



## Did Ford Really Invent Mass Production?

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*A hundred years ago, on June 16<sup>th</sup> 1903, Henry Ford launched The Ford Motor Company. The following month he sold his first car. Today, a century later, Ford is still credited as the father of mass production, the man who defined the character of the worlds' largest manufacturing industry. Since its inception this industry has produced about two billion cars. Those cars have transformed lives and lifestyles, especially in the US where society is still largely built around and predicated on car ownership and use. For a man who once famously declared that 'History is more or less bunk' Henry Ford has achieved iconic historical status. However, as the centenary celebrations unfold, the question must be asked: did Ford really invent mass production?*

### **Henry Ford: innovative and conservative in equal measure**

Ford came from humble rural origins in the US state of Michigan, showing a natural aptitude for mechanical engineering that led him into an interest in cars. He was a man inspired, with a vision of bringing motorisation to the masses, and he pursued that vision with a vigour and determination that in the end was almost the undoing of the company he founded.

After founding the company in 1903, Ford's early efforts at car production were impressive by contemporary standards, but hardly revolutionary. His dissatisfaction grew alongside his ever-deepening understanding of manufacturing. The first step Ford made to become an industrial legend was to understand that the car and the manufacturing system ultimately had to be designed together. It was this insight that resulted in the Model T Ford, arguably the most famous and influential vehicle ever designed, of which over 15 million versions were built between it's introduction in 1908, and eventual replacement in 1927.

Still, Ford was cautious. Market acceptance of the car was far from certain. So, the car was first made using tried and tested craft methods of construction whereby each car was built separately in a dedicated assembly bay, using skilled labourers. Between 1910 and 1916, however, Ford embarked on a bold, unprecedented, and many thought foolhardy strategy to expand production and reduce costs. It was in these formative years that the true dedication, courage and genius of

Ford became manifest. His vision crystallised around three basic ideas: a single standardised product, dedicated production equipment and the introduction of almost unskilled line workers performing repeated operations or tasks many times each hour. Standardisation had been tried before, and interchangeable components had been used by rival car makers such as Cadillac and Lanchester, but not on this scale. Most manufacturers still offered very complex product ranges at this time, rather than Ford's single model policy. These changes were epitomised by the moving assembly line, which was one element of Ford's innovations, introduced in 1913. The moving assembly line itself was adapted from other industries such as the meat processing factories in Chicago, and applied to car production by Ford.

Even Ford was staggered by the impact of his new approach to manufacturing. Before these changes, completion of a Ford Model T chassis with engine, axles and springs, took some 12.5 hours. Afterwards this had been reduced to only 2.6 hours. This leap in productivity left rivals like Buick and Packard trailing in his wake. However, Ford did not stop there, because his vision for mass motorisation had another vital element that all other car makers had ignored.

Ford wanted to make motorisation affordable, and in any case felt a certain puritan discomfort with the burgeoning profitability of his trusty Model T. So, he also lowered his prices every year to reflect his increased productivity - and ironically then found that he could not keep up with demand. In part, increased demand was also due to the fact he paid his workers well – in another innovation Ford introduced the \$5 day for all production staff. This was twice what competitors paid and Ford's employees now formed a substantial part of his customer base.

Still, Ford was not entirely content. He found that his suppliers of materials and components could not keep up with volume or the quality needed. Emboldened by success, and with an extremely healthy bank balance, the solution Ford came up with was typically unfashionable: he decided that his company would do all the work. Ford Motor Company rapidly became the most vertically integrated mass manufacturer in history, operating his own mines, forests, rubber plantations, even his own ships. Soon his factories made virtually the entire car, and Henry Ford became one of the most powerful figures of industrial history. Henry Ford's autocratic style became legend, perhaps typified by his declaration in 1909 by which he is still best known: "Any customer can have a car painted any colour that he wants so long as it's black."

### **The limits of Ford's system**

Perhaps surprisingly, hidden behind this oft-quoted comment about painting the car is the reason for the failure of Henry Ford to create full mass manufacturing in the car industry. The comment is more than apocryphal, for the paint on early car bodies took a very long time to dry and black was the fastest drying colour. Black paint had a higher solids content and hence dried more quickly. Car bodies could take up to 40 days to paint and dry. The result was fields full of drying car bodies. Needless to say, Ford could not put up with this with his production volumes and he in fact bought most of his bodies from outside suppliers making them watch the paint dry instead. Ford could do this, because the core of the car was its chassis; a steel frame to which engine, gearbox, axles and wheels were attached. The body was added later or indeed after the production process, and its main function was keeping out the worst of the weather. In other words, Henry Ford industrialised all aspects of car production, except the body. In practice, drying time for paint was the main bottleneck in the mass production of cars and many manufacturers, including Ford, tried to address it. One method was to heat the bodies by baking them, but this also caused problems. At this time, car bodies were built around a wooden frame to which the metal panels were attached – hence Ford's need for forests. When heated, these frames could catch fire with disastrous consequences.

Yet, at the very time when the moving assembly line was being installed into the Highland Park factory in Detroit, Michigan to smooth the production of the Model T, an unknown engineer in Philadelphia was assiduously laying the foundations that would revolutionise car design and render the Model T obsolete. Edward Gowan Budd, along with his colleague Joe Ledwinka from Austria were messianic in their advocacy of sheet steel in engineering, a modern sophisticated material that with thought and careful design could replace the crude, heavy and brittle cast iron used in many instances. While he started small, working on components such as pressed steel pulleys, Budd came to believe there should not be a piece of wood “as big as a toothpick” in a car body. After securing a series of patents in metal pressing, fixtures to hold parts, and spot welding techniques Budd managed to convince the Dodge Brothers – who had recently left Ford Motor Company to set up their own business – to place an initial order for 5000 bodies in 1915. Their new car was well received and the following year Dodge Brothers were able to order 15,000 – Budd and Ledwinka were vindicated. The all-steel car body concept swept through the industry at a pace unrivalled for almost any technological innovation. In 1920, car bodies in the US were still 85% timber-framed; by 1926, 70% were steel; such was the success of Budd's new technology. At the same time, paint technology was improved and adapted to suit the new system. Dupont lead much of this innovation in paint and their shareholding in General Motors ensured Ford's main competitor got first choice. General Motors were the first to use synthetic paints and they offered these in a range of colours when Ford was still limited to black – the industry leapt into the era of styling and marketing. Henry Ford had thought that his Model T and the manufacturing

system to produce it could not be improved upon. His obdurate refusal to change, the very determination and self-belief that laid the foundations for his success, almost brought his company to its knees.

### **The legacy of Edward Gowan Budd**

So how much of Ford's innovations do we see in a modern car plant? Considering his iconic status we see surprisingly little. A visit to a modern car factory usually starts with the press shop. Here coiled rolls of steel sheet are uncoiled and cut into shapes or blanks. These blanks are then formed by massive presses into shaped panels: doors, bonnets, roofs, front wings. In the next phase, these pressed steel shapes are held in jigs and welded by robots into a recognisable car shape. The welded all-steel car body, rather poetically known in the industry as the 'body-in-white', is then passed into the paint shop, where it is painted, again usually by robots. None of these processes that so dominate a modern car factory and constitute three-quarters of the investment in such a factory, would have been seen at Ford's Highland Park plant where the legendary Model T, or 'Tin Lizzie', was built.

By the 1960s, virtually all car makers anywhere in the world were using Budd's body technology in some form. The only exceptions were in rarefied market niches that sustained specialist makers such as Morgan Sports Cars in Malvern, Worcestershire. In time the chassis-and-body design came to be replaced by the more efficient monocoque, particularly in Europe where companies such as Citroën (with their Traction Avant of 1934) pioneered the adoption of Budd technologies. Otherwise the huge financial cost of all-steel body technology demanded and rewarded ever-growing output: the big companies got bigger; the small companies either disappeared under relentless cost pressure or were swallowed up by their larger competitors. In other words, it is these body-making investments that determine economies of scale in modern mass car manufacturing. By comparison, a final assembly line is relatively cheap and can be economic at a wide range of volumes between 100 cars per year and 800,000 cars per year.

It is often said that history is written by the winners. Perhaps because Budd never actually built cars himself, but provided licences of his ideas for others to use, his name is not one that most outside the industry, and many within it, associate with his pivotal contribution to car production. Henry Ford industrialised what in one crucial respect was a pre-industrial design. It was Edward Gowan Budd who created the core technology that truly transformed the industry. For all the achievements that will be celebrated in the Ford centenary this year, Ford was not the father of mass production in the car industry.

