

# Past and Future Impact of Lean Manufacturing

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## Abstract

This research shows how lean manufacturing was first created during the 20th century, how its implementation and techniques impacted supply chain management on a global level, and how the global pandemic of 2020 impacted lean manufacturing. The history of the Toyota Production System has shaped what we now know as lean manufacturing. Their almost century long expertise in the area has been the guide for many global companies. The descriptions and strategies of TPS are analyzed to determine how lean manufacturing will evolve in the coming years based both on the history and the effect of the recent pandemic. Some lean companies have recently experienced failures surrounding lean manufacturing because of the COVID-19 pandemic. These failures have turned some of these companies away from lean manufacturing and back toward traditional manufacturing. Traditional manufacturing offers safety and less risk for the company in the short term but does not provide the company the ability to have long term growth. On the other hand, lean manufacturing has played a vital role in keeping the manufacturing of companies up to date so they can stay on pace with their evolving and demanding customers. Therefore, it is crucial for lean manufacturing to continue to be implemented, even if its implementation is done slowly and more cautious than before, and used despite its recent shortcomings during the COVID-19 pandemic

## What is Lean Manufacturing

Lean manufacturing is combining the philosophy of continuous improvement to supply chain management. Lean is a very broad term that looks to encompass a broad approach of maximizing the value of the products produced while minimizing the waste. The key that separates lean from many other manufacturing techniques is the central focus on reducing waste. To reduce waste, lean company's commitment themselves to optimizing time, resources, and productivity. They do all this while still striving to create a top tier product for their customers. Another part of lean thinking is that the quality of the product should never be hindered but only helped during optimization. If lean manufacturing is done correctly then the quality should increase on its own as waste is eliminated. Lean systems are systematic production methods. Complete working lean systems are tedious to create and even harder to keep operational. They take years to be implemented and require continuous work and effort long after they are "done". The best lean companies strive to make their system better each day by focusing either on the waste or the quality side or of the equation. Lean principles are simple in concept but hard to implement.

The main principle of lean is deciding between Value Added vs Non-Value-Added tasks. A company must obviously eliminate unnecessary tasks as this can add waste and hinder needed tasks. Eliminating these unwanted tasks are accomplished with a variety of lean implementation techniques.

- Value Stream Mapping** is a step-by-step diagram of the total manufacturing process that attempts to breakdown each part into simple steps that can be used to find waste.
- Cellular Manufacturing** attempts to group steps and processes together to cut wasted steps of moving product around.
- Kanban/just in time manufacturing** is where each step finishes just as it is needed for the next task so no storage or pile up waste is created.
  - Kanban uses **Takt time** which refers to the amount of time between when things need to be produced to create products when customers need them. As demand increases, Takt time goes down and vice versa. This calculation is a critical to piece to lean manufacturing because lean companies to not have storage to store access unbought goods or a stockpile to meet unexpected customer needs.
- Poka-Yoke** relies on error-proofing the manufacturing line.
  - Unlike traditional manufacturing when an error might go unnoticed until the final quality check, Poka-Yoke looks to have catch systems that trigger workers of errors on the spot.
- Jidoka** is where machines automatically stop working upon detecting an abnormal condition and operators try fixing the defect to prevent recurrence of the issue
- Heijunka** is reducing the unevenness in a production process and minimizing the chance of overburden.

There are many other lean concepts and implementation strategies such as standardized work, line balancing, quick changeover, and pull system. These all attempt to improve productivity and quality in a way that eliminates unwanted waste. Many successful companies attempt to implement a couple of lean strategies at a time to not totally shock their current system. Creating a reliable lean system is difficult but has become critical in today's manufacturing world.

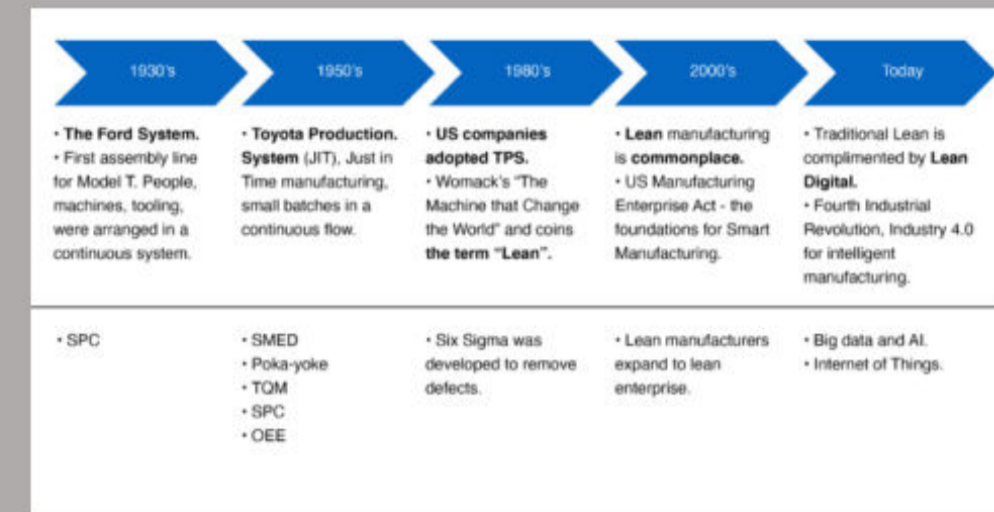
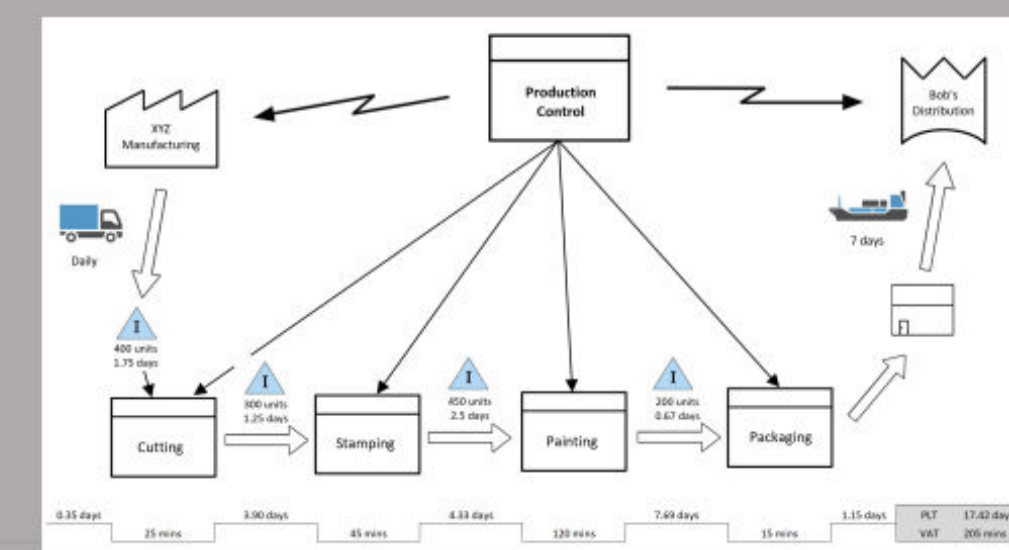
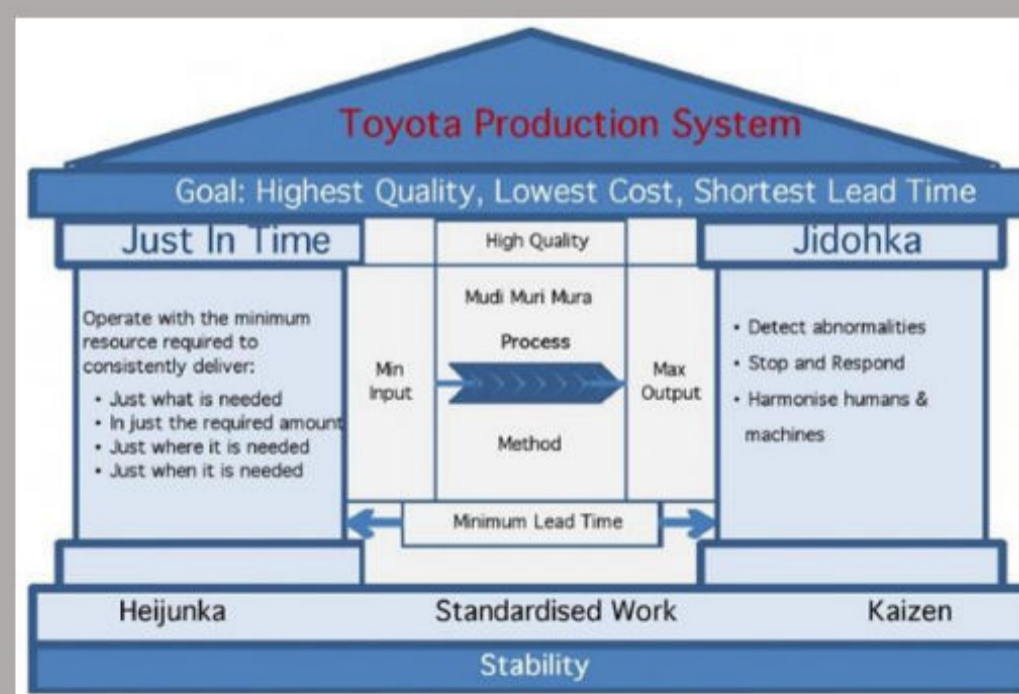
## Creation of Lean Manufacturing

Lean manufacturing is key for businesses in today's ever-changing society. Lean manufacturing was a response to the rapidly changing and newly highly competitive markets that 19th century technological advancements brought. Lean manufacturing was derived and created Toyota. The owners of Toyota, the Toyoda family created the Toyota Production System which was the foundation and glue of the modern lean system. The creation of Toyota's Production system was a 90-year process that relied on the determination and specific need of the Toyota family.

The Toyoda family was eager to take their automotive company to the level of the Ford Motor Company in the United States. In America, Ford and other large manufactures in and outside the automobile industry were doing mass manufacturing. But the Toyoda family lacked the money and resources to evenly match the mass manufacturing system. Therefore, they needed to think differently. Having studied the American automotive industry, the Toyoda family tried to adapt the foreign mass production techniques to their own smaller techniques. They needed to eliminate unnecessary steps and workers from the mass manufacturing method in order to make their small size capable of competing. They also relied on creating smaller groups that created products just as they were needed for the next step as they could not afford to have stockpiles of unused material like many large American automotive plants. By using the "Just in Time" method Toyota got rid storing a ton of inventory, a common trait in mass manufacturing. This new Toyota Production of continuously improvement (**Kaizen**) by eliminating waste and using just in time techniques quickly gave the Toyoda family the tools to compete with the top automobile manufacturers in the world.

Over the years the Toyoda family studied the American automotive industry closely but looked into ways to improve their Toyota Production System. They were always eager to find ways to improve it and create a more productive manufacturing system then their American counterparts while also creating a better-quality product. At just half the size of General Motors and two-thirds the size of Ford, Toyoda's adaption and creation of lean manufacturing allowed it to overtake its American counterparts.

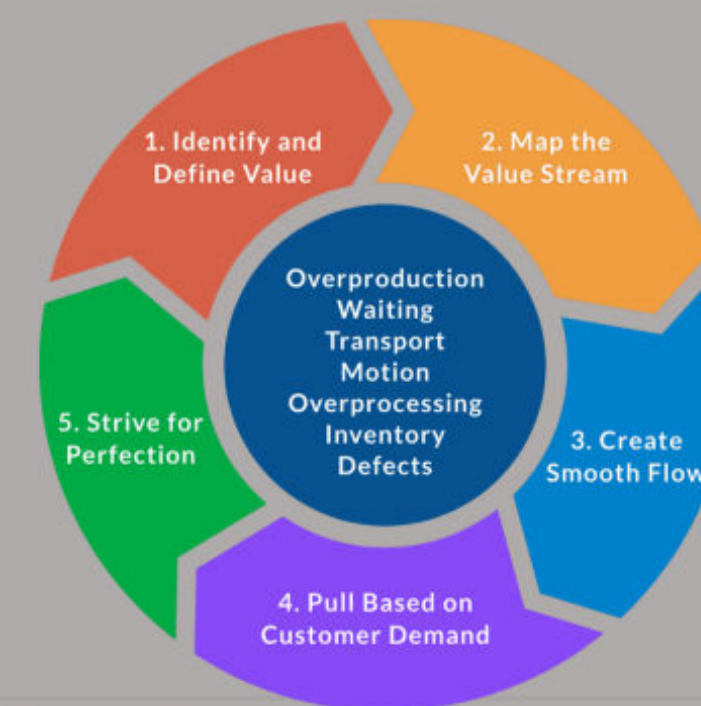
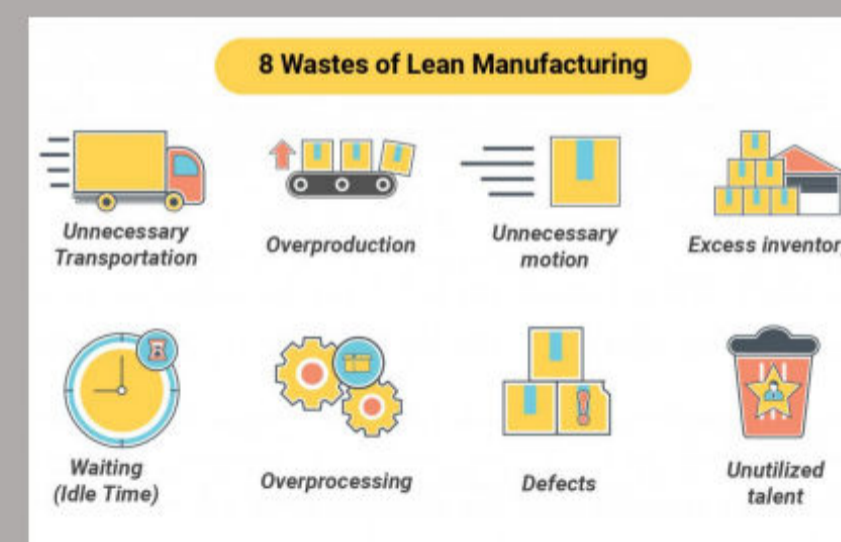
For much of the 1900s lean manufacturing and the Toyota Production System did not reach mainstream manufacturers. Instead, it was thought of as a certain kind of specialized manufacturing that was not needed for many mainstream companies that were already successful. But in the 1980s lean thinking began to gain a following around the world as more people and businesses began to understand that this "specialized" manufacturing could help their company save money from waste and make money from a better and faster product. In 1988, the term "lean manufacturing" was created by a former Toyota quality engineer and since been used to reference the Toyota Production System.



## Implementation of Lean Manufacturing

Although many companies have had a lot of success implementing lean strategies into their manufacturing, some companies have come up short. According Toyota, Lean manufacturing requires complete buy in from all levels in a company from the top-level management to the front-line workers in order to work. Lean is more of a culture that requires buy in then a script to follow. The concepts of Lean need to not only be known but understood by the actual workers so they understand and value the reason behind lean. In order to start becoming lean you must look to get rid of the 8 main wastes. You can do this by implementing the lean strategies mentioned.

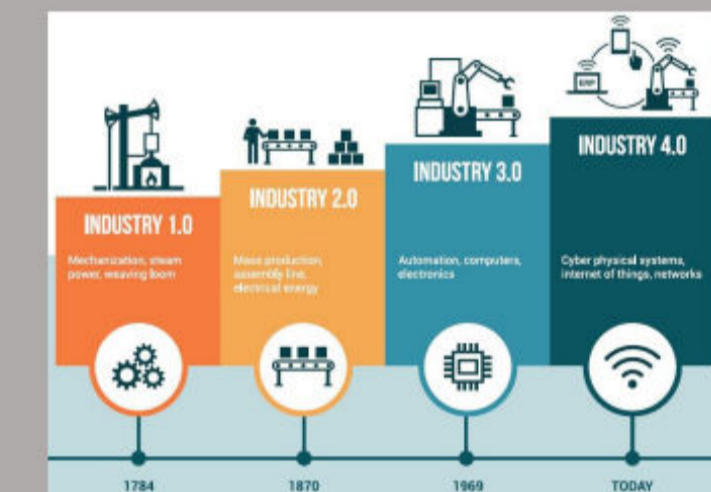
At first a lot of lean strategies are tedious and frustrating. They require a great deal of time and effort and without proper buy in this can create a toxic working environment. The results of this could plummet the company instead of raise it. Hence a lot of companies that fail in lean manufacturing lack buy in and 100% effort. They might have the proper buy in from upper and mid-level management but lack to reach down to their front-line workers. Even this scenario could make implementing lean impossible. Lean principles aim to make workflow simpler for all workers but like everything that provides great value, optimizing lean manufacturing only comes with patience and time.



## COVID-19 Impact and the Future of Lean Manufacturing

2020 brought a new problem for lean manufacturing for new and well-established lean companies. In 2020, COVID-19 hit the world on a global level. This pandemic not only affected individuals it also impacted companies. A lot of companies were faced with new obstacles and problems they had never encountered before. With an already widespread use of lean manufacturing by 2020 many problems companies faced in their supply chains had to do with lean principles and elements. Lean manufacturing heavily relies on great forecasting and error-proofing to achieve its intended goal. Even the best lean manufacturers often have little room for error to maintain their standards. When the pandemic hit the forecasts were disrupted at an all-time level. The takt time for the manufacturing was highly inaccurate causing companies to produce much to little or too much of certain products. The companies that weren't producing enough did not have enough safety stock to cover the deficit and the companies that were producing too much did not have the storage space to store all the surplus of goods. This created a lot of loss for both types of companies. Usually with good forecasts lean principles try to eliminate the need to account for major surpluses and deficits so many lean companies did not have to "waste" money on this. Now many companies are reverting to having safety stock or areas to storage extra goods. They are worried that the cost of another major hit will be more then the cost of these extra safety measures. The problem is these cushions are creating wasteful manufactures. Manufactures now know they have wiggle room again. This is not the option and will not help these companies long term.

Real-time/transparency in data is the key driver for lean companies to be successful in the post-COVID-19 world. Lean companies need to be able to continually monitor whether their production goals are being met and to do so, they must be able to visibly see the demand and supply chain in real-time by exploring available raw materials or any other available data related to the production through sophisticated technology that would allow this type of practice to be carried out. Lean manufacturing companies must adjust after what we learned through COVID-19. Companies that are slow to react will find themselves at the short end of the straw while those that invest in new technology will have the ability to create more transparency and real-time visibility to thrive during the next crisis.



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