

# Philips Consumer Electronics Company, Greeneville, TN: Survival Depends on Performance Gains, Innovation

*A passion for customers...who shell out fewer bucks each year for their TVs.*

Lea A.P. Tonkin

Are you squeezed by consumers and retailers expecting even more impressive gee-whiz technology each year, while they insist on smaller price tags every time around the block? Then you'll understand a profound challenge to the people making color televisions at the sprawling Philips Consumer Electronics Company (PCEC) facility in Greeneville, TN. Such discomfort might rattle or simply wear out many competitors. As PCEC people emphasized during the recent AME workshop, their competitive weapons include a bundle of techniques to ensure success, from quality and materials sys-

tem improvements to flow manufacturing and gainsharing activities.

Then there's the sheer will power factor — these folks are determined to beat the competition! "People sometimes wonder how we can build color televisions in the United States, with competition in Malaysia and elsewhere," said Joe Brang, general manager of PCEC's U.S. operations and plant manager at Greeneville. "We keep our labor and overhead low, and they will continue to decrease." Labor and overhead account for a relatively small percentage of their cost; material accounts for

most of the rest. Brang said 70 percent of material is U.S.-sourced.

Production volumes at Greeneville dropped after PCEC opened a new TV production facility in Juarez, Mexico in 1989. Later, Greeneville volumes increased as market share rose and unit sales increased. Brang projected more than two million TVs will be made there in 1995. Sales of 19-20-in. TVs are declining as 27-in., 32-in., and larger units gobble a larger share of the market; Brang predicted more sales of even larger units (61-in. or larger) in the future.

## About Philips Consumer Electronics Company, Greeneville, TN

Philips prides itself as the only supplier on the North American continent with a complete color television manufacturing operation certified to ISO 9000-level criteria (ISO 9002 registration in September 1992). The Greeneville, TN facility (built in 1963) is the largest and most modern TV manufacturing plant within the company. More than four million color TVs produced here and in facilities in Juarez, Mexico are sold each year. A limited number of components used at Greeneville are supplied by the Juarez facility — mostly transmitters, transformers, and jacks). Philips sells U.S.-made color TVs under the Magnavox and Philips labels.<sup>1</sup> The Greeneville manufacturing operation occupies 650,000 sq. ft. of space, and warehouse space totals 458,000 sq.ft. at the site. The great majority of its sales are to mass merchandisers such as Wal-Mart, K-Mart, etc.

The company's Greeneville PCB shop, built in 1991, supplies the TV production operation in Greeneville and Juarez; 30 percent of its sales are to outside customers.

Employment reaches a peak of 2500 in the summer and fall, dropping by approximately 1000 during off-peak sales periods. Capacity is 6000/shift for direct view TVs during peak periods, and for projection TV production, capacity is 500/shift in the union shop.<sup>2</sup> Two shifts operate year-round but more lines run in the peak season. All product is distributed from Greeneville or El Paso, TX.

An electronic data interchange (EDI) setup enables retail buyers to connect with Philips' U.S. headquarters (Knoxville, TN) and track shipments from Greeneville, etc. in real time.

Televisions produced at Greeneville reflect the company's FUSE (friendly, useful, smart, and easy) product creation philosophy. Design engineering is located in Knoxville; its engineers work with their counterparts in Philips' engineering and design centers in Briarcliff, NY to create exclusive features that consumers will use daily in television, video, and audio technologies.

The Greeneville plant is part of Philips Consumer Electronics Corporation (PCEC), with annual U.S. sales of approximately \$2 billion-\$2.5 billion (VCRs, camcorders, and other products are in this "Sound and Vision" group along with color televisions). In turn, PCEC is part of Philips Electronics North America Corporation (PENAC), reporting sales in United States of about \$8 billion per year (Philips Lighting, Norelco, etc.), which is owned by Philips Electronics N.V., the Netherlands.

### Adjusting Their Focus

Paring its list of goals, and then making sure it meets those goals, has turned out to be a useful strategy for PCEC. "Our commitment is to total customer satisfaction," said Brang.

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"We used to have more complicated goals," he said during the recent AME workshop at his facility. Although the operation uses a variety of quality, cost, and delivery/reliability measures, they've eliminated the mind set that they must choose between cost and quality, etc.

Another key adjustment: PCEC's focus has become more international in recent years. "We've changed the way we look at our customer base," Brang said. Yesterday's heavier emphasis on U.S. markets has broadened. PCEC now sets its sights on three major geographical areas: European, Western Hemisphere, and Asian. Distribution, regulatory compliance, marketing, and other activities are tailored to specific niches.

### Flexibility, Responsibility, and Shooting "Elephants"

Trying to keep finished goods low while providing topnotch service offers a continuing series of challenges. In the U.S. market, for example, fall football games and the winter holidays account for a huge chunk of color TV sales. A flex work force (as many as 1000 workers who join the company in the summer and fall months, then leave when seasonal sales slacken) come and go as needed. About 80 percent of the flex workers return the following year, with the possibility of becoming full-time employees as others retire.

Flexibility from this arrangement is a plus for PCEC (all workers receive the same training in quality, etc.) and labor costs for these workers are moderate (about \$12 an hour including benefits). Labor cost also can be considered a "minus," along with higher duty (higher duty on U.S.-made units com-

pared to TVs made in Mexico in some cases, under NAFTA — North American Free Trade Agreement), according to Brang, and it's becoming more difficult to line up large numbers of flex workers. In any case, moving people around is a way of life at Greeneville.

All employees are expected to accept responsibility for continuous improvement in quality and customer satisfaction. "The old way was 'Get the job done,' now it's, 'Improve the way the job gets done,'" Brang said. Citing improvements in quality performance (line fall-off dropped more than 50 percent on one line, for example), he added, "We've shot the elephants (big problems), and now we've moved onto many more small improvements."

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Joe Brang

### Quality Improvement System, Synchronizing Mouths and Feet

Formal quality improvement activities began in 1985 when the company's Quality Improvement System (QIS) took hold, according to Lisa Anne Deans, quality manager. Under the QIS umbrella, cross-functional quality improvement teams (QIT) attacked process quality problems in all areas of the operation. They used statistical process management, statistical quality control, design for manufacturability, design for assembly, and other concepts to achieve improvements in product quality and reliability, throughput time, and other areas contributing to customer satisfaction. Baldrige criteria, ISO 9000 standards, and Philips Quality Award (PQA-90) standards also drove quality improvements; ISO 9002 registration was achieved in the fall of 1992. The plant was named one of two winners of the Tennessee Quality Award at the highest level (Governor's Award) in 1993.

"We want to become our customers' first choice," Deans said. "Continuous improve-



Figure 1. Mildred Holt, assembly operator-chassis assembly, on final line 1. (Photo by Lea A.P. Tonkin)

ment has now become part of our culture; it helps us to synchronize our mouths and feet." Developing and actively using annual total quality improvement plans (plant- and work group-level) are among the ways to achieve desired improvements, she continued.

Deans said training (quality concepts, teaming basics, etc.) also supports this effort; employees, including flex workers, receive just under 40 hours' training annually. All new employees receive 4-8 hours' training on QIS, the plant's quality vision, etc. — even if they're returning to the plant after several months' break. New hires must complete an earlier, 40-hour training session on two-handed assembly and other assembly line basics; they also receive three days-six weeks of apprenticeship training, depending on their job code; their probationary period continues 60 days after they're hired.

Two QIS facilitators help to reduce roadblocks to teams' quality improvements.

Approximately 80 improvement teams tackle issues ranging from housekeeping to materials flow improvements.

A QIS newsletter features success stories about their achievements. Teams may submit a written description of their project that is judged against standard criteria. A panel of quality improvement facilitators from throughout the organization judges such applications against the criteria and then selects winners. Finalists' applications are submitted to a U.S. policy council for all Philips companies in the country. This council annually selects two-three winners to attend a Customer Champions Celebration in Eindhoven, the Netherlands.

A process development team (hourly employees, supported by engineers and management) in direct view TV production, for example, was cited for designing next-generation process designs for final lines 2, 4, and 6, resulting in a total cost savings of \$331,209. This team was selected to attend the recognition celebration in the Netherlands; their efforts to satisfy customers and become the "customer's first choice" were noted.

Quality recognition also includes T-shirts, sweaters, a competition for annual corporate quality awards, and other programs.

Quality improvement activities helped Greenville significantly trim its returns or repair rate (from the field) for a tenfold improvement. One challenge is that Philips eats the cost of returns when retailers accept problem-free units from consumers who bought a TV, watched "the big game," then bring it back to the store. Such units are run through quality checks and sold at reduced prices in company outlets.

#### Product Assessment

Three years ago, management decided that it made sense to bring all of the product assessment activities at Greenville into one area. They spent \$2 million to house transportation evaluation, reliability evaluation, etc. in one central area. Bob Bausch, life test manager, said TVs are randomly selected by bar-coded serial numbers and inspected here. The units are bumped and jostled as they move through a transportation analysis; in addition to vibration analysis, units are checked for

proper packaging and their ability to withstand less-than-gentle handling.

Then the units travel through Customer Oriented Audit (COA), where technicians unbox the sets to check the units, packaging, literature and "cosmetics" (appearance). Next, units undergo a complete performance audit including a check with different magnetic fields to simulate conditions in different parts of the United States. Last year, 67,500 units were checked in COA.

Next comes life test: 168 hours for short-term test and 1000 hours for long-term. About 1000 units are generally in long-term test; they're subjected daily to elevated temperatures (thermal stress). Some units are also subjected to high humidity levels; line radiation and other compliance testing to meet various standards (Underwriters Laboratories, etc.) is completed. Nearly 23,000 units were put through long-term and short-term test in 1994.

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Any failed electrical components or other failures are analyzed back to the root cause, Bausch said. They also analyze field failures and conduct surveys of consumers reporting claims. His group relays findings to engineering, reliability, supply management, and other groups in the plant.

#### Barcoding Helps to Trim WIP, Support "Quick Response"

Tracking material flow (including any failed components) has become easier with the use of bar coding by nearly all of Greenville's 138 suppliers, according to Gary Greenway, materials manager. Components as well as units in various stages of assembly each have their own unique serial numbers. "The beauty of the system is that when we read a number to a location, we've got it pegged ... mismatches



**Figure 2.** Patricia Hipps, a machine operator, working in the automatic insertion area, chassis line 2. (Photo by Lea A.P. Tonkin)

are picked up quickly," Greenway said. Barcoding enables Philips people to pick parts on a first-in, first-out basis; inventory record accuracy jumped from 60 percent in the mid 1980s to 99.7 percent after barcoding was implemented in 1989 and materials people received added training in the use of the system.

Setting up unique barcodes with suppliers was more difficult than originally projected. Monarch Marking works with Philips and its suppliers to develop workable barcodes, and Philips technicians provide supplier support. Greenway said he'd recommend working with suppliers on barcoding first, and then tackle barcoding within the customer's company. "We did the reverse," he said. The headaches were worthwhile, he believes. The new setup helped Philips cut WIP from an average of 20 days to six; their goal is one day's worth.

The supplier base was trimmed from 250-300 in the late 1980s as Philips tightened its quality focus and sought to trim cost. Approximately 98 percent of 2600 active parts are single-sourced. Greenway noted that the



**Figure 3.** A tester checking final picture performance. (Photo by Lea A.P. Tonkin)

company can call on other suppliers for most components, in a pinch; parts failures occasionally shut down lines, however.

On nearly two billion parts received last year, the overall fall-off rate was 23 ppm, Greenway said, noting the drive to reduce that rate. The deflection tube is the biggest source of failures.

Philips is learning the "quick response" ropes, Greenway said. For mass merchandisers such as Wal-Mart, they may receive 48 hours' notice of required shipments; Wal-Mart has cross-docks where product goes right through from Philips' truck to trucks heading to individual stores. In this volatile market, three days' firm schedule is nice when you can get it.

#### **Cellular Production**

Tom Hopson, product unit manager, direct view TVs, said flow manufacturing concepts have helped Philips deal with this volatility more effectively. Starting in the late 1980s, Greenville people began to look for alternatives to hand-offs between traditional functions. They began to implement focused production cells, moving industrial and pro-

duction engineers to the plant floor to support the cells.

Each cell became responsible for start-to-finish production of direct view or projection units. "It was a difficult process, and took a long time," Hopson said. "We approached it cell by cell — discussing what functions to include in the cell and working out goals for the cell."

On each line, the previous functional hand-offs from raw PCB to main chassis board installation to final assembly, etc. used to require each finished unit to travel two miles, 15 days, and more than 70 steps. Now each cell has a cell manager reporting to one of two product unit managers (direct view or projection TV). The three cell managers each manage two or more of the ten lines. Foremen as well as engineers report to cell managers.

Using a "Project 2000" or "flow" approach, employees on three lines participate in focused, on-line teams for each of seven process steps: materials, automatic insertion/surface mount, chassis, soldering, chassis test, final assembly, and final test. Each of these teams has specific goals for continuous

improvement. This approach will eventually expand to all ten focused cells. Cycle time on the Project 2000 lines dropped to one hour and 12 minutes, while total flow is now several hundred feet.

Automation on the lines is only considered when it makes sense for the business. Picture tube handling has been partially automated on some lines, for example, to reduce potential for worker injuries and part breakage.

#### **Continuous Improvement**

Continuous improvement activities within the cells generate an increasing number of achievements, Hopson said. For example, a cross-functional improvement team analyzed auto insertion equipment, helping to trim buffers covering daily downtime; quick changeover training, what Hopson called the "Richard Petty approach to downtime," boosted these efforts.

Purchasing, materials, and incoming inspection employees became one team. Incoming inspection was eliminated on all items except those considered "safety critical."

These changes have already helped Greenville people to zip product more quickly through the plant and out to customers. Yet there's no lock on success, when Philips competes with companies in low-labor cost countries such as China and Mexico. Hopson said plans include more participatory management, more coaching to encourage problem-solving on the lines, greater self-direction on the lines, and better visibility about production status on the floor.

#### **Gainsharing Gets Off the Ground**

As cost pressures to build continuous improvement momentum persist, Philips

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management also looks to its relatively new gainsharing program as a means to build employee involvement and encourage

improvement ideas. Hourly employees had been told in 1992 that there would be no pay increase for three years because of profitability challenges, said Murry Holditch, product unit manager, projection TV. Then the company announced plans to develop a gainsharing system covering all employees.

A gainsharing design team was formed; one salaried member (selected by management) and one hourly worker (chosen by the union) represented each of five operating units (color TV manufacturing, PCB manufacturing, logistics/ship, service refurbishing, and service parts). Originally the design team worked with an outside consultant to develop a gainsharing plan, later deciding to go it alone when the resulting plan got too complicated.

The design team presented its plan to management, proposing that payouts be pegged to cost and quality improvements. Under the plan launched in 1993, annual cost and quality goals are reviewed annually by an hourly-salaried team. Each of five gainsharing units has different quality criteria; for example, people on TV production lines are affected by measures of line fall-off, COA, and CLIP (Committed Line Item Performance — a yardstick for production sequence and volume). For each measure, the team is rated from level one (lowest) to level ten (highest — a stretch goal). A “rollover” feature doesn’t allow cost savings to be counted as a gainsharing improvement during more than one year.

“It’s an annual plan, but we pay out quarterly,” Holditch said. All employees who work at least three weeks during a quarter are eligible to participate in the plan. Payouts are based on the number of hours worked, not on the employee’s paycheck size. Hourly people get credit for time-and-a-half hours, and for time when there’s a line shutdown that’s not their fault (caused by a parts shortage, for example).

Performance goals have been rearranged to support the program and to encourage a “we” atmosphere, not “us versus them,” Holditch said. Twenty-five percent of credited savings are earmarked for employees at the operating unit level; the remaining 75 percent is distributed across all five units. Goals are not just functional; for example, line fall-off



**Figure 4.** The JIT delivery system for packaging material to final color TV packing stations.

reduction goals affect everyone, Holditch said.

#### **Initial Gainsharing Results, Possible Changes**

Some 40-50 percent of targeted cost savings at the Greeneville facility is shared with employees through gainsharing. For the first year of the plan, savings of nearly a million dollars meant gainsharing payouts totaling \$416,000 to Greeneville employees, according to Langdon Potts, controller of U.S. operations. The total payout rose to \$770,000 in 1994. For TV production people in Plant 3, for example, an individual who worked throughout the year received \$593.07 in gross pay (gainsharing)

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for 1994. Potts said hourly workers’ compensation (including gainsharing) increased an average 3.0 percent during the past three years.

Although line fall-off, COA, and CLIP numbers are generally improving, gainsharing

is not touted as the solution to all of Philips’ challenges. “It’s self-defeating to keep raising goals every year when performance is already to a high level,” Holditch said. He added that they’re studying measures such as overtime when it’s not needed, maintenance accounts, production supplies, scrap reduction, miscellaneous income (from recycling, etc.), and material cost savings which could be folded into the gainsharing plan.

“We have a way to go (improving the gainsharing plan), but we’re night and day ahead of a year ago,” Holditch said. “The day the plan doesn’t seem to work for us, it’s going to end.” He noted the need to encourage employees’ process and results-oriented thinking, not just focusing on results.

#### **Performance Gains, Innovation**

Although Greeneville employees have succeeded in racking up average seven percent annual productivity gains for the past five years (a 5:1 improvement), Joe Brang said survival in Philips’ tough markets depends on ever-increasing improvements in reducing the line fall-off rate and other measures. “Profitability has been significantly affected by price decreases to the consumer,” Brang said. He ticked off various achievements helping to offset the

cost squeeze during the past several years:

- A 40 percent reduction in assets deployed per unit produced in 1994 versus 1992.
- Cost of quality (failure prevention, appraisal, internal and external failure) decreased 35 percent from 1992 to 1994.
- Total customer satisfaction ratings improved and compare favorably with the competition, according to returns from monthly customer surveys. "It's important to compare yourself against competitors; otherwise, you're just measuring yourself against where you'd like to be," Brang said.
- U.S. market share increased by 1.5 times compared to 1987-1988; they're in second place for U.S. TV unit sales, after RCA.

Team activities powered many of these gains, but added training and experience are expected to rev up their results. "We want teams that work on problems with the responsibility and authority to make needed

changes," he said. "Otherwise, people identify problems they can't solve, turn them over to management, and if they're not solved, they get frustrated." Brang shied away from using the word "empowerment." He noted, "It has so many different meanings, like 'total chaos.'"

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Joe Brang

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Innovative product features snag new customers, also beefing up PCEC's competitiveness. "We like to have features that others don't have, first," Brang said. The picture in a picture, TV remote that controls both the TV and VCR, "smart sound" to reduce noise levels during commercials, "smart picture" to simplify picture adjustment, and the "remote finder" (press a button on the TV and the

"lost" remote beeps) are examples.

Brang said he's proud of Greenville employees' string of improvements. He quickly added that the plant's survival depends on making that list a longer one.

1. Magnavox was purchased by Philips in 1974; Philips bought Sylvania in 1981.
2. The IUE (International Union of Electronic, Electrical, Salaried, Machine, and Furniture Workers, AFL-CIO) represents plant personnel.

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*Lea A.P. Tonkin, Target managing editor, is a member of the McHenry County (IL) Job Training Partnership Act (JTPA) Private Industry Council.*

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Editor's note: The hospitality of many PCEC people at Greenville is appreciated.

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