacity, and enhancing performance in direct attach, housing assembly, and test operations as well as logistics, out-of-production spares, and other areas. Variability reduction efforts included implementing a process to monitor cycle time violators ("Dog Pound") in the first test operation, as pull system production was extended to six more product types. They continue to look for ways to sustain and surpass process improvements, thereby improving customer satisfaction and costs (significant reductions in working capital, attracting new business, etc.).

**People Power**

Infrared detector process variability reduction efforts yield more than faster throughput times and numbers on charts. Eliminating the continual crisis in meeting deliveries means less stress for customers, operators, and managers. Raytheon Vision Systems reports less attrition and overtime, more specialists qualified from project-related activities, and they are attracting engineers and other associates with needed skill sets. A weekly SPC roundtable consisting of process owners, process engineers, technicians, and line managers brings people together for discussions about holding the gains. Vision discussion in all-hands meetings, bulletin board displays highlighting "our vision in action," and posted performance updates with photos and stories encourage associates' participation in Six Sigma activities.

Aiming for competitive advantage through cultural change, Raytheon management understands the need for integrated human resources processes and systems. Competency models, focused training, performance management, etc. support a shared ability to change as needed, for long-term advantage. People need to understand what is expected of them and how their performance will be measured. Internal experts help associates document the "current state" and ways to move toward a defined "desired state" — better process definition, reduced process variation, risk management skills, measurement and analysis capabilities, organizational innovation and deployment, etc.
Supplier Teamwork: Signal Technology Corporation, Keltec Operation

Effective collaboration with supplier Signal Technology Corporation, Keltec Operation, Fort Walton Beach, FL, added to the success of recent Raytheon Electronic Warfare Systems’ performance gains and sets the stage for additional performance improvement processes with other suppliers, according to Daryl Combs, a Raytheon Six Sigma expert. Keltec, with 200+ employees, manufactures power supplies, amplifiers, and transmitters—a high-mix, low-volume structure that is beginning to move towards high-volume business because of the successes of Six Sigma concepts, said Gil Evangelist, Keltec’s vice president of operations.

“We started talking with Keltec in 2001 about ways that Six Sigma could help reduce cycle time,” Combs said. “Although they had already begun utilizing these concepts, I was welcomed there, and we got started on a 5S (housekeeping) project as a pilot. The lift they got from the project was tremendous.” Volunteers on the first Keltec 5S project organized tools in drawers, and otherwise streamlined the Magnetics Department area, in turn cutting the time and travel needed for operations. Keltec has two Six Sigma Green Belts (Evangelist is one) who coordinate the training and structure the teams.

Keltec associates also tackled a kaizen project on a specific low voltage product that was initiated by Green Belt training from Lockheed Martin. Their initial process map showed many wasted steps between operations. By eliminating some unnecessary process steps and moving equipment to flow the process more efficiently, operators and others on the kaizen team reduced travel time from 1650 ft. to 468 ft., slashed cycle time from 262 minutes to 187 minutes, decreased WIP 23 percent, and eliminated 66 percent of tasks identified as non-value-added (NVA).

“Fortunately for us, Daryl Combs comes to assist in our training and our kaizen and 5S projects,” said Evangelist. Combs spent 28 days at Keltec during five visits in 2002. “We have had throughput improvements and cost reductions in all of these projects,” Evangelist continued. “The margins have been steadily improving as we continue to find ways to identify and eliminate waste. We are working on improvement projects in all areas of the operation, for example, engineering in the bid and proposal stages, design to manufacturing, incoming receiving, purchasing, and also the stockroom. In 2003 we also plan to target a kaizen event in our marketing department. We will not limit our improvements to only the manufacturing processes.”

Next on the improvement agenda, according to Evangelist, will be “a solid year of internal improvement projects, with perhaps 25 percent of our kaizen and 5S projects in partnership with suppliers.” Keltec’s system already defines trends and process problems with their manufacturers. However, should, on-site Six Sigma training be required, it will begin in the near future.

Evangelist offered suggestions for other small manufacturing operations starting along the continuous improvement path. “In smaller companies, proceed one step at a time,” he said. “Don’t try to change everything in your plant overnight. Don’t take shortcuts. If a kaizen project is supposed to take five days, give your employees the time to gain understanding, make changes, and know that management is listening.”

Evangelist said recent performance improvements helped the Keltec Operation, a $40 million+ company, gain new business. “Assistance from Raytheon has helped us not only improve performance in our program with their division, but also helped us to improve globally as a business,” Evangelist said.

“We are 40 percent of their business,” Daryl Combs said. “It makes sense to work towards improvements in all areas of their operation, not just in one line. Some companies wait until their backs are up against the wall before they start trying to improve processes. At Keltec, it was different. We are building a stronger relationship over time, looking for longer-term progress in on-time delivery and cost. After starting on 5S projects, they are going on to meatier things.”

Added John Peyton, “We are gaining their confidence by sharing a process for making change that works, to benefit us and them. In the long run we will get a better, more competitive, long-term supplier. The reason why suppliers are so important to us is that a large portion of every job from the government goes right to our suppliers; we are a design and integration house. It behooves us to attack problems in our supply base, to help our bottom line. We are planning to expand this work with outside suppliers over time.”

More Challenges Ahead

The Raytheon Goleta progress report is impressive, but much improvement work lies ahead, according to Peyton. “Right now we are in the midst of an effort to lean some of our engineering process-
es," he said. "It's much more difficult to get those people engaged than factory people. We need to encourage creativity as we extend Six Sigma to other areas of the organization."

Peyton offered these lessons learned:

* Create a senior management steering committee for lean and Six Sigma to promote buy-in and involvement. A corporate mandate for improvement, combined with grassroots participation encouraged among all associates, helped Raytheon achieve dramatic performance gains.

* Develop cross-functional, diverse teaming — engineering, product development, finance, production, etc. — for better understanding and results.

* Look for measurable results, both immediate and longer-term; develop projections of measurable improvements. Make sure finance is represented on process improvement teams; it's very important to tie results to these projects, or momentum will fade.

* An infrastructure to support culture change is needed; for example, train specialists and experts in Six Sigma concepts (Raytheon wants one percent of employees certified as experts).

* A Six Sigma champion boosts improvement efforts, facilitating the needed training and improvement activities.

Asked what he'd suggest in the "do differently next time" category, Peyton said, "Look for more short-term successes. By that I mean that if an initial project was scheduled to take three months, I would schedule it for a month and a half and not allow it to go beyond three months. There's a danger of losing enthusiasm and energy if projects stretch out.

"We are not yet where we want to be," Peyton continued. "We want to make sure that Six Sigma is embedded in our culture, both internally and in our work with key suppliers. We've started our journey, but there is more work to be done."

Editor’s note: The hospitality of Raytheon employees and their assistance in the development of this article are appreciated.

Lea A.P. Tonkin, Woodstock, IL, is the editor of Target magazine.

Footnote
1. With headquarters in Lexington, MA, Raytheon Company is a global technology leader in defense, government, and commercial electronics, and business and special mission aircraft. Raytheon's Goleta facilities offer design, development, and production of electronic warfare and infrared/optical systems that are deployed on a variety of combat vehicles, aircraft, ships, and spacecraft. Raytheon Goleta employees total 1850, with annual revenues typically exceeding $500 million.

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