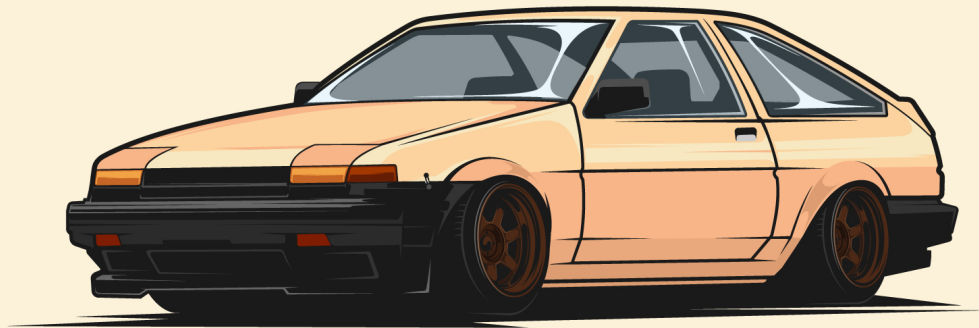


SUMMARY

THE MACHINE THAT CHANGED THE WORLD

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Summary of “The Machine that Changed the World” by James P. Womack, Daniel T. Jones, and Daniel Roos

Written by Lea Schullery

The Story of Lean Production - Toyota's Secret
Weapon in the Global Car Wars that is Now
Revolutionizing World Industry

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Introduction

Authors James P. Womack, Daniel T. Jones, and Daniel Roos concluded after much research that auto industries of North America and Europe rely on techniques that have seldom changed since Henry Ford's mass-production system. Unfortunately, these techniques are simply not competitive enough when compared to the ideas pioneered by the Japanese companies, methods which did not even have a name yet. And as Japanese companies gained market share, Western companies weren't learning from their competitors and focused on the wrong things, like erecting trade barriers and other competitive impediments, all of which simply delayed having to deal with the real issue. To prevent North America and Europe from sealing themselves off from the Japanese threat, the authors decided to undertake a detailed study of the new Japanese technique called "lean production." And thus, the International Motor Vehicle Program (IMVP) was born.

The authors spent five years exploring the differences between mass production and lean production, and they contacted insiders, industry leaders, and more. In the process, they learned that the principles of lean production could be applied to more than just the auto industry - it could be applied in every industry across the globe and have a profound effect on human society that could truly change the world. Throughout *The Machine that Changed the World*, the authors will uncover the secrets of how lean production came to be and explain how the system led Toyota to global success.

The Evolution of the Auto Industry

If we take a look at the automobile industry in the 1890s, we will see a great difference in how we do business today. We have come a long way since the “horseless carriage” that was first patented by Karl Benz in 1886. By the early 1890s, the auto industry used craft production, which meant that car manufacturers relied on skilled craftspeople to carefully hand-build cars in small numbers. They tailored each car to the precise desires of the individual buyer, making the cost of driving expensive - a luxury that few people could afford. As a result, only about 1,000 vehicles were produced each year. Today, that number is closer to 90 million.

It wasn't until Henry Ford came along that the industry moved to mass production, a change that occurred at the end of the twentieth century. Ford found a way to overcome the problems of craft production, like lack of reliability and durability. He researched new techniques that would dramatically reduce the costs of building a car while also increasing product quality. The system is what Ford would go on to call *mass production*. Ford also realized he could produce more cars in less time by designing cars that used the same interchangeable parts.

Furthermore, he understood it would be more efficient to work on producing each part separately rather than working on the car as a whole. In 1903, Ford's first efforts to assemble cars involved setting up assembly stands where one fitter would assemble an entire car. As a result, an assembler's task cycle - the amount of time he worked before repeating the same operation - totaled 514 minutes or 8.56 hours. The first step to make this process more efficient was to deliver the parts to each work station so assemblers could remain at the same spot all day. Then, in 1908, Ford achieved perfect part interchangeability, so he decided that each assembler would perform only a single task and move from vehicle to vehicle to do so.

By August of 1913, the assembly line was created, and the average task cycle for a Ford Assembler was reduced from 514 to 2.3 minutes. These

innovations meant huge savings for Ford, which allowed Ford to sell its Model T for much less than its competitors. Furthermore, Ford appealed to his target market of average consumers by making the operation and maintainability of his car easy to understand. The Model T's owner manual was written in question-and-answer format and explained how the owner could use simple tools to solve any of the 140 problems that might occur. As a result, no longer did car owners need to have a modest tool kit with mechanical skills. Anyone could drive and repair a Ford!

Assembly Line Production Had Many Flaws

As mass production began to increase production and lower costs, American cars continued to sell worldwide. In fact, by the early 1930s, over 30 million vehicles were being used all over the world and 90% of them were American. Of these vehicles, most of them were made by Ford, Chrysler, and General Motors - also known as the Big Three. However, as European companies like Germany's Volkswagen, France's Renault, and Italy's Fiat joined the competition, the assembly-line process began to reveal its weaknesses.

The first problem with mass production is the workforce and separation of labor. For instance, the industrial engineer created the blueprint for how all the parts came together; the production engineer arranged the delivery of parts and designed the conveyor belts; housecleaning workers periodically cleaned up work areas; repairmen refurbished assembler's tools; another specialist checked quality, and rework men fitted parts at the end of the assembly line that failed to be properly installed. In this atmosphere, assemblers were not given the opportunity to voice their concerns on operating conditions, such as if a tool was malfunctioning or if a method could be improved upon.

As a result, assemblers simply followed the rules and performed the assembly line's boring, repetitive tasks. There was little reward or room for growth, so employment turnover was quite high. Even worse, the assembly line moved forward on a tight schedule, so if a worker found a problem with a particular part, he might just send the defective part down the line without reporting it. Assembly-line managers were also too concerned with the number of cars the line produced, as their performance was measured by this number. Therefore, managers often instructed assemblers to ignore flaws to meet quotas.

Ultimately, assembly lines and mass production take on a "move the metal" mentality, leading to costly and time-consuming mistakes. For instance,

defects and flaws wouldn't be identified until entire cars were assembled and delivered to the rework area. Here, cars would sometimes have to be completely taken apart and rebuilt, and with so many moving parts, rework men couldn't catch every flaw. As a result, many defective cars were sold to the public.

Mass Production Didn't Meet Demands for the Japanese Market

While mass production became a popular system in both American and European companies, the Japanese market was simply not suited for mass production. First, the domestic market for Japan was tiny and demanded a wide range of vehicles. Government officials looked for luxury cars, entrepreneurs needed large trucks to carry goods, small farmers needed small trucks, and the people living in the cities needed small, more fuel-efficient cars. Therefore, the Western idea of a “one-size-fits-all” car didn’t work for Japan.

Furthermore, there were no “guest workers” in Japan. That is, temporary immigrants willing to work in poor working conditions in return for high pay. Thus, car companies struggled to find workers that were willing to do boring, repetitive tasks required for assembly lines. Lastly, the Japanese economy was recovering from the war and was starved for capital and foreign exchange, meaning that bulk purchases of the latest Western production technology were nearly impossible.

Between the years of 1925 and 1936, the Big Three dominated the Japanese market, producing around 200,000 vehicles; meanwhile, Japanese companies produced just around 12,000. By the early 1950s, the Japanese Ministry of International Trade and Industry (MITI) believed that to be internationally competitive, they needed to emerge Japan’s twelve car companies into a Japanese Big Two or Three to battle Detroit’s Big Three. The merged companies would specialize in different sizes of cars to prevent excessive domestic competition. As you may know, these plans never succeeded. Instead, Toyota, Nissan, and other companies set out to become full-range car producers with a variety of new models.

So how did they accomplish this? Well, Toyota engineers, Taichii Ohno and Eiji Toyoda came up with a process for manufacturing cars, calling it the Toyota Production System, or TPS. TPS is based on the same values of lean

production, that is, Toyota values continuous improvement and respect for both customers and employees. They understand that one system is never perfect and can always be improved upon. This system differs from the assembly line process, which values production and “metal pushing” above all else. Unlike mass production, TPS production allows workers to halt production each time a defect is identified. As a result, the system is continuously reexamined and improved, which is perhaps the main reason that Toyota cars are renowned for their safety.

Lastly, TPS also ensures that the company respects everyone involved, including its employees and business partners. Toyota, for example, offers on-the-job development programs that help employees climb the company ladder. It is programs like these that build workforce loyalty and improve the lives of employees, which benefits the company in the long run.

Lean Production Aims to Eliminate Mistakes and Waste

When it comes to a lean production system, Toyota saw such success in production and efficiency that lean principles quickly became influential all across the globe. But what is it about lean production that makes it so successful? Well, lean production works well because its main aim is to eliminate mistakes. For instance, at one GM manufacturing plant, Framingham, an enormous work area at the end of the assembly line is full of finished cars riddled with defects. Each one needs further repairs before shipment, a task that is time-consuming and often unsuccessful as many of the problems are now buried under layers of parts and upholstery.

At the Toyota assembly plant at Takaoka, however, there was almost no rework area at all. Almost every car was driven directly from the line to the boat or the trucks that take the cars to the buyer. This is because one of the main goals for lean production is perfection. They don't produce flaws, leave excess stock, or inhibit innovation. Of course, no system will ever be completely perfect, but the overall system generates better long-term results versus the mass production system.

The philosophy surrounding lean production also includes a reduction of waste and space. For instance, when walking around the Takaoka plant, there was hardly anyone in the aisles because each worker was adding value to the car. Additionally, Toyota believes in having as little space as possible to encourage face-to-face communication among workers. There is also no room to store inventories, so they are encouraged to fix what can be repaired and use every part they can. GM, on the other hand, believes extra space is necessary to work on vehicles needing repairs and to store a large inventory of parts to ensure smooth production.

Lastly, lean principles combine the best features of both mass production and craft production. Like craft production, lean automobile production focuses on the demands of the buyer. The process is based on what the

customers want, ultimately reducing costs and preventing overproduction. To keep up with fluctuating demands, Toyota has a massive database on households and their buying preferences, income levels, and family size. The company uses this information to tailor its production output to satisfy the specific needs of each customer. Meanwhile, mass production systems simply produce as many cars as possible, often resulting in more cars than interested buyers.

Lean Production Places Value in its Employees

Working on an assembly line, as you may know, requires workers to perform the same task over and over again. This makes the job boring and repetitive, and the turnover rate for such jobs is incredibly high. Toyota, however, does something different. Toyota values the welfare of its employees and focuses on teamwork and personal respect to ensure the happiness of its employees. For instance, Toyota employees are part of a community, one in which they receive lifetime employment.

Additionally, Toyota has adopted seniority-based wages, meaning a forty-year-old worker doing a given job received much higher pay than a twenty-five-year-old doing the same job; however, if that forty-year-old quit and went to another employer, he would start with a zero seniority wage that was below that of even the twenty-five-year-old. Of course, this meant that Toyota needs to get the most out of its human resources over a forty-year period - that is, from the time new workers enter the company (usually around 18-22-years-old) until the time they reach retirement age. Therefore, it only makes sense that Toyota works to continuously enhance the workers' skills through yearly training and seminars to fully benefit from their knowledge and experience.

Furthermore, assembly-line employees are typically trained on a single task they perform day-in and day-out. Toyota, however, doesn't quite follow this system. In a lean plant, such as Takaoka, all information such as daily production targets, cars produced so far that day, personnel shortages, overtime requirements, and more are displayed on electronic boards that each employee can see. Therefore, any time something goes wrong anywhere in the plant, any employee who knows how to help can run and lend a hand.

Ultimately, the plant works as a team, which means that workers need to be taught a wide variety of skills so that tasks can be rotated and workers can

fill in for one another. Workers then need to acquire many additional skills, such as simple machine repair, quality-checking, housekeeping, and materials-ordering. This system allows Toyota employees to take on more responsibility; furthermore, employees are placed in teams that are led by a team leader that oversees part of the production line. The job of the leader isn't to just bark orders at the team members; instead, the leader facilitates the team in finding more effective ways to complete tasks. So when a team comes up with a way to improve a specific process, it can share its ideas with company engineers.

Lean Production Gets to the Root of Its Problems and is Prepared for Market Changes

In the lean-production process, workers are constantly keeping an eye out for problems. Instead of waiting until the very end of the assembly line to fix mistakes, the lean production system encourages workers, not just managers, to raise the red flag on defective parts so they can quickly investigate and get to the root of the problem. When a mistake is identified, the team will analyze it to prevent the error from happening again - a process guided by The 5 Whys.

For example, if a wheel is loose, an employee would first ask, "*Why is it loose?*" Upon further inspection, he might find that a bolt is missing and ask, "*Why is this bolt missing?*" Perhaps the assembly team didn't receive the correct number of bolts, which would lead him to ask, "*Why weren't they supplied with the correct supplies?*" The answer may be that the wrong supplies were ordered, which would lead to the question, "*Why did that happen?*" Ultimately, asking "why" leads the team to the root cause of the problem, allowing them to solve it quickly and efficiently.

Asking "*why*" ensures the final product is of sound quality and makes the overall production more efficient in the long run. When a mistake is quickly eliminated, the mistake will be less likely to occur again in the future. As a result, there is almost no rework area at all and Toyota's cars have fewer defects than any other car in the world. Not only has asking "why" led to fewer defects, but Toyota also utilizes the kanban delivery system to avoid needing space for inventory. For instance, Toyota doesn't keep a warehouse full of seats; instead, the plant contacts a supplier five hours before a car is ready for its seats.

With little waste and inventory, Toyota has a plan in place in case a natural disaster or a labor strike affects its suppliers. As mentioned in the previous

chapter, Toyota ensures its assembly plants are flexible by training team leaders in more than one area so they can cover for absent workers. Additionally, the company designs each plant to serve more than one market. Therefore, if the market demand drastically changes, many plants can mobilize to fulfill those demands. Ultimately, Toyota is prepared for the many potential threats to its supply chain and is developing effective strategies for addressing the many problems that could arise.

Final Summary

The automobile industry was first revolutionized by Henry Ford with his invention of the assembly line. While the assembly line allowed for mass production and cheaper cars, the overall system had many flaws that couldn't be ignored by the Japanese labor market. Because mass-production systems weren't suited for Japan, Toyota developed its own system to rival Ford's innovation. Toyota created the lean production system, which proved to be so effective that it spread to various industries all over the world. Today, lean production is the reason Toyota still maintains its reputation of creating reliable, safe cars and continues to be the leader in the global automobile market.



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