Assembly line definition in world history

Page 2 An assembly line is a manufacturing process in which individual parts of a larger product are assembled in a particular order. Today, this process is usually performed by computers or robots, but in its early days, it requires human hands. The assembly line accelerated the manufacturing process dramatically. It allowed factories to spit out products at a remarkable rate, and even managed to reduce the working hours required to complete a product-benefiting many workers who used to spend 10 to 12 hours a day in the factory trying to meet quotas. Ford Motor Company adopted the assembly line between 1908 and 1915, and it helped the company become a significant force in the U.S. economy. Since the 1860s, a number of industries, including meatpacking, artillery and the automotive industry, use the assembly line process. The meatpacking industry was one of the earliest adopters of this invention. Originally, workers would stand at stations and operate a pulley system to get over each animal carcass in turn. They would cut the meat as needed, then move on to the next animal. The firearms industry began using the idea around the same time, which allowed weapons to be mounted much faster. But it was not the only industries to use assembly lines; As time went on, other smaller industries, such as the watchmaking industry, began to use them as well. In the 1920s, the United States was on the verge of a massive change. As more and more machines were invented and used around the country, people continued looking for ways to increase productivity. One of the most important inventions to come out of that time was the assembly line. This process spread to many different industries, and it helped to make the United States a great economic power. Today, most assembly lines are automated, and they require a human worker only at the end of the process to inspect the products to make sure they are not defective. These assembly lines operate in manufacturing facilities that require goods to be produced as necessary.. Effectively, the plants have a two- or three-day supply of the parts they need. The modern assembly line focuses on speed and quality, so that finished products can be laid out on a regular basis. The assembly line was not invented by a single person. It grew out of a combination of minor advances and discoveries. Different people invented cogs, fixtures, and machine tools. By the time Henry Ford started using the assembly line in his company, it had already evolved. Today, almost everything goes through an assembly line at some point. Without it, the world would still build everything by hand. Although the history of the assembly line is not very long, the world can hardly function without it now. The ease and uniformity it produces has helped manufacturers provide standardized products for their customers, and has made constructing spare parts very simple. 'From major car manufacturers to food chains to clothing manufacturers, our world's most integrated industries use this process to increase their speed and accuracy—deeply affecting the lives of nearly 7 billion people. It will continue to be a valuable asset for the manufacturing industry as we move towards the future. The very simplicity of the assembly line makes it one of the most useful and inspiring inventions ever. Manufacturing process For the video game company, see Assembly Line. An Airbus A321 on final assembly line 3 of the Airbus factory at Hamburg Finkenwerder Airport Hyundai's car assembly line A assembly line is a manufacturing process (often referred to as a progressive assembly) where parts (usually interchangeable parts) are added when the half-finished assembly is moved from workstation to workstation where the parts are added in sequence until final assembly is produced. By mechanically moving the parts to the assembly work and moving the semi-finished assembly from workstation to workstation, a finished product can be assembled faster and with less labor than by having workers carry parts to a stationary piece for assembly. Assembly lines are common methods for assembling complex objects such as cars and other transport equipment, household appliances and electronic goods. Workers in charge of assembly line work are called assemblers. [1] Concept Lotus Cars assembly line as of 2008 Assembly lines are designed for sequential organization of workers, tools or machines, and parts. The movement of the workers is minimized as far as possible. All parts or assemblies are handled either by conveyors or motorized vehicles such as forklifts, or gravity, without manual trucking. Heavy lifting is done by machines such as overhead cranes or forklifts. Each worker typically performs a simple action unless job rotation strategies are applied. According to Henry Ford: The principles of assembly are these: (1) Place the tools and men in the sequence of the operation so that each component part should travel the minimum possible distance while in the process of finishing. (2) Use work slides or any other form of carrier so that when a workman completes his surgery, he drops the part always in the same place—as the place must always be the most comfortable place to his hand—and if possible have gravity carry the part to the next workman of his own. (3) Use sliding collecting lines through which the parts to be assembled are supplied at comfortable distances. [2] Designing assembly lines is a well-established mathematical challenge, called assembly line balancing problems. [3] In the simple assembly line balancing problems the aim is to assign a set of tasks that need to be performed on work-pieces to a sequence of workstations. Each task requires a given task duration for completion. The allocation of tasks to stations is normally limited by two conditions: (1) a which specifies what other tasks need to be completed before specific tasks can be initiated (e.g. do not insert a screw before drilling the hole) and (2) a cycle time that limits the sum of task processing times that can be completed at each workstation before the work-piece is moved to the next station of the conveyor belt. Major planning problems for the operation of assembly lines are supply chain integration, inventory management and production planning. [4] Simple example Consider the assembly of a car: assume that certain steps in the assembly line are to install the engine, install the hood and install wheels (in it order, with arbitrary interstitial steps); only one of these steps can be done at a time. In traditional production, only one car would be fitted at a time. If engine installation takes 20 minutes, hood installation takes five minutes, and wheel installation takes 10 minutes, then a car can be produced every 35 minutes. In an assembly line, car assembly is shared between multiple stations, all working simultaneously. When a station is finished with a car, it passes it on to the next. By having three stations, three cars can be driven on simultaneously, each in a different stage of assembly. After completing their work on the first car, the engine installation crew can start working on the second car. While the engine installation crew is working on the second car, the first car can be moved to the hood station and fitted with a hood, then to the wheels station and be fitted with wheels. After the engine has been installed on the other car, the other car moves to the hood mounting. At the same time, the third car is moved to the engine unit. Once the third car's engine has been mounted, it can then be moved to the hood station; in the meantime, subsequent cars (if any) can be moved to the engine installation station. Assuming no time loss when moving a car from one station to another, the longest stage of the assembly line determines the throughput (20 minutes for engine installation) so a car can be produced every 20 minutes, when the first car takes 35 minutes has been produced. History Before the Industrial Revolution, most manufactured products were manufactured individually by hand. A single craftsman or team of craftsmen would create every piece of a product. They would use their skills and tools such as files and knives to create the individual parts. They would then assemble them in the final product, making cut-and-try changes in the parts until they fit and could work together (craft production). Division of labor was practiced in China, where state monopolies mass-produced metal agricultural implements, China, armor and weapons centuries before mass production appeared in Europe on the eve of the Industrial Revolution. [5] Adam Smith discussed the division of labour in the manufacture of pins to length in his book The Wealth of Nations (published in 1776). The Venetian Arsenal, dated to about 1104, operated resembles a production line. Ships moved down channel and and assembled by the various shops they passed. At the peak of its efficiency in the early 16th century, arsenal employed about 16,000 people who apparently could produce almost one ship every day, and were able to fit out, arm, and provide a newly built kitchen with standardized parts on an assembly line basis. Although Arsenal lasted until the early Industrial Revolution, production line methods did not become common even then. Industrial revolution The industrial revolution led to the spread of manufacturing and invention. Many industries, notably textiles, firearms, watches and watches,[6] horse-drawn vehicles, railway locomotives, sewing machines and bicycles, saw a rapid improvement in material handling, processing and assembly in the 19th century, although modern concepts such as industrial engineering and logistics had not yet been named. The pulley was the first production to be fully automated at Portsmouth Block Mills in the early 19th century. The automatic mill built by Oliver Evans in 1785 was called the beginning of modern bulk material handling by Roe (1916). Evans mill used a leather bucket lift belt, screw conveyors, canvas strap conveyors, and other mechanical devices to fully automate the process of making flour. The innovation spread to other mills and breweries. [7] Probably the earliest industrial example of a linear and continuous assembly process is Portsmouth Block Mills, built between 1801 and 1803. Marc Isambard Brunel (father of Isambard Kingdom Brunel), with the help of Henry Maudslay and others, designed 22 types of machine tools to make the parts for the rig blocks used by the Royal Navy. This factory was so successful that it remained in use until the 1960s, with the workshop still visible at HM Dockyard in Portsmouth, and still containing some of the original machines. [9] One of the earliest examples of an almost modern factory layout, designed for easy material handling, was Bridgewater Foundry. The factory areas were bordered by the Bridgewater Canal and the Liverpool and Manchester Railway. The buildings were arranged in a line with a railway to carry the work going through the buildings. Cranes were used to lift the heavy work, which sometimes weighed in tens of tons. The work went sequentially towards the construction of the frame and final assembly. [10] Bridgewater Foundry, pictured in 1839, one of the earliest factories to use an almost modern layout, workflow and material handling system The first flow assembly line was initiated at the factory in Richard Garrett & Sons, Leiston Works in Leiston in the English county of Suffolk for the manufacture of portable steam engines. The assembly line area was called The Long Shop because of its length and was in full operation in early 1853. The boiler was taken up from the 2000s and set at the beginning of the line, and as it progressed through the building, it would stay at different stages. new parts would be added. From the upper level, where other parts were manufactured, the lighter parts would be lowered over a balcony and then fixed on to the machine at ground level. When the machine reached the end of the store, it would be ready. [11] Interchangeable parts In the early 19th century, the development of machine tools such as the screw-cutting lathe, the metal decontamination and milling machine, and tool way control via jigs and fixtures, provided the conditions for the modern assembly line by making interchangeable parts a practical reality. [citation needed] Late 19th century singing and electric transporters Steam-powered conveyor lifts began to be used for loading and unloading ships sometime in the last quarter of the 19th century. [12] Hounshell (1984) shows a sketch c. 1885 of an electric motorized transporter moving cans through a filling line in a canning factory. The meatpacking industry in Chicago is believed to be one of the first industrial assembly lines (or dis-assembly lines) to be utilized in the United States starting in 1867. [13] Workers would stand at fixed stations and a pulley system would bring the meat to each worker, and they would complete a task. Henry Ford and others have written about the impact of this slaughterhouse practice on recent developments at Ford Motor Company. [14] 20th century Ford assembly line, 1913. The Magneto assembly line was the first. [15] [16] 1913 Experiment with mounting body work on Model T chassis. Ford tested various assembly methods to optimize procedures before permanently installing the equipment. The actual assembly line used an overhead faucet to mount the body. Play media Ford Model T assembly line circa 1919 Play media Ford Model T assembly line circa 1924 Play media Ford assembly line circa 1930 Play media Ford assembly line circa 1947 According to Domm, the implementation of mass production of a car via an assembly line can be credited to Ransom Olds, who used it to build the first mass-produced car , Oldsmobile Curved Dash. [17] Old's patented assembly line concept, which he put to work in his Olds Motor Vehicle Company factory in 1901. [18] At Ford Motor Company, the assembly line was introduced by the William Pa Clan on his return from visiting swift & company's slaughterhouse in Chicago and showing what was called the dismantling line, where carcasses were slaughtered as they moved along a transporter. The effectiveness of a person removing the same piece over and over again without himself moving caught his attention. He reported the idea to Peter E. Martin, soon head of Ford production, who was hesitant at the time but encouraged him to move on. Others at Ford have claimed to have put forward the idea to Henry Ford, but the Pa Klan's abattoir revelation is well documented in the archives of the Henry Ford Museum[19] and elsewhere, making him a major contributor to the modern automated assembly line concept. Ford was appreciative, having the highly automated 40-acre Sears mail order management facility around 1906. At Ford, the process was an evolution through trial and error[16] by a team consisting mainly of Peter E. Martin, the factory curator; Charles E. Sorensen, Martin's assistant; Clarence W. Avery; C. Harold Wills, rapporteur and toolmaker; Charles Ebender; and József Galamb. Part of the foundation for such a development had recently been laid by the intelligent layout of machine tool placement that Walter Flanders had done at Ford until 1908. The moving assembly line was developed for the Ford Model T and began operations on October 7, 1913, at the Highland Park Ford Plant,[20][21] and continued to develop after that, using time and exercise study. [16] The assembly line, powered by conveyor belts, reduced the production time of a Model T to just 93 minutes[17] by dividing the process into 45 steps. [22] Making cars faster than today's paint could dry, it had a huge influence on the world. In 1922, Ford (through his ghostwriter Crowther) said of his 1913 assembly line: I think this was the first moving line ever installed. The idea came in a general way from the overhead cart that chicago packers use in dressing beef. [23] Charles E. Sorensen, in his 1956 memoir My Forty Years with Ford, presented a different version of development that was not so much about individual inventors as a gradual, logical development of industrial engineering: What was worked out on Ford was the practice of moving the work from one worker to another, until it became a complete unit, then arranging the flow of these units at the right time and right place to a moving final collection line from where a complete product came. Regardless of past use of some of these principles, the direct line of succession of mass production and its intensification in automation stems directly from what we worked at Ford Motor Company between 1908 and 1913. Henry Ford is generally regarded as the father of mass production. He wasn't. He was the sponsor of it. [24] As a result of this development in method, Ford's cars came off the line in three-minute intervals, or six feet per minute. [25] This was much faster than previous methods, increasing production by eight to one (requiring 12.5 man hours before, 1 hour 33 minutes after), while using less labor. [6] It was so successful, color became a bottleneck. Only Japan black would dry fast enough, forcing the company to release the variety of colors available before 1914, until the fast-drying Duco varnish was developed in 1926. [6] The assembly line technique was an integral part of the diffusion of the car into American society. Reduced production costs allowed the cost of the Model T to fall within the budget of the American middle class. In 1908, the price of a Model T was around $825, and by 1912 it had dropped to around $575. This price reduction is comparable to a decrease from $15,000 to $10,000 in terms terms in 2000. In 1914, an assembly worker was able to buy a Model T with four months' salary. [6] Ford's complex safety procedures—especially assigning each worker to a specific location instead of allowing them to roam—dramatically reduced the injury rate. The combination of high wages and high efficiency is called Fordism, and was copied by most major industries. The efficiency gains from the assembly line also coincided with the us start. The assembly line forced workers to work at a certain pace with very repetitive movements that led to more production per worker, while other countries used less productive methods. In the automotive industry, its success was dominant, and spread rapidly throughout the world. Ford France and Ford Britain in 1911, Ford Denmark 1923, Ford Germany and Ford Japan 1925; In 1919, vulcan (Southport, Lancashire) was the first native European manufacturer to adopt it. Soon, companies had to have assembly lines, or risk breaking down by not being able to compete; 1930, 250 companies that had not disappeared. [6] The massive demand for military hardware during World War II prompted assembly line techniques in shipbuilding and aircraft production. Thousands of Liberty Ships were built with extensive use of prefabrication, making it possible to complete the ship assembly in weeks or even days. After producing fewer than 3,000 planes for the U.S. military in 1939, U.S. aircraft manufacturers built over 300,000 aircraft during World War II. Vultee paved the way for the use of the motorised assembly line for aircraft manufacturing. Other companies quickly followed suit. As William S. Knudsen (after working at Ford,[16] GM and the National Defense Advisory Commission) noted: We won because we suffocated the enemy in an avalanche of production, the likeof which he had never seen, nor dreamed possible. [26] Improved working conditions In his 1922 autobiography,[2] Henry Ford mentions several advantages of the assembly line including: Workers do not do heavy lifting. No bending or bending over. No special training was required. There are jobs that almost anyone can do. Gave employment to immigrants. The gains in productivity allowed Ford to increase workers' pay from $1.50 per day to $5.00 per day when employees reached three years of service on the assembly line. Ford continued to reduce the hourly week while continuously lowering the Model T price. These goals seem altruistic; however, it has been argued that they were carried out by Ford in order to reduce the high turnover of staff: when the assembly line was introduced in 1913, it was discovered that each time the company wanted to add 100 men to its factory staff, it was necessary to rent 963 in order to counteract the natural distaste that the assembly line seems to have inspired. [28] Sociological problems Sociological work has explored the social alienation and boredom that many workers feel due to of doing the same thing all day long. [29] One of capitalism's most famous critics, Karl Marx, expressed in his Entfremdung theory that in order to achieve job satisfaction, workers need to see themselves in the objects they have created, that products should be mirrors where workers see their reflected essential nature. Marx saw work as a chance for us to externalize the facets of our personality. Marxists argue that specialization makes it very difficult for any worker to feel that they can contribute to the real needs of humanity. The repetitive nature of specialized tasks causes, they say, a sense of disconnection between what a worker does all day, who they really are, and what they could most not contribute to society. Marx also argued that specialized jobs are uncertain, as the worker is expendable as soon as costs rise and technology can replace more expensive human labor. [30] Since workers had to stand in the same place for hours and repeat the same wave hundreds of times per day repeating stress injuries are a possible pathology of work safety. Industrial noise also proved to be dangerous. When it was not too high, workers were often forbidden to speak. Charles Piaget, a skilled worker at the LIP factory, recalled that in addition to being banned from speaking, the semi-skilled workers had only 25 centimeters to move. [31] Industrial ergonomics later tried to minimize physical trauma. See also Business portal Business and Economics portal Modern Times (film) Final Offer a documentary film about the 1984 UAW/CAW contract negotiations showing the working life on the floor of GM Oshawa Ontario Car Assembly Facility (Watch Online) References Footnotes ^ Assembler Job Description - How to Become an Assembly Worker. Spherical. Retrieved 2020-03-07. ^ a b Ford & Crowther 1922, p. 45 (on line version), p. 80 (print version) ^ Scholl, A.; Christian, B. (2006). State-of-the-art precise and heuristic solution procedures for easy assembly line balancing. European Journal of Operational Research. 168 (3): 666–639. doi:10.1016/j.ejor.2004.07.022. ^ Slack, N.; Brandon-Jones, A.; Johnston, R. (2013). Operations Management. Pearson. ISBN 9780273776291. ^ Merson 1990[page needed] ^ a b c d e G.N. Georgano 1985. 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People like Carl Emde, William Klann and William Knudsen all played key roles in early automation efforts at Ford's Highland Park factory. Two individuals were necessary for the success of the moving assembly line: Clarence Avery and Charles Sorensen. Constant redesign of model T. Many components were tweaked regularly to make the vehicle easier to assemble. In 1913 alone, Ford made more than 100 design changes each month. Continuous experiments were the rule rather than the exception at Ford's Highland Park facility. Ford engineers were constantly redesigning and tweaking jigs and fixtures, and planning new machine tools or fixing old ones, to achieve higher production. ^ a b Domm 2009, p. 29 ^ Ament, Phil. Band line history: Invention of the unit line. Ideafinder.com. Retrieved 2011-10-15. ^ Clan, W.C. (n.d.). Reminiscences. Henry Ford Museum & Greenfield Village Archives. Connection 65. 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