

Travel Back in Time: Design Methods of Two Billionaire Industrialists

Jonathan Grudin

Microsoft Research | jgrudin@microsoft.com

In this column we take a break from HCI history to revisit two earlier 20th-century technology successes. Rather than moving bits, these were people-movers. Early in the century, Henry Ford revolutionized the design, manufacture, and use of automobiles. Subsequently, Howard Hughes revolutionized the design and use of aircraft. Each was a self-taught engineer who created an industry that changed the world.

Success has many parents. Biographies of Ford and Hughes identify sources of inspiration, reservoirs of determination and perspiration, supportive conditions, and good fortune. Each man had qualities that helped early in life but seemed to harden into damaging eccentricities. Neither one can be held up as a general role model. Nevertheless, some of their methods anticipate those we strive for today.

We did not invent these methods! Ford and Hughes differed from their competitors in adopting incredibly traveler-centered approaches to design. These contributed significantly to their successes, yet generally go unmentioned. Henry Ford first engaged in extensive iterative design based on testing of prototypes by end-users (drivers), and only later focused on the manufacturing efficiencies for which he is best known. Howard Hughes employed remarkably incisive participant observation for requirements analysis; had he not, he would likely be known today as a film producer, record-setting pilot, and eccentric, and not as the force behind commercial air travel that he became.

Henry Ford

“If you travel the roads in the neighborhood of Dearborn you can find all sorts of models of Ford cars. They are experimental cars—they are not new models. I do not believe in letting any good idea get by me, but I will not quickly decide whether an idea is good or bad. If an idea seems good or seems even to have possibilities, I believe in doing whatever is necessary to test out the idea from every angle.”

— Henry Ford (with Samuel Crowther), *My Life and Work*, 1922

When a new mode of transportation appears, the public asks “How fast can it go?” Ford sought a vehicle that was useful, not fast. He grew up on a farm; his first aim was to use an internal combustion engine to power a tractor. Determining that this was not feasible at a cost farmers could afford, he shifted to automobiles. When he needed financial backing and publicity, he turned his attention briefly to speed and built two race cars that set world records. But he dropped that pursuit; in words that we might apply to the early focus on processor speed in computing, he wrote, “The industry was held back by this initial racing slant, for the attention of the makers was diverted to making fast rather than good cars.”

Ford was not alone building cars from scratch in the late 19th century. But he was different. Most inventors got a car running to their satisfaction, and then took it on a long exhibition tour. Ford

EDITOR
Jonathan Grudin
jgrudin@microsoft.com

happily sold his cars, getting feedback from buyers and money to work on another car. He gave away the first internal combustion engine he built to someone who proposed a use for it. He drove his first car for a thousand miles, “then sold it to Charles Ainsley of Detroit for two hundred dollars. That was my first sale. I had built the car not to sell but only to experiment with. I wanted to start another car. Ainsley wanted to buy. I could use the money and we had no trouble in agreeing upon a price. I built three cars in all in my home shop and all of them ran for years in Detroit.”

The years of mass production of Model Ts with little visible change may seem at odds with iterative design, but between 1892 and the formation of his company in 1903, most of which time he worked for the Edison Illuminating Company, Ford built about 25 cars. The Ford Motor Company then built and sold eight models in the five years preceding the Model T—Models A, B, C, F, K, N, R, and S—and tested prototypes labeled with the 11 missing letters. (Imaginative branding this was not—in fact, Ford was hostile to aesthetic differentiation. He cheerfully announced, “Any customer can have a car painted any colour that he wants so long as it is black,” and later observed, “We did not make the pleasure appeal. We never have.”)

Ford summed up his commitment to research: “I do not believe in starting to make until I have discovered the best possible thing. This, of course, does not mean that a product should never be changed, but I think that it will be found more economical in the end not even to try to produce an article until you have fully satisfied yourself that utility, design, and material are the best. If your researches do not give you that confidence, then keep right on searching until you find confidence.... I spent twelve years before I had a Model T that suited me. We did not attempt to go into real production until we had a real product.”

Ford’s 1922 autobiography details a carefully constructed philosophy. Most unusual was Ford’s extreme focus on customer experience, rooted in an idealistic worldview based on “service.” He wrote, “Profit must and inevitably will come as a reward for good service. It cannot be the basis—it must be the result of service....The most surprising feature of business as it was conducted was the large attention given to finance and the small attention to service. That seemed to me to be reversing the natural process which is that the



► Iterative design: Henry Ford with his first and 10 millionth automobiles (From the collections of The Henry Ford).

money should come as the result of work and not before the work... A dissatisfied customer was regarded not as a man whose trust had been violated, but either as a nuisance or as a possible source of more money in fixing up the work which ought to have been done correctly in the first place.... Even as late as 1910 and 1911 the owner of an automobile was regarded as essentially a rich man whose money ought to be taken away from him.”

His first product goal was ease of use: “Simplicity—most of the cars at that time required considerable skill in their management... (For example) the simplicity and the ease of control of the transmission....”

He monitored customer experience to an extreme degree. For example, of his first commercial car, the Model A, Ford wrote, “Every one of these has a history. Take No. 420. Colonel D. C. Collier of California bought it in 1904. He used it for a couple of years, sold it, and bought a new Ford. No. 420 changed

hands frequently until 1907 when it was bought by one Edmund Jacobs living near Ramona in the heart of the mountains. He drove it for several years in the roughest kind of work. Then he bought a new Ford and sold his old one. By 1915 No. 420 had passed into the hands of a man named Cantello, who took out the motor, hitched it to a water pump, rigged up shafts on the chassis and now, while the motor chugs away at the pumping of water, the chassis drawn by a burro acts as a buggy.”

Ford repeatedly returned to a user-centered focus on service: “A manufacturer is not through with his customer when a sale is completed. He has then only started with his customer. . . . A man who bought one of our cars was in my opinion entitled to continuous use of that car, and therefore if he had a breakdown of any kind it was our duty to see that his machine was put into shape again at the earliest possible moment. . . . If your car broke down you had to depend on the local repair man—when you were entitled to depend upon the manufacturer. . . . We met that situation squarely and at the very beginning.”

Chapter four of the 1922 autobiography is titled “The Secret of Manufacturing and Serving.” In it Ford wrote, “I adopted this slogan: ‘When one of my cars breaks down I know I am to blame.’”

Howard Hughes

It was 1939. The president of TWA had a problem. TWA’s fleet was growing obsolete. In “The Aviator,” Martin Scorsese’s well-researched albeit fictionalized account, a young Howard Hughes meets Jack Frye. A few years earlier, Hughes Aircraft had produced the revolutionary, streamlined H-1, with which Hughes set several world speed records[1]. Now Frye wanted Hughes’s help in designing a new plane. The meeting in the film did take place; the exact words were of course reconstructed.

Frye: Try 50 seats with a ceiling of 12,000 feet.

Hughes: No. No, 20,000. Think about it Jack, what does 20,000 feet give you?

Frye: Less turbulence.

Hughes: Right, because it’s above the weather. Jack, we want to fly above the weather. Only 1 percent of the American population has ever set foot on a commercial airliner. Why? Because they’re scared to death, Jack, and they should be. I mean, 7,000 feet is bumpy as shit. You know that. We build a plane that flies above the weather, we

could get every man, woman and child in this country to feel safe up there. An airplane with the ability to fly into the stratosphere, across the country, across the world. Now that is the future.

Howard Hughes himself had no fear of turbulence. He was a stunt pilot and held numerous flying records. Unlike Ford, he was captivated by speed and had no need for money. Why did he shift his focus to commercial aircraft? How was he so sure that allaying passenger fear justified a less fuel-efficient, less economical design?

Seven years earlier, in 1932, already a successful filmmaker, Hughes formed his aircraft company. One of his first steps was to assume the pseudonym Charles Howard and work for two months in various capacities on the American Airlines commercial route between Fort Worth and Cleveland. The accompanying photo of Hughes as a baggage handler next to a Fokker Trimotor is from Charles Barton’s book *Howard Hughes and his Flying Boat*. The plane had a ceiling of 8,500 feet. Its range was 700 miles, so passengers endured multiple takeoffs and landings. Howard Hughes, participant observer and requirements analyst, saw terrified passengers. Many passengers were no doubt aware of the Fokker Trimotor crash in Kansas of a commercial flight the year before, which killed American football legend Knute Rockne and all seven others aboard. Prior to World War II, all flight attendants were registered nurses.

After making these observations, Hughes tracked aircraft developments. When Douglas Aircraft produced the safer, more comfortable metal-bodied DC-2 in 1934, Hughes again worked a commercial route incognito, observing passengers and crew. In 1938 Boeing produced the first plane with a pressurized cabin; Hughes personally bought one of the 10 307s ever made. He was prepared for the 1939 discussion with Jack Frye.

Instead of building a plane for troubled TWA, Hughes bought TWA. An anti-trust decree had mandated separation of airlines and airplane manufacture, so he had Lockheed build his plane. Requirements for the Lockheed Constellation included a high cruising altitude, pressurized metal cabins, and a further sacrifice of efficiency to provide a range of 3,500 miles (5,600 kilometers), which enabled nonstop transcontinental and U.S.-to-London flights. TWA bought the first couple years of Constellation production, after which it

[1] Unlike Ford, Hughes took his planes on tours and to competitions. He focused on design and use, but not on the manufacturing process. Prior to working for him, Hughes’s brilliant engineer Glenn “Odie” Odekirk built automobiles and took them on demonstration tours, the common practice that Ford avoided with his laser focus on product improvement and manufacturing efficiency.

was adopted by more than a dozen major airlines. While waiting, TWA bought and put into use five of the 10 Boeing 307 Stratoliners. The era of commercial passenger travel was underway, just as Hughes had envisioned 15 years earlier.

Carl Babberger, Hughes's chief aerodynamicist, told Barton years later, "We were not a big enough company and we were in full competition with the giants." Hughes once said, "You know, Carl, we have to figure out, project, and prophesy where this industry is going to be ten or twenty years from now," recalled Babberger. "It amounted to watching the straws to see which way the wind was blowing. At the time I thought it was crazy, but since I had to do it to get along with him, I learned the trick, and have been fairly successful in predicting way ahead," concluded Babberger.

Some of us may also be largely self-taught engineers who are most comfortable around our colleagues. How many of us, initiating a project, overcome this to spend two months out of the office, alone, watching prospective customers and discerning their deepest concerns?

Staying Too Long

Time eventually overtook both men. Henry Ford concluded early on that for 95 percent of the public, car ownership was status enough; they were happy with identical vehicles. But as years passed, customers wanted differentiation, and General Motors came to dominate. In other respects too, Ford fell out of step with the times. Hughes became extraordinarily reclusive, a participant observer no more.

Once established, the careers of the two men drew considerable attention. Their methods were less closely examined. In getting started, these inventors took user-centered methods far beyond today's typical engineering practice. And they succeeded spectacularly.

A Tip of the Hat...

Henry Ford material and quotations are from *My Life and Work*, downloadable from Project Gutenberg at <http://www.gutenberg.org/etext/7213>. The book might be more widely read were it not for a disgraceful anti-Semitic passage, a prejudice Ford later publicly recanted. Howard Hughes material is from Charles Barton's *Howard Hughes and His Flying Boat* (Aero Publishers, 1982; 1998 revision published by Charles Barton). Only the Hughes/Frye dialogue is from Martin Scorsese's



► Participant observer: Howard Hughes working incognito as a baggage handler on a commercial flight (Courtesy Charles Barton).

2004 film "The Aviator," but some automobile and aircraft details are from Wikipedia, so caveat lector! For early flight attendant qualifications see the nice video at <http://www.unitedafa.org/res/nh/video/>. Thanks also to Jon Sciortino, George Engelbeck, and photo archivists at University of Nevada, Las Vegas, the Evergreen Aviation and Space Museum, the Houston Public Library, the Benson Ford Research Center, Panda Lab, and the Yamhill County Historical Society and Museum. Thanks especially to Charles Barton.



ABOUT THE AUTHOR Jonathan Grudin is a principal researcher in the Adaptive Systems and Interaction group at Microsoft Research. His Web page is <http://research.microsoft.com/~jgrudin>.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without the fee, provided that copies are not made or distributed for profit or commercial advantage, and that copies bear this notice and the full citation on the first page. To copy otherwise, to republish, to post on services or to redistribute to lists, requires prior specific permission and/or a fee. © ACM 1072-5220/08/0500 \$5.00