Training Technologies ▼ Labor Management Cooperation ▼ Education

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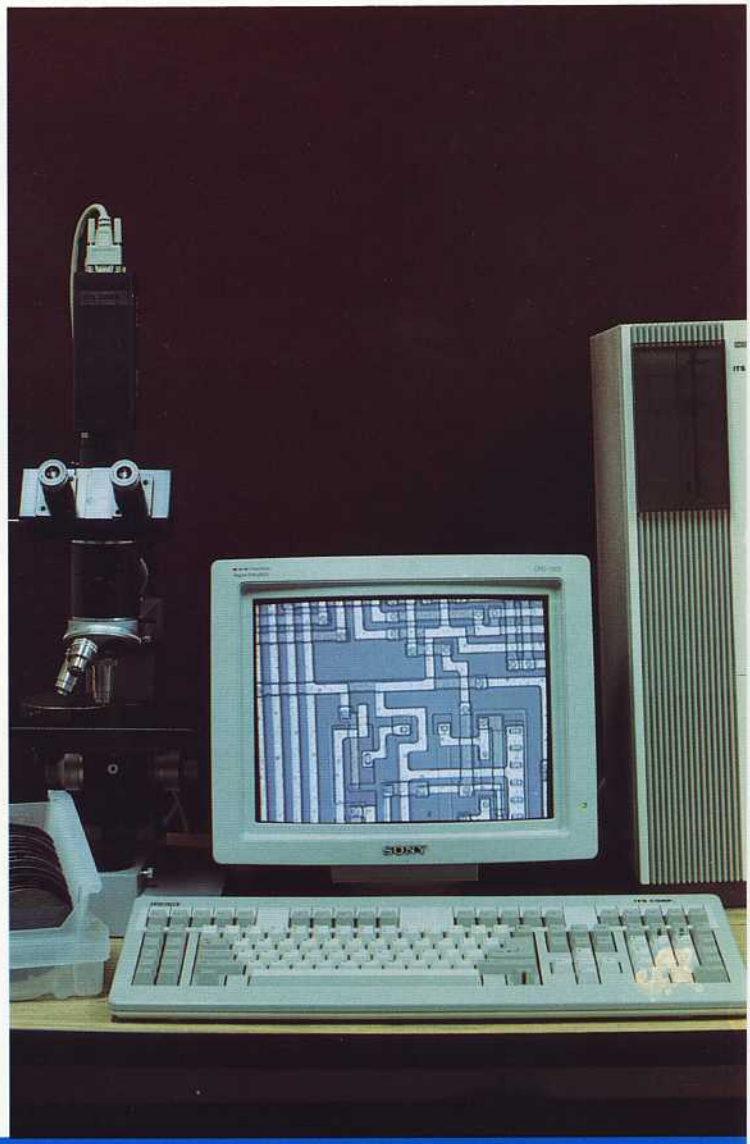
TECHNICAL&SKILLS TRAINING

Technology: The Future of Training

A division of Northern Telecom was a beta test site for digital video interactive. *See page 22.*



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CBT, however, responded favorably and were interested in more CBT training. Given the CBT's difficulty and unfriendliness, we interpreted this response as a healthy endorsement of the technology. A 90-day follow-up indicated slightly better information retention rates by the group who used the CBT than by the group who took the classroom training.

The division decided to explore other ways to use CBT. At the same time, and by coincidence, a task team was formed to look at developing a strategy to use artificial intelligence. The task team ultimately recommended looking into advanced training technologies for the manufacturing areas.

...to Beta Test Site

Northern Telecom then funded a project with the Integrated Training Systems Corporation (ITS) of San Diego, and became a beta test site for a state-of-the-art training system. Northern Telecom's role was to provide subject matter experts (SMEs) and to comment on design preferences with respect to instructional design and delivery.

The complexity involved in such a product development activity can be daunting. Reflecting on the difficulties during the activity, we often doubted our initial decision to begin. Would we have been better off had we not started? Well, who knows? But our belief is that we also would have missed an incredible opportunity to stretch our horizons and absorb a great number of new and useful skills into the organization.

Our next step was to survey the manufacturing operation using four basic methods:

- Personal interviews were conducted with 15 NTE-RB employees who represented a vertical slice of the manufacturing organization.
- Twenty-four project selection questionnaires were completed.
- The manufacturing areas were observed in operation to assess their potential as application sites.
- Numerous discussions were held with operators, trainers, managers, and engineers.

This data was organized into a chart comparing 14 possible operations to determine how thoroughly they might use the new system.

A team of manufacturing managers reviewed the chart and identified four operations for further evaluation. After additional meetings between manufacturing, engineering, and project personnel, an operation called "After Develop Inspection" (ADI) was selected.

ADI was selected for several reasons:

- It would use all functions of the system.
- It provided a good platform for a generic system for future training applications.
- This application had generated the most interest among the people we interviewed.
- The potential for resource allocation for the project was extremely high.
- SMEs were available for all the knowledge-base requirements.
- The training requirements provided enough challenge to exercise the system.
- The potential for improved trainer efficiency was estimated at 75 percent.
- The job complexity, in terms of judgment, was the highest of any application.

Defining the System

At this time, a design and analysis (D&A) was performed to produce a complete and thorough definition of what the training system would require. The resulting document was essentially our wishlist for a system. It also contained an acceptance test plan (ATP) that clearly stated the system's measurement criteria.

The D&A had seven major components:

- a courseware document that described the training to be delivered, authoring requirements, certification, and testing procedures
- a database management system document that identified six databases to be created—process, test, visual, certification, training, and the expert knowledge databases
- an operating system document addressing the requirements for speed and real-time multitasking
- a system engineering document describing the details of CPU allotments, image capture and processing requirements, and the possible configurations of the host system
- a control document, which is a chart bringing together all of the other elements of the D&A and is used to manage the system from both the developer's and project manager's viewpoints
- a functional decomposition diagram, which is a hierarchical block diagram that allows the reader to see the relationship between the component systems
- the ATP, which is a list of all performance requirements of the system and ensures that the user and the project developer are clear about the demonstrable performance requirements.

A set of milestones for the implementation plan were included as well.

We released the D&A in January 1989. Following this, work began on the actual development of the system, and the Northern Telecom project participants began a long, steep learning curve in a number of areas.

The SMEs were totally inexperienced with CBT. They learned how to gather and analyze data for use in electronic media, how to create instructional design for the medium, how to program courseware using a proprietary, high-level language, how to capture and process data using seven different tools, and how to work with quality assurance practices, systems administration, and field testing. To be honest, as the work proceeded, we felt as if we had opened a Pandora's box of high-tech training.

Release of DVI

While this was going on, monumental developments were occurring in terms of technology advancements. The biggest event for us was the release of Intel Corporation's digital video interactive (DVI™) technology. This technology captures, compresses, and decompresses full-motion video and audio digitally in real time. By using the PC's hard disk, we could capture, store, and have direct access to audio and video. This offered the potential for unprecedented flexibility in program development, modification, and delivery.

ITS offered to modify the plan to incorporate DVI. Our division agreed that it was a significant opportunity and provided some additional funding for the DVI hardware. This commitment meant that many of the original images captured for the ADI program would have to be reshot to be compatible with the DVI, and all tutorials and quizzes would have to be rewritten.

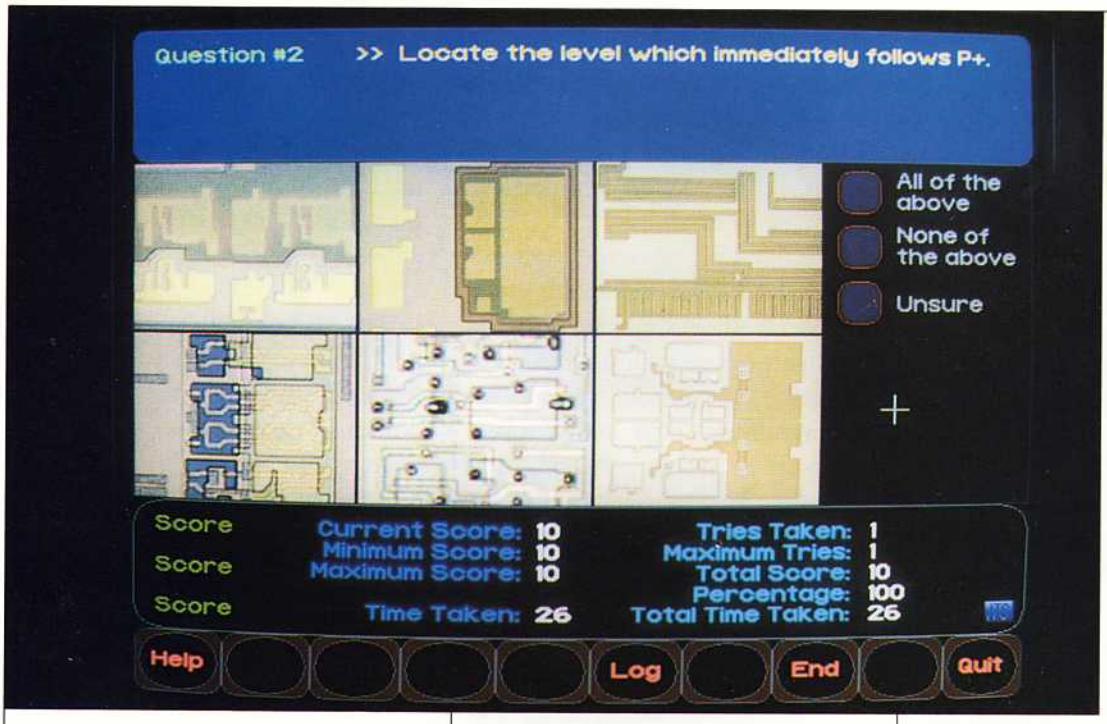
The pre-DVI work was thorough, and the training databases were complete. We developed matrices and tables to identify all possible defect categories and locations. While doing this, we discovered defect categories that, until then, we had not recognized. As the SMEs worked with engineering to verify the database content, they asked questions never asked before.

Northern Telecom's WITS

In September 1990, the ITS Corporation released to us the system, called WITS™ (Wafer Inspection Training System).

NTE-RB has two ITS workstations: One is a combination development/delivery workstation; the other is a delivery workstation only. The development/delivery workstation has a digital video camera mounted on a microscope and connected directly to WITS. The instructor can capture images instantly for program development purposes or use the system's real-time image processing capability to put high-resolution images directly on the screen.

The courseware, however, is the most exciting outcome of all. The difficulty and complexity of training operators in wafer inspection is well known in the semiconductor industry. Learning to perform this job requires understanding complex engineering concepts as well as memorizing patterns, colors, defects categories, and specifications. Traditionally, this has been taught by a trainer or experienced operator working with one or two trainees. Regardless of the approach, this training requires a tremendous amount of data. It is not unusual for trainers to use 50 boxes of slide carrousels filled with images



This screen design provides pictures and text as well as a tracking system for student certification. The oversized function keys and touch points were designed because the system is used in a cleanroom environment, where students wear gloves, which can impede motion.

taken through a microscope.

Formal training usually lasts for two or three months. Estimates of six months to one year are typical for bringing new employees to full proficiency. Even then, there is usually a great deal of learning left.

Inconsistency of training content and methodology is not unusual in a 24-hour, multishift manufacturing operation. Furthermore, sudden upturns in business, followed by increased personnel requirements, inevitably strain training resources. Finally, cross-training operators to do other jobs presents difficulties for line managers. When one manages a production area staffed for maximum efficiency, releasing a worker for several weeks of crosstraining is problematic.

WITS has transformed this training into 95 minutes of material. The operator controls the training so the actual total time an operator spends on the program is open-ended. There is ample opportunity to review lessons or specific frames of a lesson as often as desired.

The initial feasibility studies indicated an extraordinary 85 percent savings in trainers' time. A central training database stores the training programs, thus guaranteeing consistency of course material. The 24-hour availability of the system helps to provide more efficient crosstraining. Instead of a manager having to remove someone from production responsibilities for several weeks, the system can be accessed when work is at a lull.

Where skill-based pay systems are used, the rigorous, impartial certification system is fair to all workers. Detailed reporting of certification information—such as speed and accuracy levels—helps to assign achievement pay.

WITS stores all the training data in object-oriented databases. This means that each screen the student views is constructed the instant it is required by bringing relevant images, text, and sound together to create the lesson element. The same image, for example, can be brought up and used in a different context with graphic overlays, different text, and different audio, to create an entirely different lesson element in a completely different module.

This characteristic of the system can be enormously valuable. The flexibility to make on-the-spot changes—even translating the text into foreign languages—means that we can keep programs up to date. Competing video technologies, such as laserdisc, would require that a new program be mastered with updated information. The general practice in such media is to wait until a significant number of changes have occurred to justify producing new disks.

The student is treated to high-quality stereo sound as well as high-resolution still and motion video images. There are several different screen designs. The main design uses one window to present such images as still and full-motion video, graphics, and animation. A second window provides the instruction, complemented by an audio narration that reads the screen and may elaborate on specific points. Below these windows is another that adds special instructor comments

when appropriate. Function keys and other touch points are oversized, taking into account the cleanroom environment where gloves are worn. The function keys are located at the bottom of the screen (see the photo above).

The system's ability to access and display instantly several images at the same time allows us to present visual information in the main window, then to retain that image in a much smaller form while presenting the next image. We use this method to explain difficult concepts by keeping several of the previous images on the screen while proceeding with the lesson. Students more easily can make the cognitive associations necessary in this training.

Operators, trainers, and line managers are enthusiastic about this training system. Toward the end of 1991, we will complete a performance evaluation of the system. The built-in training management and certification programs will provide much of the data. We also will analyze the return on investment and conduct attitude surveys.

Working on the edge of technological innovation definitely has some glamor appeal—when it is being described. But it also includes an extraordinary amount of frustration, and requires a great deal of patience and persistence. Commitment to work as a beta test site for new product development should be made with all affected parties completely informed of the resources required. Once the commitment is made, the excitement, adventure, and learning begins.▼

(WITS is a trademark of Integrated Training Systems Corporation. DVI is a trademark of Intel Corporation.)