History of Manufacturing

Lessons learned from the Past for the Future of Manufacturing

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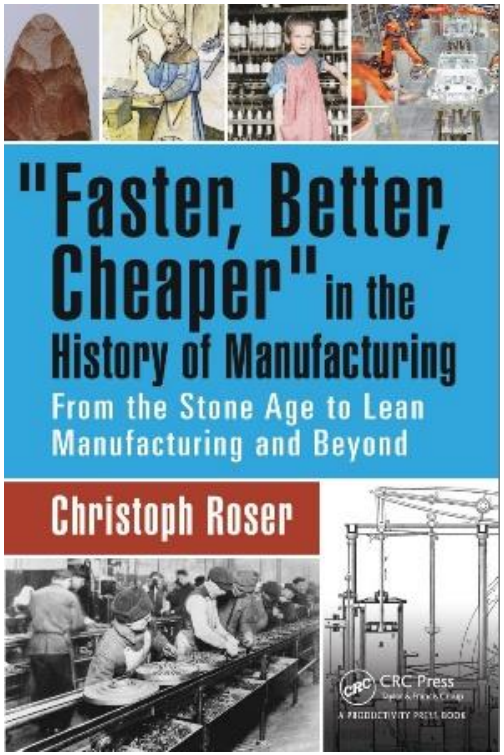
TOYOTA

McKinsey&Company

BOSCH



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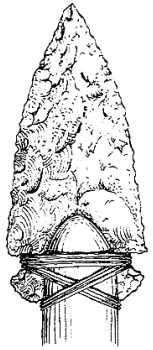
The Six Manufacturing Techniques

Cutting	Changing Material Properties	Joining
2.600.000 BC	120.000 BC	72.000 BC
		
Coating	**Molding**	**Forming**
30.000 BC	25.000 BC	8.700 BC
		

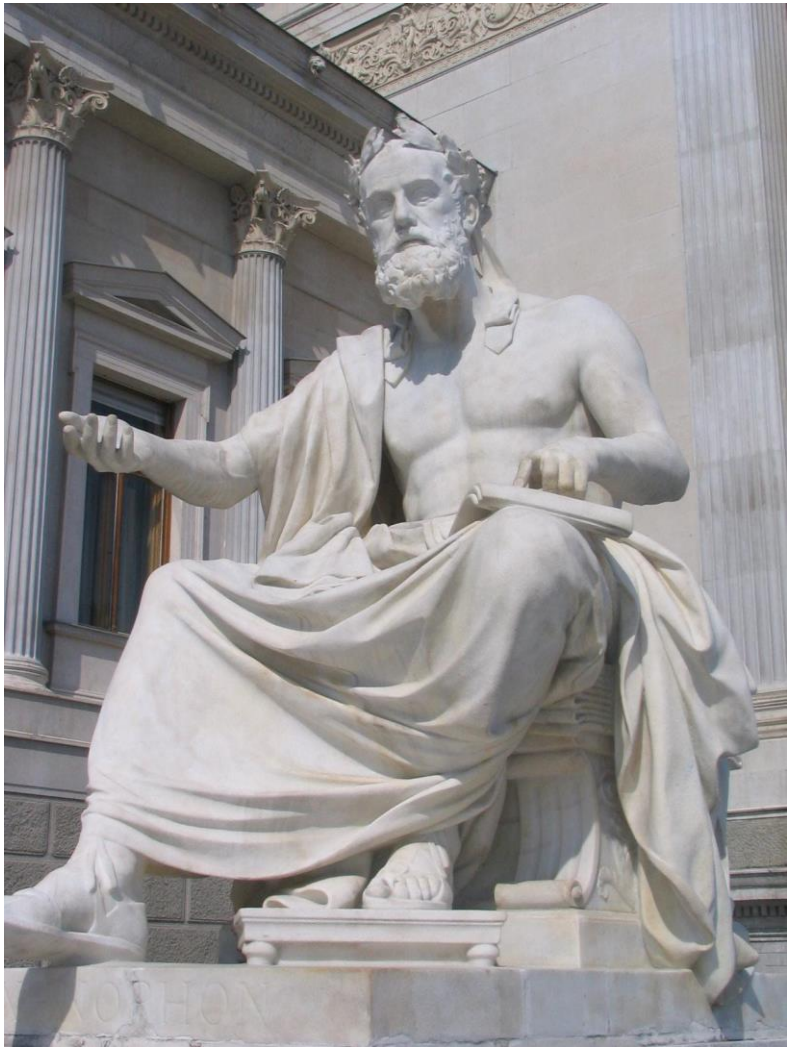
Sources: Material properties ©Niedersächsisches Landesamt für Denkmalpflege, H. Pfarr; Molding Petr Novák, CC-BY-SA 2.5 license; Forming Rob Lavinsky, CC-BY-SA-3.0 license

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

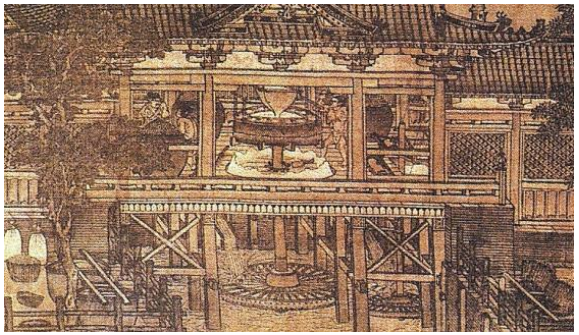
Egyptian Potter's Wheel

Egyptian Lathe

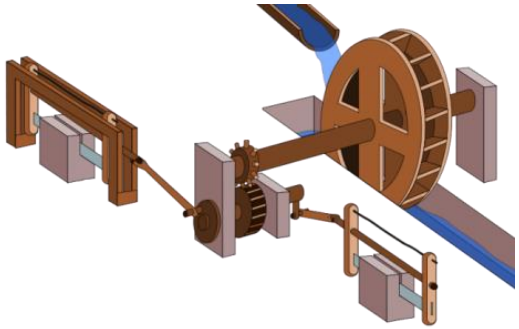
Roman Flour Mill

Persian Windmill

Chinese Watermill



Roman Sawmill



Sources: flour mill ©Roser, windmill by Saupreiß CC-BY-SA 3.0 license, saw mill by chris 論 CC-BY-3.0 license,

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)

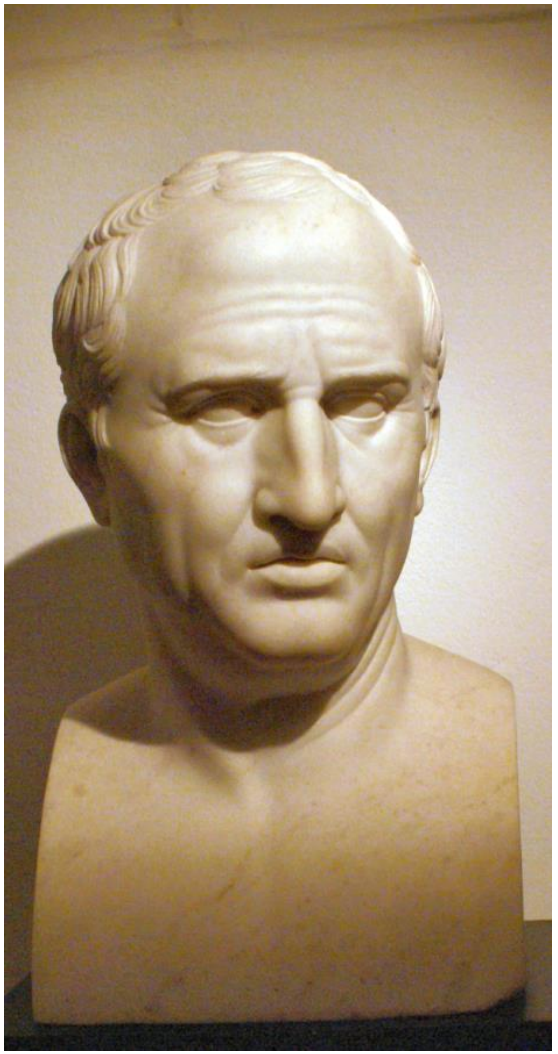


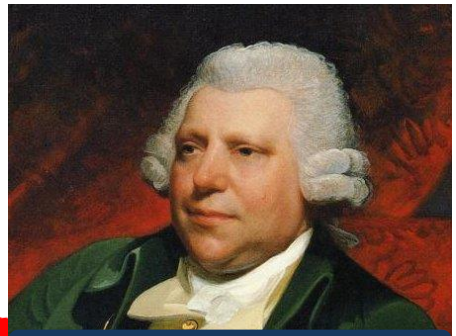
Image Gunnar Bach Pedersen, public domain

Advancement during the Middle Ages

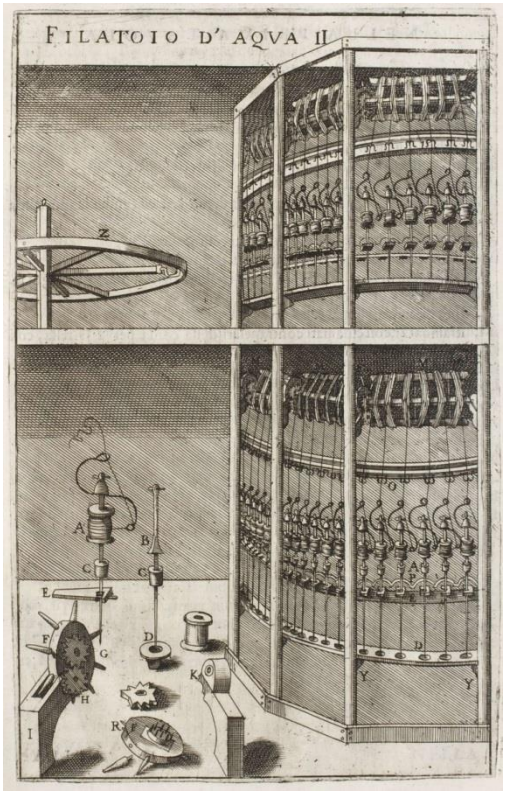
Map: Ziegelbrenner auf Wikipedia unter der CC-BY-SA license; Blacksmith in Public Domain

The Industrial Revolution 1715

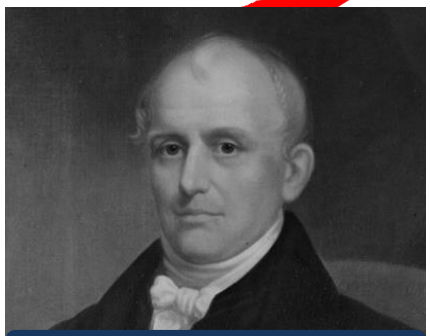
John Lombe



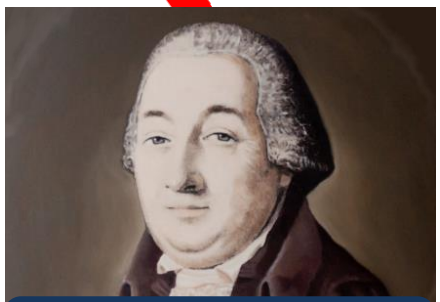
Sir Richard Arkwright



Piedmont, Italy



Samuel Slater

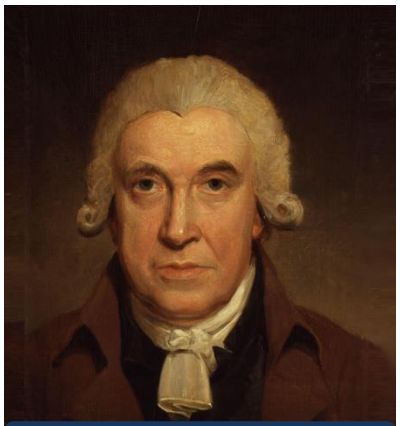


Johann Gottfried Brügelmann

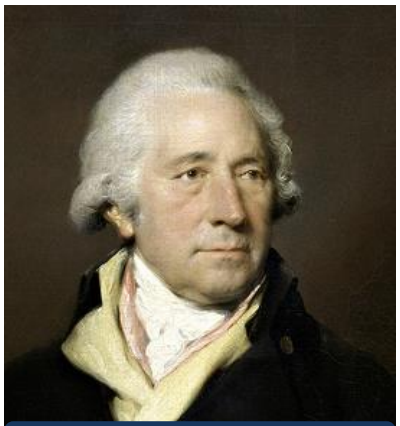
Images: John Lombe by Steve Bowen; Sir Richard Arkwright by Mather Brown 1790; Samuel Slater by James Sullivan Lincoln; Johann Gottfried Brügelmann by unknown artist; Spinning Machine Vittorio Zonca, all in public domain

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

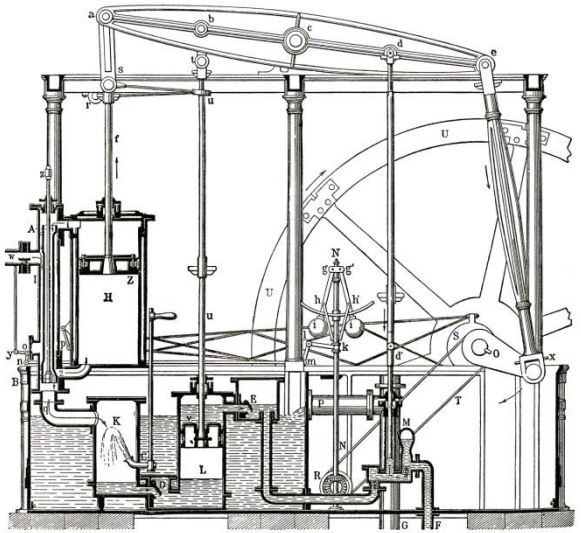


James Watt



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!

Luddite by unknown author, in public domain

Henry Ford & Mass Production

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

Images by Ford, in public domain.

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

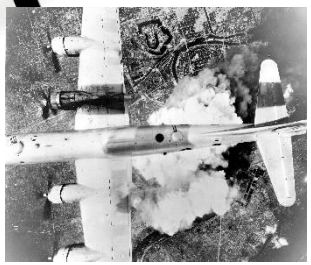
Sources: Model T 1927, Chevrolet AA, AB, AC, AD, AE, BA Lars-Göran Lindgren Sweden CC-BY-SA 3.0 license

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

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Computer and Automatization

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

Helicopter Public domain, other imager Roser

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!

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Questions?

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