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INDUSTRY 4.0

-

Factories of the future

Milan EDL

Проект „Развитие международного сотрудничества с украинскими ВУЗами в областях качества, энергетики и транспорта“

г. Харьков, 11/2018

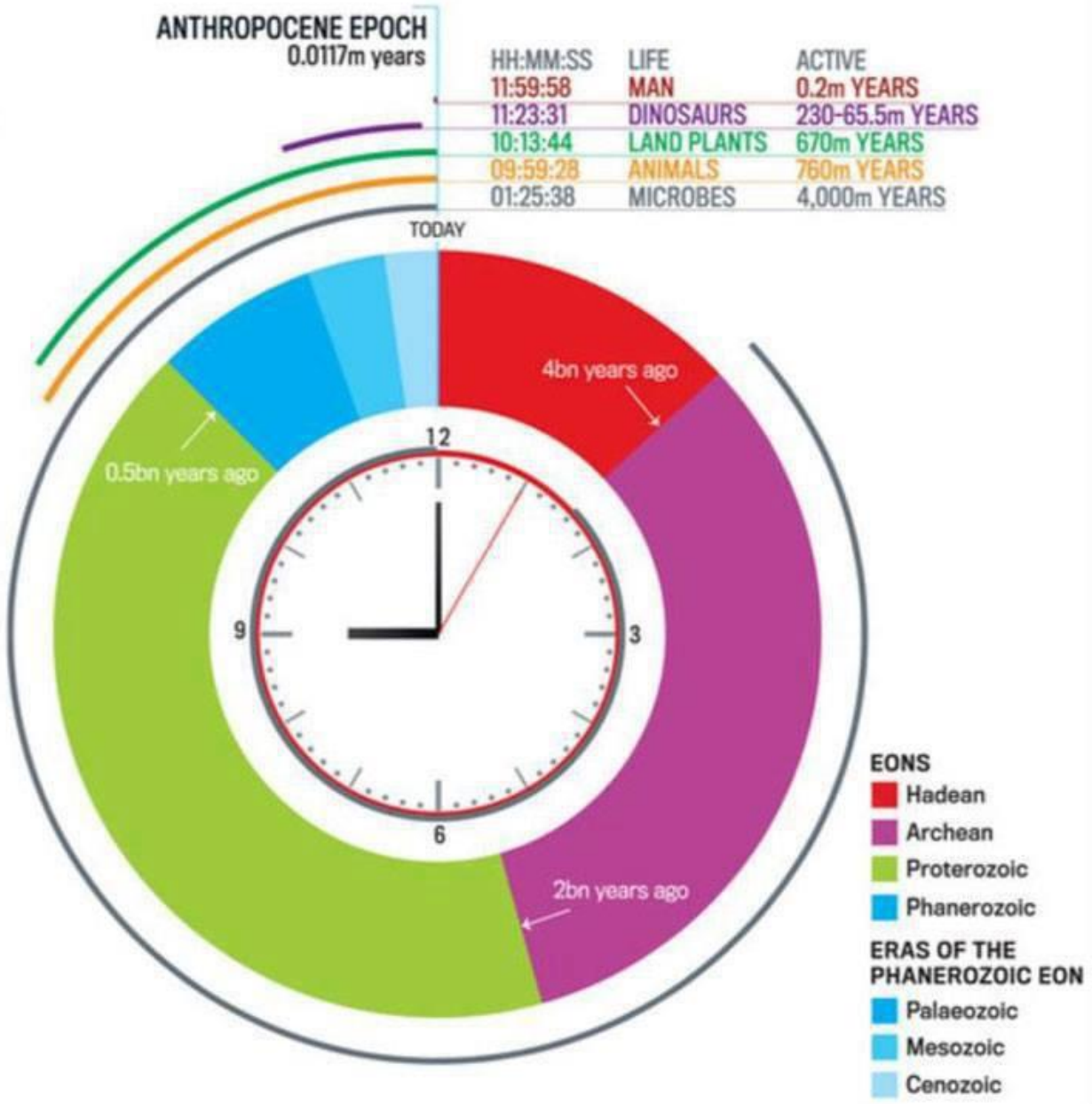
History

Who wants to know the future, he must know the past.

Хто хоче знати майбутнє, він повинен знати минуле.

THE HISTORY OF THE EARTH IN 12 HOURS

If the history of our planet were condensed into a 12-hour period, *Homo sapiens* would appear in the last two seconds and the Anthropocene epoch, when mankind starts leaving a mark in the geological record, would begin around one-tenth of a second ago

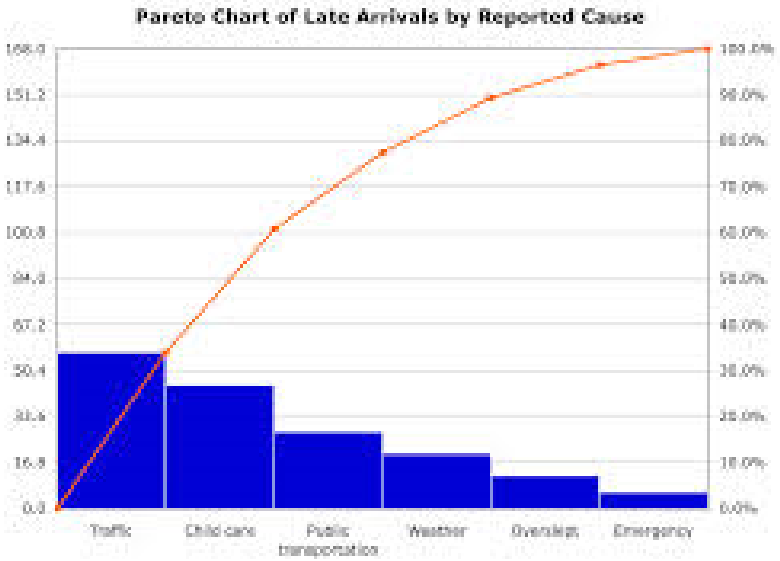


History

- 1793 - cotton processing machinery (Eli Whitey) - USA

History

- 1883 - Pareto law



History

- 1898 - timewise studies (Frederick Taylor) - USA

History

- 1904 - Cadillac used parts into multiple car models - USA

History

- 1908 - Model T Ford (Henry Ford) - USA

History

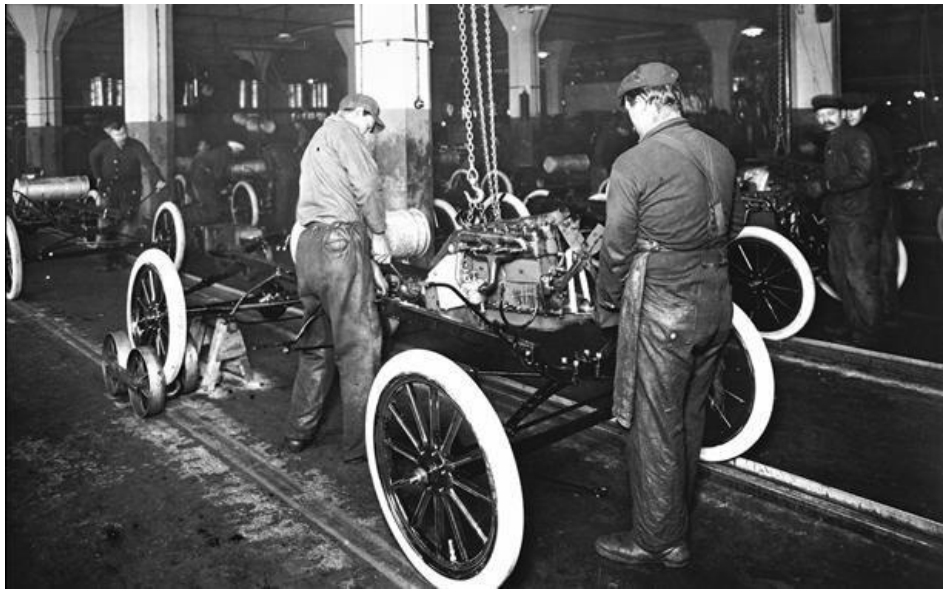
- 1908 - analysis work, analysis of human-process analysis of movements (Franc and Lillian Gilbreth) - USA

History

- 1911 - scientific management business (Frederick Taylor) - USA

History

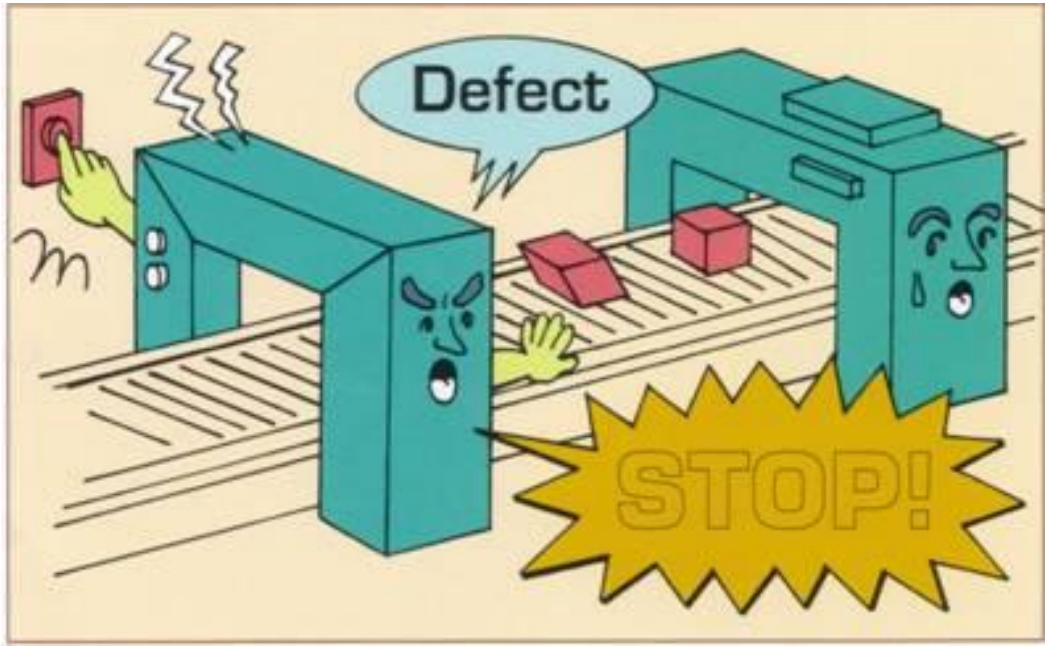
- 1913 - complete production strategy Ford (Henry Ford, Charles Sorenson) - USA



http://www.youtube.com/watch?v=kzRnZjY82xE

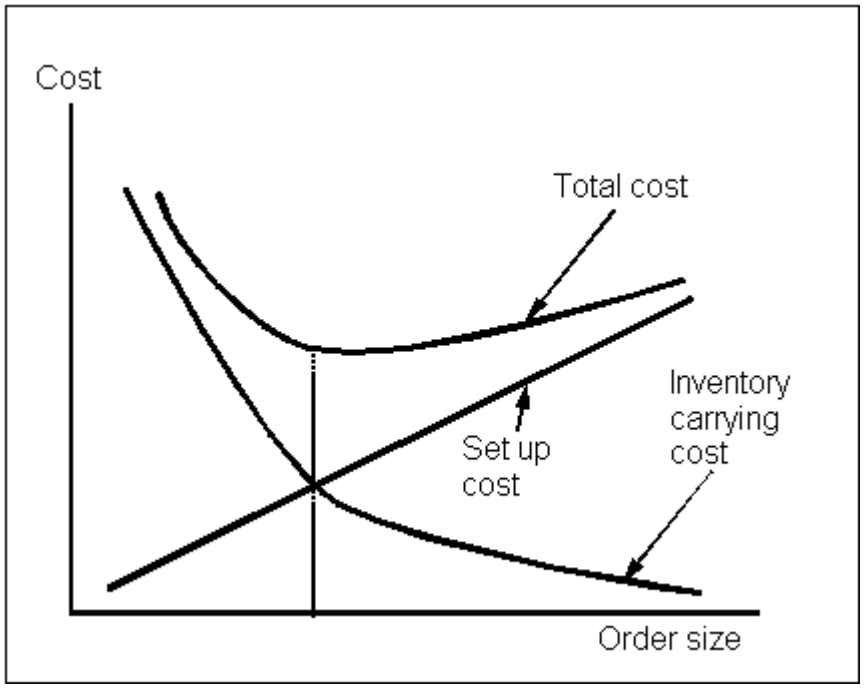
History

- 1915 - separation of man from the machine (JIDOKA) - JPN



History

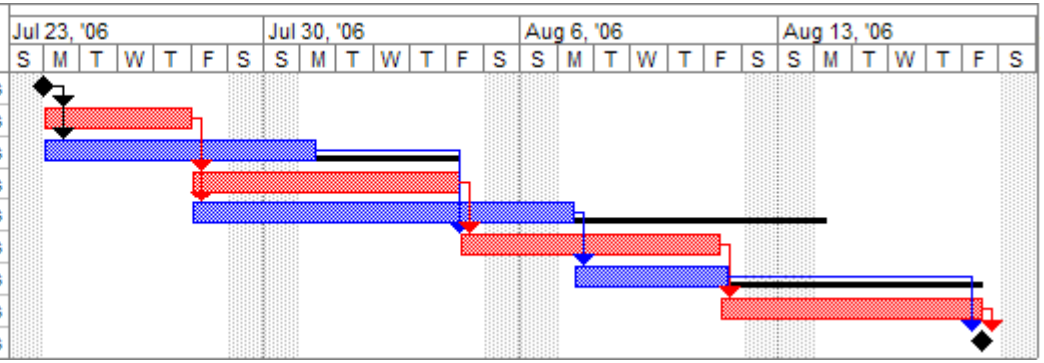
- 1915 - use EOQ model (inventory management)



History

- 1922 - use Gantt chart

ID	Task Name	Predecessors	Duration
1	Start		0 days
2	a	1	4 days
3	b	1	5.33 days
4	c	2	5.17 days
5	d	2	6.33 days
6	e	3,4	5.17 days
7	f	5	4.5 days
8	g	6	5.17 days
9	Finish	7,8	0 days



History

- 1925 - introduction of the concept "mass Production "- USA

History

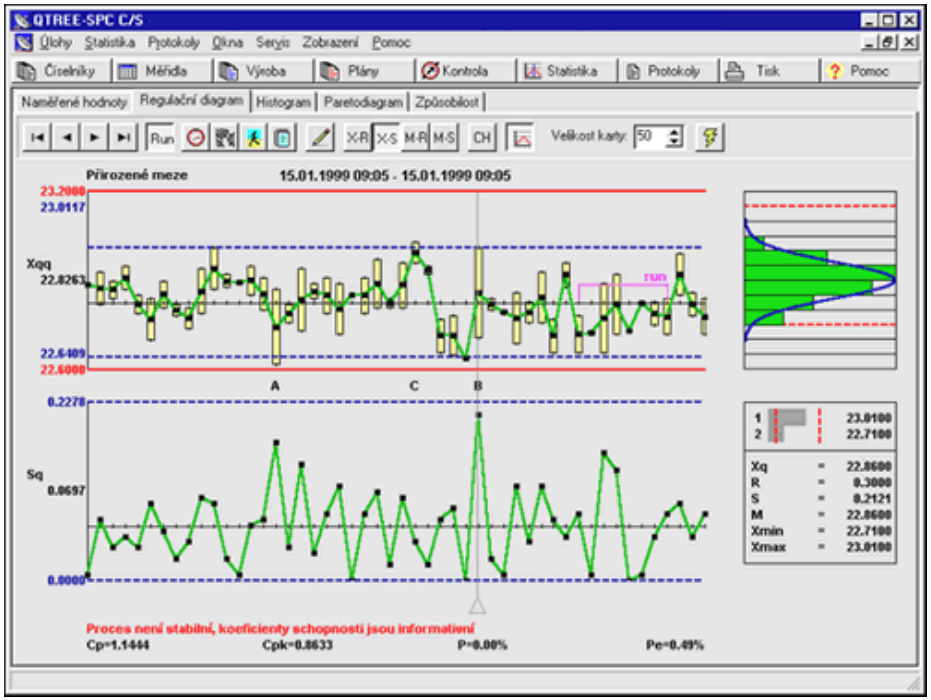
- 1927 - The company was founded Toyota - JPN

History

- 1930 - GM production concept (Alfred Sloan) - USA

History

- 1931 - Statistics Process Control (Walter A. Shewhart)



History

- 1936 - GM introduces the term "automation" - USA

History

- The 30s - Tomas Bata - Lean manufacturing shoes

History

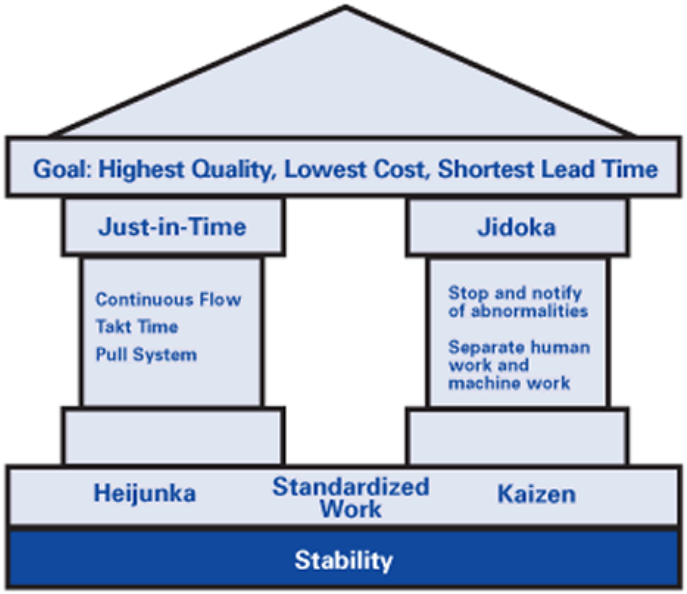
- 1945 - "doběhnot US within three years, otherwise the Japanese production will not survive" (Taichii Ohno) - JPN

History

- 1945 - Concept Toyota Production System (Sheigeo Shingo) - JPN

History

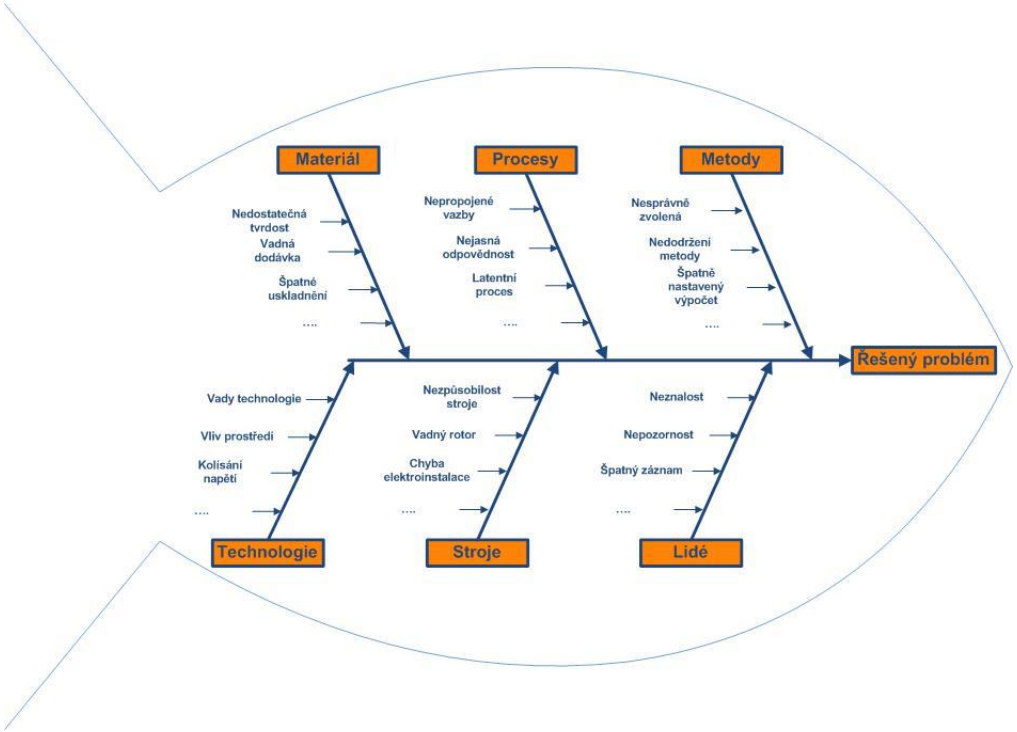
- 1950 - Toyota Production System (Taiichi Ohno) - JPN



Toyota Production System "House."

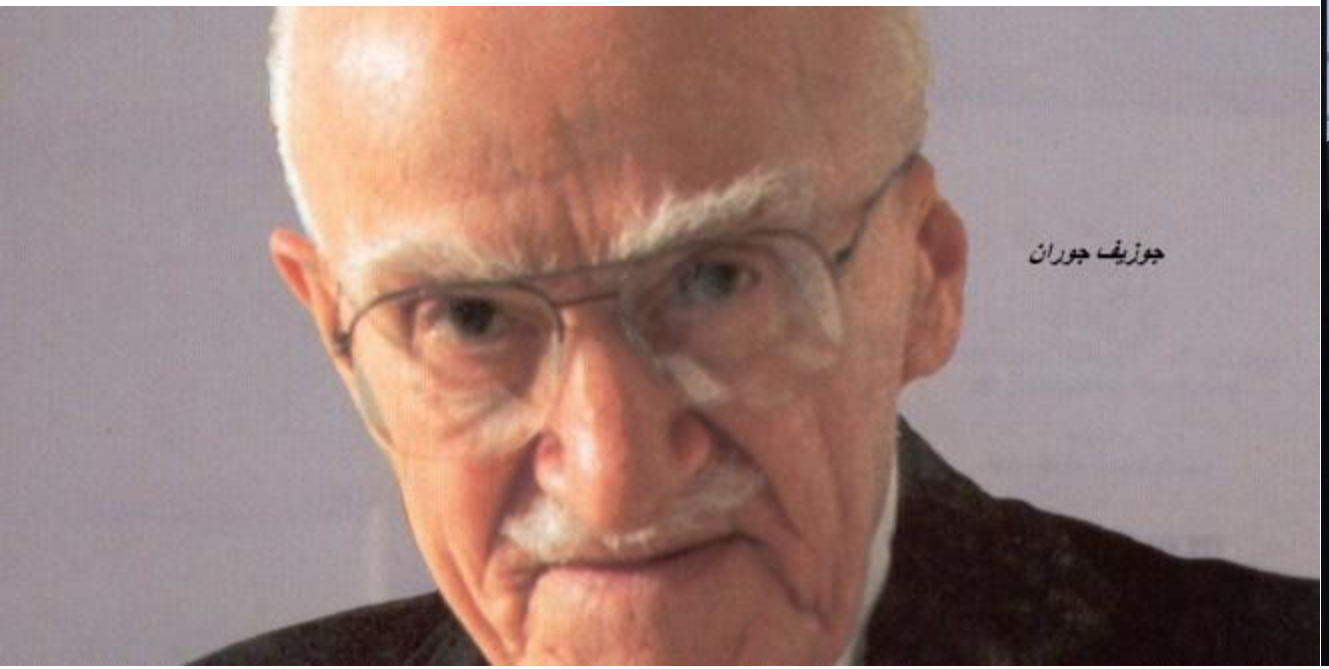
History

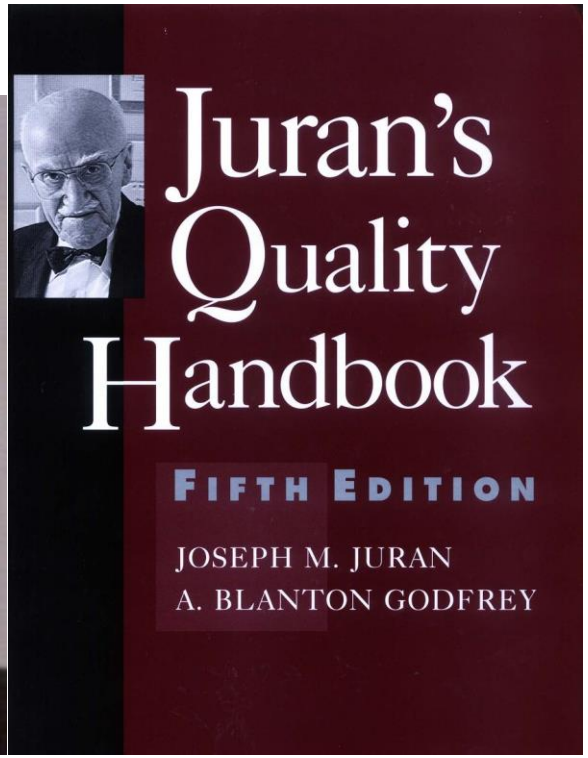
- 1950 - using Ishikawa diagram



History

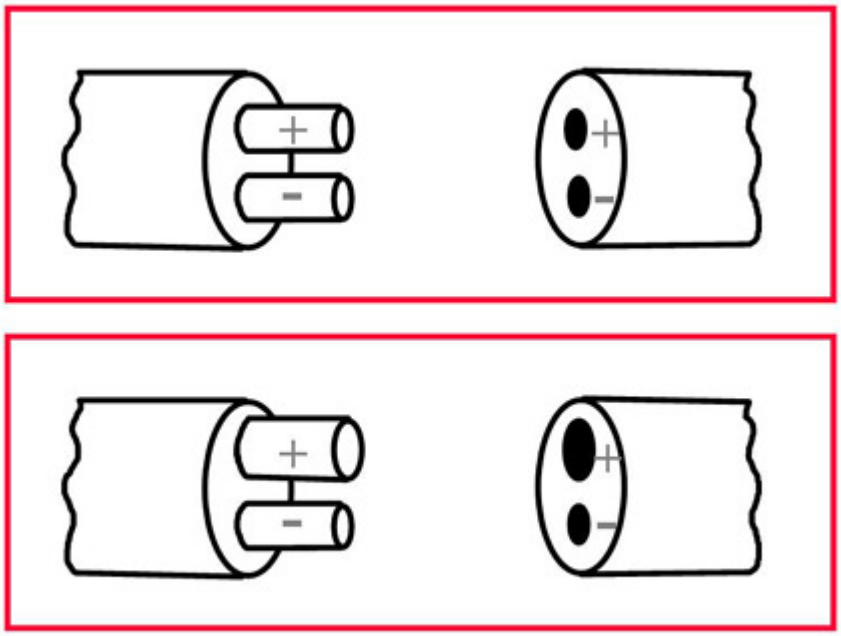
- 1951 - "Handbook Quality of Control " (Joseph Moses Juran) - JPN





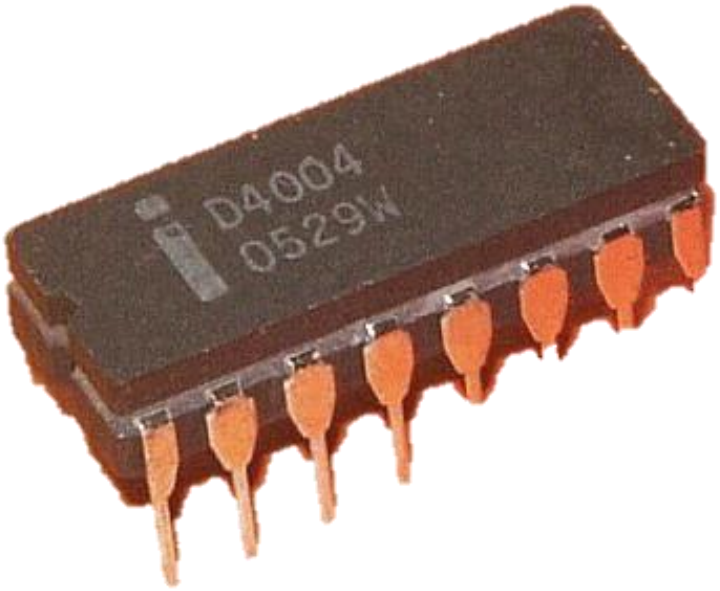
History

- 1961 - Poka yoke (Shingeo Shingo) - JPN



History

- 1969 - The first microchip from Intel



History

- 1971 - Walmart is used for data exchange EDI

History

- 1975 - "non-stock" production (Shingeo Shingo) - JPN

History

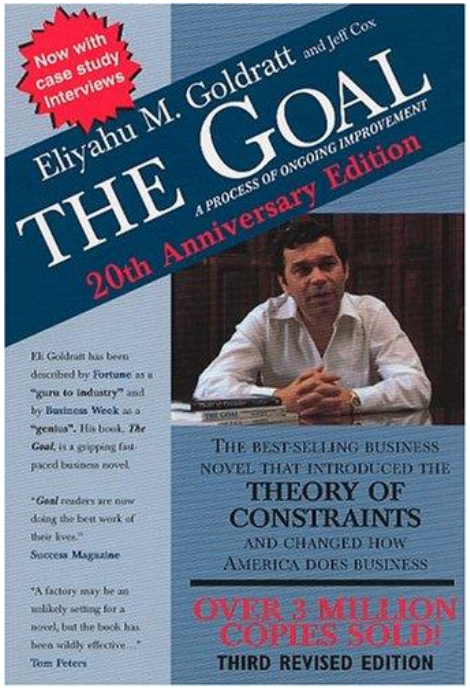
- 1979 - The first articles about GO

History

- 1980 - NBC broadcasts show: "If the Japanese can do, why not us?" - USA

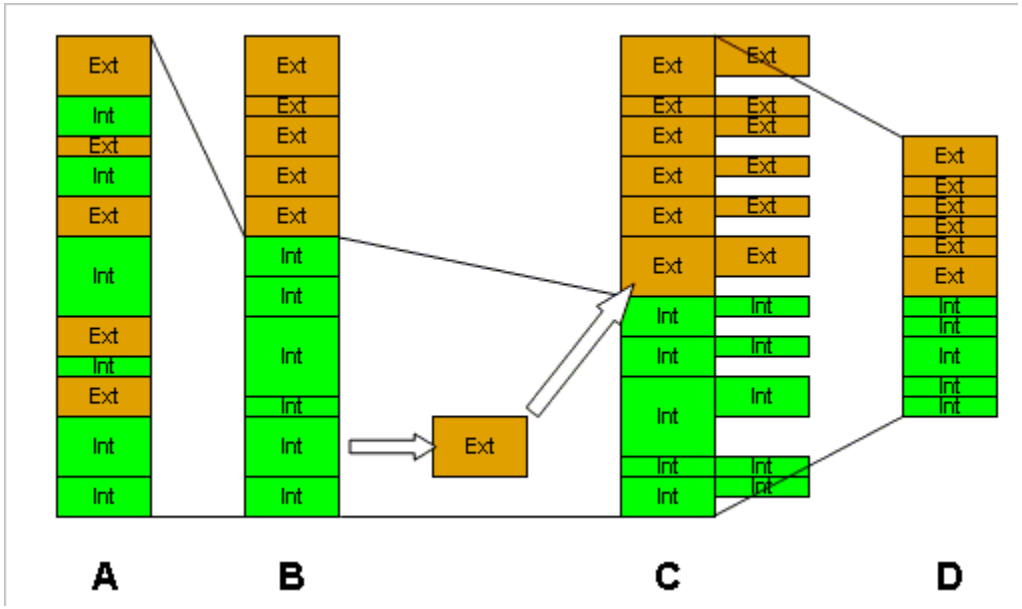
History

- 1984 - book "The Goal" (Eliyahu M. Goldratt)



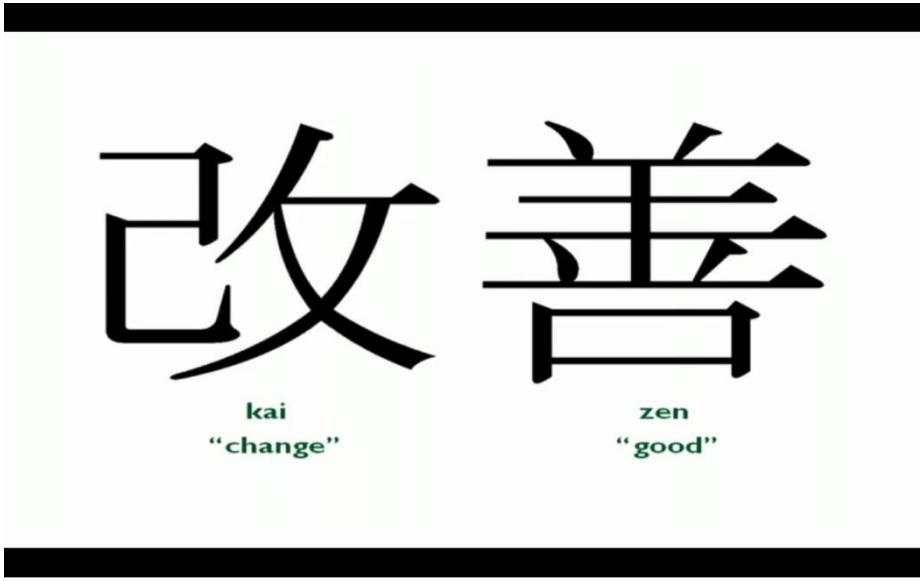
History

- 1985 - using the SMED method (Shingeo Shingo) - JPN



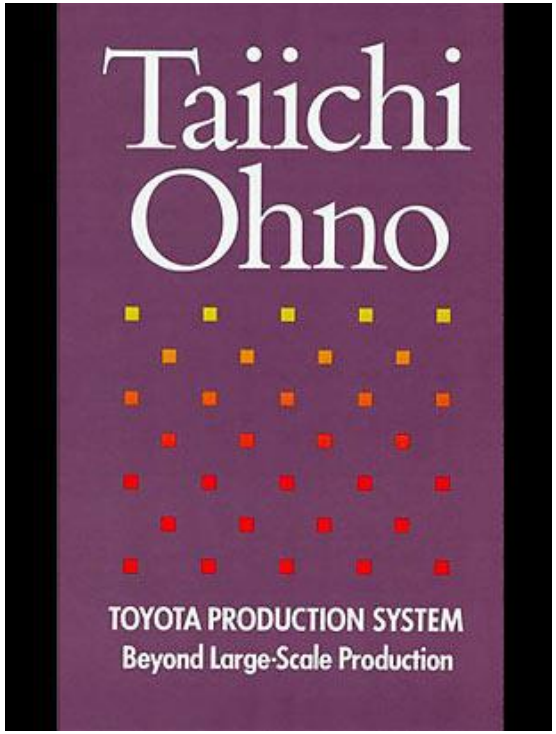
History

- 1986 - "Kaizen - The Key to Japan's Competitive Success" - JPN



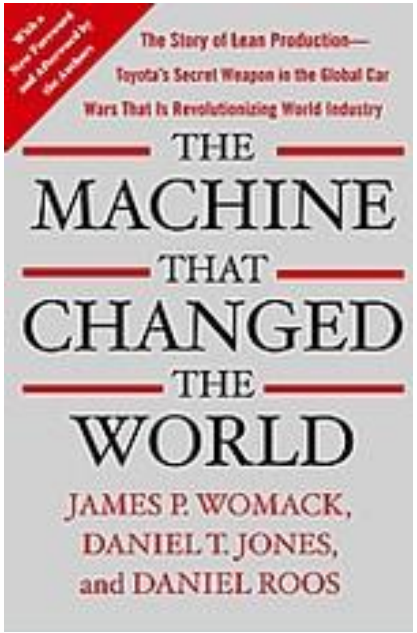
History

- 1988 - book Toyota Production System (Taiichi Ohno) - JPN



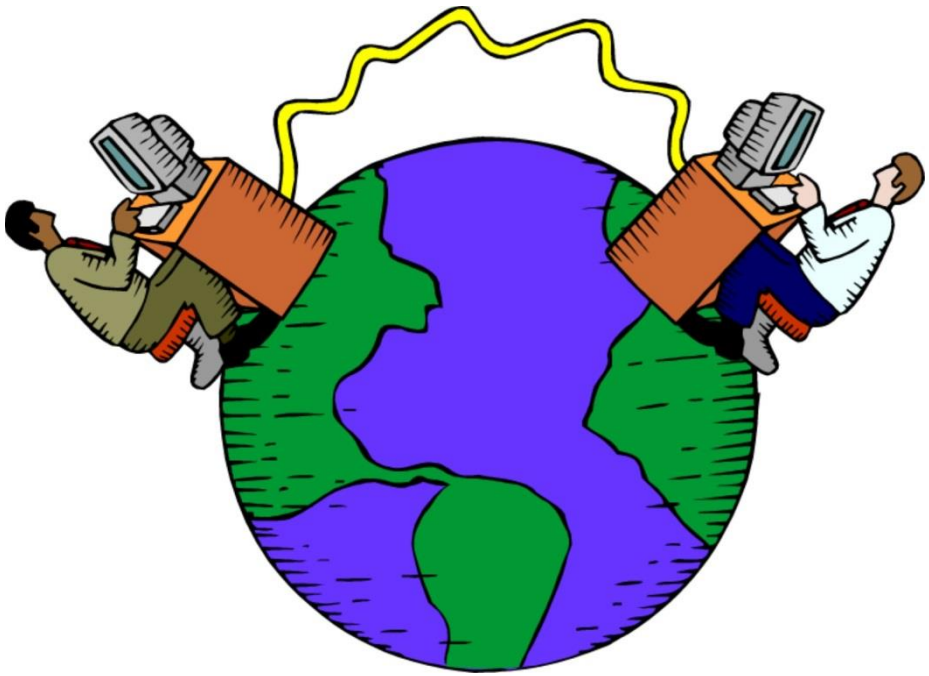
History

- 1990 - the book "The Machine That Changed the World" (Womack and Jones) - USA



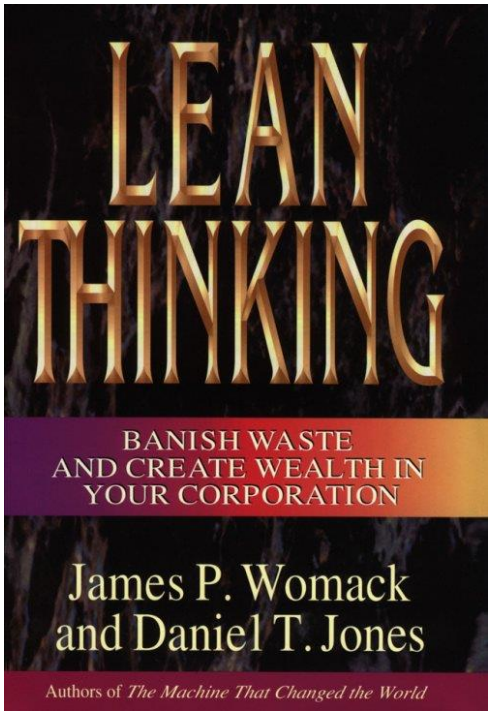
History

- 1993 - the Internet - for commercial expansion use



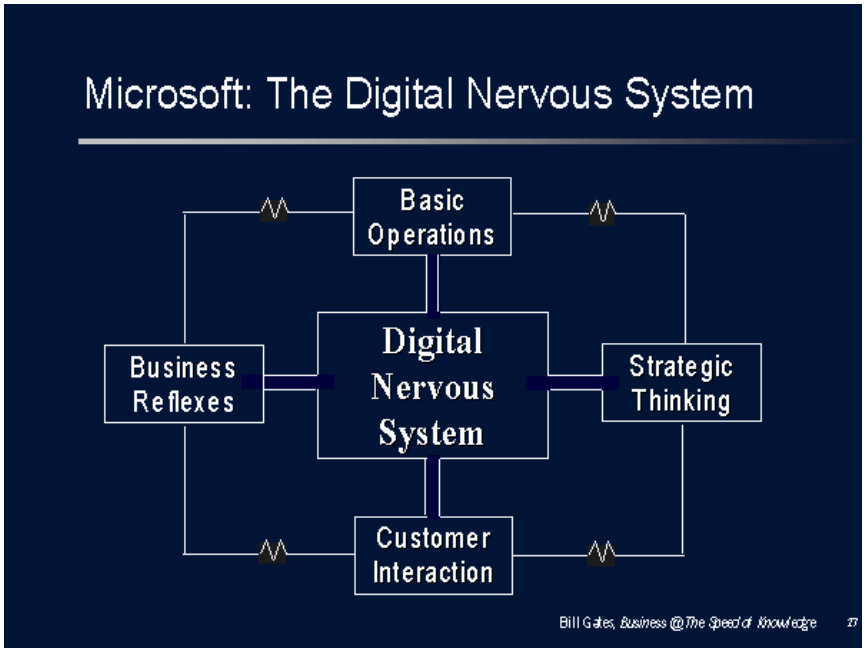
History

- 1996 - book "Lean Thinking" (Womack and Jones) - USA



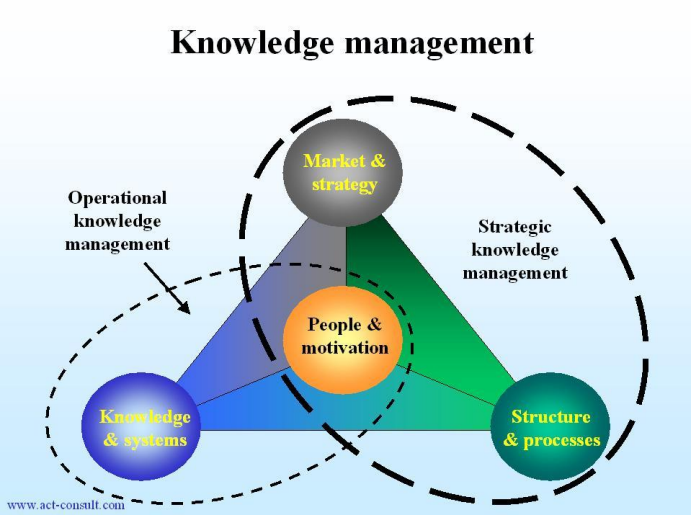
History

- 1999 - Bill Gates vision: "The Digital Nervous System" - USA

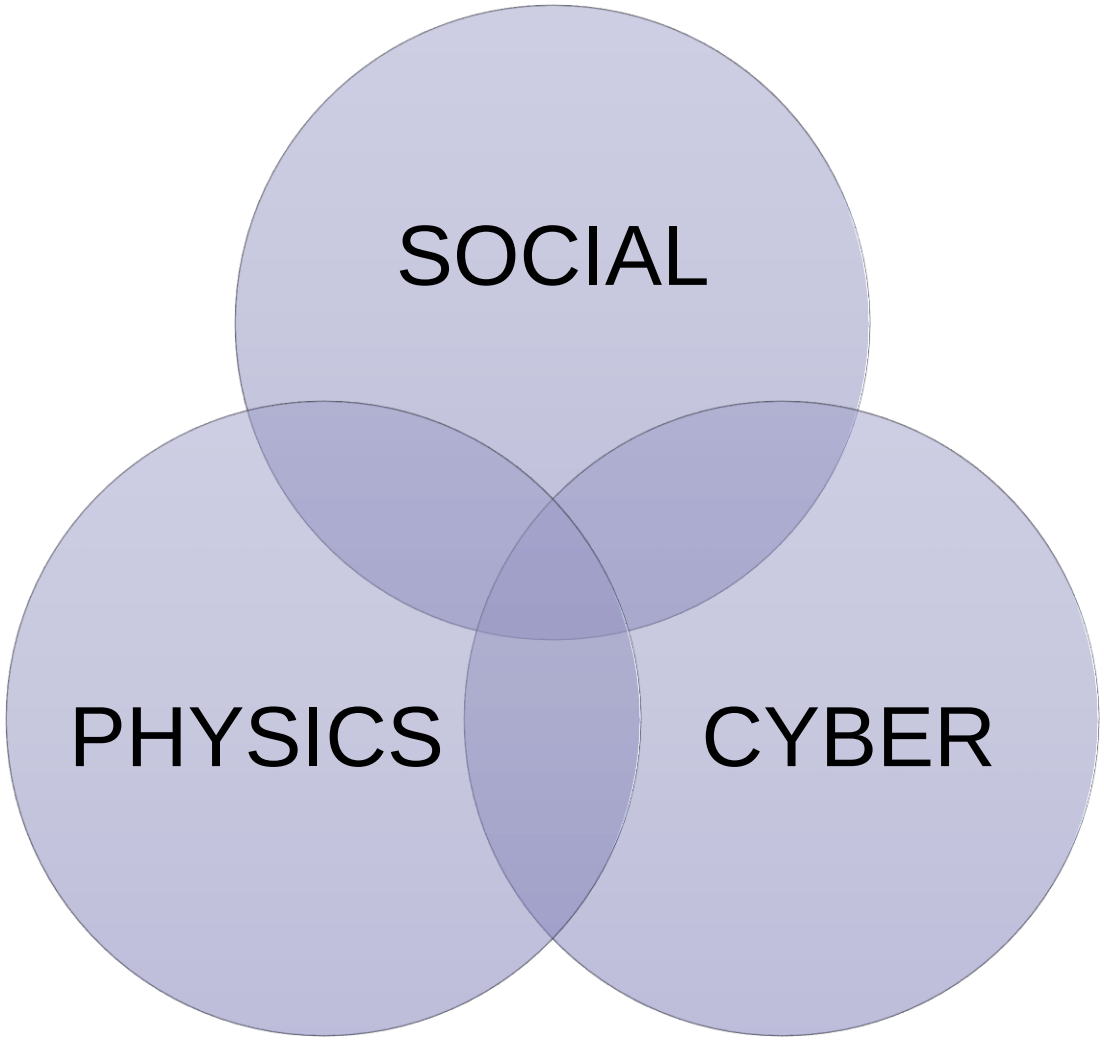


History

- 2000 plus - LEAN understanding of the strategic dimension



History



History

History is crap ... the only history that's worth something, is that we are creating now.

Історія є лайкою ... єдиною історією, яка стоїть за щось, є те, що ми зараз створюємо.

Henry Ford

Industry

- industry is the production of goods or services within economy
- manufacturing industry has become a key sector of production and labor in the world
- it happened because of the rapid development of technologies such as steelmaking and coal
- after industrial revolution, about a third of global economic output is derived the manufacturing sector industry

Industry

Primary	Sources directly from nature - agriculture, mining, logging, ...
Secondary	Processing of primary products industries. This includes all plants
Tertiary	Providing services - also a teacher, manager, ...
Quaternary	Research and development - also doctors and lawyers ...
Quinary	The highest levels of decision-making in society and the economy - also the government, science, universities, non-profit, healthcare, culture and media

Industrial revolution

- 1. Industrial revolution: steam
- 2. Industrial revolution: electrocity
- 3. Industrial revolution: computers and robots
- 4. Industrial revolution: Cybernetic-Physical Systems (CPS)

Industrial revolution

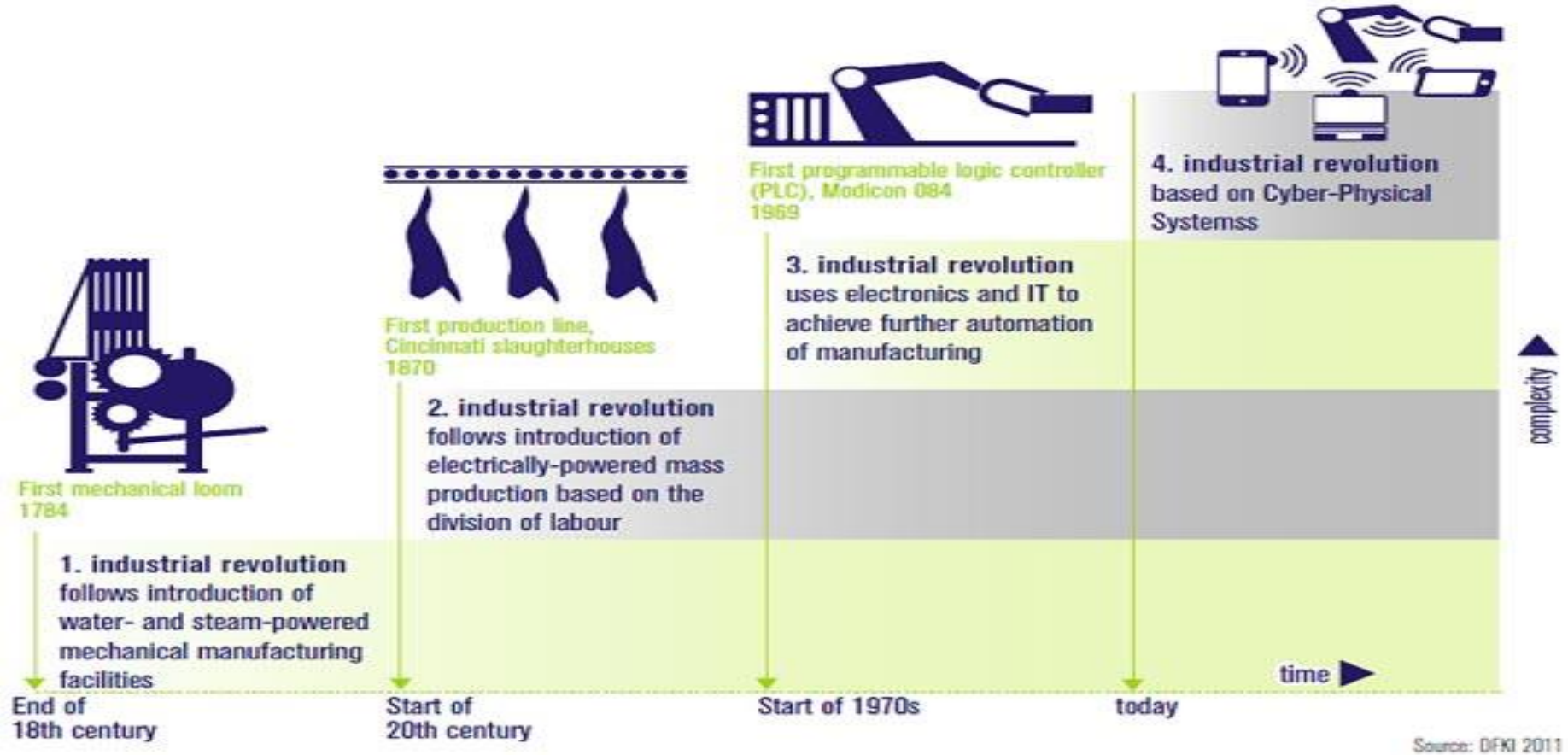


Figure1: The four stages of the Industrial Revolution [1]

Industrial revolution

- Revolution or Evolotion?

- an industrial revolution with an impact on society as a whole

Industrial revolution

The main idea:

Computer interconnection of:

- production machines,
- processed products and semi-finished products
- of all persons involved in the processes (through the interface)
- of all other systems and subsystems of the industrial enterprise

create an intelligent distributed network of heterogeneous entities along the entire value-creating chain, while subsystems operate relatively autonomously and in parallel, communicate each other as needed - each physical system has its virtual twin or virtual image in the virtual world

Industrial revolution

- interconnection of the Internet of Things and Internet Services
- creating a cybernetic - physical space in which there are already unclear boundaries between real and virtual, which move as needed

- Gradually, a third dimension can not be ignored:
- in addition to two technologically-oriented worlds, the physical world of the production and virtual world of services, one must also count on the social world that begins to interact strongly with both technology

Industrial revolution

An integrated production system, understood as a cyber-physical system, is a very complex system that can only be managed on the basis of consistent decentralization, asynchronous address communication and coordination.

Three-dimensional knowledge-based integration of industrial systems:

- **Integration of the horizontal (value chain)** - a complete computer integration (not just a linking of information systems !!) ensuring everything from order submission to supply chain, development, production to expedition and distribution network

- **Vertical Integration** - knowledge-based integration from real-time management, through scheduling and scheduling of production and ERP systems to decision-making at the highest level

- **Integrating engineering support** across the entire engineering chain - from research, development, prototyping, scheduling to product life cycle treatment

Background

- The production is the driving force of the economy
  - Production has tremendous potential to generate income, jobs and a better quality of life
  - Manufacturing is the dominant element of international trade
  - Manufacturing is important in terms of environmental impact
  - Production is important for small and medium-sized enterprises
  - Production strengthens and supports a service economy
  - The production is crucial for emerging markets
  - Manufacturing is critical for research, education and innovation

What does this mean?

- The most important factor of production in the brain
- The company needs talent and their knowledge

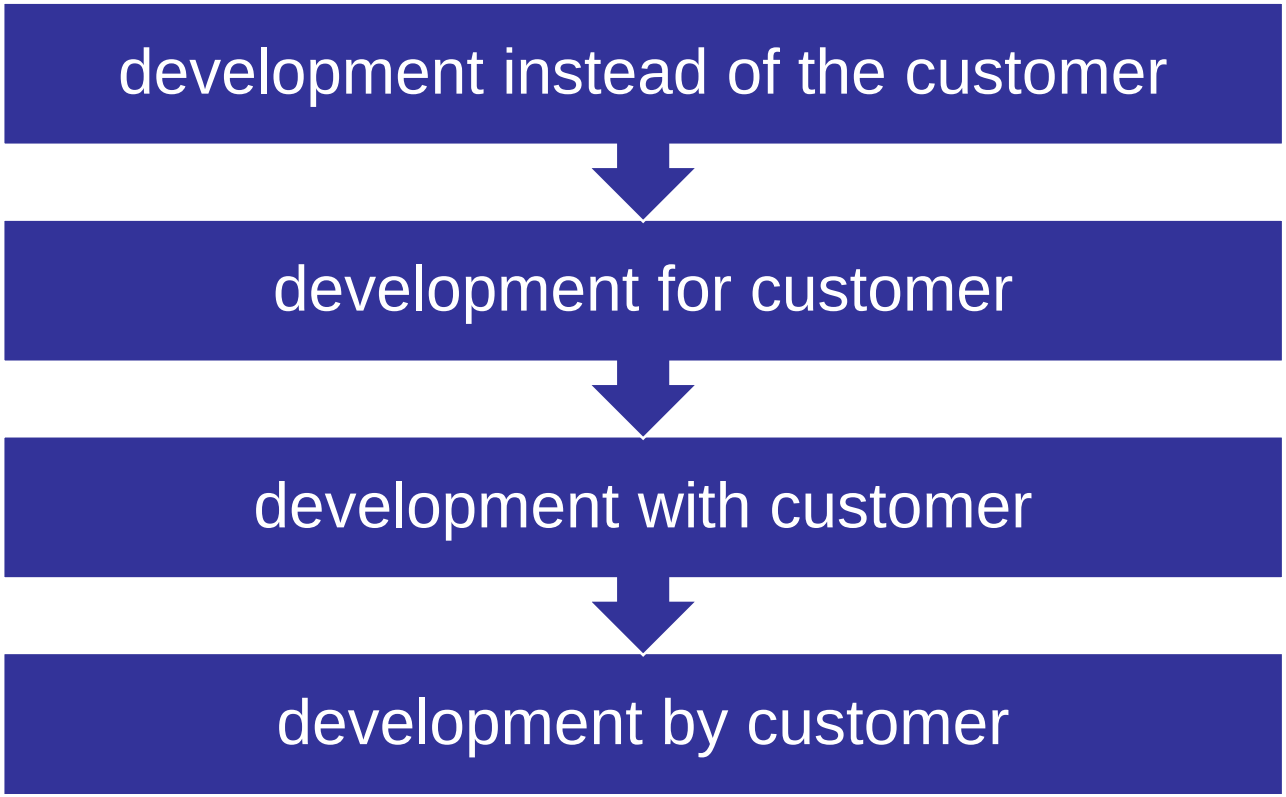
- The factory is just a pile of bricks and iron.
- Give her life people.

Tomas Bata

What is necessary?

- Shortening (perhaps timing) launch time Product Launch
- Orientation the quality product
- product modularity
- Reduction (optimization) costs
- Flexibility
- Teamwork
- Learning
- Knowledge of human potential and the ability to use it
- ...

Customer role

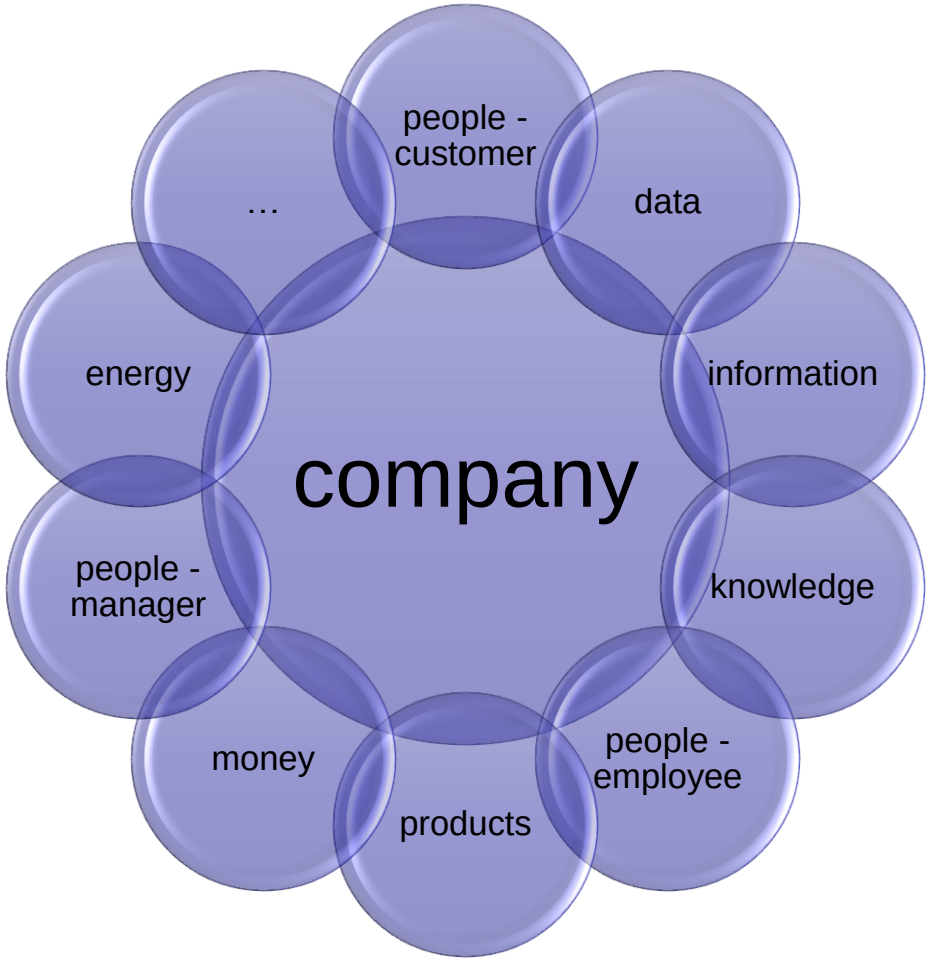


Tailor vs. Taylor

Products and production systems should BE 'tailor made 'not'Taylor made '!

Product and production system should be 'tailored to the customer' not 'made-to-performance and capabilities individual / team / institution '!

What is company?



Human role in the enterprise

man as an active element of the manufacturing system

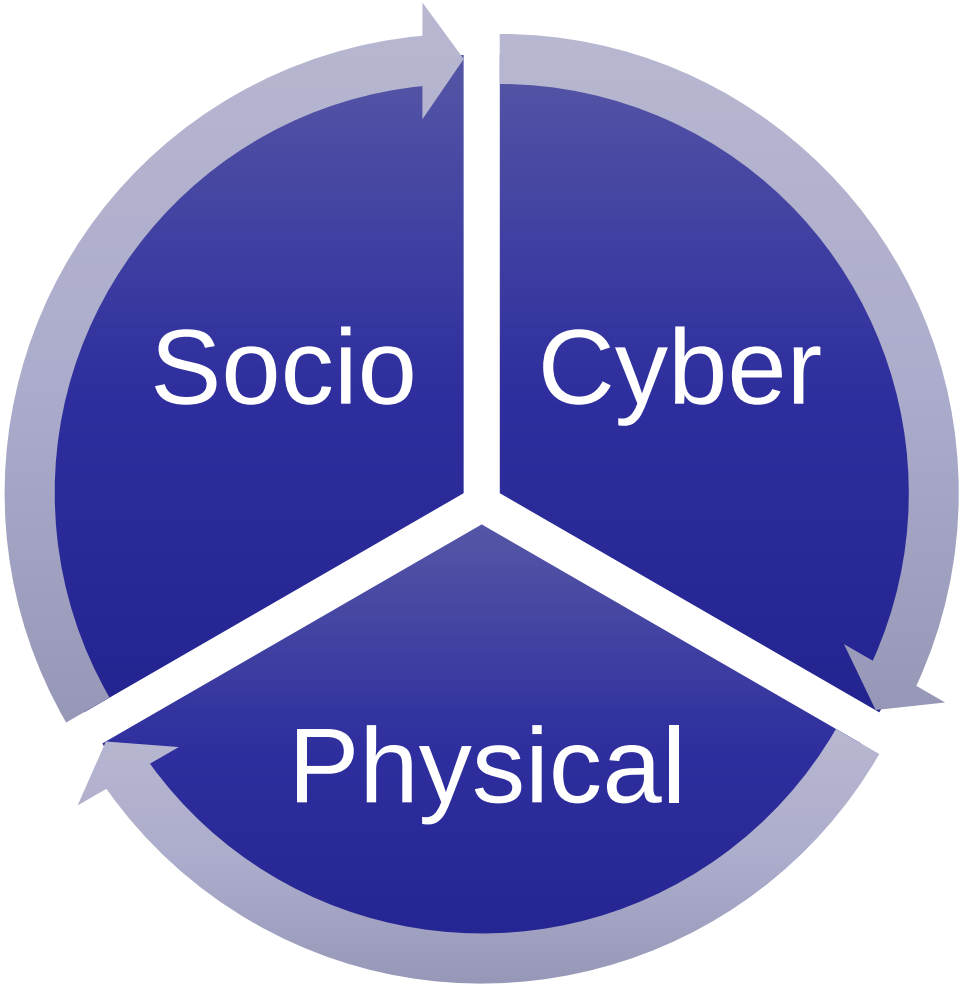
- self-organizing
- self-optimizing
- self-configuration
- self-control
- cooperation

Socio-Cyber-Physical System

- virtual collaboration system models (IT) management entity physical production system and other technical equipment with regard to man as a worker

- virtual model
- physical device
- human factor

SCP System

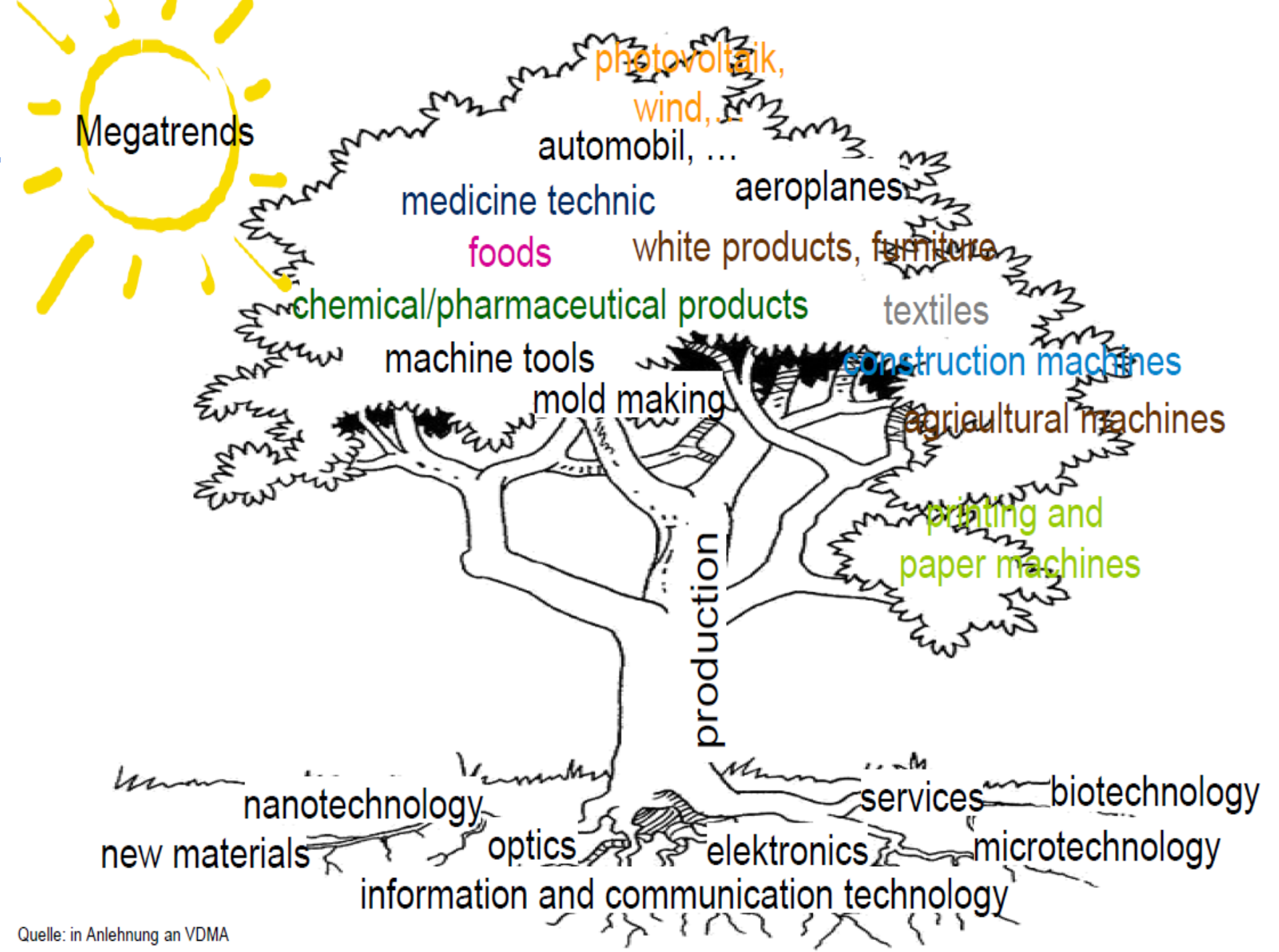


What is the objective?

- From…
  - minimizing costs
- To…
  - a high added value
- How…
  - through competitiveness and sustainable development
- Why…
  - for growth, jobs, satisfaction

What is the objective?

- And how do specifically?
  - innovative products
  - new business models
  - the development of manufacturing strategies
  - the newly created technology
  - infrastructure
  - education



Quelle: in Anlehnung an VDMA

Factory of the future

- Basic topics:
  - Product Lifecycle Management
  - "Zero" emissions low-carbon processes "green "processes
  - "Waste-free" process
  - re-manufacturing, re-CYCLING - RE general approach - perhaps a return to something? re-invent, re-use, re-duce ...
  - work with knowledge
  - education
  - key element HUMANS
  - ...

factory of the future

- example basic approaches:
  - factory as a "good neighbor"
  - Továrna and nature
  - Továrna a man
  - Továrna value chain
  - Factory and ICT

The factory as a "good neighbor"

- the company is close proximity to housing
- company integrated into cities
- enterprise-oriented products tailored to the customer
- integration into cities

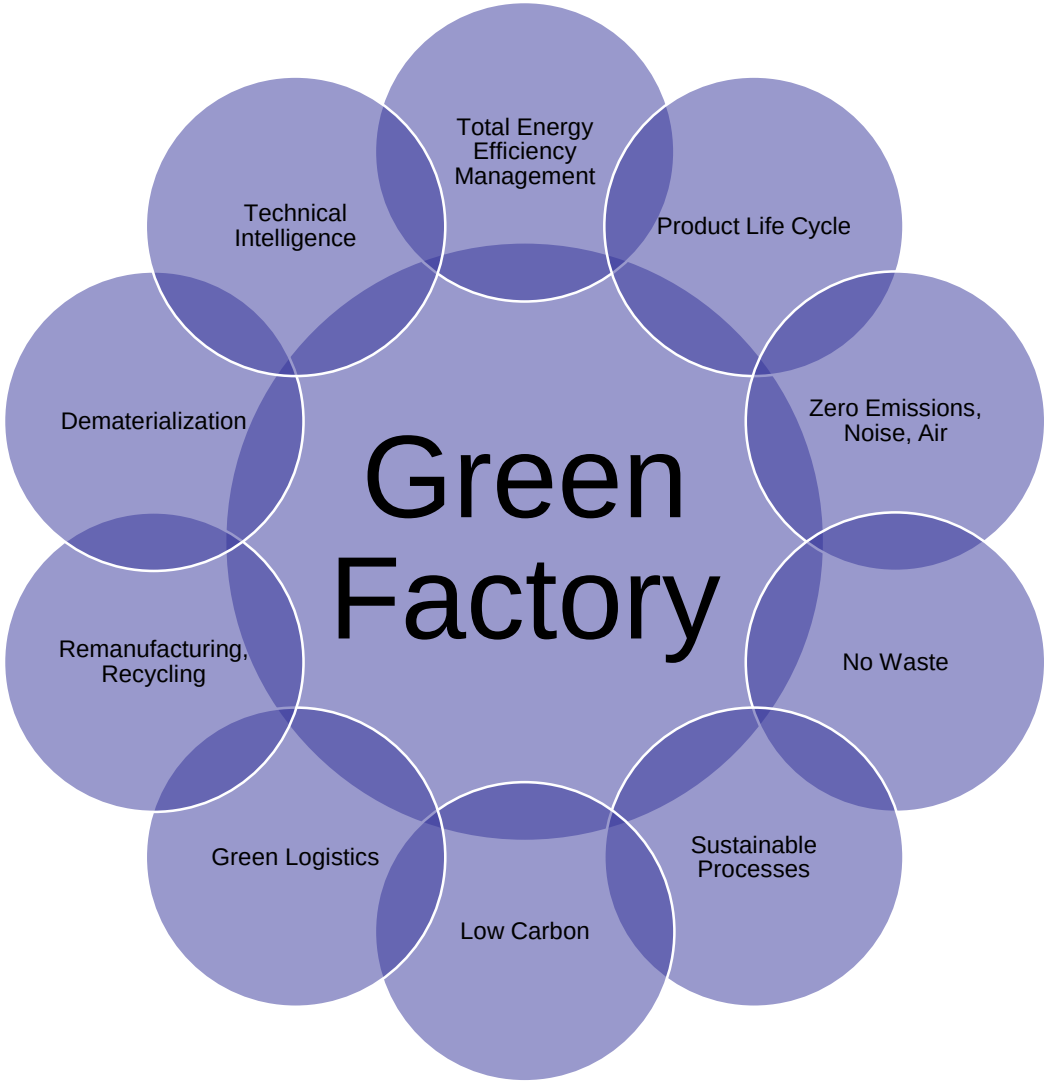
The factory as a "good neighbor"

- key technologies
  - zero emissions (not only emissions, but also the elimination of noise pollution in the air ...)
  - integration processes shortening the process chain
  - desktop machines: small and medium size
  - intelligent green logistics
  - digital products - digital factories
  - workplace customized employee
- The deployment of machines: flexible, open, integrated
- Production system: adapted workers, flexible working hours, event-driven management organization

Factory and Nature

- reduce resource consumption
- reusibility of product resources
- use of materials, factors in production processes, workers simply ...
- new production technologies

Factory and Nature



Factory and man

- human-machine interface
- products and work for different kinds of working groups
- education
- regional adaptation

Factory and man

- use of flexible automation and technical intelligence
  - lean, clean, green manufacturing
  - knowledge integration processes in machines and monitoring systems
  - IT support staff - e-learning at work
  - on-line support: maintenance, knowledge processes, …
- human-machine interface
- regional adaptation: working conditions tailored to individuals

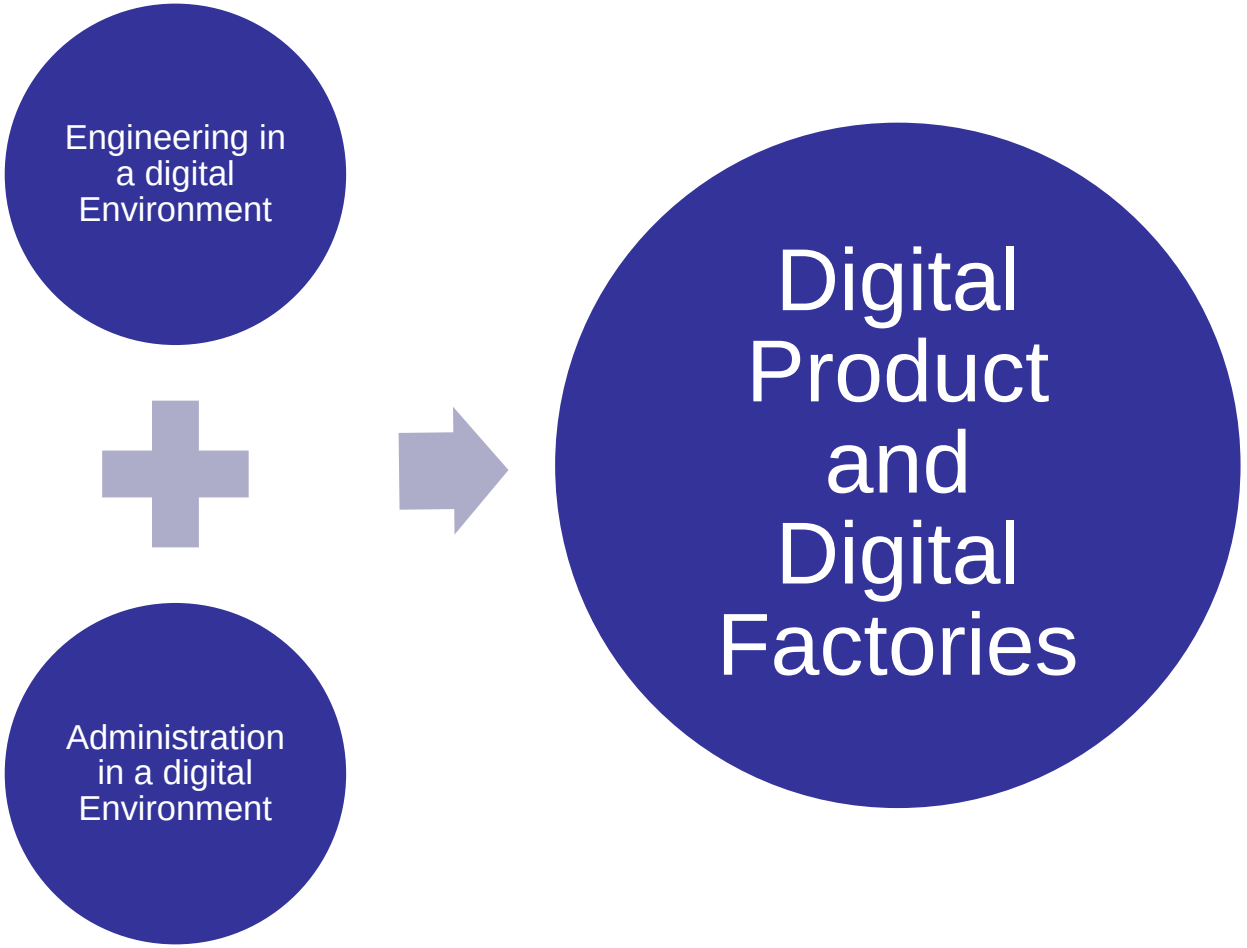
Factory value chain

- competitive products
  - flexible manufacturing
  - High-Speed Processing
- mass customization
- integration of products and processes based:
  - on agility
  - on request
- cooperation product value-chains on different geographical locations

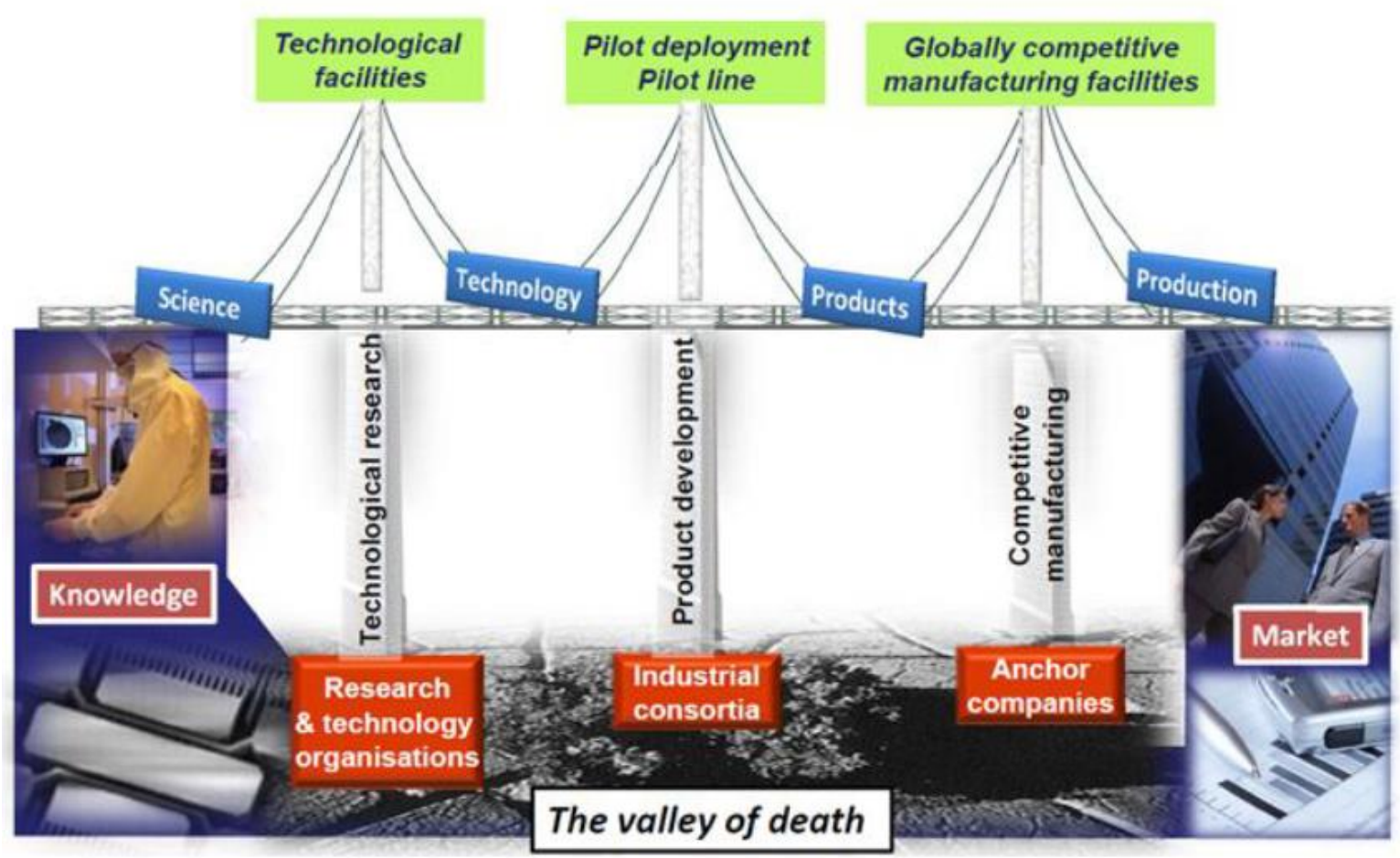
Factory and ICT

- **ICT is one of the most important key technologies for production**
  - integration all the business, technical, production and service processes life within cycle product
  - But it requires flexible working systems
- **IT support for industrial workers**
  - open platform technicians and integration Environmental management cycle product as a requirement of the industry (the digital world / real world)
  - Multiple Knowledge Based Engineering tools
- **ICT security standards and services**
  - Global standards for global cooperation
  - IT service for production, with particular emphasis on SMEs
- **E-learning at work**

Factory and ICT



Valley of death



Source: EU KET HLG Final Report

Priority

- priorities:
  - advanced manufacturing processes
  - adaptive and "smart" manufacturing systems
  - digital, virtual enterprises and enterprises to effectively working with resources
  - collaborative and mobile business - clusters
  - production with regard to human
  - production according to customer

Trends affecting production

- aging
  - future markets and products
  - human and labor organizations
- individualism
  - "tailored"
  - the relationship between man and working conditions
- knowledge in the global ICT
  - knowledge-based product development
  - optimization of production processes
- globalization
  - products and manufacturing technology for global markets
  - local conditions and regulations
- urbanization
  - environment, mobility, ...
  - New products for the city
  - work in big cities
  - factories in the urban environment
- sustainability
  - priorities for economic, environmental, social production efficiency

FAKULTA STROJNÍ
ZÁPADOČESKÉ
UNIVERZITY
V PLZNI

Contact

- Milan EDL
- University of West Bohemia in Pilsen
- Faculty of Mechanical Engineering
- Department of Industrial Engineering and Management
- University 22
- 306 14 Plzen
- e-mail: edl@kpv.zcu.cz