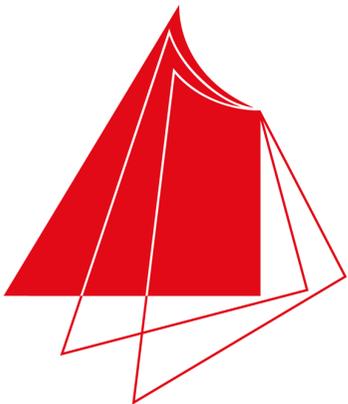


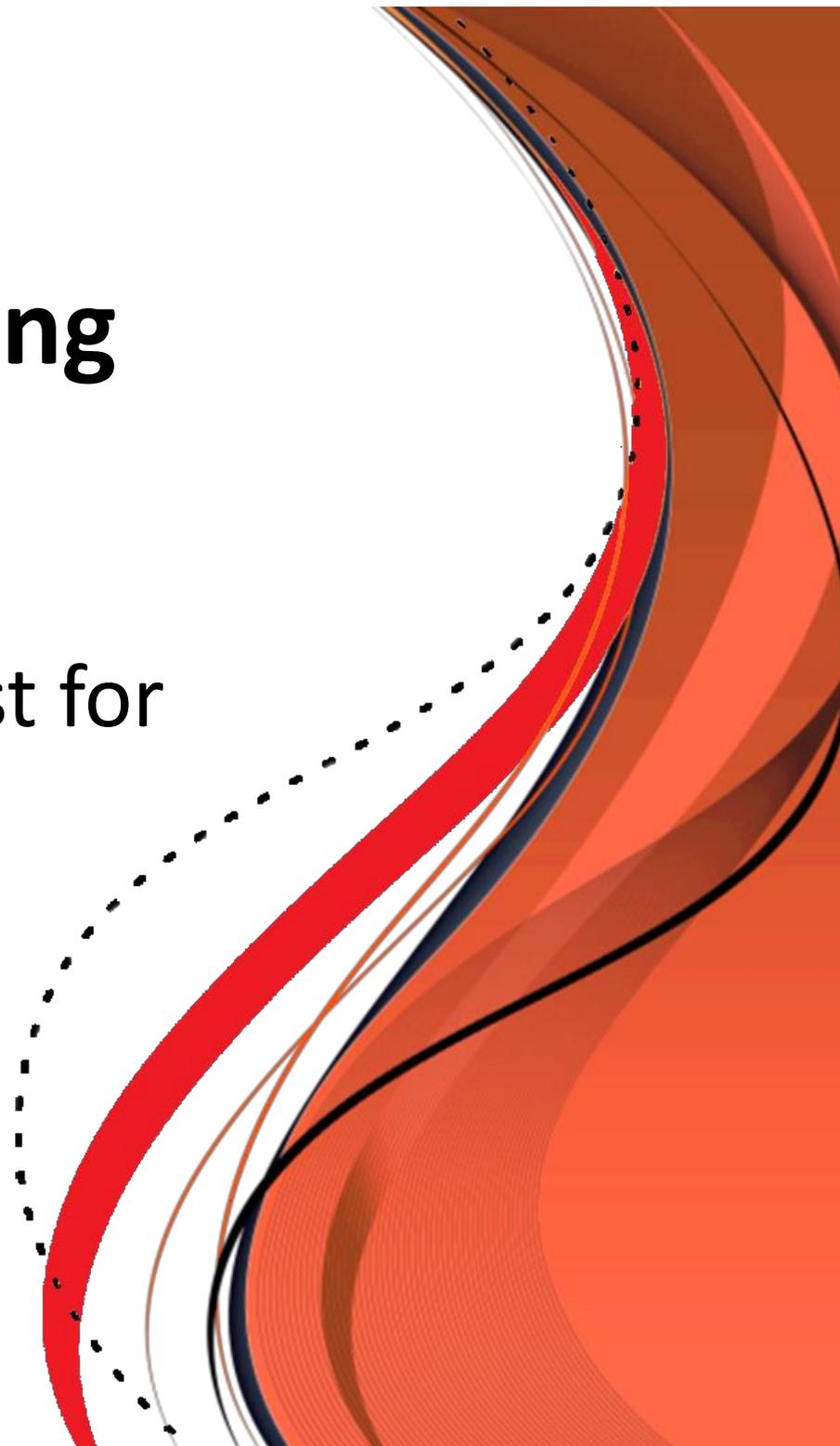
History of Manufacturing

Lessons learned from the Past for
the Future of Manufacturing

Prof. Dr. Christoph Roser



Hochschule Karlsruhe
Technik und Wirtschaft
UNIVERSITY OF APPLIED SCIENCES

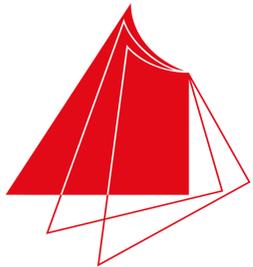




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AllAboutLean.com



"Faster, Better,
Cheaper" in the
History of Manufacturing
From the Stone Age to Lean
Manufacturing and Beyond

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The Six Manufacturing Techniques

Cutting

2.600.000 BC



Changing Material Properties

120.000 BC



Joining

72.000 BC



Coating

30.000 BC



Molding

25.000 BC



Forming

8.700 BC

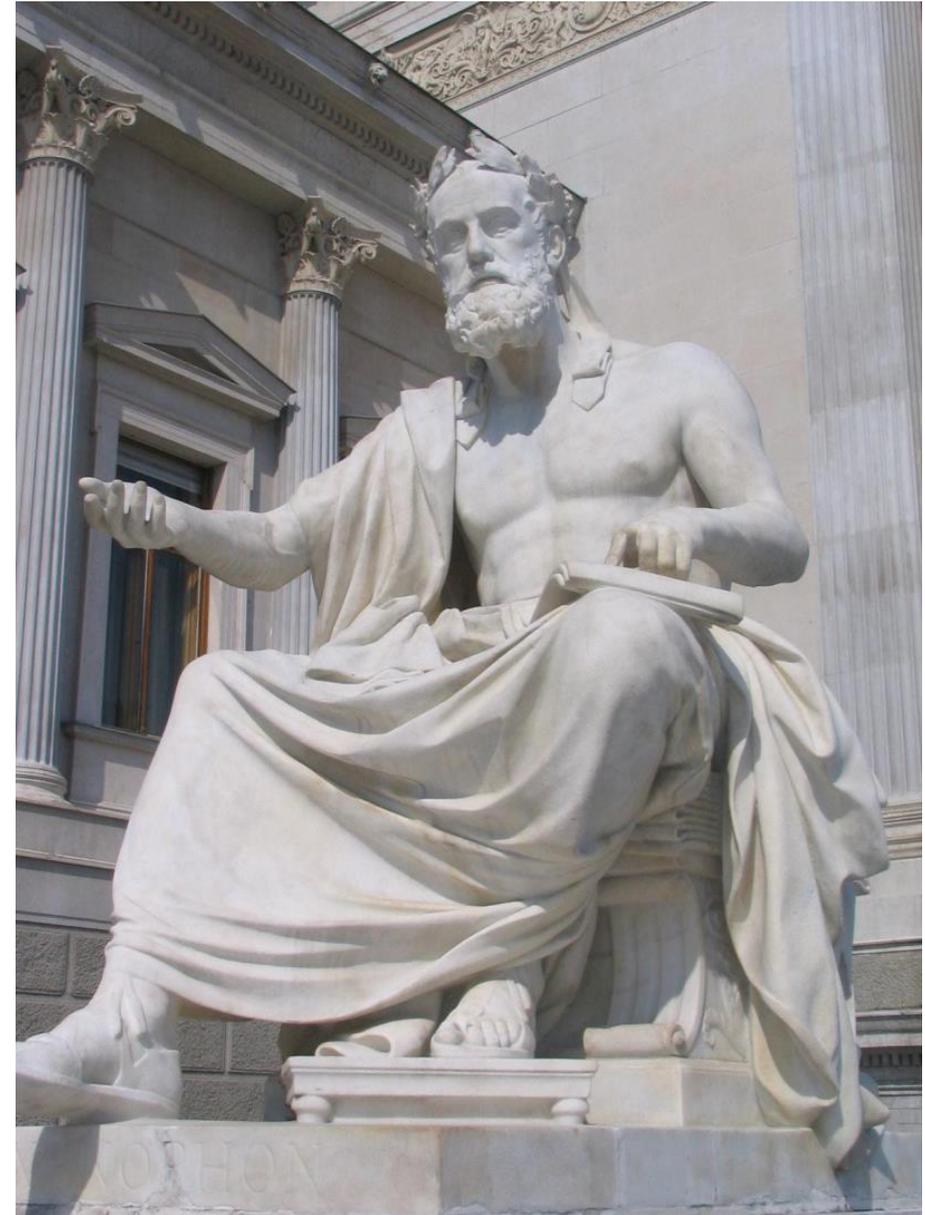


Division of Labor in Ancient Times

In a small city the same man has to build beds, chairs, ploughs and tables and often even to build houses. [...]

But in the big cities [an artisan will get] his living merely by stitching shoes, another by cutting them out, a third by shaping the upper leathers, and a fourth will do nothing but fit the parts together.

Xenophon (ca. 430 – 354 BC)



Mechanization and Energy Sources

Egyptian Potter's Wheel



Egyptian Lathe



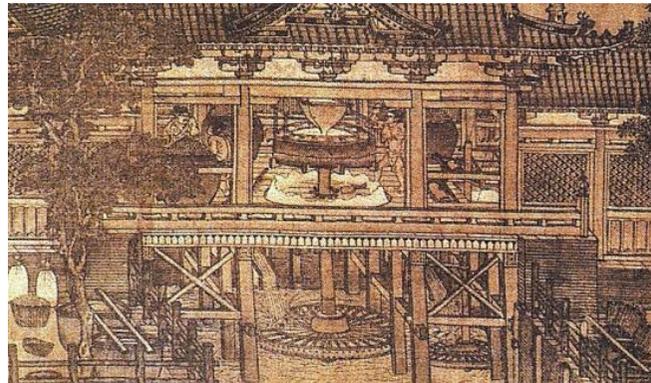
Roman Flour Mill



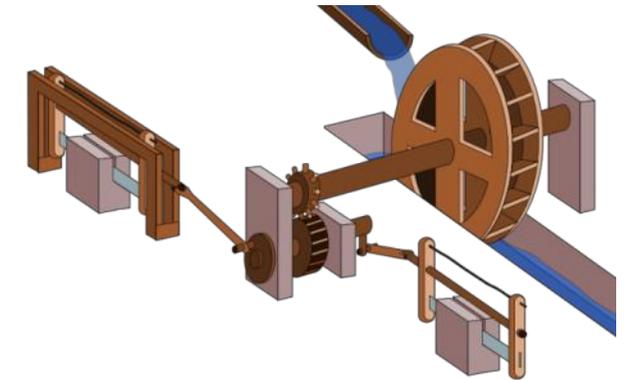
Persian Windmill



Chinese Watermill



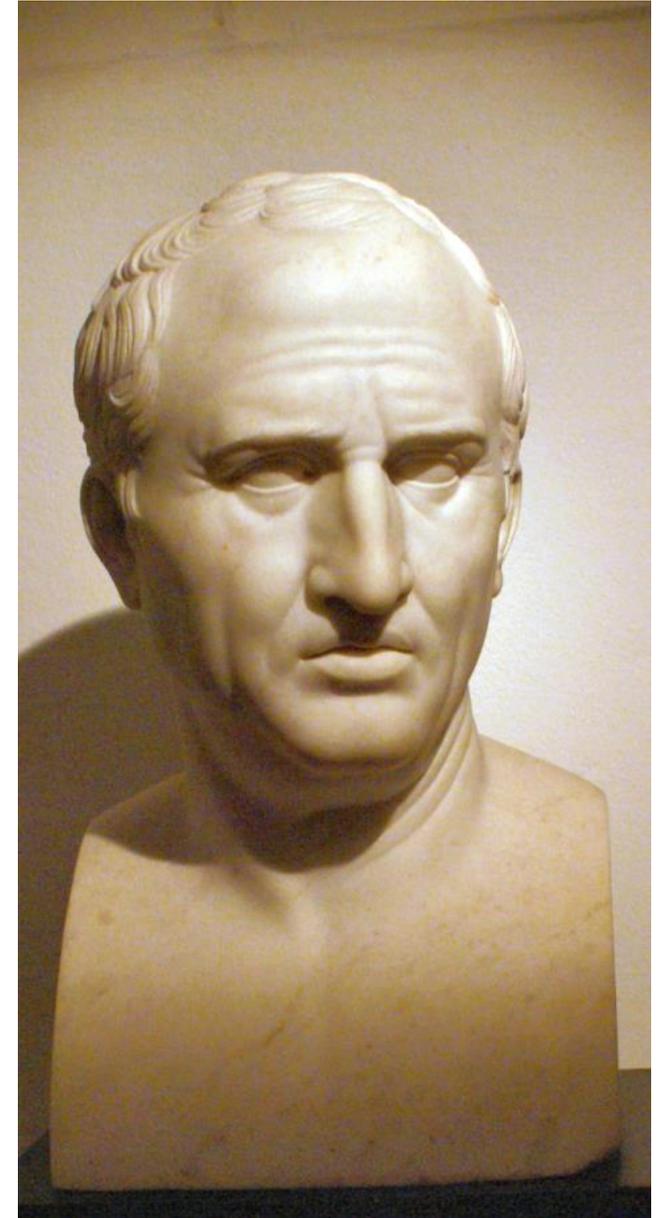
Roman Sawmill



Prestige of Craftmanship in Antiquity

All mechanics are engaged in vulgar trades, for no workshop can have anything liberal about it.

Cicero (106 – 43 BC)





Advancement during the Middle Ages



Map: Ziegelbrenner auf Wikipedia unter der CC-BY-SA license; Blacksmith in Public Domain

The Industrial Revolution 1715



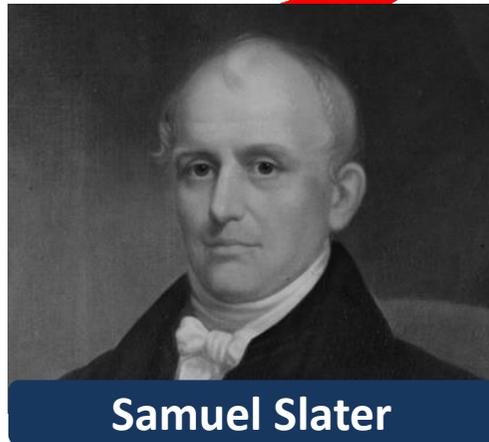
John Lombe



Sir Richard Arkwright



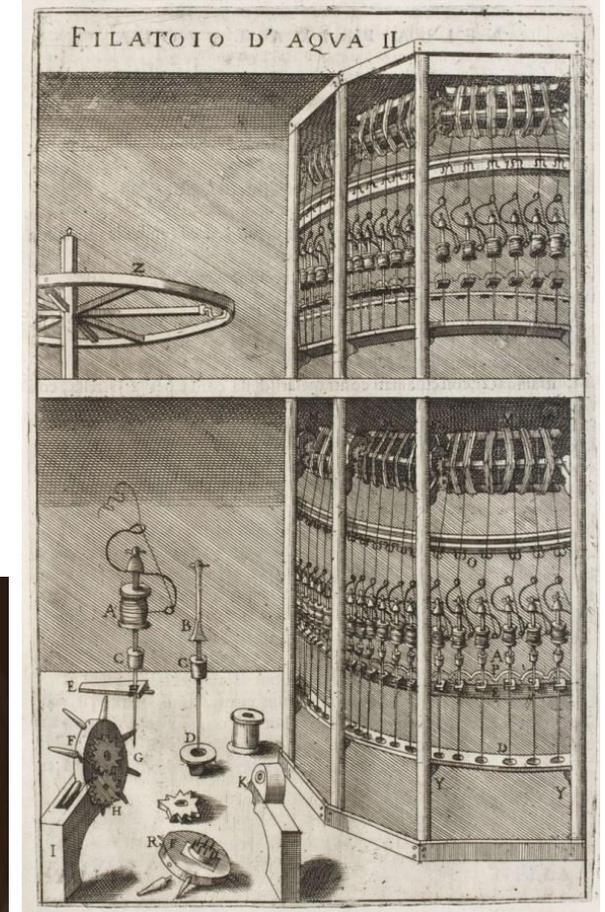
Piedmont,
Italy



Samuel Slater



Johann Gottfried
Brügelmann

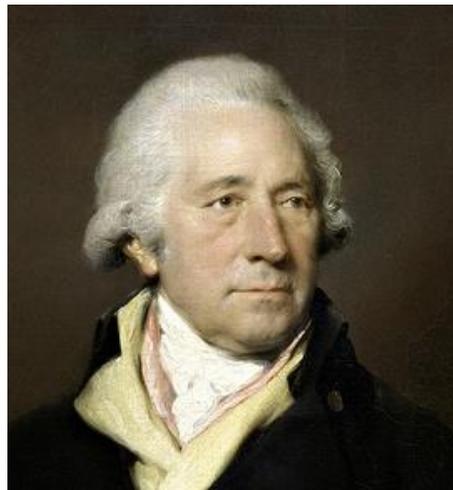


The Steam Engine 1775

- First effektive steam engine from James Watt
- Soho Manufactory Matthew Boulton
- Production of cylinders John "Iron-Mad" Wilkinson
- Huge synergy effects



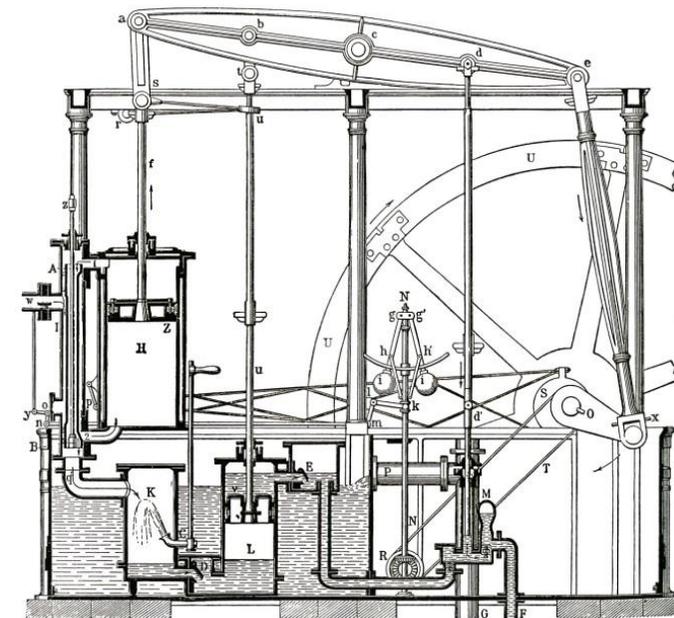
James Watt



Matthew Boulton



John Wilkinson



Images James Watt by Henry Howard; Matthew Boulton by unknown artist; John Wilkinson by Lemuel Francis Abbott; Steam engine by Meyers Konversations-Lexikon; all in public domain.

Social unrests – Luddism

- Financial and social decline of weavers through mechanization
- Luddite uprising 1811-1817
- Objectives of the Luddites
 - Fair Salary
 - Ban of mechanization
- Deployment of the British army

The Luddites did not accomplish any of their goals!



Henry Ford & Mass Production

- Rigorous optimization of production efficiency
- Use of assembly line
- Model T: 1908 €20.000 → 1925 €3.500
(in modern Euro)



Relevance of Flexibility

Henry Ford

Ford Model T 1908 – 1927



Ford Model A 1928 – 1931

Ford Model B 1932 – 1934

Alfred P. Sloan (GM)



Chevrolet Series AA
Capitol 1927



Chevrolet Series AB
National 1928



Chevrolet Series AC
International 1929



Chevrolet Series AD
Universal 1930



Chevrolet Series AE
Independence 1931



Chevrolet Series BA
Confederate 1932

Lean Production from 1950



Edward Deming



TWI

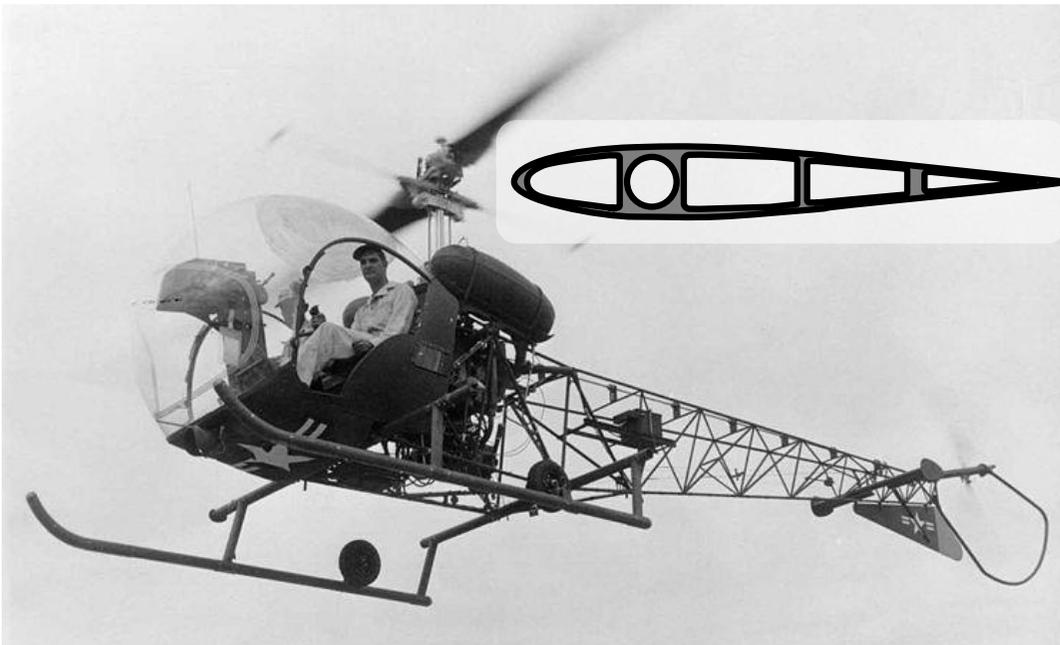
Toyota Production System



- 5S
- Andon
- Chaku Chaku
- Gemba
- Genchi
- Genbutsu
- Heijunka
- Jidoka
- Just in Time
- Kaizen
- Kanban
- Mizusumashi
- Muda
- Mura
- Muri
- Poka Yoke
- SMED

Computer and Automatization

- John Parsons NC Machine 1950
- Only from about 1985 on cost effective
- George Devol industrial robot UNIMATE 1954



Lessons for the Future

- Speed and Flexibility of Logistic chains will increase in significance
- Attention to Detail will remain important
 - Strategy Execution over
 - Strategy Creation
- New Technologies will disrupt
- businesses
 - Artificial Intelligence
 - Battery and Self Driving Cars
 - Gene Modification Technology



Manufacturing continues to need people!
Manufacturing continues to need leadership!

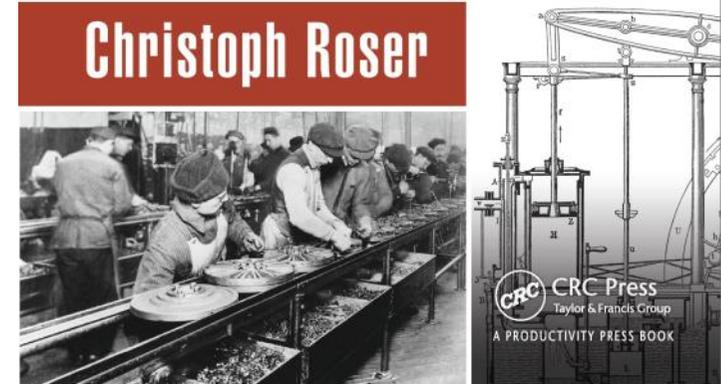


Questions?



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