

MAKING BIG GAINS FROM SMALL STEPS

Constantly improving existing products, says IBM's former top scientist, is as critical as developing new ones. Japanese manufacturers do this well. Americans had better learn how.

By Ralph Gomory **Jeremy Main**
REPORTER ASSOCIATE Constance A. Gustke

April 23, 1990

(FORTUNE Magazine) – REMEMBER Woody Hayes? The late, great Ohio State football coach had a passion for winning the old-fashioned way. His teams moved downfield not with razzle-dazzle passes but by grinding out 3 1/2 yards and a cloud of dust. If Ralph Gomory is right, U.S. business needs to take a page from Woody's playbook. In the global game of economic competition, Gomory argues, America remains tops at creating products and rushing them to market. But U.S. companies have lost ground to Japan because they too often ignore the gritty task of constantly improving existing products. And that requires mastering the basic blocking and tackling of manufacturing. A mathematician, Gomory, 60, joined IBM in 1959. He rose to senior vice president for science and technology before retiring last year to become president of the Alfred P. Sloan Foundation, which supports research on scientific and economic issues. A member of both the National Academy of Sciences and the National Academy of Engineering, Gomory also serves on President Bush's Council of Advisers on Science and Technology. He talked with Jeremy Main.

You hear a lot of different explanations for the competitive problems of the U.S. -- that the cost of capital is too high, that we have an uneducated work force, that others take our scientific ideas and put them into practice. There's some truth in all these notions. But I believe that we could educate ourselves and do research until we are blue in the face, and we still would not be competitive. Our real problem is closely tied to the mundane issue of manufacturing. Why does manufacturing matter? First, international trade is overwhelmingly in manufactured goods. You can't balance your international payments with services. Second, about 20% of the gross national product in the U.S. comes from manufacturing, and another large percentage consists of services that live off manufacturing industries. Third, and even more important, over 90% of the research and development in this country is performed by the manufacturing sector. It's the only sector that really does any R&D, and it's from that sector that most of our material progress comes. Within manufacturing, our problems occur not in the early stages of an industry but once it matures and settles into a cycle of gradual improvements, year after year. In the long run, being successful in this process, known as the manufacturing-development cycle, is as important as your ability to create wholly new products.

Look at what has happened in three of our major industries: computer memory chips, consumer electronics, and automobiles. Who did the basic science behind semiconductors? The U.S. did. Who

used that science in the transistor? The U.S., in the Bell Labs. Who made the first products? The U.S. did. We owned the semiconductor industry for roughly six rounds of products. We went from 16 bits on a chip to 64,000. And then Japanese competition became significant, and after the next round, took over. It was not that the Japanese took our ideas and became the first to turn them into an industry. We had already developed an advanced, multibillion-dollar industry, and then they took it over. Everybody knows who started the automobile business. I don't know how many product cycles we went through over the years. Then Japan started to make a better car, at a lower cost, with fewer people, and with higher-quality manufacturing. In consumer electronics we conceived of the TV set -- this gets a little repetitive -- we created and dominated the industry, and then it got away from us. Now biotechnology is where semiconductors were maybe 20 years ago. There again, we are in a leadership position, as we always are when an industry is being born out of science. That's still our strength. The time to worry about biotechnology is once it gets past the early stages. AMERICANS INVENTED highly integrated mass production to make things in big batches. We were very good at that style of manufacturing. But the Japanese have created a new style of manufacturing and a better way of improving existing products. What is it? Partly, it's a lot of little things, techniques like just-in-time inventory controls. But it also reflects a different way of looking at the manufacturing-development cycle. For example, the Japanese do not divorce development people from manufacturing people as we in the U.S. have traditionally done. Here manufacturing has been mostly a blue-collar operation. Our engineers all want to be on the design side, developing the next round of products. But if an engineer is working on a product and he does not understand manufacturing, he may design something that does not readily fit the tools in the factory, or something that the manufacturing people will have trouble building. In Japan these groups are tied closely together. Design engineers do not just hand off a product to manufacturing engineers; they develop it together so that a high-quality product can be readily made by the existing work force with existing tools. Now, if the name of the game is bringing out round after round of products and improving them each time, and one company can bring out a new round in two years while another takes three, then the first company has a tremendous competitive advantage. Consider two products that appear in the marketplace in 1990, one from a company with a two-year cycle and the other from a company with a three-year cycle. The two-year product incorporates the technology of 1988, the other the older technology of 1987. The result is technological leadership, even though no one has invented anything new. That kind of disparity often exists between American and Japanese companies. Here's another example of the profound difference between the two systems. In Japan manufacturing people have very close relations with their suppliers -- so close that sometimes parts are delivered to the loading dock and no one counts them. Japanese suppliers are even paid a different way; if so many things come out of the front end of the factory, then the supplier must have delivered so many parts. Relations are so close that a Japanese manufacturer may have only one supplier for a given part. In the U.S. it's the exact opposite. Purchasing agents are rotated so that they don't get to know suppliers too well, for fear of kickbacks. It's a different system. American companies normally like to have multiple suppliers so that they can get them to bid against each other. There's no shared destiny between the supplier and the manufacturer. Then there is the role of the development engineering team itself. In introducing new ideas, new materials, or new technology into the next round of a product, such a team is always constrained by the existing product. Will a new printer head, for example, fit well with the rest of the printer, or does it require a complete redesign? Can the new product be ready two years from now, as the schedule demands? Does it fit the constraints of manufacturability? BECAUSE OF these constraints, any new design or technology presented from the outside is likely to be rejected, not just because of the not-invented-here syndrome but because of real difficulties. The answer is not to push new ideas at the development group but to encourage that team to go out and pull them in. It's a large world. If engineers go to engineering meetings or visit universities, they will likely find something that either

fits their needs or can easily be adapted. This is something that the Japanese do extremely well and we do less well. In the U.S., travel to meetings of engineering societies is regarded as indulging the personal ambitions of the engineer rather than as a necessary part of product development. But when this kind of travel is treated as expendable and curtailed, product development suffers. What the Japanese have done is no secret. It's easy to grasp intellectually. The difficulty lies in actually doing it. Americans don't have to turn into samurai or ants. But we do have to learn how to do a lot of little things ! right. What we need in this country is a cultural change. I am not talking about vast changes in the work ethic or national habits, such as how much we save. I mean something much more doable -- a change in the way that the participants in the microculture of manufacturing and development do their jobs. Finally, when I argue that manufacturing and the product-development cycle matter if the U.S. is to stay competitive, I don't mean for a moment we should give up our ability to create new products and start new industries. That's our great strength and we want to keep it. It benefits this country and the rest of the world. American industries have always been good starters. But now, in a much more competitive world, we have to be good finishers as well.