Training's the Problem! Or Is It?

Training is often the first to be blamed for a kink in the manufacturing process. But a task force at a high-technology firm uncovered other culprits in its so-called "training problem."

By JOHN R. BONAR

The setting was a 50- to 75-million-dollar manufacturing company, the largest division of a midwestern high-technology firm. The division had recently been pegged for improved manufacturing training programs, following a rapid growth in personnel from 250 to more than 800. The products were microelectronic components—integrated circuits designed, built and assembled into more complex parts. The problem was that many parts were being rejected and discarded at the inspection stage, and many of the rejects were flawless. Estimated loss to the company: *millions of dollars worth of good parts a year.*

The rejected parts problem hit the company's management committee agenda early in May 1981. The committee disclosed that for the fiscal year 1981, several million dollars worth of parts—good ones along with unacceptable ones—had been rejected and scrapped in visual inspection operations. To make matters worse, the estimated loss was based on a 1981 cost-per-part that was expected to escalate by more then 50 percent in 1982 as the compexity of the parts increased.

Not surprisingly, lively discussions regarding this problem ensued. A consensus emerged that more thorough operator training was the likely solution to the problem. As a result, the management committee quickly assigned several senior engineers and me, the training and development manager, to thoroughly investigate the problem. We were to return within four to six weeks with recommendations for a solution. My major responsibility in this task force was to design a "training solution," calling on the engineers as needed for their technical expertise in production methods, quality assurance and so on.

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The investigation

Our task force immediately sought further clarification of the rejected parts problem. The position that inadequate training was the culprit impressed us as being just one among a number of possible causes. We decided to gather additional, independent data by conducting structured personal interviews with some of the manufacturing skills trainers and visual inspection operators, supervisors and managers. Forty-eight interviews were conducted, and the data obtained were tabulated and analyzed. These revealed a number of conditions:

- The visual inspection of product parts took place in three different production departments under three different and independent sets of supervision.
- The total production floor work force of approximately 400 operators included slightly more than 100 operators dedicated to visual inspections. Seventy-five percent of the production floor work force had no more than a high school education. Fifty percent had no prior microelectronics manufacturing experience before joining the company.
- Most of the production and engineering support managers acknowledged that visual inspections were some of the most difficult jobs on the production floor. Those operators required high levels of competence, personal motivation and task discipline. Nevertheless, there were no differential hourly wages between the visual inspectors and the rest of the production work force.
- Three independent groups of manufacturing skills trainers provided the training for the 100 + visual inspection operators. Training consisted largely of having the operators read and study technical specifications drafted by professional engineers. Operators were certified as visual inspectors if they could pass a written test covering the relevant specs.
- The several lengthy technical specifications associated with conducting visual inspections were frequently changed, often several times a week. Many times those changes were communicated haphazardly to the trainers and operators.
- The visual inspections were conducted on a variety of equipment with different configurations. For example, the visual inspection of microelectronic circuits requires using microscopes at magnification powers that may range from 50-power to over 600-power. The use of various lens combinations and lighting sources affects what an operator sees. The inspections also were conducted without standardized techniques.

The results of the structured interviews gave us real reason to believe that the visual inspection operations had more than a training problem. The results also provided clear direction for conducting two additional studies.

In the first study we surveyed all production floor equipment used for conducting visual inspections. All important features of the equipment were compared and contrasted. A sample of rejected parts was evaluated for defects by a skilled operator who used each of the existing configurations of inspection equipment.

The results of this study were somewhat unexpected. Because the equipment and equipment configuration differences were so great, it was difficult to obtain consistent inspection evaluations of the rejected parts. What could be seen as a defect with one piece of equipment could not always be verified with another. Also, because of differing viewing lens arrangements, the various operators were inspecting parts at different levels of magnification. This resulted in some operators seeing defects that others could not see.

In the second study, our task force looked more closely at the technical specifications for the visual inspections.

Those specs were the major training aids in preparing operators. A reading specialist determined the reading level of the key specs. They were so heavy with technical jargon that they were judged at a "professional" reading level. Selected key paragraphs from several of the specs were also given to new and experienced operators for their interpretation. Sixty percent could not correctly interpret the paragraphs. When the same paragraphs were given to the visual inspection skills trainers, one-third could not give a correct interpretation.

Recommendations

With the second study concluded, we were ready to formulate corrective recommendations for review by the management committee. The data we had collected strongly suggested that there were actually several problems:

■ *Problem: organizational structure and coordination of information processing.* We recommended grouping all of the various visual inspection operations into one operating unit under a general supervisor reporting to the area production manager. All visual inspection training should be coordinated through a supervisor of visual inspection training. A new position, supervisor of visual inspection change control, should be created to coordinate and evaluate changes made to the technical specs guiding visual inspections.

We believed these changes in organizational structure would reduce organizational complexity and increase the functional grouping of visual inspection personnel. The proposed structure would elevate the status of visual inspection training within the production organization. The managerial focus needed to develop consistency of training approach and technique would thus be established, and adequate exposure and redress to identified problems would be ensured.

Finally, the structure we recommended would introduce a needed control point for the communication of changes in production processes and visual inspection operations to all affected parties.

■ *Problem: operator job training.* Recommendations included reviewing for technical accuracy all technical specs used for training visual inspection operators. If necessary, a technical writer should be used to develop the specs. The format and language should be easily understood by operators with no more than a high school education and no prior exposure to microelectronics manufacturing.

A train-the-trainer program should be initiated for all visual inspection skills trainers to make them proficient at conducting the inspections. Also, the trainers should complete cross training for the various inspection operations. We recommended directing all visual inspection skills trainers to develop cooperatively training specifications, training manuals, training aids and job performance evaluations to accompany the redeveloped technical specs.

■ *Problem: operator work incentive.* Our task force recommended that the management committee study, adopt and imple-

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ment some form of work incentives for visual inspection operators. A work incentive program would acknowledge the complexity of the task, the sophistication of necessary job skills, and the high levels of personal dedication and motivation required to produce consistent long-term quality work. Through wage differentials or non-wage incentives, this program would reduce the high operator turnover (which some years reached 50 percent) and improve operator morale. In making the recommendation, we recognized that a more thorough study would have to be conducted to identify an incentive program tailored to the needs and values of the company and its operators.

■ *Problem: inspection equipment and equipment configuration.* We recommended standardizing all equipment used to conduct visual inspections. (A particular configuration of equipment was recommended for adoption.) We also recommended conducting all visual inspections at standardized levels of microscope magnification and in an established sequence of activities.

We recognized that equipment could not solve inspection disparities caused by differences in operator visual acuity. But we strongly believed that a standardized equipment configuration would allow all operators to begin from essentially the same point.

The task force was convinced that acceptance and corrective action on all our recommendations was required to solve the problem totally. Adoption and action on some but not others would be similar to putting patches on a leaking bucket. The patches might hold, but the bucket still would be defective and could begin leaking again at any time.

Reactions from the committee

The management committee reviewed and endorsed all of the recommendations. They authorized immediate implementation of some and withheld action on the others.

The management committee decided not to act on any of the recommendations regarding organizational structure and coordination of information processing. They reasoned that "implementing the recommendations would be too costly and too disruptive of the status quo in the manufacturing departments." They also decided to "defer and continue to study" the matter of operator work incentives for "possible implementation at some later date."

Corrective action was authorized for the recommendations concerning the standardization of inspection equipment, equipment configurations and inspection procedures. To accomplish those recommendations, equipment was traded between inspection areas in order to develop, as much as possible, matched equipment and equipment configurations within areas. All new inspection equipment purchased had to conform to our recommendation as well. Through a combination of these activities, most of the desired equipment standardization was achieved.

We made an attempt to standardize the inspection procedures used in the different visual inspection areas. But because there were different points of view regarding the need for standardization, and because the organizational structure recommendations had not been implemented, we were not totally successful in achieving and maintaining that recommended standardization.

Our task force had the most success in the area of operator job training. The management committee authorized immediate action on all of those recommendations.

All the technical specs used to direct the visual inspection operations were carefully reviewed for technical accuracy. An attempt was also made to reduce the complexity of the language used in the specs. The shortcoming in this action was management's assignment of professional engineers to conduct the reviews and rewrites, without the aid of a layperson or technical writer. Some improvement was made in developing a format that could be more easily understood by operators. But the rewritten specs still did not constitute a very effective training aid for operators.

My staff and I developed a comprehensive train-the-trainer program, which was completed by the skills trainers serving the visual inspection operations. An attempt was made within the production departments to improve the trainers' own inspection skills. They also became more familiar with the visual inspection operations conducted in production areas outside their own areas.

We also developed a comprehensive system for designing and conducting operator job training and job certification. This system detailed the development of training specs, training manuals and other training aids. Guided by this system, we developed a comprehensive training program for visual inspection operators. The program was composed of specific job knowledge and job performance training objectives. Each objective was evaluated by one of several different evaluative techniques. A minimum level of acceptable performance for each objective was also determined. Operators worked through the training objectives in a predetermined order, "passing" each objective before moving ahead. The skills trainers worked with the visual inspection operators to make sure that they successfully mastered all the objectives in the training program. Upon successful completion of the training program, the operators were "job certified" to conduct visual inspections of product parts.

Retraining existing operators uncovered many shortcomings in their knowledge of the job. As problems were identified, they were corrected through additional training before individuals continued in the program. The training concluded with each operator inspecting a group of 50 parts, several of which contained known defects. By the time the training ended, all operators could correctly differentiate good from bad parts within predetermined error limits.

Lessons to the trainer

More than a year has passed since our task force made its recommendations to the management committee. Since that time, the new training activities have been completed.

The skills trainers working with the visual inspection operators are better prepared now and work with effective training materials. The technical specifications that guide the inspection operations are better than before. The operators are now more highly skilled at their jobs. The inspection differences caused by using nonstandardized equipment have been just about eliminated. The organizational structure in which the visual inspection operations take place, and the employee incentives to do the job remain about as they had been before our involvement with the problem.

Training problems, such as the one reviewed here, can be quite instructive for training practitioners. Working through this problem clearly refocused several important lessons:

- *Look before you leap.* Up-front "hip-pocket" analyses of problems in organizations often tend to be too simplistic. Early solutions should be considered, but in the context of a wider study of the problem. There is no substitute for data about the problem. Fact finding is essential. The people most closely associated with the problem often see it clearly and can offer plausible solutions. Solicit their views.
- *Things aren't always what they seem to be.* Upon close inspection, a "training" problem frequently turns up interrelated problems associated with technology, communications and management structure. All must be dealt with before training solves the problem.
- *Half a loaf is better than none.* When making recommendations to solve complex training problems, expect less management endorsement than you believe necessary for a total solution to the problem. It is important initially to shoot for total approval, but it's equally important to be prepared to work with just one or a few endorsed parts. Localized (intergroup, interdepartment) solutions are more likely to be approved than system (intragroup, intradepartment) ones.
- *Success is where you find it.* Partial success in solving a complex training problem is better than no success at all. There may be other opportunities in the future to chip away at yet unresolved parts of the problem. Be thankful for any documental successes, however small they may be.