It's a Matter of Time:

Ship Servicers Use Quick Kaizen to Shorten Long Turnaround

by Jeanne Chircop

At a Glance . . .

- A team of quality experts at the Yokosuka Calibration Laboratory, U.S. Naval Ship Repair Facility and Japan Regional Maintenance Center (SRF-JRMC), used a series of five-day kaizen events to shorten service lead-time by 68 percent.
- Improvement occurred even while the shop increased its workload to maintain one of the world's largest and most sophisticated aircraft carriers.
- The team qualified as a finalist in ASQ's 2008 International Team Excellence Award process.

It takes years to build an aircraft carrier, but once one's in service, every day it is tied to the pier for maintenance is a strike against U.S. naval readiness.

At the Calibration Laboratory, U.S. Naval Ship Repair Facility and Japan Regional Maintenance Center (SRF-JRMC), in Yokosuka, central Japan, a team of quality experts understands that the clock starts ticking with them. Calibration of testing equipment is the first step in any ship service or repair process. If the calibration step is slow, the entire process is held up; if it's inaccurate, however, there are issues at stake more critical than time.

The pending arrival of the *U.S.S. George Washington*, one of the world's largest nuclear-powered super-carriers, at SRF-JRMC meant the Yokosuka Calibration Laboratory had to be in top form. The floating airbase, along with its already forward-deployed Seventh Fleet vessels, would add another 1,350 items to the high inventory the shop had to manage. The calibration team, long immersed in a dedicated SFR-JRMC lean management culture, turned to trusted quality tools and techniques to increase productivity and cut turnaround time while ensuring accurate work. A series of five-day kaizen blitzes led to:

- 68-percent reduction in lead time (approximately 53 days to 16 days)
- Annual avoidance of 3,000 calibration worker-hours
- Elimination of 26 unnecessary steps
- Overall productivity increase of 11.25 percent

Serving the U.S. Seventh Fleet

SRF-JRMC Yokosuka and its Sasebo Detachment in southwestern Japan are among about 55 U.S. military facilities in Japan, collectively known as United States Forces Japan (USFJ). Located at the entrance to Tokyo Bay near Yokohama, SRF-JRMC Yokosuka was created under a cooperative defense labor contract between the United States and Japan at the end of World War II. The Japanese government provides support for the maintenance of U.S. forces in the Navy's Seventh Fleet to ensure peace and stability throughout the region. The work performed at SRF-JRMC is representative of the strength of the alliance between the United States and Japan.

The naval facilities at Yokosuka comprise the largest, most strategically important overseas U.S. naval installation in the world and function as the Navy's main repair and supply center in the western Pacific. Approximately 2,000 Japanese employees work alongside U.S. military and civilian personnel to meet one common goal: "to keep the U.S. Seventh Fleet operationally ready."

Permanently home ported in Yokosuka, the U.S. Seventh Fleet is the largest U.S. numbered fleet, consisting of 60 to 70 ships, 200 to 300 aircraft, and some 40,000 sailors and Marines. Approximately half of the world's population lives within the Seventh Fleet's area of responsibility, which encompasses more than 48 million square miles.

The *U.S.S. George Washington* is the centerpiece of the U.S. Seventh Fleet. As high as a 24-story building, the supercarrier can accommodate 80 to 90 fixed-wing aircraft and helicopters. It is the first nuclear-powered surface warship to be stationed outside the continental United States. As befits a ship of its stature, it incorporates some of the most complex and sophisticated materials and electronic devices in the U.S. fleet. Specialized teams at SFR-JRMC Yokosuka and its Sasebo Detachment carefully maintain these items, along with the ship structure itself. The execution phase of all service and repair at Yokosuka begins with the facility's Calibration Laboratory, where personnel are experts in calibrating various types of test equipment, such as oscilloscopes, digital voltage meters, gauges, calipers, and micrometers. The laboratory consists of three distinct work sections: gauges, electronics and electrical work, and dimensional work.

Team Rainbow Seven

Member	Role	Assignment
Shinji Iwase	Green Belt	Super Tech
Yoshinori Takahaski	SME	Super Tech
Toshiaki Suzuki	Green Belt	Technician
Ken Akahane	SME/Champion	Section Head
Masaru Ishikawa	SME/Champion	Section Head
Shouichi Kosuge	SME	Technician
Youichi Kanamaru	SME/Champion	Section Head

Finding Focus Through Kaizen

As SFR-JRMC prepared for last year's arrival of *U.S.S. George Washington,* the Yokosuka Calibration Laboratory was tasked with increasing its efficiency. Such quality improvement efforts are nothing new to SFR-JRMC: The facility has engaged in continuous improvement since 1991 and follows lean manufacturing principles in all segments of its operation.

The Calibration Laboratory organized a quality improvement team to lead a series of kaizen or rapid improvement events (RIE). "Team Rainbow Seven" includes five Lean Six Sigma professionals—two Green Belts and three Champions. All seven team members are subject matter experts (SME) who were selected because of their multi-skill capability, effective communication and people skills, and ability to think outside the box.

Kaizen efforts are a regular feature of lean manufacturing. Designed to simplify work processes and help employees identify wasteful steps, kaizen efforts are based on the philosophy that small changes can bring large results. To identify where in the calibration service the team would suggest making changes, Rainbow Seven members used several quality tools:

- *Work-in-process* data to determine existing workload
- *Workload forecast* to project future workload
- *Value stream mapping* for a clear view of existing processes

Work-in-process data provided the foundation. Analysis showed the number of jobs in the Calibration Laboratory had increased significantly—nearly 200 more jobs in the last year (see Figure 1). Known data about items required to maintain *U.S.S. George Washington* (see Figure 2) and its supporting group were added to create a workload forecast—a total of an additional 1,350 items. Interviews with stakeholders from four groups—Aircraft Carrier Group, Surface Ships, Production Group, and Support Group—revealed that average lead time for calibration was 50 days or longer and this delay was a major concern for stakeholders (see Figure 3).

Obviously, if lead-time were already a concern, then the projected workload increase that would arrive along with the *U.S.S. George Washington* would cause even worse delays. Efficiency and timeliness thus became key focuses. Team Rainbow Seven specified five goals for improving efficiency and timeliness:

- Increase productivity by 10 percent
- Eliminate non-value-added steps

***Figure 1**—Work-in-process data showing increase in number of jobs in previous year*

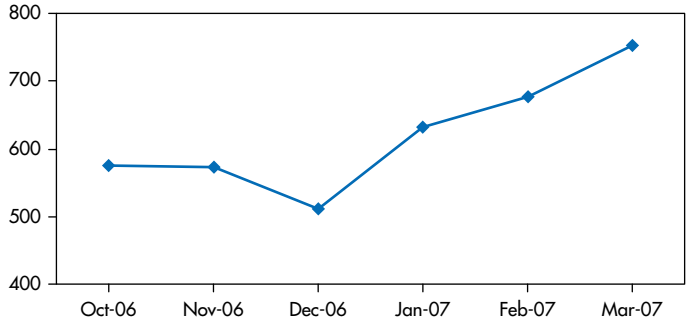
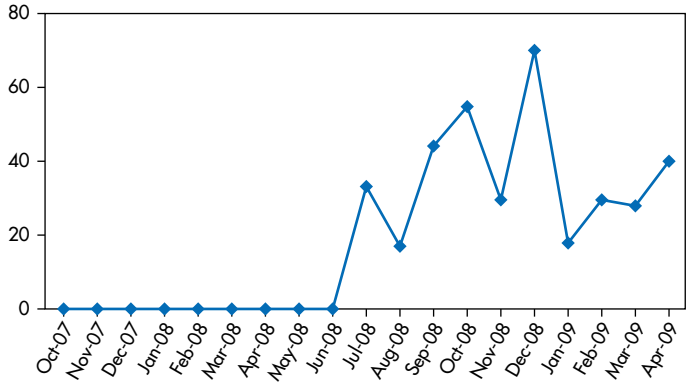


***Figure 2**—Workload forecast showing projected increase resulting from the arrival of the nuclear aircraft carrier (new primary customer)*



- Implement cell production
- Improve production control
- Reduce defects

Once the team had identified long lead-time as a top concern, they began to search for root causes. Methods and tools they used to identify possible root causes included:

- Brainstorming
- Data analysis
- Trend analysis
- Value stream analysis
- Operation work analysis

These processes helped the team to uncover several areas in need of improvement. For instance, they learned that the average 53-day turnaround included 44 days of wait time, caused in large part by scheduling irregularities and inefficiencies. They also discovered more than 200 unused or unnecessary standard calibrators in the shop, which required approximately 1,000 hours to keep in "active" status through regular calibration. (Inactive duplicate or excess standard calibrators could easily be brought back into active status if needed.) Equally significant, they discovered that customer micrometers occupy about 40 percent of the test equipment the shop calibrates.

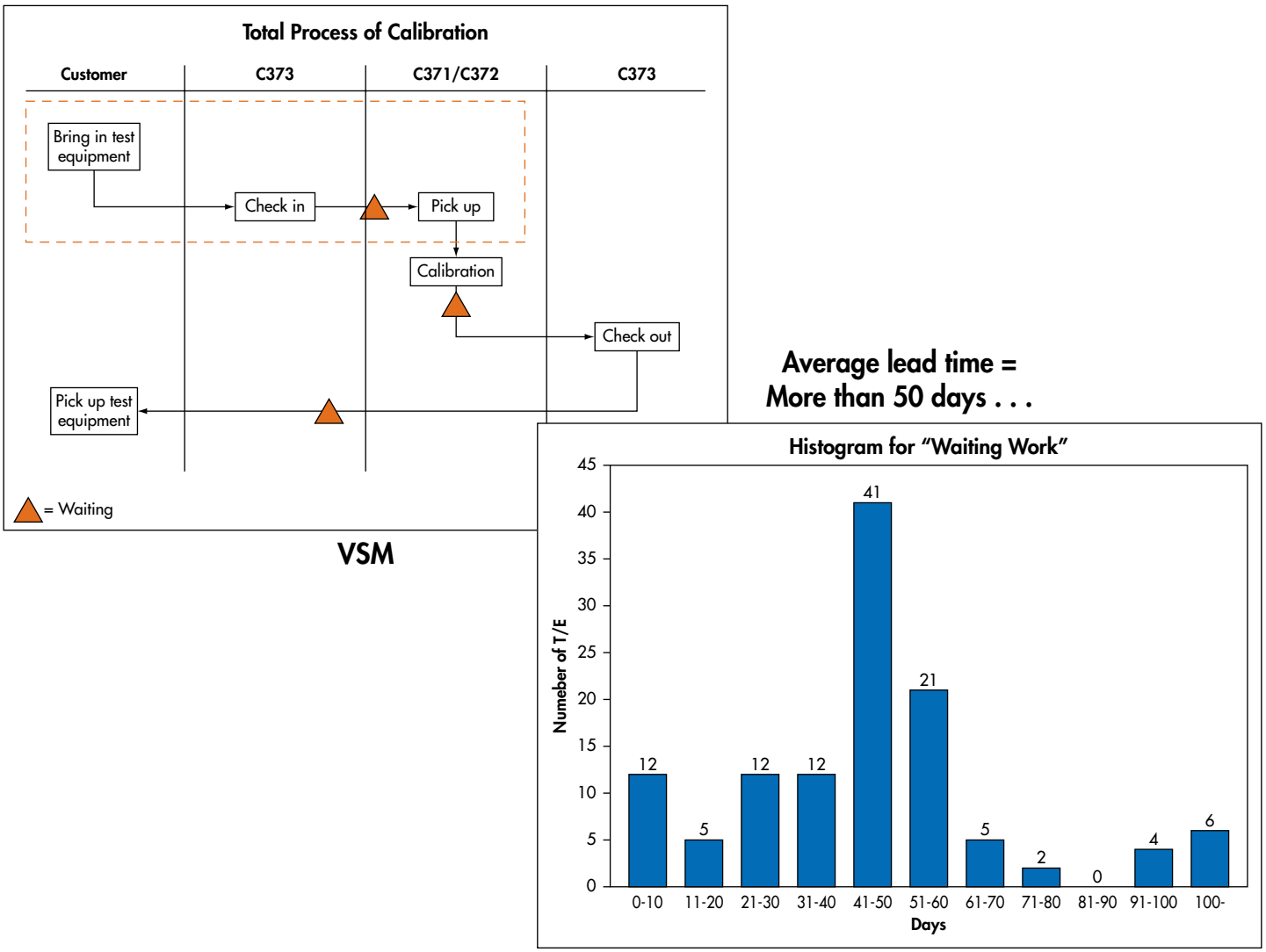
Understanding that outside micrometers constitute the largest single portion of their calibration work, Team Rainbow Seven decided to concentrate on how these items could be serviced more efficiently. They theorized that making changes in this area would translate into better overall efficiencies for the shop.

Finding Solutions Through Creative Thinking

With a target area identified, the next step became finding root causes for delays in servicing micrometers. Only after identifying root causes could possible solutions be devised. The team turned to operation work analysis for insight.

Operation work analysis involves examining every aspect of work procedure: work environment, work scheduling, and work methods. It also means organizations must compare their own processes with

***Figure 3**—Value stream map and histogram showing time spent waiting*



standard operating procedures for their specific type of work—in this case, standard calibration procedures. The team also employed data analysis, failure mode and effects analysis (FMEA), and the 5 Whys.

Team Rainbow Seven's analysis uncovered several tangible root causes:

- Excessive travel distance within the work environment—approximately 1,000 feet
- Many non-value-added steps—26 out of 47 steps involved wasted effort
- Many unused standard calibrators—approximately 200
- Inefficient individual work benches—no consolidation of calibrators
- No effective production control system—lack of consistent scheduling
- Nonconforming calibration procedures—unnecessary steps included

The team relied on brainstorming and stakeholder input to devise solutions to these specific problems. For instance, they worked to design a more effective workspace layout based on the simplified systematic plant layout method. They also brainstormed to design an improved scheduling system, whereby the first customers in could be assured of being the first customers served. In all, they devised seven final solutions that correspond with the five project goals they had set:

Using FMEA and the 5 Whys

Both failure mode and effects analysis (FMEA) and the 5 Whys take a step-by-step, systematic approach to identifying root causes. Using FMEA, organizations go through a formal process to identify ways a process or design might fail and then review possible consequences of that failure. Using the 5 Whys, organizations begin by listing five effects and then linking them to their direct causes, identifying a chain of causation.

1. **Conduct layout change.** The laboratory's calibration standards and tools layout would be changed to eliminate non-value-added steps and reduce travel distance. For the micrometer calibration process, the proposed layout reduced travel distance from more than 1,000 feet to only 30 feet, a 71-percent reduction.
2. **Reduce unused standard calibrators.** Team Rainbow Seven identified 200 unused calibrators. Maintaining these unneeded calibrators in active status wasted some 1,000 worker-hours each year. Changing the status of unused calibrators to "inactive" would mean they would no longer require regular calibration but could nonetheless be made "active" any time, if required, with proper calibration.
3. **Consolidate standards and tools.** By rearranging workbenches and consolidating the calibration standards and tools required for specific testing equipment, such as micrometers, the shop could create a cell production system. This change alone was expected to increase productivity by 10 percent.
4. **Implement first in, first out.** Using the database for work-in-process items, this solution would ensure that promised delivery dates would be met.
5. **Establish new calibration recall system.** With this solution, lead-time would be reduced and the shop would be able to introduce workload leveling, or "heijunka." In any process, waste occurs when production mix and sequence fluctuate. Consolidating micrometer calibrations on a visual scheduling board, sometimes known as a "heijunka box," would mean less down time caused by changeovers in tools and standards use.
6. **Improve job assignment system.** Using a more efficient system for assigning jobs would support a first in, first out production system.
7. **Simplify calibration process.** Existing practice prescribed creation of a written datasheet upon completion of every calibration job. Discussion among managers, however, revealed that not all equipment required such paperwork. Analysis indicated the shop could expect a reduction of about 2,000 worker-hours by filling out paperwork only for those items specified in the standard operating procedure.

Obtaining Support for Change

Having prepared well, Team Rainbow Seven next moved to approval and implementation of their data-based plan. Getting their lean champions and management to sign off was the easy part. Presenting a value stream map (VSM) indicating where their proposed changes would bring value in the service process helped to illustrate the tangible benefits possible with their plan.

The harder challenge proved to be convincing other workers in the Calibration Laboratory. During face-to-face interviews, workers revealed that their chief concerns dealt with a perceived loss of lucrative overtime hours and a hesitation to abandon old ways of working. Data once again saved the day. By showing how their workload would increase once the *U.S.S. George Washington* was in port, Team Rainbow Seven members assured hesitant workers that they would still have plenty of work.

Double-digit Results

Team Rainbow Seven's face-to-face interviews, lean out-brief meetings, and information sharing paid off, as they gained the support of both the production department and the shop's lean champions. In fact, the members of Team Rainbow Seven considered effective communication between the team and lean champions to be an essential factor in ensuring success.

With the assistance of their lean champions, Team Rainbow Seven devised an implementation plan as follows:

- Layout change—spearheaded by team members
- Reduction of standard calibrators—carried out by subject matter experts
- Implementation of new calibration recall system—responsibility of lean champions and production department
- Streamlining the calibration process—to be done by lean champions

Once changes were implemented, the tangible results realized by the Calibration Laboratory exceeded the benefits expected by Team Rainbow Seven:

- Calibration hours were reduced by 3,000 worker-hours annually.
- Travel distance was reduced by 70 percent, from 1,040 feet (317 m) to 318 feet (97 m).
- Non-value-added steps were eliminated from the service process. Twenty-six steps were simplified.
- Cell production system was established for servicing outside micrometers.
- Productivity increased by 11.25 percent.
- Lead-time was reduced by 68 percent. Workload leveling reduced the standard 53-day time to 16 days, including parts and delivery.

SRF-JRMC's Yokosuka Calibration Laboratory also experienced intangible benefits from its kaizen improvement efforts:

- Reduced customer complaints
- Improved communication between sections
- Stimulated team collaboration

Sustaining Improvement

Team Rainbow Seven shared the positive results of their efforts through a lean out-brief to senior leaders, including their commanding officer. They also conducted face-to-face briefings with internal stakeholders, members of the production department, and external stakeholders, including customers. Most important, the team's solutions were implemented by the chain of command and are currently a daily part of their section.

SRF-JRMC Yokosuka ensures that positive results of rapid improvement events such as this one continue by utilizing a lean dashboard, or database, that can track and measure organizational lean activities. The lean dashboard is updated and managed by the facility's Continuous Improvement Office. Results are routinely reviewed at 13 and 26 weeks after implementation and shared through a *Continuous Improvement Newspaper*.

Results were also shared with outside communities. Team Rainbow Seven showcased their achievement to the Japanese community by participating in the QC Circle National competition. They addressed an international audience as participants of the 2008 ASQ International Team Excellence Awards competition.

For More Information

- More case studies featuring the U.S. Naval Ship Repair Facility and Japan Regional Maintenance Center (SRF-JRMC) are available at www.asq.org/economic-case/markets/naval-case-studies.html.
- For more information on SRF-JRMC Yokosuka, visit http://www.srf.navy.mil/.
- For more information on lean tools and methods, visit the ASQ Knowledge Center at www.asq.org/knowledge-center.
- Learn more about the ASQ International Team Excellence Award by visiting http://wcqi.asq.org/team-competition/.