PCB UPdate

最近十年，第三方审计的质量系统一直在发生变化。ISO 9000系列标准最初的用意是建立一个框架，保证有关产品质量的所有程序得到一致的文件记录。ISO 9001:2000特别强调核心业务程序与不断改进的需要的相互关系。ISO/TS 16949建立在ISO 9001:2000增强部分的基础上，还格外强调过程效率、对客户需求更紧密配合、对雇员积极性和授权更加重视、以及更强调对供应链的管理。

# A Strong Framework for Outsourcing

Jim Lanigan

Think ISO/TS 16949 is just for automotive applications? Think again.

Third party-audited quality systems have been undergoing a transformation over the last decade. The original intent of the ISO 9000 series of standards was to create a framework that ensured that all processes relevant to product quality were consistently documented. The standardized framework and third-party audit and registration process simplified supplier qualification processes. QS 9000 added more focus on organization vision and long-term direction, as well as specific requirements related to the automotive industry. ISO 9001:2000 placed greater emphasis on the inter-relationship of core business processes and the need for mechanisms to ensure continuous improvement. ISO/TS 16949 builds on the enhancements found in ISO 9001:2000, with additional emphasis on process efficiency, closer alignment with customer requirements, greater focus on employee motivation and empowerment, and more emphasis on supply chain management.

ISO/TS 16949 is a standard developed by the International Automotive Task Force (IATF). While it is of most interest to companies building for the automotive and transportation industries, many of its enhancements are relevant to any outsourced manufacturing relationship. In fact, it is beginning to see increased adoption among electronics manufacturing services (EMS) providers.

My employer, Preco Electronics, Inc. (Morton, IL), an EMS provider, became ISO/TS 16949 registered in May 2003. We have been registered
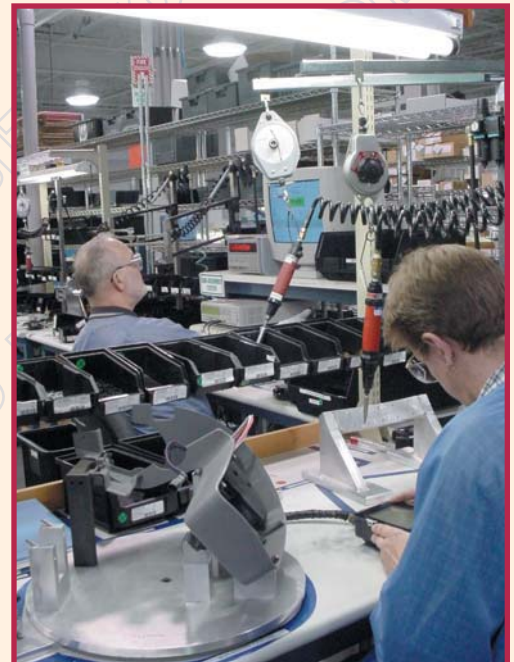
Preco's work areas are carefully arranged to minimize the travel time of components in the assembly process.

to applicable revisions of ISO 9000 standards since fall 1996 and QS9000 registered for three years. This article will look at some of the processes we have enhanced to better align with ISO/TS 16949.

At the heart of both ISO 9001:2000 and ISO/TS 16949 is continuous improvement of the quality management system. Both standards place strong emphasis on monitoring internal performance to defined metrics and measuring customer satisfaction relative to conformance to specifications and program metrics. Both look for integration of customer feedback into the corrective action process.

Customer Requirements, Process Efficiency

An adjunct of ISO/TS 16949 is a requirement for process efficiency that requires top management to review product realization processes to ensure their effectiveness and efficiency. This mandate expands on the provision for management responsibility for quality outlined in the ISO 9001:2000 standard. This added requirement can help better align program management and operations personnel to common goals in support of customer requirements. It is further enhanced by the requirements of both standards to measure customer satisfaction.

In our company's model, 5S and Lean Sigma principles are utilized as the foundation for process efficiency improvement focus. Customer account management reports to the operations organization. However, because operations goals are aligned with critical metrics based on continuous improvement and value to the customer, no conflict occurs between the focus of the operations team and program management's responsibility to champion customer needs.

ISO/TS 16949 actually specifies a requirement for a designated customer representative with the responsibility and authority to ensure that customer requirements are addressed. In the EMS business model, the program manager meets this requirement. Our company's model includes provision for the traditional program manager and a cross-functional support team dedicated to a customer or customers. It also includes a provision for a designated customer representative on-site at the customer's location when program needs justify a dedicated resource of that nature.

While ISO 9001:2000 has a requirement to measure customer satisfaction, ISO/TS 16949 goes a step further by defining minimum data collection requirements. These requirements include delivered part quality performance, customer disruptions including field returns, delivery schedule performance including incidents of premium freight, and customer notification related to quality or delivery issues. In addition, the standard requires the organization to monitor performance of manufacturing processes to demonstrate compliance with customer requirements for product quality and efficiency of the process. This further aligns internal systems with customer requirements.

To better comply with this section of the standard, we enhanced our customer satisfaction program to look at both objective and subjective customer feedback. The objective portion of the survey uses either a Preco-generated index survey or a customer-generated supplier scorecard to measure quantitative performance metrics. The subjective portion of the survey looks at qualitative performance issues related to expectations and value indicators. A formal system is in place to channel feedback back to the program team for appropriate corrective action response. We defined three separate classifications of

ems

response: immediate corrective action for customer complaints related to an internal breakdown in service, longer-term joint problem-solving focus for customer issues requiring changes in process at both Preco and the customer, and propagation of best practices when positive customer feedback identified a service element that should be incorporated company-wide.

Closer Supplier Alignment

Another area of enhanced focus is related to supply chain management practices. ISO/TS 16949 has some very specific requirements related to product design and manufacturing process inputs and outputs and product acceptance practices. These include definition of targets for productivity, process capability and both product and process cost. Also, ISO/TS 16949 includes a requirement for integrating supplier feedback into the design process for both current and future projects. The end result is an emphasis on greater linkage with the supply base relative to achieving goals for product quality and cost.

We have developed a structured supplier qualification and evaluation process to support this area. We assign commodity teams to major commodities, and these teams establish criteria for supplier technical capabilities, quality and commercial practices. The cross-functional teams are charged with understanding how and where they are spending money, rationalizing the supply base in their commodity and developing programs for continuous supplier improvement.

Printed circuit board (PCB) commodity team practices provide a good example of how the supplier qualification process works. Preco's PCB supply base remained domestic for a fairly long time because of the enhanced requirements many of our customers had in new product introduction (NPI) activities and the fact that much of their product was higher mix, low-to-medium volume.

Two years ago, the PCB commodity team was charged with developing a PCB supply base in Asia capable of supporting these requirements. While cost was a driving factor and the end result of the process was a 30% cost reduction, the team also focused on the ability of suppliers to meet their customers' requirements. We looked not only at current technical capabilities vs. Preco's technical capability requirements, but also at each supplier's longer term goals in this area. In the area of quality, we evaluated not only the ability of the supplier to deliver acceptable quality products but also at their ability to meet the supplier feedback and continuous improvement focus driven by ISO/TS 16949. In commercial practices we evaluated issues such as price, delivery performance and flexibility. The end result was a lower cost supply base capable of providing fast turns during the NPI process, providing appropriate acceptance testing and documentation consistent with our customers' requirements, supporting flexibility in scheduling on variable demand products, and supporting continuous improvement initiatives in process efficiency and quality.

The ISO/TS 16949 emphasis on process efficiency also ties back to supply chain management practices at Preco. We use Lean Sigma principles in our production activities, which drives a focus on greater supplier responsibility relative to supporting demand requirements. Practices include supplier-managed inventory, an in-plant store, supply base electronic data interchange (EDI) linkage and supply base access to our enterprise resource planning (ERP) system.

Employee Empowerment

Another area of differentiation between ISO 9001:2000 and ISO/TS 16949 relates to training, employee motivation and empowerment. The ISO 9001:2000 standard requires definition of competencies required for each job function, appropriate training and evaluation, and maintenance of training records. ISO/TS 16949 enhances this standard with requirements for on-the-job (OJT) training; alignment of employee training with satisfaction of customer requirements; and training that motivates employees to achieve quality objectives, make continual improvements and create an environment that promotes innovation.

We have developed a comprehensive employee training and skills measure-

ment program in support of these requirements. Employees receive a combination of classroom and OJT training. Employees take a minimum of 12 hours of classroom training in the orientation phase; they also receive training in 5S principles, lean manufacturing principles and kaizen techniques. A 10-hour basic solder training class is included, and production operators completing this course receive IPC certification. Evaluation of competency is achieved through observing hands-on performance of learned skills and formal testing.

Under our system, training is a continuous focus during an employee's tenure. We have identified 140 critical skills required for each employee. Matrixes are kept on each employee that document competency levels in each of these 140 skills. Each production team has a senior operator designated as an OJT trainer in addition to his/her regular duties.

OJT training is conducted as needed by the team trainer, and operator proficiencies in critical skills are evaluated at least weekly by the team trainer and/or team lead person. Evaluations are reflected in each employee's skills matrix rating form. This data is maintained and analyzed by human resources. The critical skills matrix is used as a core evaluation tool in selecting production personnel for new assignments or promotion. The skills matrix also drives a focus on cross-training. Our training goal in this area is to have every production employee cross-trained to a minimum of four functions.

Both employee empowerment and process efficiency are addressed in our continuous improvement process (CIP) program. Employees are encouraged to look for ways to increase efficiency and reduce cost. Employees can suggest improvements to their team lead person, make recommendations to a specific process improvement team or contact the engineer responsible for the product or process. The change is evaluated and, if implemented, the employee originating the suggestion is eligible to receive a monetary award. Cross-functional process improvement teams are also formed to evaluate and improve specific processes. Finally, each production team sets

detailed annual performance metrics. Each month those metrics are achieved, the team is entered in a drawing for a Team of the Quarter Award.

The end result of this focus on continuous improvement at the team and individual employee level sustains a culture of continuous incremental improvement. No one improvement is typically huge. Many CIP suggestions reflect small improvements related to reduction in operation cycle time or distance traveled during a production process, but the cumulative effect of many small improvements is significant over time. During the first 12 months of implementation of the 5S principles underlying our continuous improvement efforts, we achieved:

- reduced work in process by 60%
- reduced cycle time by 70%
- reduced changeover times by 40%
- improved surface-mount output by 42%
- improved output per employee by 11%

- improved schedule adherence by 60%
- 4,000 sq. ft. of manufacturing floor space for future customers/projects freed up.

Conclusion

Both ISO 9001:2000 and ISO/TS 16949 represent evolutionary steps in quality frameworks. They have migrated to closer alignment with achievement of business objectives through better definition of the inter-relationship of core business processes. The ISO/TS 16949 standard's more specific requirements are worthy of study in even non-automotive product applications because many of these enhancements represent best practices for outsourced manufacturing relationships. ∎

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