



Toyota: The Birth of the Prius

The world's most admired automaker had to overcome punishing deadlines, skeptical dealers, finicky batteries, and its own risk-averse culture to bring its hybrid to market.

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New York (FORTUNE Magazine) – In late 1995, six months after Toyota decided to move forward with its revolutionary hybrid, the Prius, and two years before the car was supposed to go into production in Japan, the engineers working on the project had a problem. A big problem.

The first prototypes wouldn't start. "On the computer the hybrid power system worked very well," says Satoshi Ogiso, the team's chief power train engineer. "But simulation is different from seeing if the actual part can work." It took Ogiso and his team more than a month to fix the software and electrical problems that kept the Prius stationary. Then, when they finally got it started, the car motored only a few hundred yards down the test track before coming to a stop.

It's hard to imagine [Toyota \(Research\)](#), with its aura of invincibility, running into such trouble. But the story of how it brought the Prius to market -- a tale of technological potholes, impossible demands, and multiple miscalculations -- reveals how a great company can overcome huge obstacles to make the improbable seem inevitable. The gas-electric auto represents only a tiny fraction of the nine million cars and trucks the Japanese company will produce this year. But it is the first vehicle to provide a serious alternative to the internal combustion engine since the Stanley Steamer ran out of steam in 1924. It has become an automotive landmark: a car for the future, designed for a world of scarce oil and surplus greenhouse gases.

For all its success as a high-quality manufacturer, before the Prius, Toyota had never been much of a pioneer. It was known as a "fast follower," a risk-averse company in which process -- the famous Toyota lean production system -- trumped product. Indeed, Toyota, based in rural Aichi prefecture, 200 miles from Tokyo, enjoys depicting itself as a slow-moving company of simple country farmers. But as interviews with company executives in Japan and the U.S. make

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clear, Toyota is capable of breaking its own rules when it needs to. In rushing the Prius to market, it abandoned its traditional consensus management, as executives resorted to such unusual practices (at least for Toyota) of setting targets and enforcing deadlines that many considered unattainable.

Toyota's push into hybrids is only going to accelerate. Although the Prius first came to life under Hiroshi Okuda and Fujio Cho, Toyota's two previous presidents, new boss Katsuaki Watanabe wants hybrids to become the automotive mainstream. Watanabe, 64, who became the company's top executive last June, has the deferential air of a longtime family retainer. But he is intent on continuing Toyota's explosive growth of the past five years, in which worldwide production rose by nearly half. In an interview earlier this year at company headquarters in Toyota City, he stressed that a key part of his strategy is making hybrids more affordable for consumers. "We need to improve the production engineering and develop better technology in batteries, motors, and inverters," he said. "My quest is to produce a third-generation Prius quickly and cheaply." By early in the next decade he expects Toyota to be selling one million hybrids a year.

Since no other automaker can even approach that quantity, Toyota is way out in front -- an unusual place for a fast follower. "Is Toyota a conservative company?" asks Jeffrey Liker, an engineering professor at the University of Michigan and author of *The Toyota Way*. "Yes. Does it seem to be very plodding and slow to make changes? Yes. Is it innovative? Remarkably so. Go slow, build on the past, and thoroughly consider all implications of decisions, yet move aggressively to beat the competition to market with exceptional products." If he's right, Toyota is becoming a double threat: the world's finest manufacturer and a truly great innovator. The story of the Prius suggests that he is.

IGNITION

The car that became the Prius began life in 1993, when Eiji Toyoda, Toyota's chairman and the patriarch of its ruling family, expressed concern about the future of the automobile. Yoshiro Kimbara, then executive vice president in charge of R&D, heard the rumblings and embarked on a project known as G21 (for global 21st century) to develop a new small car that could be sold worldwide. He set two goals: to develop new production methods and to wring better fuel economy from the traditional internal combustion engine. His target was 47.5 miles per gallon, a little more than 50% better than what the Corolla, Toyota's popular small car, was getting at the time.

By the end of 1993 the development team had determined that higher oil prices and a growing middle class around the world would require the new car to be both roomy and fuel-efficient. Other than that, they were given no guidance. "I was trying to come up with the future direction of the company," says Watanabe, who headed corporate planning at the time. "I didn't have a very specific idea about the vehicle."

Direct responsibility for the project lay with executive vice president Akihiro Wada. To lead the team, Wada went looking for an engineer with the right blend of experience and open-mindedness. He found it in Takeshi Uchiyamada. As Wada, now an advisor to Aisin Seiki, a Toyota brake supplier, explains, "Uchiyamada was originally an expert in noise and vibration control. But he was serious and hardworking, and we thought it would develop his capability to make him chief engineer of a product that could go rapidly into production."

At first Uchiyamada assumed he could increase the G21's fuel economy by making refinements to existing technology. In a plan he submitted to Wada in 1994, he wrote that the introduction of an improved engine and transmission system could boost fuel efficiency by 50%. But that wasn't audacious enough for Wada, who didn't want to be remembered for producing yet another Japanese econobox. "It was not enough to be a simple extension of existing technology," Wada says. One possible solution intrigued him: a hybrid power system.

The concept wasn't new. Toyota had been dabbling for 20 years with the idea of placing a traditional gasoline motor alongside an electric one powered by batteries that are recharged whenever the car coasts or brakes. ([Honda \(Research\)](#) was working on a version too.) Masatami Takimoto, now an executive vice president, says he was developing a hybrid minivan at the time but that the project had run into trouble. "There was a split between the engineers and sales executives," he says. "Engineers had the firm belief that the hybrid was the answer to all those questions -- oil depletion, emissions, and the long-term future of

the automobile society -- but the business people weren't in agreement." They thought the premium price for the hybrid would make it impossible to sell.

Wada sided with the engineers and ordered the team to develop a concept car with a hybrid powertrain for the 1995 Tokyo Motor Show, just 12 months away. To reinforce his directive, he demanded that they raise the fuel-economy target even higher to compensate for higher hybrid costs. "Don't settle for anything less than a 100% improvement," he says he told Uchiyamada. "Otherwise competitors would catch up quickly." As Uchiyamada, now an executive vice president and a member of Toyota's board, concedes, "At that moment I felt he demanded too much."

To find the right hybrid system for the G21, by now called the Prius, Uchiyamada's team went through 80 alternatives before narrowing the list to four, based largely on fuel efficiency. "We had to go through numerous problems -- heat, reliability, noise, and cost," recalls Takimoto, who shifted over to the project. "We had experience in mechanical elements, but we didn't have much experience with electronic components like motors and batteries, especially high-powered ones." Then the team factored technical feasibility and cost to come up with its final choice. In June 1995, Toyota got serious about putting the Prius into production and set a target to begin manufacturing by the end of 1998.

Two months later Hiroshi Okuda became president of the company, which only increased the heat on Uchiyamada. Okuda liked to move fast, and he told Wada he wanted the Prius to go into production a year sooner, by December 1997. That meant Uchiyamada's team had to develop the car, hybrid powertrain and all, in only 24 months -- about two-thirds the time an automaker might take with a conventional vehicle. Okuda believed the technology was critical to the future of Toyota, but his directive wasn't very popular. "I have to admit that we were against the decision," Uchiyamada says. "Our team believed it was too demanding. Even Mr. Wada was initially against it."

Today Wada explains Okuda's order philosophically. "This is always how it is," he says. "The top management is not going to give detailed instructions on technology. As long as engineers come up with solutions by the deadline, that is fine." As Watanabe, who also had a lot riding on the decision, puts it, "Everything was challenging about the development of the Prius."

THE ENGINE COUGHS

Watching developments from across the Pacific were the product planners at the company's U.S. division, Toyota Motor Sales, in Torrance, Calif. The TMS planners had first heard about hybrids at a meeting in Japan in 1995. "It was all new and unconventional," recalls marketing executive Mark Amstock. "There was skepticism within the company about whether the hybrids were really cars." Early consumer research in the U.S. supported the skeptics. "It wasn't clear that better fuel economy alone could drive premium pricing," says Andrew Coetzee, now vice president of product planning for TMS. But another factor was at play at TMS: the ever more stringent emission targets set by the California Air Resources Board. Gradually support began to build around hybrid's ecological potential.

Thirty miles to the south, at Toyota's design studio in Newport Beach, stylists were competing with colleagues in Japan to develop body concepts for the Prius. Like everything else, it was a rush job. "Ordinarily we get two to three months to make sketches and prepare models," recalls designer Erwin Lui. "For Prius we got two to three weeks." Lui's design for a four-door sedan was one of three that Toyota executives in Japan liked, and he went there in the summer of 1996 to develop an engineering production model. But some of his colleagues were unenthusiastic. "The exterior design was polarizing," says Amstock. "With the Corolla already in our lineup, we wondered if we would be able to sell another fuel-efficient small car."

Meanwhile the engineers in Japan kept running into problems. According to a 1999 account written by Hideshi Itazaki and published in Japan, the batteries continued to be a nightmare. The Prius needed a large battery pack to power the car at low speeds and to store energy, but it would shut down when it became too hot or too cold. During road tests with Toyota executives, a team member had to sit in the passenger seat with a laptop and monitor the temperature of the battery so that it wouldn't burst into flames.

Okuda kept up the pressure. He told Wada in December 1996 that he wanted to announce by the following March that Toyota had developed a hybrid technology. But despite 1,000 Toyota engineers racing to get the Prius ready, Uchiyamada's team still didn't have a workable prototype. During cold-weather testing in February on Hokkaido island, the cars ground to a halt at temperatures below 14 degrees Fahrenheit. A media test-drive was conducted in May, but each participant was limited to two laps around the track because battery performance was so poor.

But one by one, the problems were corrected. A radiator was added to an electronic component to prevent overheating; two months were spent redesigning a semiconductor to keep it from breaking down. And after endless fussing and tweaking, the team finally reached 66 miles per gallon -- the 100% mileage improvement Wada had asked for.

MAKING REPAIRS

Toyota unveiled the Prius in Japan in October 1997, two months ahead of schedule, and it went on sale that December. The total cost of development was an estimated \$1 billion -- after all the anguish, about average for a new car. But the Prius's initial reception took some executives, including Watanabe, by surprise. "I did not envisage such a major success at that time," he says. "Some thought it would grow rapidly, and others thought it would grow gradually. I was in the second camp." Production was quickly doubled to 2,000 cars a month.

Over in California, TMS executives were still worried about sales prospects in the U.S. Introducing cars with novel powertrains wasn't something they were used to. "It's difficult to build consumer technology awareness," says Chris Hostetter, now vice president of advanced-product strategy. "Consumers would have to be taught that the car didn't come with an extension cord. Dealers would have to be trained on how to sell the car and service it."

When the first Prius arrived in California in May 1999, TMS gave it a thorough going-over. There was still concern about the design. Ernest Bastien, now vice president of vehicle operations, thought an SUV configuration would work better because it would carry batteries more easily; Hostetter was sure that an SUV would send the wrong environmental message. What the California team needed was to gauge public reaction. So they took what few cars they had -- all of them right-hand drives for the Japanese market -- to Orange County to let potential buyers try them out. The cars barely passed muster. Some drivers didn't like the feel of the brakes; others complained that the interior looked cheap, that the arm rest was too low, that the rear seats didn't fold down. TMS planners also discovered that a baby stroller wouldn't fit in the trunk. "It was a Japan car," says Bill Reinert, national manager of advanced-technology vehicles. "And it seemed out of context in the U.S."

When left-hand-drive models finally arrived, the testers fanned out across the country for a demonstration program. The cars had been modified for the U.S. market, with more horsepower and additional emissions equipment, and the battery pack was now lighter. But the team had a hard time figuring out who the car would appeal to. It quickly learned that extreme environmentalists weren't interested in hybrids: They were turned off by the technology and tight with a buck. And some dealers were still skeptical. Salt Lake City dealer Larry Miller, who owns nine Toyota and Lexus outlets, liked the way the Prius drove but wasn't sure about the design. "It was passable," he says. "It looked like it wouldn't embarrass us." Focus groups further tempered the early hopes. "When we told the dealers how difficult it was to predict who the buyer would be," Bastien says, "they lost their enthusiasm to have a lot full of them."

Meanwhile Honda, which had been racing to get a hybrid, the Insight, to the U.S. market first, launched its car in December 1999, seven months ahead of the Prius. But the Insight was more an experiment than a serious car. It had extreme aerodynamic styling, no back seat, and a smaller engine that used less sophisticated technology. Coming in second provided a benefit for Toyota: An Insight buyer in the U.S. posted his owner's manual on his website, and TMS used the information to modify its warranties.

The two biggest decisions TMS had to make were how many cars to order and how much to charge, the latter causing friction between California and Japan. Under the Toyota system, the U.S. sales group buys cars from the parent company at a negotiated price, then resells them to dealers. Japan wanted the Prius to sell for more than \$20,000, putting it in Camry territory. But the Americans saw a car about the size of the smaller Corolla and produced research showing

that buyers would balk at paying that much. A compromise was reached when TMS cut the dealer margin on the car from 14% to 10% so that it could pay Japan more and still make a decent profit. Since the Prius was expected to account for less than 1% of their total sales, dealers didn't complain. The car went on sale with a base price of \$19,995. Japan lost money on the first batch -- not unusual for a small car.

Worried about the hybrid's economics, the stateside Prius team armed itself with contingency plans to boost sales if they started to sag: cut-rate leases, rental coupons, free maintenance, roadside assistance. But with profit margins scant and volumes low, there was no money for advertising. When Hostetter wanted to buy newspaper ads on Earth Day, TMS chairman Yoshi Inaba turned him down. Instead, he relied on grass-roots marketing, public relations events, and the Internet.

Since no one really knew who might buy these things, Toyota created a special Internet ordering system to ensure Priuses were allocated wherever demand popped up. Some 37,000 interested consumers signed up, and 12,000 eventually became buyers. Preselling the cars on the Internet also enabled Toyota to identify customer hot spots. (It came as no surprise that the San Francisco area accounted for 30% of Prius sales, compared with 6% for all other Toyota models.) But some Toyota dealers liked the old system better; they felt they were being cut out of the process. "Online was hard to get used to," says Miller, then head of the Toyota Dealer Council. "I said, 'Boy, if Toyota has misestimated, it would fall to us to market this turkey.' "

SLEEPER HIT

The Prius made its U.S. debut in July 2000. It wasn't a delight to drive, requiring 13 seconds to get to 60 miles per hour (the Corolla needed just ten). A Car and Driver writer reported, "The Prius alternatively lurches and bucks down the road, its engine noise swelling and subsiding for no apparent reason."

But the Prius caught on anyway and, as in Japan, sales were much higher than the company dared hope. Buyers didn't care about the jerky ride or premium price -- they focused on the improved fuel economy, lower emissions (as much as 80% lower), and advanced technology. Resale value protected them on the downside: The Prius retained 57% of its value after three years. Pride of ownership was so high that only 2% of buyers opted to lease.

Then celebrities discovered the Prius, and it really took off. Leonardo DiCaprio bought one from a Hollywood dealer in 2001; Cameron Diaz soon followed. A California public relations agency asked Toyota to provide five Priuses for the 2003 Academy Awards. Toyota says no money changed hands, but the value of seeing Harrison Ford and Calista Flockhart step out of a chauffeur-driven Prius was, as they say, priceless.

The boost from the Oscars and steadily rising gasoline prices stoked interest in the second generation Prius, which was in development even before the first version went on sale in the U.S. Launched in the fall of 2003, the new model became a fashion statement. It had a unique hatchback body style that made it stand out in traffic. It was faster and more powerful than its predecessor, used less gas, and produced fewer emissions. (And, thanks to a successful effort by American planners, it did not have a complicated touchpad control that required scrolling through several menus just to operate the defroster. "We had some pretty bare-knuckled fights [with Japan] because it was already packaged in," says Reinert.) People waited months to get their Priuses, as production struggled to keep pace with demand. U.S. sales doubled to 53,991 in 2004 and nearly doubled again to 107,897 the following year -- about 60% of global Prius sales. "It's the hottest car we've ever had," says Jim Press, president of TMS.

GOING MAINSTREAM

With success has come the inevitable backlash. Critics complain that hybrids are inherently uneconomical because the \$3,000 or more the technology adds to the cost of the vehicle can't be recouped with greater gas mileage; that they don't improve fuel efficiency that much; and that some American models were being built more for performance than to benefit the environment. Carlos Ghosn, CEO of Japanese rival [Nissan](#), likes to poke fun at Toyota's supposed social responsibility.

"Some of our competitors say they are doing things for the benefit of humanity," he says. "Well, we are in a business, and we have a mission of creating value."

The knocks against hybrids are all true. But what the critics didn't put a price on was the value of being seen as eco-sensitive without giving up performance. "Does it save enough money to pay for itself?" asks Press. "That's not the idea. What's the true cost of a gallon of gas, if you factor in foreign aid, Middle Eastern wars, and so on? The truth is on our side."

The most prominent convert to the hybrid cause has been [General Motors \(Research\)](#) vice chairman Bob Lutz. As recently as 2004, Lutz dismissed hybrids as "an interesting curiosity," adding that they didn't make sense with gas at \$1.50 a gallon. (Besides, GM had its own powertrain of tomorrow: fuel cells.) A year later, with gas heading to \$2.50 a gallon, Lutz was backpedaling, admitting that GM had missed the boat: "The manifest success of the Prius caused a rethink on everybody's part." Now GM is bringing out hybrid pickup trucks, SUVs, and buses. Other makers are also rushing to develop models. Lordly [Mercedes-Benz \(Research\)](#) showed a diesel-electric S-class at the Frankfurt auto show last fall. [Ford \(Research\)](#), which licenses Toyota technology, has promised the capacity to build 250,000 hybrids by the end of the decade. Even Ghosn is bringing hybrids to market under the Nissan brand.

Toyota is relentlessly adapting hybrid technology to more models, with the goal of offering it in every vehicle it makes. Last October the company invited a dozen journalists to its test track outside Tokyo, in the shadow of Mount Fuji, to drive two future hybrid vehicles. On a cold, rainy day, both cars performed flawlessly. The hybrid Camry proved roomy yet thrifty, capable of achieving a combined city and highway fuel economy of 40 miles per gallon. The silvery Lexus GS450h was quick -- zero to 60 in 5.8 seconds -- and still got combined mileage in the high 20s.

If Toyota can continue to reduce costs, and it most probably will, the potential for hybrids may be nearly unlimited. With its huge headstart, better technology, enormous scale, and powerful will to make hybrids an everyday alternative to the internal combustion engine -- a combination no other auto maker can match -- it's hard to see Toyota not dominating the industry for years to come.

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