

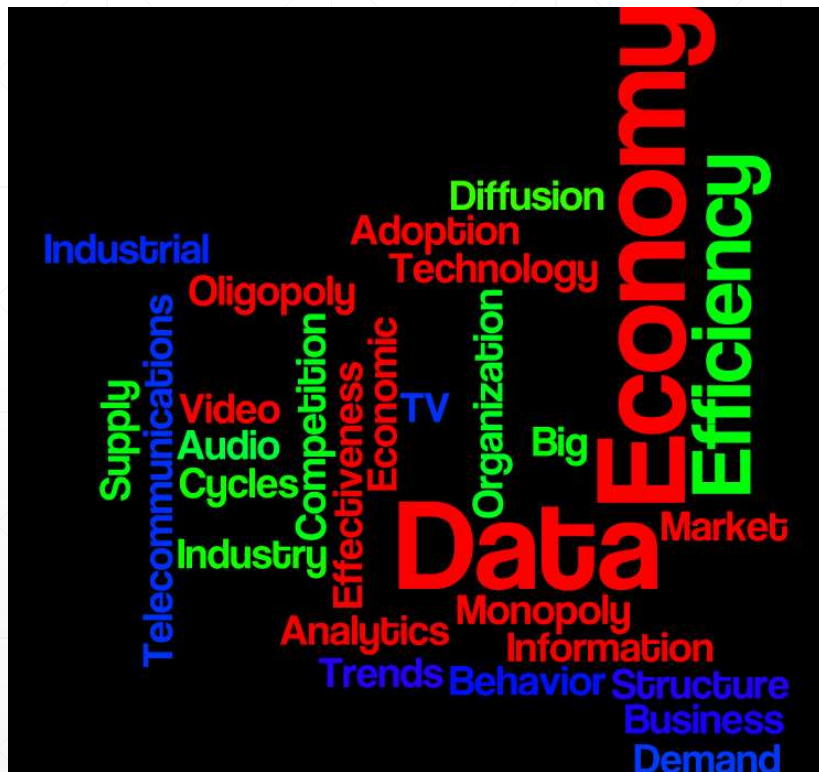
Digital Transformation

Class # 1: Welcome to the Digital Economy!

EPITA | Spring 2022

Valeriu Petrulian, PhD

Kick-Off



- Introductions
 - Student Roll-call
- Course outline
- Organization



Before we get started Organization

- Logistics:
 - ❑ WIFI
 - ❑ Video-projector
 - ❑ White board, paper board, pens, Post-It notes
- We will have several group work sessions during the lecture, please organize yourselves in work groups. Individual participation is largely encouraged. Please try to participate to all team works and throughout the sessions.
- Prior to each class, you will be asked to read 1-2 articles/papers about the specific topics to be addressed during the course

Remote Learning | COVID19

- MS Teams
 - Mainly F2F, online presence for students who are not yet in France
 - We'll use MS Teams for communications
 - Quiz – Tool: MS Forms integrated with Teams
 - Course materials upload
 - Readings prior to each class
- Breaks

Course Outline

- We are living in a world driven by digital technologies. And unlike previous technology-driven major society shifts, the current wave of innovation has the potential to fundamentally change the way individuals behave, companies and whole industries operate and, some believe, the nature of work itself.
- The purpose of this course is to provide a multidisciplinary perspective (from a technological, economic, management standpoint) on Digital Transformation, as a fundamental trend in today's economy.
- The course starts by discussing the fundamental aspects of technology adoption by individuals and organizations. Then, it deep-dives in several major technology trends (IoT, Big Data, AI, ...). Finally, the course examines the behavior of Digital Platforms, in their role of key players of today's Digital Economy, thereby illustrating the role digital technologies play in transforming industries, markets and organizations.
- The course allows students to dive in, analyze, and attempt to bring answers to some of the underlying challenges of the Digital Economy, such as:
 - How is digital innovation, and its supposedly inherent disruptive nature, shaping business organizations? Have all technologies the same potential for innovation?
 - Are the work structure and traditional value chain inherited from past industrial revolutions still valid in a digital world?
 - Are digital platforms the business model of choice in the digital economy?

Course Breakdown

EPITA Spring 2022 | Option 1

Class	Date & Time Topics
Class # 1	Welcome to the Digital Economy!
Class # 2	Technology Trends # 1: Internet of Things (IoT), Blockchain
Class # 3	Technology Trends # 2: Big Data & Artificial Intelligence (AI)
Class # 4	Digital Platforms
Class # 5	Final Presentations and Course Wrap-Up

Today's Reading:

- **Geoffrey Moore.** *Darwin and the Demon: Innovating Within Established Enterprises.* Harvard Business Review, July–August 2004 Issue

Learning environment

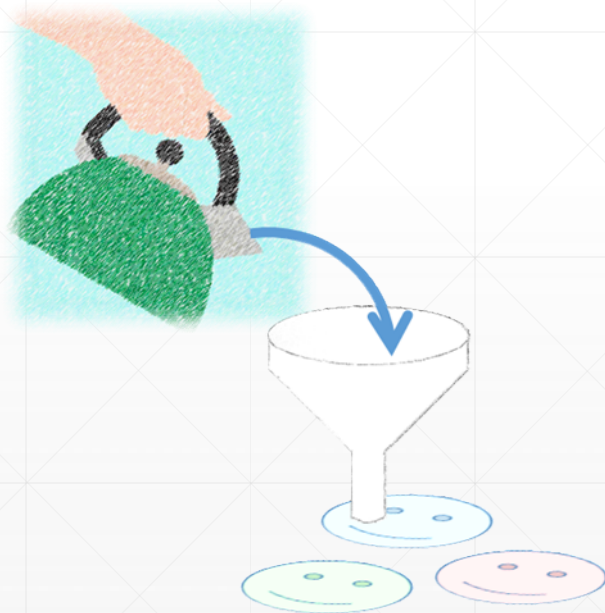


Image source: <http://clipart-library.com/clipart/1308819.htm>

Digital Transformation

Final Grade

Final Composition	Grade Class attendance and participation throughout the lecture	Course (MCQ)	quiz	Final presentation (group or individual)
	30%	20%		50%

Presence
Questions asked, "hands raised"
Participation to class assignments and group discussions

A project (essay), in the form of a question to which students will answer through a carefully drafted presentation (.ppt presentation)

Final presentation

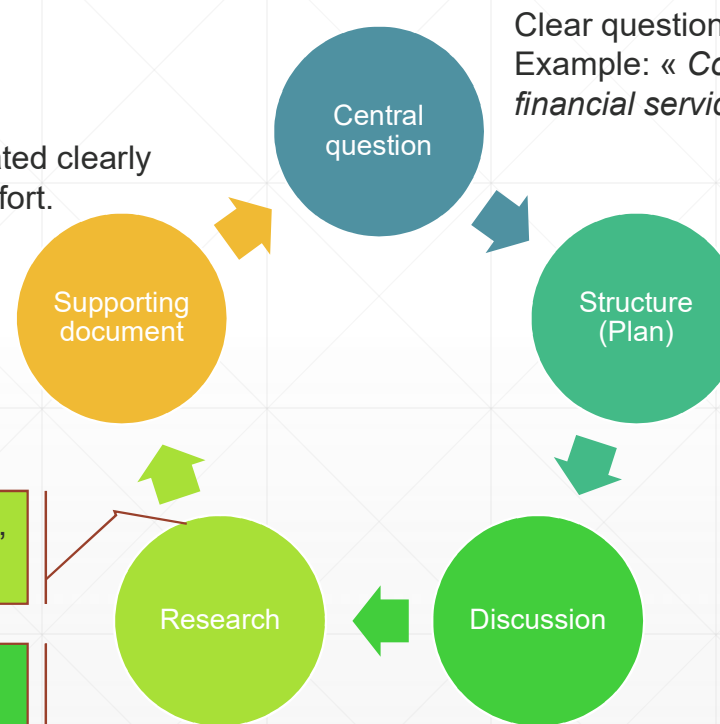
Structure and expectations

In a **group presentation**, it should be stated clearly (in writing) 'who did what' in the overall effort.

A carefully drafted presentation (.ppt presentation), produced either individually or as a group effort

Original research (articles, figures, charts, ...) should be **properly quoted**

Utilization of the course's ideas and concepts in order to sustain the analysis



Clear question in close relationship with the course's topics
Example: « *Could several business models coexist in the financial services industry ?* »

Outline of presentation

Example:

- FSI – an overview
- Existing Business models
 - Traditional Banks
 - Independent services providers
 - Neo-banks
 - ...
- Coexistence of business models:
 - A 5-F comparison between BM 1 and 2
- Conclusion:
 - Ex: "Traditional banks are challenged by new entrants but they're fighting back"

Digital Transformation ()

Final Presentation | Subject Examples

1. Using an example of your own, please elaborate on IoT's or on Blockchain's « enabling technology » nature and its impact on an industry of your choice
2. Using an example of your own, please elaborate on AI's « general purpose technology » nature and its impact on an industry of your choice
3. Please discuss existing potential internal limitations of a digital technology of your own. Elaborate on how such limitations impede the technology's adoption process and identify mitigation measures and initiatives in a concrete setting of your choice
4. Illustrate, using an example of your own, how digital changes:
 - a) An industry (ex: automotive)
 - b) A company (for example: a social network becoming a media company, a telecom company becoming a bank, an industrial company becoming an IT company)
 - c) A firm function (marketing/sales, production/operations, finance/accounting, HR, etc...)
5. Elaborate, through an example of your own, on the main differences between a platform business model and a P2P business model
6. Illustrate, through an example of your own, how a Digital Platform is leveraging digital technologies, as compared to a company in the same business that has not chosen the platform business model
7. Describe a digital platform ecosystem and discuss its strengths and weaknesses compared to an open, multiple-party non-platform environment

Digital Transformation ()

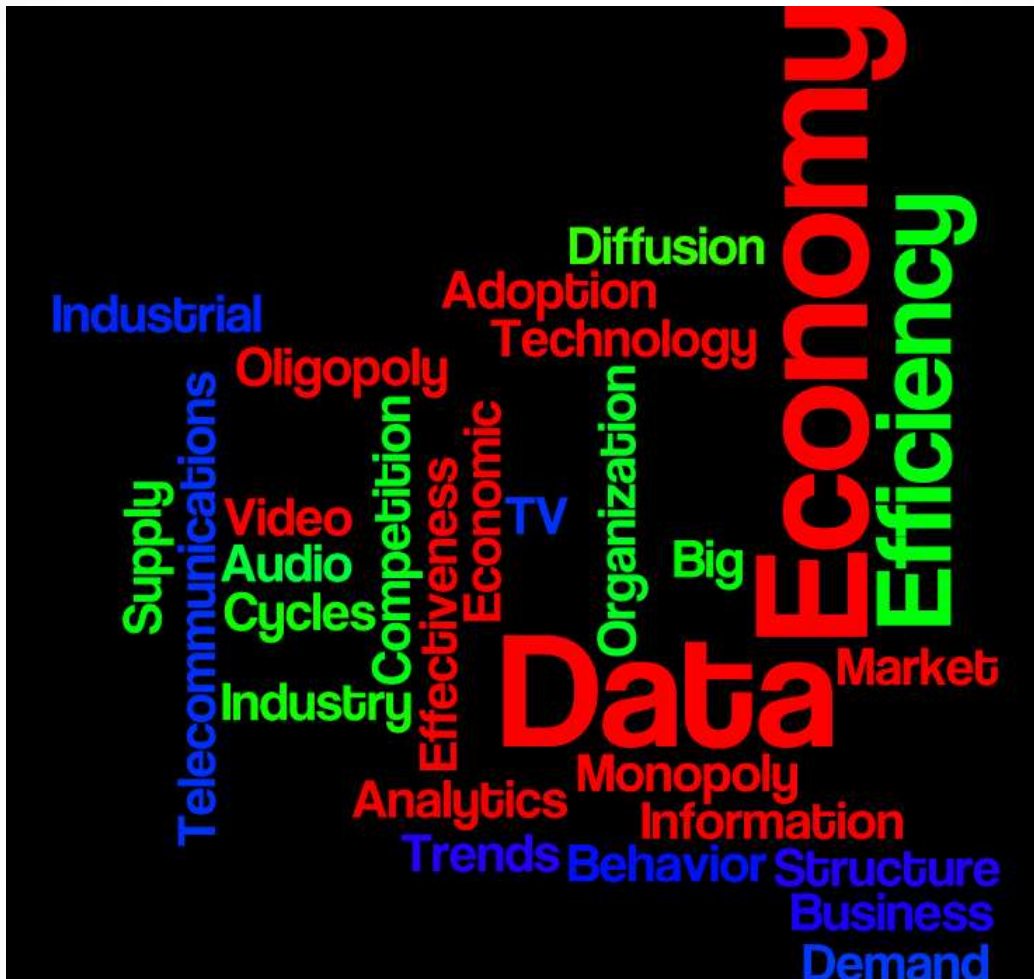
Final Presentation | Guidelines

1. Be specific, concrete and focused
 - **Ex:** Don't talk about how AI may impact an industry, in general, but rather choose a specific industry aspect and analyse AI's impact from this narrower, more focused perspective
2. Try avoiding generalities and « usual suspect » examples
 - **Ex:** Rather than doing another, nth, presentation on Google, Tesla, Apple and the like, consider that perhaps finding a less known company would be more interesting. And if you still do want to talk about these highly-publicized companies, try to find a new angle
3. Use resources for what they are: sources to develop your own analysis and point of view
 - **Ex:** Avoid utilizing exclusively a single resource (report, book, famous author), it is not what other people think and say that is important, but rather what your own opinion on the matter is

Digital Transformation ()

Final Presentation | Timeline

1. (Class 1): Choice between group or individual, groups are formed
2. (Class n-2): Subjects are chosen, contents is discussed with professor
3. Class (n-1): Additional guidelines, if needed
4. Class (n): Final Presentations
 - INDIVIDUAL WORK
 - Either chosen, prepared and presented individually
 - Or, chosen as a group subject, but prepared and presented individually. **In this case, it should be made crystal-clear for everybody on who prepared what in the final presentation (who did what).**



Class # 1 Welcome to the Digital Economy!

Digital Revolution and 5th
Technological wave

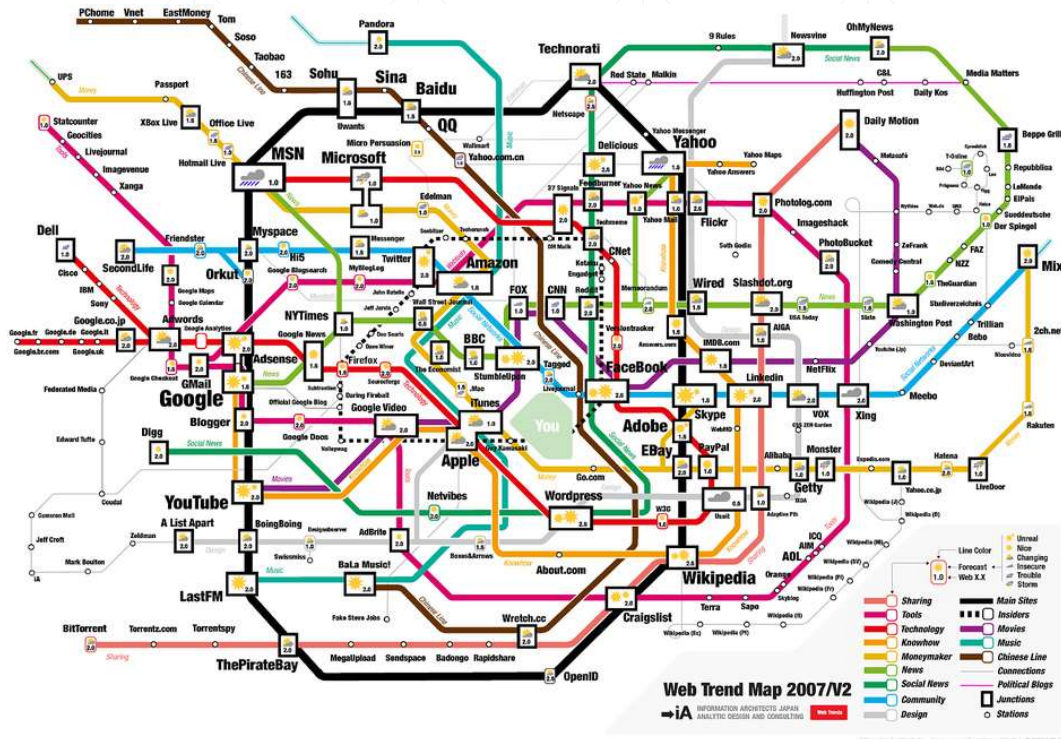
Forces driving the Digital Economy

Technology-Driven Long Business
Cycles

Technology Adoption

Today's Digital Economy ...

WE
ARE
HERE



[https://en.wikiquote.org/wiki/Information_age#/media/File:WebTrends_2007_otro_mapa_de_web_2.0_\(1149873101\).jpg](https://en.wikiquote.org/wiki/Information_age#/media/File:WebTrends_2007_otro_mapa_de_web_2.0_(1149873101).jpg)

- Highly interconnected and interdependent
- Changing rapidly
- High pace of technology innovation
- At the beginning, limited to “high-tech” industries, now spreading fast throughout the economy
- Highly virtual but not so immaterial
- Information and data as new “oil” or “currency”

Digital Economy

Digital Revolution or 4th Industrial Revolution



<https://www.weforum.org/agenda/2015/09/fourth-industrial-revolution/>

Digital Economy

Five technological industry cycles

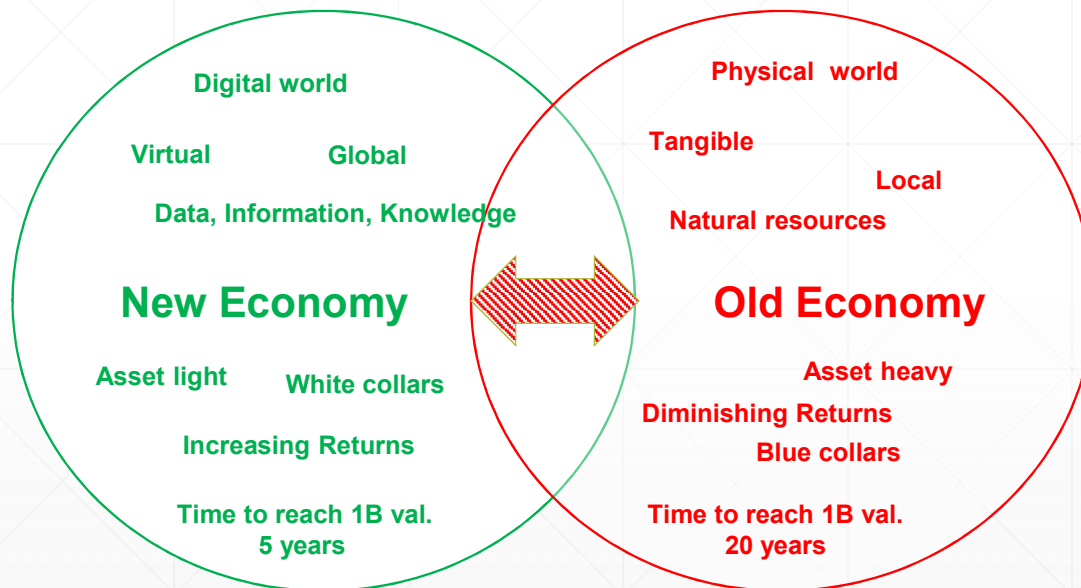
The five technology revolutions in modern economy

	Name	Home	Trigger	Year
5	Personal computers and networks	United States	Intel Microprocessor	1971
4	Automobile and mass production	United States	Ford T-Model	1908
3	Steel and electricity	United States and Germany	Ironworks	1875
2	Steam engine and railroads	Great-Britain	Rocket-train	1829
1	Industrial Revolution	Great-Britain	Spinning Machine	1771

(Adapted from Carlota PEREZ, *Technology Revolutions and Financial Capital*, 2003)

Digital Economy

It's no longer about “new” vs “old” economies



- Digitalization of all industries is rapidly blurring the traditional sector borders
- Not only the frontiers between traditional industries are disappearing...
- ... but also, the divide between the « old » (non-digital) and « new » (digital) economies is slowly being absorbed

Forces shaping the digital economy



1. Technology adoption by businesses and individuals
2. Fundamental underlying “laws and principles” and their consequences:
 - Convergence of networks and interconnectedness
 - The rise of the internet
 - Affordability of technologies
 - “Long” innovation cycles

Digital Transformation Technology Adoption



https://fr.wikipedia.org/wiki/Machine_analytique

https://en.wikipedia.org/wiki/File:Turing_machine_1.JPG

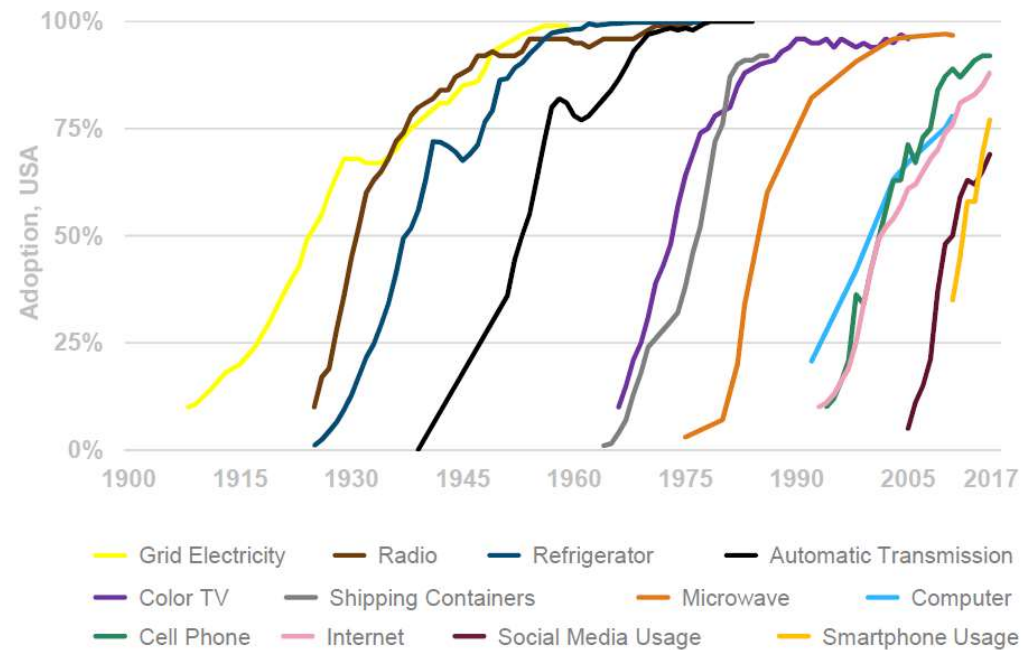
https://en.wikipedia.org/wiki/Mainframe_computer

https://en.wikipedia.org/wiki/IBM_PC_compatible

<http://www.theguardian.com/commentisfree/2015/jun/25/wikipedia-editors-dying-breed-mobile-smartphone-technology-online-encyclopedia>

Technology Adoption 1/2

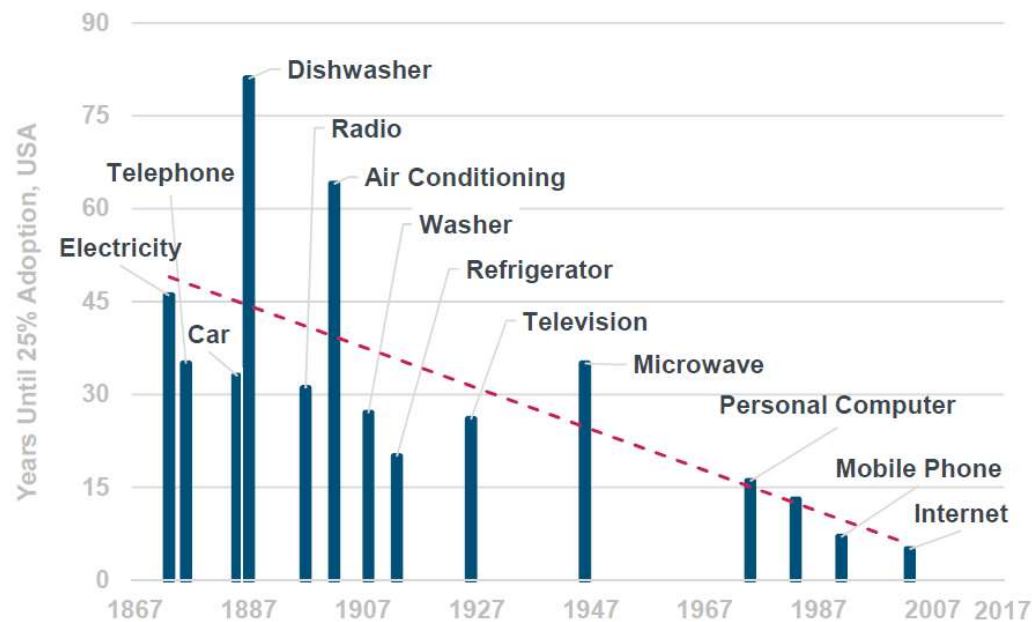
New Technology Proliferation Curves*



Kleiner Perkins. *Internet Trends Report* by Mary Meeker. 2018

Technology Adoption 2/2

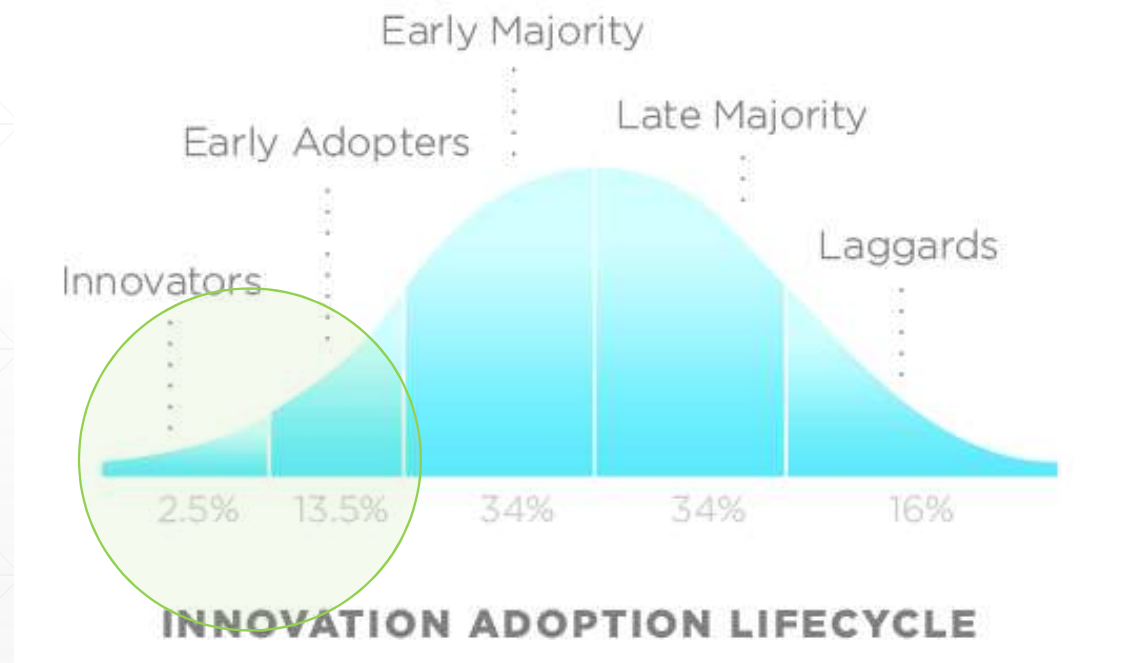
New Technology Adoption Curves



Kleiner Perkins. *Internet Trends Report* by Mary Meeker. 2018

Technology Adoption

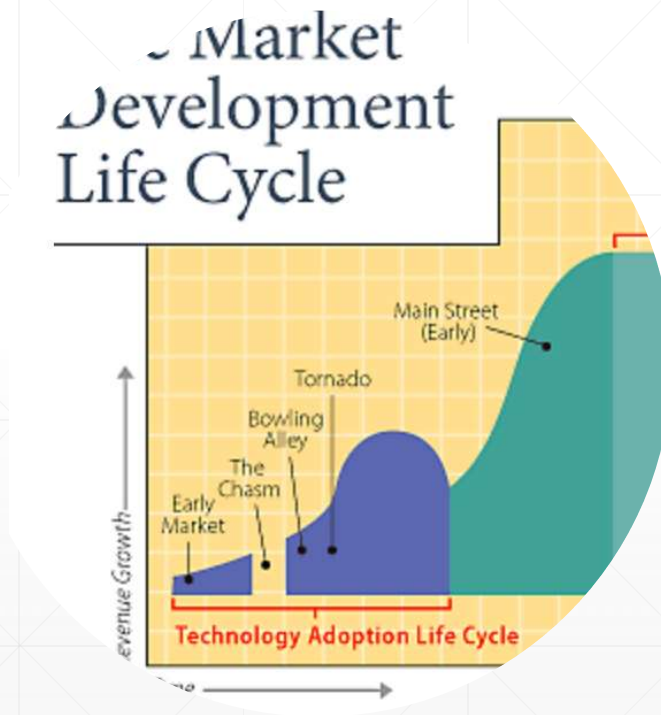
A framework



The Diffusion process. Joe M. Bohlen, George M. Beal and Everett M. Rogers
https://en.wikipedia.org/wiki/Technology_adoption_life_cycle#/media/File:DiffusionOfInnovation.png

Technology Adoption

A refinement to the original framework



In Geoffrey Moore's Market Development Lifecycle, the early adoption stages are:

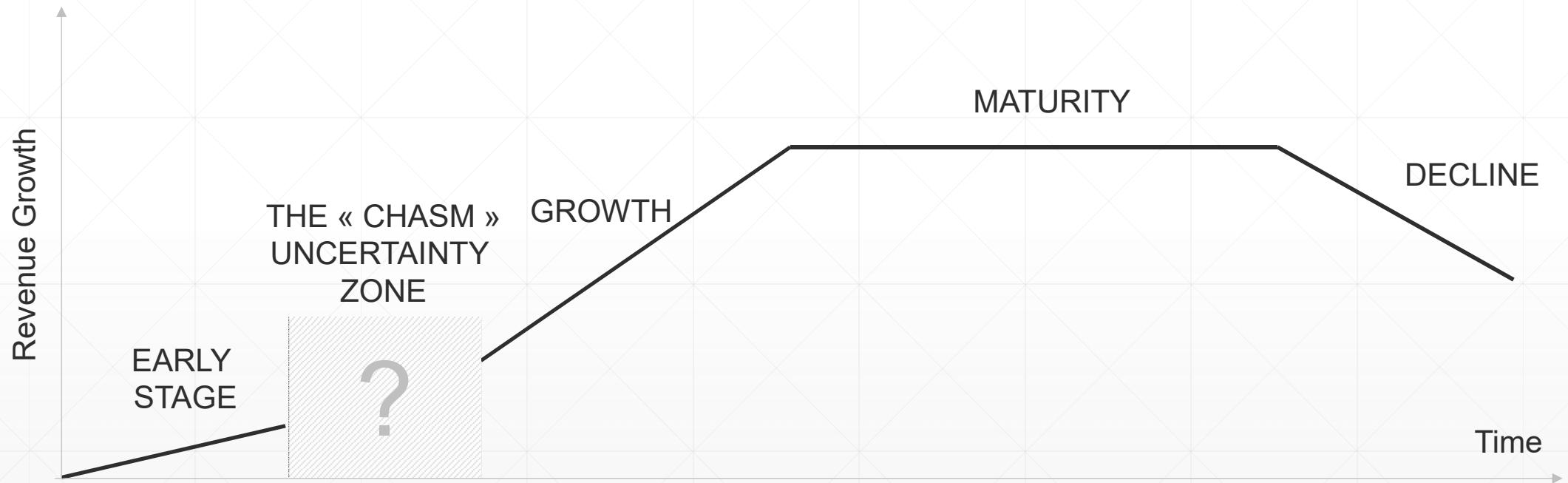
1. **Early market** (visionaries and technology enthusiasts)
2. **The Chasm** (looking for niches)
3. **Bowling alley and Tornado** (new applications have been found, market is experiencing growth)

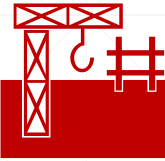
<https://hbr.org/2004/07/darwin-and-the-demon-innovating-within-established-enterprises>

Darwin and the Demon: Innovating Within Established Enterprises. by Geoffrey Moore, July – August 2004 HBR Issue

Technology Adoption

Our framework

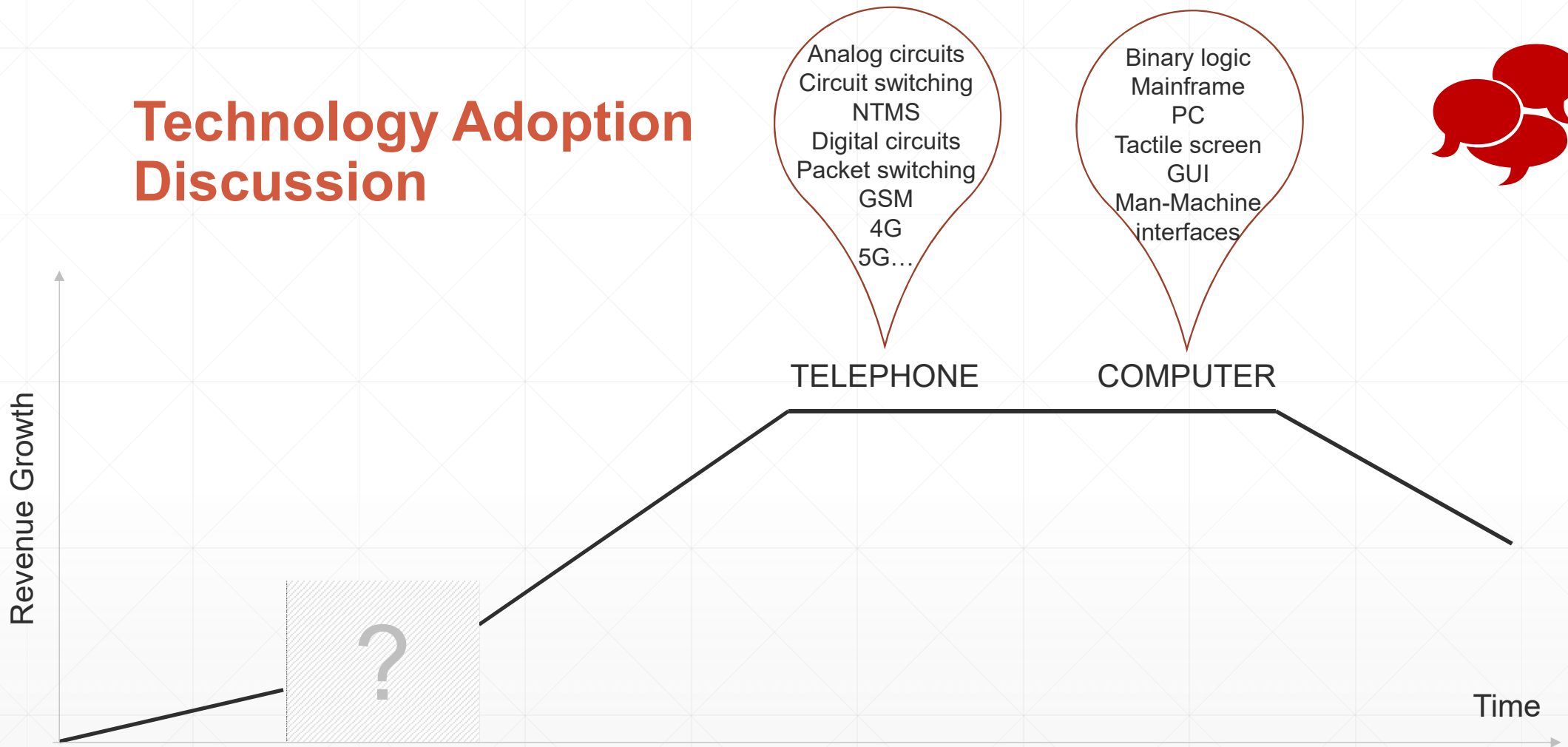




Class assignment # 1

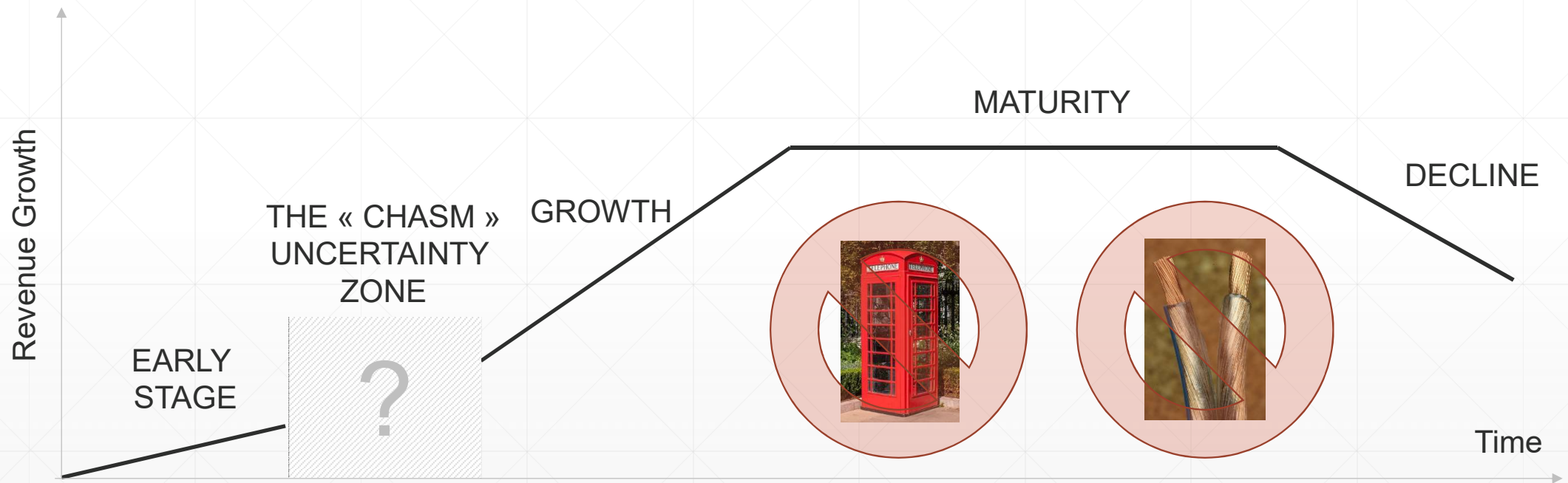
- Choose one of the proposed items below and **position it in our technology adoption cycle**. Explain how the chosen item has appeared, evolved and how you foresee its future, for example:
 - How has it appeared (i.e. from existing technology or 'out of the blue')?
 - Evolution over time
 - Transition from one stage to another (early stage, market growth, etc)
- Proposed items
 - **Internet of Things (IoT)**
 - **Artificial Intelligence Systems**
 - **Big Data Technologies**
 - **Blockchain**

Technology Adoption Discussion



Technology and Information Industries

The telecommunications industry



The telecommunications industry

What has happened along the way...

JOBS THAT HAVE DISSAPEARED



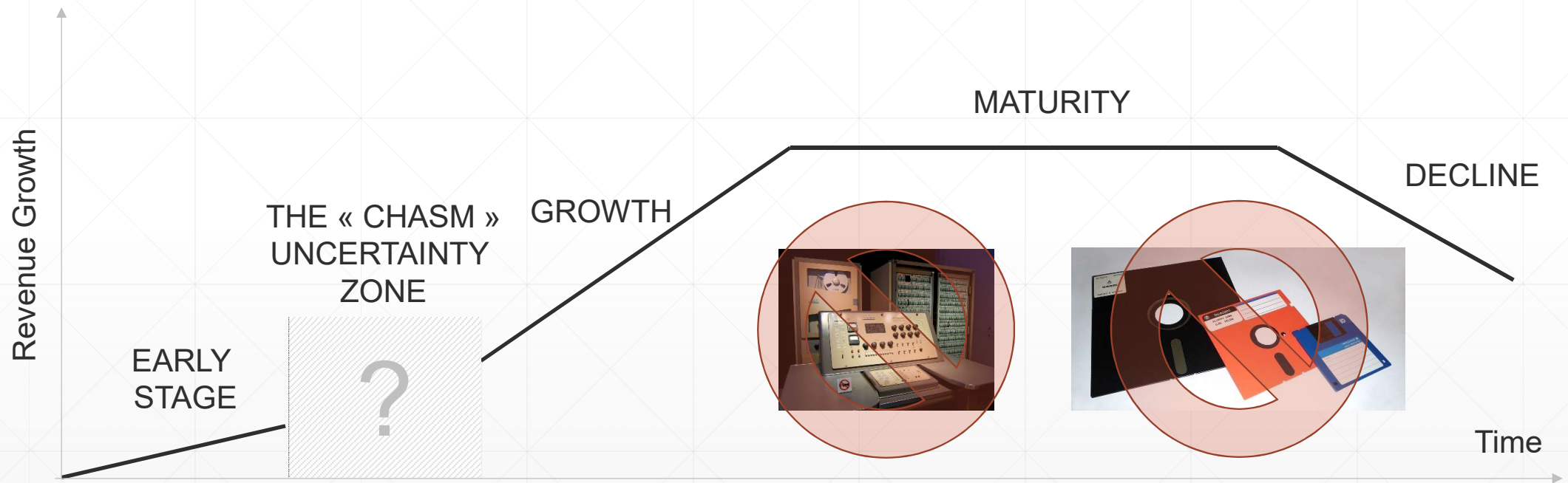
Switchboard Operators
Picture: © Getty - Hulton Archive

COMPANIES TRANSFORMED, OR ELSE ...

- France Telecom => Orange
- British Telecom => BT Retail, BT Wholesale, BT Openreach, EE
- RIP:
 - Nokia,
 - Siris,
 - Cegetel,
 - LDCOM, ...

Technology and Information Industries

The computer industry



The computer industry

What has happened along the way...

JOBS THAT HAVE DISSAPEARED



Accounting Clerks and Typists

Picture: https://www.officemuseum.com/Large_Office_by_Nat_Phographic_Advertising_Co_Chicago.jpg

COMPANIES TRANSFORMED, OR ELSE...

- Microsoft
- Oracle
- IBM
- RIP
 - Silicon Graphics
 - Digital Equipment Corporation
 - Sun

Fundamental “laws and principles” and their consequences

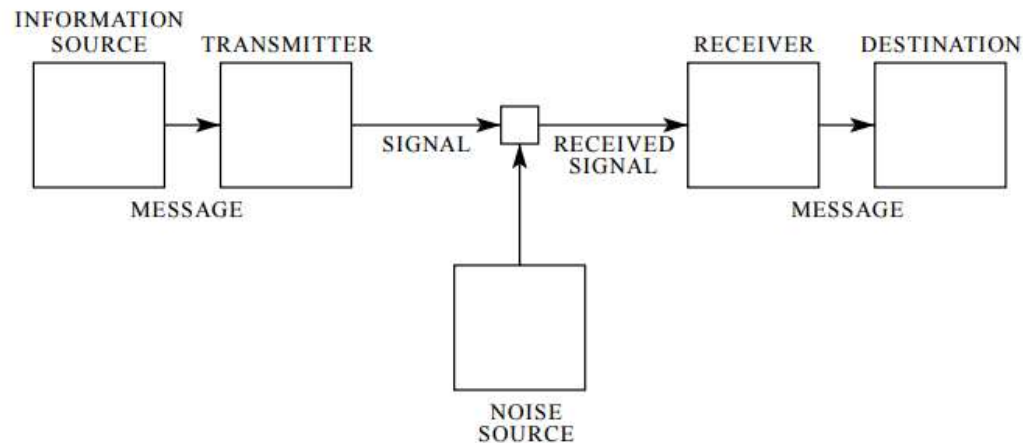


Fig. 1— Schematic diagram of a general communication system.

Claude E. SHANNON. *A Mathematical Theory of Communication*.
The Bell System Technical Journal, Vol. 27, pp. 379–423, 623–656, July, October, 1948.

Claude Shannon's Information Theory

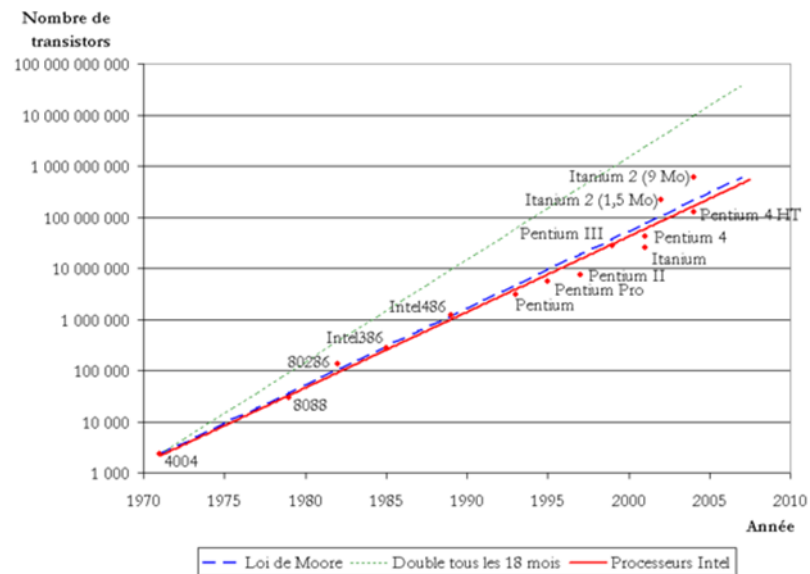
It has been formalised by Claude E. Shannon in a 1948 landmark article.

Additional developments to the information theory include those of Adrian Mc Donough (Information economics, 1963) who defines information as the meeting between data and a problem. In such a setting, data is the cost side and information is the value side of the information system.

In management, Russel Ackoff (1967) has stated that beyond a certain amount of data, the amount of information diminishes.

Implications of Shannon's Information Theory

1. Relationship between INFORMATION and DATA
 - SIGNALS => BITS OF INFORMATION
2. It became possible to reconstruct a signal at the receiving end, even in case of partial information alteration, due to noise, for example
3. It highlights the correlation between the amount of information and the capacity of the media to handle it correctly



https://fr.wikipedia.org/wiki/Loi_de_Moore#/media/File:Loi_de_Moore.png

Moore's Law(s)

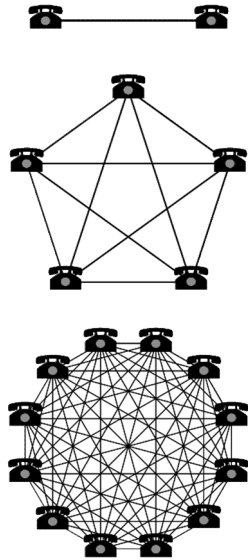
Gordon E. Moore (one of the founders of Intel) has stated that:

1965: « The number of transistors in a semiconductor chip doubles every year »

1975: « The number of transistors in a microprocessor doubles every 2 years »

Implications of Moore's law

1. Increasingly faster, more powerful (=more knowledgeable?) computers
2. MINIATURISATION
3. The frontiers between the « ANALOGUE » and « DIGITAL » worlds have gradually disappeared
 - SENSORS – PROCESSORS
 - => CYBER-PHYSICAL SYSTEMS



Metcalfe's Law: https://en.wikipedia.org/wiki/Metcalfe%27s_law

Reed's law

From Wikipedia, the free encyclopedia

Reed's law is the assertion of [David P. Reed](#) that the [utility](#) of large [networks](#), particularly [social networks](#), can [scale exponentially](#) with the size of the network ^[1].

The reason for this is that the number of possible sub-groups of network participants is $2^N - N - 1$, where N is the number of participants. This grows much more rapidly than either

- the number of participants, N , or
- the number of possible pair connections, $N(N - 1)/2$ (which follows [Metcalfe's law](#)).

so that even if the utility of groups available to be joined is very small on a per-group basis, eventually the [network effect](#) of potential group membership can dominate the overall economics of the system.

Reed's Law: https://en.wikipedia.org/wiki/Reed%27s_law

Metcalfe's Law Reed's Law

Metcalfe: The value of a network is proportional with the square number of its users

Reed: The importance of subgroups in network formation

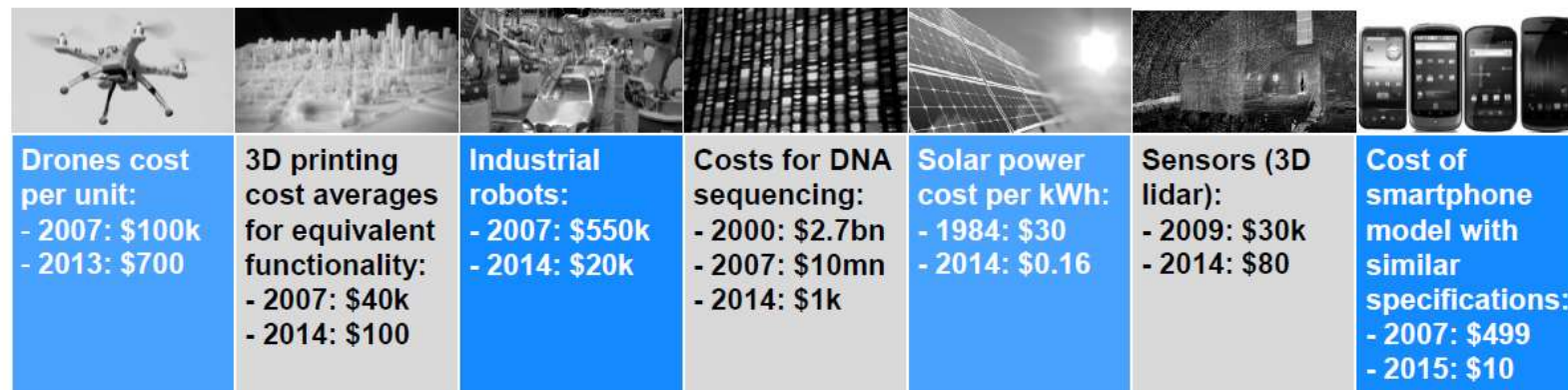
Implications of Metcalfe's & Reed's Laws

1. The importance of NETWORKS in the economy and the society
 - NETWORK = INFRASTRUCTURE, but also, and even more importantly
 - NETWORK = MARKET/INDUSTRY ARRANGEMENT
2. Network effects allow to understand how:
 - ECONOMIC VALUE is generated in information-driven industries
 - TECHNOLOGY ADOPTION is influenced by social dynamics

Consequences of the fundamental laws

1. Affordability of technologies

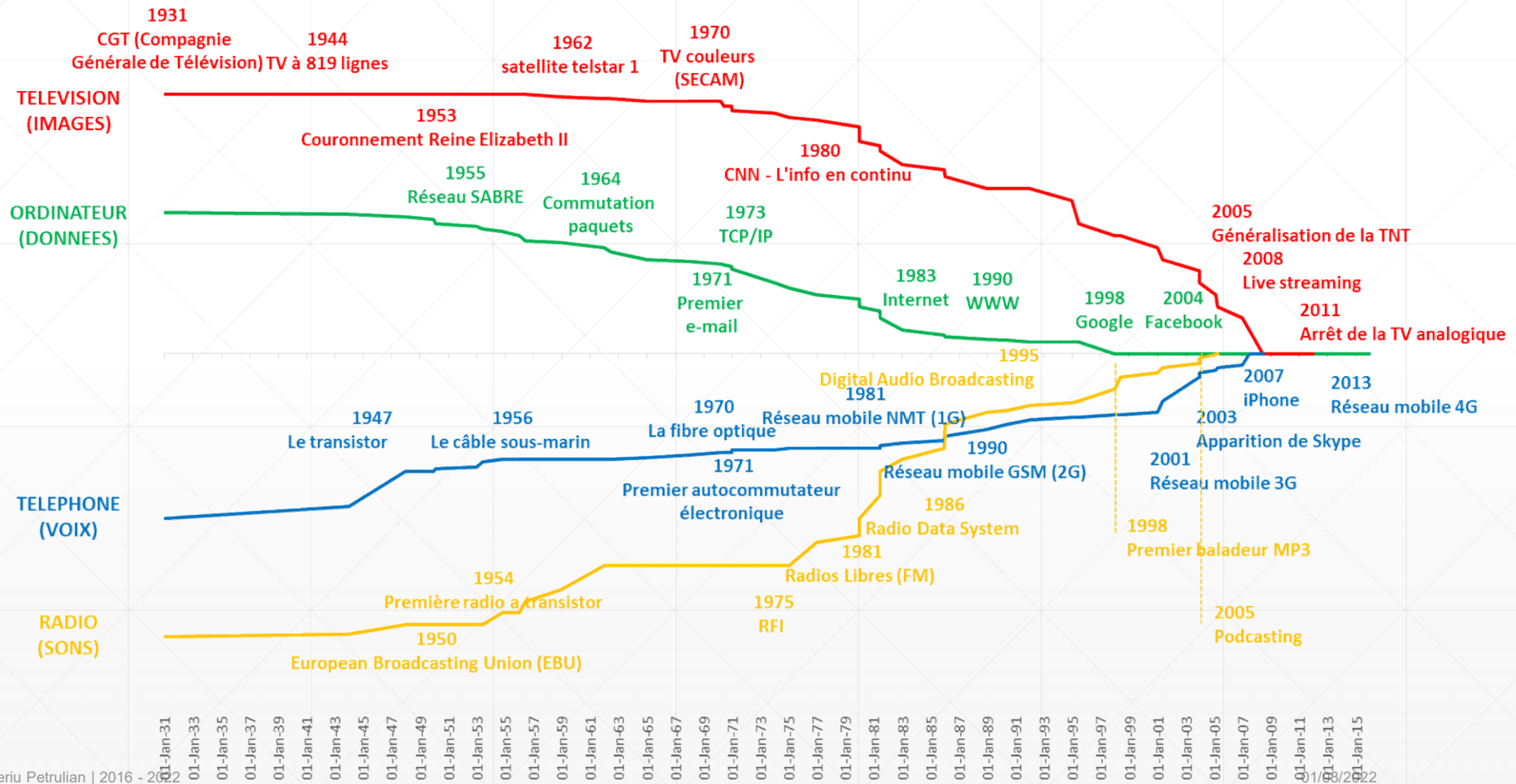
Figure 1: The cost of key technologies has fallen rapidly



Source: World Economic Forum. Digital Transformation of Industries: Demystifying Digital and Securing \$100 Trillion for Society and Industry by 2025. WEF, Geneva, January 2016

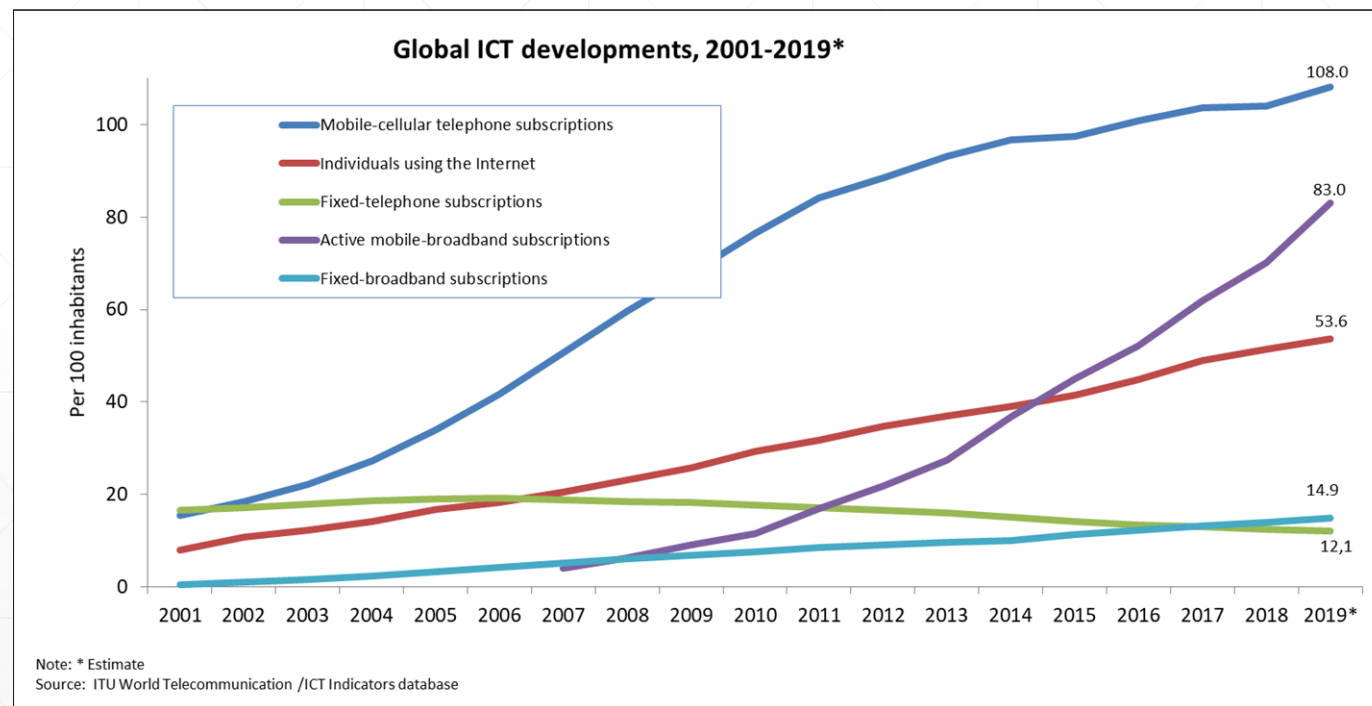
Consequences of the fundamental laws

2. Convergence of information networks



Consequences of the fundamental laws

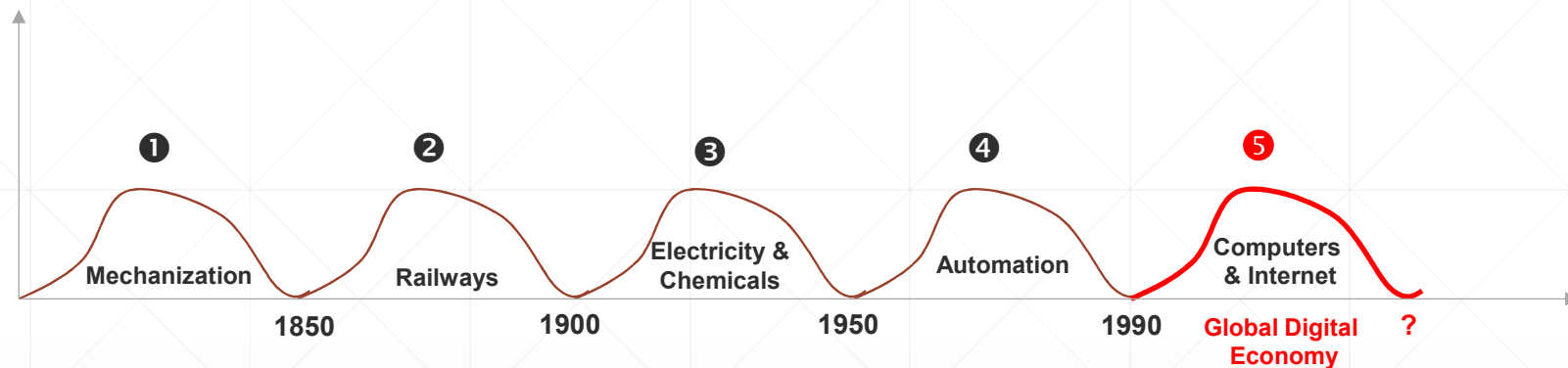
3. The rise of the Internet



Source: ITU. <https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx>

Consequences of the fundamental laws

4. « Long » Innovation Cycles



- **Some technologies drive “long” economic cycles (50 to 60 years long)**
- Each such cycle is driven by innovation coming initially from a distinct industry, then permeating the entire economy
- Austrian economist Joseph A. Schumpeter has brought to fore the idea that the economy is permanently disrupted by technological innovation (*i.e. creative destruction*)
- According to Schumpeter, innovation and the entrepreneur are at the heart of the economy

General Purpose Technologies

A **General Purpose Technology** is a technology which is:

“... characterized by pervasiveness (they are used as inputs by many downstream sectors), inherent potential for technical improvements, and ‘innovational complementarities’, meaning that the productivity of R&D in downstream sectors increases as a consequence of innovation in the [general purpose technology].”

Source: (Bresnahan & Trajtenberg, 1992)

Examples of General Purpose Technologies:

- Electricity,
- Computer,
- Internet

General Purpose Technology

Electricity

- It takes time to realize how to take advantage of the technology, that means:
 - Reorganizing work. division of labor, industry relations
 - Adapting exiting offices, plants, infrastructure
- In the case of electricity, before the economy as a whole could benefit from it: new distribution grids had to be installed, adaptation of manufacturing plants to the new source of energy had to be performed, having each machine powered by its own electric device (dynamo) had to be implemented
 - Source: (David, 1990)
- GPTs require innovations to happen at all levels of the value chain (or supply chain), therefore they deliver their benefits with a delay

Digital Technologies

General Purpose Technologies

“The most important general-purpose technology of our era is artificial intelligence (AI), particularly machine learning (ML).”

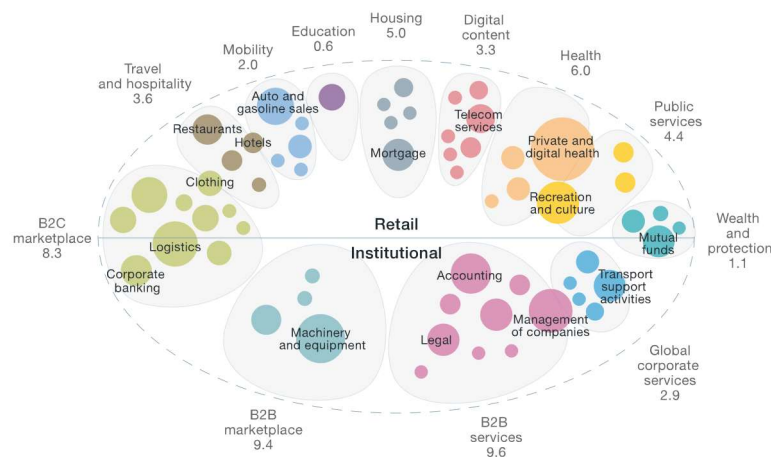
Source: (Brynjolfsson & McAfee, 2017)

Digital Transformation

ALL industries are going digital...

New ecosystems are likely to emerge in place of many traditional industries by 2025.

Ecosystem illustration, estimated total sales in 2025,¹ \$ trillion



¹Circle sizes show approximate revenue pool sizes. Additional ecosystems are expected to emerge in addition to the those depicted; not all industries or subcategories are shown.

Source: IHS World Industry Service; Panorama by McKinsey; McKinsey analysis

McKinsey&Company

- Digitalization of all industries is rapidly blurring the traditional sector borders
- Not only the frontiers between traditional industries are disappearing...
- ... but also, the divide between the « old » (non-digital) and « new » (digital) economies is slowly being absorbed

Illustration: <https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/competing-in-a-world-of-sectors-without-borders>

Digital Transformation

... and, not all industries are equal

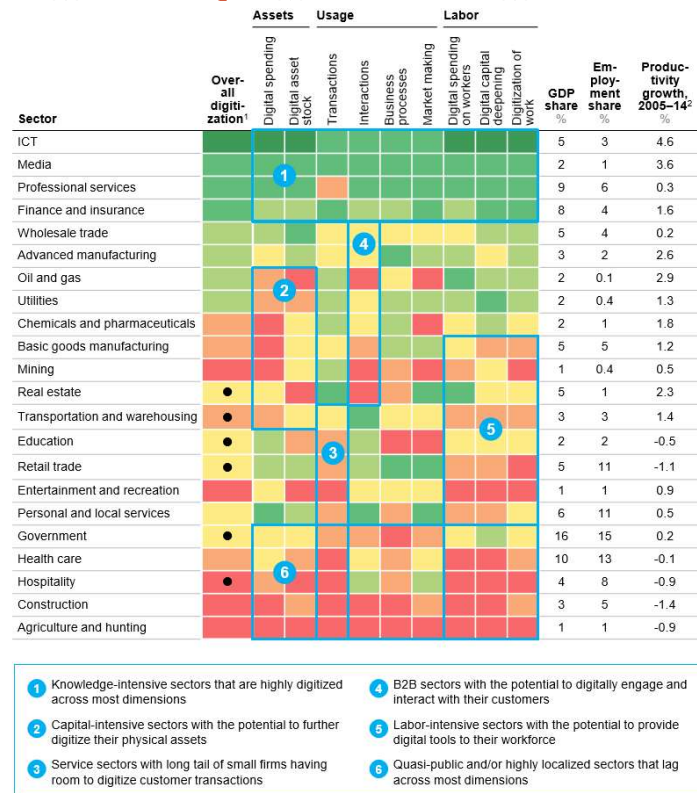


Illustration: McKinsey Global Institute. *Digital America Report*. December 2015

- In the global race to digitalization, some industries are better positioned than others.
- According to this 2015 report, knowledge-intensive sectors (e.g. ICT, media, ...) are best placed to further digitize their activities
- Then come services sectors and capital intensive sectors

Digital Economy

One paradox and one bottleneck in the information society

- The paradox
 - Productivity grows relatively slowly while there is remarkable increase in computer power. (At the origin of which there is a famous quote from Robert Solow - American economist, Nobel Prize in Economics - in a *New York Times* article from 1987).
- The bottleneck
 - Human attention tends to be overwhelmed by such massive amounts of information (Herbert Simon, 1978 Nobel Prize in Economics, 1975 ACM Turing Award)
 - Attention is becoming a scarce resource => “Attention Economy”



Herbert A. Simon in his office at Carnegie Mellon University in March 1986.

“ In an information-rich world, the wealth of information means a dearth of something else: a scarcity of whatever it is that information consumes. What information consumes is rather obvious: it consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention and a need to allocate that attention efficiently among the overabundance of information sources that might consume it.

<http://www.edgepolitics.com/?p=271>

The Information Society

One paradox and one bottleneck

RARITY => VALUE

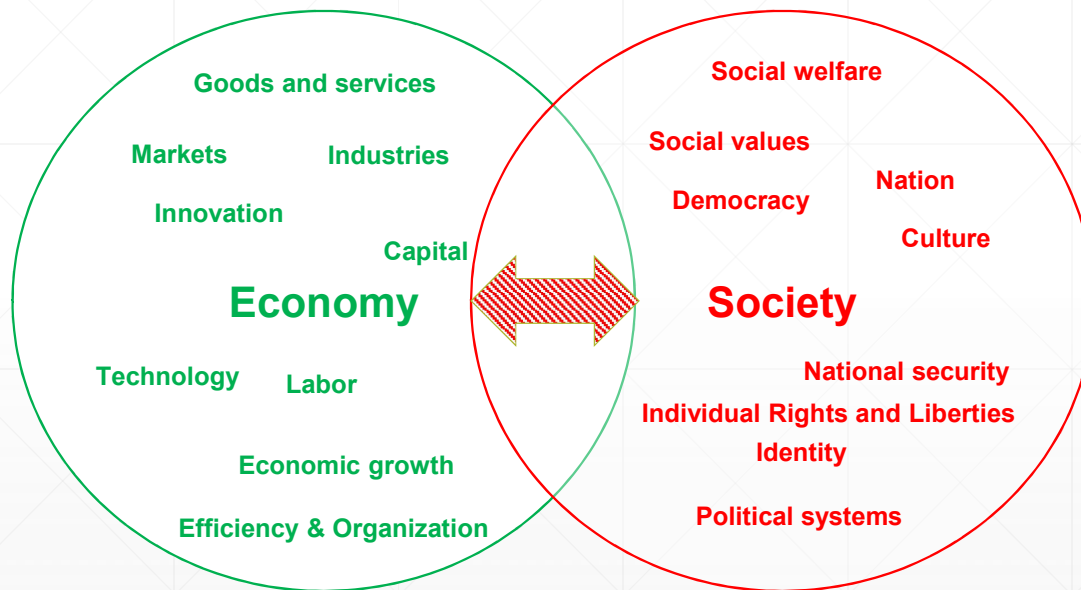
- On the one hand, abundance of something creates a scarcity in other areas
- Whenever something is scarce, then there is value in providing the rare item

EFFICIENCY/PRODUCTIVITY

- On the other hand, the question arises on how to organize efficiently in order to cater – in the most effective way - for the needs to be fulfilled through scarce goods or services

Digital Transformation Class 1| Concluding remarks

Class discussion



- Digital technologies influence of the economy on the society, as a whole
- Types of regulation
 - Are market mechanisms adapted to all the aspects of the society?
 - Is government intervention necessary at all times?
- Can public policies keep pace with technological progress?

Digital Transformation

Class 1 - Summary



- ☑ The Digital Economy is, among other things, the result of the accelerated convergence (e.g. human voice, data, images and sounds) and of rapid adoption of technological innovations
- ☑ The « digitalization of everything » has several economic consequences, notably:
 - It has seriously challenged some existing industries and is, as we speak, transforming several other
- ☑ Internet and the WWW have contributed to changing our world into “an ocean of data”
 - Data, information and knowledge are increasingly becoming essential ingredients of our modern economy and societies
- ☑ The Digital Economy blurs the borders between traditional industrial sectors
- ☑ Some Digital technologies are General Purpose Technologies (such as, Artificial Intelligence)
- ☑ With all its promise and positive aspects, the Digital Economy also raises challenges on several of the fundamental aspects of our modern societies, i.e. data privacy, labor protection, ...

Thank You!

Valeriu Petruian, PhD