

Lean manufacturing: the machine that changed the world

The machine that changed the world (1990)

STELLANTIS



Politecnico
di Torino

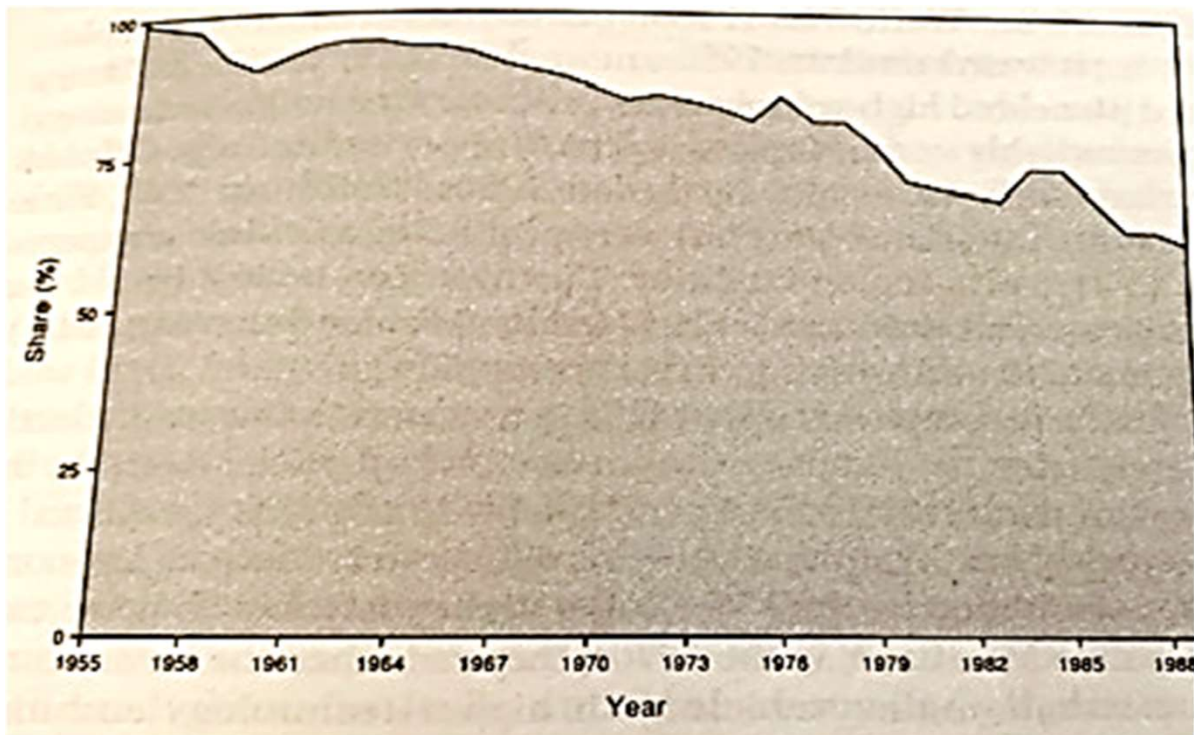
- It is the title of an iconic book, issued in 1990 by Womack, Jones and Ross, that told all the world that the Japanese Automotive industry was eclipsing the Western one based on outstanding results.
- This book was not the best or the most detailed but had the merit to be not a technical one so not read by only the specialist of the sector.
- The three authors were originally researched of MIT and mainly focused the attention to the comparison between Japan and US industries. This is one of the analysis weak points: Europe is not considered or in case with a negative imagine. And confuse US and Europe as a one single entity is also imprecise.
- The book starts with the description of the handcraft period of car building and soon arrives to Ford.
- The first step that Ford faced was the interchangeability of the part in order to allow the independent production of the components.
- The rest of the story is known: the introduction, according to Taylor's principles, of interchangeable workers whose work is arranged by a skilled engineer.

The rise and fall of mass production

- If Henry Ford had a single vision, mono-product approach to the production, not the same was the case of other competitors. E.g., **Alfred Sloan** gave to GM a different evolution.
- Ford aimed to high verticalization, self-banking.
- Sloan understood the importance of synergetic support of specific competences and created some satellite companies dedicated to steering gears (Saginaw), generator (Delco), carburetors (Rochester). Further joined a bank to have the necessary capital and financial services. Finally split the business in different brands dedicated each in a specific sector, from low to high, from Chevrolet to Cadillac.
- **The mass production system was absolutely not primitive** and, having high profits, contributed to increase the welfare of the workers.
- Manufacturing engineers studied the most productive machines improving at the same time the quality. Industrial engineers was analyzing every day the assembly operations to improve **even a second in the activities**.
- Notwithstanding, there was a tipping point after which (1955 in America) the matter started to change and the mass production model start his decline.

The trauma of US automotive market

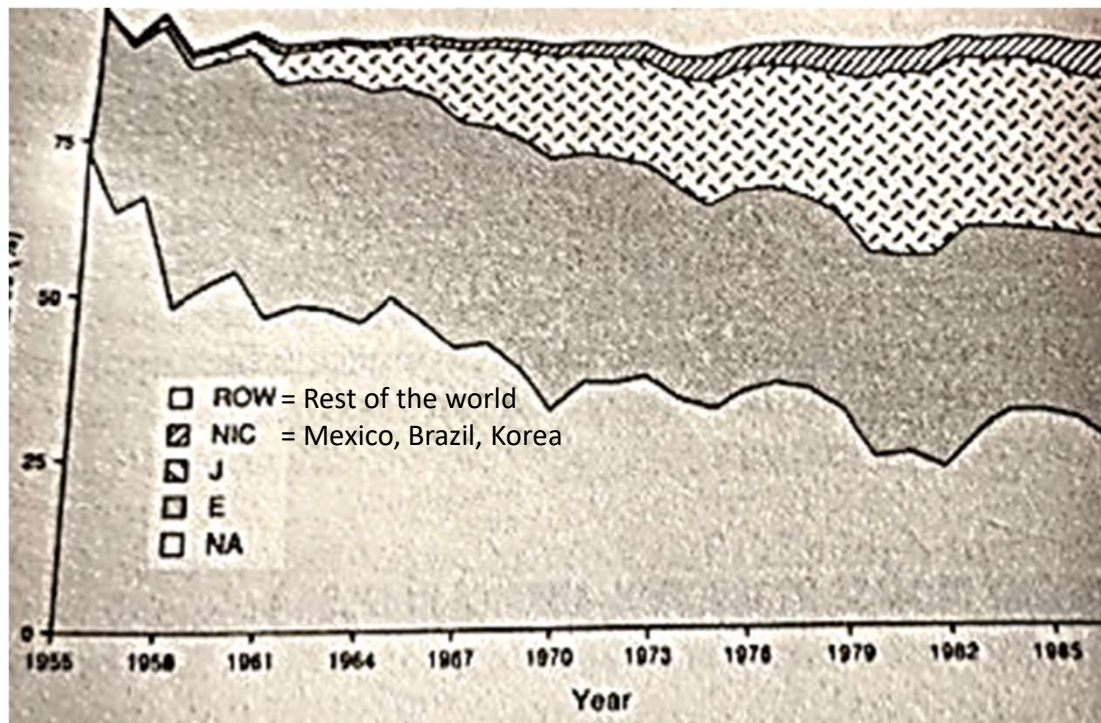
Share of the American Market held by American owned Companies 1955-1988



- For the generation that lived the youth in the post war period the decrease of American car share was a trauma.
- Even if less perceived by the 1980 youngsters, at the issue of the book it was clear that there was a problem in the US.
- Notwithstanding, in the 90's a lot of European still was looking at the American innovation as reference

Who replaced the American car makers?

Share of the world car production by region 1955-1988



- It is clear looking at the picture that in the period Europe had slow growing trend and, because of different products, did not impact the American market.
- European car makers since 1930 had studied the Ford system and, if not hindered by the II world war, VW Wolfsburg and Fiat Mirafiori had risen before.
- These as others in Europe, were modeled completely to Ford Rouge Complex in Detroit and got the sundown between 60's and 70's.
- Differently, Japan growth **hit directly North America.**

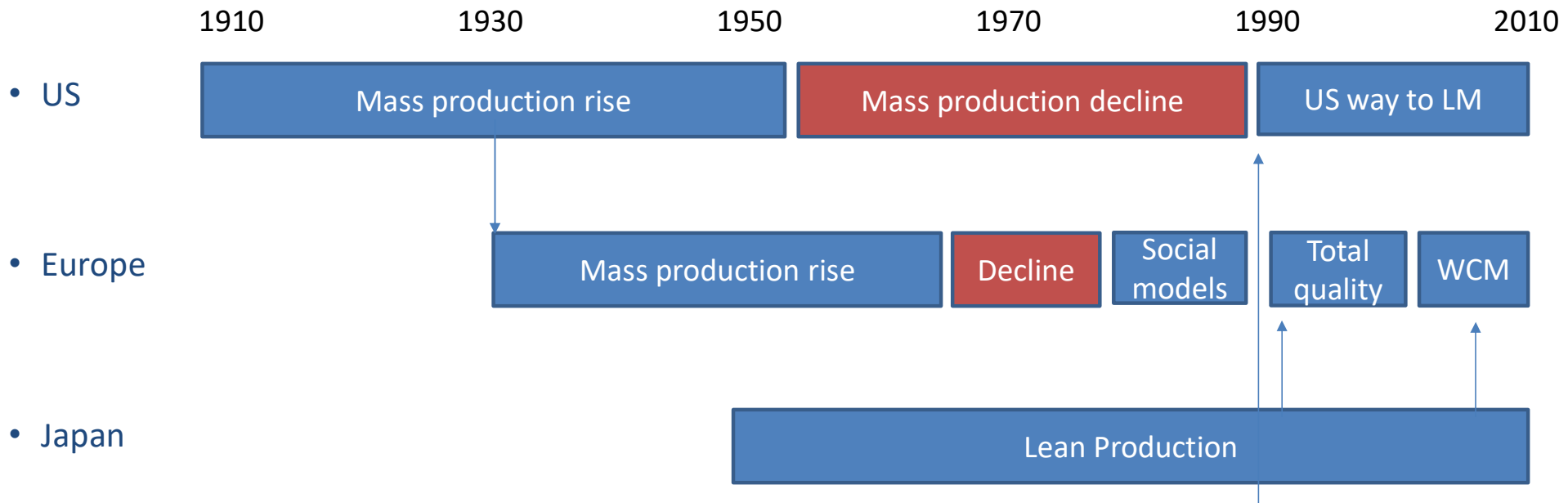
The rise of lean production

- The Lean Production is a term defined to synthesize the Toyota Productive System that gradually was diffused in all Japan, becoming synonymous of Japanese production system.
- The origin of the system required of course several years but the start can be imagined when, after the war, Toyoda has a deep crisis and was forced to fire most of the workers. Was followed strikes and fight between Unions and the Company. The end was given by an agreement that included:
 - Resignation of Kiichiro Toyoda that assumed the responsibility of the failure.
 - Reduction of one quarter of the number of workers
 - The remaining workers got lifetime employment, salary's increase based on the seniority in the Company rather than the specific job and finally some benefit tied to Company's profitability.
 - Most of all, the employees did enter inside the Toyota community with a wide set of rights.
- This fact created in 1950 a relationship employer/employee **unimaginable** in any other part of the world.

One minute for the die change

- Supported by affiliates workers, protected by duties tha hinder othe competitor to sell in Japan, the Company was able to grow with an ideal system based on the improvement requested by **Eiji Toyoda**, nephew of Kiichiro, did during his period of visit of Ford plants.
- The limited resources combined to his observation of the waste (*muda*) of Fordism, pushed the main industrial engineer **Taiichi Ohno** to define new solutions.
- The first problem, that was almost an obsession, was how to deal with the Stamping process.
- The mass production's standards got a low-price level guaranteed by huge presses able to produce a huge number of parts with a long die change and a sophisticated process of setup.
- A rising company was not able to have the large volumes that supported the high investment.
- The problem was formulated by Toyota as: **“to find a way to produce small batches in one single press minimizing the changeover”**. Working hard on this objective they reduced the die change, that was measured normally in three days in Ford, to three minutes.
- The system was then universally named “single minute exchange die” or in acronym SMED.

Synoptic



It is interesting to observe that the Lean production model faced not the mass production model at his top but in its decline in US . In Europe there were less impact by competition, as said, and the culture comparison was between Lean manufacturing and the European Social model.

Ideas behind the Japanese Automotive development: quality and efficiency



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- We have seen as the **Employer/employees' agreement** and the **Batch reduction** were a base for the development of Toyota. The other Japanese industries, more or less, followed the same path to grow.
- Another important idea is that to support the batch reduction is necessary **to increase the efficiency and the quality**. The losses caused by these two factors have an impact that is mitigated by the work in progress, so, reducing it, it **becomes paramount to get the max regularity in the process even slowing down or plan to a lower saturation..**
- The focused strategy to improve both was for the initial period considered two separate policies, Total Quality and TPM, that were analyzed and applied in the western companies as tools rather than organic components of a same system.
- They were the natural consequence of the transformation of the workers from poor executors in the mass production to **responsible actors of the production in terms of efficiency and quality**. They gradually oversaw quality, cleanness and simple maintenance.
- So, while in all the rest of the world there was a supervisor to overview the result with dedicated resources to control quality, to the maintenance and to technical cleaning in Toyota all these activities were done by the same people, workers driven by a **team expert, even blue collar**.

Ideas behind the Japanese Automotive development: supply chain

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- Based on the positive experience with the employees the next step was to implement a similar **relationship with the main suppliers**, through participation in the share or acting as a bank to finance their investment, requiring as counterpart and independent product development and reliability growth.
- This long-term relationship allowed to the supplier to plan a global improvement involving gradually in a virtuous loop also the second level supplier.
- This allowed at the same time **to reduce suppliers' stocks** as well as the work in progress.
- A final consideration of capital importance is that these improvements happened during a “peaceful business period” supported by national duties and by a society growing from a basic welfare.
- **The outstanding result is that no one exploited the period to get personal advantages but they worked hard to be ready to the global competition starting the exports.**

Logistics

- The reduction of batches and work in progress determined a **central importance of the logistics**: either as inbound or internal logistic including the line feeding.
- The system risen from this principle was called **Just in time** in order to emphasize the fact that there were not anymore stocks of material waiting for the right moment but everything was synchronized in a perfect organization.
- A misinterpretation that Western industries did sometimes is to confuse the JIT, that was the result of the above-mentioned actions called also **Total Quality** like workers loyalty, supplier reliability, mixed production, perfection in quality and efficiency, as the initial objective to pursue with a disaster in the results. Hoping that reducing suddenly the stocks all the rest would have followed was a simple mistake. Indeed, **JIT and Total quality are completely embedded**.
- The European Plants were put in the dramatic condition to improve simultaneously quality, supplier reliability, efficiency without any social agreement and skill. Everything in a short time since they were under the stress of a highly competitive market and no regional duty protection.
- But another mistake was done by Western companies : consider the Japanese approach as a pure Manufacturing system limiting the involvement of other functions.

Designing a car in a Lean Company

- One of the point completely neglected in the Toyota story-telling, even if mentioned in the book “The machine...”, is that the Toyota Production system wasn’t only based on process concepts. In the reality, Manufacturing had to drive the full company from Purchasing to Product Development.
- The **Design for Manufacturing** that in Toyota was essentially based on the production standard was never considered in Western industries and even object of fun like synonymous of “to produce what is easy to produce and not what the customer want”. This was a global blindness that started to be clear in Europe only in the recent years.
- The **Teamwork in Platform** was one of the first concept imported in US from Japan but years were necessary before becoming effective at the beginning of 2000. The problem was the functional priorities that limited the effect of the cross functional team. Initially it seemed a problem of skill, imagining the Japanese Program Manager as a Renaissance man, expert of all. The reality was again the loyalty of the Japanese environment. In other words, team spirit rather than individualism. Not easy to build in a Company that lives inside a local culture different form Japanese one.
- The second point, as said, was that the platform in western industries were always driven by product that considered of secondary importance the process needs, putting at risk the whole Company since **a lean manufacturing without a lean product became extremely fragile**.

Kaizen

- The guidelines of Lean Manufacturing has been introduced, maybe not all.
- Once the ideas behind have been explained it is time to go through the practice of Toyota production system:
 - Batch reduction
 - Total quality control
 - Machinery simplification
 - Production management: mixed model
 - JIT: pull system and Kanban
- Further we will analyze an organic lean manufacturing methodology, World Class Manufacturing (WCM).
- As an introduction to the following lesson let me introduce the main principle of Lean Manufacturing:

Nothing can be done suddenly as per magic: the perfection is obtained through a continuous improvement (kaizen) and there is no kaizen without a standard.