V10.128 –
A Holistic Approach on Innovation

Lecture 02:
Technological Innovation

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1. **Technological innovation**
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1. Technological Innovation:
1.2. Definitions

- Garcia and Calantone (2002), based on their literature study, state that the OECD (2005) study on innovations best captures the essence of innovation from an technological perspective: "**Innovation is an iterative process initiated by the perception of a new market and/or new service opportunity for a technology-based invention which leads to development, production, and marketing tasks striving for the commercial success of the invention**."

- There are many definitions of innovation that have been given by researchers. These definitions can be broadly classified into **two categories** (Ghoshal & Bartlett, 1987):

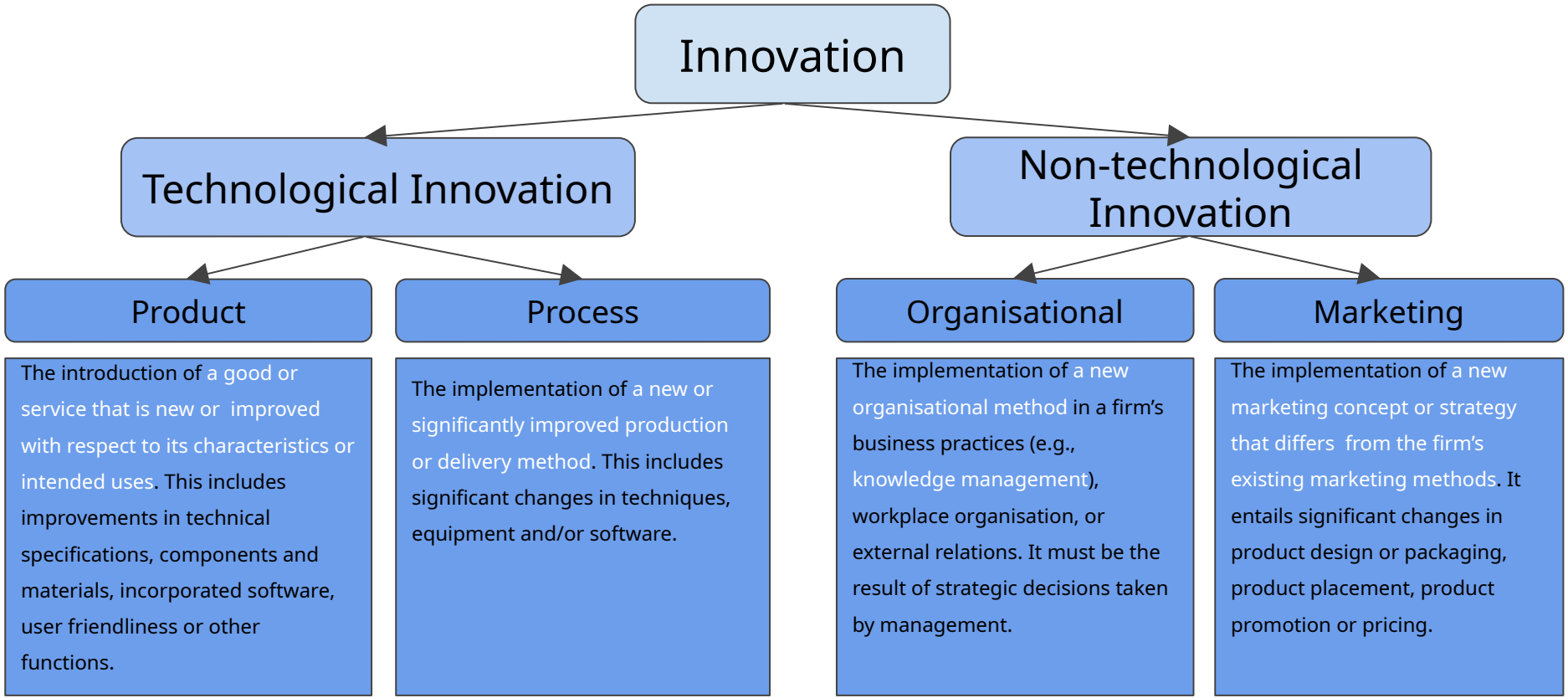
  - Category 1 (product): **Innovation is considered as the final event.** 'The **idea, practice or material** artifact that has been invented or that is regarded as novel, independent of its adoption or nonadoption' (Zaltman, Duncan & Holbeck, 1973).

  - Category 2 (process): **Innovation is considered as a process**, 'which proceeds from the **conceptualization of a new idea to a solution of the problem** and then to the actual utilization of a new item of economic or social value' (Meyers & Marquis, 1968).

Bartlett, C., Ghoshal S. (1987). "Managing Across Borders: New Organizational Responses," Sloan Management Review (Fall).
Garcia, R. Calantone, R. (2002). "A critical look at technological innovation typology and innovativeness terminology: a literature review," J PROD INNOVAT MANAG 19.
Myers S., Marquis D. (1968). Successful Industrial Innovations. National Science Foundation.
OECD (2005) Oslo Manual, 3rd Edition.
Zaltman G., Duncan R., Holbeck J. (1973) Innovations and Organizations, New York, Wiley.

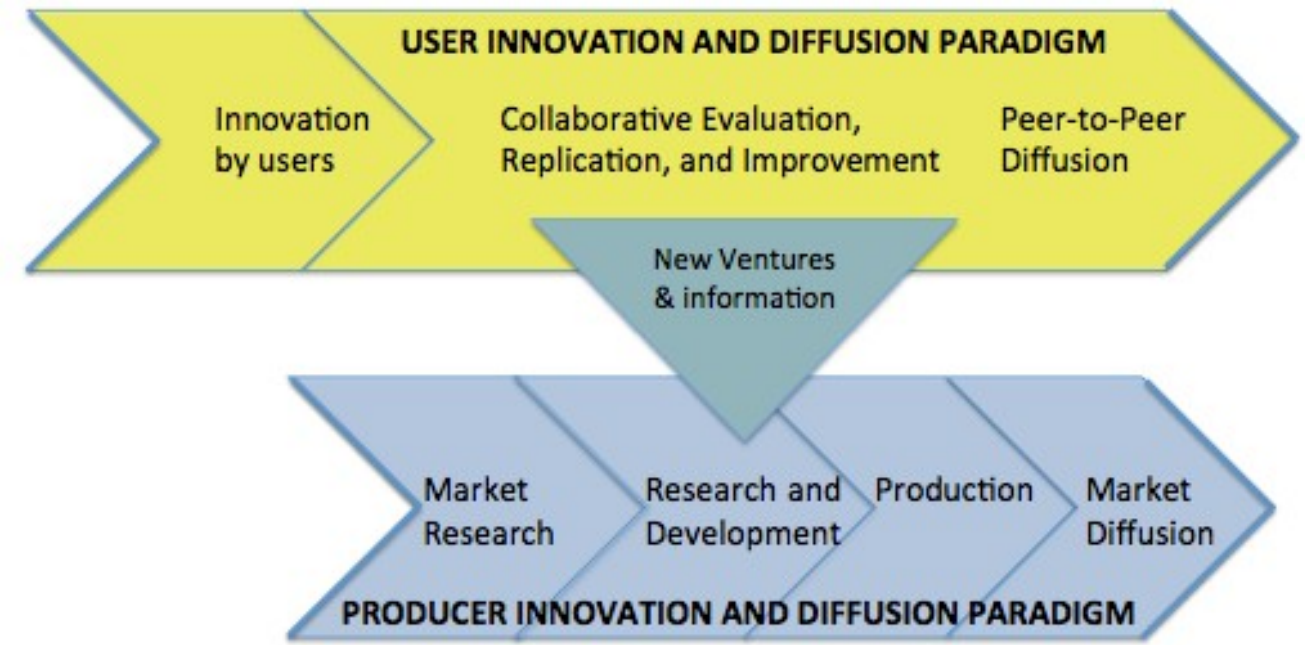
1. Technological Innovation:
1.1. Classification

- Following OECD and Eurostat (2005), innovation activities can be classified as:



1. Technological Innovation:
1.3 User Innovation & Open Innovation

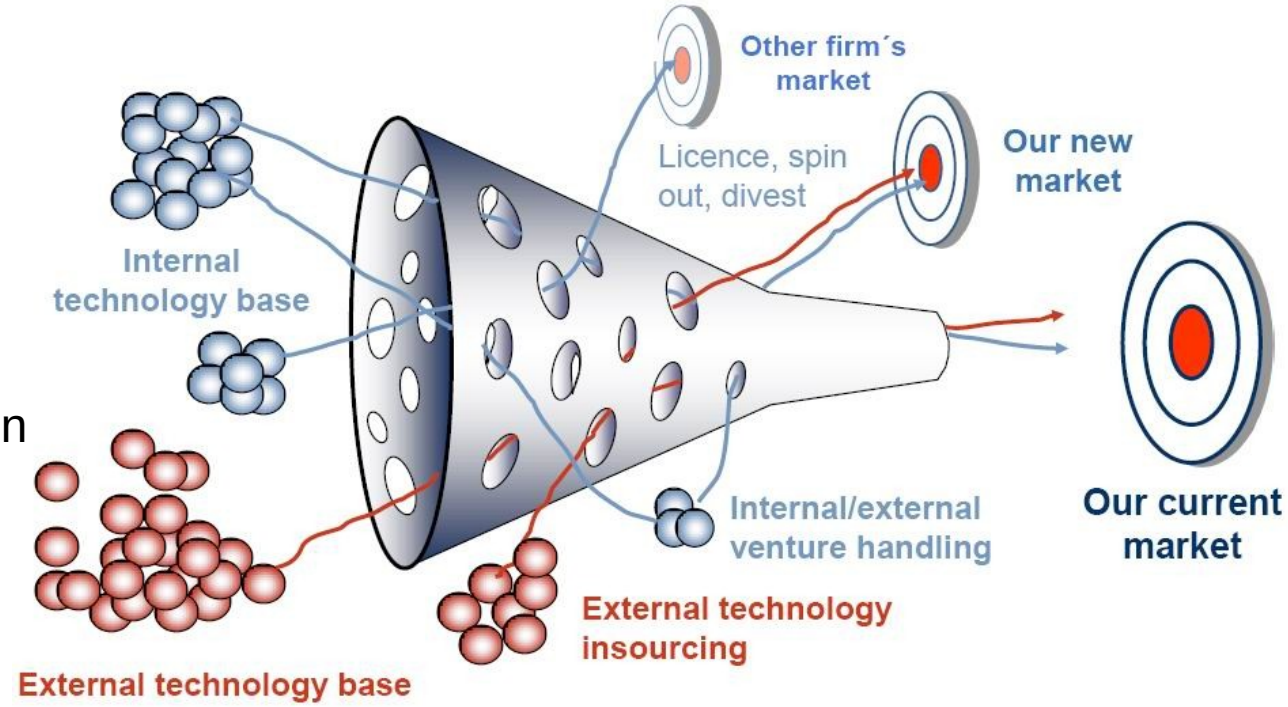
- Hippel (1986) stated that **user innovations** could present not only complements but also substitutes to producer innovations.



Erik von Hippel (1986) The New Imperative for Creating And Profiting from Technology

1. Technological Innovation: 1.3 User Innovation & Open Innovation

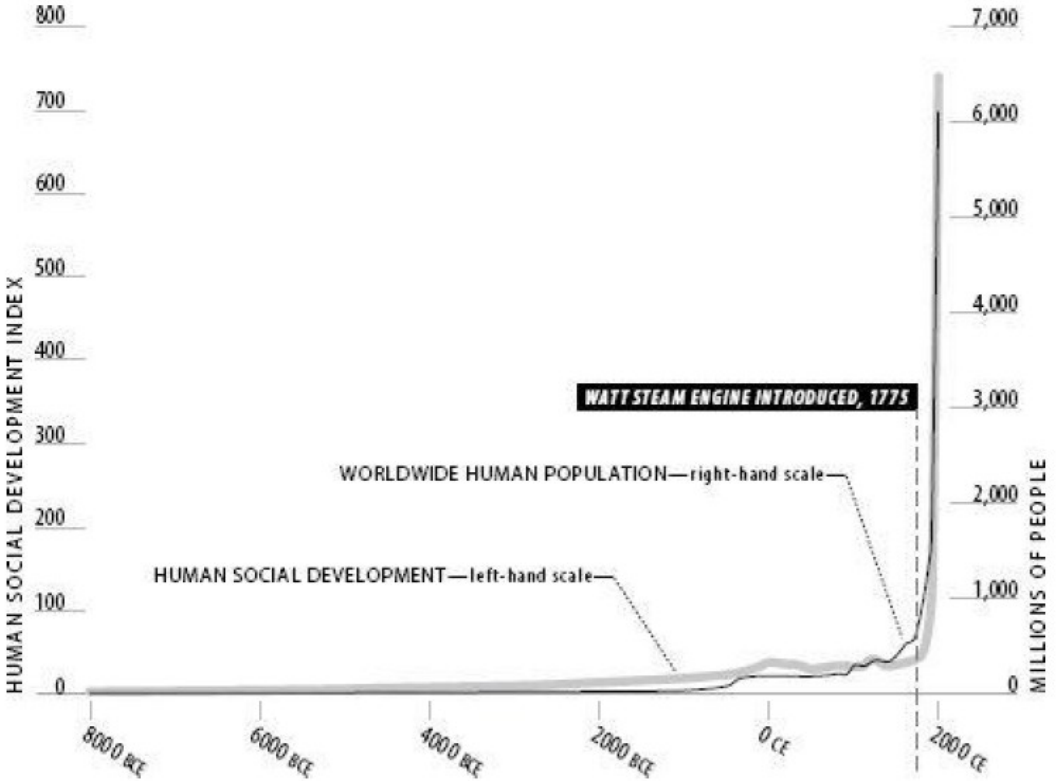
- Chesbrough (2003) introduced **open innovation**, which is also related to user innovation, cumulative innovation, and know-how trading. It requires to compete on business models and not on technologies only.



Henry Chesbrough (2003) Open Innovation: The New Imperative for Creating And Profiting from Technology

1. Technological Innovation: 1.4. Speed of Innovation

- **“Human Social Development Index”** is defined as the sum of the scores of four factors:
  - **Energy Capture** (Total Calories used for food, industry, transportation etc.)
  - **Organization** (The population in the largest City)
  - **Capacity for Warfare** (Number of troops, power, and speed of weapons, logistics etc.)
  - **Information Capacity** (Capacity of society to process and share information)



Brynjolfsson, E., McAfee, A. (2014). The second machine age: Work, progress, and prosperity in a time of brilliant technologies.

1. Technological Innovation:
1.5. Intensity of Impact of Innovation

- The many definitions of innovation have also resulted in an **ambiguity of impact that innovation causes on products and markets**.

- For example, Garcia and Colantone (2002), who conducted a literature review, analyzed these definitions and came up with 5 levels of impact of technological innovation:

Discontinuous	A discontinuous innovation may be either a radical innovation or "really new" innovation, dependent upon **at which discontinuity it originates from** (marketing/technology/both). It results in a market discontinuity or technology discontinuity.
Radical	Innovation that **embodies a new technology** resulting in a **new market infrastructure (macro level)**
Really New	A "really new" product will result in a **market change at a micro level**, at which product innovativeness is identified as new to the firm or the customer.
Incremental	Products that provide **new features**, benefits, or improvements to **the existing technology in the existing market**. An incremental new product involves the adaptation, refinement, and enhancement of existing products and/or production and delivery systems.
Imitative	Imitative innovators need not necessarily be aware of or be able to **benefit from the first innovator**. Imiitative products are frequently new to the firm, but not new to the market. Thus, imitative innovations usually have **low technological innovativeness and low market innovativeness**.

1. Technological Innovation:
1.6. Impact of Innovation on Economy

- Being innovative can be beneficial at all levels of a society:
  - At the global level, innovation can be linked to **economic growth**, which in turn leads to increasing economic and social well-being (Gault, 2014).
  - At the national level, innovation is a crucial factor for regions and/or countries to pull ahead of its neighbors with respect to **economic performance** (Fagerberg, 2004).
  - At the firm level, innovation has been shown by Arthur D. Little (2005) to be the most important aspect for **profit growth**. Innovative companies can expect, among other things, higher sales of new products and higher returns on R&D investments.



Fagerberg, J. 2004. 'Innovation: A guide to the literatur' in Fagerberg, J. 'The Oxford Handbook of Innovation, Oxford'
Gault, F. 2014. 'Handbook Of Innovation Indicators And Measurement'

1. Technological Innovation:
1.7. Impact of Innovation on Society

- Impact of innovative technology on Society (Brynjolfsson and McAfee, 2014) in the
  - Short-term
    - Innovations brings opportunities for companies to grow, and the majority of companies will **need to hire people to make growth possible**
    - Technologies quickly leave the research stage to enter mainstream business. This progress may be rapid, but companies still **need human workers to satisfy their customers and succeed** in the economy.
  - Long-term
    - The element that is most likely to change: People acquire money to buy things by offering their labor to the economy. **Due to increased automation, this exchange will become less feasible** in the long-run.
      - **As digitization becomes more common**, capable, and powerful, **companies will be increasingly unwilling to pay people wages** that they will accept and that will allow them to maintain their current standard of living.
      - The challenge of long-term: **Unemployed people do not create much demand for goods** and, therefore, the overall growth slows down.

Brynjolfsson, E., McAfee, A. (2014). The second machine age: Work, progress, and prosperity in a time of brilliant technologies.

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    2. **Group discussion session**
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2. Discussion Sessions
What Could be Goals of Innovation?

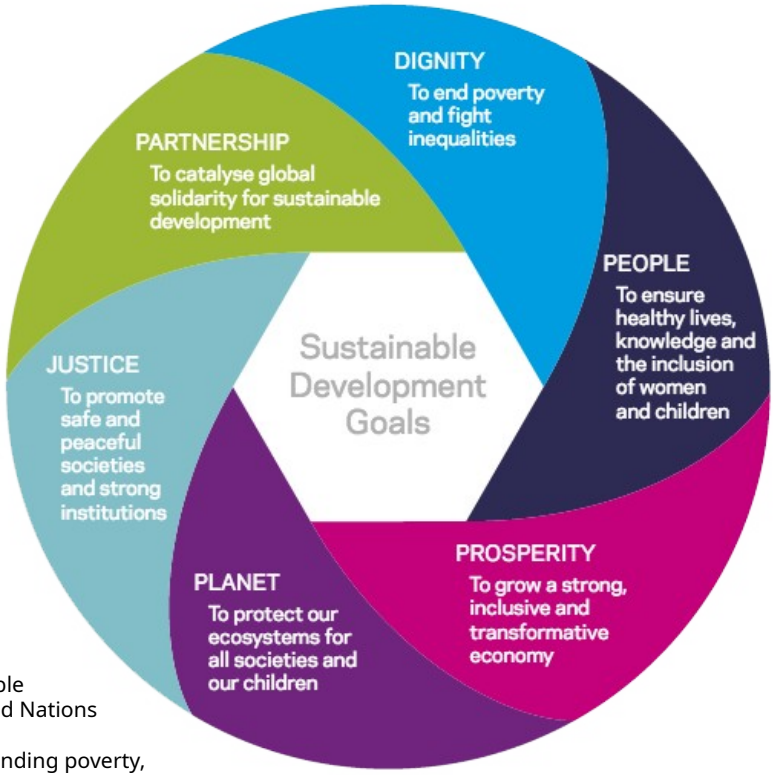
- **Potential goals of innovation**
  - Individual wealth accumulation
  - Individual power over other individuals (and/or countries)
  - Self-actualization
  - (Each level of the hierarchy of needs represents another goal of innovation)
- Assuming that we will have **full automation in the very long run, a circular economy, and unlimited renewable energy**, **self-actualization is the only real need that is left**



Maslow's Hierarchy of Needs (1943). A theory of human motivation

2. Discussion Sessions
True Sub-Goal of Innovation

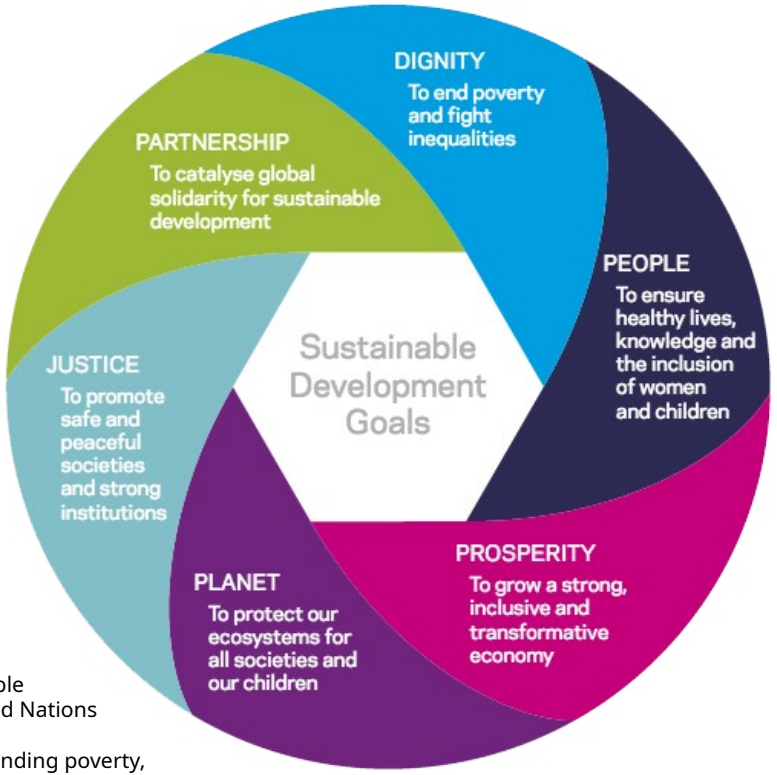
- **Until then, we need to sustain our environment, in which we live**
  - There are six dimensions that need to be addressed: Dignity, People, Prosperity, Planet, Justice, Partnership
  - E.g.: Environment-friendly, sustainable products and services based on an environment-friendly, sustainable supply chain
  - E.g.: New business models based on environment-friendly, sustainable value chains



- Figure by Elsevier and SciDev.Net (2015) on sustainable development goals reproduces the figure of the United Nations (2015)
- United Nations (2015). The road to dignity by 2030: ending poverty, transforming all lives and protecting the planet
- Elsevier (2015) Sustainability Science in a Global Landscape, Elsevier and SciDev.Net.

2. Discussion Sessions
Consequence of Other Innovation Goals

- **Consequently, without sustainability, there is a high risk of collapse of the entire socio-economic system as we know it.**
- As sustainability is a factor, on which to compete, sustainability will just force companies to change the way they think about products, technologies, processes, and business models (Nidumolu et al., 2009).
- So, a marketing campaign is needed to convince people to demand the factor sustainability in the products that they consume.



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2. Discussion Sessions
But, the Current Innovation Model

- **Due to the current innovation system in place, the existing approach to achieving sustainable development goals failed.**
- **Moreover, there are short-term perspectives and long-term perspectives in people's mind.**
  - **When they accept and adopt certain innovations (and the risks that come with them), they hardly think about the long-term consequence**
- **These two kind of perspectives can be summarized as**
  - "Continue As We Did" (Group 1 – short-term perspective – e.g., Elon Musk, Peter Thiel)
  - "Change Now, And Use Only Appropriate Innovation" (Group 2 – long-term perspective – e.g., Extinction Rebellion, Fridays-for-Future)

2. Discussion Session: Group Discussion on Innovation

(Group 1 – Short-term Perspective – Elon Musk, Peter Thiel: “Continue As We Did”)

- Task: Describe that we need to exploit our natural resources and our environment through innovation, in order to keep up economic growth and, with that, improve our standard of living.
- Task: Argue that the advancements of technology is for the good of the entire society, and not for just a few rich people.
- Task: Explain how our innovation system will solve all the problems once they become serious (i.e., loss of biodiversity, climate change, depletion of resources, environmental destruction, poverty, unemployment through automation (e.g., AI)).
- Task: Describe the benefit of your solution.

2. Discussion Session: Group Discussion on Innovation

(Group 2 – Long-term Perspective – Extinction Rebellion, Fridays-for-Future: “Change Now, And Use Only Appropriate Innovation”)

- Task: Describe the potential innovation that we need (and those innovation that we do not need), to solve the big problems in the world (i.e., loss of biodiversity, climate change, depletion of resources, environmental destruction, poverty, unemployment through automation (e.g., AI))
- Task: Describe how we should deal with those people that cannot or do not want to change.
- Task: Describe how we could convince the society to change towards a new innovation system.
- Task: Describe the benefit of your solution.

2. Discussion Session: Plenary Discussion Session

- 10 min presentation (3 slides) of Group 1 – Short-term Perspective
- 10 min presentation (3 slides) of Group 2 – Long-term Perspective