

# MANUFACTURING ENGINEERING®

April 1994

*SHOP FLOOR '94*

## THE POWER OF PARTNERSHIPS

**MACHINE TOOL 101:  
TOOLS & HOLDERS**

**NEXT-GENERATION  
MAINTENANCE**

**WHEN A GOOD  
PROCESS GOES BAD**



Society of  
Manufacturing  
Engineers





*Impressive models abroad and in our own backyards—all driven by new alliances—are revitalizing the shop floor to raise productivity and skills*

## SHOP FLOOR '94

# THE POWER OF PARTNERSHIPS

**A**s flattening plant hierarchies push more responsibility down to the plant floor, and labor cuts slash workforces, the spotlight is on the people left: a workforce whose critical skills are out-of-date or absent.

Some US companies solve the skills/productivity/cost problem by paying low wages and using temporary workers to avoid a long-term commitment. Some go offshore to find a workforce better trained in basics. But many that dropped their apprenticeships and pared on-the-job training to the bone are now fattening the training budget, hiring consultants, and looking for local partners.

### What Skills?

To help schools better meet the demands of the workplace, in 1991 the Labor Secretary's Commission on Achieving Necessary Skills (SCANS) described the skills high-performance employers look for in tomorrow's workers, challenged parents to insist that their schools teach them, and challenged employers to demand them. SCANS lists five competencies resting on a three-part foundation of skills.

*Foundation 1—Basic skills:* reading (written interpretation), writing (written communication), math (basic computation), listening (verbal interpretation), and speaking (verbal com-



munication).

*Foundation 2—Thinking skills:* generating creative ideas, evaluating alternatives and making decisions, solving problems, interpreting visual

processing data.

*Competency 4—Systems:* ability to understand and work with social, organizational, and technological systems, to monitor and correct their performance, and to improve or modify them.

*Competency 5—Technology:* ability to select procedures, tools, or equipment (including computers) appropriate for a task and maintain and troubleshoot equipment.

All students need to meet these

■  
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Senior Editor

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Editor, Special Projects



eight requirements whether they go directly to work or on to college. Groups like the National Tooling and Machining Association (Ft. Washington, MD) think this is the way to bring schools closer to the workplace. SCANS also developed a set of scenarios showing how a student would use these skills in the real world of work. Here's one SCANS titled "Know-How: A Painting Scenario."

**Managing resources:** Develop cost justifications of the cost of new painting equipment and schedules for delivery to minimize disruption of other operations. Read blueprints and manufacturers' guidelines for placement and installation.

**Interpersonal:** Participate in team training and solving problems of scheduling the move.

**Information:** Analyze SPC charts to monitor error rate. Develop, with team, ways to conform to best production practice in competing plants.

**Systems:** Analyze painting system and suggest ways of minimizing downtime and improving paint finish.

**Technology:** Evaluate cost, speed, and health and safety issues involved with three new paint spray guns with vendors. Interview other users of the equipment. Report to management

on the competing systems.

Although begun under President Bush, the SCANS program has not faltered under President Clinton. The Dept. of Labor continues issuing SCANS reports to help employers and educators develop teaching and training methods.

Researchers at Sandia National Laboratories (Albuquerque, NM) found employers surveyed in Michigan and New York State listing as "most important skills" absence of substance abuse, honesty and integrity, following directions, respect for others, attendance, and punctuality. Least important were mathematics, social and natural sciences, foreign languages, and computer programming. Of 38 academic skills, the only ones on these employers' critical lists were reading and following directions. The Sandia group concluded that technical skill requirements weren't soaring but merely inching up.

Training in basic skills, not behaviors, is mostly aimed at older workers. Face it: most of Workforce 2000 is already on the floor. Education reform must target skills a decade ahead, while industry is just beginning to identify skills needed today. (We will look at efforts in this direction next month.) Changes in skills education will affect, at most, one in five workers by the turn of the cen-

tury, and these will be entry-level employees with little impact on overall productivity.

That doesn't mean we shouldn't try, and the Dept. of Labor is determined to do so. "Enlightened employers now acknowledge that labor is not a cost to be minimized, but an asset whose value is to be maximized," says John Stepp, deputy undersecretary of labor-management relations, Dept. of Labor. He suggests maximizing human capital by continuous education and training of workers throughout their careers.

Smart companies from job shops to giants are doing just that. Employers find that tapping into the reservoir of ideas and skills on the floor can improve manufacturing capability or profitability. Here are some snapshots.

#### **Volunteers for CNC**

Training can be full of surprises. When the owner of an Ohio machine shop, with \$7 million in annual sales, needed workers trained to run two new CNC machines, he looked for partners in this technology upgrade. The local college had the trainers and the state had small-business grants to make it happen. The problem was class size: a minimum of 25 students were required, and he was short nine people.

"Rather than pay to train empty

### **Is Germany the Right Model?**

The German social contract among government, industry, and labor guarantees, among other things, subsidized training for any trade or profession. Once a worker picks a training path, the rest follows: world-class wages and benefits, six-week vacations, 35-hour weeks, and almost guaranteed employment. The elite workforce the policy produced was the envy of the world.

Is this a model for the US, as some Clinton Administration officials are saying? Germany and other European countries with similar social contracts now find they can't support them. When BMW trades \$24/hr German wages for \$12/hr British wages and views opening a US plant as a cost-cutting measure, when half the German machine tool industry has disappeared in the last five years, it's clear that the world market will no longer pay that skills premium.

The strength of the German system, says Lothar Kinscher, vice president of manufacturing, Russell T. Gilman Inc., is flexibility and access. If an able person with good grades sees an oversupply in a technical trade, there's always college instead—tuition, like apprenticeship training, is free. "You can go where your talents take you," says Kinscher. "Most engineers in German manufacturing companies are journeymen

machinists or skilled tradesmen in other fields."

Helmut Aeugle, manufacturing engineering manager at German metrology equipment builder Carl Zeiss's IMT Div. (Minneapolis), sees apprenticeship as a hedge against recession too. "Young people looking for engineering careers used to go directly from high school to the university. Now they may become apprentices in a company first, build up their contacts, then go on to the university. That increases their chances of landing an engineering job in that company."

Another strength of the German system, adds Kinscher, is its recession-proofing. "Training is bred into the system," he says, so companies don't cut training first in hard times, as they do in the US. In 1989-91, according to Bernhard von Rosenbladt, a workforce statistician with Infratest Sozialforschung, Munich, 43% of the German workforce took at least some vocational training, and 60% participated in some job-related learning.

Impressive numbers, but "not all this activity was useful," says Von Rosenbladt. Skills needed weren't well defined, companies and trainers didn't know what worked and what didn't, and the quality of the training delivered wasn't measured. "In eastern Germany," Von



seats," says Randolph Richardson, manager of consulting at Coopers & Lybrand (Detroit), "the owner told his workers that any friend or family member who wanted to learn these skills could take the class free." The unknowns filling the empty spots turned out to be the best students in the class. What's more, says Richardson, "some of the poor performers in his shop turned out to have a real aptitude for CNC, and some of the best performers weren't worth a damn." The volunteers provided a pool of trained and motivated people, and with an increase in business he has already hired half of them.

### No More Shopping Carts

Sometimes an outsider can tap employee creativity and turn a company around. East Bay Generator (East Oakland, CA) grew too fast from a startup company to 48 employees. Larry Lista, the owner of the generator rebuilder, was too busy running things to fix problems like chaotic inventory. The shop was clogged with parts in grocery carts, overflowing barrels, and cardboard boxes, and employees wandered around for hours to find parts for a rebuild.

"Rebuilding is a cutthroat business," says Lista, "and we were losing money fast. Lose just one part, and you wind up throwing away \$100

in components." He tried to convince his Spanish-speaking workforce to increase yields and get control of their jobs, with no success. Finally he looked for a partner. A state worker training program offered a grant of \$100,000, and Lista enlisted Leonard Bertain of the American Productivity Group (Oakland, CA) to restructure production.

Many workers thought the effort was a waste of time. Bertain, however, told the employees they themselves had the answers to the productivity problem. Training focused on visualizing what could be done with existing resources and talent.

Bertain moderated long and heated discussions in which the workers finally made their decision. They moved conveyors to the center of the plant, changed layouts, and redesigned workcells. Parts are now neatly stacked and labeled in plastic trays around each assembly station, which get restocked when empty. The box and cart jungle is gone.

Though the state training grant helped, the biggest restructuring cost (about \$350,000) was in lost production time. Lista spent about \$70,000 on fixtures and shelving, and he says he'd happily do it again. "These new workstations are turning out 100 rebuilds a day, compared to 15 before training began. We're making money again."

### South-of-the-Border Benchmark

What about *maquiladores*, those plants filled with illiterate, unskilled assembly workers with minimal training doing repetitive tasks for pennies per hour? Can such places be models for anyone?

Alcatel Network Systems (Richardson, TX), a manufacturer of telecommunications systems, saw a stereotype shaken when Alcatel de Nogales SA, its Mexican 382-employee subassembly plant, went to a team-based structure, eliminated engineering titles and supervisors, team-trained the assemblers, and constructed a management structure so lean it's seldom seen elsewhere.

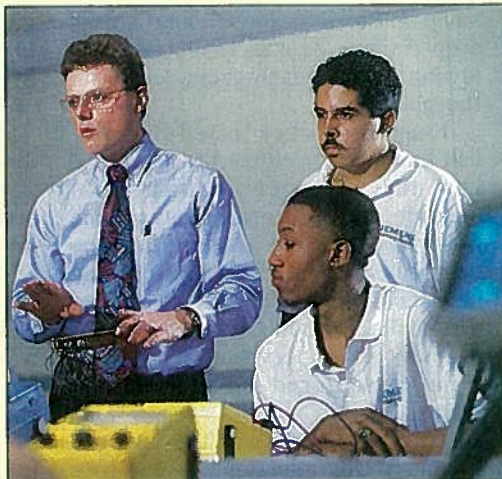
Though giants like AT&T's Network Systems Div., Eastman Chemical's Kodak unit, General Electric Lighting, Motorola's Government Electronics group, and Xerox product development activities are moving toward this model, most experiments are going on at lower levels in organizations.

Nogales is one of them, a textbook horizontal organization, centered not around functions or departments but around core processes with performance goals and "owners"; a minimum of activities in each process with a few self-managed and accountable teams performing an entire process; customer satisfaction as the driver and measure of performance;

Rosenblatt says, "training is often just a way of avoiding unemployment."

Eastern Germany does have a model, however. The lean-manufacturing lessons taught by Toyota and translated into the General Motors-Toyota joint venture NUMMI have been passed on to the Opel Eisenach plant, where workers who used to make the Wartburg car now make Opel Corsas. Each of the 2000 employees in the revamped, team-based plant was extensively interviewed to determine ability to fit into a team environment, then trained and cross-trained for 12 weeks in every job done by the team.

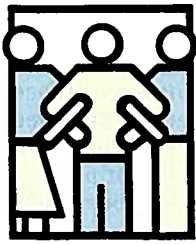
Success in producing a car in under 20 hours this year, GM says, will make Eisenach its corporate benchmark. In the process, it may focus training efforts of other German manufacturers. But it may not. Though



**Meister Werner Franz (center) trains apprentices at Siemens Stromberg-Carlson in Lake Mary, FL, just the way meisters do in plants around the world. He must be doing it right: Lake Mary's first class of apprentices outscored all other Siemens apprentices worldwide.**

the state of Baden-Wurttemberg, machine tool builders' and auto manufacturers' traditional home, is pushing lean production to small firms, the nationwide collective bargaining system can stall reengineering the manufacturing process, and so can the culture.

Gilman's Kinscher expects things to change. "A worker's first priority is survival, not a high wage," he says. "Germany must go through the transition the US began in the '80s. The agony won't be as long there as here, but it will still be agony."



rewards for multiple skills rather than specialization; and employees trained to make their own decisions.

As Ernesto Machado, the manufacturing manager, explains it, planning to restructure the plant and achieve dramatic process improvement began in 1981; action began in 1985. The plant relied on its Richardson parent for design engineering, building models, engineering change orders, and assembly documentation. Now Nogales builds all prototypes and handles documentation and standards and ECOs.

It took a decade of planning to simplify the plant hierarchy. At the top is the plant manager. Reporting to him are Machado and managers for human resources, technical services (product and computer support), finance, and planning. That's it.

The upper and middle-level managers who handled planning, quality, material flow, introduction of new technology, changes in product mix, and setting and measuring production goals are either gone or members of a team. The engineering department is gone. Manufacturing engineers work with line workers on teams to solve technical problems. Former production supervisors and quality inspectors do staff work for their teams.

"After years of responsibility for long-range planning or process improvement, an engineer now shares that work with 15 operators," says Machado. "It was choppy at first. The engineer on the team running a cell must get consensus on process improvement, quality, cost—everything to do with the cell."

The *filosofia* or vision statement the plant adopted is not window-dressing here. It promises employees job security, participation in decision-making, training, elimination of language barriers, job rotation, good salaries, and clean and

healthy facilities. When territorial behavior and conflicts over job assignments and titles erupted during the transition, it was often invoked to settle arguments.

An organizational upheaval like this depends heavily on an organizational development and training plan. The vision statement promises employees training, and they got it and still do. Organizational development consultant McFletcher Corp. (Scottsdale, AZ) has been involved

pay and leave, and some did. Mexican labor law protects job titles and pay. Some team members, for example, still carry the title and pay of Inspector, though the inspection department is gone.

Not every square peg was hammered into a new round hole. "Everyone doesn't fit the pattern," says Machado. "If you fire 40% of the workers who don't fit your pattern, you'll hire new ones who don't fit the pattern either. Some people can't be trained to manage people, or communicate well face to face. You see what each person has to offer, and find a process for that person to manage."

The upheaval has produced dramatic improvements. Machado has seen some significant changes over the last four years: in-process rejection rate cut 77%, final rejection rate cut 60%, functional test rejection rate cut 51%, and customer reports cut 81%. Work in process was halved, cycle time dropped 22%, labor efficiency improved 27%, and the plant saves \$285,000 annually on indirect labor.

The plant, which is ISO-9001 certified, is going through the audit process for the Shingo Prize for Excellence in Manufacturing, and is planning a shot at Mexico's national quality award. It is also an environmental benchmark itself, a green manufacturing operation that generates no harmful waste and pioneered in solvent-free cleaning of PC boards.

When neighboring companies ask Machado why the plant is doing so well, with a 1% turnover rate (many workers have been there 20 years) when their rate is 55%, he tells them that Alcatel offers education, job security, and respect for employees' ideas. "Other companies don't believe me," he says. "They think money is the only motivator, whereas any plant, in Mexico or across the border, with long-term management commitment could do what we have done."

Not all shop-floor teams get results like these, says David



**Workforce 2000 is out there on your plant floor now, so periodic technology updates are important. At Charmilles Technologies (Lincolnshire, IL), an EDM operator gets a refresher.**

since 1981, first developing a five-step training approach and now following up with yearly group studies at the plant.

Employees were tested to establish how each preferred to work and how they experienced their jobs. Next department teams analyzed the *filosofia* statement to see how the department's activities fit into the new mold. Assemblers then learned new skills, including training in management and supervision. Engineers' training centered on working on teams.

The fourth step was the big one: the move from functional hierarchies to workcells and teams. Roles changed as the plant focus shifted to assembly, not hierarchy: the line was the internal customer, with circles, teams, and workcenters to serve that customer.

Workers who disliked the new system could take their severance





Eisenhart of Coopers & Lybrand (Detroit), who often works with teams. If managers expect teams to be agents of change, tackling major problems, team members cannot be distracted from that goal by the issues raised in their regular jobs. Team training should be fulltime, and the training should be applied immediately, as it was in these examples. "Give a team the time and resources, and that team will create change," says Eisenhart. "Give a team only a piece of both, and it will fail."

### Partnership In High Gear

Can giant companies with unions upgrade workforce skills to stay competitive? Chrysler Corp. (Highland Park, MI), a company that went through significant plant restructuring with an older workforce, has seen the need for a strong training commitment. It also has a strong union and devotion to cost control based in its bankruptcy bailout in the '80s. The solution it found is a union-management training partnership led by Chrysler and the United Auto Workers and paid for by a paycheck setaside.

At the UAW/Chrysler National Training Center (Detroit), workers learn basic skills in "tech prep" classes. Instructors from local high schools do one-on-one tutoring; computer-based interactive instruction goes on in small groups, with an instructor at hand to help. "Only the instructor knows each student's working level," says William Gorman, International Union Representative, so no one is embarrassed by lack of the basics.

Educational coordinators determine the level of training each worker requires. Each Chrysler plant has a training facility. Several thousand workers so far have learned specific skills, become computer-literate, or brushed up on the basics to get a GED equivalency degree. Workers

can even get associate's and bachelor's degrees, Gorman says, via "distance learning," a satellite interactive teaching link to Indiana University and other schools. A second major technology center at Chrysler's Outer Drive plant will provide year-round machine-specific training.

In the plants, a version of one-on-one training called "each-one, teach-one" is at work. In the high-tech Jefferson Assembly Plant (Detroit) workers use sophisticated Oasis work terminals on the shop floor to enter data and pass messages down the assembly line. "These ter-

matching arrangement in the 1985 Chrysler contract, a pattern set in 1982 at General Motors and Ford Motor Co. Fifteen cents for each hour worked by a union member goes to a skills training fund and 4 cents to a safety and health training fund. Training funds are "earned" but don't show up on workers' paychecks.

An overtime penalty clause put into the contract by the union to hold down overtime and encourage new hires actually siphons off extra funds in boom times to use for training in the down cycles when employers typically cut it back. If 10% of the workforce is on overtime, the penalty might be \$1.25/overtime hr worked. Maximum overtime can generate as much as \$5/hr for the fund. The overtime penalty provides one-fifth of Chrysler's training budget today, according to Gorman.

### Incentives for Change

Without special arrangements like training partnerships with unions, sweeping change can meet sweeping resistance. Take cellular manufacturing. Coopers & Lybrand's Richardson points out that "a cell work group may need one third of a machinist or welder." This fragmentation makes it hard to maintain continuity in a workcenter.

Richardson helped a union shop that builds fractional-horsepower electric motors go cellular by adopting a pay-for-knowledge system. Twelve job classifications shrank to two: Class A, people who knew every job in the manufacturing cell, and Class B, people who knew enough jobs to qualify for the cell.

"The agreement negotiated with the union allowed Class B workers to move up to Class A and higher pay in several steps," Richardson says. "No job was hard to learn, and most workers had done most of the jobs before the cell was set up, so all the Class B workers moved up in a few months." The amount of money wasn't huge (the three steps from B to A amounted to 45 cents/hr), but



**This senior apprentice works at the Pfauter-Maag training center for half of every school day. When she graduates from Harlem High in June, she'll have a career direction, and it won't be flipping burgers: 1300-1500 hours toward her journeyman's card, a job, and credits toward an associate's degree.**

minals were difficult to learn," says Gorman, "and data had to be entered correctly. We took everyone through a one-week course to get them computer-literate. Then we picked 15 of the best students, put them in teams of two, and sent them out to train anyone on the line still struggling with the new terminals."

To keep workers up to speed on the latest technologies, Chrysler began a two-week program for skilled tradespeople dealing with robotics, CNC equipment, programmable controllers, and other innovations. The program has migrated to operators on the floor, and now both levels of workers can trouble-shoot and fix these machines, Gorman says.

Bills are paid through a paycheck

added to the threat of moving production to a plant in Mexico, it was motivator enough.

When people know their jobs well enough, and the problem is not skills but poor work habits, pay-for-knowledge probably won't work, says Richardson. Gain-sharing—bonuses tied to improvements—may be a better approach, but it has drawbacks too. Tracking such a system is complicated, management may cook the profit-sharing books, profit feedback at the end of the year isn't much of a daily motivator, and employees tend to maximize their own output whether parts are needed or not. "Whatever you call it, the system is essentially piecework," says Richardson, and dismantling it is the first step to a coordinated or cellular approach.

### From Learning to Earning

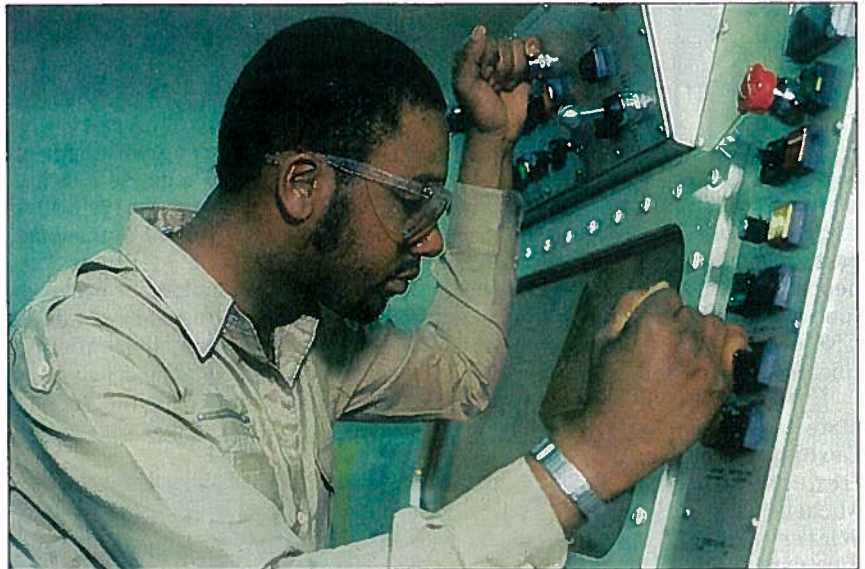
Labor Secretary Robert B. Reich has a favorite sweeping statement: "America may have the worst school-to-work transition system of any advanced industrial country." That judgment, he explains, was made by the federal government's Commission on the Skills of the American Workforce.

Reich and the Depts. of Labor and Education want to make the connection between learning and earning for the 75% of young people who do not graduate from college and who will land a dead-end job or no job at all. "Employers, public officials, and educators must acknowledge," Reich says, "that the development of workforce skills is an ongoing process that begins in the earliest grades and continues through a worker's training and retraining."

There's a practical angle here: the education job, like retraining, is too big for any company to do alone. That means apprenticeship programs beginning in the local high school, tech-prep alliances, career academies, cooperative education programs, and business-education compacts popping up around the country. Secretary Reich sees these partnerships as the first steps toward a school-to-work program that is locally based but national in scope.

### High-Tech Vo-Tech

One way to be sure training is work-related and relevant is to involve employers, and successful vo-tech programs have such partners. Greenville Technical College



**At Greenville Technical College, lots of hands-on time and state-of-the-art equipment make students confident as well as competent the first day on the job.**

(Greenville, SC), a leader in vo-tech education, has an employer advisory committee in every program on campus to watch course content and keep equipment comparable to what's found in the workplace.

As a result, Greenville Tech's Advanced Machine Tool Resource Center, which trains faculty from vo-tech schools across the state in CNC programming and operation, has \$900,000 worth of high-tech equip-

ment. South Carolina's "quick-start" program to attract industry uses Greenville Tech's machine tool labs to train production and technical workers for new companies in the area. Local companies provide scholarships for full-time and co-op students and hire them, attend career-day events at the school, and train workers at local plants at their convenience—any day, any shift. Some plant employees teach at the college.

### Writing It Write

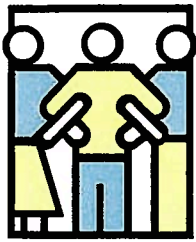
The jobs of line workers at Alcan Rolled Products (Oswego, NY) were becoming more complex, and managers wanted better communication between shifts, shorter reports, clearer sentences, and improved communication on forms. For example, a typical line worker's memo read: "For the past six months we had problems with our wood skids. Reports from the field show metal damage. May be due to the poor workmanship of the supplier. My finding is we can cut cost and improve quality. We could change supplier Company A to Company B. Or maybe we should use both at first."

Word-Wrights Inc. (Syracuse, NY), which had trained Alcan's supervisors and technical staff, took on the job of improving operators' messages. The training was simple and job-related. Nobody had to write a short story or "ele-

gant prose," as workers had feared. Ten hours of training in five weekly classes (with graded assignments in class and at home) showed how to begin a message with a topic sentence, revise for conciseness and clarity, and punctuate properly. The students had dreaded the writing class but ended up liking it: 80% thought it would help in their work and said they would encourage other workers to try it.

Managers liked it too. Here's that memo after the trainees got through with it: "We need better wood skids and should change suppliers. Reports from the field show metal damage from Supplier A. These problems have been reported for the past six months. We can cut cost and improve quality if we change to Supplier B. We need to use both A and B at first to be sure of an adequate supply."





The partnership is tight: 98% of students are hired before they complete their program. A machinist's diploma gets a student to an entry-level position, the associate's degree program prepares machine operators and setup people, supervisors, and apprentice tool and diemakers and machinists. CNC operation and programming certificates are offered.

If Greenville Tech serves the state and big employers like Owens-Corning Fiberglass, General Electric, Michelin Tire, Ernst Winter & Son, and Torrington Co., Vincennes University (Vincennes, OH) is just as important to the small tool and die and injection moldmaking shops around it in Ohio. Many moldmakers in the area steer their apprenticeship applicants toward this program.

About 60% of Vincennes students graduated from high school five to 10 years ago and came because their friends in the machine trades told them Vincennes is the place to go for a good job. John Ludlow, who heads the machine trades technology department, says his advisory committee of 20 employers is key to Vincennes' successful placements. "If they tell us to add a course, we do," he says. "If they tell us not to bother teaching something, we drop it."

### Youth Apprenticeships

A recent National Alliance of Business (Washington, DC) survey of 3000 small companies found 75% willing to spend time and money to get better prepared workers, and 80% willing to try a youth apprenticeship program if they got help with the costs.

Last month NAB responded by issuing a handbook called *Real Jobs for Real People: An Employer's Guide to Youth Apprenticeship* and opening a youth apprenticeship center to help employers network, develop skill and

training standards for apprenticeship programs, and find state and school-district partners.

What about employers who fear losing their training investments? "The only thing wrong with apprenticeships in the US today is a lack of employer commitment," says Lothar Kinscher, vice president of manufacturing, Russell T. Gilman Inc. (Grafton, WI), a builder of precision spindles, slides and index tables. Kinscher, a former apprentice in Germany, supports similar programs and workplace training in the Milwaukee area. "Losing people after you've



**A budding Vincennes University tool and diemaker assembles a progressive die that lances, draws, side-action pierces, and trims. Local shops look for Vincennes graduates.**

invested heavily in them is a risk, but if every company made an equal investment, it wouldn't be. A journeyman who moves on after three years of training because of opportunities and benefits elsewhere is just doing what salaried people do."

German-based companies, logistically, are leading the way. Pfauter-Maag's US subsidiary Pfauter-Maag Cutting Tool Co. (Rockford, IL) generated Rockford's tech prep youth apprenticeship program, complete with *meisters* (skilled craftspeople who share their skills with students), a title borrowed from the German apprenticeship system. Here's how this popular, though mostly untested, school-to-work strategy operates.

The pilot program in 1992 involved 15 juniors from Rockford's Harlem High School who worked from 7:30 to 9:30 every school day in a training

center created in the Pfauter-Maag plant, then were bused to school for their classes. At the end of the school year they received a scholarship of \$1000 to \$1300. All worked that summer full-time for one of the sponsoring companies. In senior year students spend about half the school day working and training at one of the sponsoring companies' plants, at an hourly rate from minimum wage to \$5.25.

All applicants had at least a 2.0 average, a pass in algebra, no more than 4 absences during the previous year, and a top attitude rating (Harlem High grades every student on attitude as well as performance in each course). All were interviewed by the companies involved. Out of 190 who applied, 15 made the cut.

Nine other companies have joined the original sponsors (Pfauter-Maag, Atwood Industries, Elco Industries, Ingersoll Milling Machine, and Header Die and Tool), committing a total of \$380,000 to the program. Four high schools and 38 students are now involved.

To hook the vo-tech effort into the educational mainstream, Rock Valley College

and Career Education Associates of North Central Illinois, a cooperative of 13 area high school districts, point apprentices toward an associate's degree at Rock Valley once they are on the job. The power of the program, says Gary Schott, Tech Prep director at Rock Valley, is that students enter adult apprenticeships with a head start (1300-1500 hours toward a journeyman's card), acquire hands-on experience, and get some credit toward that associate's degree (employers will pay tuition if grades are satisfactory).

In January, the State of Illinois, which has a \$460,000 grant from the Dept. of Labor to design a school-to-work system, named the Rockford program as one of 15 business-education partnerships that represent "outstanding working models." The Dept. of Labor is funding





Rockford's effort to assist a neighboring vocational system starting a tech prep effort.

Siemens Corp., whose German parent company trains 2500 apprentices a year in 16 countries, began pilot programs in 1992 and 1993 in Lake Mary, FL, Franklin, KY, and Wendell, NC. The Lake Mary program run by Siemens Stromberg-Carlson is the only youth apprenticeship of the group at the moment; one begins this fall in Wendell.

The Lake Mary program has partnerships with two high schools and Seminole Community College and enrolled 40 preapprentices and 40 apprentices last year. High-school students spend two afternoons a week at the lab. The 40 college-level apprentices in this 30-month program spend 20 hours a week in class and 20 hours at the Stromberg-Carlson plant, in the lab or on the floor. Completion of the program means an A.S. degree from the college and Siemens certification.

Siemens trains apprentices the same way all over the world, and Lake Mary has its *meister*, the master craftsman who provides the hands-on training. Can this work in the US? Every year Siemens tests apprentices in every country. When the 1993 scores were in, the first electronics technician class at Lake Mary astonished everybody by outscoring all other Siemens apprentices worldwide.

### Breaking Down the Walls

There's talk of delivering education on demand, anywhere, any time; education modules tailored to the worker's skills and abilities; interactive videos; information networks linking community colleges, universities, and industries; learning via cable; worker retraining in a regional network of government centers. Even that old night-school phrase "lifelong learning" has been recycled, and high school and community college programs have gotten a shot in the arm.

Clearly, there are no quick fixes and no one solution. Dietra Rosenkoetter at machine tool builder Hurco Companies (Indianapolis) is convinced from talking to customers about CNC training that manufacturers need to target the middle schools and high schools. "You must plant the

seed in grade school," she says, "so by the eighth grade students will see machine trades and manufacturing as interesting careers, then focus on math and science in high school." That's not a new idea; the question is how.

To promote manufacturing careers to teenagers, Rosenkoetter is helping form a coalition of Hurco's own educational partners (which include vo-tech colleges, a city university, a high school, and an elementary school), the state vo-tech establishment, industry groups, and manufacturers. The Indianapolis chapter of the National Tooling and Machining Association, the American Mold Builders Association (Medinah, IL), and Indianapolis SME Chapter 37 are all enthusiastic so far, she says. If they can develop a workable plan and sell it to teachers and parents, any manufacturer in the US could use it as a model.

Don't expect the education establishment to take the lead itself here, warns the US Dept. of Education's Thomas L. Hurley. Public education is a local matter, and setting the workforce training agenda is a job for local manufacturers with the help of the Dept. of Labor.

William H. Kolberg, president and CEO, National Alliance of Business (Washington, DC), agrees. "We can't simply demand that schools do a better job," he says. "Business people

must join with educators to strengthen the connection between education and work."

When they do, they may face an old controversy: student tracking. To students, parents, and teachers who see vo-tech as a dumping ground for underachievers and troublemakers, Dr. Stephen F. Hamilton of Cornell University (Ithaca, NY) has a simple answer: "We have strong discriminatory tracks now. One track leads to select colleges and universities; the other tracks don't lead anywhere."

Hamilton, who runs a youth apprenticeship project, believes incorporating two years of post-high school education into the apprenticeship system is crucial to ensure the new vo-tech education isn't another dead end for these young workers.

Secretary Reich believes it too. Perhaps the most important element in the investment in skills, he says, is developing "sign-posted paths from school to work for those not choosing college. The walls between vo-tech and academic education must come down to create a system in which work experience is part of the school curriculum and is meaningful because it is part of a planned job training program."

Next month our series will wrap up with some speculations about the look of the new world of work taking shape in the decade ahead. ■

### Want More Information?

You can read Sandia National Laboratory's report on workforce skills and education in the May-June 1993 issue of *Journal of Educational Research* or order it from Heldref Publications, 1319 18th St. NW, Washington, DC 20036-1802.

The Commission on the Skills of the American Workforce report, *America's Choice: High Skills or Low Wages*, is published by the National Center on Education and the Economy, 39 State St., Ste. 500, Rochester, NY 14610; ph. (716) 546-7620. Order the SCANS reports *Skills and Tasks for Jobs*, and *Learning a Living: A Blueprint for High Performance* from the Superintendent of Documents, POB 371954, Pittsburgh, PA 15250-7954 or any government bookstore.

On the fence about appren-

ticeships? Talk to the National Alliance of Business Business Center for Youth Apprenticeship, 1201 New York Ave. NW, Washington, DC 20005-3917; ph. (202) 289-2938. Ask for its handbook *Real Jobs for Real People: An Employer's Guide to Youth Apprenticeship*.

The National Center for Research in Vocational Education is a good source of information on students, teachers, curricula, accountability and assessment, workplace literacy programs, tech prep, technical skills training, economic impact of various kinds of training, and analyses of related legislation. Products directory is available from the Materials Distribution Service, Western Illinois University, 46 Horrabin Hall, Macomb, IL 61455; ph. 1-800-637-7652; INTERNET: msmdsuxa.ecn.bgu.edu.