

# Fundamentos de Lean



Universidade do Minho

**Dinis  
Carvalho**

**Bases  
Lean**



1850

American  
Civil War

Eli Whitney  
Interchangeable Parts



Whitney

Frederick Taylor  
Standardized Work  
Time Study & Work Standards  
Worker/Management Dichotomy



Taylor

1900

Great War

Henry Ford  
Assembly Lines  
Flow Lines  
Manufacturing Strategy



Ford

WWII

1950

Eiji Toyoda, Taiichi Ono  
Toyota Production System  
Just-In-Time  
Stockless Production  
World Class Manufacturing



Ohno



Shingo

***“One of the most noteworthy accomplishments in keeping the price of products low is the gradual shortening of the production cycle. The longer an article is in the process of manufacture and the more it is moved about, the greater is its ultimate cost.”***

Quem disse isto?

Quando é que foi dito?



Henry Ford

Em 1926



# História do TPS

Taiichi Ohno



Shigeo Shingo

# Os dois conceitos básicos do TPS



## International Journal of Production Research

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Toyota production system and Kanban system  
Materialization of just-in-time and respect-for-human system

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# Os dois conceitos básicos do TPS

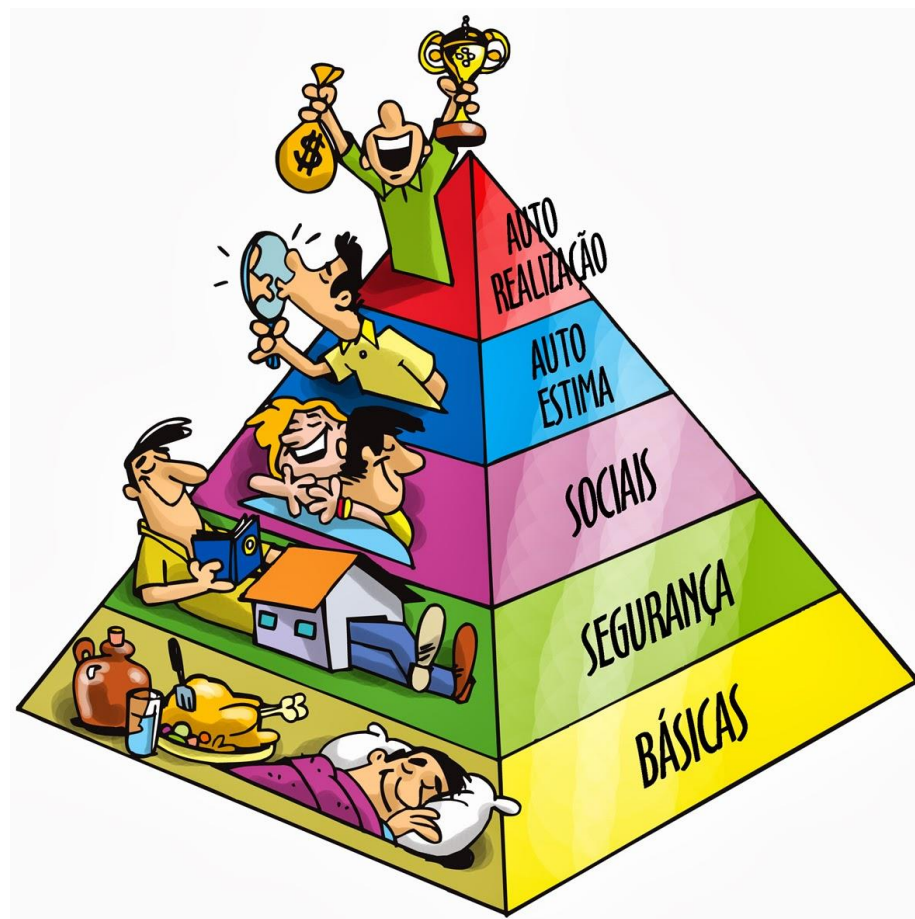
## **Toyota production system and its basic concept**

Upon recognition of the matters related above, Toyota is planning and running its production system on the following two basic concepts.

First of all, the thing that corresponds to the first recognition of putting forth all efforts to attain low cost production is “**reduction of cost through elimination of waste**”. This involves making up a system that will thoroughly eliminate waste by assuming that anything other than the minimum amount of equipment, materials, parts, and workers (working time) which are absolutely essential to production are merely surplus that only raises the cost.

The thing that corresponds to the second recognition of Japanese diligence, high degree of ability, and favoured labour environment is “**to make full use of the workers' capabilities**”. In short, **treat the workers as human beings and with consideration.** Build up a system that will allow the workers to display their full capabilities by themselves.

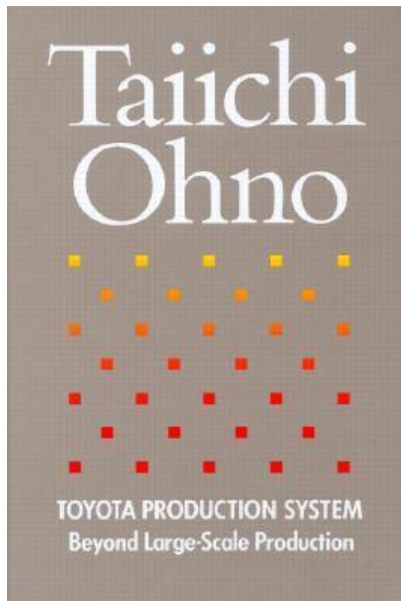
# Pirâmide de Maslow





# Desperdícios

Jogo das canetas



### ► Just-In-Time

The basis of the Toyota production system is the absolute elimination of waste. The two pillars needed to support the system are:

- *just-in-time*
- *autonomation*, or automation with a human touch.

Just-in-time means that, in a flow process, the right parts needed in assembly reach the assembly line at the time they are needed and only in the amount needed. A company establishing this flow throughout can approach zero inventory.

From the standpoint of production management, this is an ideal state. However, with a product made of thousands of parts, like the automobile, the number of processes involved is enormous. Obviously, it is extremely difficult to apply just-in-time to the production plan of every process in an orderly way.

An upset in prediction, a mistake in the paperwork, defective products and rework, trouble with the equipment, absenteeism — the problems are countless. A problem early in the

**CUSTOMER SATISFACTION  
BUSINESS SUCCESS**

**JIT**

Pull  
Flow.  
Takt Time  
Heijunka  
Cell Design  
SMED

**Respect for People**

Team Building  
Empowerment  
Cross Training  
Hoshin  
Supplier Relationships

**JIDOKA**

Poka-yoke  
Andon  
Autonomation  
5 Whys  
Line Stops  
Built in Quality

**STABILITY and STANDARDIZATION**

5S  
TPM

Standard Operations  
Kaizen

# Os 3 inimigos do Lean Muda, Mura e Muri

**MUDA**  
Wastefulness



**MURA**  
Imbalance

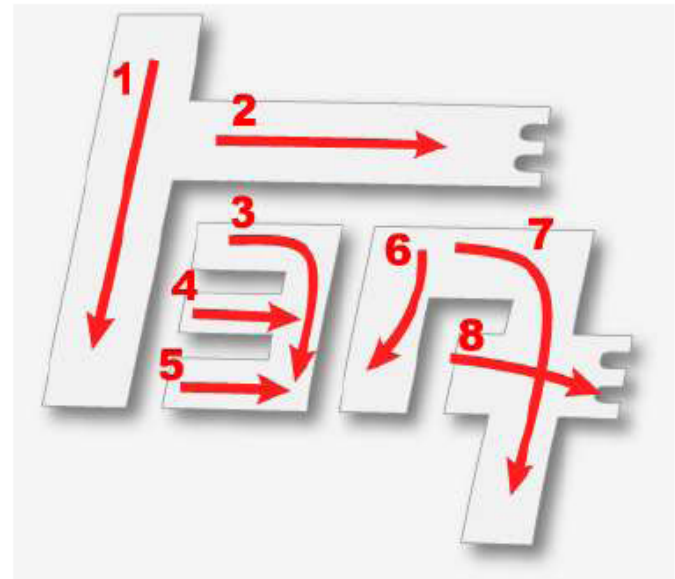


**MURI**  
Overload



### 3. Kaizen Mind

15) *“Being content with one’s current situation could be the first step towards corruption.”* (words of Mr. Eiji Toyota)

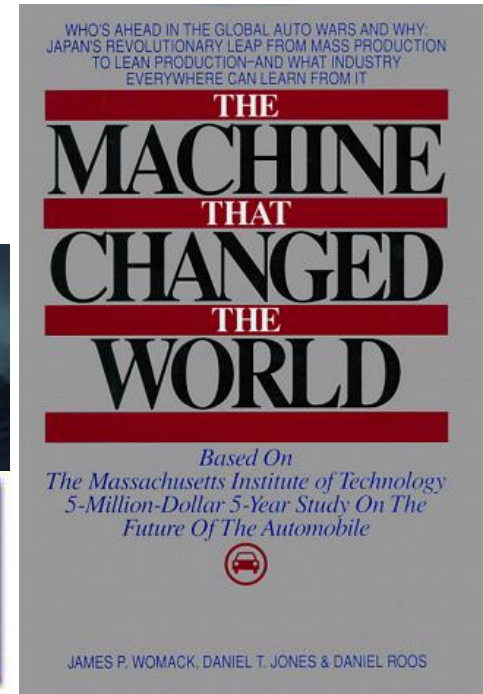


Why did they switch  
from **TOYO-DA** to **TOYO-TA**???



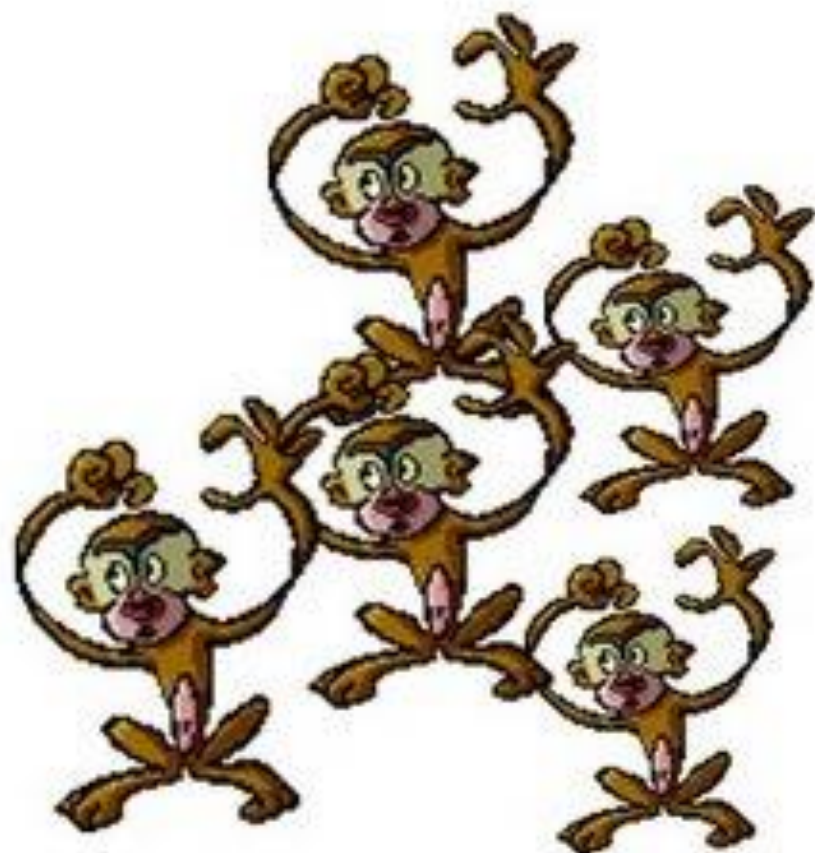
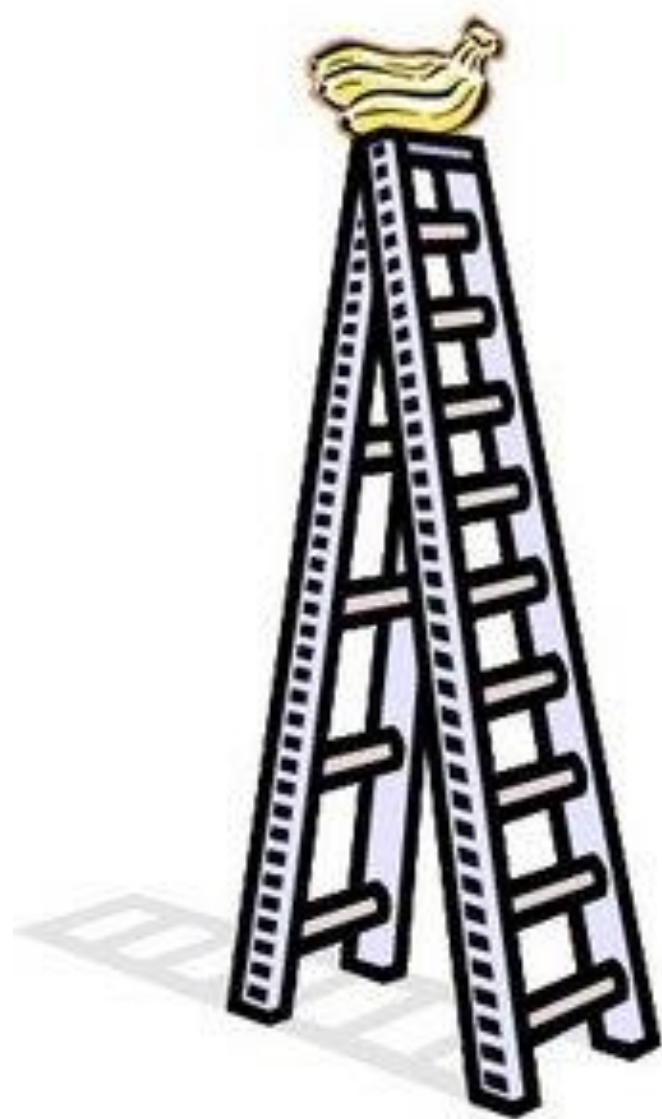
# The machine that changed the world

- James P. Womack
  - Daniel T. Jones
  - Daniel Ross
- 
- Pesquisa no MIT
  - 5 Milhões de Dólares
  - 5 Anos de Estudo (1985-1990)
  - Em torno de 200 Pesquisadores
  - Cunharam o termo ocidental **“Lean Production”**



Paradigma





# Paralisia de Paradigma

$$4\ 4\ 5\ +\ 5\ =\ 450$$

Tire ou coloque apenas um traço para que a equação fique correta.

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