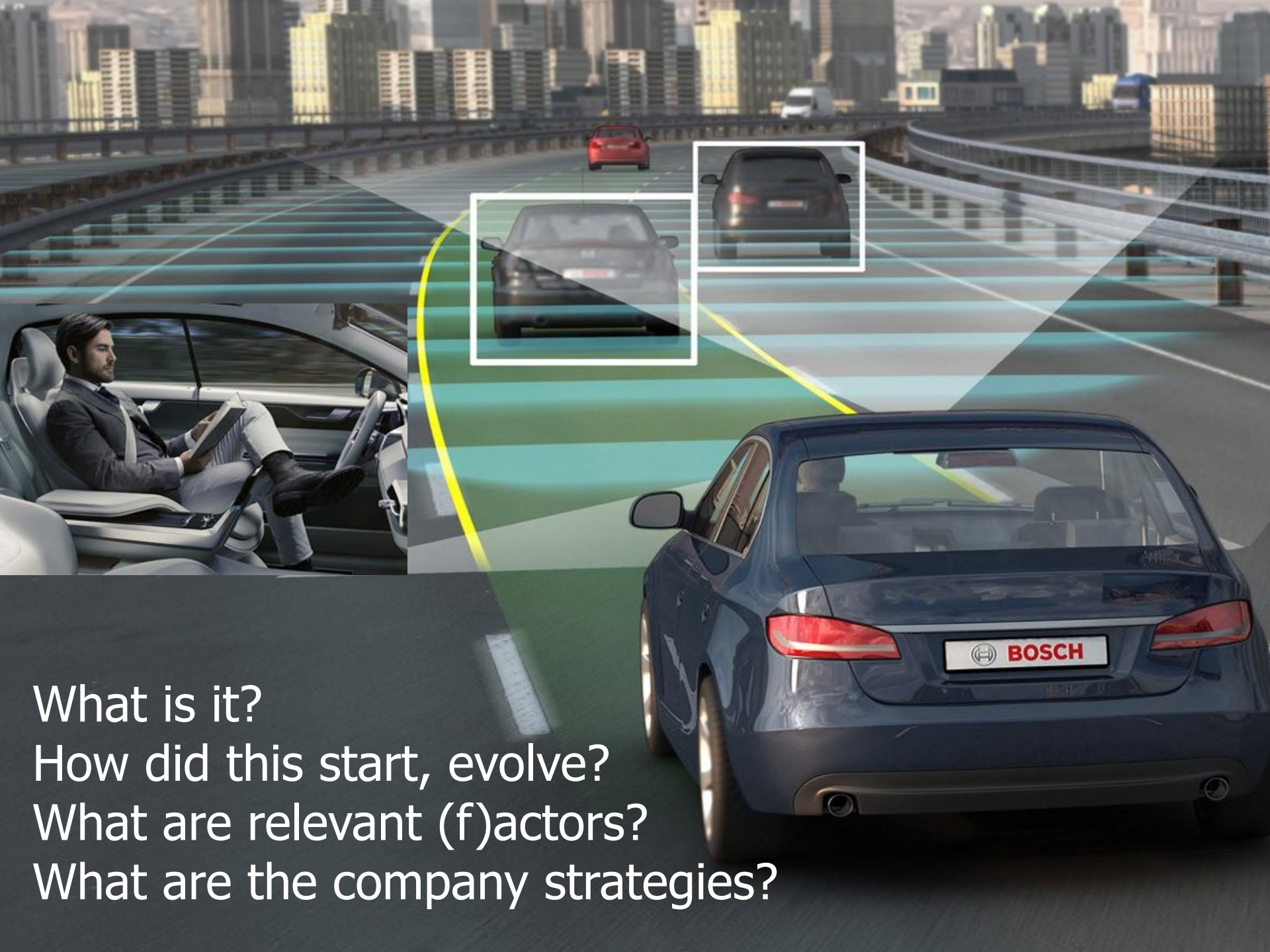
MOT 2421 Emerging and Breakthrough Technologies

Prof. dr. J. Roland Ortt

MOT 2421
Contents Today

Introduction to the course

1. The topic of the course
2. Innovation processes on three levels
3. Learning goals
4. Schedule and practicalities
5. Innovation process as a project
6. Typical phases in a project



What is it?
How did this start, evolve?
What are relevant (f)actors?
What are the company strategies?

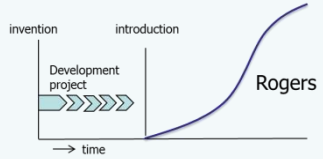
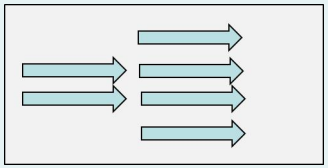
1980s Ernst Dickmanns and team at Bundeswehr University Munich

Topic of the course: emerging and breakthrough technologies.
Company perspective: at invention of technological product or system

What is it?
How will it evolve?
What are relevant (f)actors?
What are the company strategies?

Focus MOT2421: Technological innovation process as a complex phenomenon

- Many actors factors interact over time
- at different levels of analysis

Levels	Questions	Scientific relevance; Managerial relevance
1. Project level: 	Innovation project approaches? Fit of project in organization, market, innovation?	Innovation = product + …. **Topics:** History innovation projects Different project approaches Contextual view Application
2. Technology level: pattern of development/diffusion 	What is the pattern? How does diffusion proceed? How does technology development proceed? What are (f)actors, mechanisms? What are company strategies?	Pattern = project + …. **Topics:** History patterns Different patterns (scientific) Actors, factors, strategies Application
3. Multi-technology level 	How do different technology patterns emerge and influence each other?	Discipline = range of related new technologies (same principle) + What are other ways in which technologies relate to each other? **Topics:** Example of discipline How tech's influence each other

TU Delft

Innovation process
(level 1 : project)

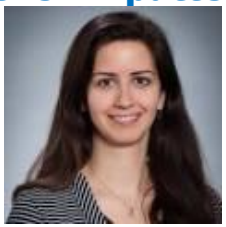
Mirjam Fuchs
MOT graduate
thesis project
DSM

Wieger Aarts
MOT graduate
thesis project
Philips

Problem:
Fuzzy front end of npd project takes too long is expensive and has uncertain outcome.

Solution:
Distinguish context variables that determine the type of npd process and design adapted process for each context.

Innovation process
(level 2: pattern)



Nikoo
Delgoshaie
MOT graduate
thesis project
research internal

Problem:
Why does it take so long after the first market introduction of radically new high-tech products before large-scale diffusion starts?

Explanation:
Length of this process is assessed for multiple cases. For each case the variables slowing down the process are listed and combined.

Innovation process
(level 3: discipline)

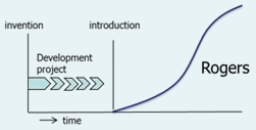
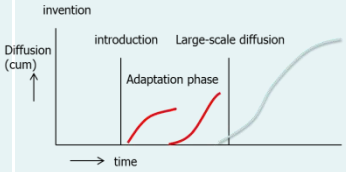
Thijs Jonckheere
MOT graduate
thesis project
research internal

Problem:
What is the effect on innovation process if technologies are combined?

Explanation:
High-tech products were chosen that represent a combination of products/technologies

Three levels of innovation processes

Alternative models, theories on each level

Project (level 1)	Stage-gate 	Agile-projects 	Hybrid-projects ….	Ad-hoc 
Technology (level 2)	innovation-diffusion paradigm 	Pattern development and diffusion 	Minnesota studies  Figure 2. Illustration of Emerging Innovation Process Model.	-
Multi-technology (level 3)	**Technology creation** Genious inventor; Fertile R&D context; Combining techn's.	**Disciplinary technologies** 	**Competitive technologies**	**Complementary technologies**

Learning goals for the entire course (1)

Learning goals: After the course you should be able to …

- **Explain that innovation processes represent a complex multi-level phenomenon.**
  - Describe why studying innovation on multiple levels of analysis is important.
- **Describe different types of innovation processes (project-level).**
  - Describe why an innovation is more than a new product.
  - Describe several types of innovation projects.
  - Describe how the ideas about innovation projects evolved in time.
  - Relate the innovation process to organizational structures, market characteristics and types of products, for example, and be able to propose specific processes in a situation.
- **Distinguish patterns of development and diffusion of breakthrough technologies (technology-level).**
  - Describe why pattern is more than a project + diffusion.
  - Describe how theories about technological progress evolved over time.
  - Describe phases that can be combined into different patterns.
  - Describe different actors, factors and mechanisms (long/short phases).
  - Describe company strategies during the pattern.

Learning goals for the entire course (2)

Learning goals: After the course you should be able to …

- **Describe different types of innovation processes (multi-technology-level).**
  - Describe why an invention is more than a new technology.
  - Describe how a discipline emerges and evolves (with an example).
  - Describe how technologies can influence each other in other ways.
    - Competition and substitution between products/technologies.
    - Complementarity between technologies
- **Describe how the system of three levels can be used to make sense of**
  - Increasing speed of technological innovation.
  - Effect of digitization on innovation.
  - Competition

Schedule

N	Date	Time	Place	Topic
1	24-04 Mo	13.45-16.30	EEMCS Hall Ampere	Introduction; Innovation projects (part 1)
	28-04 Fr	No lecture		
2	01-05 Mo	13.45-16.30	EEMCS Hall Ampere	Innovation projects (part 2); **Guest lecture (Vladimir)**
	05-05 Fr	No lecture		
3	08-05 Mo	13.45-16.30	EEMCS Hall Ampere	Innovation projects (part 3); Pattern of development and diffusion; Intro assignment.
4	12-05 Fr	08.45-11.30	TBM-A	Actors and factors during the pattern (1).
5	15-05 Mo	13.45-16.30	EEMCS Hall Ampere	Actors and factors during the pattern (2);
	19-05 Fr	No lecture		
6	22-05 Mo	13.45-16.30	EEMCS Hall Ampere	Hype cycle; Technology development.
7	26-05 Fr	08.45-11.30	TBM-A	Strategies during the pattern (1); **Guest lecture (Barbara)**
	29-05 Mo	No lecture		
8	02-06 Fr	08.45-11.30	TBM-A	Strategies during the pattern (2); Discussing the assignment.
9	05-06 Mo	13.45-16.30	EEMCS Hall Ampere	Development of a discipline; Innovation processes on different levels; **Guest lecture (Lassi Tiihonen)**
10	09-06 Fr	08.45-11.30	TBM-A	Innovation processes on different levels; Discussing the assignment
	16-06 Fr	No lecture		
	16-06 Fr	Before 18.00u		Hand in assignment via E-mail. j.r.ortt@tudelft.nl

Schedule

One assignment

Form group of 5 people

Assignment

- Will be introduced first
- Can be discussed halfway
- Then you hand in assignment

See schedule for dates

Literature, Exam & Grading

1. Literature: Slides and several articles (Brightspace)
2. Grading: Exam (50%) and Assignment (50%)

MOT 2421 Introduction

After a short break

we will start again at …..

MOT 2421
Contents Today

Introduction to the course

1. The topic of the course
2. Innovation processes on three levels
3. Learning goals
4. Schedule and practicalities
5. Innovation process as a project
6. Typical phases in a project

Innovation is more than a new product (a)

Xerox copier: a complex innovation

- Product innovation:
  - Product (physical): Very complex product for high volume high quality copies
  - Distribution: Personal sales
  - Price: Lease model for machine + variable price per copy
  - Communication: a top product for the high-end niche of organizations
- Compl prod & services: Special paper, dedicated sales and service personal
- Process innovation: Completely dedicated production line and dedicated complementary prod/services
- Organization: Big personal sales unit and big R&D unit
- Supply chain consequences Xerox manages it all (with some suppliers)

Innovation is more than a new product (b)

Canon copier: a simple innovation

- Product innovation:
  - Product (physical): simpler product less parts (less volume, less speed)
  - Distribution: retail
  - Price: lower price
  - Communication: a simple product that everybody can use
- Compl prod&services: self-repair
- Process innovation: re-design of product, production, distribution and service
- Organizational innovation: personal sales unit is no longer needed, R&D has different role
- Supply chain innovation Changes in the network of companies

Innovation is more than a new product (c)

Observations from the case

1. Xerox Canon machines were fundamentally different
2. Xerox and Canon have fundamentally different marketing mixes, compl prod/services, production facilities and organizations. And client groups are fundamentally different.
3. Xerox created the market, Canon made it a mass market (both entered in different phases of the pattern)

Messages from this case

1. Innovation = product as part of consistent marketing mix (link high-tech marketing)
2. Innovation as a consistent marketing mix needs to fit into the type of organization (requires a particular type of organization).
3. Innovation as a consistent marketing mix needs to fit into the type of organization and larger network (supply chain and market context (requires a particular type of organization) and needs to fit with the type of customers (which to some extent depend on the phase in the pattern of development and diffusion)

Innovation = consistent marketing mix fitting in organization, fitting in customer groups and accordingly fitting in stage of the market

Message (innovation =)	Consequence
1. Product + service 2. Marketing-mix 3. Organization 4. Network of companies 5. Ecosystem (customers ..)	Good product is not enough for success Innovation can require a fundamental system change for the entire organization and network around it. • Innovation that fits system is easier than one that requires new/changed system. • Innovation with new system is easier than innovation that needs to rebuild existing system. Incumbent company problem Start-up company problem

Typical phases in the process (a)

a) Idea generation, testing and selection

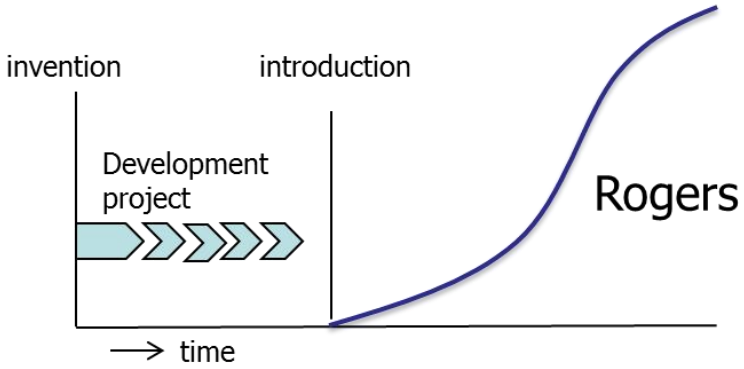
b) Concept generation, testing and selection

c) Product development, testing and improvement

d) Production development

e) Marketing development

f) Market introduction



Anything missing?

- You have to innovate
- Innovation is a project, after that you can introduce the innovation

Typical phases in the process (b)

a) Strategic phase (to innovate or not)

b) Idea generation, testing and selection

c) Concept generation, testing and selection

d) Product development, testing and improvement

e) Production development

f) Marketing development

g) Market introduction

h) Life cycle management

- Innovation is a strategic choice
- Innovation can be organized as a project, after introduction many projects can follow

Typical phases in the process (c)

Learning points regarding the NPD-process

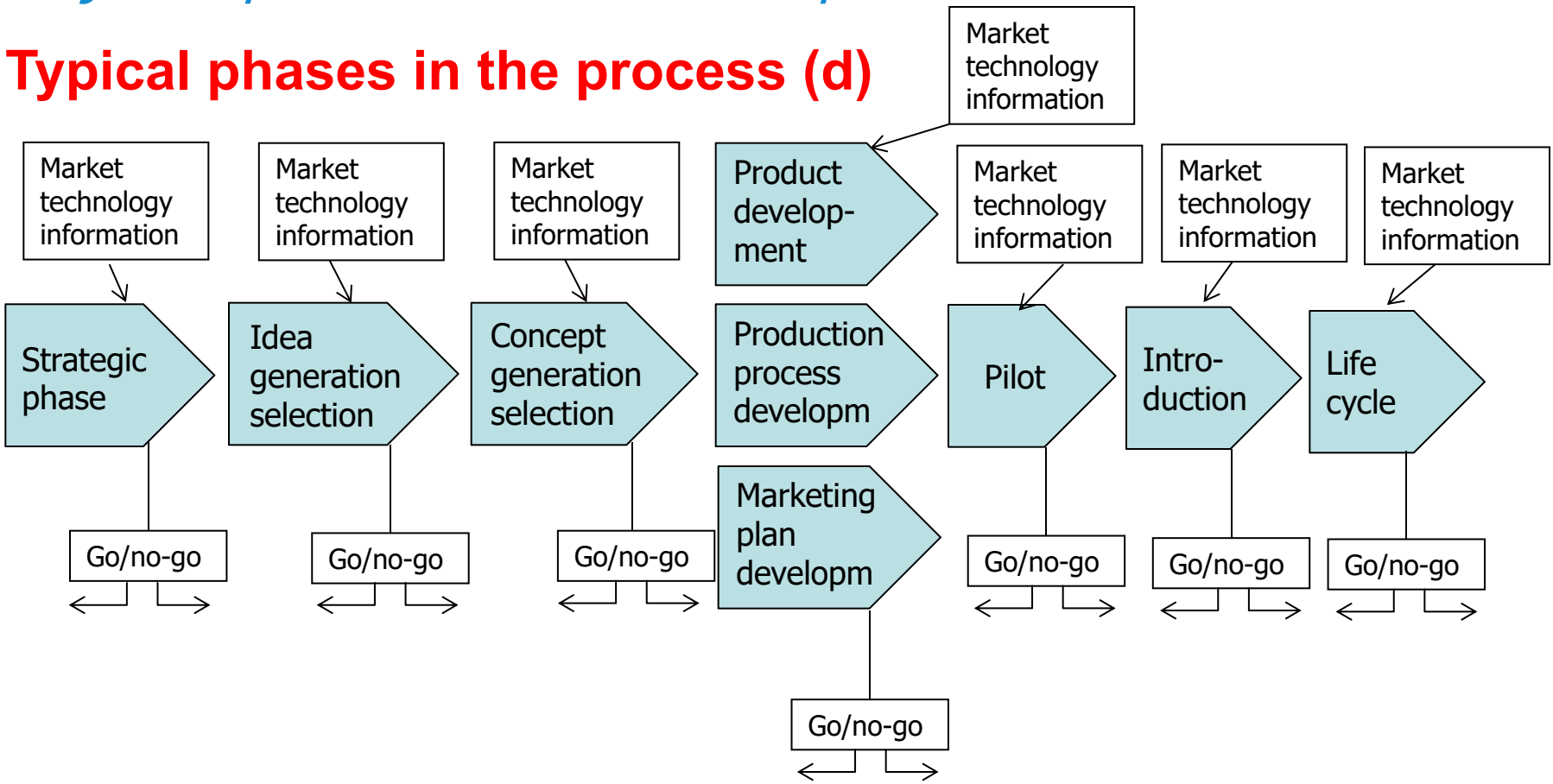
1. In each stage multiple alternatives are created and a limited number of alternatives is selected. The number of alternatives typically decreases over the npd-process.
   (innovating by creating many alternatives and then selecting)

2. Stage-gate: go/no-go at each stage.
   (innovating by having the selected alternatives evaluated)

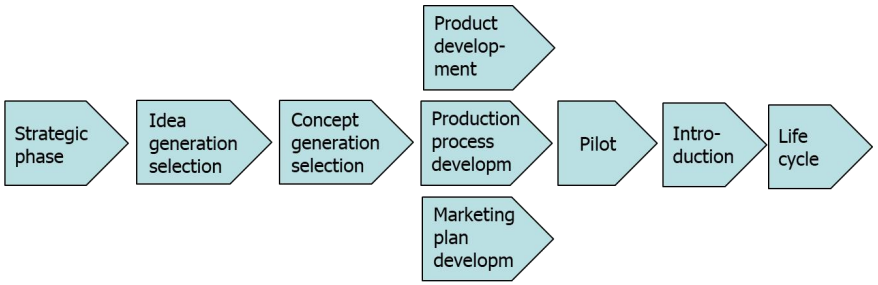
3. Market and technology input throughout the process
   (*innovating by considering information during the process*)

4. Typical stages: idea/concept and product creation/selection
   Stages typically forgotten:
   Up front: decision to innovate
   End: life cycle management

Typical phases in the process (d)



Typical phases in the process (e)



Why are some activities completed in parallel?

- Because they only can be completed in combination.
  - Since they are interrelated.

Why are iterations needed?

- Because there is uncertainty (there is no upfront and exact definition of the innovation that will be developed).
  - In the earlier stages many alternatives are considered and choice are made, and sometimes in turns out that a choice was wrong, so the process needs to be reiterated.
  - In parallel stages, the activities are so much dependent and unknown.

Learning goals

After today you should be able to explain ….

1. Innovation processes evolve on multiple levels simultaneously
2. Examples of innovation processes on three levels: project, technology and multi-technology level.
3. That an innovation is more than a new product alone, each product innovation is part of a larger mix of aspects.
4. What possible consequences are of this mix of aspects around an innovation.
5. Typical phases of an innovation project and which ones are often forgotten.
6. Why phases are scheduled in parallel/sequential and why iterations are required.

Next lecture: innovation projects (part 2)

(Monday 1st of May 2023)

Study material

1. Article: Cooper (1990) article on the stage-gate process
2. Article: Szalvay (2004) on agile software development
3. Article: Different approaches to cope with the same trends
4. Article: The evolution of innovation management over time
5. Article: Contextual Innovation Management

Questions?

TU Delft

MOT 2421 Introduction

After a short break

we will start again at ….