# Six Sigma Case Study

## Tried-and-true Six Sigma techniques lead to quantifiable, real-world improvement.

This project was initiated by an executive steering committee, a group of senior leaders, after receiving numerous customer complaints. The executive steering committee members, who had received Six Sigma training, applied Pareto analysis on customer issues raised in the previous 12 months. They determined that solder problems were the No. 1 problem to customers.

A program manager for a particular missile was chosen to sponsor the project and a high-level Six Sigma team was formed to identify project candidates. A Master Black Belt provided technical leadership. The team began working through the design, measure, analyze, improve and control cycle. After defining critical-to-quality measures, the team applied Pareto analysis to the types of solder defects. A wave solder team was formed and a subproject chartered. The team included a process engineer, the wave solder machine operator, a solder inspector and a touch-up solder operator. The team established a status reporting system to monitor progress, including routine reporting of issues to the project manager, which would prove vital.

A Black Belt chosen to assist the wave solder team began by providing training on basic process improvement principles and techniques. The team identified and assigned various tasks, including data collection, creating "as is" and "should be" process maps, and performing process audits.

From these activities the team learned the following:

1. Touch-up was performed before any data were collected. Because solder problems were routine, touch-up was considered part of the soldering process. There were 24 full-time personnel and four full-time inspectors assigned to touch-up.
2. Most of the defects were touch-up defects, not wave solder defects.
3. The equipment desperately needed maintenance. No preventive maintenance program was in place.

The team recommended several immediate changes:

1. Conduct inspection immediately after wave solder and before touch up.
2. Use a control chart to analyze the results.
3. Perform a complete maintenance of the process.

After three fruitless weeks of working toward these recommendations, the team raised these issues with the executive steering committee. Subsequently, the executive steering committee directed the sponsor to provide immediate assistance. The sponsor contacted the managers in charge of quality and maintenance and obtained their support. The sponsor also established a mid-level management team to review the project status more frequently than the executive steering committee reviews. The team leader (the process engineer) began making weekly status reports to the Champion, including "obstacles." The sponsor began daily walk-throughs of the area to speak to team members.

Defects dropped by 50 percent within a month of these changes. Productivity also increased.

The Black Belt and process engineer began design of experiments. The DOEs revealed several opportunities for improvement. For example, it was always assumed that boards with heat sinks had more problems than those without, that boards soldered in fixtures had fewer problems than those without, and so on. DOEs revealed that the majority of these assumptions were false, and sometimes the results were precisely the opposite of the accepted point of view. Significant quality and cost savings resulted as the new knowledge was used to modify procedures. Often, higher quality was obtained at reduced cost. For example, because boards in fixtures had *more* problems than those without fixtures, fewer fixtures were needed and quality improved.

In addition to the DOEs, the inspector and operator made a number of discoveries by conducting ad hoc experiments (undesigned experiments or UDOEs). Control charts were used to graphically investigate a number of hypotheses. Although UDOEs lack the sophistication and economy of DOEs, they can still produce dramatic improvements at little or no cost.

As a result of these and many other changes, the defect rate in the area dropped by 1,000 percent over a period of 10 months. Productivity increased by 500 percent in terms of labor hours per board. This occurred even though only a few of the proposed improvements were fully implemented. For example, procedure changes were needed before some of the boards could be run across the solder wave in the recommended direction. At the time I lost contact with the project, there were four full-time people on wave solder touch-up (vs. 24 at the start) and two half-time inspectors (vs. four full-time inspectors at the start.)

It appeared that there was no reason why touch-up and inspection could not be completely eliminated in a relatively short time. In addition to quality improvements and cost reductions, a large amount of factory space was released for more productive uses. In light of these results, senior leadership began reconsidering their facility expansion plan.

### About the author

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