Challenges of globalization · Episode II

1. **Big history.** Big history is "the approach to history in which the human past is placed within the framework of cosmic history, from the beginning of the universe up until life on Earth today." (Spier, p. ix) "In big history, any question can be addressed concerning how and why certain aspects of the present have become the way they are. Unlike any other academic discipline, big history integrates all the studies of the past into a novel and coherent perspective." (Spier, p. xi) "The shortest summary of big history is that it deals with the rise and demise of complexity at all scales." (Spier, p. 21)

2. **Globalization in big history.** Big history adopts a process approach to human history. With respect to humanity, big history is concerned with the identification and explanation of major historical processes (and events and regularities, as well) in human history. Globalization is one such process. The list includes the agrarian revolution, the emergence of civilizations, state formation, the industrial revolution and industrialization…

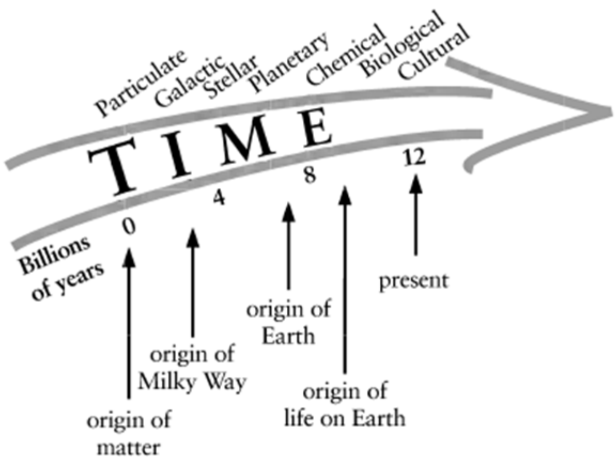
3. **Fred Spier's big explanation of big history.** "… the energy flowing through matter within certain boundary conditions has caused both the rise and the demise of all forms of complexity." (Spier, p. 21)

Spier, Fred (2010): *Big history and the future of humanity*, Wiley-Blackwell, Chichester, UK.

4. **A general theory of organized systems based on evolution.** Developments in several scientific disciplines suggest that the emergence, development, evolution and possible demise of organized systems (physical, biological, social systems) share strong similarities (Chaisson, p. ix). The prospect of unification in the study of these different domains appears plausible. Evolutionary thinking is a reasonable candidate for conducting the unification, so that it can be applied as well to pre-biological and post-biological domains.

5. **Cosmic evolution.** "… cosmic evolution is the study of change – the vast number of developmental generative changes that have accumulated during all time and across all space, from big bang to humankind." (Chaisson, p. 2) Cosmic evolution is not presumed teleological or anthropocentric: there is no implication of progression or directedness in the arrow of time. Humans are not the end product of cosmic evolution.

Illustration of cosmic history: The arrow of time and salient features in cosmic history, Chaisson, Fig. 1, p. 4

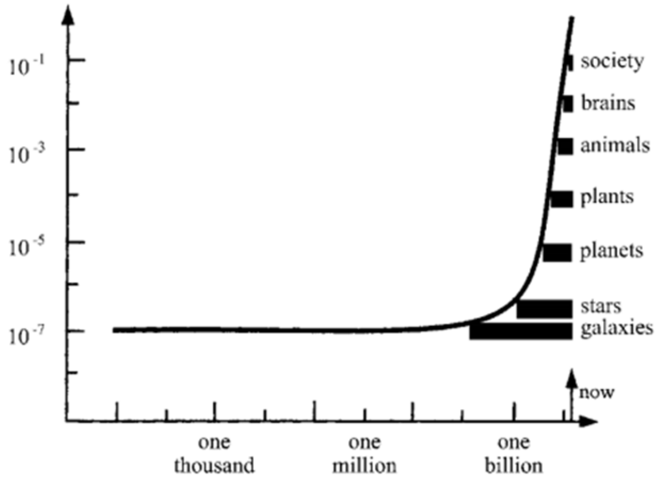


6. **Chance (randomness) and necessity (regularity) as instruments of change that lead to a rise in complexity.** "Nature is not clean and clear, not simple and equilibrated, not 'black and white,' but rather locally complex with shades of grey throughout; chance mixes with necessity, reductionism with holism, physics with biology" (Chaisson, p. 223).

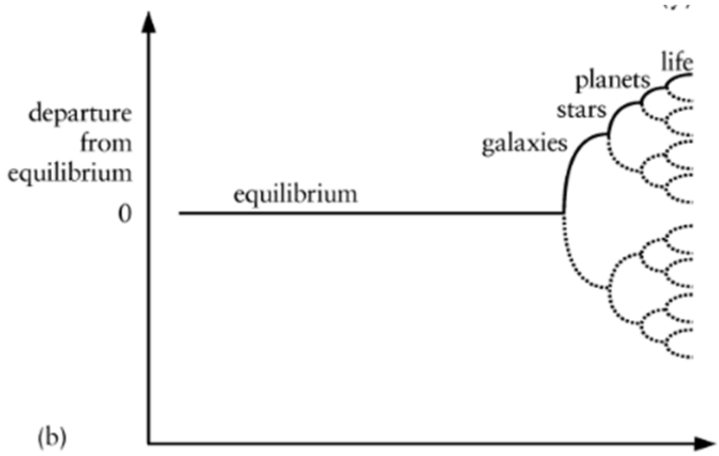
Chaisson, Eric J. (2001): *Cosmic evolution: The rise of complexity in nature*, Harvard University Press, Cambridge, MA and London, UK.

7. **Eric Chaisson's seven ages of the cosmos.** (1) Particle epoch ('simplicity fleeting'). (2) Galactic epoch ('hierarchy of structures'). (3) Stellar epoch ('forges for elements'). (4) Planetary epoch ('habitats for life'). (5) Chemical epoch ('matter plus energy'). (6) Biological epoch ('complexity sustained'). (7) Cultural epoch ('intelligence to technology').

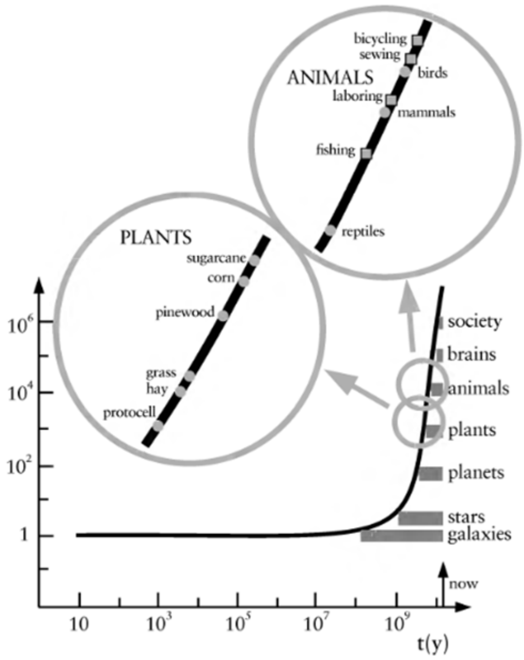
8. **Complexity and power densities.** Eric Chaisson has identified a correlation between complexity level in known entities and its associated power densities (energy that flows through an amount of mass per period of time); see chart immediately below on the left (on the vertical axis, energy rate density in watts/gram; on the horizontal axis, times in years). Humanity is responsible for the largest power densities in the known universe.



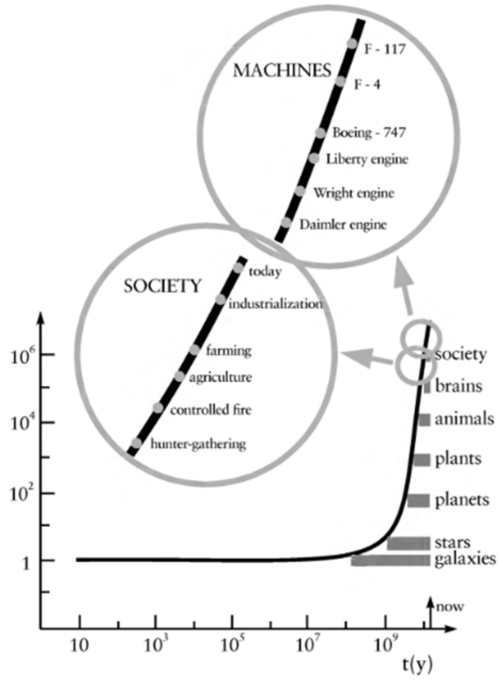
Chaisson (2005, p. 294)



Chaisson (2001, p. 140)



Chaisson (2001, p. 192)



Chaisson (2001, p. 205)

Chaisson, Eric (2005): Epic of evolution: Seven ages of the cosmos, Columbia University Press, New York.

9. **The Goldilocks principle**. As complexity can only emerge and exist under appropriate conditions and circumstances, the Goldilocks principle expresses the idea that all stable complex systems require certain conditions to emerge and last; see Spier (2010, pp. 36-40). In this respect, there are Goldilocks circumstances for a prosperous economy to arise and continue to exist; similarly, there are Goldilocks circumstances for a globalized economy (or the globalization phenomenon) to emerge and thrive.

10. **Waves of globalization**. Spier (2010, pp. 168-183) identifies three waves of globalization.

• First wave. Triggered by the European transatlantic voyages at the end of the 15th century. It was made possible by the exploitation of the energy stored in winds and ocean currents for transportation. As a result, Eurasia, Africa and the America became interconnected. A global trade network dominated by European states was established. Modern science was created during the first wave.

• Second wave. The second wave is the outcome of industrialization. The Industrial Revolution (end of the 18th century and beginning of the 19th century) was made possible by the attainment of a new complexity level based on the use of machines and the solar energy stored in fossil fuels (coal and oil). The Goldilocks conditions for industrialization initially favoured a single country: Great Britain. Its example was nonetheless quickly followed by other countries. Those countries that industrialized successfully reached unprecedented wealth levels, that eventually reached most of the population. Apparently, the continuation of the second wave required the elites to share the wealth created by industrialization with the rest of the population. Affluence was no longer a privilege of elites. Modern science and technology spread to businesses and society. A global division of labour also developed.

• Third wave. An ongoing wave associated with the current information technology revolution: electronic computers, global electronic networks, modern data technology… The term 'globalization' was coined during this wave. It is still uncertain whether the third wave will produce global convergence (in standards of living, cultural and political institutions, ideologies, world views, economic structures…).

11. **Globalization 1.0, 2.0, 3.0**. Thomas Friedman offers a similar typology of globalization episodes. In this account, states were the key agents in Globalization 1.0 (1492-1800), which hinged on the ability of states to mobilize resources. Multinational companies were the key agents in Globalization 2.0 (1800-2000), which involved the integration of labour and good markets, first through improvements in transport and next through improvements in communications. Individuals are the key agents in Globalization 3.0 (2000-?), who are being empowered by a convergence of digital technologies (personal computer, fiber-optic cable and software). This convergence has created a truly global community where anyone has access to massive amounts of information and can produce discoveries and innovations.

Friedman, Thomas L. (2007): *The world is flat 3.0: A brief history of the twenty-first century*, Picador, New York.

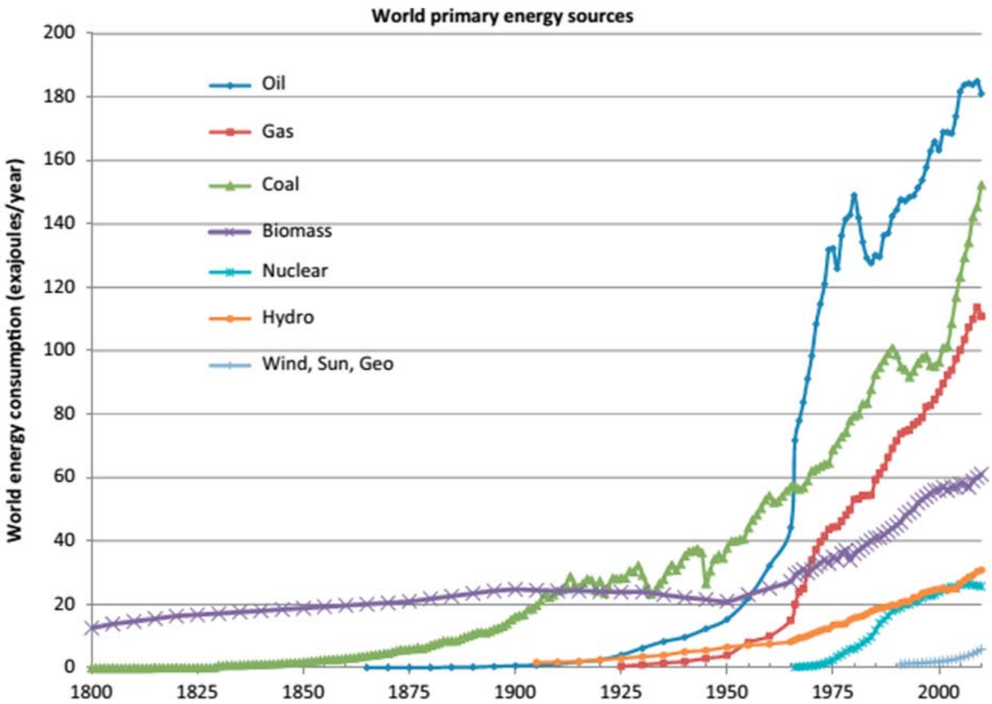
12. **Human future**. "To me and many others, the most fundamental question concerning our human future is whether the inhabitants of planet Earth will be able to cooperate in achieving the goal of reaching a more or less sustainable future in reasonable harmony, or whether the current large division between more and less wealthy people, as well as the unequal distribution of power within and among societies, will play havoc with such intentions." Spier (2010, p. 203)

	Energy Use in Watt per Capita
Hunting man	200
Primitive agricultural man	480
Advanced agricultural man	1,040
Industrial man	3,080
Technological man	9,200

Cook, Earl (1971): "The flow of energy in an industrial society," Scientific American 225(3), 134-147.

13. **The Towler principle**. "It is not possible to extract energy from the environment without having an impact on the environment." (Towler, p. 2)

Towler, Brian F. (2014): *The future of energy*, Academic Press, London.



Primary sources of energy in the world, 1800-2010 (Towler, p. 7)

14. Anthropocene. Term coined by ecologist Eugene F. Stoermer in the early 1980s. It designates a division of the Earth's history in which humanity has developed the capacity to affect significantly planet Earth (its surface, atmosphere and living environment). James Lovelock suggests the Anthropocene is connected with the flow of energy and started in 1712, when Thomas Newcomen invented an engine (the steam engine) capable of, for the first time, delivering a continuous flow of energy above a certain threshold for a sufficiently long period of time in an economically successfully way. Lovelock holds:

• that the Anthropocene is the start of a new evolutionary process ('accelerated evolution') that operates considerably faster than evolution by natural selection;

• that humanity was the agent that innocently put in motion a positive feedback process that, by consuming much of the easily available fuel, would release the Earth's stored energy;

• that humanity failed to notice that this process was an entirely new form of evolution with unexpected impacts on population growth, technological innovation, economic growth, the climate… ("No one knew enough in the eighteenth and nineteenth centuries to realize how large a change we were making");

• that this process has transformed humanity into the intelligent part of Gaia (the Earth system), the idea that the Earth is a live, self-regulating planet (Gaia was the Greek goddess of the Earth); and

• that sustainable retreat may be preferable to sustainable development, since humanity may lose control of a technological world in which invention proceeds exponentially.

Lovelock, James (2014): *A rough ride to the future*, Overlook, New York.

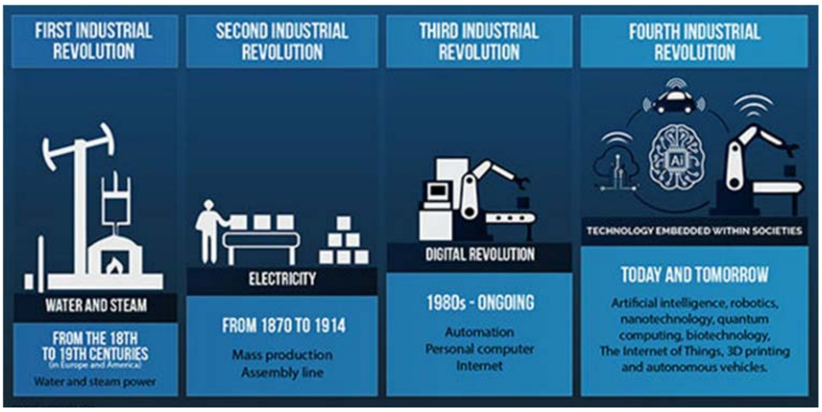
15. A tale of good news: the possibility of abundance. Diamandis and Kotler (2012) claim that, thanks to progress in exponentially growing technologies (such as robotics, computational systems, artifical intelligence, broadband networks, digital manufacturing, 3-D printing, nanomaterials, human-machine interfaces, synthetic biology, biomedical engineering…) "for the first time in history, our capabilities have begun to catch up to our ambitions. Humanity is now entering a period of radical transformation in which technology has the potential to significantly raise the basic standards of living for every man, woman, and child on the planet. Within a generation, we will be able to provide goods and services, once reserved for the wealthy few, to any and all who need them. Or desire them. Abundance for all is actually within our grasp." "Imagine a world of nine billion people with clean water, nutritious food, affordable housing, personalized education, top-tier medical care, and nonpolluting, ubiquitous energy. Building this better world is humanity's grandest challenge."

16. Emerging forces of abundance. (i) Exponential technologies: networks and sensors; artificial intelligence; robotics; digital manufacturing; infinite computing; medicine; nanomaterials; nanotechnology… (ii) The do-it-yourself innovator: "small groups of dedicated DIY innovators can now tackle problems that were once solely the purview of big governments and large corporations." (iii) The technophilanthropists: "The high-tech revolution created an entirely new breed of wealthy technophilanthropists who are using their fortunes to solve global, abundance-related challenges." The rich can, and will, save the world. (iv) The rising billion, the poorest of the poor. The combination of a global transportation network with the internet, microfinance and wireless communication technology are transforming the bottom billion into an emerging market force: the 'world's biggest market'.

Diamandis, Peter H.; Steven Kotler (2012): *Abundance: The future is better than you think*, Free Press, New York.

17. 100 things machines learnt to do in 2016. Sebastian Huembfer, https://goo.gl/fgKVAu

18. 'Artificial intelligence is the new electricity.' Quote by Andrew Ng. Just as during the Second Industrial Revolution the easy accessibility to electricity made mass production and assembly lines possible, artificial intelligence is seen as the crucial element for the Fourth Industrial Revolution (tool to power other technologies and be a new part of our lives).



Rouhiainen, Lasse (2018): *Artificial intelligence: 101 things you must know today about our future*.

19. Fourth Industrial Revolution (or Industry 4.0, term coined at the Hannover Fair in 2011). "By enabling "smart factories," the fourth industrial revolution creates a world in which virtual and physical systems of manufacturing globally cooperate with each other in a flexible way. This enables the absolute customization of products and the creation of new operating models. The fourth industrial revolution, however, is not only about smart and connected machines and systems. Its scope is much wider. Occurring simultaneously are waves of further breakthroughs in areas ranging from gene sequencing to nanotechnology, from renewables to quantum computing. It is the fusion of these technologies and their interaction across the physical, digital and biological domains that make the fourth industrial revolution fundamentally different from previous revolutions. In this revolution, emerging technologies and broad-based innovation are diffusing much faster and more widely than in previous ones, which continue to unfold in some parts of the world." (Schwab, 2017)

20. Drivers of the Fourth Industrial Revolution. "All new developments and technologies have one key feature in common: they leverage the pervasive power of digitization and information technology." (Schwab, 2017)

21. Why a Fourth Industrial Revolution is under way. (i) "Velocity: Contrary to the previous industrial revolutions, this one is evolving at an exponential rather than linear pace." (ii) "Breadth and depth: It builds on the digital revolution and combines multiple technologies that are leading to unprecedented paradigm shifts in the economy, business, society, and individually." (iii) "Systems impact: It involves the transformation of entire systems, across (and within) countries, companies, industries and society as a whole." (Schwab, 2017)

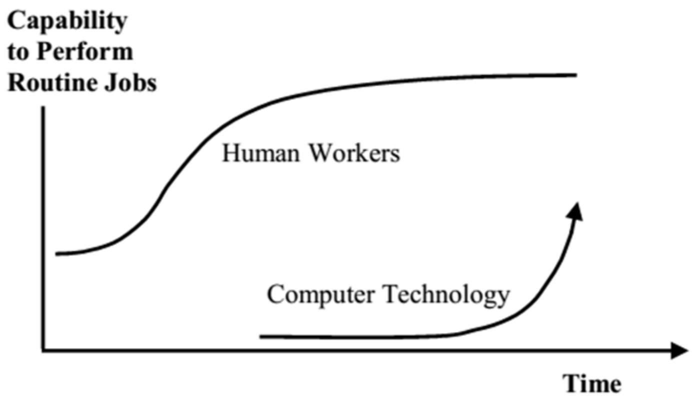
	%
10% of people wearing clothes connected to the internet	91.2
90% of people having unlimited and free (advertising-supported) storage	91.0
1 trillion sensors connected to the internet	89.2
The first robotic pharmacist in the US	86.5
10% of reading glasses connected to the internet	85.5
80% of people with a digital presence on the internet	84.4
The first 3D-printed car in production	84.1
The first government to replace its census with big-data sources	82.9
The first implantable mobile phone available commercially	81.7
5% of consumer products printed in 3D	81.1
90% of the population using smartphones	80.7
90% of the population with regular access to the internet	78.8
Driverless cars equaling 10% of all cars on US roads	78.2
The first transplant of a 3D-printed liver	76.4
30% of corporate audits performed by AI	75.4
Tax collected for the first time by a government via a blockchain	73.1
Over 50% of internet traffic to homes for appliances and devices	69.9
Globally more trips/journeys via car sharing than in private cars	67.2
The first city with more than 50,000 people and no traffic lights	63.7
10% of global gross domestic product stored on blockchain technology	57.9
The first AI machine on a corporate board of directors	45.2

Percentage of respondents who expect that the specific tipping point will have occurred by 2025, Deep Shift—Technology Tipping Points and Societal Impact, Global Agenda Council on the Future of Software and Society, World Economic Forum, September 2015.

Schwab, Klaus (2017): *The fourth industrial revolution*, Crown Business, New York.

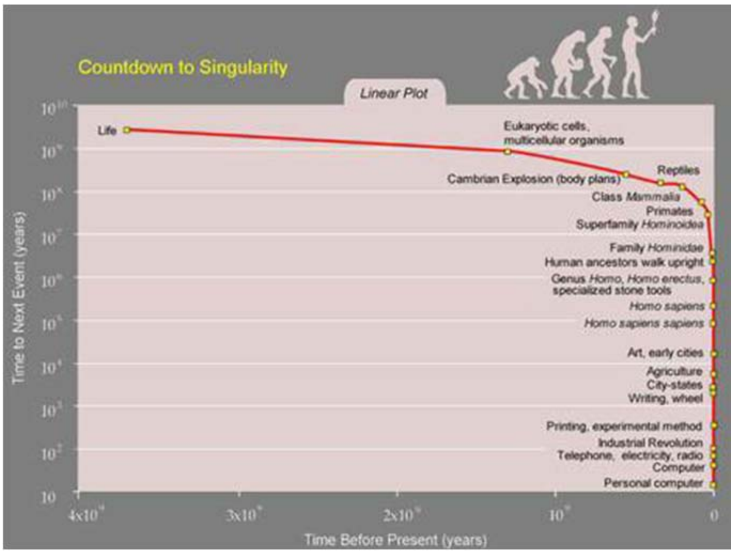
22. On automation (replacement of human jobs by machines). What if machines will eventually be able to do most jobs people currently do (jobs performed by typical people are automated) and that the people displaced by machines will not be able to find a new job? Martin Ford argues tha when "full automation penetrates the job market to a substantial degree, an economy driven by mass-market production must ultimately go into decline. The reason for this is simply that, when we consider the market as a whole, the people who rely on jobs for their income are the same individuals who buy the products produced." Since machines are not consumers, the more business automate jobs, the smaller becomes the consumer base; with a reduction in the potential set of consumers, business are forced to cut more jobs, so global demand is further narrowed down. Automation then sets in motion a downward spiral process in which the direct gains of automation in production are eventually neutralized by the indirect, global negative impact in consumers' demand.

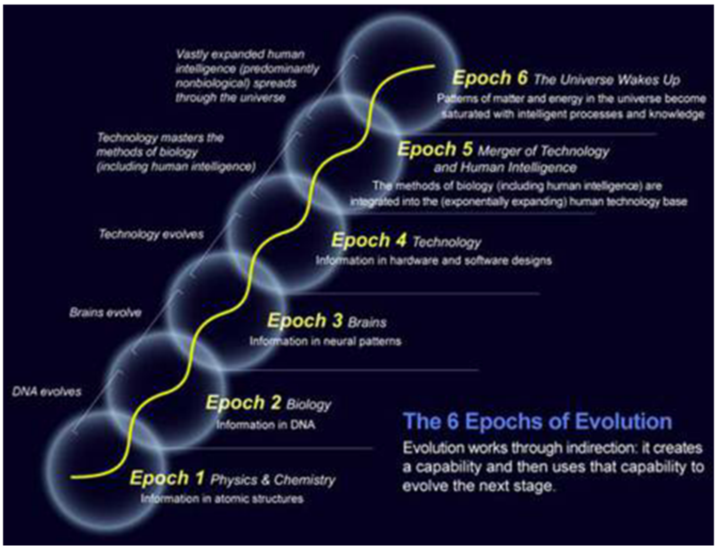
23. The Luddite fallacy fallacy? Named after the Luddite movement (start of the 19th century) advocating machine destruction, the Luddite fallacy refers to the claim that machine automation is incapable of creating unemployment at a global scale. The argument is that the unemployment caused by technological innovation (due to the workers' outdated skills) is temporary. On the one hand, automation reduces production costs and, therefore, prices, and that stimulates consumption demand. On the other, technological innovation allows new production activities to emerge and create new job opportunities. This line of reasoning encapsulates the conventional economic wisdom that technological improvements ultimately create jobs.



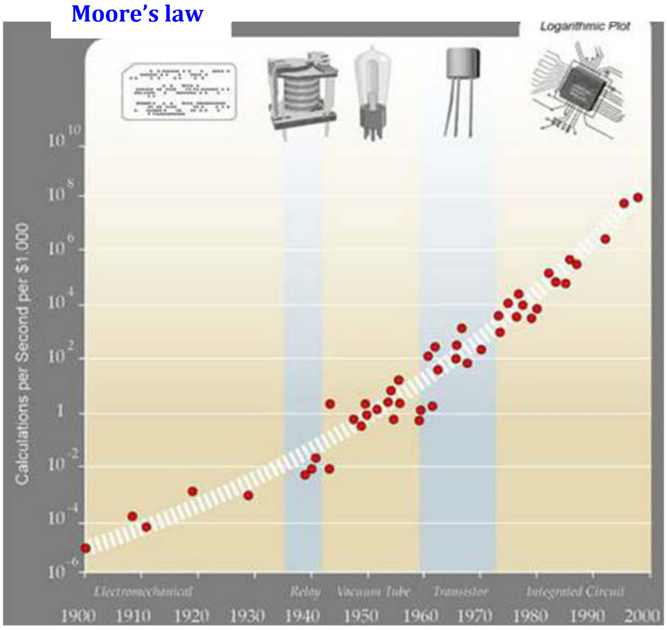
24. Human capability vs computer technology. Ford replies to the Luddite fallacy view that they suffer from a fallacy of composition effect. Specifically, that view rests on two premises: (i) machines help workers to raise their productivity; and (ii) the average worker can use machines to improve their productivity. "What happens when these assumptions fail? What happens when machines become workers—when capital becomes labor? It is important to note that such a change in the relationship between workers and machines will have a worldwide impact." "… technological progress will never stop, and in fact, may well accelerate. While today jobs that require low and moderately skilled workers are being computerized, tomorrow it will be jobs performed by highly skilled and educated workers." "The reality is that the Luddite fallacy amounts to nothing more than a historical observation. Since things have worked out so far, economists assume that they will always work out." (Ford, pp. 97-99)

25. The technological singularity (Ray Kurzweil). The technological singularity is the hypothesis that exponential technological progress will bring a dramatic change (seismic consequences) in human life and human societies (transcend our biological limitations). Kurzweil justified this hypothesis on the grounds of the 'law of accelerating returns.' A technology subject to this law progresses in proportion to its level: the better the technology, the more rapidly it becomes better. Moore's law is offered as an example: it is the conjecture, by Gordon Moore in the 1960s, that computing power (number of transistors in a fixed area, memory capacity) doubles every 1-2 years. Murray Shanahan hypothesizes that the technological singularity could be precipitated by developments in artificial intelligence and/or neurotechnology.





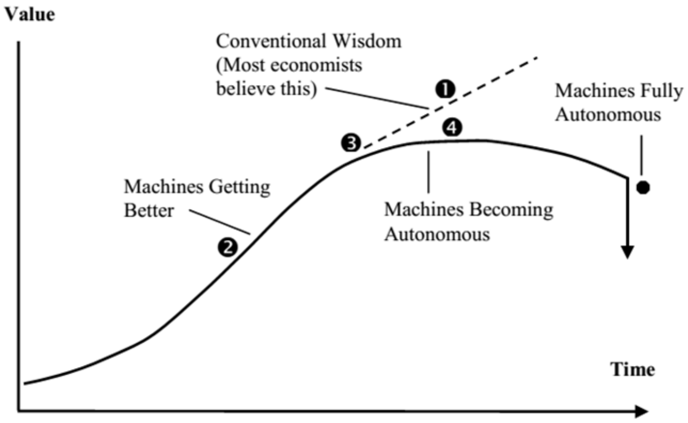
Moore's law



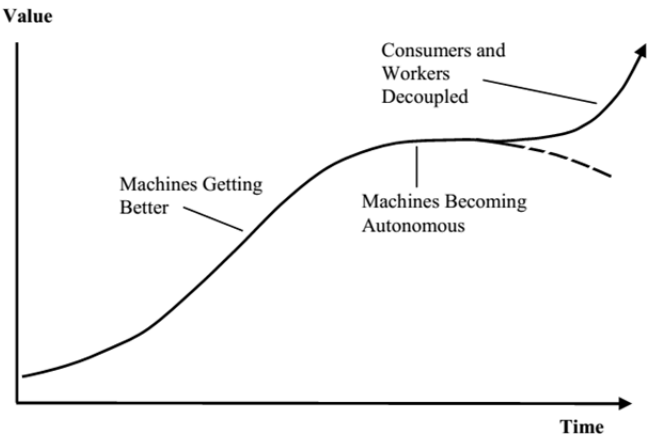
26. The singularity is near. "To this day, I remain convinced of this basic philosophy: no matter what quandaries we face—business problems, health issues, relationship difficulties, as well as the great scientific, social, and cultural challenges of our time—there is an idea that can enable us to prevail. Furthermore, we can find that idea. And when we find it, we need to implement it." (Kurzweil, 2005)

"As the figure demonstrates, there were actually four different paradigms—electromechanical, relays, vacuum tubes, and discrete transistors—that showed exponential growth in the price-performance of computing long before integrated circuits were even invented. And Moore's paradigm won't be the last. When Moore's Law reaches the end of its S-curve, now expected before 2020, the exponential growth will continue with three-dimensional molecular computing, which will constitute the sixth paradigm." Kurzweil (2005)

27. Economic paradox of the singularity: technology could kill itself off. "In a free market economy, (...) there is no incentive to produce products if there are no consumers with sufficient discretionary income to purchase those products. This is true even if intelligent machines someday become super-efficient producers. If average—or even exceptional—human beings are unable to find employment within their capabilities, then how will they acquire the income necessary to create the demand that in turn drives production? If we consider the singularity in this context, then is it really something that will necessarily push us forward exponentially? Or could it in actuality lead to rapid economic decline?" (Ford, p. 102)



Ford's 'scary graph': value added (wage, average income) of the average worker operating the average machine (Ford, p. 136: "As more machines begin to run themselves, the value that the average worker adds begins to decline.")



28. Where are we now? Ford's (pp. 224-25) four cases.

❶ "...conventional wisdom is correct, and the current crisis is just an aberration."

❷ "...we are still far away from the point where automation is going to become important."

❸ "...we are going to see increasing economic impacts, and we will have difficulty in achieving sustained, long-term growth. If I had to bet, I would choose this case."

❹ "If things have gotten away from us, then we could, in fact, be much further along than we imagine. This could perhaps be explained by suggesting that consumer borrowing masked the reality of the situation (...) and that the current crisis is the beginning of the reckoning (...) If this is the case, we need to adopt new policies rapidly."

Ford, Martin R. (2009): *The lights in the tunnel: Automation, accelerating technology and the economy of the future*, Acculant Publishing.

Kurzweil, Ray (2005): *The Singularity is near: When humans transcend biology*, Viking, New York.

Shanahan, Murray (2015): *The technological singularity*, MIT Press, Cambridge, MA and London, England.

29. Peter Frase's futures. The future world can end up dominated by either scarcity or abundance (reflecting ecological limits) and also by either hierarchy or equality (reflecting the political limits of a class society). Equality + abundance = communism ('from each according to their ability, to each according to their need'). Hierachy + abundance = rentism ('the techniques to produce abundance are monopolized by a small elite'). Equality + scarcity = socialism ('live within your means while providing everyone the best lives possible'). Hierachy + scarcity = exterminism ('communism for the few' and 'genocidal war of the rich against the poor').

	ABUNDANCE	SCARCITY
EQUALITY	Communism	Socialism
HIERARCHY	Rentism	Exterminism

Frase, Peter (2016): *Four futures: Life after capitalism*, Verso, New York.