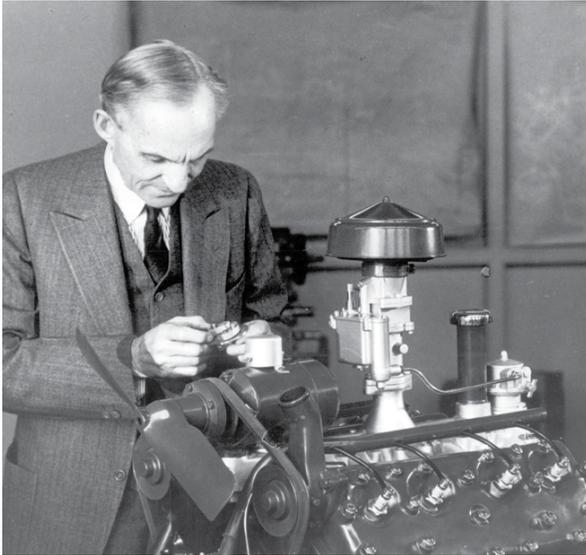


Henry Ford and Innovation

"From the Curators"



Transportation in America



mission statement

The Henry Ford provides unique educational experiences based on authentic objects, stories and lives from America's traditions of ingenuity, resourcefulness and innovation. Our purpose is to inspire people to learn from these traditions to help shape a better future.

Henry Ford and Innovation

Bob Casey, John & Horace Dodge
Curator of Transportation, **The Henry Ford**

“From the Curators” is a collection of thematic articles researched and written by curators at **The Henry Ford**. The background information and historical context presented in “From the Curators” can be used in many ways:

- For teachers to refresh their memory on selected themes before teaching a related unit or lesson.
- For students doing research projects.
- For users of **The Henry Ford's** ExhibitBuilder looking for a big idea or information for developing their online exhibit.
- For anyone interested in learning more about these selected themes.

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Chapter 1

HENRY FORD: A CASE STUDY OF AN INNOVATOR

Introduction

Henry Ford did not invent the automobile. But more than any other single individual, he was responsible for transforming the automobile from an invention of unknown utility into an innovation that profoundly shaped the 20th century and continues to affect the 21st.

Innovators change things. They take new ideas, sometimes their own, sometimes other people's, and develop and promote those ideas until they become an accepted part of daily life. Innovation requires self-confidence, a taste for taking risks, leadership ability and a vision of what the future should be. Henry Ford had all these characteristics, but it took him many years to develop all of them fully.

Portrait of the Innovator as a Young Man

Ford's beginnings were perfectly ordinary. He was born on his father's farm in what is now Dearborn, Michigan, on July 30, 1863. At this time, most Americans were born on farms, and most looked forward to being farmers themselves.

Early on, Ford demonstrated some of the characteristics that would make him successful. In his family, he became infamous for taking apart his siblings' toys as well as his own. He organized other boys to build rudimentary waterwheels and steam engines. He learned about full-size steam engines by becoming acquainted with the engines' operators and pestering them with questions. He taught himself to fix watches and used the watches themselves as textbooks to learn the basics of machine design. Thus, at an early age Ford demonstrated curiosity, self-confidence, mechanical ability, the capacity for leadership and a preference for learning by trial and error. These characteristics would become the foundation of his whole career.

Ford could simply have followed in his father's footsteps and become a farmer. But young Henry was fascinated by machines and was willing to take risks to pursue that fascination. In 1879, he left the farm to become an apprentice at a machine shop in Detroit. Over the next few years, he held jobs at several places, sometimes moving when he thought he could learn more somewhere else. He returned home in 1882 but did little farming. Instead he operated and serviced portable steam engines used by farmers, occasionally worked in factories in Detroit, and cut and sold timber from 40 acres of his father's land.

By now, Ford was demonstrating another characteristic—a preference for working on his own rather than for somebody else. In 1888, Ford married Clara Bryant and in 1891 they moved to Detroit, where Ford had taken a job as night engineer for the Edison Electric Illuminating Company—another risk on Ford's part, because he did not know a great deal about electricity at this point. He took the job in part as an opportunity to learn.

Early Automotive Experiments—Failure and Then Success

Henry was a skilled student and by 1896 had risen to chief engineer of the Illuminating Company. But he had other interests. He became one of the scores of other people working in barns and small shops trying to make horseless carriages. Ford read about these other efforts in magazines, copied some of their ideas, added some of his own and convinced a small group of friends and colleagues to help him. This resulted in his first **primitive automobile**, completed in 1896. A second, more sophisticated car followed in 1898.

Ford now demonstrated one of his most important characteristics—the ability to articulate a vision and convince other people to sign on and help him achieve that vision.

He convinced a group of businessmen to back him in the biggest risk of his life—a company to make horseless carriages. But Ford knew nothing about running a busi-

ness, and learning by doing often involves failure. The new company failed, as did a second. To revive his fortunes, Ford took bigger risks, building and even driving a pair of [racing cars](#). The success of these cars attracted additional financial backers, and on June 16, 1903, just before his 40th birthday, Henry incorporated his third automobile venture, the Ford Motor Company.

The early history of Ford Motor Company illustrates another of Henry Ford's most valuable traits—his ability to identify and attract outstanding talent. He hired a core of young, highly competent people who would stay with him for years and make Ford Motor Company into one of the world's great industrial enterprises. The new company's first car was called the [Model A](#), and a variety of improved models followed. In 1906, Ford's 4-cylinder, \$600 Model N became the best-selling car in the country. But by this time, Ford had a vision of an even better, cheaper “motorcar for the great multitude.” Working with a small group of employees, he came up with the [Model T](#), introduced on October 1, 1908.

The Automobile—A Solution in Search of a Problem

As hard as it is for us to believe, in 1908 there was still much debate about exactly what automobiles were good for. We may see them as necessary parts of daily life, but the situation in 1908 was very different. Americans had arranged their world to accommodate the limits of the transportation devices available to them. People in cities got where they wanted to go by using electric street cars, horse-drawn cabs, bicycles and shoe leather because all the places they wanted to go were located within reach of those transportation modes.

Most of the commercial traffic in cities still moved in horse-drawn vehicles. Rural Americans simply accepted the limited travel radius of horse- or mule-drawn vehicles. For long distances, Americans used our extensive, well-developed railroad network. The fact was that people did not need automobiles to conduct their daily activities. Rather, the people who bought cars used them as a new means of recreation. They drove them on joyrides into the countryside. The

recreational aspect of these early cars was so important that people of the time divided motor vehicles into two large categories: commercial vehicles like trucks and taxicabs and pleasure vehicles like private automobiles. The term “passenger cars” was still years away. The automobile was an amazing invention, but it was essentially an expensive toy, a plaything for the rich. It was not yet a true innovation.

Henry Ford had a wider vision for the automobile. He summed it up in a statement that appeared in 1913 in the company magazine, *Ford Times*:

“I will build a motor car for the great multitude. It will be large enough for the family but small enough for the individual to run and care for. It will be constructed of the best materials, by the best men to be hired, after the simplest designs that modern engineering can devise. But it will be so low in price that no man making a good salary will be unable to own one—and enjoy with his family the blessings of hours of pleasure in God's great open spaces.”

It was this vision that moved Henry Ford from inventor and businessman to innovator. To achieve his vision, Ford drew on all the qualities he had been developing since childhood: curiosity, self-confidence, mechanical ability, leadership, a preference for learning by trial and error, a willingness to take risks, and an ability to identify and attract talented people.

One Innovation Leads to Another

Ford himself guided a design team that created a car that pushed technical boundaries. The Model T's one-piece engine block and removable cylinder head were unusual in 1908 but would eventually become standard on all cars. The Ford's flexible suspension system was specifically designed to handle the dreadful roads that were then typical in the United States. The designers utilized vanadium alloy steel that was stronger for its weight than standard carbon steel. The Model T was lighter than its competitors, allowing its 20-horsepower engine to give it the performance equal to that of more expensive cars.

The new Ford car proved to be so popular that Henry could easily sell all he could make, but he wanted to be able to make all he could sell. So Ford and his engineers began a relentless drive to raise the rate at which Model Ts could be produced and to lower the cost of that production.

In 1910, the company moved into a huge new factory in Highland Park, a city just north of Detroit. Borrowing ideas from watchmakers, clockmakers, gunmakers, sewing machine makers and meat processors, Ford Motor Company had, by 1913, developed a moving assembly line for automobiles. But Ford did not limit himself to technical improvements. When his workforce objected to the relentless, repetitive work that the line entailed, Ford responded with perhaps his boldest idea ever—he doubled wages to \$5 per day. With that one move, he stabilized his workforce and gave it the ability to buy the very cars it made. He hired a brilliant accountant named Norval Hawkins as his sales manager, and Hawkins created a sales organization and advertising campaign that fueled potential customers' appetites for Fords. Model T sales rose steadily while the selling price dropped. By 1921, half the cars in America were Model Ts, and a new one could be had for as little as \$415.

Through these efforts, Ford turned the automobile from an invention bought by the rich into a true innovation available to a wide audience. By the 1920s, largely as a result of the Model T's success, the term "pleasure car" was fading away, replaced by "passenger car."

The assembly line techniques pioneered at Highland Park spread throughout the auto industry and into other manufacturing industries as well. The high-wage, low-skill jobs pioneered at Highland Park also spread throughout the manufacturing sector. Advertising themes pioneered by Ford Motor Company are still being used today. Ford's curiosity, leadership, mechanical ability, willingness to take risks, ability to attract talented people and vision produced innovations in transportation, manufacturing, labor relations and advertising.

What We Have Here Is a Failure to Innovate

Henry Ford's great success did not necessarily bring with it great wisdom. In fact, his very success may have blinded him as he looked into the future. The Model T was so successful that he saw no need to significantly change or improve it. He did authorize many detail changes that resulted in lower cost or improved reliability, but there was never any fundamental change to the design he had laid down in 1907. He was slow to adopt innovations that came from other carmakers, like electric starters, hydraulic brakes, windshield wipers and more luxurious interiors. He seemed not to realize that the consumer appetites he had encouraged and fulfilled would continue to grow. He seemed not to want to acknowledge that once he started his company down the road of innovation, it would have to keep innovating or else fall behind companies that did innovate. He ignored the growing popularity of slightly more expensive but more stylish and comfortable cars, like the Chevrolet, and would not listen to Ford executives who believed it was time for a new model. But Model T sales were beginning to slip by 1923, and by the late 1920s, even Henry Ford could no longer ignore the declining sales figures. In 1927, he reluctantly shut down the Model T assembly lines and began the design of an all-new car. It appeared in December 1927 and was such a departure from the old Ford that the company went back to the beginning of the alphabet for a name—it was called the Model A.

One area where Ford did keep innovating was in actual car production. In 1917, he began construction of a vast new plant on the banks of the Rouge River southwest of Detroit. This plant would give Ford Motor Company complete control over nearly all aspects of the production process. Raw materials from Ford mines would arrive on Ford boats, and would be converted into iron and steel, which were transformed into engines, transmissions, frames and bodies. Glass and tires would be made on-site as well, and all would be assembled into completed cars. Assembly of the new Model A was transferred to the Rouge, and eventually the plant would employ 100,000 people and generate many innovations in auto manufacturing.

But improvements in manufacturing were not enough to make up for the fact that Henry Ford was no longer a leader in automotive design. The Model A was competitive for only four years before needing to be replaced by a newer model. In 1932 at age 69, Ford introduced his last great automotive innovation, the lightweight, inexpensive [V-8 engine](#). It represented a real technological and marketing breakthrough, but in other areas Ford's continued to lag behind their competitors. By 1936, the company that once sold half of the cars made in America had fallen to third place behind both General Motors and the upstart Chrysler Corporation.

By the time Henry Ford died in 1947, his great company was in serious trouble, and a new generation of innovators, led by his grandson Henry Ford II, would work long and hard to restore it to its former glory. Henry's story is a textbook example of the power of innovation—and the power of its absence.

Chapter 2

THE MODEL T AND THE ASSEMBLY LINE

Introduction

On October 1, 1908, the Ford Motor Company introduced one of the most famous and influential products in the history of American business—the Ford Model T. By the time the last the Model T rolled off the assembly line in 1927, it had made the company and its founder famous, wealthy and powerful—and altered American society forever. The key to the Model T's success was Henry Ford's ability to recognize what Americans wanted in an automobile and then deliver such an automobile at a price most could afford.

The Auto Industry Before the Model T

The Model T appeared when the American automobile industry was only a dozen years old. Charles and Frank Duryea of Springfield, Massachusetts, had become the first Americans to build a series of automobiles for sale in 1896, kick-starting a flourishing industry that by 1908 was selling some 63,500 cars a year. Yet the automotive landscape remained a muddle: No particular size or price range clearly dominated. Not merely was there uncertainty about the right combination of size, power and features, but also a deep confusion about what automobiles were for, or as one historian later put it, “At stake were not only the forms motor vehicle technology would take, but also the social ends it would serve. How, where and with what effects should people use the new machines?”

Henry Ford, whose Ford Motor Company had been making cars since 1903, thought he knew what kind of cars Americans wanted. In 1906, Ford wrote to *The Automobile* magazine that the “greatest need today is a light, low-priced car with an up-to-date engine with ample horsepower, and built of the very best material. . . . It must be powerful enough for American roads and capable of carrying its passengers anywhere that a horse-drawn vehicle will go without the driver being afraid of ruining his car.”

The same year Henry Ford made that statement, his company introduced a car that met many of those requirements, the Ford Model N. But it had several shortcomings and still seated only two or three people. Henry Ford thought he could do better. Early in 1907, he ordered construction of a room in the northeast corner of the third floor of the company's plant on [Piquette Avenue](#) in Detroit. Behind the padlocked door of that room, Henry Ford and a small group of his closest associates created the Model T.

The Model T—An Advance in Car Design

Development proceeded straightforwardly. Henry brought his ideas and concepts. Draftsman Joe Galamb drew them, often on a blackboard. Ford and his colleagues critiqued the designs and made changes. At some point, Ford moved in a lathe, a milling machine and other machine tools for making prototype parts. As Galamb noted, Ford “liked to see a model working first. He didn’t like to go just by the blueprint. He never did. He always liked to have a sample made first.” A Model N chassis provided the initial test-bed for prototype parts, but by October 1907, two hand-built Model Ts were ready for testing.

Ford said that Americans wanted a light car, and the finished [Model T touring car](#) fit the bill, weighing only 1,200 pounds. No other popular four-passenger car came close. The Buick Model 10 Tourabout weighed 1,570 pounds and the Overland Model 32 Toy Tonneau, 1,750 pounds. Even so-called highwheelers, flimsy cars based on carriage designs, exhibited little advantage over the Model T. The four-passenger version of the popular Holsman highwheeler weighed only a hundred pounds less.

The Model T’s engine met Ford’s requirements for being “up-to-date” by having a [one-piece cylinder block and a detachable cylinder head](#). These are standard practice today, but in 1908 they represented real advancements. Most contemporary cars, regardless of cost, used cylinders cast singly or in pairs and bolted to a separate crankcase, resulting in large, heavy and expensive engines. Among the cars exhibited at the 1909 New York auto show at the Grand Central Palace, only 7 percent had engines cast in one piece, and all those were made in Europe except one—the new Ford Model T. Ford’s detachable cylinder head was even more rare. The separate cylinder block and cylinder head were simpler and cheaper to cast and machine, and also made maintenance tasks, such as grinding the valves, easier to perform.

The Model T engine’s 20-horsepower hardly seems “ample” today, but it made the 1,200-pound Ford a lively performer. Typical American cars of the day weighed about 80 pounds

for each horsepower. The Model T’s 60 pounds per horsepower stacked up well against that of expensive cars, such as the Thomas Flyer, which won the New York-to-Paris race in 1908. The Thomas weighed 64 pounds for each horsepower, but it cost \$3,500.

The Model T was indeed “built of the very best material.” It had many parts made of light, strong vanadium alloy steel. But Ford also developed methods for heat-treating ordinary carbon steel that yielded strong, tough parts that were no larger or heavier than they needed to be.

Ford had to design his car for dreadful roads. In 1909, only 8.5 percent of American roads were classified as “surfaced,” which usually meant covered with gravel. The remainder were simply dirt paths: dusty in dry weather, muddy tracks in the rain and creased with frozen ruts in the winter. Cars driving over such roads took a terrible pounding. Most manufacturers dealt with this problem by building cars with big, strong, rigid frames. But such cars were also heavy and expensive, the opposite of Ford’s goal of a “light, low-priced” vehicle. Ford and his fellow engineers used a different solution. They devised a clever suspension and engine mounting system that was inexpensive to manufacture and allowed the lightweight Ford chassis to [flex with the bumps and ruts](#). The Model T might rattle, squeak and groan as it danced over America’s awful roads, but it rarely broke.

The Model T did use one design feature that seemed outdated in 1908—a planetary transmission. The most popular form of transmission was the sliding gear, in which a lever moved spinning gears from one position to another. Making these changes smoothly, quietly and without damage to the moving parts themselves required practiced, coordinated movement of the lever, clutch and engine throttle. But Henry Ford wanted to sell his Model Ts to people who had never driven a car before, and he wanted to make learning to drive his car easy for them. So he gave the Model T a planetary transmission, whose gears were always meshed. Drivers changed speeds by means of brakes (usually called bands) that stopped or released shafts connected to the gears. Planetary transmissions were generally not rugged enough to

use in larger cars but were plenty rugged for the lightweight Model T. Even though such transmissions were falling out of favor, Ford knew that people with no driving experience would prefer the easy-to-learn planetary transmission over the more complicated sliding-gear transmission.

A choice Ford designers had to make is one we don't even think about today—whether to put the steering wheel on the right or the left side of the car. Most American cars, and all previous Fords, had the wheel on the right. For the Model T, Ford designers moved the [wheel to the left](#), the position we think of as normal. Ford ads said that having the steering wheel on the left allowed the driver to judge more accurately the distance between the driver's car and one passing in the opposite direction, and gave the driver a better view of oncoming or overtaking traffic when passing or turning left. They also said it was safer because passengers could enter and exit the car from the curb rather than from the street. Over the next few years, no doubt because of the Model T's vast popularity, left-hand steering became standard in the United States.

The first running prototype Model Ts rolled out of the Piquette Plant in [October 1907](#), and the company tinkered with the car for another year, even after serial production began. The Model T had its first great shakedown trip in late September 1908, when Ford drove one of the prototypes from Detroit to Michigan's Upper Peninsula by way of Chicago and Milwaukee, a 1,357-mile round trip. The most significant problem on the trip was a punctured tire. The Model T's fundamental design was clearly sound. It was time to stop testing and to start building and selling.

The Assembly Line—A Revolution in Car Production

Priced at \$850, the Model T was not cheap, but it was a great value, and it rapidly became the most popular car in the country. Ford soon outgrew the Piquette Avenue plant, and in 1910 the company moved into a huge new factory in [Highland Park](#), Michigan, north of Detroit. Here Henry Ford pushed his team in a relentless drive to increase production and lower costs. Henry Ford believed that “machines are to a mechanic what books are to a writer. He gets

ideas from them and if he has any brains he will apply those ideas.” Ford's engineers had plenty of brains, and they freely borrowed ideas from other industries to help them make cars faster and cheaper.

Factories that made pistols and rifles or clocks and watches used [specialized machines](#) and jigs and fixtures to make parts quickly and accurately. Ford borrowed these ideas and adapted them to making much larger parts for automobiles.

Breweries and flour mills used conveyors to move grain around inside their plants. Ford borrowed these ideas and used conveyors to move molding sand around in the Highland Park foundry.

The Westinghouse Air Brake Company used different types of conveyors to move molds and castings. Ford borrowed that idea to move large molds and castings in its foundry.

[Ford applied these ideas so well, and organized the new plant so efficiently, that production increased from 10,660 in the Model T's first year of production to 182,000 cars in 1912, while the price dropped from \\$850 to \\$550.](#)

In 1913, Ford borrowed from an unlikely source—meat packers in Chicago and Cincinnati. In the packing plants, hog and cattle carcasses were hung on conveyors and moved past the meat cutters who sliced off various parts as the carcass went by—disassembling the animal piece by piece. Ford engineers turned that idea inside out and set up a line to [assemble an important component called the magneto](#) piece by piece.

Rather than one worker assembling the entire magneto himself, each worker put on one or two parts and passed the item on to the next man in line, who put on another one or two parts until at the end of the line the whole magneto was assembled. This proved so efficient that engineers tried the idea on other components like the transmission, engine, axles and dashboard. By August 1913, they were bringing the components together on an [assembly line](#) that produced a whole car. By July 1914, assembly time for a complete car had dropped from 150 minutes to 26 1/2 minutes.

The moving assembly line was truly revolutionary. It increased productivity, lowered production cost and gave the company complete control over the rate of production. But the assembly line created its own problem—people didn't want to work on it. Assembly line work did not demand great skill, but it was so tiring, so boring, so relentless and so different from what people were accustomed to that most workers would not stay at it. They would work a few weeks, or even a few days, and quit and go to some other company that didn't yet have assembly lines. Labor turnover was so high that Ford had to hire 53,000 people a year to keep a constant workforce of 14,000 at the new plant. The solution to that problem went beyond technology.

On January 5, 1914, Ford Motor Company announced that it was more than doubling its prevailing wage rate to \$5 per day. This was an unheard-of amount of money for unskilled or semiskilled work, and it ended Ford's turnover problem. Overnight, Ford went from begging workers to stay to turning job seekers away. The work was still just as demanding, but the wages were so attractive that people were willing to put up with the conditions. The continued success of Ford Motor Company was now assured.

In the years that followed, prices of the Model T continued to drop and sales grew steadily. Ford even expanded sales and manufacturing overseas, so that by the early 1920s half of the cars in the world were Model Ts.

The End of the Model T

But something else happened: Ford, both the man and the company, lost sight of his and its ultimate goal. Henry and the company became so fascinated with producing an ever-growing number of Model Ts at ever-lower cost that they forgot about the possibility that customers might eventually want something different. In fact, after 1923 Model T sales steadily declined. General Motors' [Chevrolet](#) offered more style, more comfort and more power for not much more money than a Model T. Henry Ford ignored this changing reality as long as he could, but in August 1926, he reluctantly acknowledged that customers' tastes had changed and that

another model was needed. He ordered that work begin on the design of a new car. On May 26, 1927, [the last Model T](#), number 15,000,000, came down the Highland Park assembly line, and the line shut down. The new car, called the Model A, did not enter production until December. It was a success, but not the hit the Model T had been. Ford lost its sales leadership to General Motors and to this date has never recovered it.

The Model T's Legacy

The automobile filled deep, abiding desires that most people barely knew they had—desire for rapid, unfettered mobility; for control of something powerful; and for ownership of something valuable, modern and complex. This is why people aspired to own automobiles before they could actually afford to buy automobiles or before automobiles were actually useful for daily transportation. The inexpensive, rugged, immensely capable Model T allowed people to fulfill their automotive aspirations. The consequences went far beyond anything Henry Ford ever imagined.

The auto industry became the driving force in the 20th-century American economy, and the steel, oil and rubber industries grew rich fulfilling its needs. Highway construction, virtually insignificant at the beginning of the century, grew steadily, fed by gasoline taxes willingly paid by drivers who wanted better roads. The culmination of this building boom was the Interstate Highway System, one of the great public works projects in human history, on the scale of China's Great Wall or Rome's aqueducts.

The American propensity for owning a house in the middle of a piece of land, no matter how small, created "streetcar suburbs" in the 19th century. But mass automobility facilitated the growth of vast new suburbs with their attendant schools, retail stores and industries. The depopulation of older cities like Detroit and Buffalo, and the expanding population of cities like Houston and Atlanta, would have been impossible without ready access to automobiles.

Mass ownership of cars not only has allowed us to drastically alter our landscape, it has drastically altered our atmosphere. Once viewed as preferable to the manure and urine deposited by horses, auto exhaust gradually came to be understood as a serious problem. Successful efforts to reduce emissions from individual cars are offset by increases in the sheer numbers of cars and in the miles people drive. The long-term atmospheric consequences of the 20th-century choice of mass automobility are hotly debated in the 21st century, as are the possible solutions.

Mass automobility is something to die for—literally. Since the late 1930s, traffic fatalities have averaged between forty and fifty thousand people per year. Great strides have been made in making both cars and roads safer, but as with air pollution, these efforts are offset by the increase in the number of miles driven. Deaths per mile have fallen steadily, but rising mileage keeps total annual deaths about the same.

Finally, in the early years of the 21st century, it is difficult to think about automobiles without also thinking about oil, its price, its availability and its location. A huge oil strike at Spindletop, near Beaumont, Texas, in 1901 meant that the automobile boom could be fueled by abundant and cheap domestic gasoline. Americans came to view cheap and abundant gas as the natural order of things, even after domestic wells could no longer meet domestic demand. But it turns out that some of the world's most abundant oil fields are in some of the world's most politically volatile places—or perhaps those places are volatile because they contain abundant oil fields. Maintaining a high level of automobility means becoming deeply involved with those places, for better or worse.

The Assembly Line's Legacy

The assembly line had its own powerful legacy. Without mass consumption of goods, mass production would not be economically viable. As Henry Ford himself said, “The two go together.” Both the methods of mass production and the sales methods necessary to promote mass consumption were spawned and perfected in the auto industry, with Ford leading the way. Producers of other consumer goods, like refrigerators, washing machines, vacuum cleaners and radios,

quickly adopted both mass-production and mass-marketing methods. The American standard of living came to mean the purchase, discard and repurchase of large quantities of machine-made goods.

When World War II broke out, American mass-production industries made a remarkably quick conversion to producing war material. None of the other belligerents could match the ability of the United States to turn out guns, helmets, tanks, ammunition and combat boots. Assembly line techniques were even adapted to the manufacture of aircraft and ships. American aircraft factories more than kept up with the appalling losses of planes over Europe, while American shipyards built Liberty and Victory ships faster than two Axis navies could sink them.

Ford's \$5 day is often cited as a key factor in expanding the middle class. But less often understood is just how that happened. The \$5 day did more than simply increase wages. It reversed the historical relationship between wages and skill.

Throughout history, the way for workers to increase the price they demanded for their services was to increase their skill level. The master craftsman always made more money than the journeyman. Conversely, the way for an employer to lower labor costs was to lower the skill required to do the work. For example, mechanization in the textile industry and the shoe industry lowered the skill level required to spin yarn and make shoes, and lowered the value of the labor of the workers in question. But the \$5 day turned that relationship on its head by creating something the world had never seen before: the low-skill/high-wage job. Suddenly high-wage jobs were available to large numbers of people who could never have had them before, especially people from rural areas and from foreign countries. The Georgia sharecropper and the Polish peasant both found in Detroit or other industrial cities the opportunity to make a good living despite their lack of industrial skills. Unfortunately, this process led to a devaluing of education on the part of many workers and their children. Why do I need an education, they asked, to work on the line? A willingness to work, not a high school diploma, is all that is required.

But it turned out that the reversal of the wage/skill relationship was not permanent. As the automobile industry fought to meet competition from foreign cars in the 1980s, especially from Japan, it became clear that the Japanese had a different approach to assembly line work. Japanese automakers had discovered that they could increase quality and productivity by actually involving their workers in the improvement of the process. They did not want workers who turned their brains off when they punched the time clock and turned them on again at the end of the shift. They wanted workers who were educated, engaged and who could do a variety of different jobs in the manufacturing process. They wanted their employees to have a high school education and even training beyond high school. To compete in quality and productivity, the U.S. industry gradually adopted the same approach. The consequences for anyone seeking an entry-level job at an auto plant were profound. No longer was the industry an “opportunity gate,” opening wide to anyone willing to work hard. It became instead an “opportunity turnstile,” open only to those with sufficient education and skill.

The \$5 day had a major unintended consequence. Henry Ford’s new wage policy constituted an unwritten contract with his workers: They submitted to the discipline of the assembly line, and he paid unprecedented high wages. When the Great Depression came along, Ford and other assembly-line-based industries could no longer pay the high wages. Workers responded by joining industrial unions based not on craft skills but on common employment in an industry. When they withheld their labor through strikes, they forced employers to sign written contracts defining a new balance of power between worker and employer. Thus it was that Henry Ford, who hated labor unions, unwittingly created the conditions that gave rise to an organized labor movement that would remain a potent social and political force for the remainder of the century and beyond.

The long-term effects of both the Model T and the assembly line are so profound that one observer summed them up by saying that Ford’s Highland Park Plant, where the Model T was produced and the assembly line was developed, was the place where “the mainspring of the 20th century was wound.” Our own 21st century is still feeling the effects of that winding.