BRIGHT FRIDAYS

THE SCIENCE OF MAKING SCIENCE

POLITÉCNICO DE LEIRIA

Knowledge, Intangibility, Innovation

1

1

Which are the industries of the future and what is the role of the quadruple helix (Government, University, Companies and Society) in this transformation process?

Is Industry 4.0 more than a buzzword, or is it a combination of technological and organizational innovations that create more competitiveness, sustainability and satisfaction?

2

2

Why do industries change?

3

Innovation

4

Dynamics

5

5

6

The Knowledge Economy

THE CLASSICAL ECONOMY

Over the past 200 years, the economy neo-classical recognized only 2 factors of production:

Labor and Capital

S = S (K, L)

S - Function of classical production
K - Capital
L - Labor

7

The Knowledge Economy

THE NEW PRODUCTION FUNCTION

S = S (K, L, KN)

S - Function of classical production
K - Capital
L - Labor
KN - Knowledge (Intellectual capital)

8

Comment

1997 [edit]

This *Financial Times*–based list is up to date as of 30 September 1997.[79]

Rank	Name	Headquarters	Primary industry	Market value (USD million)
1	General Electric	United States	Conglomerate	222,748
2	Royal Dutch Shell	The Netherlands	Oil and gas	191,002
3	Microsoft	United States	Software industry	159,660
4	Exxon Mobil	United States	Oil and gas	157,970
5	The Coca-Cola Company	United States	Beverage	151,288
6	Intel Corporation	United States	Computer hardware	150,838
7	Nippon Telegraph and Telephone	Japan	Telecommunications	146,139
8	Merck	United States	Health care	120,757
9	Toyota Motor Corporation	Japan	Automotive	116,585
10	Novartis	Switzerland	Health care	104,468

1996 [edit]

This *Financial Times*–based list is up to date as of 30 September 1996.[80]

Rank	Name	Headquarters	Primary industry	Market value (USD million)
1	General Electric	United States	Conglomerate	136,515
2	Royal Dutch Shell	The Netherlands	Oil and gas	128,206
3	The Coca-Cola Company	United States	Beverage	117,258
4	Nippon Telegraph and Telephone	Japan	Telecommunications	113,609
5	Exxon Mobil	United States	Oil and gas	102,161

2019 [edit]

This list is up to date as of June 28, 2019. Indicated changes in ma

Rank	First quarter	Second quarter
1	Microsoft ▲904,860[10]	Microsoft ▲1,028,000[10]
2	Apple Inc. ▲895,670[11]	Amazon.com ▲928,540[12]
3	Amazon.com ▲874,710[12]	Apple Inc. ▲911,240[11]
4	Alphabet Inc. ▲818,160[13]	Alphabet Inc. ▼751,170[13]
5	Berkshire Hathaway ▼493,750[14]	Facebook ▲551,490[15]
6	Facebook ▲475,730[15]	Berkshire Hathaway ▲521,100[14]
7	Alibaba Group ▲472,940[16]	Alibaba Group ▼439,150[16]
8	Tencent ▲440,980[17]	Tencent ▼432,080[17]
9	Johnson & Johnson ▲372,230[18]	Johnson & Johnson ▼370,300[18]
10	ExxonMobil ▲342,170[19]	JPMorgan Chase ▲363,450[20]

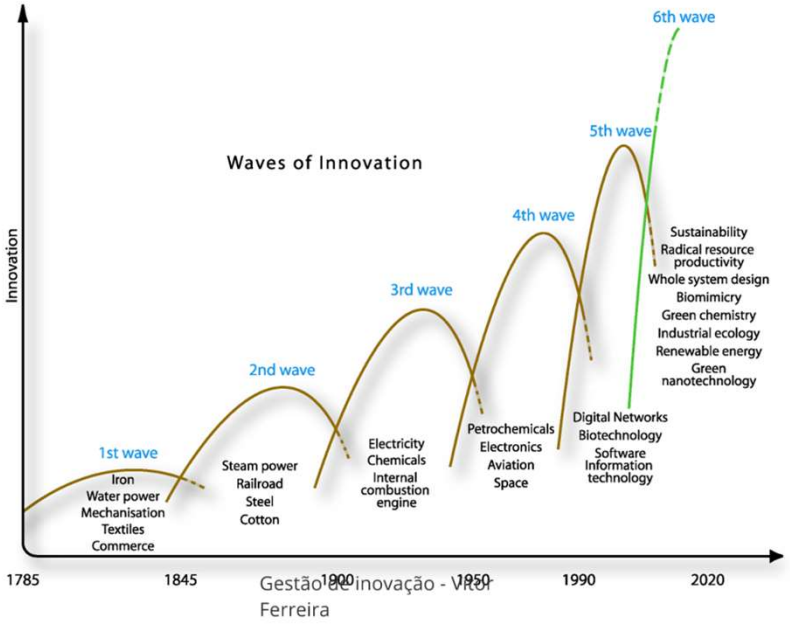
9

9






10



11

The "Industrial Revolutions" of Nick von Tunzelmann, 2003

	1st Industrial Revolution	2nd Industrial Revolution	3rd Industrial Revolution
Approximate Dates	1750-1815	1870-1914	1973 -
Location	UK	USA, Germany	USA, Sud. Asian
Technology	Machinery	Chemistry	ICT, biotechnology
(driving)	Water, steam	Electric., Petroleum	Nuclear, renewable
(materials)	Iron	Steel, plastics	Silicon, mat. intellig.
(transport)	Railways	Automobiles	Aviation
Automation	Transformation	Transfer	Of control
Process type	Work	capital	Information
Company	Little	Great	Mixed
Benefits	Specialization	Internal integration	External integration
Organization	Business	Multidivisional	Networked
Industrial structure	Competitive	Oligopolistic	Mixed
Type of capitalism	Personal	Manager	Collaborative
Governance mode	Markets	Hierarchies	Networks

Nick von Tunzelmann (2003), Historical coevolution of governance and technology in the industrial revolutions, *Structural Change and Economic Dynamics*, 14.

12

Industry 4.0

- Fourth industrial revolution - digitalization of industry and value chains;
- There are many technological components that allow the implementation of Industry 4.0 to a regular production line, but some of the most discussed are the Systems Cyberphysicists (CPS), Cloud computing, Artificial Intelligence (AI) and the Internet of Things (IoT).
- Other concepts: Production and training in AR / VR; Digital Manufacturing; Perspective centered on the human being;Big Data, Security, Sustainability, etc.

13

13

"From dumb to Smart"

- New connected systems;
- Intelligent machines and processes;
- Smart products;
- Smart factories;
- These elements can connect and exchange information with each other autonomously, trigger autonomous actions and direct production;
- The intelligent factory can "help people and machines in carrying out their tasks", based on information from the physical and virtual world.

14

14

15

16

17

PSS

- Xerox's copy-to-pay model for selling office equipment;
- The service package Power-by-the-Hour Rolls-Royce for aircraft engines, where maintenance, repair and overhaul services are charged per flight hour;
- Service Contract Air from Atlas Copco, where air compressors are sold per m^3 of compressed air supplied;
- The model pay-per-lux from Philips for the sale of lighting equipment, where customers pay a promised level of lighting in a building;
- Michelin's fleet management solution, according to which trucks are sold per kilometer traveled.

18

18

vitor.ferreira@ipleiria.pt