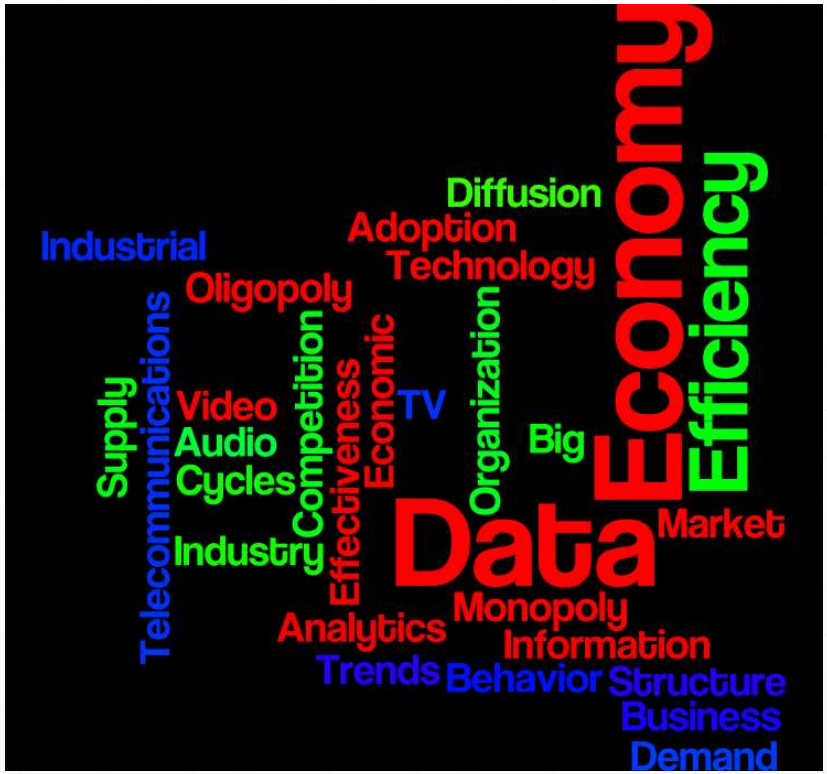
Digital Transformation

Class # 1: Welcome to the Digital Economy!

EPITA | Fall 2025

Valeriu Petrulian, PhD

Kick-Off



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

Course Outline

- We are living in a world driven by digital technologies. Perhaps, 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, …). Then, 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?

Digital Transformation Learning Objectives

- The “Digital Transformation” course aims at attaining, for ambitious students, the following learning objectives:
- Understand the present challenges of Digital Transformation in its multiple dimensions
  - Get an exposure to the way technologies can, and have already, changed, fundamentally, the socio-economic tissue of a region, country, industry, and market
  - Explore the pervasive dimension of technology adoption, through the concept of general purpose technologies
- Understand, from an individual and collective perspective, how technologies evolve, are being brought to the market, and ultimately adopted
  - From an “offer” side perspective
  - From a “demand” side perspective
- Explore the “change-driving” nature of selected current digital technologies on the workplace and the business environments
  - Illustrations via IoT, Big Data, and AI
- Assess, concretely, the changing potential of digital technologies on existing business models
  - Deep-dive into “Digital Platforms”

Be able to develop, by the end of the course, a critical thinking approach towards technology adoption and a “Digital Transformation” personal vision

Critical thinking as a learning objective

“Critical thinking is the process of analysing available facts, evidence, observations, and arguments to make sound conclusions or informed choices. The goal of critical thinking is to form a judgment through the application of rational, skeptical, and unbiased analyses and evaluation… (Source: Wikipedia) “… and the combination of several **elements of thought**, such as:

Point of view – frames of reference

Purpose – goal and objectives

Question at issue – problem, issue

Information – data, facts, observations, experience, evidence

Interpretation and inference – conclusion, solution

Concepts – theories, laws, definitions, principles

Assumptions – presuppositions, axioms, hypotheses

Implications and consequences.

(Source: *www.criticalthinking.org)”*

Digital Transformation course
Developing critical thinking abilities

1. **Identify** a range of positions on a particular issue. Compare and contrast opposing views.
2. **Judge** the credibility of the sources. Is there any bias, prejudice or self-interest?
3. **Evaluate** the opposing arguments, based on the evidence presented.
4. **Synthesise** – bring together a range of evidence to make your point.
5. **Draw conclusions** based on your own line of argument.
6. **Present** your argument clearly, in a manner to persuade others.

… TO DEVELOP YOU OWN, PERSONAL UNDERSTANDING AND VISION OF THE SUBJECT MATTER

Source: Adapted from IAD, University of Edinburgh 2025

Course Breakdown
EPITA Fall 2025

Class	Date & Time | Topics
Class # 1	Welcome to the Digital Economy!
Class # 2	Technology Drivers # 1: Internet of Things (IoT), Blockchain
Class # 3	Technology Drivers # 2: Big Data & Artificial Intelligence (AI)
Class # 4	Other (non-technical) drivers of Digital Transformation
Class # 5	Platforms as digital business models
Class # 6	Beyond Products: Designing Digital Businesses, and Markets | Course Wrap-Up
Class # 7	Final Presentations

Today's References:

- **Geoffrey Moore**. *Darwin and the Demon: Innovating Within Established Enterprises*. Harvard Business Review, July–August 2004 Issue
- **Clayton Christensen**. *Exploring the limits of the technology S-Curve*. Series of articles, Production and Operations management, Vol. I. No. 4. Fall 1992

Learning environment

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

Digital Transformation
Final Grade

Final Grade Composition	Class assignments and participation throughout the course	Course quiz (MCQ)	Final presentation (preferably, individual)
Weight	**30%**	**20%**	**50%**

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)

Digital Transformation
Teams Group | Class Assignments | Course Quiz

- In each class, there will be a class assignment for which you shall need to prepare.
- Information for the class assignments shall be communicated before each class via the course's Teams group.
- Students shall be chosen randomly for each class assignment.
- Not being prepared for the class assignment because you haven't received the notification via the Teams group is not an acceptable excuse, it will earn you a 0 for the class assignment (30% of the final grade).
- Not joining the Teams group before or shortly after the first class may lead to additional disciplinary measures such as being banned from taking the course's quiz (20% of final grade)

Digital Transformation
Final Presentation | Subjects

1. Using an example of your own, please elaborate either on IoT's or on Blockchain's nature of "infrastructure-building" type of technology and its impact on an industry of your choice, using specific and well-defined contexts. Your presentation should clearly outline your chosen industry structure and its current challenges and the way the selected infrastructure-type technology attempts to bring answers to these challenges. Assess, critically, the role and limitations of the selected technology

2. Using an example of your own, please elaborate on AI's « general purpose technology » nature and, through its combination with other technologies, its impact on the economy, using specific and well-defined contexts. Your presentation should clearly outline your chosen industries structure and current challenges and the way the selected general-purpose technology attempts to bring answers to these challenges. Assess, critically, the role and limitations of the selected technology.

3. Illustrate by mobilizing the most appropriate course concepts, on a focused example of your own, how digital changes:

    a) A country or a government initiative to bring about change as an answer to existing challenges

    b) An industry (ex: automotive, industrial manufacturing, media, telecoms, ...),

    c) A company (for example: a social network becoming a media company, a telecom company becoming a bank, an industrial company becoming an IT company, ...),

    d) A firm function (marketing/sales, production/operations, finance/accounting, HR, etc...)

Digital Transformation
Final Presentation | Subjects

4. 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 to digitalize its assets. Is the “platform” notion only about technical change? Or are there other (non-technical) aspects of it that make a difference, and which are they?
5. Describe a digital platform ecosystem and discuss its strengths and weaknesses compared to a multiple-party, non-platform, environment. Identify accurately and exhaustively all the ecosystem players and relationships between them
6. Discuss a multi-sided platform of your own choice in terms of Business Model (you may use the Business Model Canvas from the Enterprise Essentials course). Identify the areas where two, (or multi) sided markets, may bring tangible business benefits and explain why and how such benefits could be achieved in a multi-sided platform.
7. Using an example of your own, please discuss the role of networks properties in driving digital change. Emphasize how certain network properties may influence (accelerate, increase the reach, distort/divert initial intentions, ...) an existing situation, when network structures are present, implemented or deployed in the social, or business, or organizational setting of your choice.
8. Starting from a digital product, design a digital business, or a digital market. Mobilizing all relevant course concepts, propose a credible design for the transformation of your chosen product into a viable business model or market, enabled by digital technologies. Demonstrate the business’s or market’s pertinence, feasibility, usability, and viability. Identify the need/problem your design will solve and then elaborate your “solution” by combining all the appropriate and relevant concepts and tools disseminated throughout the course.

Final presentation
Structure and expectations

Overall quality of final presentation: written .ppt document, and verbal communication 3

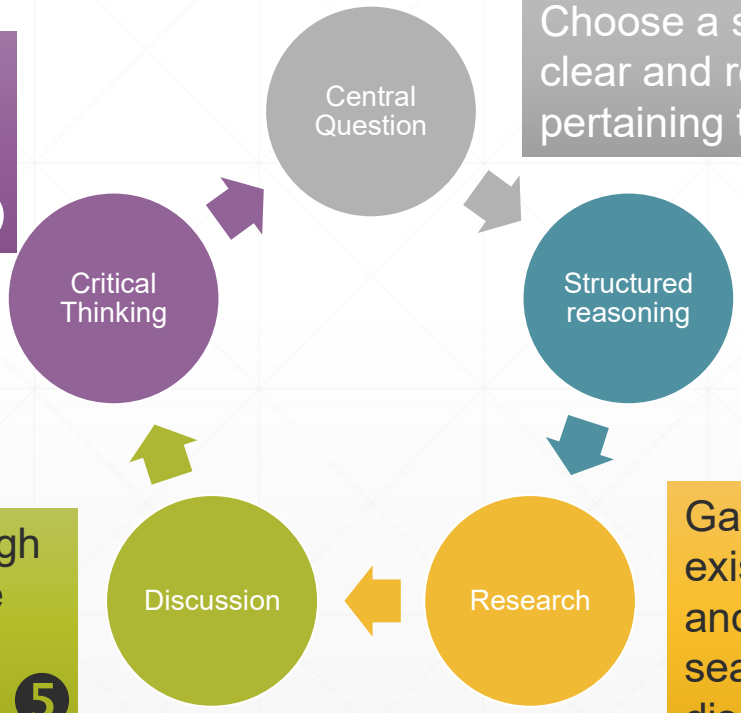
Choose a subject and ask yourself a clear and relevant question pertaining to the chosen subject 2

The main stages that will allow you to answer the central question, clearly stated (structure of presentation) 2

Gather a reasonable amount of existing, relevant & **trustworthy** data and information that you have searched and selected to inform your discussion 4

Answer your central question through rational and logical thinking and the mobilisation of the relevant course concepts, ideas, and notions 5

Demonstrate that your conclusion (i.e. answer to your question) is the result of rational, skeptical, and unbiased analysis and evaluation 4



Digital Transformation ()
Final Presentation | Guidelines

1. Choose a subject. Ask a clear question!
2. 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
3. Try avoiding generalities and « usual suspect » examples
   - **Ex**: Rather than doing another, n^{th}, 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
4. 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
5. Use the course's concepts and tools to develop your own, personal, thinking.
6. Utilisation of Gen AI tools (such as ChatGPT) is allowed as long as it's **clearly, transparently, and unambiguously** demonstrated how the tool has been used (show prompts and answers)

Guidelines - continued
The central question

For example, a student chooses the following subject (Subject 2):

- « Using an example of your own, please elaborate on AI's « general purpose technology » nature and its impact on the economy, using specific and well-defined contexts"

He/She will first have to find a question closely related to this subject, for example:

- « In how many industries is AI's *'general purpose technology'* attribute a valid assumption? An S-Curve analysis across several manufacturing industries»
- Or "Is the rapid adoption of ChatGPT an illustration of AI's *'general purpose technology'* nature ? An analysis in terms of dominant design"

… and then, produce the answer to the question through a structured presentation utilizing relevant course concepts/ideas (in this case: technology adoption lifecycle, general purpose technology, fundamental laws and principles, dominant design, S-Curve, … to quote just a few)

Guidelines - continued
On research

- You are expected to underpin your presentation with well-researched data and information, from books, articles, on-line resources, …

ALL RESEARCH REFERENCES AND SOURCES SHOULD BE PROPERLY QUOTED AND REFERENCED!

  - **Both** when they are mentioned in the course of the presentation, **and** at the end of the presentation!

- Example:
  - Student shows a picture/image/drawing/graph coming from a report
    - The image should bear underneath the source, the source should be quoted again at the end of the presentation! It's as simple as that!
- Gen AI tools should be treated the same way!
- **And, of course, all other comments and guidelines related to plagiarism and academic fraud, apply!**

Guidelines - continued
On individual/group final presentations

You have the choice to do your final presentations either individually, or part of a small group (3 students max.)

THE ASSUMPTION THAT DOING THE FINAL PRESENTATION WITH OTHER FELLOW STUDENTS MEANS "LESS" WORK IS A *WRONG* STARTING ASSUMPTION!

- **In reality,** working in a group, means **more** work!
- So, if you choose to work in small groups, please:
  - State clearly, **in writing**, 'who did what' in the overall presentation
  - Beware of 'gaps' and ensure the individual parts are consistently linked
  - Rehearse before D-Day

Final presentation
A note of plagiarism | Common forms

According to the University of Oxford (source: https://www.ox.ac.uk/students/academic/guidance/skills/plagiarism), the most common forms of plagiarism are:

- "**Verbatim (word for word) quotation without clear acknowledgement**
  Quotations must always be identified as such by the use of either quotation marks or indentation, and with full referencing of the sources cited. It must always be apparent to the reader which parts are your own independent work and where you have drawn on ideas and language from another source."
- **"Cutting and pasting from the Internet without clear acknowledgement**
  Information derived from the Internet must be adequately referenced and included in the bibliography. It is important to evaluate carefully all material found on the Internet, as it is less likely to have been through the same process of scholarly peer review as published sources."
- **"Paraphrasing**
  Paraphrasing the work of others by altering a few words and changing their order, or by closely following the structure of their argument, is plagiarism if you do not give due acknowledgement to the author whose work you are using."

Final presentation
On plagiarism | Related matters

Plagiarism may be induced. This happens when one DOES NOT CHECK the trustworthiness of the cited sources. For this course, you are supposed to:

1. Cite books, which were published, and that you have read
2. Cite academic sources, published in peer-reviewed journals, such as the ones proposed as readings before coming to class
3. Cite trustworthy websites, such as, but not limited to company official websites, government, regulatory authorities; websites of creators, (Wikipedia is included)

DO NOT (EVER):

Copy/paste, nor even cite, websites that are not trustworthy, whose ownership is not clearly acknowledged, whose content is not traceable

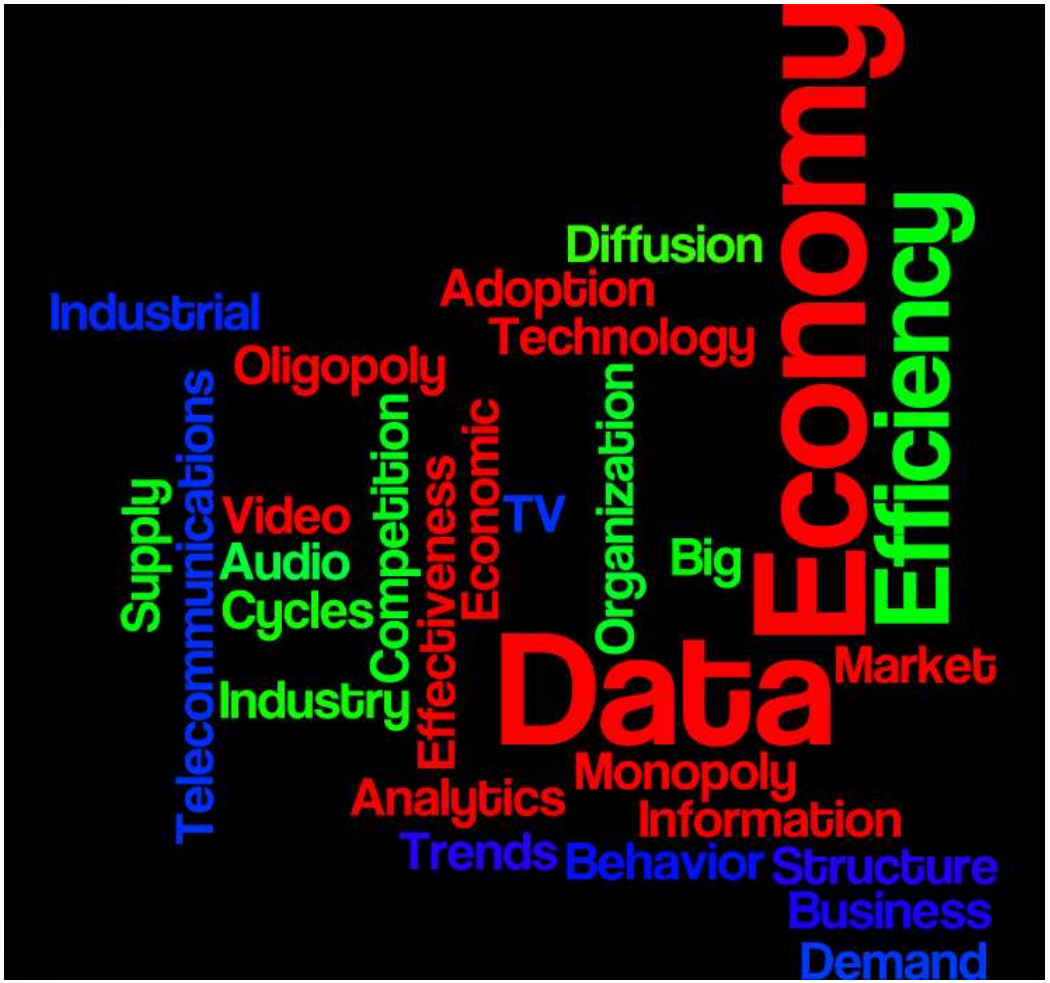
Grading Criteria

	Outstanding Between 17.50 and 20.00 points	Very good Between 15.5 and 17.5 points	Good Between 14.00 and 15.5 points	Correct Between 10.00 and 14.00 points	Below average Below 10.00 points
Class assignment	High-quality contributions showing that the reading material for the class has been read and understood and that the student is keen to leverage the concepts in order to explain a real-life situations	Pertinent contributions to the class assignment, showing interest in the topics discussed in class and the reading material	The contributions to the class assignments are robust, reading material was obviously taken into account	Student participates to class assignments, with moderate or uneven contributions, the linkage between reading material and class discussion is not apparent	Student is obviously disengaged with the course's objective and topics, participation to class assignments shows that the reading material was neglected
Final presentation	Illustrates excellent mastery of the concepts discussed during the course; and the results are presented in a clear, well-written, well-structured way. The final presentation's subject is relevant for the subject matter, it is well documented and student has invested in research	The final presentation shows strong understanding of the concepts and ideas discussed during the course, the supporting document is of excellent quality in terms of topic, structure and supporting research	The final presentation is of good academic quality, interest for the subject matter is consistently shown through the application of the guidelines for the final project	Illustrates an acceptable understanding of the concepts discussed in class; and the presentation is written and presented in an understandable way with admissible quality in terms of plan, structure, and supporting research	The presentation shows that there's no keen interest in the subject matter, its quality does not meet the academic standards, and the topic is not relevant for the course's content

Digital Transformation ()
Final Presentation | Timeline

1. (Classes 1-3): Choice between group or individual, groups are formed
2. (Class n-2): Subjects are chosen, contents is discussed with professor, if needed
3. Class (n-1): Additional guidelines, if needed, groups are formed for final sessions
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

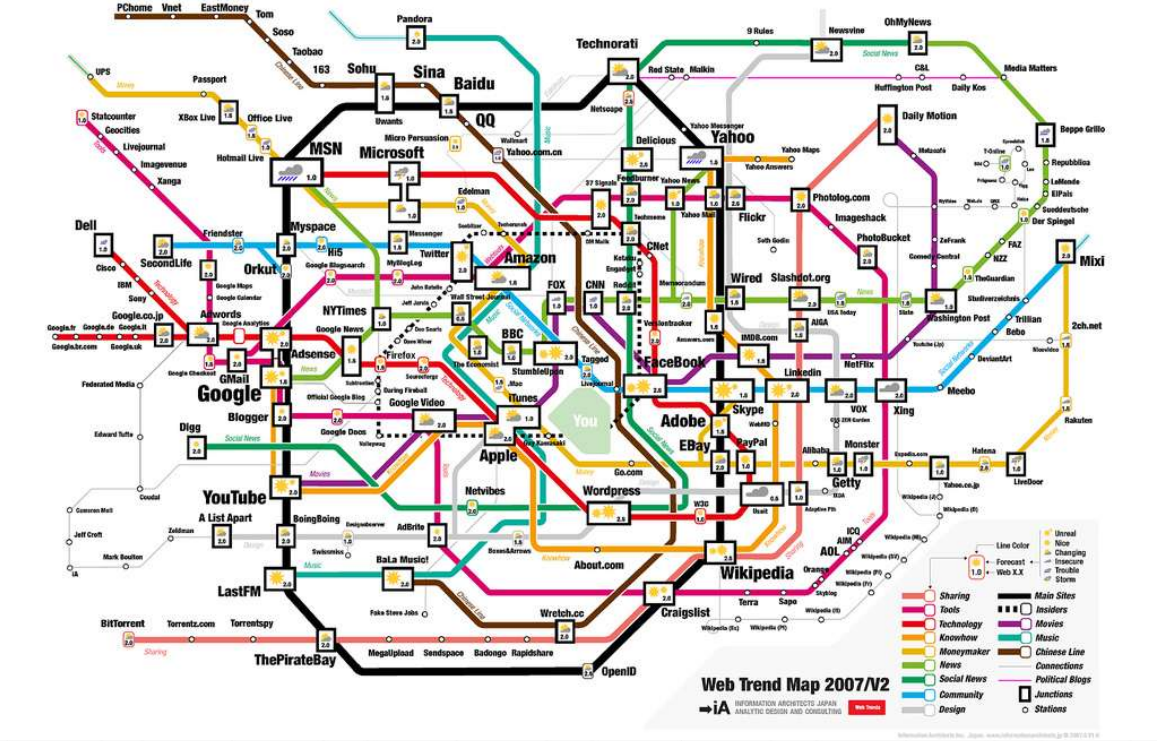
Technology Adoption

S-Curve

Dominant Design

Today's Digital Economy …

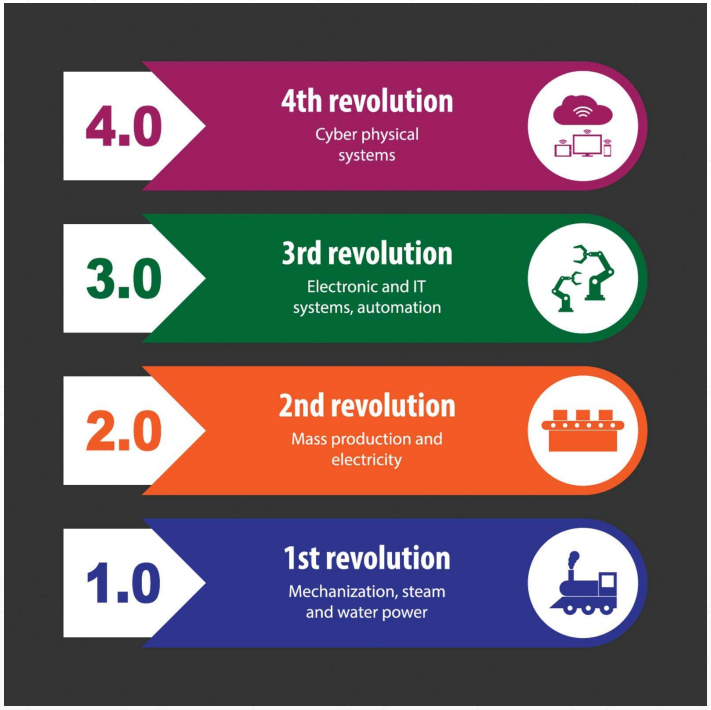
WE ARE HERE



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

- 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/

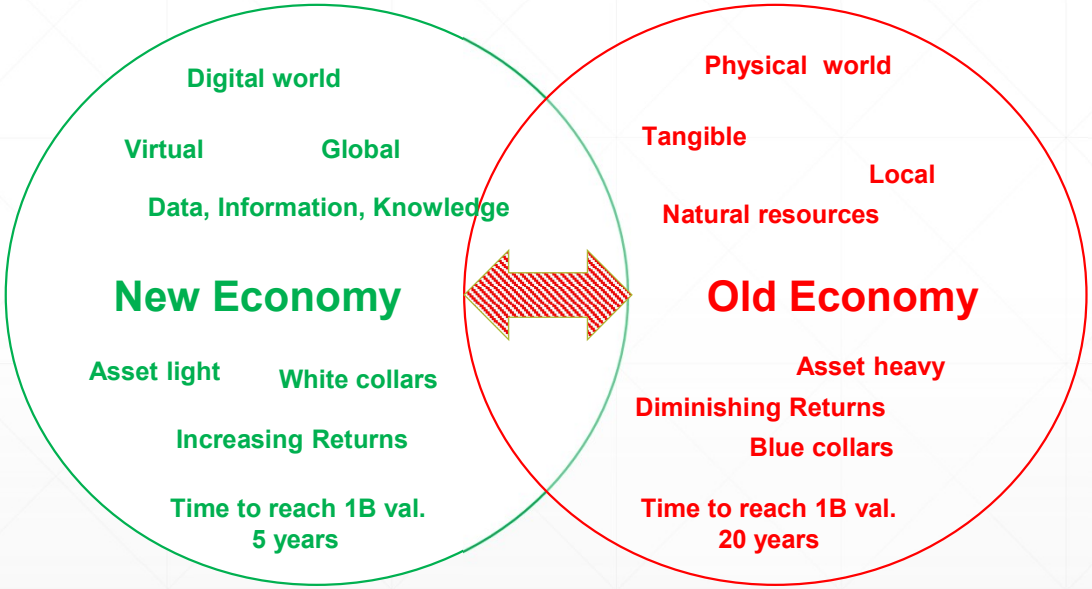
Digital Economy
Five technological industry cycles

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://ro.wikipedia.org/wiki/Machine_analytique

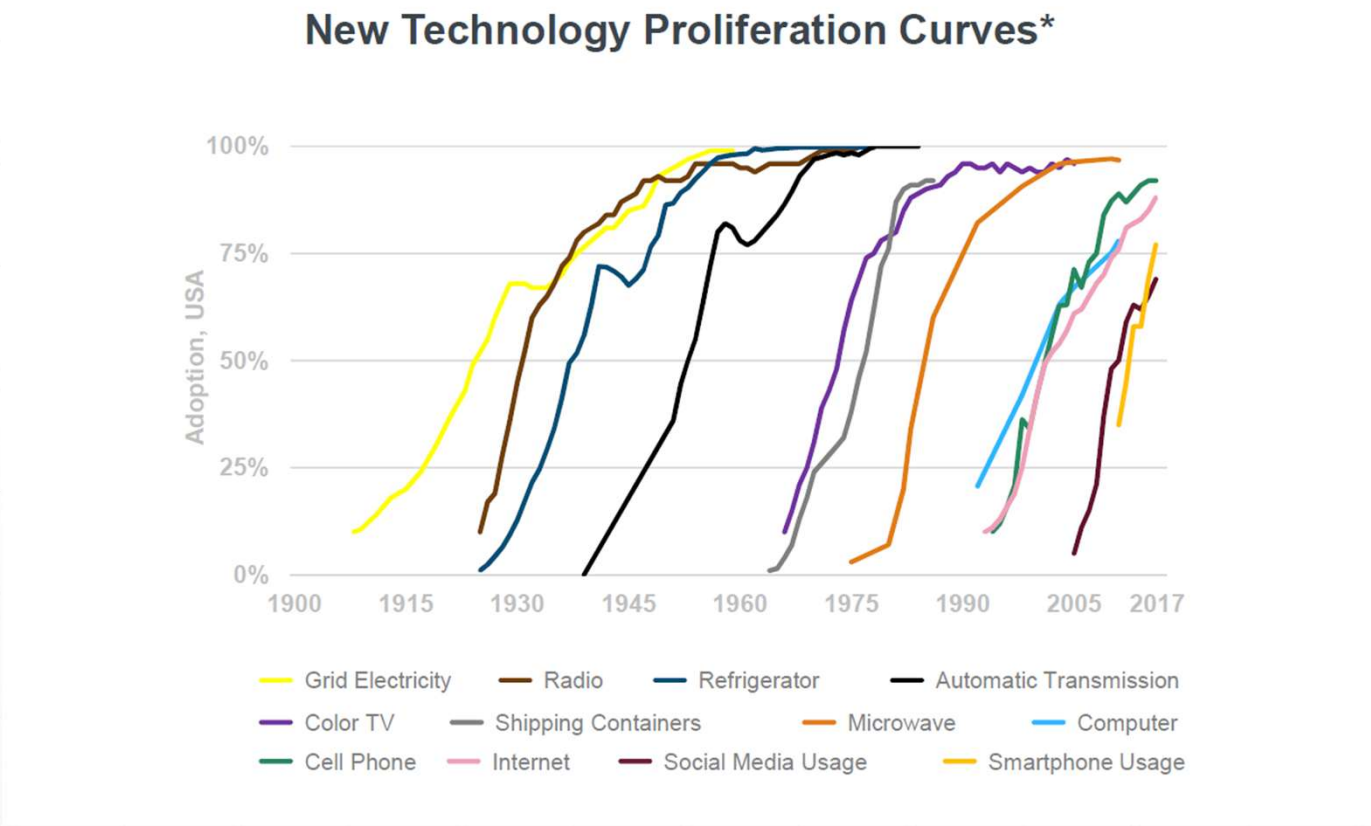
https://en.wikipedia.org/wiki/File:Turing_machine_1.JPG

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

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

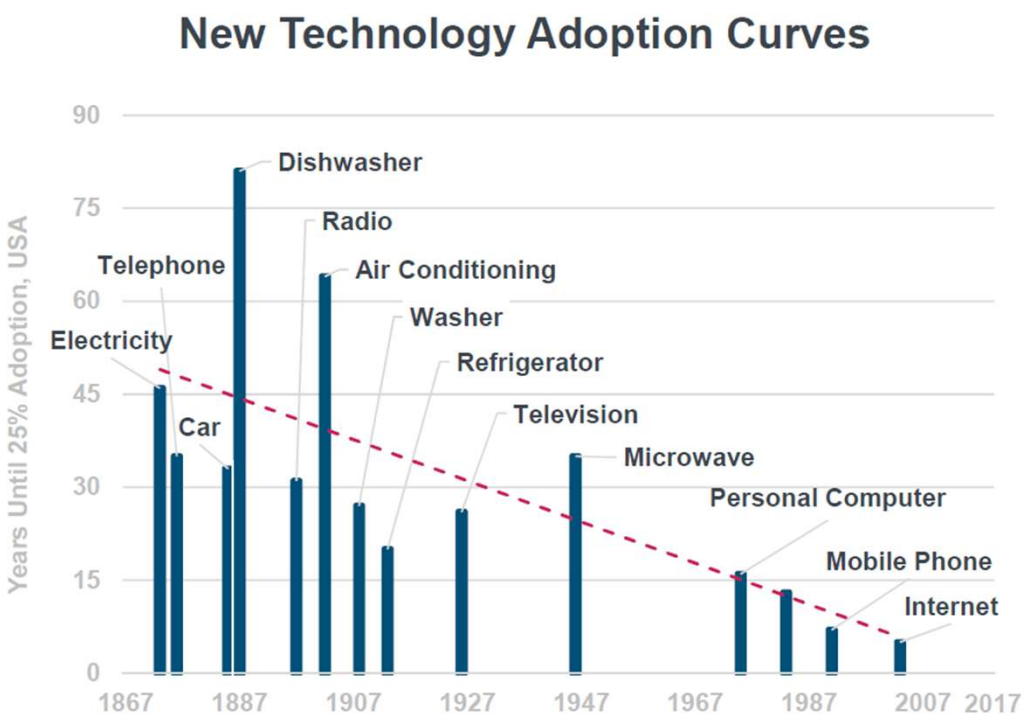
http://www.theguardian.com/commentisfree/2015/jun/25/wikipedia-editors-dying-breed-mobile-smartphone-technology-online-encyclopedia

Technology Adoption 1/2



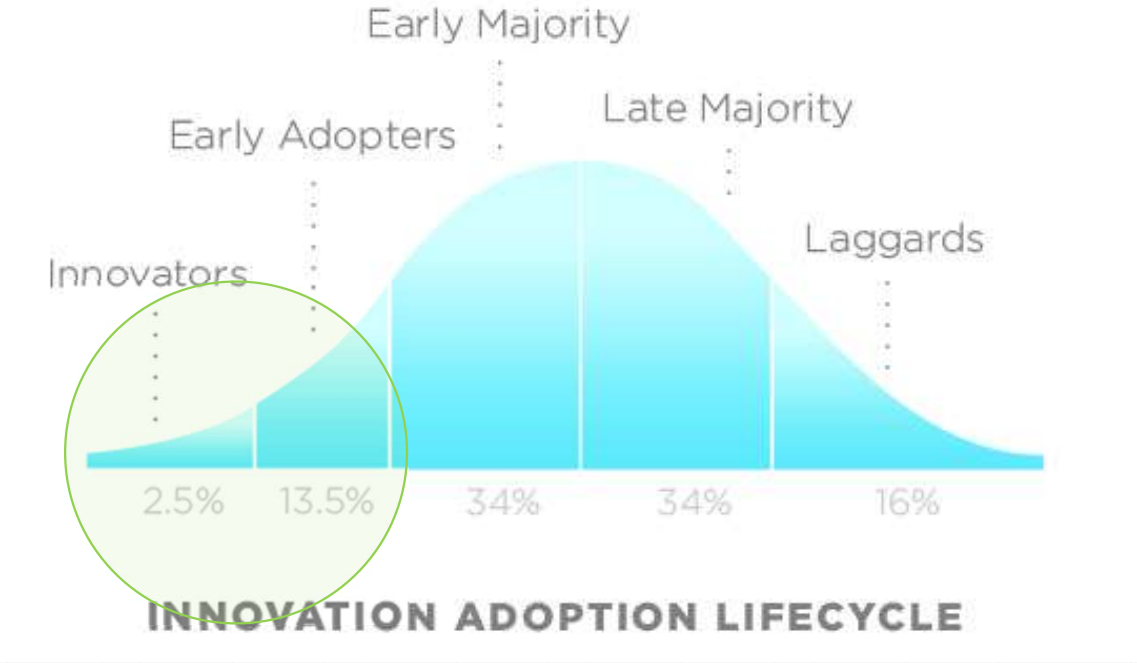
Kleiner Perkins. *Internet Trends Report* by Mary Meeker. 2018

Technology Adoption 2/2



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

Class assignment # 1

Choose one of the proposed items below and position it in the **technology adoption cycle** composed of:

1) Innovators – 2) Early adopters – 3) Early majority – 4) Late majority – 5) Laggards (as per: https://en.wikipedia.org/wiki/Technology_adoption_life_cycle)

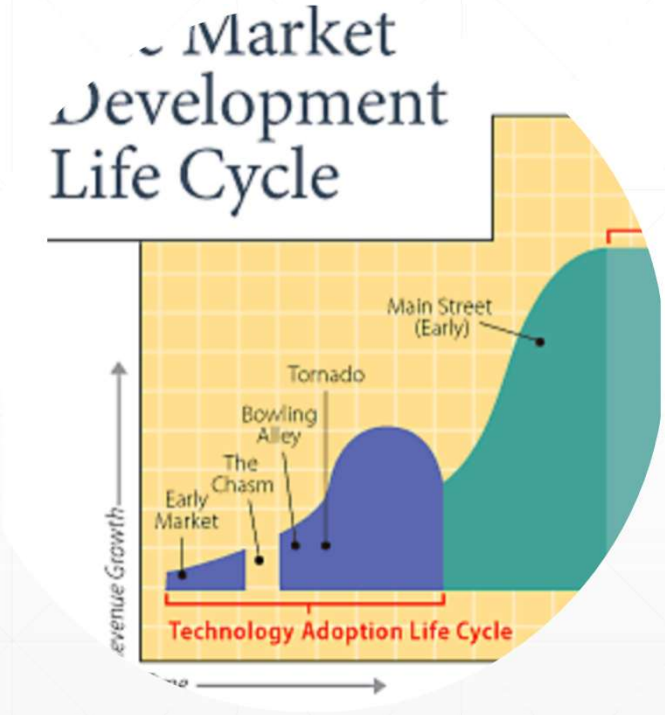
Respond to the following questions:

1. In which of the 5 segments would you position it today and why?
2. What does it take, in your opinion, to transition from 1) to 2)? From 3) to 4?

Proposed items

- **Internet of Things (IoT)**
- **Artificial Intelligence Systems**
- **Big Data Technologies**
- **Blockchain**

Technology Adoption
A refinement to the original framework

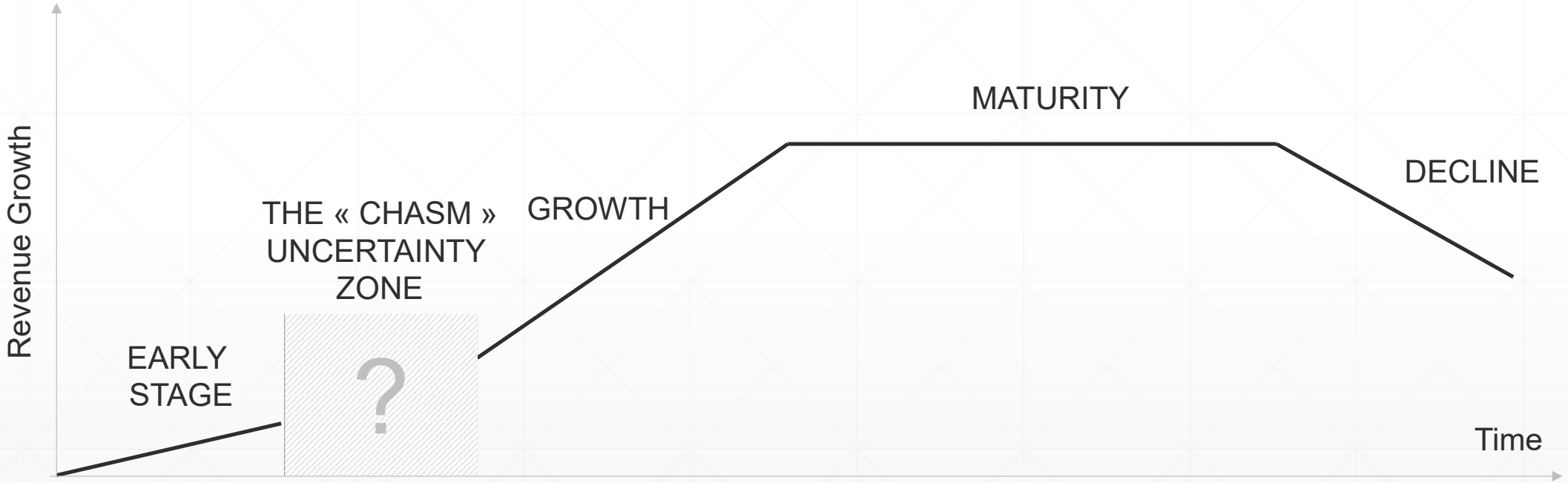


In Geoffrey Moore's Market Development Lifecycle, the early adoption stages are:

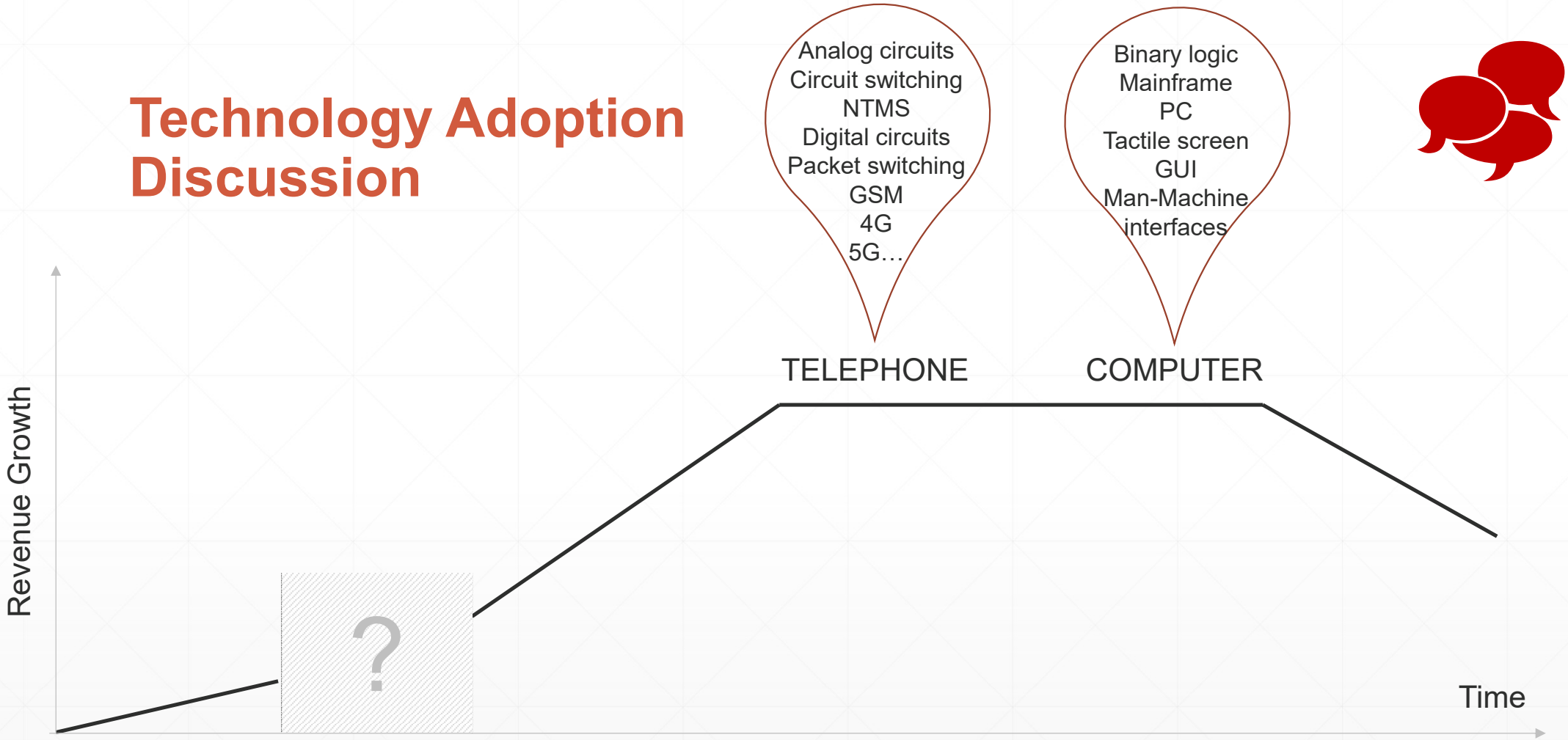
1. **Early market** (visionaries and technology enthusiasts)
2. **The Chasm** (looking for niches)
3. **Bowling alley and Tornado** (new applications have been found, market is experiencing growth)

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

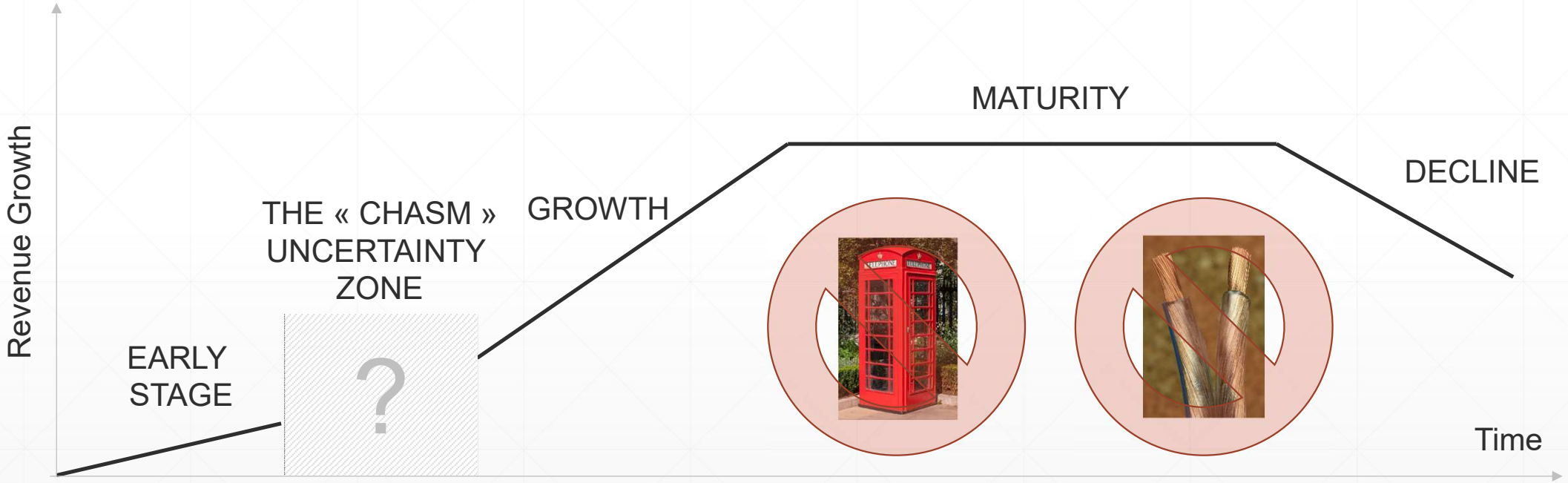
Technology Adoption
Our framework



Technology Adoption Discussion



Technology and Information Industries
The telecommunications industry



The telecommunications industry
What has happened along the way…

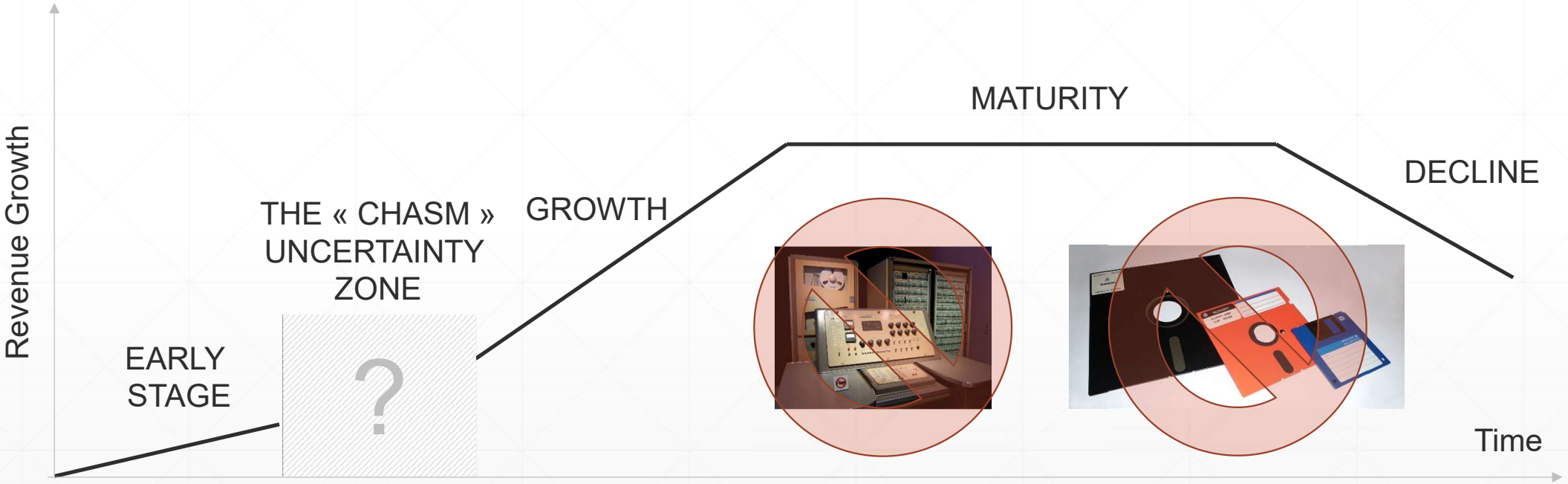
JOBS THAT HAVE DISSAPEARED

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_Photographic__Advertising_Co_Chicago.jpg

COMPANIES TRANSFORMED, OR ELSE…

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

Telecommunications and computers
Dominant Design - Discussion

HOME

LP record 1950

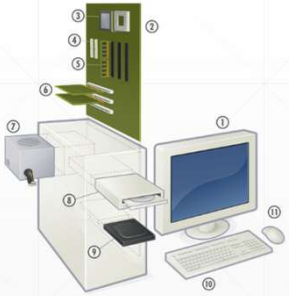
Audio cassette 1970

Audio CD 1980

Audio streaming 2000

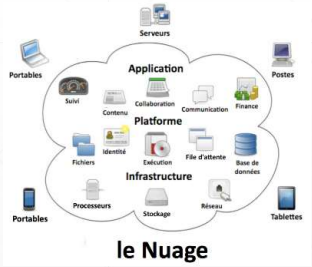
OFFICE

Mainframe computer 1950



Personal Computer 1980

Smartphone 2000



Cloud computing 2010

Source for all images: Wikipedia

Dominant Design - continued

“A dominant design in a product class is, by definition, the one that wins the allegiance of the marketplace, the one that competitors and innovators must adhere to if they hope to command significant market following. The dominant design usually takes the form of a new product (or set of features) synthesized from individual technological innovations introduced independently in prior product variants.”

Source: Utterback, *Mastering the Dynamics of Innovation*

Dominant Designs:

- Are useful when trying to understand technology adoption
- Determine the adoption lifecycle quite early in the cycle

Fundamental “laws and principles” and their consequences

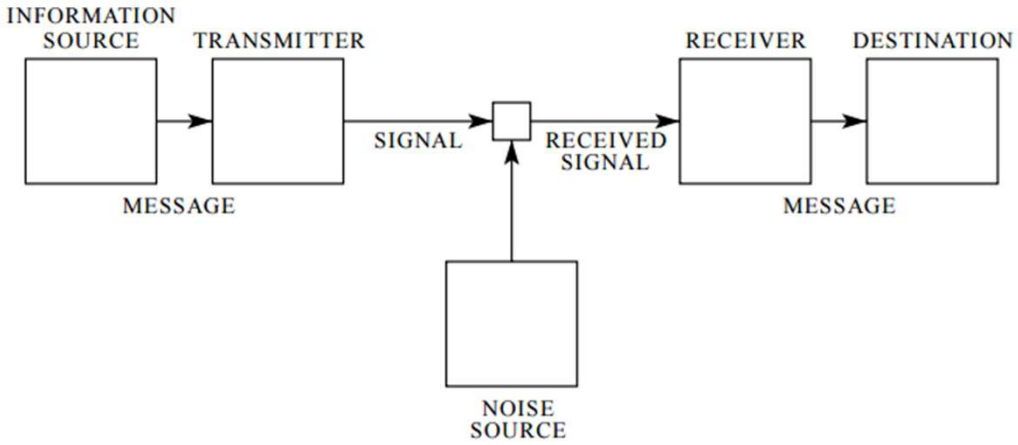


Fig. 1—Schematic diagram of a general communication system.

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.

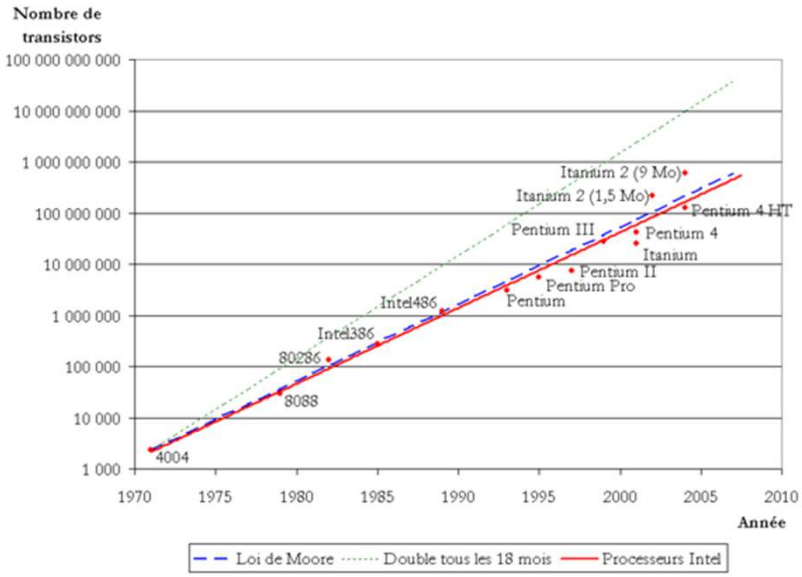
In management, Russel Ackoff (1967) has stated that beyond a certain amount of data, the amount of information diminishes.

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)

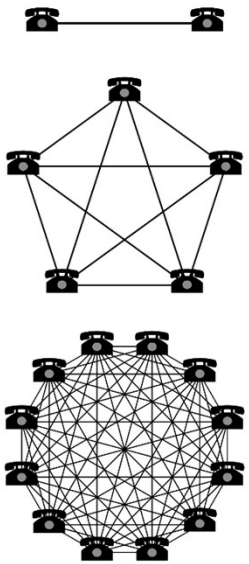
Gordon E. Moore (one of the founders of Intel) has stated that:

> 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

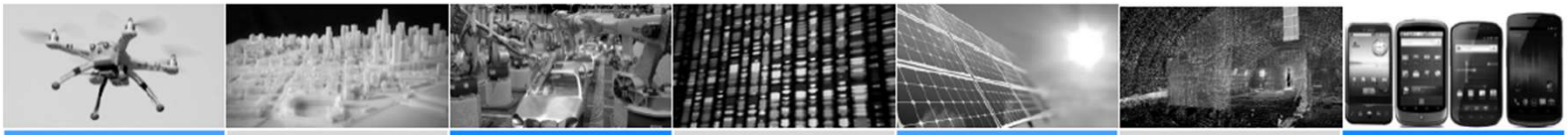
1. The importance of NETWORKS in the economy and the society

   - 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

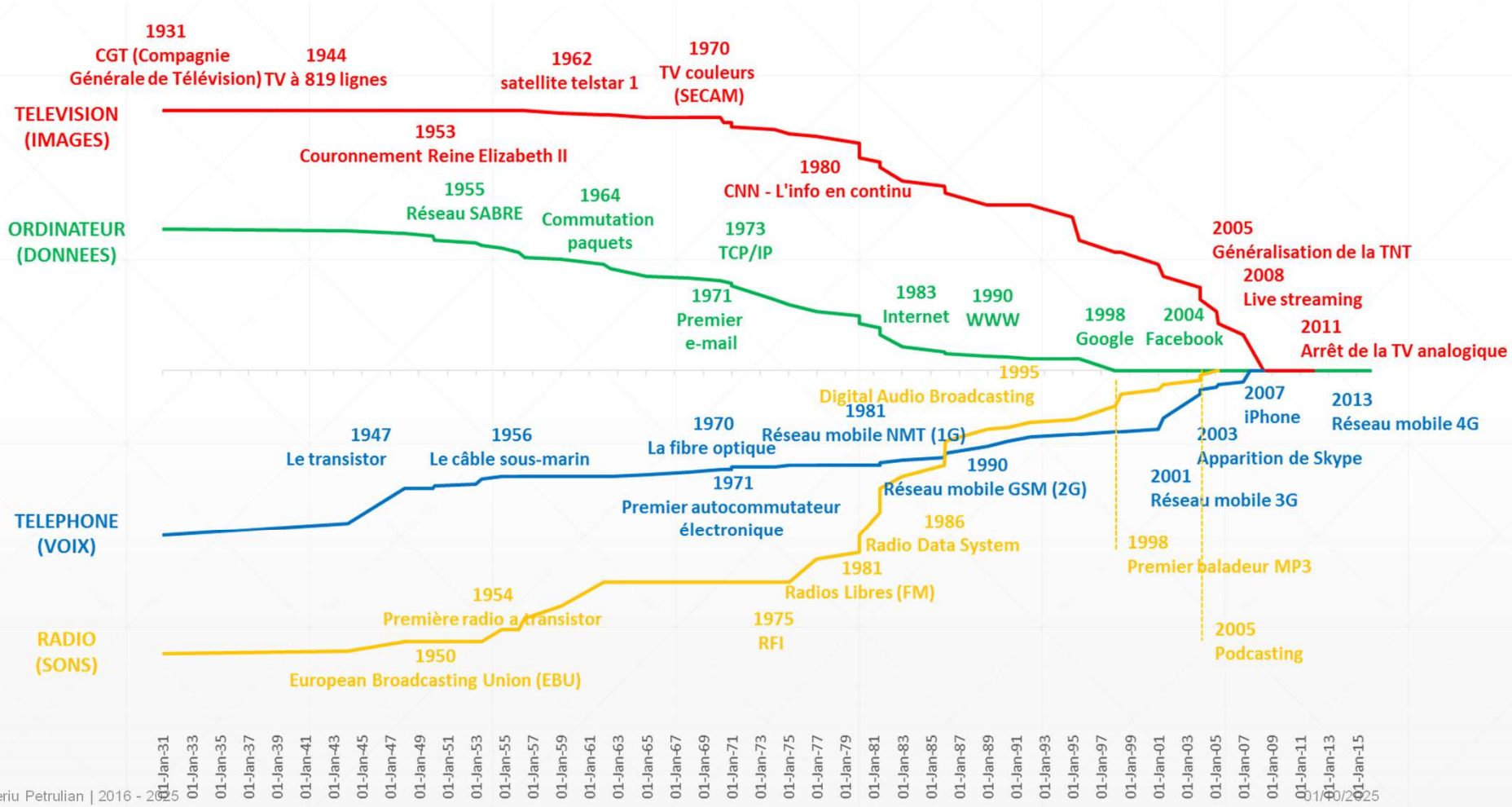
Figure 1: The cost of key technologies has fallen rapidly



Drones cost per unit: - 2007: $100k - 2013: $700	3D printing cost averages for equivalent functionality: - 2007: $40k - 2014: $100	Industrial robots: - 2007: $550k - 2014: $20k	Costs for DNA sequencing: - 2000: $2.7bn - 2007: $10mn - 2014: $1k	Solar power cost per kWh: - 1984: $30 - 2014: $0.16	Sensors (3D lidar): - 2009: $30k - 2014: $80	Cost of smartphone model with similar specifications: - 2007: $499 - 2015: $10

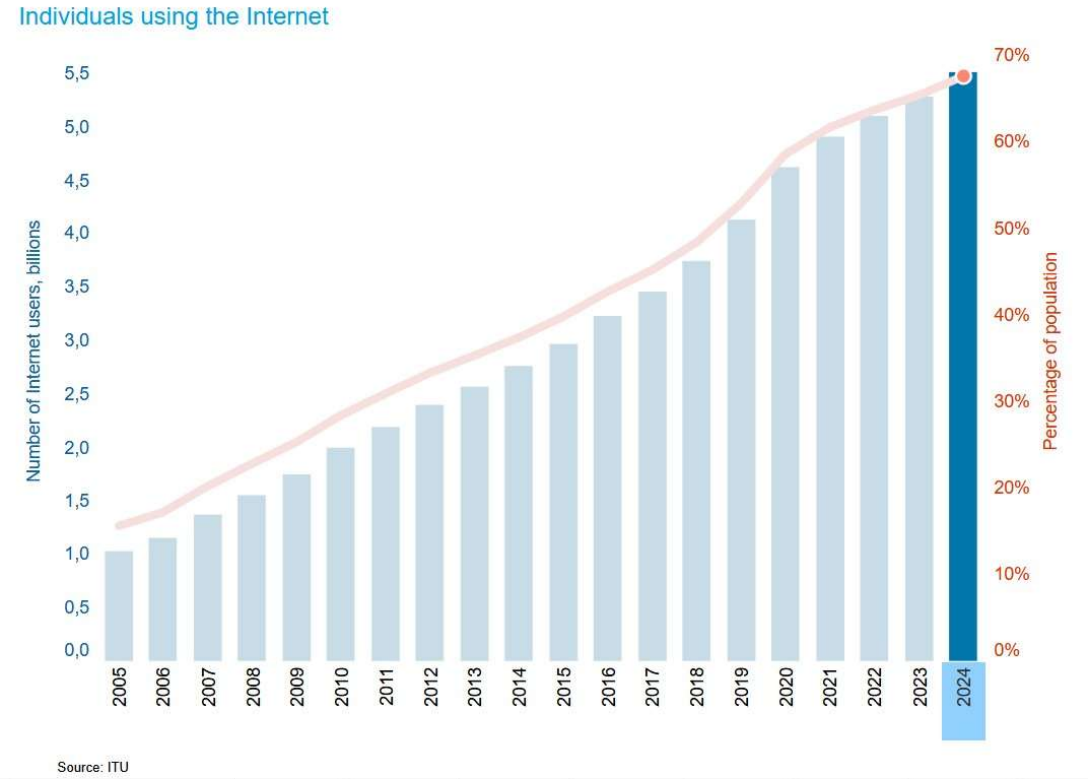
Source: **World Economic Forum.** Digital Transformation of Industries: Demystifying Digital and Securing $100 Trillion for Society and Industry by 2025. WEF, Geneva, January 2016

Consequences of the fundamental laws
2. Convergence of information networks



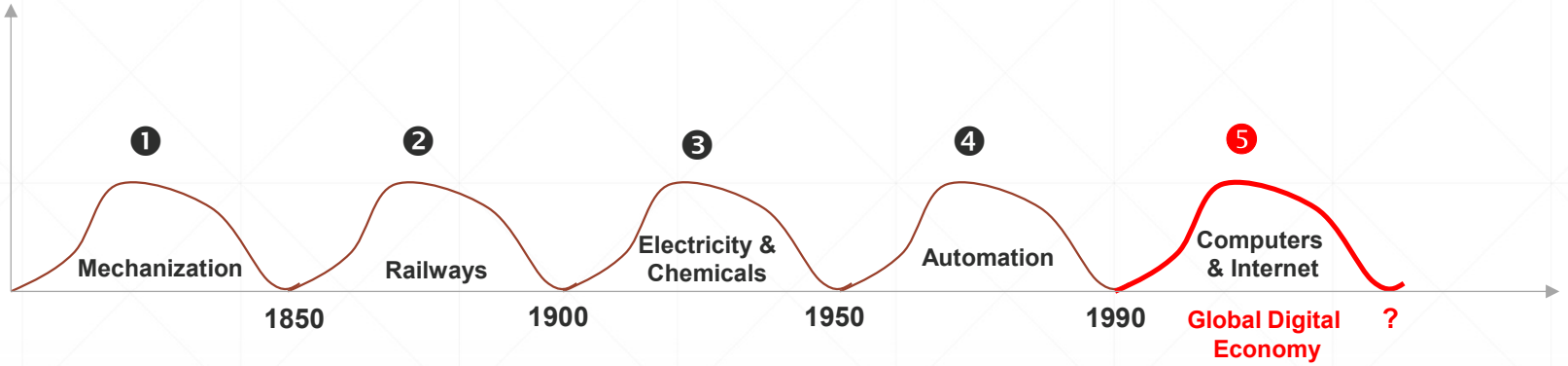
Lecturer's contribution for the Sciences Po « Executive Master Digital Humanities » class work, Module 1. November 2015

Consequences of the fundamental laws
3. The rise of the Internet



Source: ITU. https://www.itu.int/itu-d/reports/statistics/2024/11/10/ff24-internet-use/

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

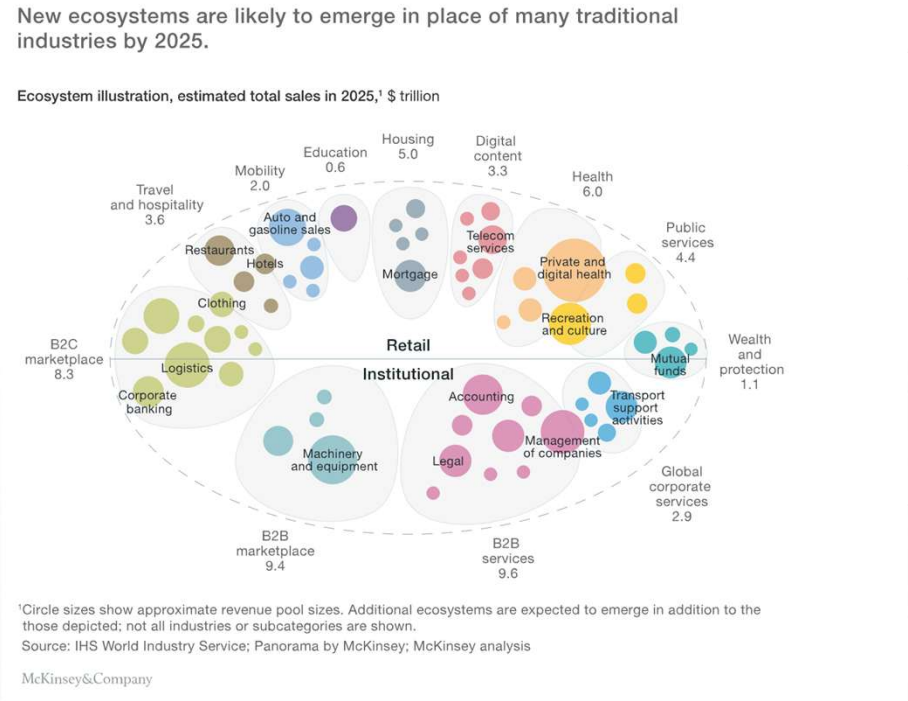
- It takes time to realize how to take advantage of the technology, that means:
  - Reorganizing work. division of labor, industry relations
  - Adapting exiting offices, plants, infrastructure
- In the case of electricity, before the economy as a whole could benefit from it: new distribution grids had 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)

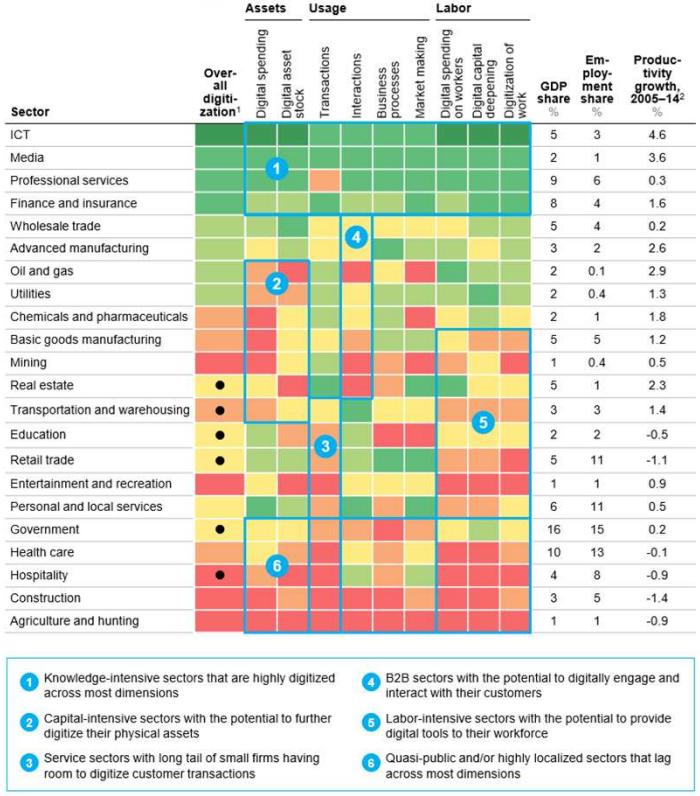
Digital Transformation
ALL industries are going digital...



- 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



Sector	Overall digitization[1]	Assets: Digital spending	Assets: Digital asset stock	Usage: Transactions	Usage: Interactions	Usage: Business processes	Usage: Market making	Labor: Digital spending on workers	Labor: Digital capital deepening	Labor: Digitization of work	GDP share %	Employment share %	Productivity growth, 2005–14[2] %
ICT											5	3	4.6
Media											2	1	3.6
Professional services											9	6	0.3
Finance and insurance											8	4	1.6
Wholesale trade											5	4	0.2
Advanced manufacturing											3	2	2.6
Oil and gas											2	0.1	2.9
Utilities											2	0.4	1.3
Chemicals and pharmaceuticals											2	1	1.8
Basic goods manufacturing											5	5	1.2
Mining											1	0.4	0.5
Real estate	●										5	1	2.3
Transportation and warehousing	●										3	3	1.4
Education	●										2	2	-0.5
Retail trade	●										5	11	-1.1
Entertainment and recreation											1	1	0.9
Personal and local services											6	11	0.5
Government	●										16	15	0.2
Health care											10	13	-0.1
Hospitality	●										4	8	-0.9
Construction											3	5	-1.4
Agriculture and hunting											1	1	-0.9

1 Knowledge-intensive sectors that are highly digitized across most dimensions
2 Capital-intensive sectors with the potential to further digitize their physical assets
3 Service sectors with long tail of small firms having room to digitize customer transactions
4 B2B sectors with the potential to digitally engage and interact with their customers
5 Labor-intensive sectors with the potential to provide digital tools to their workforce
6 Quasi-public and/or highly localized sectors that lag across most dimensions

- 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

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

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

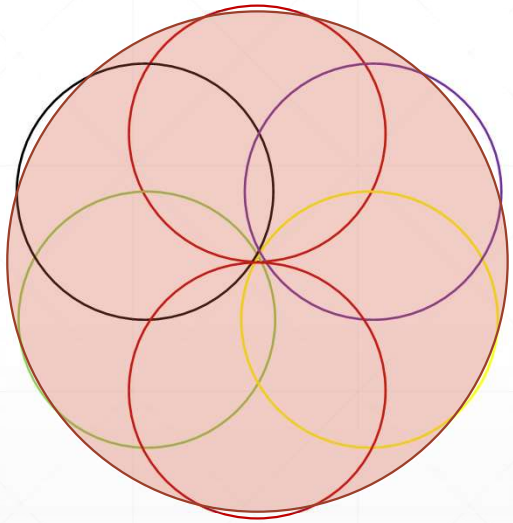
RARITY => VALUE

- 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 Economy = Σ of several economies?



The common element = INNOVATION

The Attention Economy
- Our attention span is solicited in multiple directions

The Knowledge Economy
- Performing in today's world requires mastering of different perspectives on data, information and knowledge

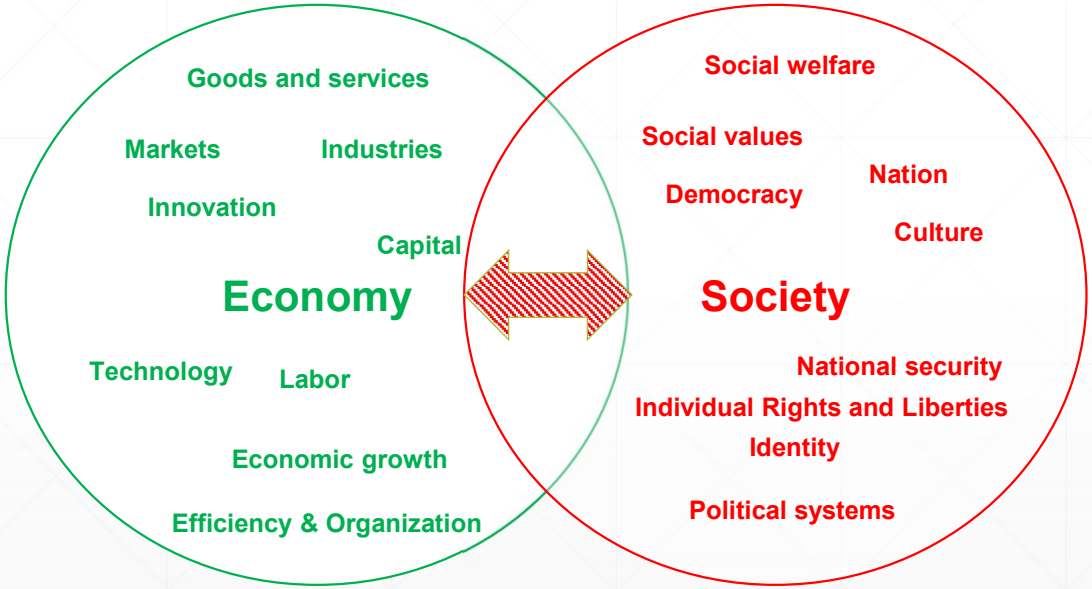
The Sharing (or collaborative) Economy
- We increasingly consider P2P as a basis of exchange and production (and wealth creation?)

The Subscription Economy
- We are increasingly relying on recurrent purchase patterns

The Platform Economy
- We are becoming increasingly dependent and reliant on globally dominant platforms

The Access Economy
- Rather than preferring ownership of goods, we favour being given access to them

Digital Transformation Class 1 | Concluding remarks
Class discussion



Digital technologies influence the economy and the society, as a whole

Opportunities:

- Engines of growth
- New industries and business models

Challenges:

- Digital labor
- Privacy, protection of personal data
- Can public policies keep pace with technological progress? => Regulation

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 Petrulian, PhD