Quality Assurance in Surveying & Mapping

>> By Fred Henstridge, LS

In 2003 the Mercedes Benz motorcar company had dropped from No.1 to 26th place on the J.D. Powers and Associates, Inc[1]. rating of auto manufacturers in the category of quality. This was eight slots below the industry average, trailing Chrysler and Ford. In 1991 Mercedes ranked No. 1 in quality and customer satisfaction; by 2000 they had dropped to No. 6 and by 2003 to 26th. Some of the problems cited in the J.D. Powers reports were handling, braking, shocks and struts, electronic window controls, and inaccurate fuel gauges. How did this one-time industry nameplate fall on such hard times?

The problems cited in the survey arose from three models from the year 2000, including the midsize E-Class sedan, Mercedes' big money maker. In the 1990s Toyota and Nissan stormed the U.S. market with lower-priced luxury cars such as the Lexus and Infiniti. To compete, Mercedes' engineers had to overhaul their process of building cars. Instead of letting design determine the cost, engineers had to design cars to meet a target price. These German engineers, accustomed to designing for quality, weren't very good at this practice. Quality took a back seat. Fortunately for Mercedes this situation did not last long and the company regrouped and went back to its roots, designing for quality and value.

Several years ago the firm I work for received a call from a Mercedes engineer in Stuttgart, Germany requesting that we take elevations on a section of the Harbor Freeway in Los Angeles. They wanted elevations taken to 3 millimeters on a ten-foot-by-ten-foot grid along a very rough section of this heavily traveled roadway. The Mercedes engineers wanted to use this data to create a digital terrain model of the roadway so they could design their front-end suspension for California drivers, many of which had been complaining about the stability and durability of the

Quality assurance: Training and mentoring of field staff.

> **"It takes years to build a good reputation and about one minute to ruin it."**

[1] "Mercedes' Head-On Collision with Quality Survey," *Business Week*, July 21, 2003

Quality control: Locating the position of a found or set monument with GPS assists in future recovery.

Quality control: Each welded joint in the pipe line is inspected, X-rayed and surveyed prior to cover. This information is recorded in a GIS database for future recovery.

Quality assurance: Training is a critical element of a Quality Assurance program

suspension systems. We carried out this assignment using the Vangarde 505 remote sensing pavement survey system. Due to the density of the grid, heavy traffic conditions requiring working off hours and nights, and coordinating with Caltrans, this was a very costly survey. It was also quite a change in philosophy from designing for cost rather than quality and customer satisfaction.

What has all of this to do with surveying and mapping? I believe we, as surveyors and mappers need to take a close look at our own practices and how we deliver 100% quality and customer satisfaction. Someone once told me that it takes years to build a good reputation and about one minute to ruin it. You can perform thousands of precise, accurate, timely and reliable surveys in the course of building your reputation. All you need is for one project to go astray and you have a major rebuilding effort ahead of you. What steps can you take to build a Quality Assurance (QA) program within your own practice, firm or agency?

In this series of articles I will share some of my thoughts and beliefs on quality assurance. These are based on more than fifty years' of experience in surveying and mapping both in public and private practice. Some of the issues I will cover in this and upcoming columns are:

- Defining the terms
- Addressing the commitment of management to a QA program
- Five steps to the development of a QA program
- Scope and standards
- Why QA must reach from the boardroom to the field
- Training for QA
- The importance of communications
- The human resources element
- Technical applications in QA
- How to get valuable client feedback

First, let's look at some terms.

Quality Assurance is a set of procedures designed to ensure that quality standards and processes are adhered to and that the final product meets or exceeds the required technical and performance requirements. Quality Assurance covers all activities from design, development, and production to installation, servicing and documentation. It includes the regulation of the quality of raw materials and subcontractors, assemblies, products and components; services related to production; and management, production, and inspection processes.

Quality Control (**QC**) is a system for achieving or maintaining the desired level of quality in a service or manufactured product by inspecting samples and assessing what changes may be needed in the manufacturing process or a service product.

Quality Assurance, therefore, is a means of conducting business, while Quality Control focuses on the one particular product or service. In this sense mapping, checking, or closing a traverse would fall under quality control, while training and leadership by management would constitute part of a quality assurance program.

Total Quality Management (**TQM**) is a management strategy aimed at embedding awareness of quality in all organizational processes. TQM has been widely used in manufacturing, education, government, and service industries, as well as NASA space and science programs. TQM requires that a company maintains this quality standard in all aspects of its business. This requires ensuring that things are done

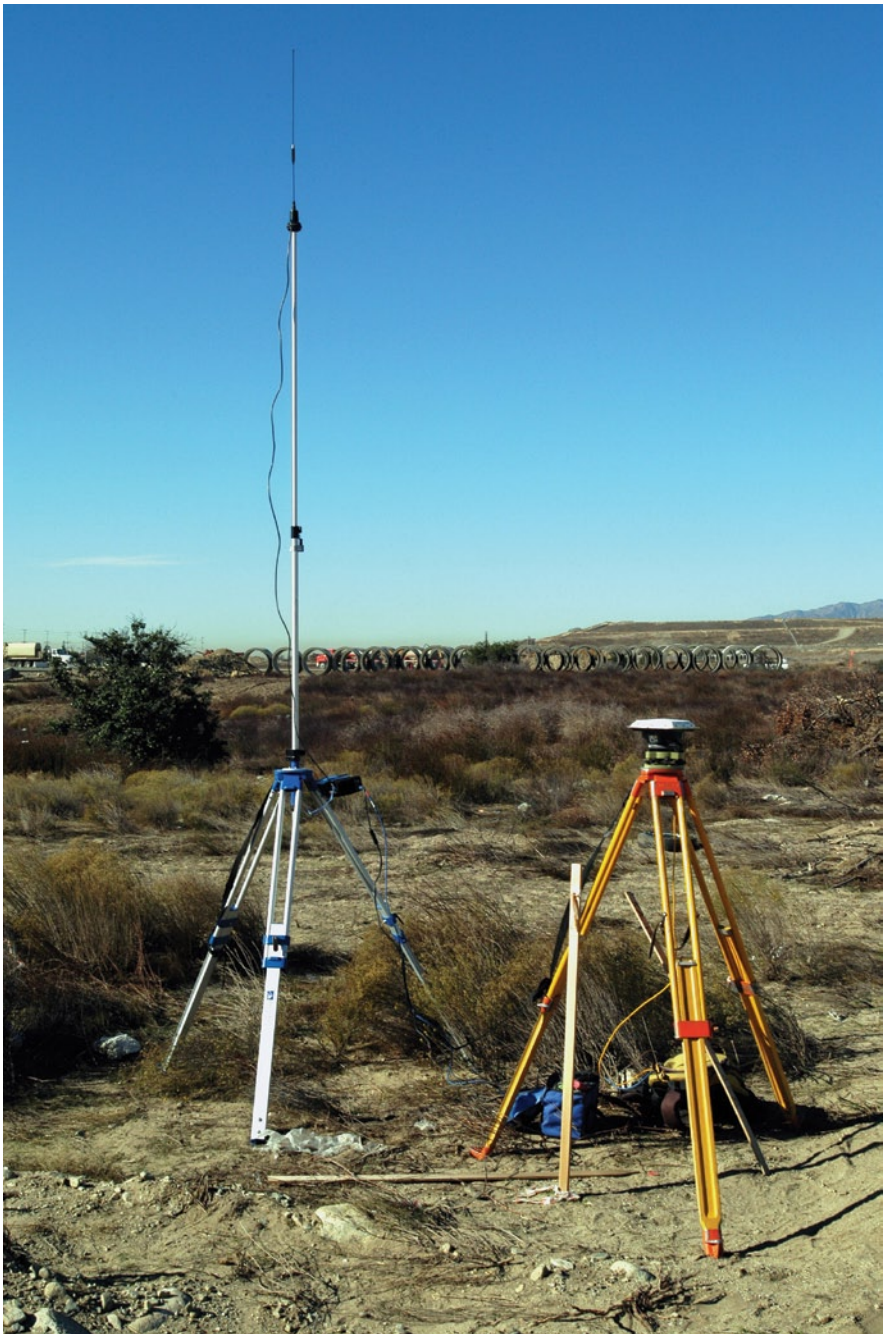
right the first time and that defects and waste are eliminated from operations. Implementing this program can be very costly and time consuming.

ISO 9000 is a widely accepted series of standards that specifies requirements for a Quality Management System. ISO 9000 was created by the British Standards Institute as BS 5750. The standard is now maintained by ISO (the International Organization for Standardization) and administered by accreditation and certification bodies. It is widely accepted, although its high price and effort has resulted in many companies using alternatives such as IC9700, or IC9200, both of which are issued by the International Charter.

Both TQM and ISO 9000 (and its deviants) are very complex programs requiring a great deal of management's time and training throughout the enterprise. I will refrain from referring to these programs as in my opinion they do not address the focus of my articles. They are valuable programs and for many large private and public sector contracts the qualifying firms must demonstrate either ISO 9000 or a TQM certification. Keep in mind that both of these programs require external and internal audits of a company's business and client service practices, and run the gamut from accounting systems to answering the phone. ISO 9000 covers the basics of what quality management systems are and also contains the core language of the ISO 9000 series of standards. ISO 9001 is intended for use in any organization that designs, develops, manufactures, installs and/or services any product or provides any form of service. It provides a number of requirements which an organization needs to fulfill if it is to achieve customer satisfaction through consistent products and services that meet customer expectations.

All of these quality assurance programs are rooted in the teachings of W. Edwards Deming. Deming is to quality as Peter Drucker is to management (*Management by Objectives*) and Tom Peters (*In Search of Excellence*) is to client service.

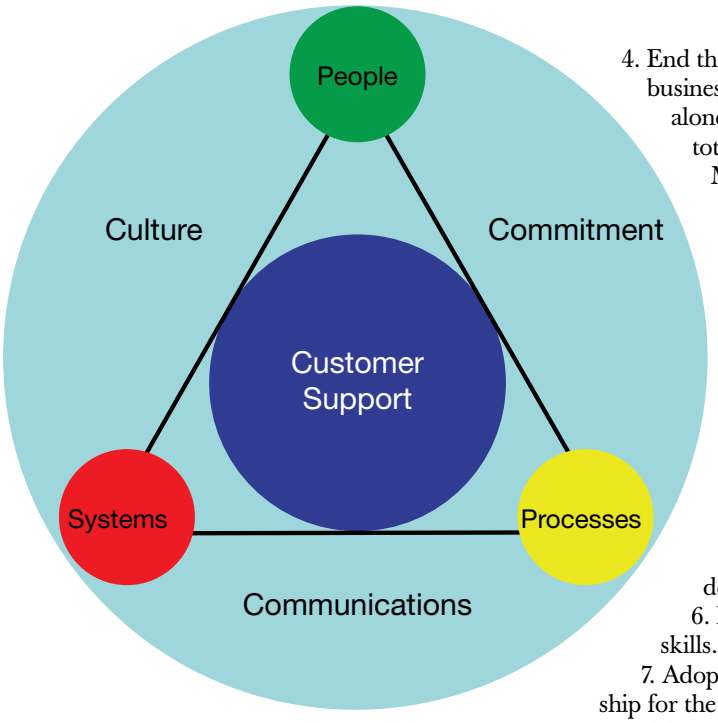
William Edwards Deming (1900-1993) was an American statistician, widely credited with improving production in the United States during World War II. He is perhaps best known for his work in Japan, where from 1950 onward he taught top management the principles of Statistical process control (SPC), a forerunner of TQM. During the post-war reconstruction of Japan General Douglas MacArthur invited Deming to assist in the rebuilding of Japanese industry. At that time products made in Japan were considered to be of very low quality. Some Japanese cottage industries had located in the village of Usa so they could claim the their products were made in the USA! This did not help very much. When Japanese cars began arriving in the United States in 1960, Detroit automakers sneered. But we all know the end of the story. It is the Japanese and Korean automakers that are now building their cars in the "real" USA, and they are known for quality.



Quality control: What steps should be taken when using GPS-RTK in construction staking to insure and document quality?

Under Deming's stewardship Japan became renowned for producing innovative high quality products. Deming is regarded as having had more impact upon Japanese manufacturing and business than any other non-Japanese individual.

Deming taught that by adopting appropriate principles of management, organizations can increase quality and



simultaneously reduce costs (by reducing waste, rework, staff attrition and litigation while increasing customer loyalty). The key is to practice continual improvement and think of manufacturing as a *system*, not as bits and pieces. In 1960, Deming became the first American to receive the Second Order of the Sacred Treasures from Prime Minister Nobusuke Kishi. An accompanying citation stated that the people of Japan attributed the rebirth and success of their industry to his work. Today the highest prize awarded by the Japanese Union of Scientists and Engineers (JUSE) for industrial achievement is the Deming prize. This is comparable to the Malcolm Baldridge National Quality Award, established by the U.S. Congress in 1987 to recognize quality and business achievements of U.S. organizations.

The building blocks of Deming's quality management are 14 key principles for transforming business effectiveness:

1. Create constancy of purpose for the improvement of product and service, with the aim to become competitive, stay in business, and provide jobs.
2. Adopt a new philosophy of cooperation (win-win) in which everybody wins and put it into practice by teaching it to employees, customers and suppliers.
3. Cease dependence on mass inspection to achieve quality. Instead, improve the process and build quality into the product in the first place.
4. End the practice of awarding business based on price tag alone. Instead, minimize total cost in the long run. Move toward a single supplier for any one item, based on a long-term relationship of loyalty and trust.
5. Improve constantly, and forever, the system of production, service, planning, of any activity. This will improve quality and productivity and thus constantly decrease costs.
6. Institute training for skills.
7. Adopt and institute leadership for the management of people, recognizing their different abilities, capabilities, and aspiration. The aim of leadership should be to help people, machines, and gadgets do a better job. Leadership of management is in need of overhaul, as well as leadership of production workers.
8. Drive out fear and build trust so that everyone can work more effectively.
9. Break down barriers between departments. Abolish competition and build a win-win system of cooperation within the organization. People in research, design, sales, and production must work as a team to foresee problems of production and use that might be encountered with the product or service.
10. Eliminate slogans, exhortations, and targets asking for zero defects or new levels of productivity. Such exhortations only create adversarial relationships, as the bulk of the causes of low quality and low productivity belong to the system and thus lie beyond the power of the work force.
11. Eliminate numerical goals, numerical quotas and management by objectives. Substitute leadership.
12. Remove barriers that rob people of joy in their work. This will mean abolishing the annual rating or merit system that ranks people and creates competition and conflict.
13. Institute a vigorous program of education and self-improvement.
14. Put everybody in the company to work to accomplish the transformation. The transformation is everybody's job.

This column is not intended to be a primer on the quality management theories and principles of W. Edward Deming, but rather to provide background and context for my future comments on quality assurance as it pertains to our profession. I would, however, suggest that any study of Deming's principles would well be worth the effort. I suggest two books by Deming that provide much greater details of his principles; *Out of the Crisis* and *The New Economics for Industry, Government, Education.*

In my next column I will lay out my five-point plan for quality assurance and client service focused on our surveying and mapping profession, along with some real work examples.

Fred Henstridge has more than 50 years of professional experience in geomatics engineering, surveying, mapping, transportation engineering, municipal engineering, and GIS management. After 10 years with Caltrans, he started his own geomatics and civil engineering firm, which was acquired by Psomas and Associates in 1982. Since that time, he has been a Principal of Psomas, and Corporate Director of Geospatial Services and GIS. He is currently Director of Psomas' Federal Programs Development.

Quality control: Fixed height tripods should be employed when using GPS to better insure quality.