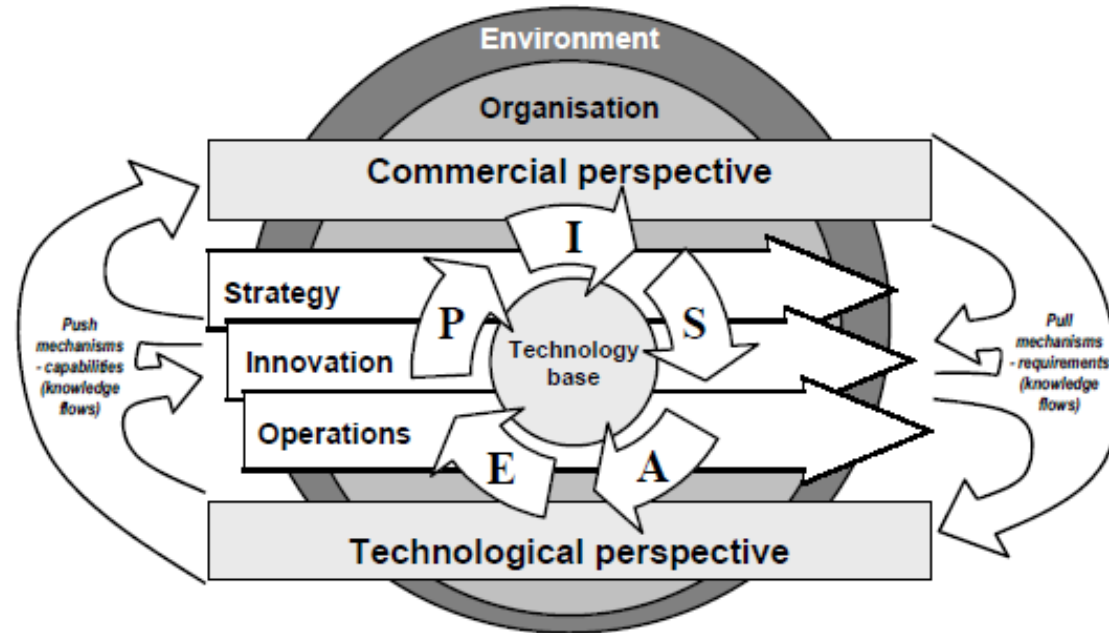


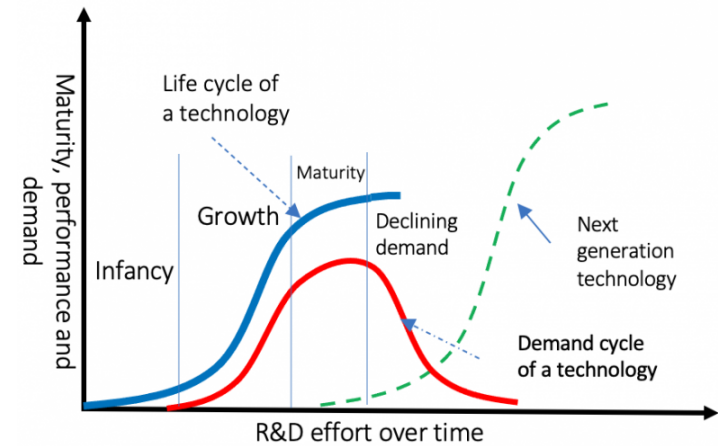
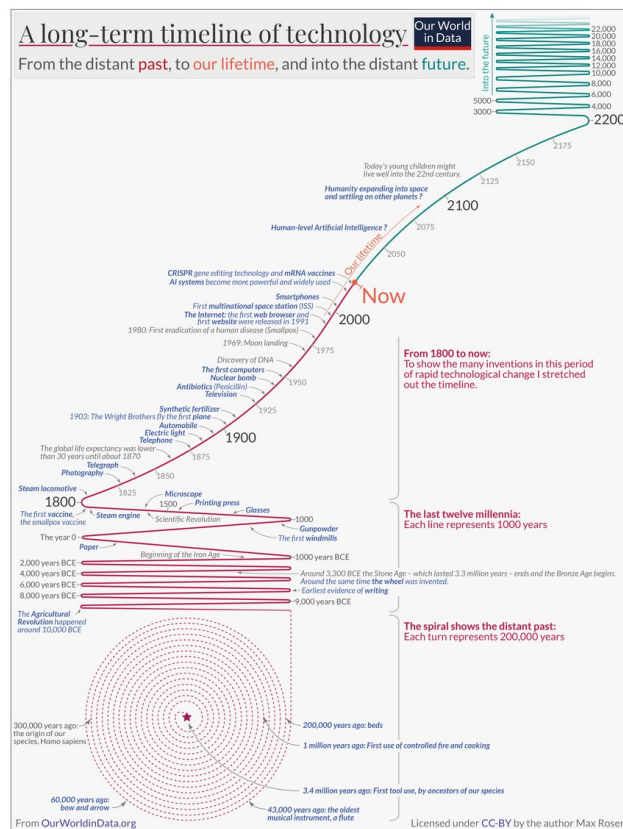
Micro and Macro Approaches to Technology Management

Recap of Technology Management Framework



- Think about, how can the technology management framework be applied in a real-world scenario? Provide an example.

Technology is changing our lives



Note: technology has S-Curve like life cycle; however, the demand life cycle of a technology is bell-shaped like curve (not S-curve)

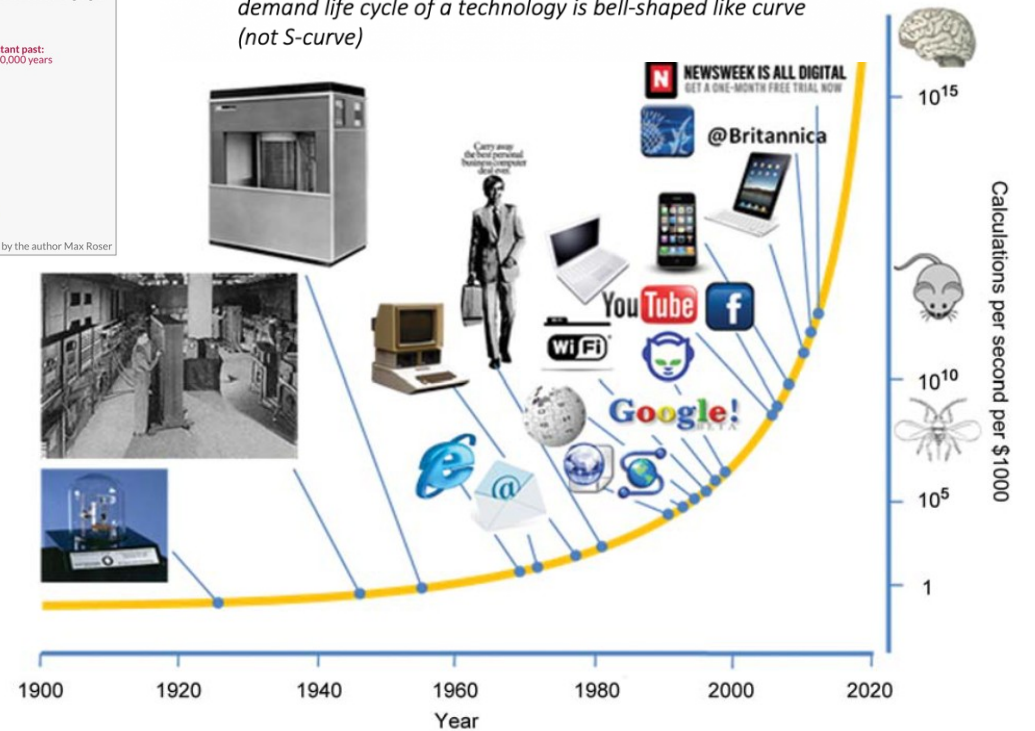
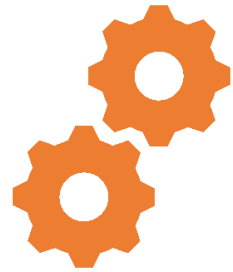


Fig. 1: Some important events in the development of information and communication technologies over the last century

Content of the lecture



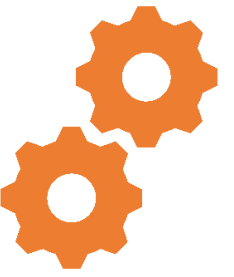
Macro view

Technology s-curve,
Technology cycle and dominant design
Technology diffusion
Triple helix model

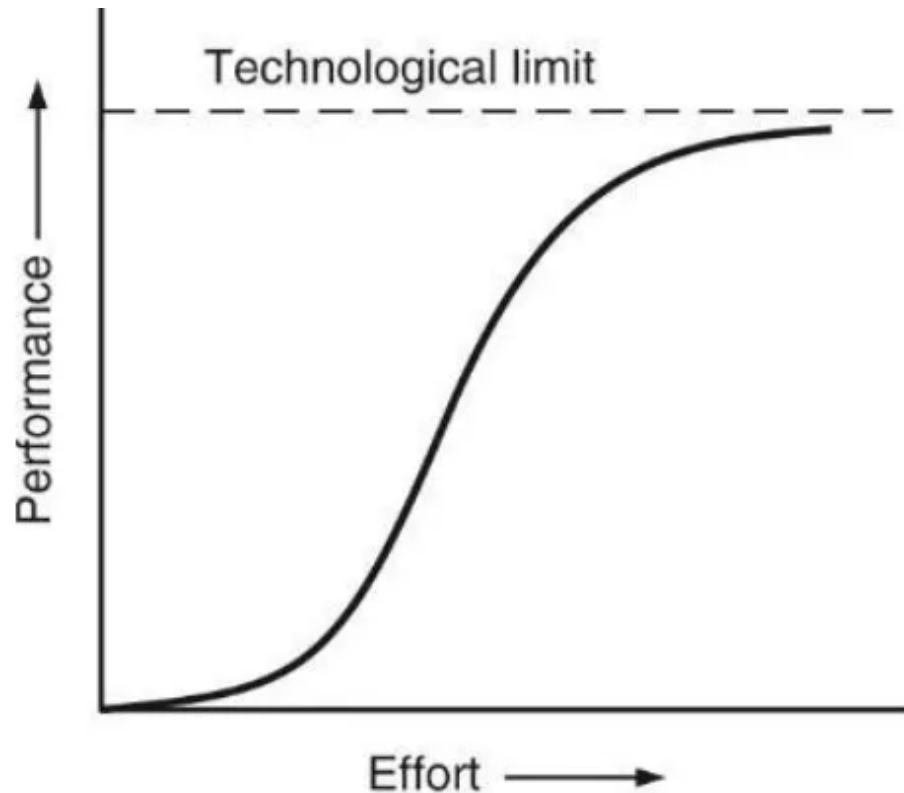


Micro views

Technology adoption model
Absorptive capacity
Communities of practice
Stage-gate model

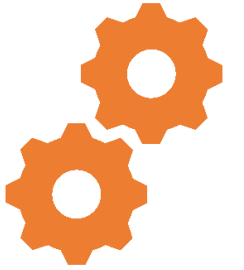


Technology s-curves

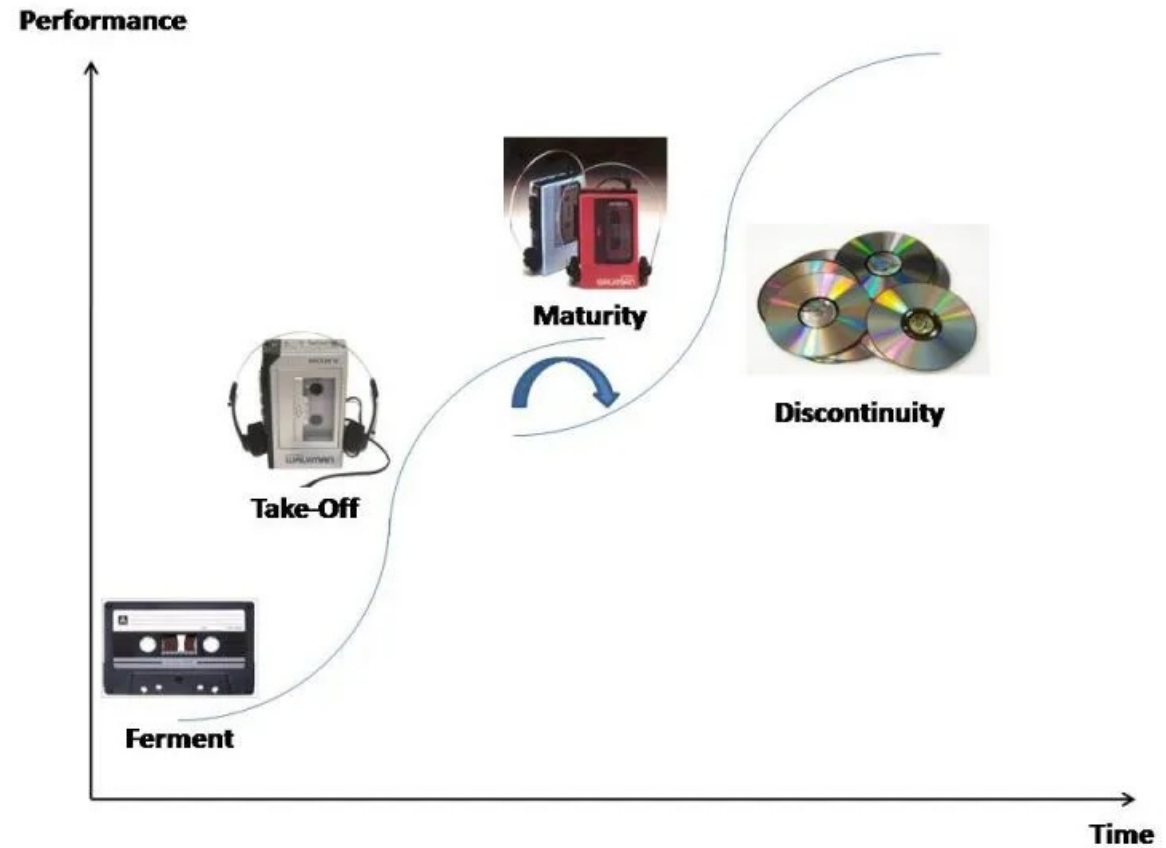
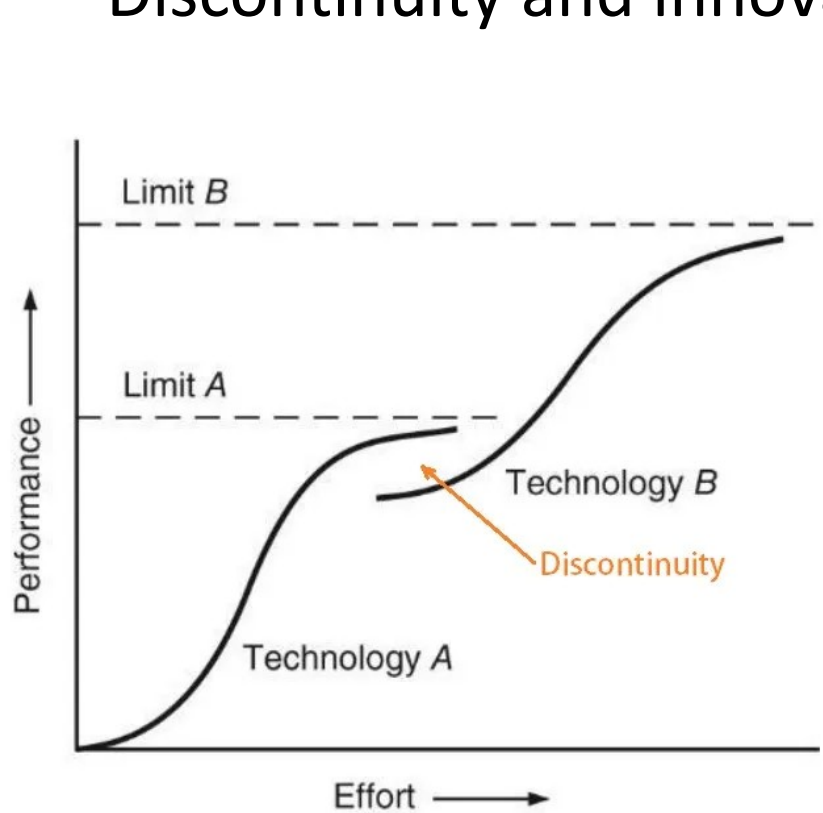


- Depict how a technology develops and declines
- enables the analysis of the evolution of the performance of any technology
- Brought to the mainstream by Everett Rogers in 1962

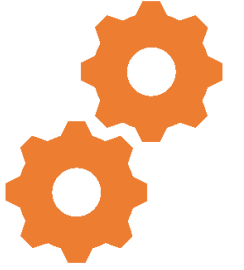
Technology s-curves



- Discontinuity and innovation:



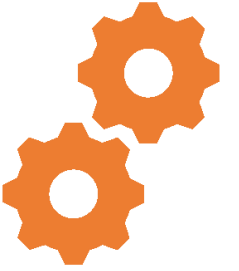
Technology s-curves



Select three social media platforms that have been around for a while and plot the S-curve for your chosen platforms.



Technology s-curves

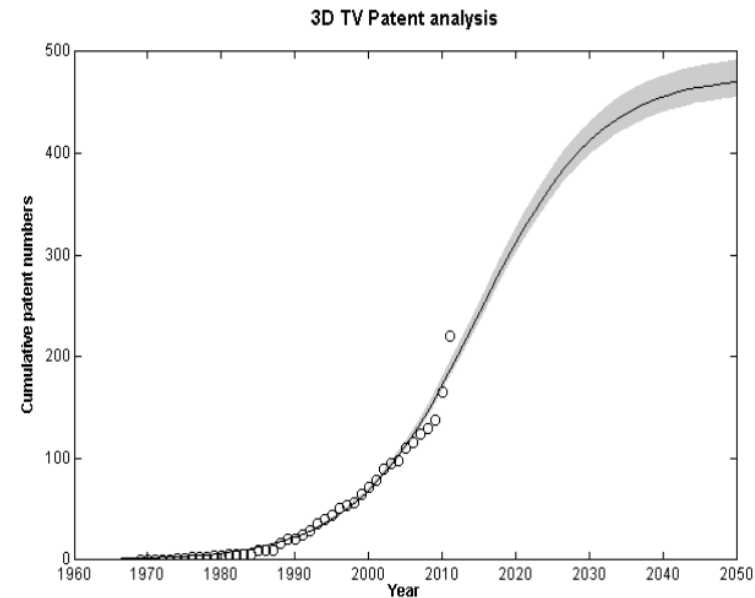
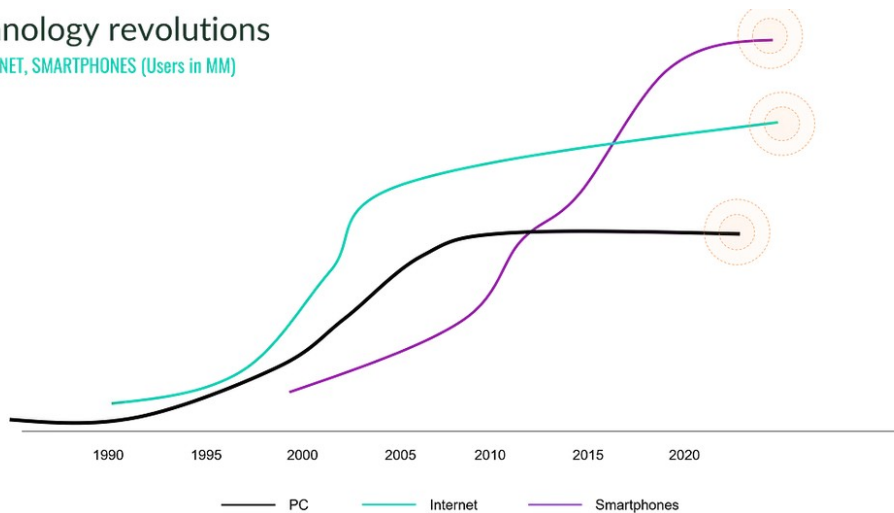


How to use S-curves (methodologically):

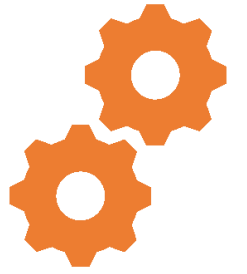
1. Longitudinal data collection based on a performance metric.
2. Observing or forecasting the evolution and plotting the curve.
3. Using the resulting curve for planning and decision making.

Technology revolutions

PC, INTERNET, SMARTPHONES (Users in MM)

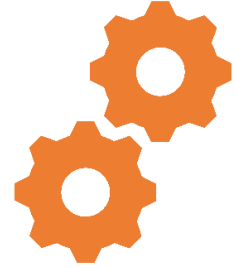


Technology s-curves



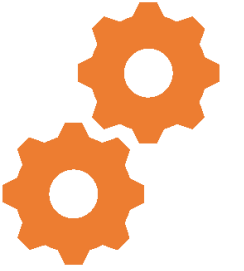
Discuss with your neighbors: How can technology managers make use of the s-curve for planning and decision making? For instance, think of activities by linking s-curves with the technology management framework by Phaal et al. (2004).

Technology s-curves



- Main advantages of using the S-curve
 - Evaluating the different stages of a technology.
 - Pointing out the importance of being ready for technological discontinuities highlighting the importance of strategic positioning in case of a decline in gains.
 - Giving the company the opportunity to be the first mover within a market.

S-curves benefits and shortcomings



- Evaluating the different stages of a technology.
- Pointing out the importance of being ready for technological discontinuities highlighting the importance of strategic positioning in case of a decline in gains.
- Giving the company the opportunity to be the first mover within a market.

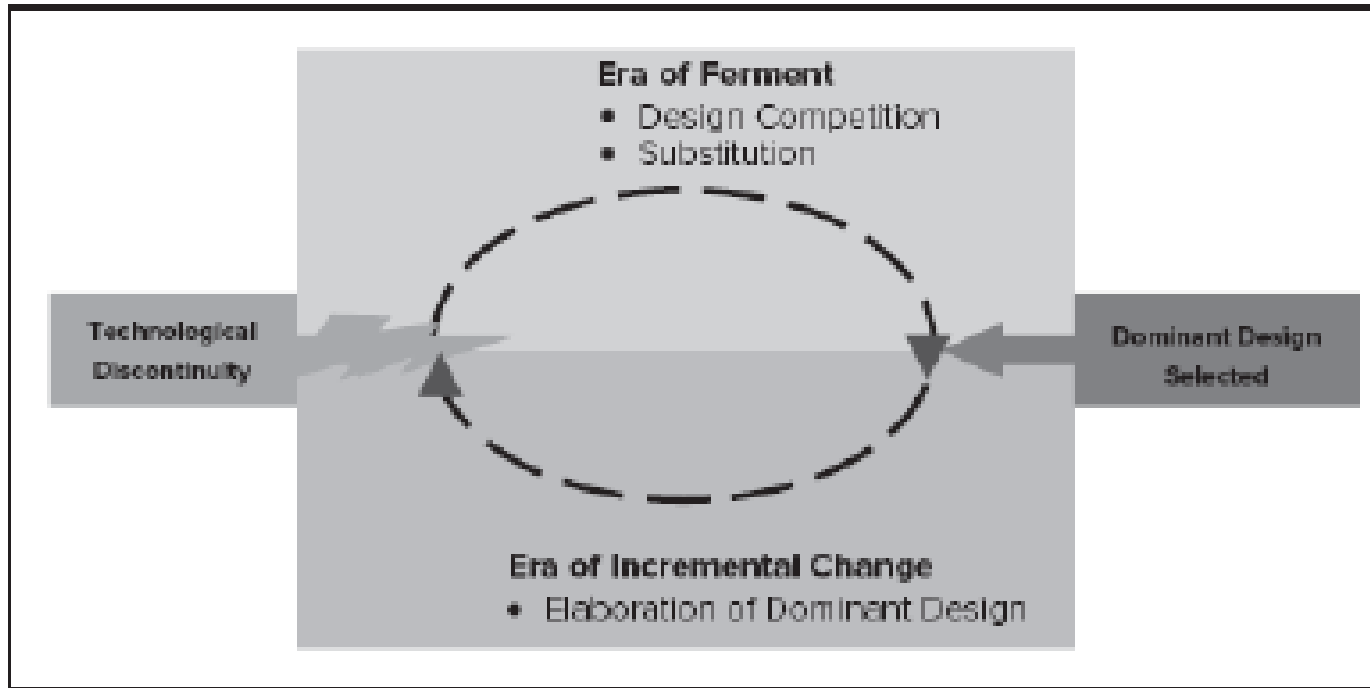
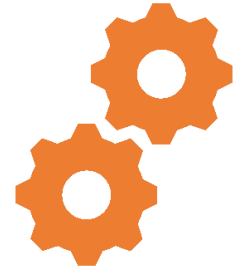
(Fichman and Kemerer, 1995):

→ S-curves are largely seen as descriptive rather than analytical.

- The S-curve does not provide suggestions on how strategists should react to discontinuities in their technology.
- The advantage to be gained from new technologies cannot be quantified by the model.
- It is hard to conclude when to invest in new, and dispose of current, R&D.
- The S-curve does not reveal how the new technology could be foreseen by others or by whom it will be introduced.
- S-curves might not reflect the dynamic product or market changes.

Christensen, 1992):

Dominant design within technology cycle



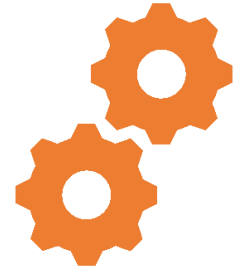
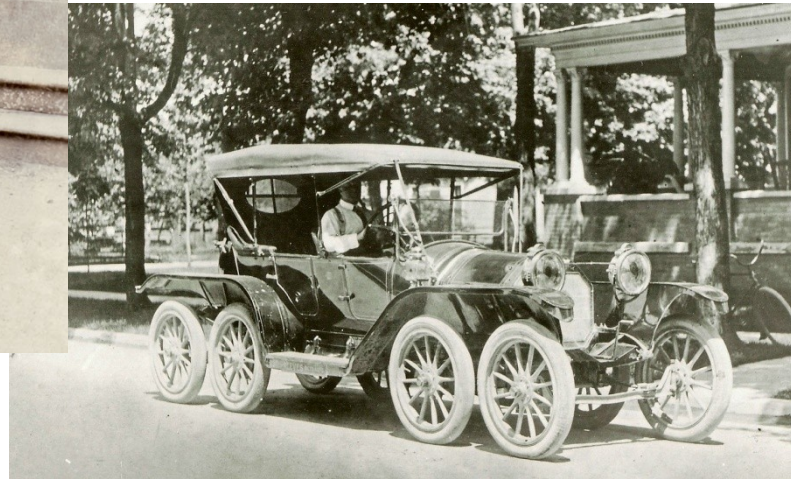
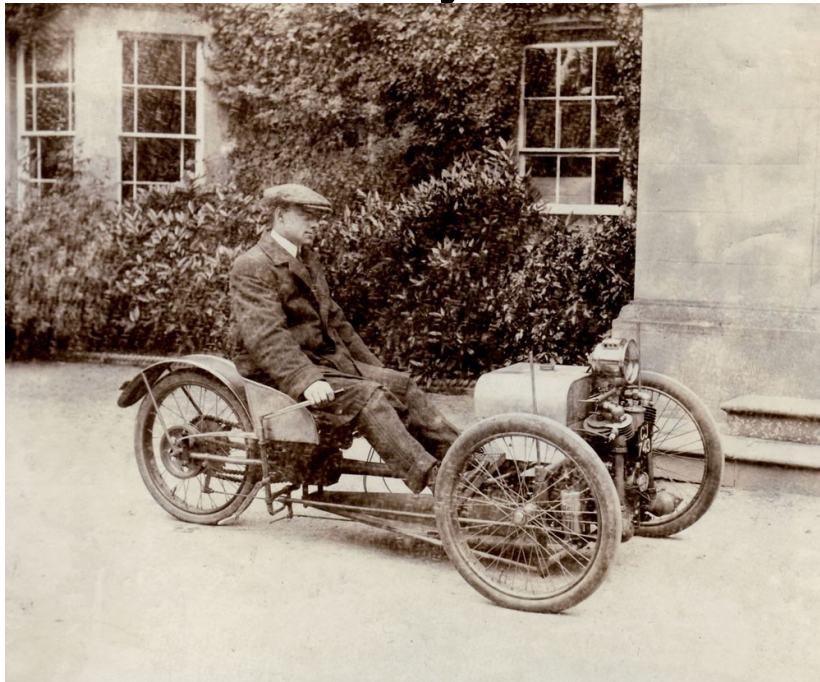
Dominant design: A product design that is adopted by the majority of producers, typically creating a stable architecture on which the industry can focus its efforts.

Source: Schilling/Shankar (2019)

Anderson, P., & Tushman, M. L. 1990. Technological discontinuities and dominant designs: A cyclical model of technological change. *Administrative science quarterly*: 604-633. (→ background reading on Moodle)

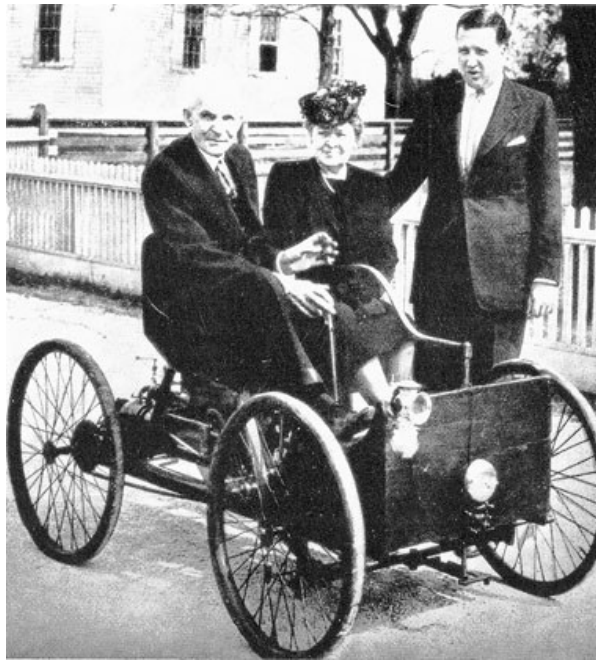
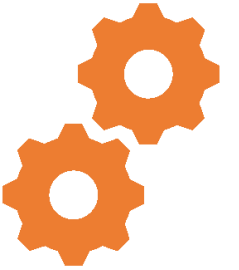
Design competition

- How many wheels for a car?

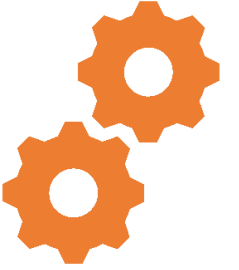


Design competition

What type of steering ?



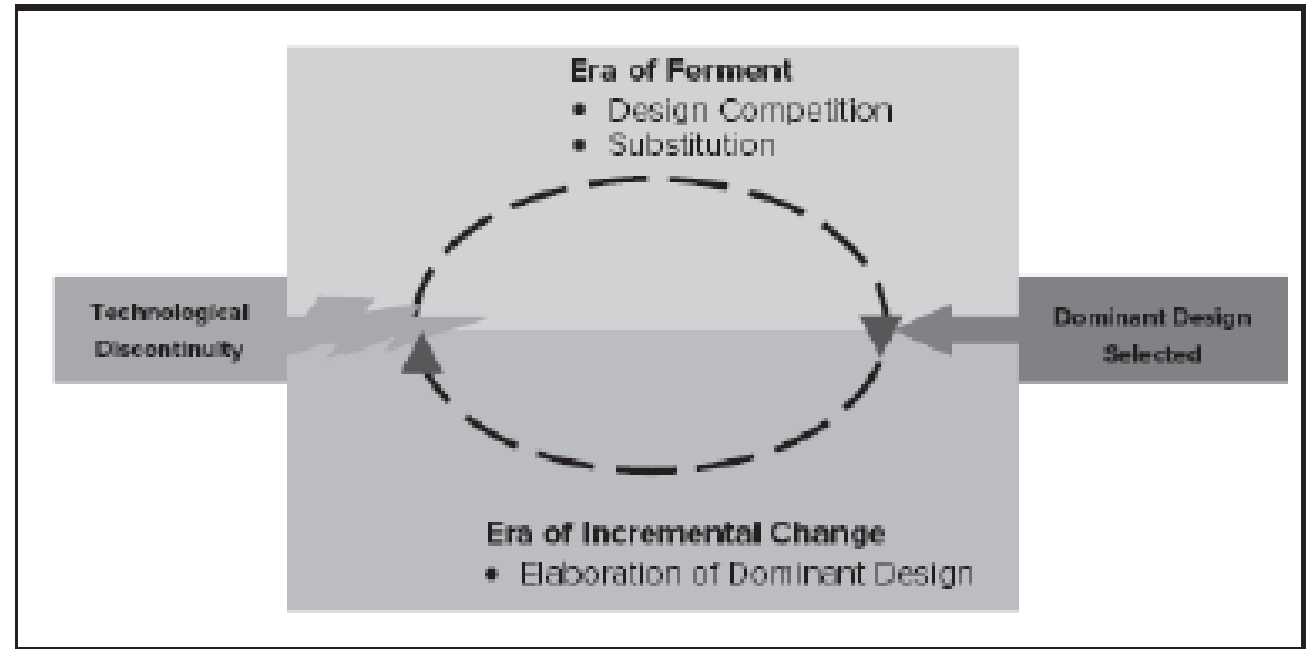
Dominant design selection



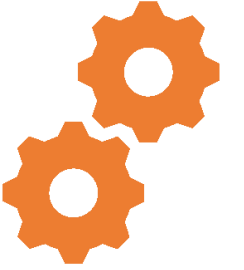
Dominant design: A product design that is adopted by the majority of producers, typically creating a stable architecture on which the industry can focus its efforts.



Ford Model T introduced in 1908

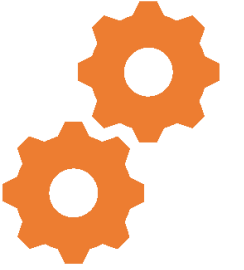


dominant design



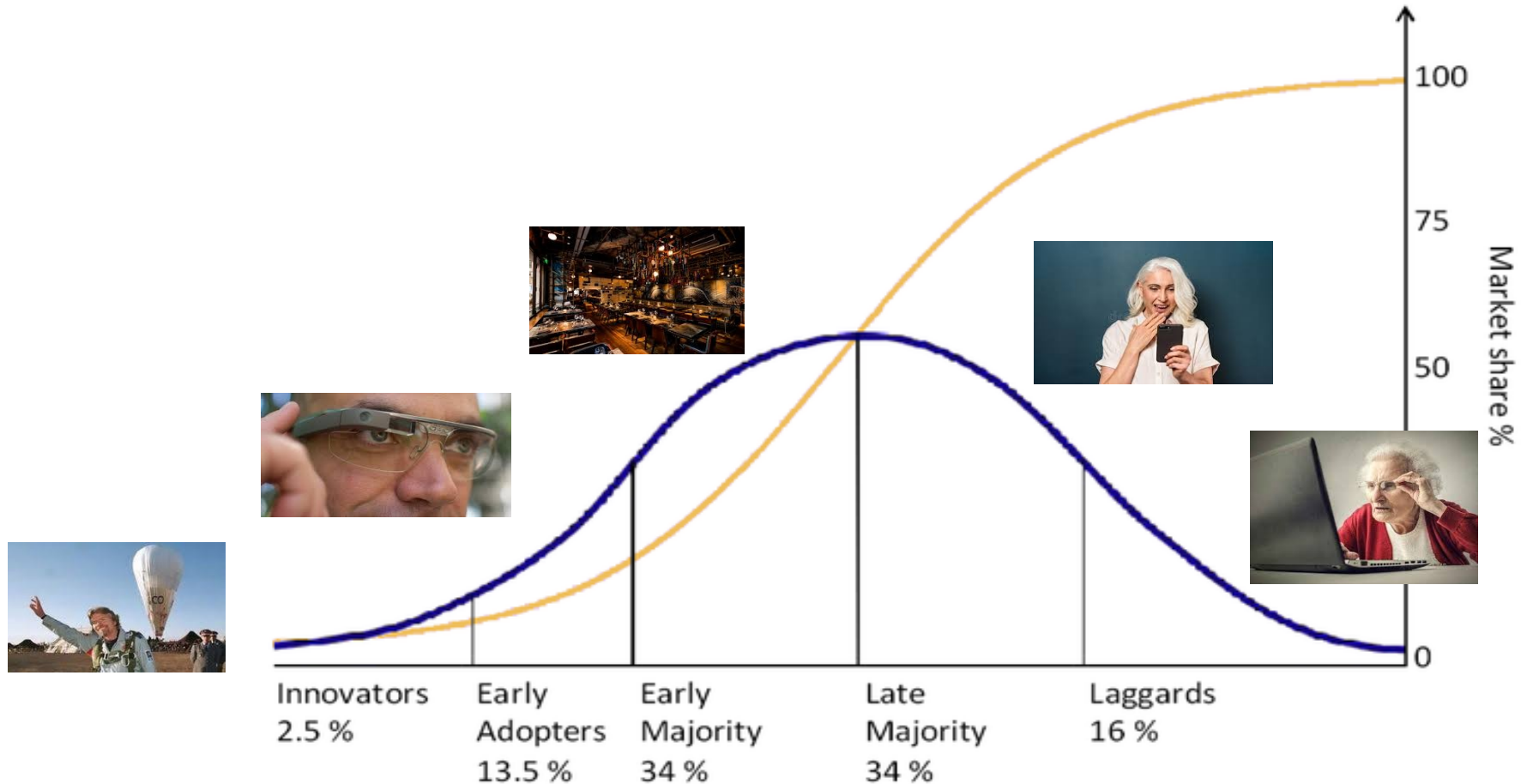
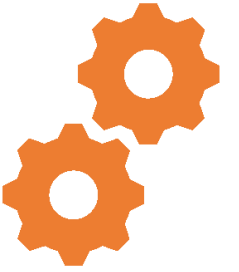
What factors contribute to firms winning the design competition in the era of ferment?

Technology adoption



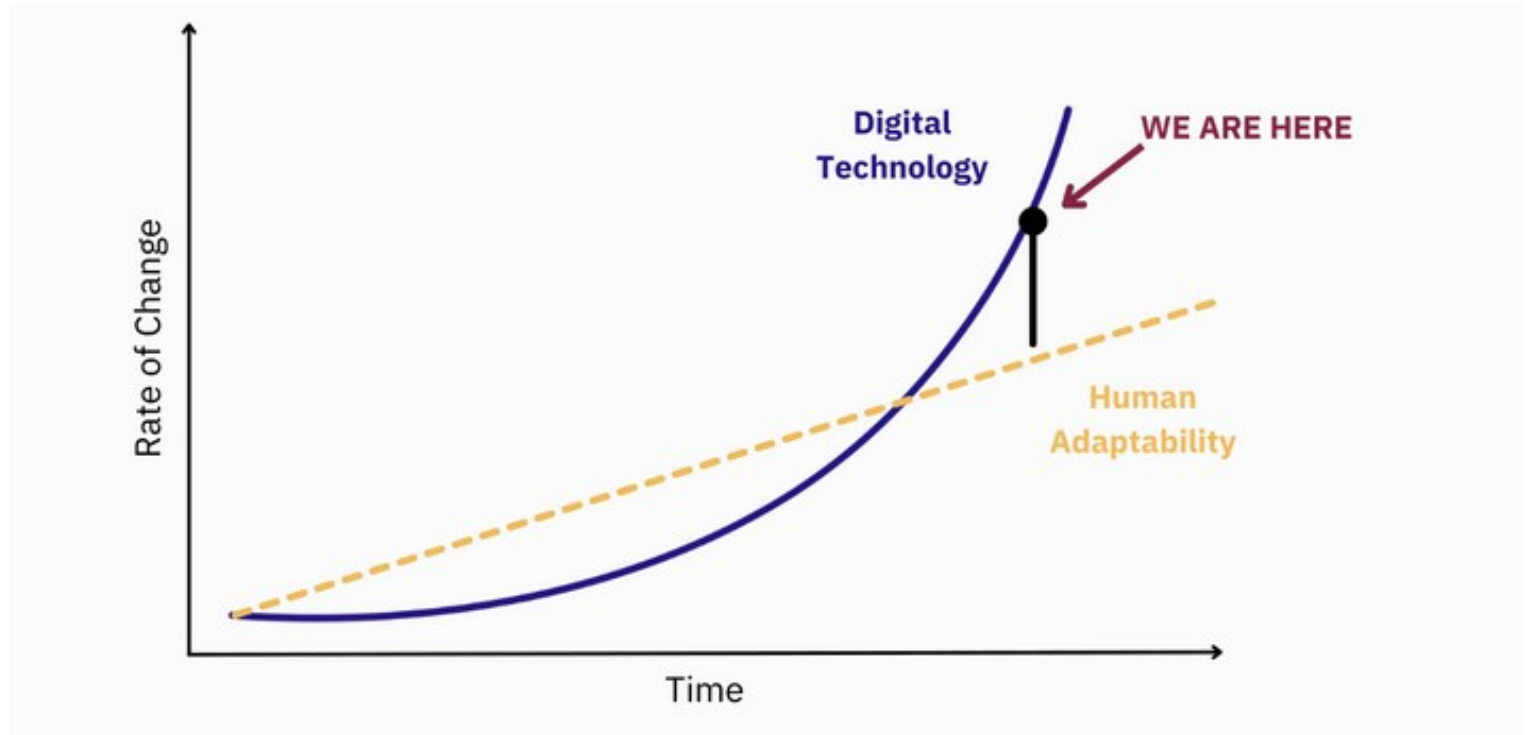
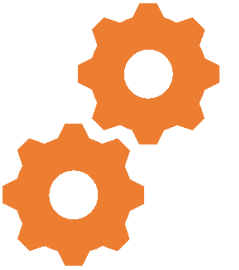
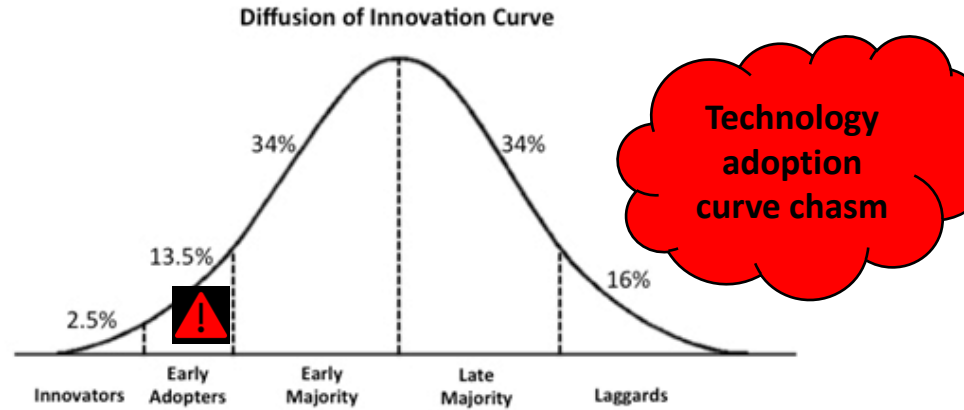
- Some research questions:
- Will anyone use what I've built?
- How can I get more people to use it?
- And why do people leave after a few days?

Diffusion of technology



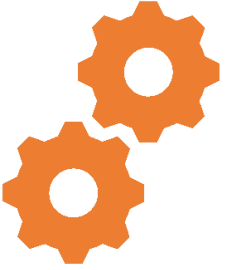
Based on Rogers (2003). Diffusion of Innovations. New York: Free Press. 5th Ed.

Early adopted but not with majority. What would you do?



Based on Moore (1991). **Crossing the Chasm**. Harper Business Essentials. 1st edition

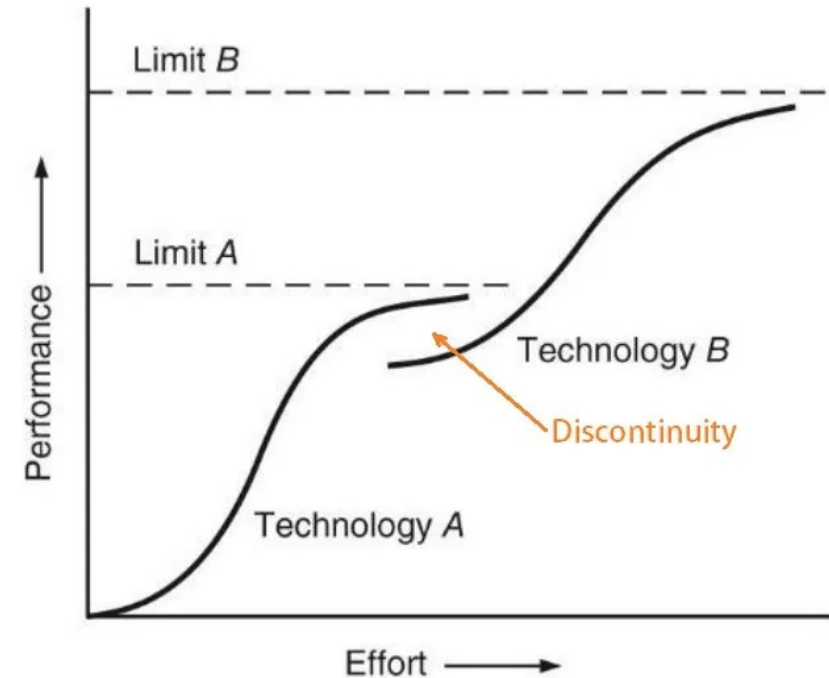
Interaction



Work with your neighbors: Discuss how the three macro views are connected by establishing a link between

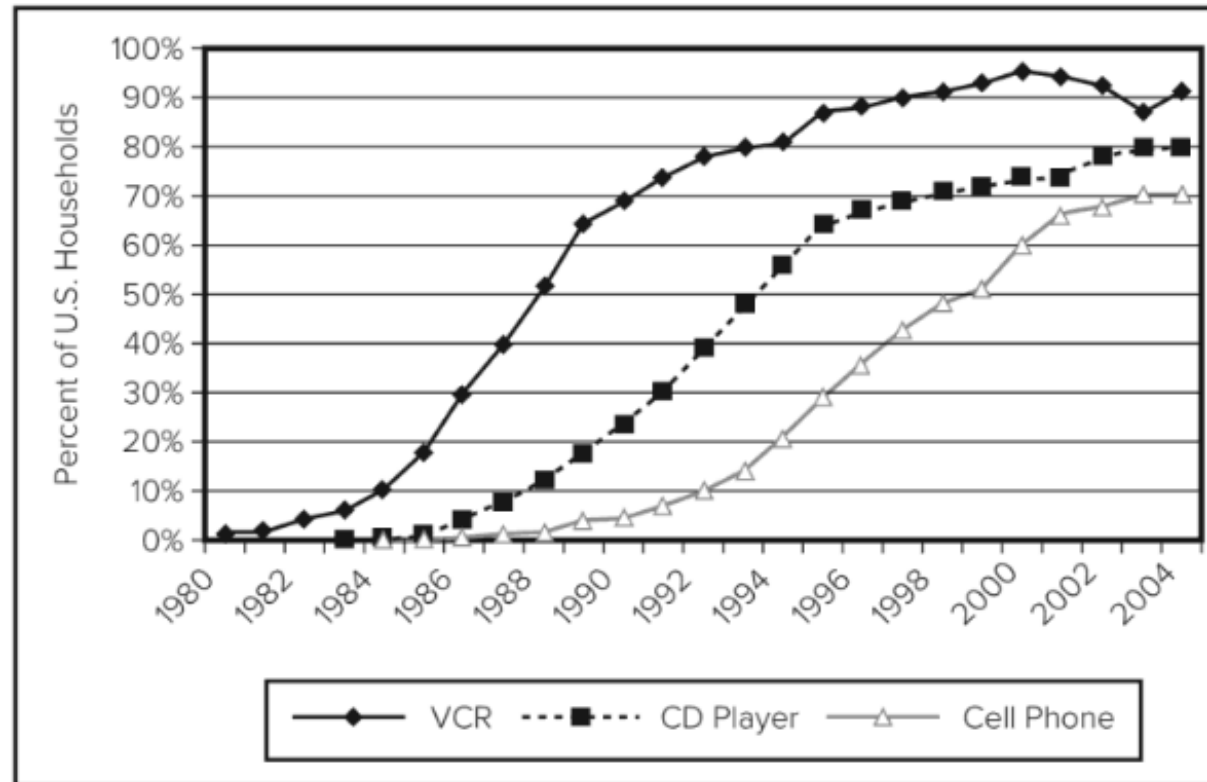
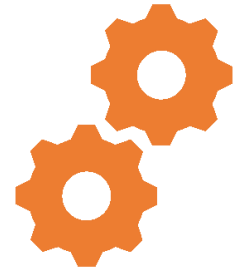
- a) s-curves
- b) technology cycles and dominant design
- c) technology diffusion theory.

Use drawings to connect the approaches.



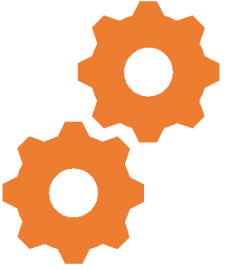
Source: <https://extrudesign.com/what-is-technology-s-curve/>

S-curves and the diffusion of innovation



Source: Schilling/Shankar (2019)

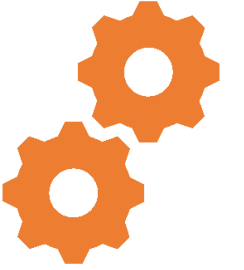
Collaborative concepts



Modern technology development is a collaborative enterprise between various actors, in different combinations, and at different stages of the technology development process.

Collaborative Concept	The big idea	Starting reference	Key Authors
Triple Helix	Interactions between government-industry-universities with each fulfilling both their traditional and non-traditional role.	Cai & Etzkowitz, 2020	Henry Etzkowitz
Open Innovation	A view of collaborations of an individual firm that focusses on inflows & outflows of intellectual property.	West & Bogers, 2014	Henry Chesborough
Networks	Enduring inter-organisational ties involving the exchange of knowledge and other economic resources	Birkinshaw, Bessant & Delbridge, 2007	Ron Burt
Eco-systems	Loosely inter-connected network of innovation actors that co-evolve technology capabilities	Furr, O’Keeffe & Dyer, 2016	Annabelle Gawer

Triple-helix model



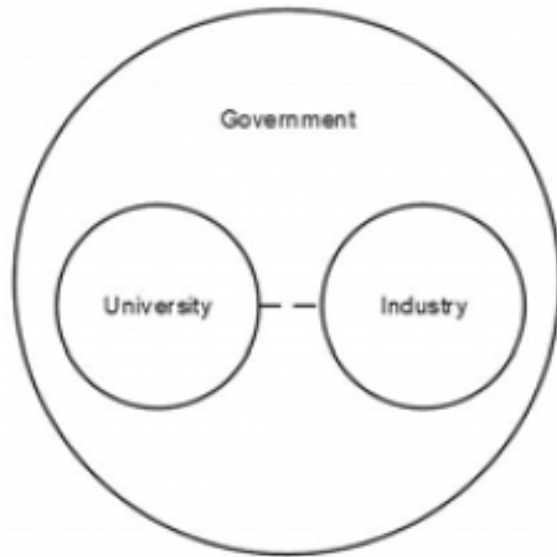
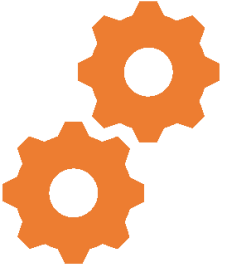
“A new mode of [technology] production is emerging based on linkages among academia, industry and government.”

(Etzkowitz/Leydesdorff, 1995)

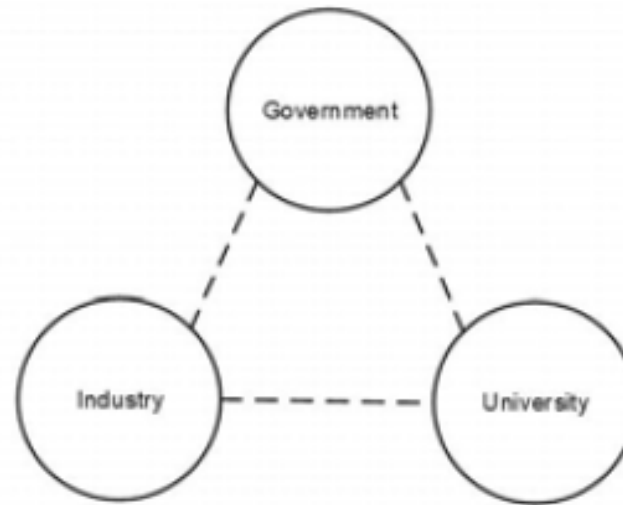


- What role do a) universities, b) industry, and c) government and policy organizations play for the production of new technologies?

Triple-helix model



Statist model



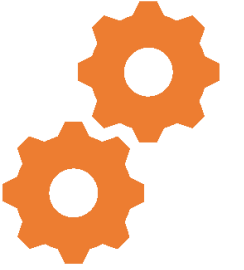
Laissez-faire model



Balanced helix model

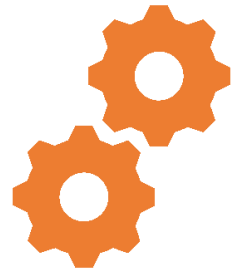
Cai, Y., & Etzkowitz, H. 2020. Theorizing the Triple Helix model: Past, present, and future. *Triple Helix*, 7(2-3): 189-226.

Triple-helix model



- What are the implications of the triple-helix model for
- a) the innovating firm (*e.g., Bose, Mellanox, SAP, Siemens Mobility, Vestas Wind*) and
- b) the technology (*e.g., sustainable packaging, quantum computing, biotechnology, 5G technology*)?

Agenda



Macro views

Technology s-curve,
Technology cycle and dominant design
Technology diffusion
Triple helix model



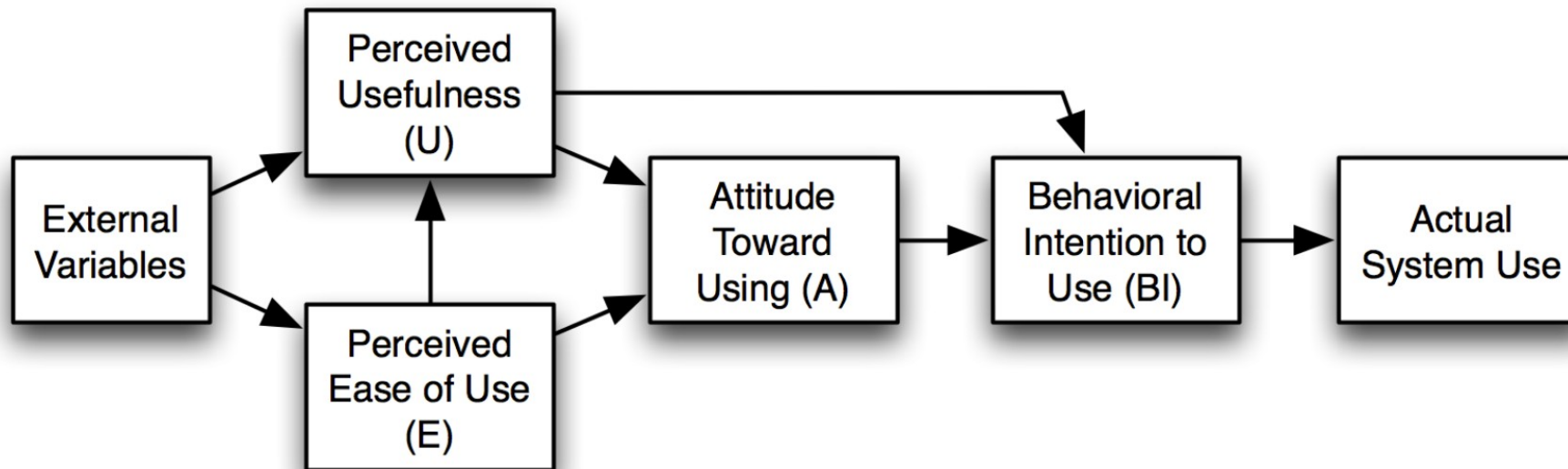
Micro views

Technology adoption model
Absorptive capacity
Communities of practice
Stage-gate model

Technology acceptance model (TAM)



- explains how users come to accept and use a technology
- Constantly under criticism



Davis, F. D. (1989), "Perceived usefulness, perceived ease of use, and user acceptance of information technology", MIS Quarterly, 13 (3): 319–340, [doi:10.2307/249008](https://doi.org/10.2307/249008), [JSTOR 249008](https://www.jstor.org/stable/249008), [S2CID 12476939](https://www.s2cid.com/12476939)

Technology acceptance model (TAM)



- Imagine new software system you started to use in the past and think about your behaviour. How did you perceive usefulness and ease of use and did it affect your adoption of the system?

Communities of Practice CoP



- groups of people who share a concern or passion for something they do and learn how to do it better through regular interaction.
- Dimensions of practice within community: mutual engagement, joint enterprise, and a shared repertoire
- Learning viewed as a social participation
- Dynamic boundaries defined by practice rather than institutionally
- Knowledge is a key asset

Based on „Wenger, Etienne. *Communities of Practice: Learning, Meaning, and Identity*. Cambridge University Press, 1998.

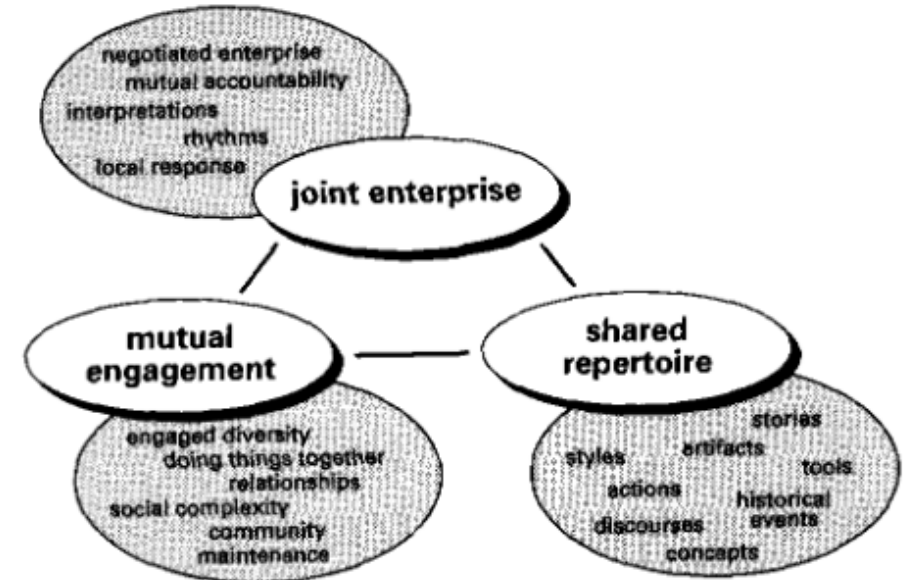
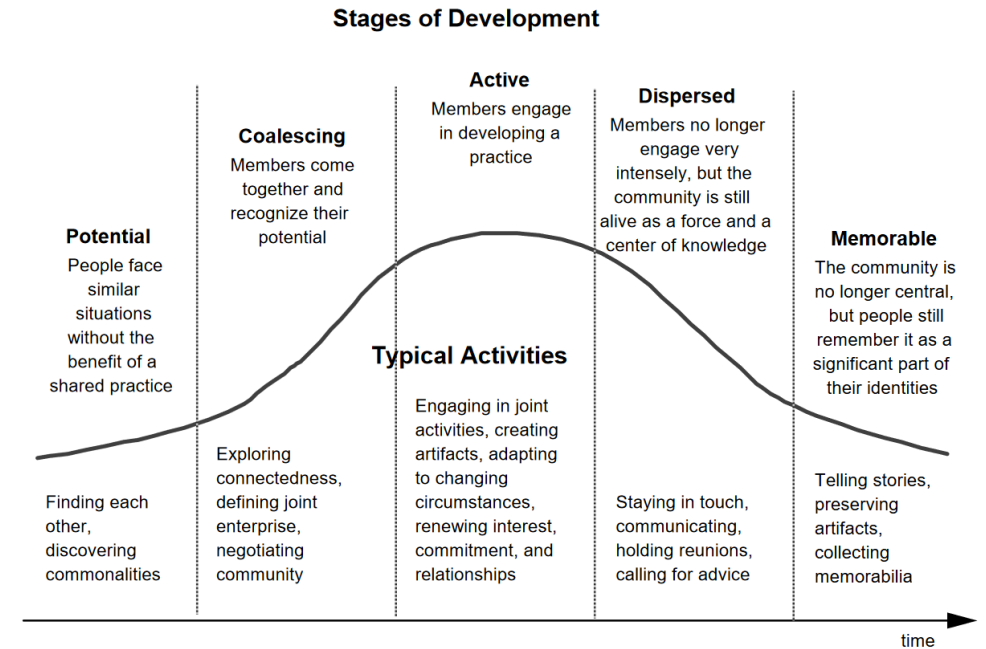


Figure 2.1. Dimensions of practice as the property of a community.

Communities of practice CoP



<http://andrearabin.blogspot.com/2015/08/task-4-communities-of-practice.html>

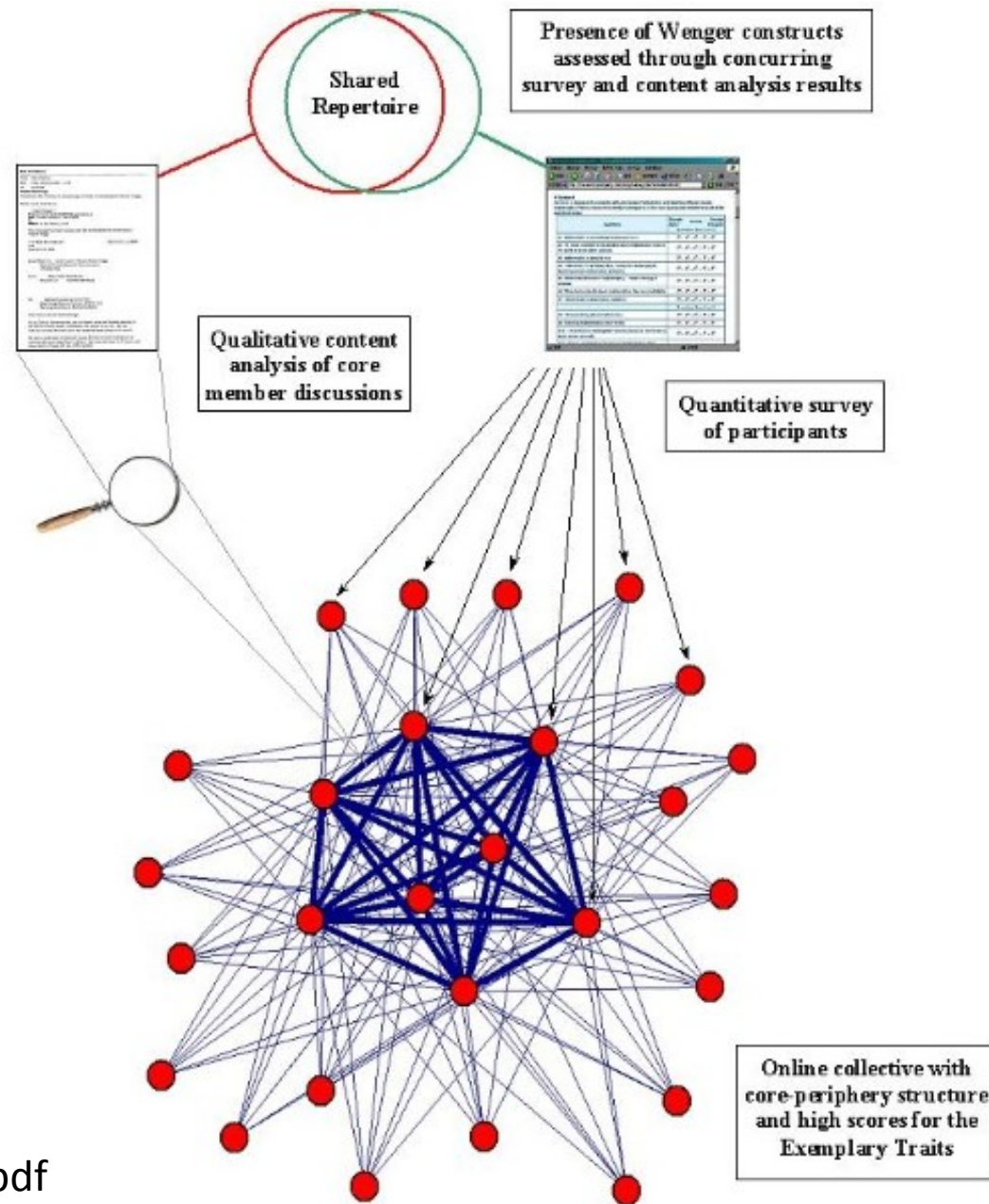
Communitits of practice to discuss



- Discuss how do CoP differ from other types of social groups like teams, networks, interest groups, functional department



Communities identification



<https://files.eric.ed.gov/fulltext/EJ837276.pdf>

Figure 3: Multi-method assessment of virtual community of practice

Absorptive capacity



Absorptive capacity is “The ability of a firm to **recognize** the value of new, external information, **assimilate** it, and **apply** it to commercial ends” (Cohen & Levinthal, 1990)

- Recognising the value of knowledge and external ideas, for instance by collaborating
- Assimilating knowledge: Synthesising and disseminating information/knowledge internally
- Applying knowledge for commercial ends: Embedding knowledge in products, services, processes

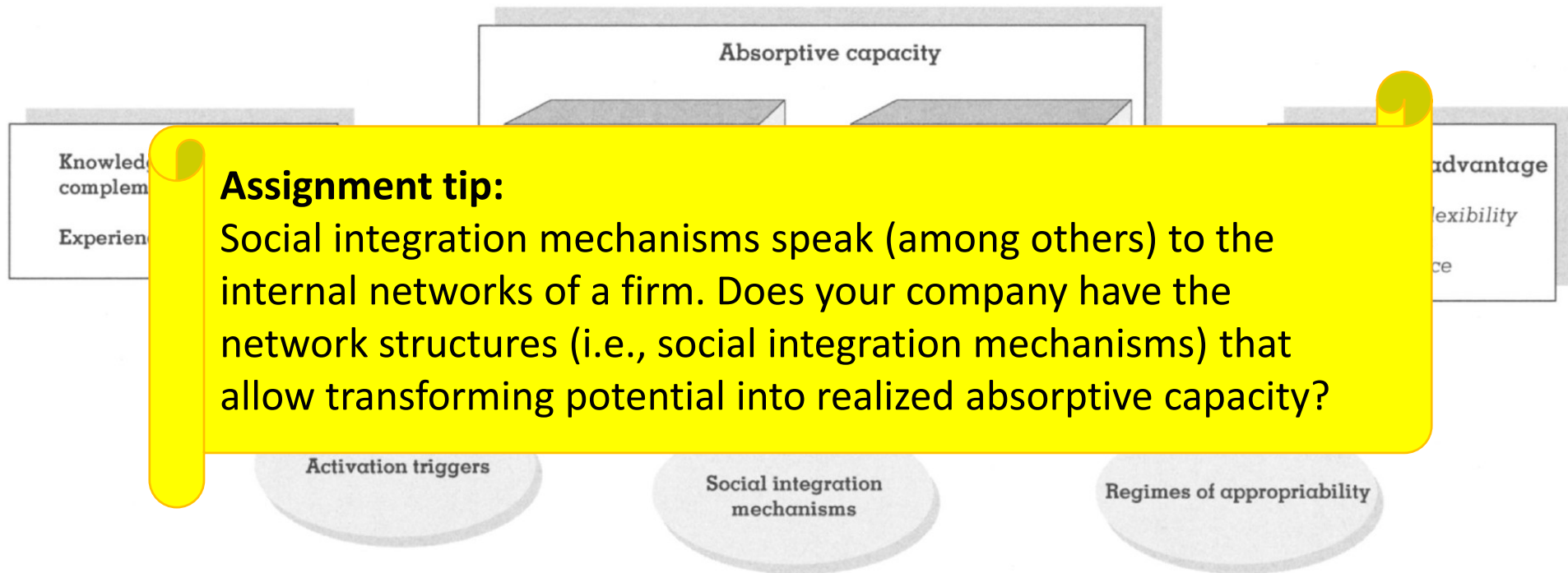
Absorptive capacity



Type of ACAP	Capability	Meaning	Elements
Potential	Acquisition	The capability to identify and acquire externally generated knowledge that is critical to its operations (e.g., technology development)	Prior knowledge Prior investments
	Assimilation	The routines and processes that allow it to analyse, process and interpret information from external sources.	Understanding
Realised	Transformation	The capability to refine and combine existing knowledge, newly acquired and assimilated knowledge	Internalisation Conversion
	Exploitation	The routines that allow firms to deploy existing competencies or to create new ones by incorporating acquired and transformed knowledge into its operations	Implementation

Based on Zahra, S.A., George, G. (2002) → see Moodle

Absorptive capacity



Assignment tip:

Social integration mechanisms speak (among others) to the internal networks of a firm. Does your company have the network structures (i.e., social integration mechanisms) that allow transforming potential into realized absorptive capacity?

Regimes of appropriability: Institutional and industry dynamics that effect of firms ability to protect the advantages of any benefit from new technologies.

CoP and Absorptive capacity



- What are the challenges organizations face in leveraging CoPs to develop absorptive capacity, and how can these be addressed?
- How do Communities of Practice facilitate the acquisition, assimilation, transformation, and exploitation of knowledge within an organization?



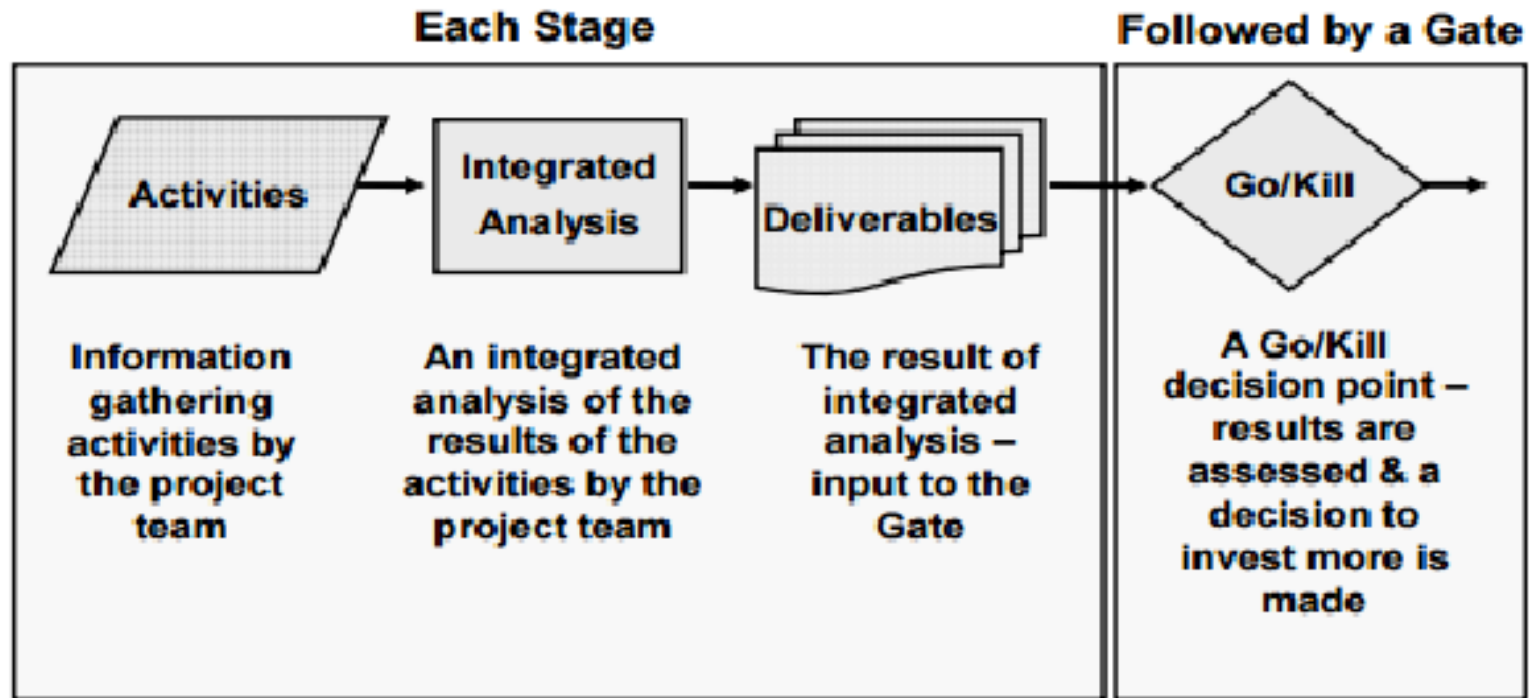
Conclusions

- S-curves are a useful (descriptive) approach to understand the development of technologies
- S-curves, dominant design, and diffusion models are inherently linked
- Modern technology development is a collaborative enterprise as reflected for instance in the triple helix model
- Absorptive capacity is key to reap value from collaboration
- Firm-internal social networks help translate potential into realized absorptive capacity

Stage gate model



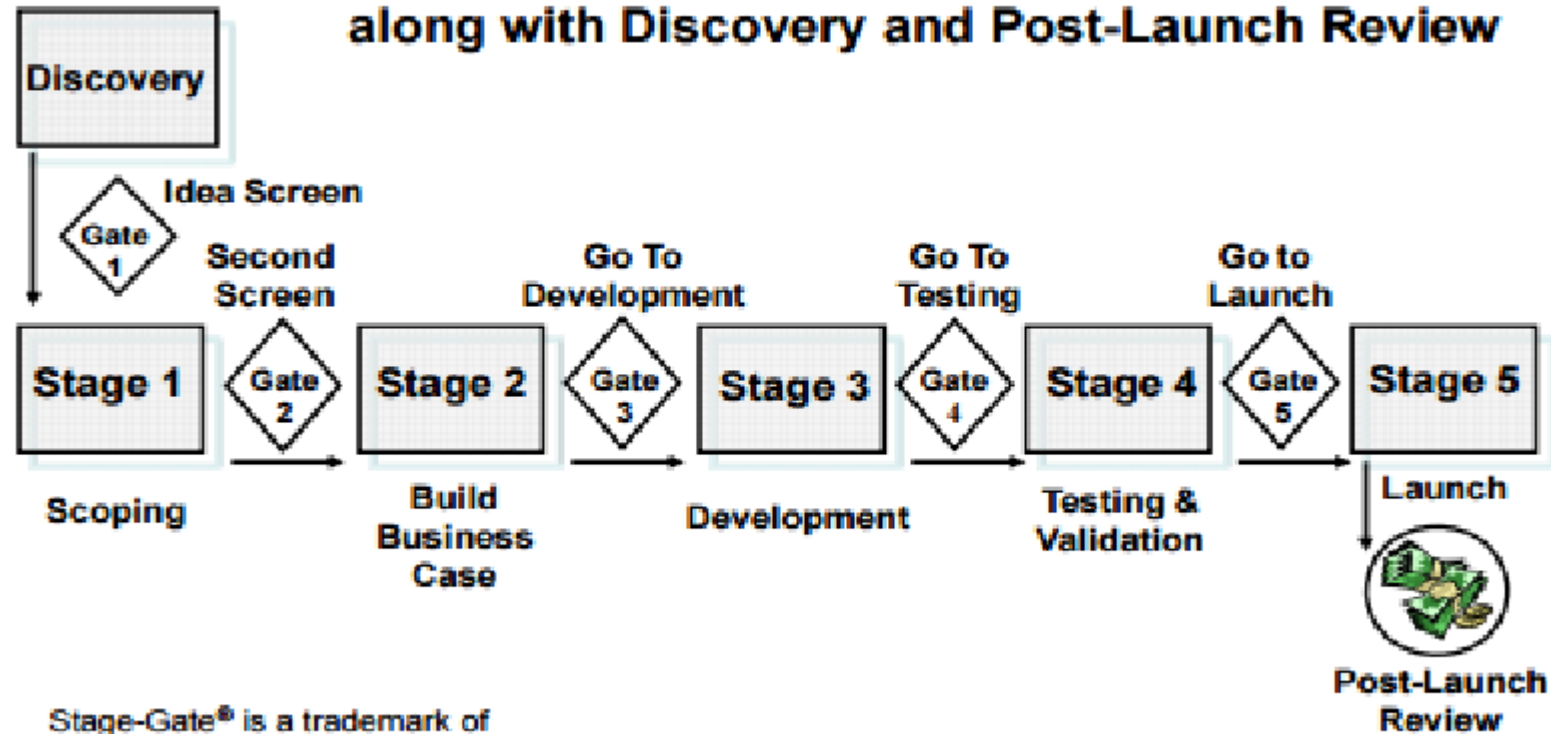
Exhibit 1: Stage-Gate Consists of a Set of Information-Gathering Stages Followed by Go/Kill Decision Gates



Stage-gate model



Stage-Gate®: A five stage, five-gate system along with Discovery and Post-Launch Review



Stage-Gate® is a trademark of Product Development Institute
Source: Cooper, 2001.

Technology evolution

- Relation between new and old technologies
- Discuss with your neighbours relation between new and old technology
 - *Competitive substitution (Fisher and Pry, 1971), predator-prey relation (Farrell,*
 - Symbiosis, host-parasite relation – *Theory of technological parasitism*

- Tractor Technology 1920-1953 (FTM=mechanical efficiency: ratio of drawbar to belt)
 - Locomotive Technology 1904-1937 (FTM= tractive effort in pounds)
 - Aircraft Technology 1932-1965 (FTM= airspeed in miles per hour)
 - Bicycle Technology 1901-1934 (FTM= bicycle run power)

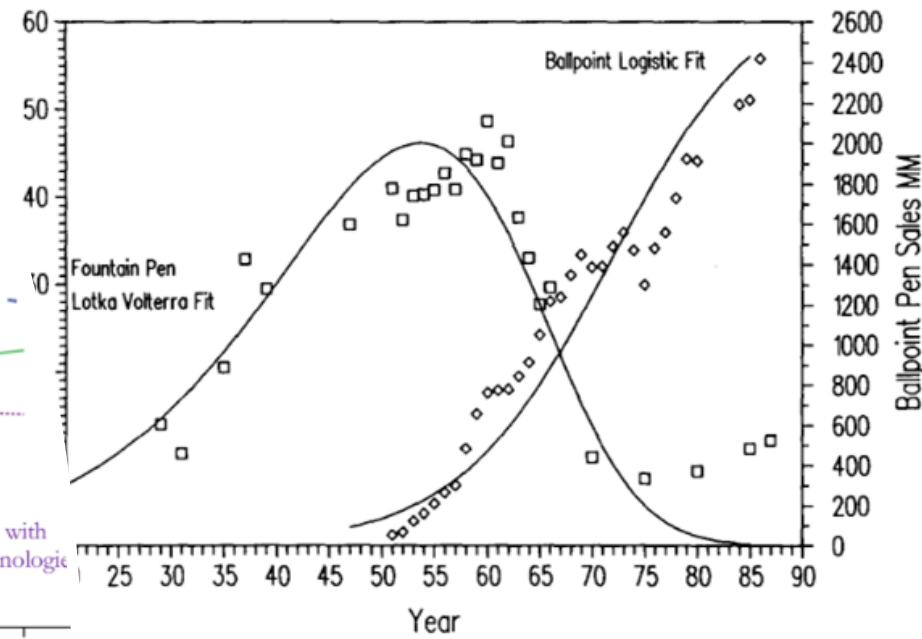
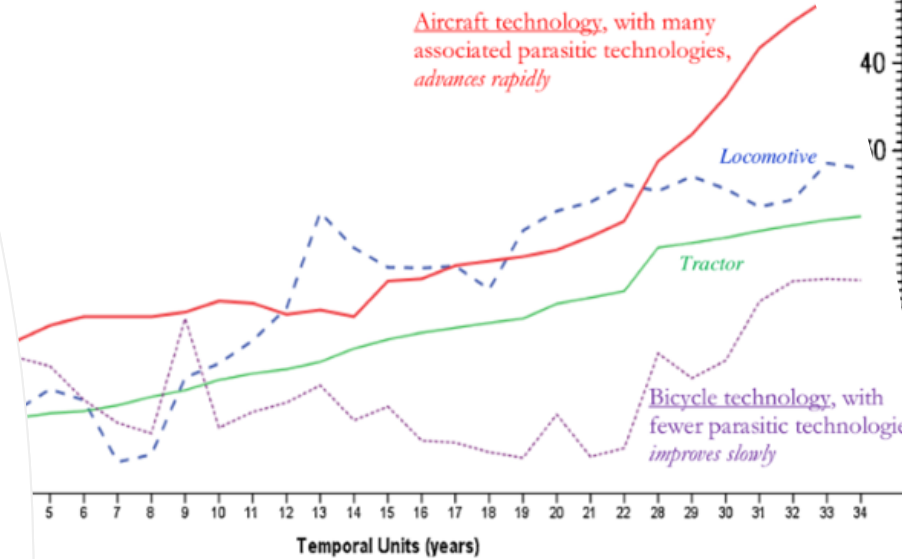
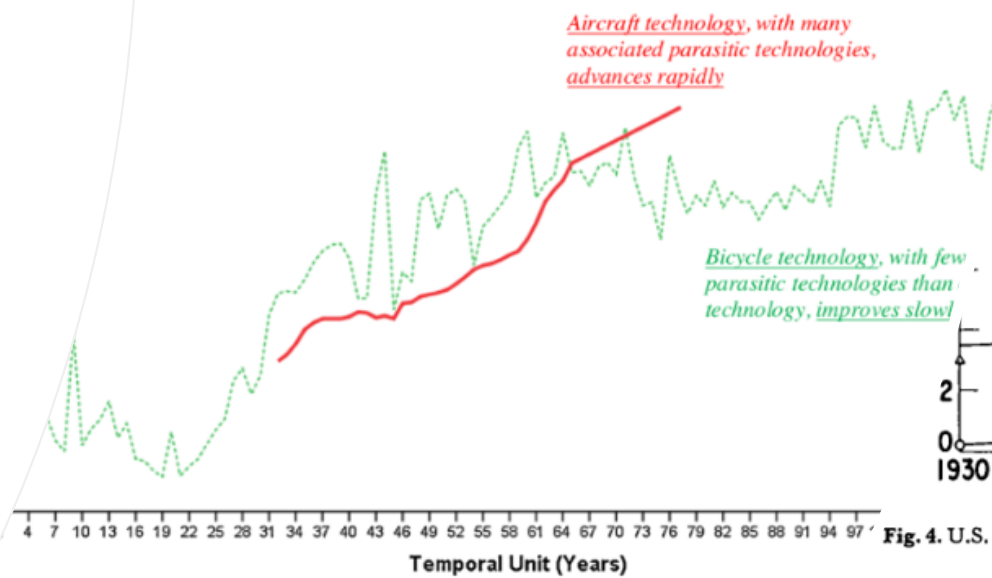


Fig. 8. Sales of pens 1929-1987.

- Technology 1901-2017, FMT = bicycle run power
 - Technology 1932-2017, FMT = air speed in miles per hour



○ SYNTHETIC FIBER
 △ NATURAL FIBER
 — MODEL PROJECTION

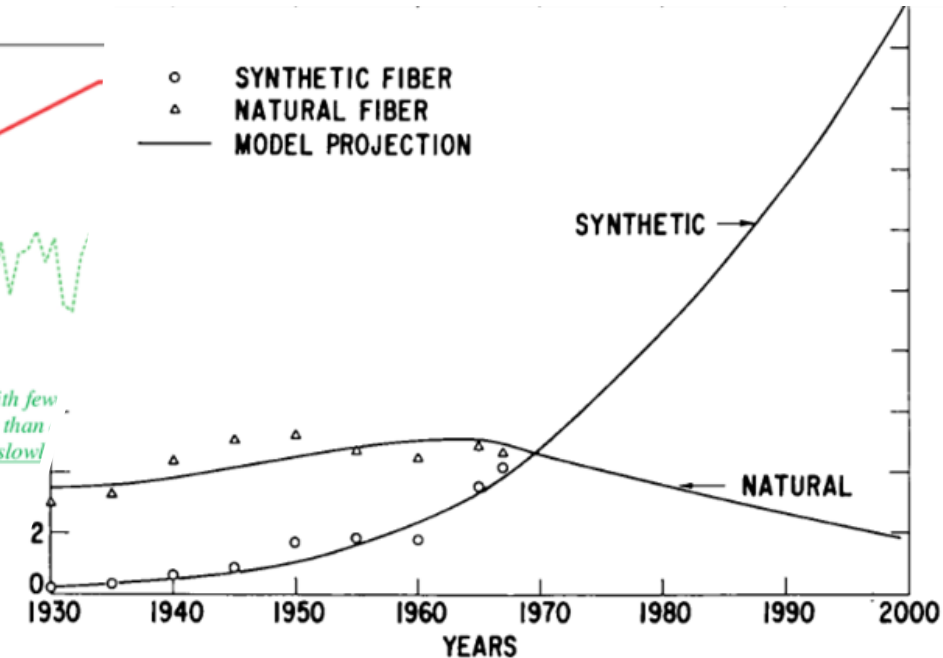
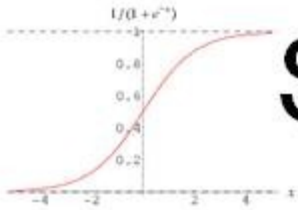
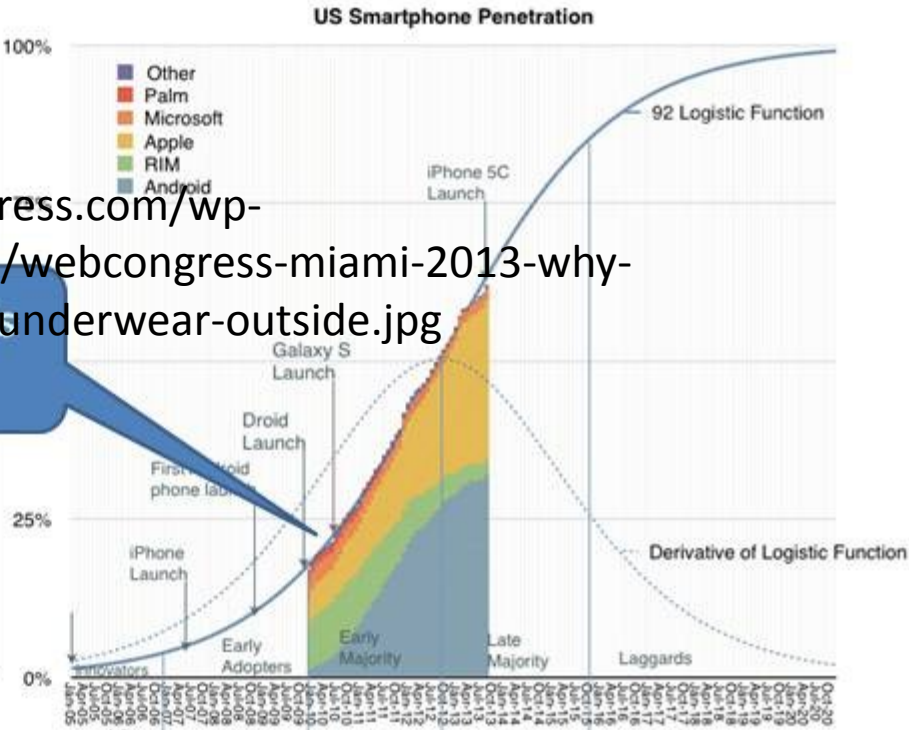
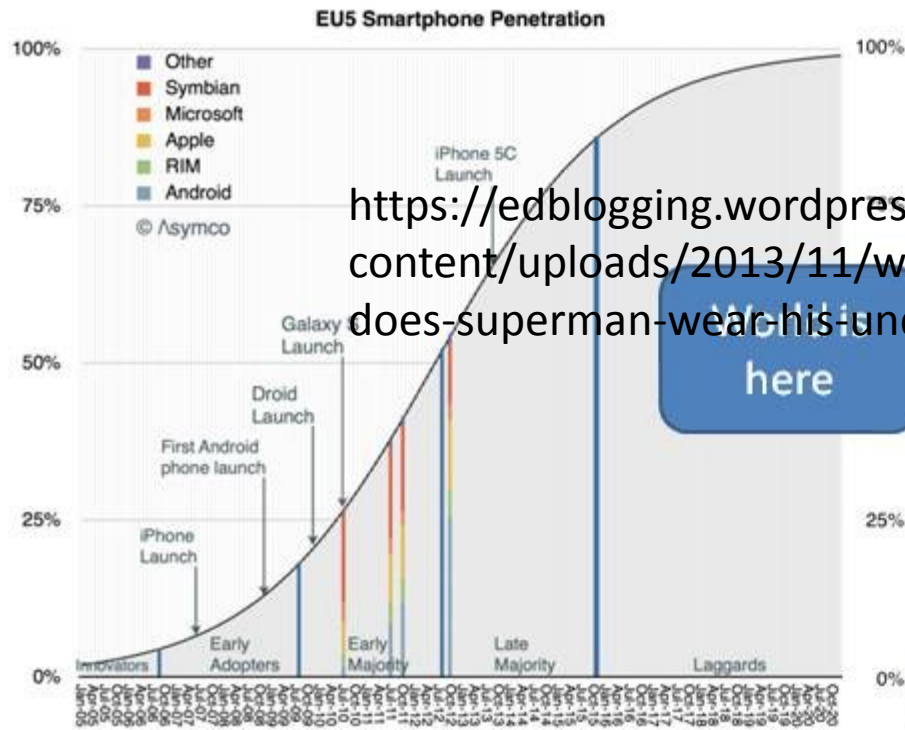


Fig. 4. U.S. fiber consumption vs. years—data and projection using the substitution model.



Smartphone adoption

not even half way



<https://edblogging.wordpress.com/wp-content/uploads/2013/11/webcongress-miami-2013-why-does-superman-wear-his-underwear-outside.jpg>

Adopters here

Adopter categorization on the basis of innovativeness