

2004 EDITION

DISPLAY UNTIL MAY 23, 2004 | WWW.FORBES.COM

Forbes

THE WORLD'S

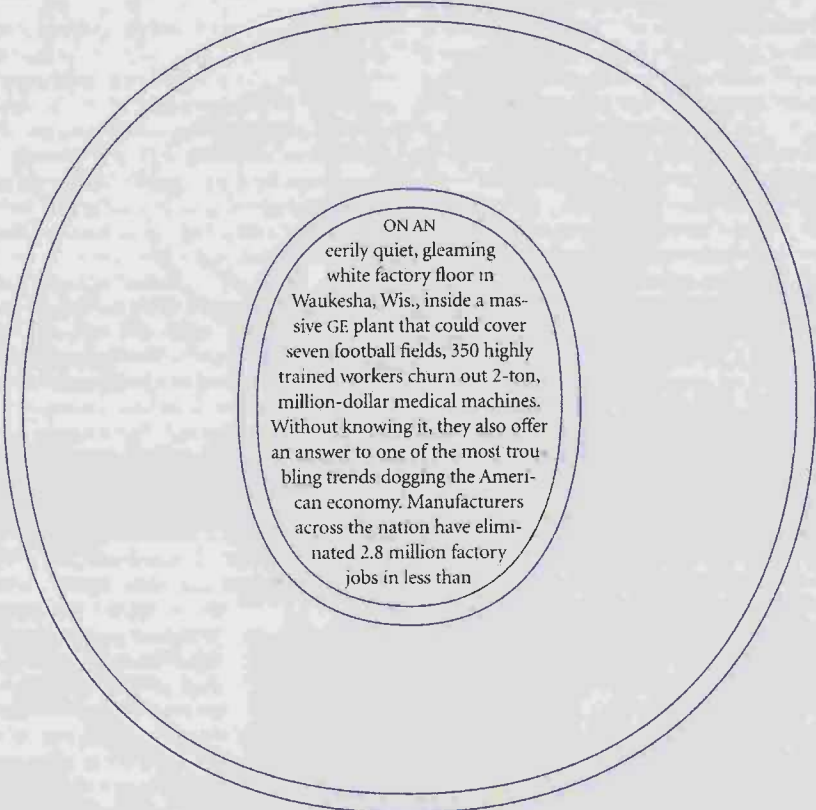
2000

LEADING
COMPANIES

\$4.99/ CANADA \$6.99



0 09281 01639 433



ON AN
cerily quiet, gleaming
white factory floor in
Waukesha, Wis., inside a mas-
sive GE plant that could cover
seven football fields, 350 highly
trained workers churn out 2-ton,
million-dollar medical machines.
Without knowing it, they also offer
an answer to one of the most trou-
bling trends dogging the Ameri-
can economy. Manufacturers
across the nation have elimi-
nated 2.8 million factory
jobs in less than

Made in America

Millions of manufacturing jobs are headed overseas.
So how is it that, in the U.S., GE's medical-gear
factories are thriving? By Kerry A. Dolan

PHOTOGRAPHS BY TIM EVANS FOR FORBES



Ever better:
Productivity at
GE Healthcare's
Waukesha, Wis.
plant is up 25%
since 2001.

graduates with better skills in software and electromechanical troubleshooting. Once a grad is hired at GE, he gets an additional two weeks of on-the-job training to man the testing stations for things like computed tomography (CT) scanners and magnetic resonance imaging (MRI) machines. Most workers on the assembly line start with a high school degree and two weeks of new training. All workers get another two hours a month of training in manufacturing methods and environmental health and safety. Pay at the Waukesha factory, where workers are unionized, ranges from \$16 to \$25 an hour. These jobs breed loyalty: Average tenure is 25 years, and the turnover rate is a low 4%.

To reduce factory injuries and keep productivity up, design teams work to improve the ergonomics of assembly each time a new product is in development. They track how many times an assembly worker has to lift something above the shoulders or below the hips, altering the design to reduce the strain. On its latest CT machine, the LightSpeed Pro, such lifting was reduced 70%—helpful when one component is a 250-pound X-ray tube. As a result of moves like this the number of injuries at GE Healthcare's plants dropped 40% last year. So far this year the injury rate is down 50% from the year-ago period; this helps keep productivity improving.

The U.S. is still a fount of new technology, and GE Healthcare takes full advantage of it. Vendors in the U.S. (and GE's own U.S. sites) account for 65% of what GE Healthcare spends on tech for its newest products. Of the 150 suppliers to GE's mobile "C-arm" X-ray plant in Salt Lake City, 80% are domestic. Even some foreign suppliers have set up here. Barco, a Belgian-based supplier of liquid crystal display (LCD) screens and graphics cards used in GE machines, produces cards at a small facility in Beaverton, Ore., where it also houses a research team.

For all the high-tech wizardry inside the machines, GE also uses the latest inside the factory. A year ago the Waukesha plant started using e-tags, sophisticated radio-frequency ID tags about the size of your index finger. The e-tags are attached to carts that transfer parts to various stations along the assembly line; each tag identifies which parts are on board. Antennas relay the data to GE tracking software as the cart leaves an off-site warehouse and as it enters the factory. A few times a day an employee drives a cart around the factory to refill it with the right parts. "Assemblers can spend the day assembling instead of looking for, or waiting for, parts," says Stephen Leonard, a GE Healthcare general manager. "They're much more efficient."

To better align design and assembly, GE Healthcare has the top engineers on a product work on-site with assembly workers. For each new product GE assembles a team from eight departments,

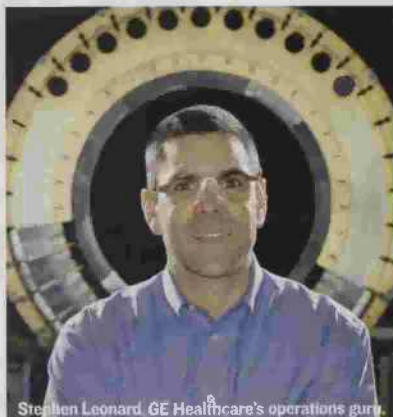
including engineering, manufacturing, service, marketing and regulatory. For the LightSpeed 16 CT scanner, 86 people came together, 85 of them based in the Milwaukee area. The team followed a 450-step process that included answering questions to ensure the new model not only delivered the right features but also was cheaper to build and service. The final design involved 300 suppliers and 800 unique parts, 40% fewer parts than in the previous model. It used components from 16 different internal GE "feeder lines," such as an X-ray tube from GE's Electric Avenue facility in Milwaukee, a circuit board from another GE plant nearby and padded-plastic patient tables from GE in China.

Two years ago GE Healthcare adopted "lean" manufacturing, the obsessively efficient approach pioneered by Toyota in Japan that encompasses just-in-time delivery, low inventory and plants that churn out several different products. Previously parts were stored on the factory floor, and workers would go find what they needed when they needed it. Now the parts are gathered at a warehouse 20 miles from the Waukesha factory and put into production "kits" for each of the six stations along the CT assembly line. The kits are delivered to the Waukesha plant for final assembly on an as-needed basis. Signs above the assembly stations ("Power Supply," "Drive Handle") make it obvious what goes where.

When lean manufacturing was introduced, Leonard says, his team erred by trying to make the assembly line move before the parts delivery system was perfected. "For a month the line was physically stopped more than it was moving, stalling for up to three hours, he says. "We were losing 20% to 30% of the available time during the day. The fact is, we were losing that time before. We just didn't know it." One benefit of lean, he says, is that it highlights the inefficiencies. After a month the assembly line was running smoothly again.

Design innovations on a new model can be radical. For the latest CT machine, workers suggested attaching the base to the 4,000-pound machine at the beginning of assembly rather than at the end. This eliminated the need for a 15-foot crane to flip the doughnut-shaped rotating body of the CT machine from a horizontal to a vertical position so it could be placed on the base. That freed up more room on the factory floor: The new line takes up half the footprint of the old one, plus 35% less assembly time. It also cuts back on inventory: The new CT line has only 5 chassis on the floor, down from 12. "Once you fix this, productivity improvements start to happen automatically," Leonard says.

An entire CT is assembled in two days. Then it endures four days of around-the-clock testing. Before the plastic cover is added, the machine is loaded inside a 20-foot-tall metal cage for spinning



Stephen Leonard, GE Healthcare's operations guru

"Assemblers can spend the day assembling. They're much more efficient."

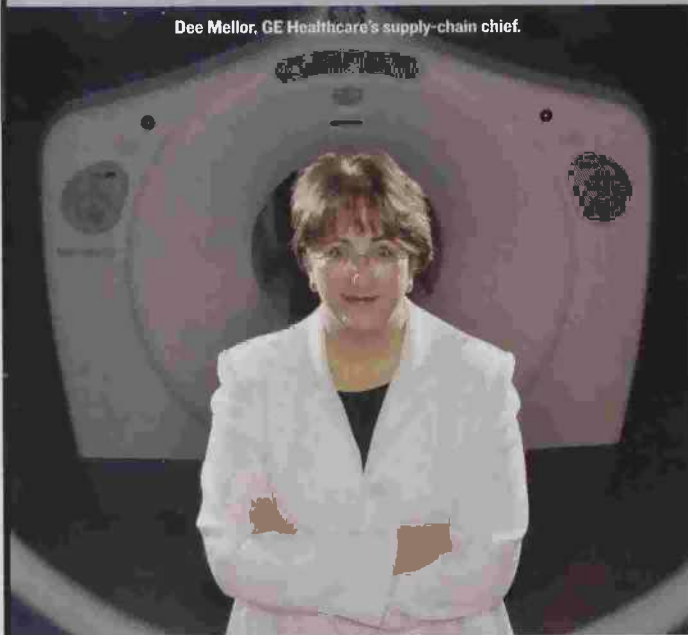
four years, including a million jobs that moved to cheap-labor markets overseas. Some experts worry the U.S. has lost its manufacturing might.

But General Electric's medical-equipment business hasn't imposed a major factory layoff in five years, holding the manufacturing payroll steady at 3,200 people. These workers are a crucial part of GE Healthcare's success. Annual revenue at GE Healthcare, one of the fastest growing units at GE, has rocketed up 65% to \$10 billion in four years. The company makes its most sophisticated and highest-priced gear—CT scanners, MRI machines, PET scanners, portable X-ray machines—at 15 factories in the U.S. GE used to debut just one new CT product each year; now it unveils eight. It manufactures here because the U.S. has the highest-skilled engineers, designers and production workers in the world. "We just keep getting better at the process," says Diane (Dee) Mellor, GE Healthcare's supply-chain chief. "It's how we keep ourselves competitive."

Thus GE Healthcare offers a blueprint for the U.S. manufac-

**"We just keep getting better at the process.
It's how we keep ourselves competitive."**

Dee Mellor, GE Healthcare's supply-chain chief.



turing base and how it must adapt to survive. The GE business moves up the food chain to make pricey, complex products that are beyond the ken of factories overseas; it relentlessly pursues ways to innovate in both features and production methods to stay out in front. It uses factory clusters to tie suppliers more closely, geographically, to GE plants for instant delivery. And GE continually trains and retrains workers and, even after a new product is perfected, forms troubleshooting committees that

scrutinize how all of it might be done better next time.

"GE tends to be more at the cutting edge when it comes to global business models," says Eric Schwalm of consulting firm Bain & Co. "They're a good company to look at to see where the bulk of the market will get to five years from now."

The Waukesha plant produces a masterpiece of human invention. A CT scanner takes 3-D X-ray images by spinning thousands of pounds of metal and microchips—including a detector array, an X-ray tube and a few circuit boards—around a prone patient. Housed inside a plastic skin, the CT rotates at up to 150 revolutions in 60 seconds, producing more G-forces than the space shuttle endures while in orbit. Worldwide, CT machines are used to diagnose 25% of all disease. Annually, 100 million scans are done; one in ten people will get one at some point. GE scanners serve more hospitals than all other brands combined.

GE's latest "16 slice" machines take cross-section images of the body that are as thin as a credit card, letting doctors spot problems early by peering inside the body at submillimeter levels (smaller than the head of a pin). Starting price: \$1 million. These magical machines attract business from hospitals around the U.S., which accounts for half of GE's market, and in more than 100 countries around the world. To be sure, GE has 30 plants overseas, mostly in Asia and western Europe, for older-generation models sold in nearby markets. But at the high end the U.S. offers clear advantages in the constant quest for better performance, lower cost and easier assembly.

Working here at home offers GE Healthcare ready access to top-quality production workers and the training they need for them. It puts GE plants close to suppliers of much of the new technology in its products. And it lets GE engineers work alongside its production teams. The result: U.S. plants turn out 62% of GE Healthcare's products, in dollar terms, but account for only 40% of its factory workers' applied labor. Productivity at the Waukesha plant is up 25% since 2001. The U.S. presence also lets the GE unit maintain close links to hospitals, doctors and academics, soliciting their advice on new product features. "You want to be in the market that you're serving, so you're close to the customer you can understand," explains GE's Mellor, who oversees 6,000 workers at GE Healthcare, which employs 32,000 people in 34 countries. Doctors in the U.S. regularly traipse into GE Healthcare headquarters just outside Milwaukee for consults and factory-floor visits.

GE Healthcare works with local technical colleges to help tailor curriculums to fit its workers' needs. Last year Mellor asked the president of a two-year technical college near Milwaukee for

and balancing, in preparation for the high-speed spinning it will do around the patient's body. From there the unit heads to one of 86 test bays, enclosed cubicles where employees conduct still more tests, including simulating a patient getting a scan.

GE Healthcare has made similar strides with the new line of positron emission tomography (PET) machines. Sales volume grew 300% from the first to the fourth quarter last year, fueled by a new mobile format and better insurance coverage. A popular combination CT/PET machine sells for \$2.6 million to \$3.3 million. The new stand-alone PET uses one circuit board instead of ten, and half the parts of its predecessor. Assembly time has been cut in half, so the Waukesha plant—the sole source of GE's PET line—now turns out one unit a day.

In Salt Lake City a GE Healthcare division makes mobile X-ray machines, called C-arms, for orthopedic and cardiac use. Innovations on these contraptions, which sell for up to \$300,000, include motorizing the movement of a previously manual X-ray arm so the doctor, rather than a technician, can control it. That reduces staff workload and lets the patient spend less time exposed to radiation, says Lewis Dudley, president of the division. The factory employs 160 production workers, up 20% since 1999—yet their output is up 57% in the same period, to 3,000 units a year. Revenue has more than doubled to \$500 million in that time.

GE's less advanced plants overseas help keep costs down in the U.S. In assembling the mobile C-arm X-ray machines in Salt Lake, mechanical components come from GE's plant in Monterey, Mexico, generators from its factory in Bangalore, India and displays from its site in Beijing. "No one has the luxury not to play in the global marketplace," says GE's Dee Mellor. "That growth has allowed us to continue to invest in new products."

As China and India gain more expertise, they could threaten high-end manufacturing in the U.S., but GE Healthcare aims to keep accelerating the cycle of innovation. "It isn't just a labor-cost play. This is about speed to market, the right product and operational efficiencies," Mellor says. "We have a huge market here in the U.S. that's growing. We're going to be here to serve it."