BONUS FEATURE

# TOYOTA'S GLOBAL BODY SHOP

## The Japanese automaker is putting the final touches on a new strategy: being able to build almost anything, anywhere. By Stuart F. Brown

Other carmakers can only shiver. In a sweeping multibillion-dollar program, Toyota is integrating its assembly plants around the world into a single giant organism that will enable the company to save time—and money—on every vehicle it builds. This manufacturing network will make it much cheaper to build a wide variety of models. That means Toyota will be able to fill market niches as they emerge without having to build whole new assembly operations. With consumers increasingly fickle about what they want in a car, such market agility gives Toyota a huge competitive edge.

Among the U.S. auto companies, GM is the most advanced at creating this kind of flexibility, but it still trails Toyota by three to four years—and by the time it reaches the Toyota standard, Toyota will have moved on. Ford and DaimlerChrysler are even further behind. And as Detroit pulls out the stops to recover market share, its relatively laggard manufacturing performance could prove costly.

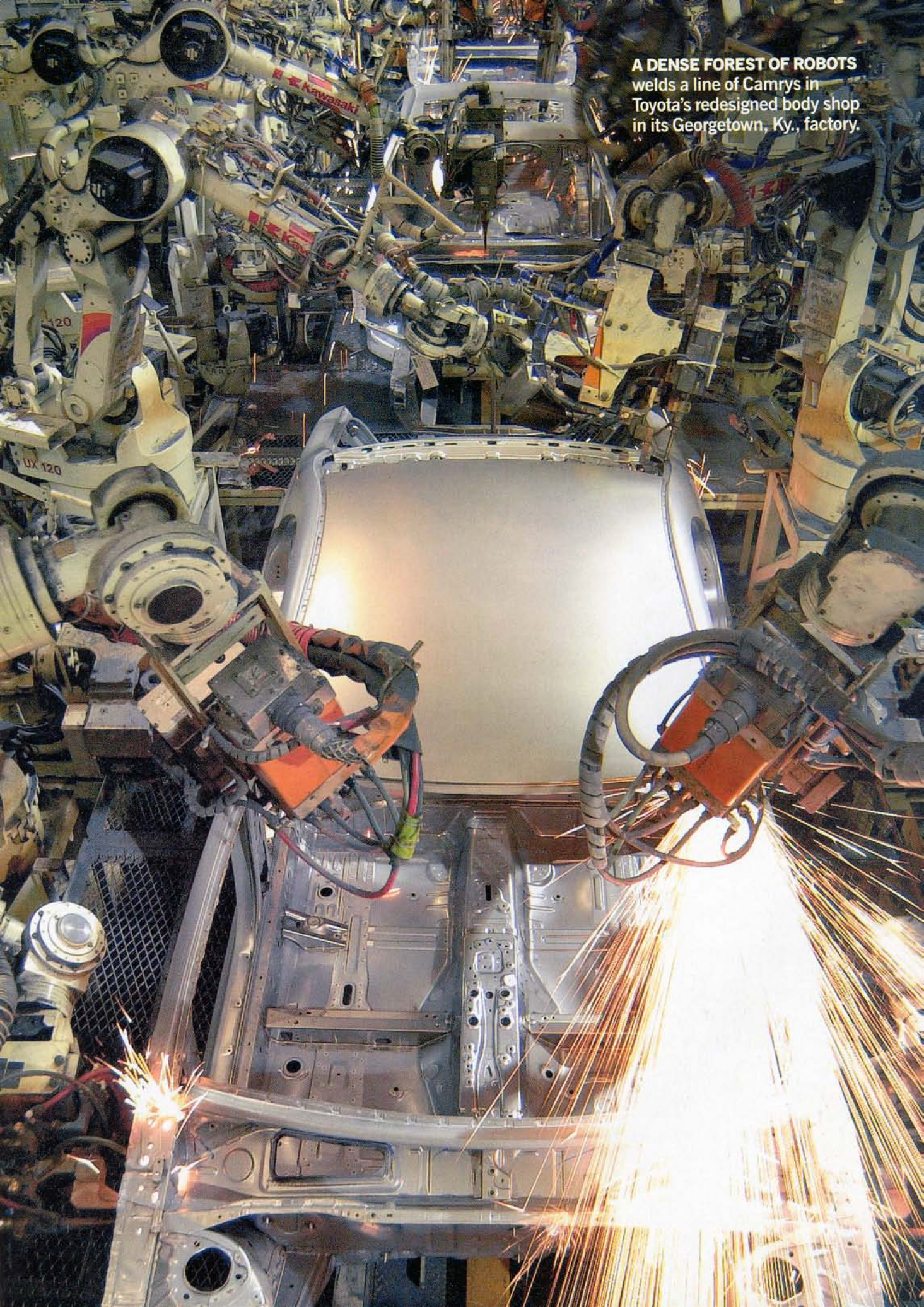
An essential element in Toyota's grand scheme is its so-called global body line, a standardized metalworking system in which all Toyota plants build vehicle bodies using the same equipment and using whatever mix of labor and robots makes sense on location. In a low-wage country like Vietnam, for example, Toyota uses more humans on the line, while in high-wage nations like Britain or the U.S., it uses more robots. Coupled with a program known as the global midsize platform, under which Toyota is greatly increasing the number of different vehicles that can be built on the same assembly lines, the global body line gives the company an unmatched ability to respond to the changing whims of automotive fashion.

"Return on investment is everything," observes Michael Robinet, vice president of global forecasting at research firm CSM Worldwide in Farmington Hills, Mich. "If Toyota can more efficiently use its capital in North America, it frees up more dollars to go and expand in its other markets. Toyota's new body line raises the bar for the global auto industry."

In 2002 the final piece of the puzzle snapped into place at Toyota's huge Georgetown, Ky., plant, which employs 7,000 people. Over a period of two years, engineers tore out the body-welding section of an assembly line and installed two new body shops in the same floor space. About 30 of the company's 34 body lines worldwide have by now been equipped with the new system, and the rest will follow soon.

"The new line represents 50% less investment than the one it replaces," says Don Jackson, "and lets us add a different car type to the line at 70% lower cost than before." (Jackson oversaw the installation of the global body line in Georgetown; now he is at Toyota's new plant in San Antonio.) Georgetown builds Toyotas based on the Camry platform; it expects to produce about 370,000 Camrys, along with 52,000 Solara coupes and 36,000 Avalon sedans, on the same assembly line this year. Even five years ago mixing models with such widely varying volumes just couldn't be done.

To grasp why Toyota's global body line is more efficient, it helps to understand its predecessor, the "flexible body line," which




**A DENSE FOREST OF ROBOTS** welds a line of Camrys in Toyota's redesigned body shop in its Georgetown, Ky., factory.

was installed at Georgetown in 1988. That system, which was cutting-edge at the time, used three big pieces of expensive, high-precision tooling, known as pallets, to grasp the vehicle's body sides from the outside and its roof from above, positioning the parts as robots applied thousands of spot welds to give the finished body its strength. The pallets accompanied each body through to completion. As a car came down the line, heavy conveyors would fetch a trio of appropriate pallets from an overhead storage area and lower them to the body line. If the next vehicle in the queue was different (a Sienna minivan rather than a Camry, say), the system would fetch a set of Sienna pallets and ferry them to the line, and so on. The body shop needed to keep more than 50 sets of pallets circulating, requiring a storage area the size of a football field.

In designing the new system Toyota engineers hit on the idea of building from the inside out. Working this way not only simplifies the operation but also increases flexibility—as many as eight different models can move through the same body shop. That makes it easier to produce boutique models, for which total volume is small but the profit on each sale is hefty. And with the global body line in place almost everywhere, Toyota plants building the same cars in different countries can promptly share production-line fixes.

The way the system works is that a single pallet reaches down through the open roof and holds the body sides in place while they are being welded. Then the pallet is extracted from the body, which proceeds down the line for further welding (and the addition of the roof) without the need for special tooling to support it. Only one pallet is needed to build each car type.

By doing away with side-gripping pallets, the body line permits about 600 welding robots to fit into just half the floor space required for the old line. That's how Toyota fit two body shops into the area formerly occupied by just one—and at half the cost. The flailing arms of the robots move through their work routines in a mechanical ballet that allows just a whisper of clearance between neighboring machines. To ensure that the robots don't tangle with one another, Toyota used three-dimensional simulation software to refine the global body line's choreography. Seeing machines collide virtually on a computer screen is far preferable to having them crash physically on startup day.

The global body line program started in 1996 with trials at a small, labor-intensive plant in Vietnam that assembles Camrys. The following year it was installed at a more automated plant in Japan that produces Prius hybrid cars. Since then it has gone to work in France, Britain, and the U.S. Whether people or robots are doing the welding, the underlying architecture is the same: a single pallet that supports the parts from the inside.

The Georgetown plant is an example of the ascendance of "flexible manufacturing"—producing different kinds of cars on the same line without fuss. All major automakers are going in that direction, but Japan's big three—Toyota, Honda, and Nissan—are well ahead of America's Big Three and manufacturers in Europe.

The key to flexible manufacturing is that the people who design the cars stay in close touch with the people who will build them. "Toyota won't design a vehicle that it can't build efficiently," says Robinet. "The engineers are governed by design rules that say, 'Thou shalt not design a vehicle exceeding certain dimensions or lacking certain precise locator points.' "

Locator points are where steel pins on the body line grip a car's floor pan and lock it in place. Although that may sound like something only a car guy could appreciate, the principle is simple. By presenting a Camry or an Avalon or a Solara body to the robots in an exact and repeatable way, the flexible line lets the same automatons work on different products. That keeps the production line going smoothly. The only change for the robots is in the software as they execute thousands of spot welds on the different models.

Inflexibility, by contrast, can lead to missed opportunities. A case in point is DaimlerChrysler's PT Cruiser. Based on the Neon compact car, the PT Cruiser was a big hit in the 2000 and 2001 model years; demand quickly exceeded the capacity of the Mexican plant where it was built. But DaimlerChrysler was unable to shift overflow production to its Neon plant in Belvidere, Ill., which had capacity to spare. Why? Planners had neglected to make the Belvidere paint shop tall enough for the PT Cruiser, which is a few inches higher than the Neon. The oversight meant the company flushed away $480 million in forgone pretax profits, estimates Prudential's car analyst, Michael Bruynesteyn. It is a safe bet Toyota would not have left that half-billion on the table.

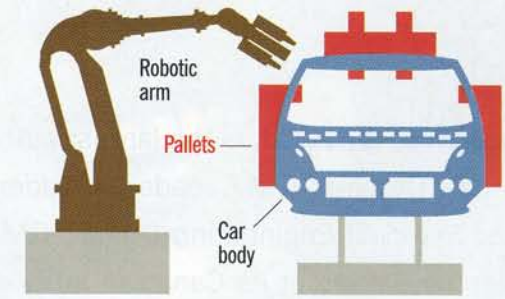
In addition to keeping plants running flat-out, mastery of flexible manufacturing can slash the amount of money a producer ties up in inventory. The Georgetown plant's body shops now have just 50 cars in the works at any given moment, vs. 100 before. "We're constantly working on reducing the lead time needed to fill an order from a dealer," says Toyota's Jackson. "We're at five days now, and our goal is to build cars with even less lead time." Catch him if you can, carmakers of the world. F

## THE NEW BODYBUILDING

Engineers reduced the number of fixtures, or pallets, needed during welding. That increased access for robots.

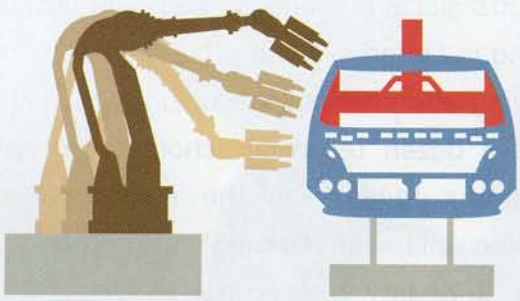
### OLD METHOD

Three pallets (in orange) are needed to support the pieces.




### NEW METHOD

A single pallet holds the car body sections together from inside.



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