

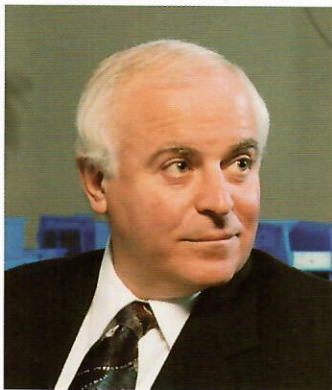
# FORTUNE

INDUSTRIAL MANAGEMENT & TECHNOLOGY

## Heroes of U.S. Manufacturing

*American manufacturing is bigger than ever, thanks to innovators like the six honored by FORTUNE this year. Their achievements range from tiny new machining tolerances to better ways for whole industries to arrange production.*

**BY GENE BYLINSKY**



Costanza

### Production's New Choreographer

AMONG THE MEN AND WOMEN WHO have helped U.S. manufacturing return to world pre-eminence, John Costanza, 51, stands out like a lighthouse. He has been on this crusade for 16 years, successfully executing his dream from the John Costanza Institute of Technology (JCIT), headquartered in a big, airy, glass, brick, and concrete building in the Denver suburb of Englewood. Boasting 240 employees in Colorado and at its branch offices in San Jose and in Nice, France, JCIT has trained more than 70,000 representatives of 3,000 companies, most of them American and European. Costanza's 1990 book, *The Quantum Leap in Speed to Market*, has sold 250,000 copies.

Costanza is the father of demand-flow manufacturing, a concept that stands conventional repetitive manufacturing on its ear. All those famous technologies Americans borrowed from the Japanese—the Toyota production system, just-in-time parts delivery, and similar approaches—are designed for repetitive production of the same item.

The word "flow" was used earlier by Japanese manufacturers but in a different context. Their approach, says Costanza, has been: "Flow it through, fill up the warehouse with the wrong stuff, and go broke. One of their companies recently filled up its warehouses with a VCR nobody wants." Today the world demands many products, particularly computer equipment, made at lightning speed with frequent variations to accommodate and stimulate shifting demand. This calls for a flexibility that repetitive manufacturing lacks.

Demand flow does away with schedules and forecasts, inventories of finished goods, and warehouses in which to store them. For the fabled just-in-time concept, it substitutes raw-in-progress

## HEROES

(RIP), in which a cushion of varied materials is kept on hand to meet changing customer demands. Finished goods move directly from assembly lines into waiting trucks. The results are astonishing: American Standard, for example, saved \$500 million in working capital during the year it started using demand-flow technology (DFT). Another JCIT client, General Electric, has installed DFT in all its divisions; the technology has earned high praise from CEO Jack Welch for boosting productivity. By shrinking clients' stocks of finished goods, DFT has also enabled them to double and triple their inventory turn rates. This has helped them move toward the goal of zero working capital—the state of ultra-efficiency, proved possible by DFT user Dell Computer, in which inventories are so lean and production so prompt that a company can collect payments from its customers even before the raw materials are on the books.

John Costanza's story is the story of America. An Italian laborer immigrates to toil in the coal mines in Trinidad, Colo., and later in steel mills in the town of Pueblo in the same state. Two generations later his brilliant grandson flies around the world in his own Falcon 2000 jet and owns a \$70,000 Federal Mogul dragster, which a sextuple heart bypass operation last year hasn't stopped him from driving. His 18-year-old daughter, Melissa, has her own dragster, in which she has won elimination rounds at the famed Indianapolis Speedway.

Before these luxuries came a decidedly modest childhood in Pueblo,

where Costanza's father was a postal worker and his mother a housewife. Growing up, Costanza was an avid reader of science fiction. He was also fascinated by how mechanical devices worked, taking apart and putting together radio-controlled cars and other toys. He helped his father in his small workshop, where they repaired neighbors' motorcycles and other machines.

After graduating from Colorado Southern University with a degree in applied mathematics and physics, Costanza worked at Johnson & Johnson and Hewlett-Packard. Moving from Colorado to Texas and then to California, he gained experience not only in manufacturing but also

### JOHN COSTANZA

#### COMPANY

John Costanza Institute of Technology

#### FIELD

Production engineering

#### ACHIEVEMENT

Invented demand-flow manufacturing

#### HOBBIES

Driving a dragster, flying

*Costanza at a training factory in Colorado*



in product design, materials handling, marketing, and software development. From Texas he ran an HP plant located across the border in Mexico.

**I**n the early 1980s, Costanza's expertise caught the eye of HP co-founder David Packard, who was looking for an engineer to help figure out how U.S. industry could survive the Japanese manufacturing assault. Concerned government officials had created the President's Council on Productivity. To head it, President Reagan had chosen Packard, who turned to Costanza. That he and Packard hailed from Pueblo allowed them to reminisce about their childhood days.

After extensive firsthand studies of Japan's repetitive manufacturing and Germany's highly departmentalized production systems, Costanza decided there must be a better way. Sensing a trend toward global manufacturing that needed to respond quickly to customer demands, he decided to engineer a new manufacturing system. Packard encouraged Costanza to put his ideas into practice.

"I sat down and decided that when you look at manufacturing, it's nothing more than a relationship of work and volume," Costanza says. "The work is performed by people and machines, and the volume is whatever you think your capacity is going to be. I came up with a calculation for that foundation and called it operational cycle time."

He explains: "If, for example, you want to build an automobile and you want to build eight per day, and the plant works eight hours a day; that's one car every hour. If it takes 32 hours to build a car, you just break it into one-hour pieces, staff each step with a person and a machine, and have one piece come out every hour. If

you use that as a premise, you're getting to a mathematical foundation. But what if you can't hit that one-hour target? How do you balance this? The auto has four tires. So how do you balance four tires in an hour when you only make one frame in an hour? I came up with a series of formulas to balance it." To avoid sets of tires piling up, the solution was to shift workers who completed their jobs ahead of time to other tasks in the plant.

"Now I could get anything to flow, and I could balance anything mathematically," Costanza says. "The next question was, How do you get material to this process? We don't know what we're going to make,

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and it's going to be driven by demand, so we have to figure out how to replenish the material that has been used up. I put a math foundation under that as well. And a lot of people thought I was nuts. Others—including Packard—said, 'You may have something, and we should try it.'"

Costanza's demand-flow system, which also substituted semicircular work cells for some linear production lines, performed well when a couple of HP divisions tried it. But it ran into resistance elsewhere in the company. HP was then trying to sell factories on the large-scale use of computers. DFT sharply cuts their

use, since it involves no transactions—no work orders and schedules, for example, to make up and follow. In a DFT plant, the role of computers—mostly PCs—is limited to such tasks as calculating total production cycle time and tracking actual vs. planned worker efficiency.

David Packard loved the logic of DFT, but even he couldn't change HP's computer-oriented culture overnight. Yet DFT became a permanent feature at some parts of the company. Packard also helped Costanza start his institute by investing \$10,000 in it. Costanza and his wife, Linda, put in another \$10,000, and with the help of numerous relatives, started JCIT in the basement of their Denver home. An advocate of the hands-on approach to learning, Costanza developed a four-day course to be taken in a lab factory that he designed. In JCIT's early years, Costanza and his wife would load the portable factory into a big moving van they had bought for the purpose and drive down, say, to Texas Instruments in Dallas to teach engineers there the new techniques.

JCIT's stationary classrooms now have model factories too. Students first assemble products such as motors in the conventional repetitive assembly style. Then they restructure the assembly lines into semicircular cells and make the same products the demand-flow way. Even skeptical old-timers generally come out of the four-day course believing in DFT.

Costanza's ideas have caught on especially fast among advanced manufacturers such as contract electronics houses, which must quickly accommodate product changes. It takes time to put in a DFT system, and even longer to change a corporate culture, says Costanza. The changes should be coming faster now that JCIT, which formerly made its DFT software available only to clients, is selling it to all comers.