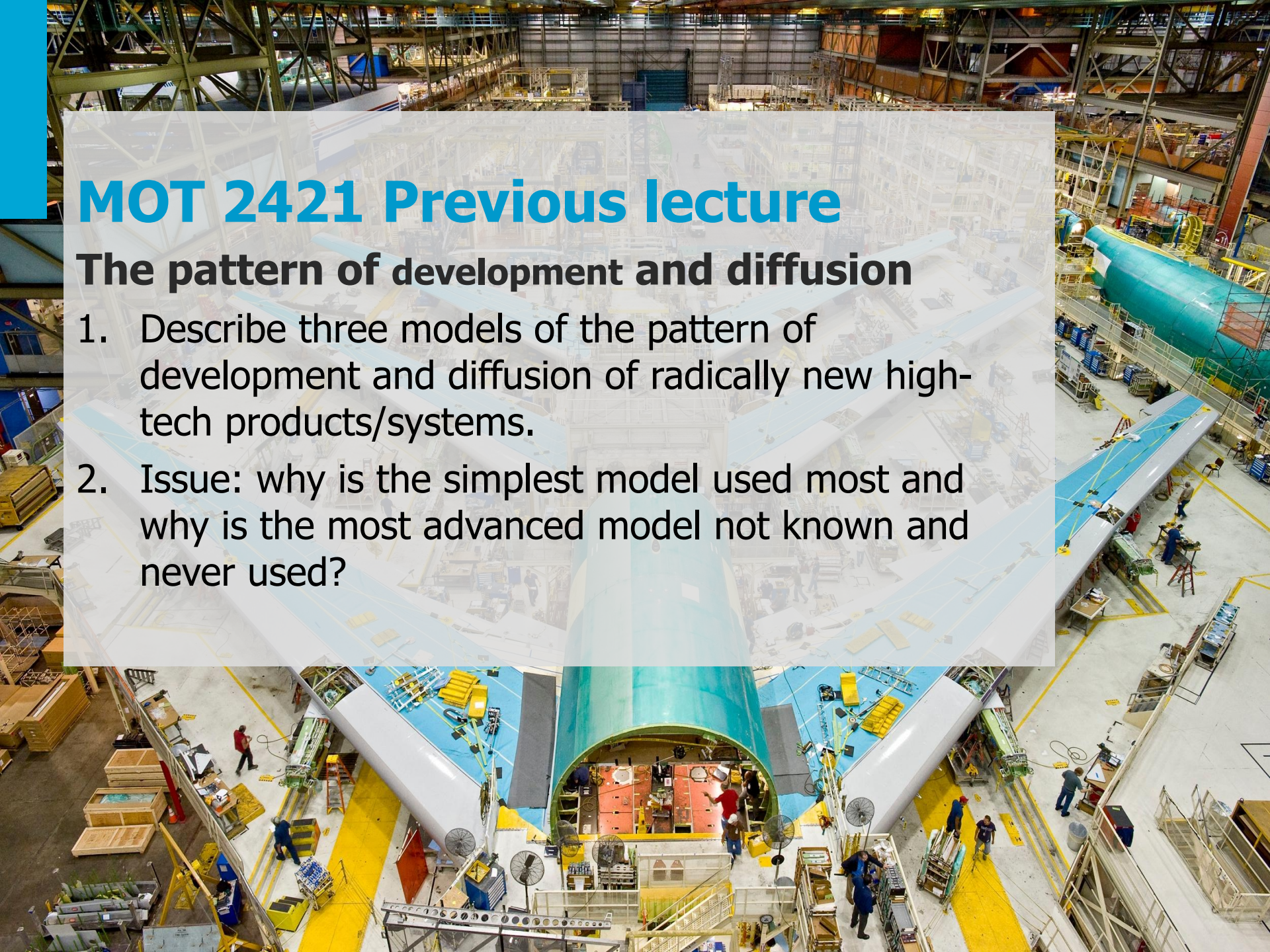
MOT 2421 Emerging and Breakthrough Technologies

Prof. dr. J. Roland Ortt

Lecture 5: actors and factors on pattern-level



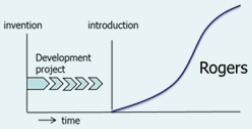
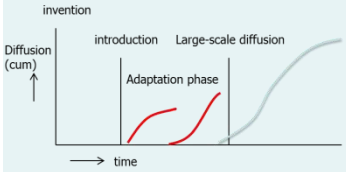
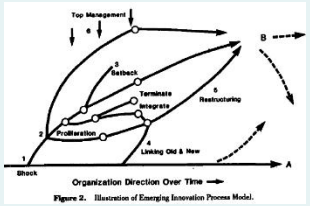
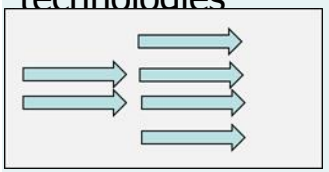
MOT 2421 Previous lecture

The pattern of development and diffusion

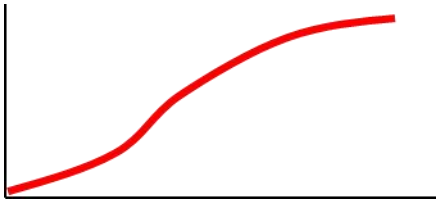
1. Describe three models of the pattern of development and diffusion of radically new high-tech products/systems.
2. Issue: why is the simplest model used most and why is the most advanced model not known and never used?

Three levels of innovation processes

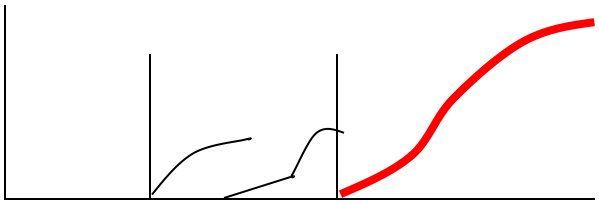
Alternative models, theories on each level

Project (level 1)	Stage-gate 	Agile-projects 	Hybrid-projects ….	Ad-hoc 
Pattern (level 2) - (F)Actors, mechanisms - Strategies	innovation-diffusion paradigm 	Pattern development and diffusion 	Minnesota studies 	-
Discipline (level 3)	The genious inventor 	The fertile R&D context 	Invention is combining technologies 	-

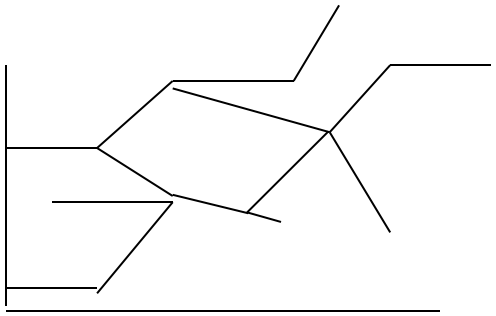
Three models to cope with development and diffusion



Diffusion model
Life cycle model



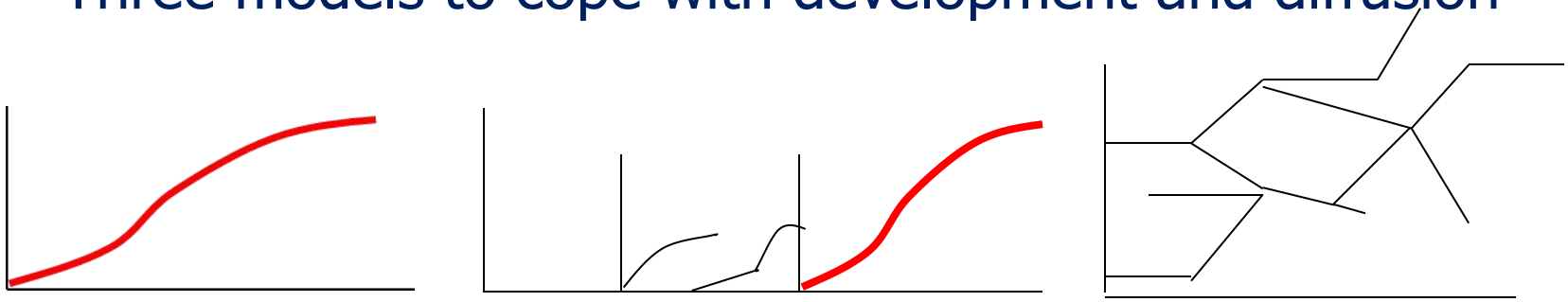
Punctuated equilibrium model
Evolutionary model



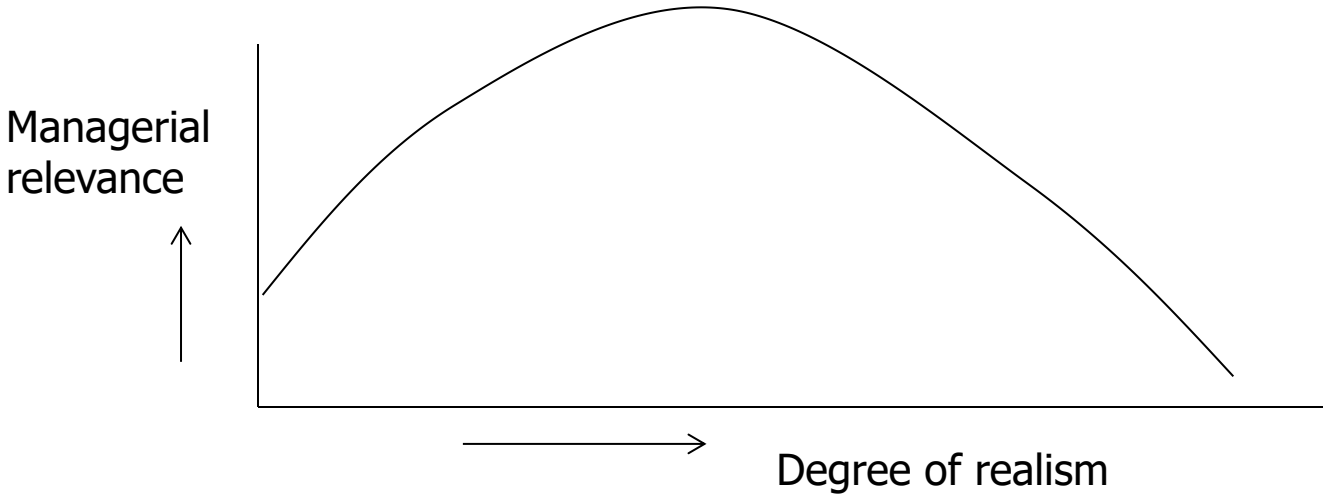
Minnesota studies
Process model

Many (unrealistic) and most implicit assumptions. Curve holds in many cases but distorts what happens after invention and first introduction. Very actionable but in particular cases only (wrong advice)	Less assumptions: 1. Unit constant 2. Hallmarks exist 3. Uncertainty hallmarks is limited (compared to length phases) Curve does hold in wide variety of historical cases if scenarios are included. Managerially relevant but open issues (hindsight bias)	No assumptions at all. No model that holds for multiple cases, unique situation per case. Limited managerial relevance

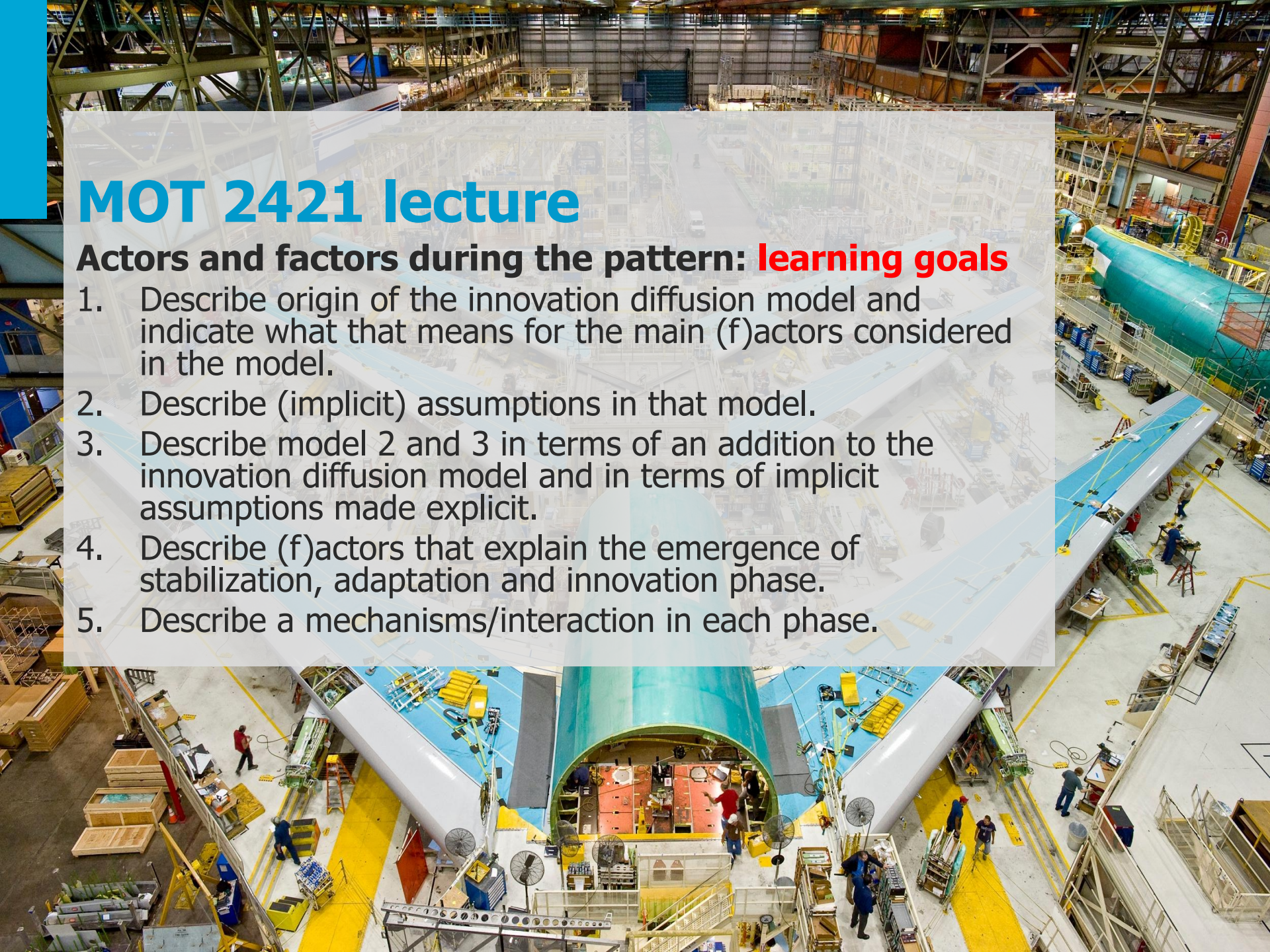
Three models to cope with development and diffusion



Increased realism does not increase managerial relevance



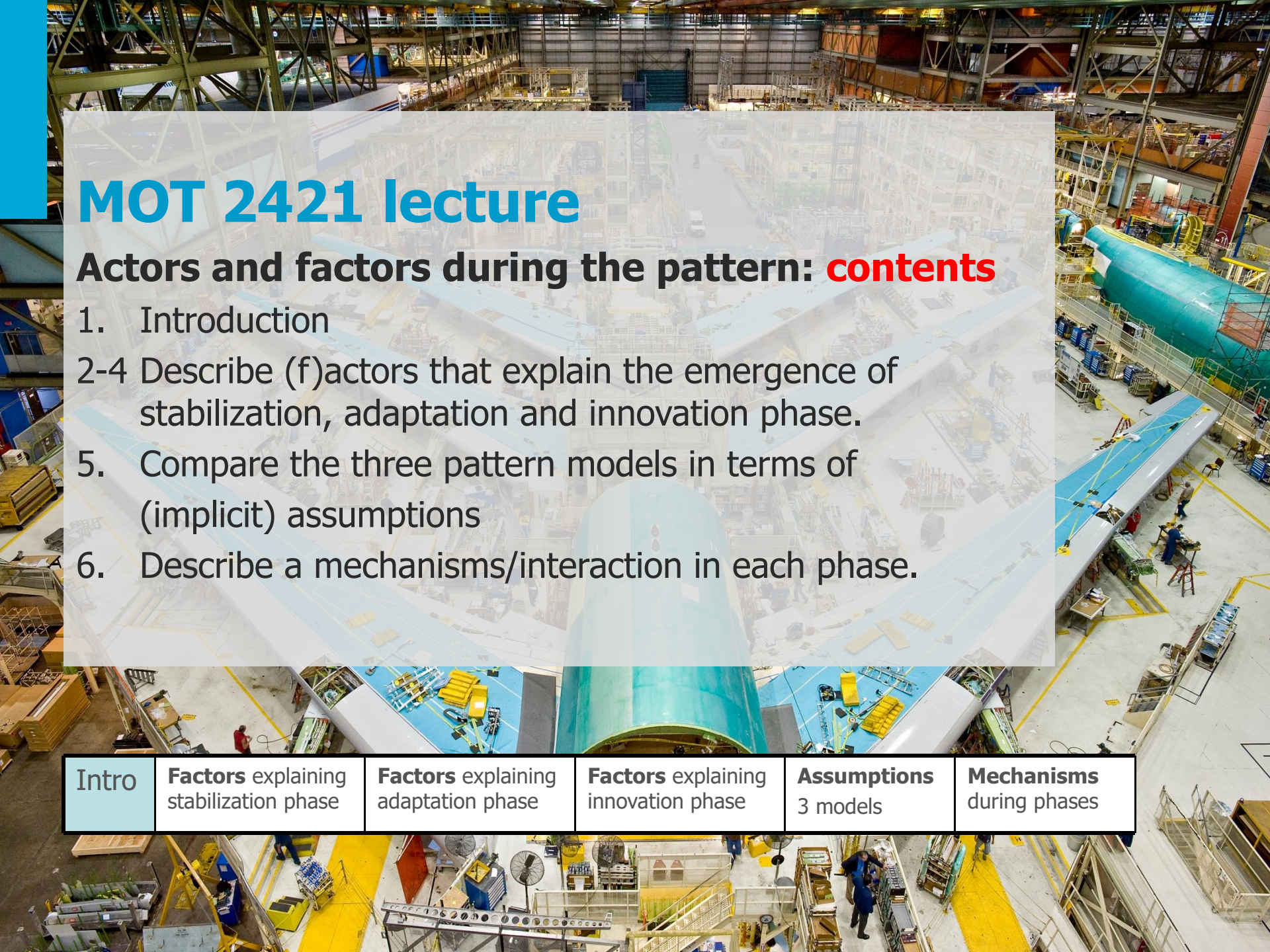
Practical advice from the Minnesota Studies?



MOT 2421 lecture

Actors and factors during the pattern: learning goals

1. Describe origin of the innovation diffusion model and indicate what that means for the main (f)actors considered in the model.
2. Describe (implicit) assumptions in that model.
3. Describe model 2 and 3 in terms of an addition to the innovation diffusion model and in terms of implicit assumptions made explicit.
4. Describe (f)actors that explain the emergence of stabilization, adaptation and innovation phase.
5. Describe a mechanisms/interaction in each phase.



MOT 2421 lecture

Actors and factors during the pattern: contents

1. Introduction

2-4 Describe (f)actors that explain the emergence of stabilization, adaptation and innovation phase.

5. Compare the three pattern models in terms of (implicit) assumptions

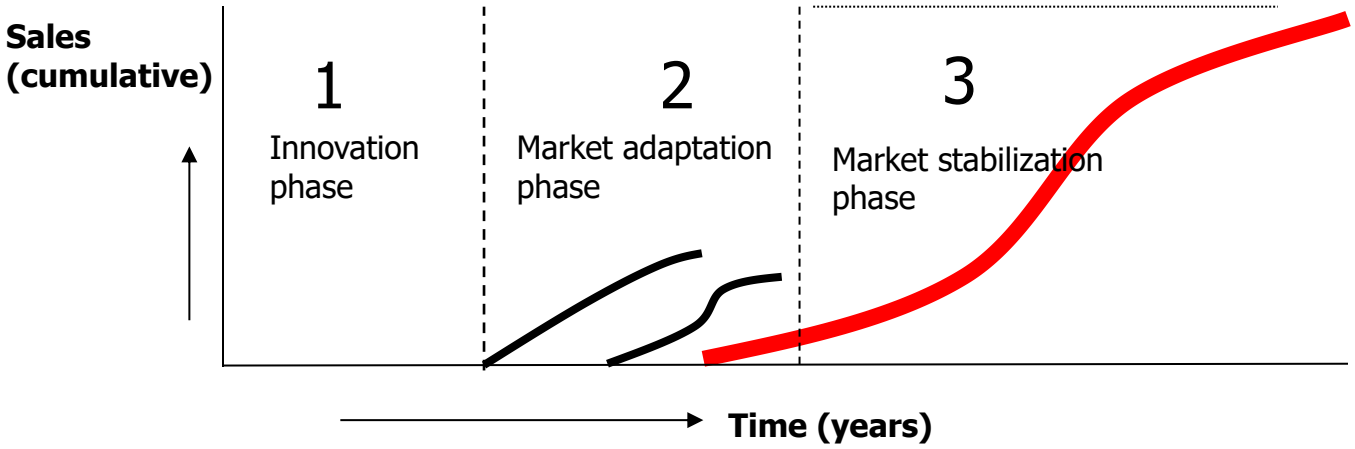
6. Describe a mechanisms/interaction in each phase.

Intro	**Factors** explaining stabilization phase	**Factors** explaining adaptation phase	**Factors** explaining innovation phase	**Assumptions** 3 models	**Mechanisms** during phases

Generic pattern with three phases

What type of factors?

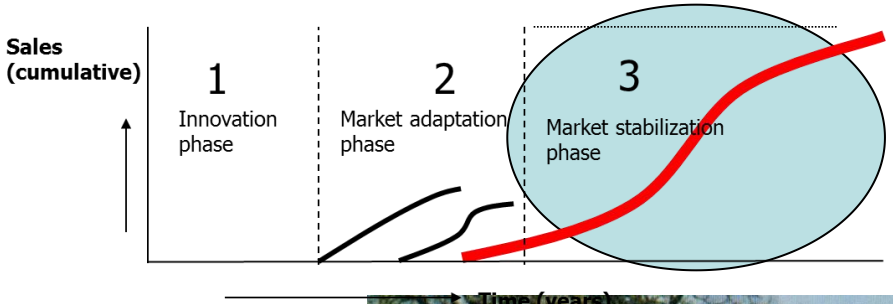
(F)actors that make new phase start (type 1)
(F)actors that determine the length of a phase (or how it evolves) (type 2)



Factors explaining stabilization phase

Goal: explain diffusion curve in stabilization phase

- Why did tractors diffuse in agriculture?
- What are the variables that explain the pattern of diffusion in the stabilization phase? (type 1-2 factors)



Theoretical perspectives of disciplines on these factors:

Psychologists (individuals)

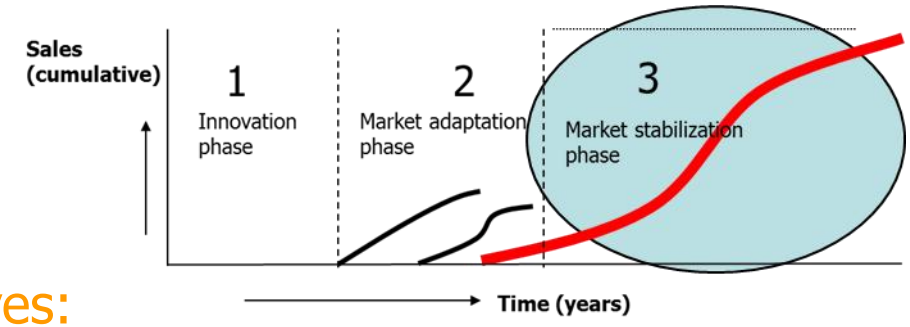
Sociologists (groups)

Economists (financial aspects markets)

Engineers (technical system performance))

Factors explaining stabilization phase

Goal: explain diffusion curve in stabilization phase



PS similar multi-level phenomena as discussed for innovation

Theoretical perspectives:

Psychologists (individuals) Focus on characteristics of individual adopters to explain adoption/rejection, time of adoption and type of adoption process for individual consumers.

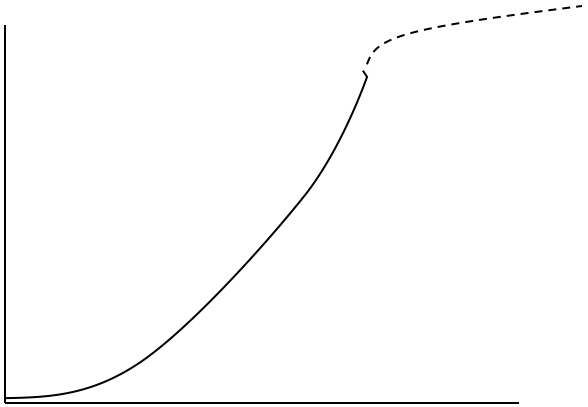
Sociologists (groups) Focus on typical characteristics of adopters in groups (how do people influence each other on the demand-side) to explain steepness/ceiling of curve. Describe how different subgroups perceive innovation (vision and closure among social groups)

Economists (society) Focus on economic factors (supply and demand) to explain start, slow down or speed-up of diffusion curve (socio-economical system development)

Engineers (system): technical system development and relative performance.

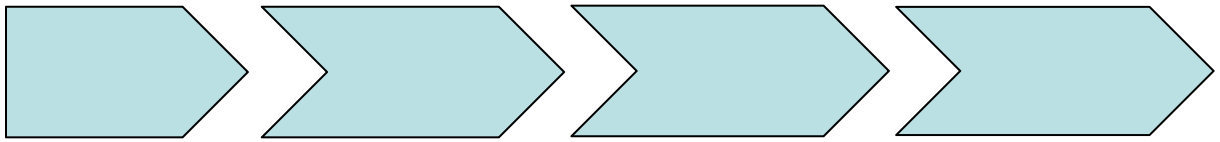
Mechanism driving stabilization phase according to psychologists and sociologists

Diffusion as macro communication-process between individuals (sociologists)



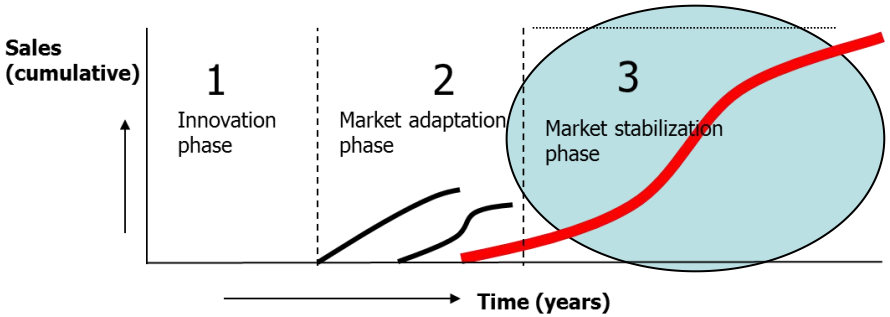
$F(t) = C4^t$

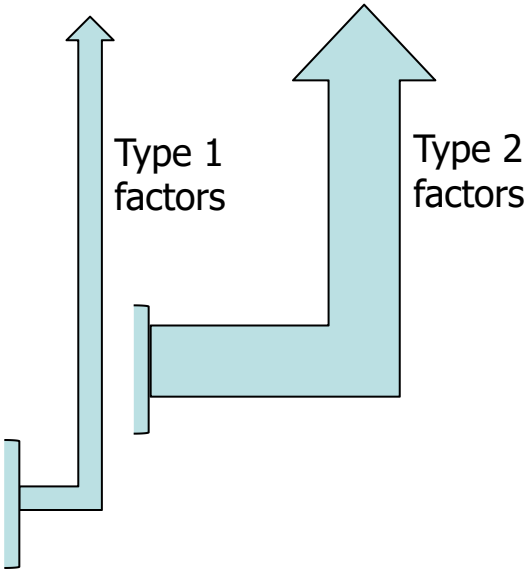
Diffusion as micro-adoption process of individuals (psychologists)



Effect Mass media, Social media, You tubers + Influencers?

Factors explaining stabilization phase





Theoretical perspectives of disciplines on these factors:

Psychologists (individuals)

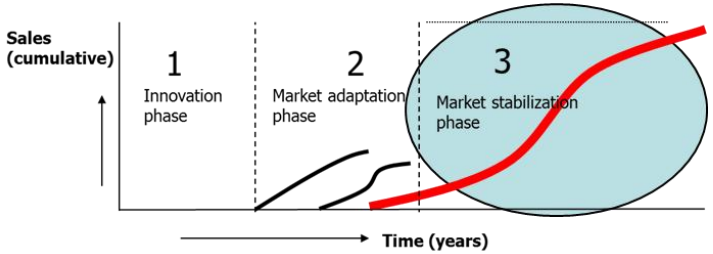
Sociologists (groups)

Economists (financial aspects society

Engineers (technical system performance))

Psychologists' and sociologists' perspective on diffusion

Subsequent adopter groups in stabilization phase



Subsequent adopter groups: innovators, early adopters, early majority, late majority, laggards

Basic idea: innovators have characteristics in common (as a group)

Why are these innovators important:

- The first group to focus on when introducing an innovation
- Their role in communicating the benefits of the innovation to subsequent groups

The early identification of innovators and early adopters is therefore important for businesses developing new products, "since it assists in the process of tailoring each element of the marketing mix to the requirements and behaviors of those buyers who initiate markets and without whom the social comparison that leads to diffusion would often not occur."

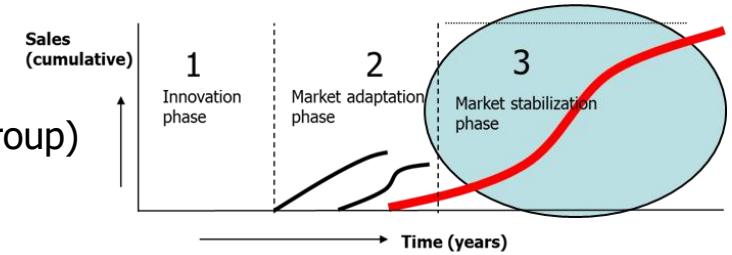
(Foxall and Goldsmith, 1994, p. 35-36).

Psychologist and sociologist perspective on diffusion

Subsequent adopter groups in stabilization phase

Basic idea:

innovators have characteristics in common (as a group)

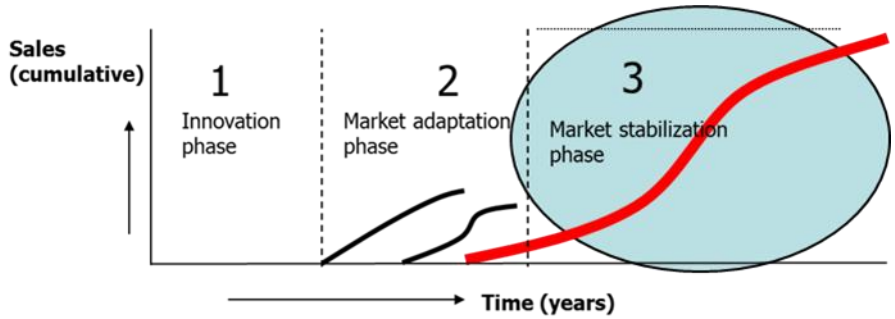


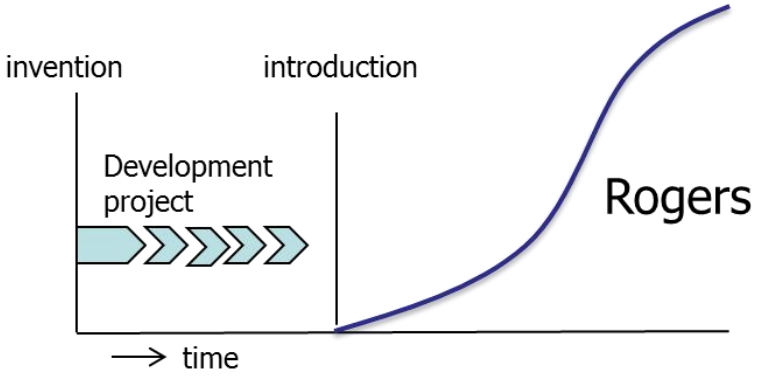
Results after reviewing many studies on the characteristics of innovators:

1. Some widely held notions about specific innovator characteristics do not hold (age, education, etc).
2. Characteristics are in general (very) weakly related to (relative timing of) adoption.
3. Product-related characteristics have stronger relationships than generic (e.g. socio-demo) characteristics.
4. Characteristics differ per product category.
5. Early rejecters are found to have similar characteristics as early adopters (Labay and Kinnear, 1982)
6. Innovators sometimes scare away subsequent adopters (instead of convincing, they discourage)
7. Many other variables determine the start of diffusion (supply side factors in the market)

(Sources: Ortt et al. 2017; Engel, Blackwell & Miniard, 1990)

Factors explaining stabilization phase





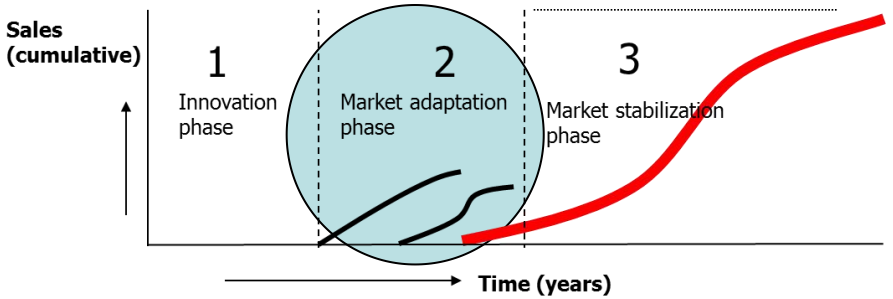
Origin of diffusion theory (hybrid corn) (Ryan and Gross, 1948)

1. Corn was dominant in price/performance.
2. Competition was (objectively) no issue.
3. No lock in: farmers need seed corn every year.
4. Innovation was essentially the same over LC
5. Production, complementary p/s, network of companies and institutions in place
6. Relatively homogeneous market (farmers US)

Model of relevant (F)actors	Score
1. Product perform	V
2. Price	V
3. Production	V
4. Compl prod/serv	V
5. Network of supply	V
6. Customers	X
7. Institutions	V

Factors explaining adaptation phase

Problem: Endless number of factors and different categorizations + focus



Theoretical perspectives and the emergence of the adaptation phase:

Psychologists: Individuals that adopt and are deviant scare away subsequent adopters. (see Note

Sociologists: Individuals that are fanatic opponents to adoption may also scare away adopters
Different groups hold different views and hence diffusion is constrained.

Relatively closed segments of customers (constrain diffusion)

Economists: Moore: Row of p/m combinations is required segments have different requirements

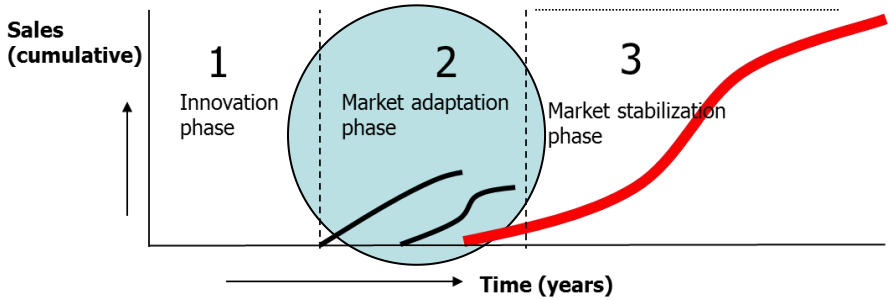
Marx : New production machine and its consequences in a factory

Tushman Andersson Utterback: Market disturbed by new product, chaotic competition

Engineers: Performance competition between alternative technologies (see Note)

Factors explaining adaptation phase

Problem: Endless number of factors and different categorizations + focus



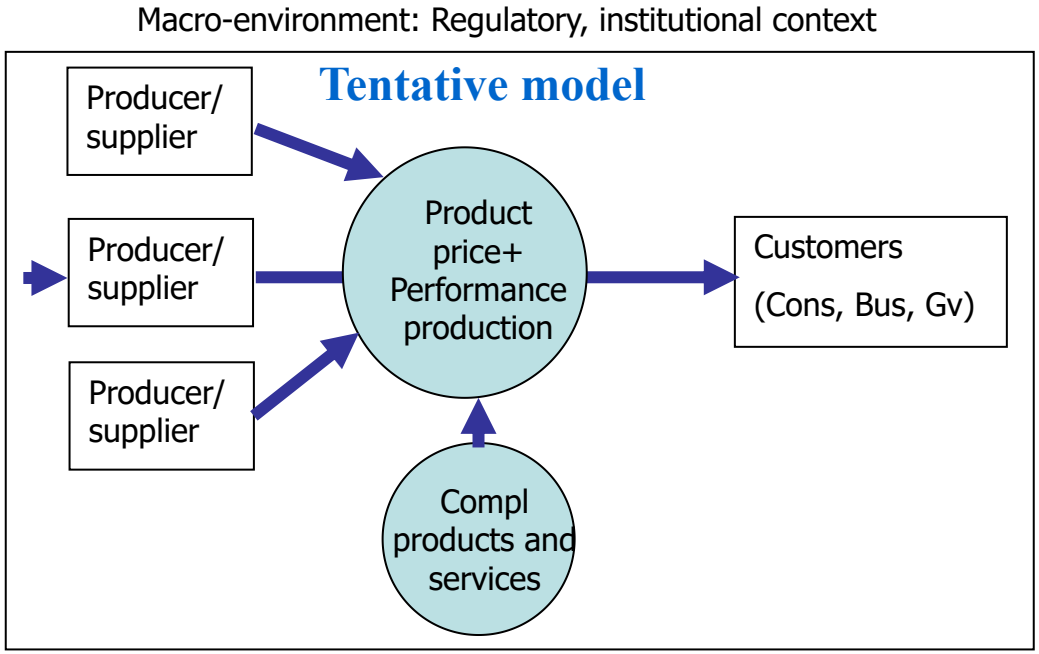
Model of relevant (F)actors	Score
1. Product perform	X
2. Price	X
3. Production	X
4. Compl prod/serv	X
5. Network of supply	X
6. Customers	X
7. Institutions	X

Link with the adaptation phase

1. Perform too low
2. Price too high
3. Large-scale production impossible
4. Compl prod/serv unavailable
5. Network of supply not ready
6. Customers not ready/unknown
7. Institutions unfit

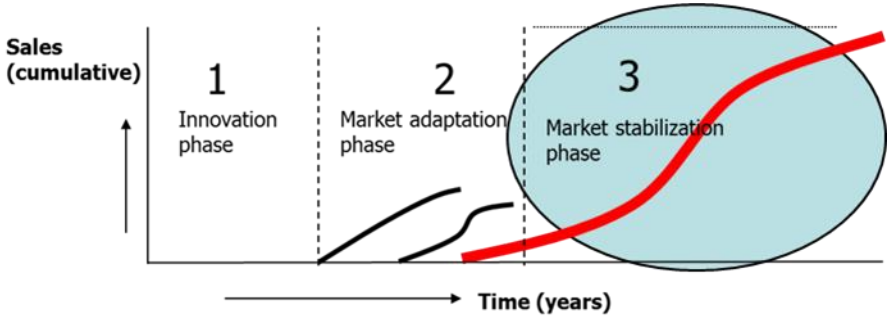
Model of relevant (F)actors

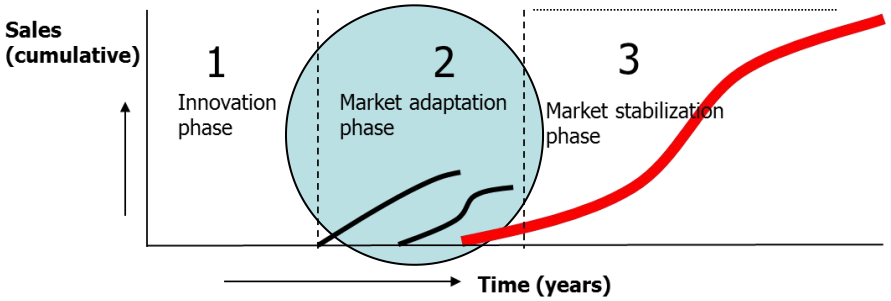
1. Product perform
2. Price
3. Production
4. Compl prod/serv
5. Network of supply
6. Customers
7. Institutions



Factors based on findings reported in IAMOT 2008 (Ortt & Delgoshaie, 2008)

Factors explaining stabilization and adaptation phase

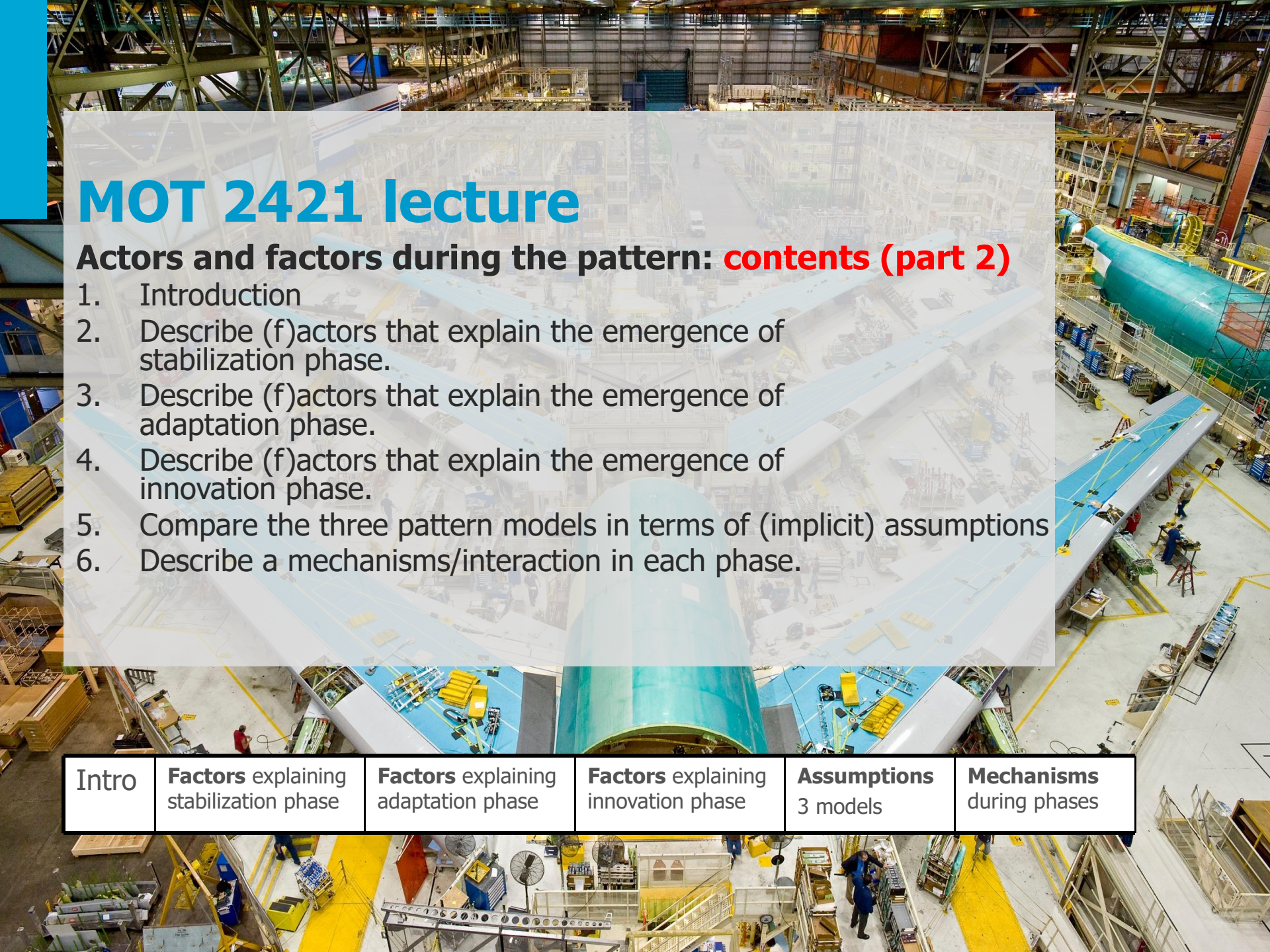




Model of relevant (F)actors	Score
1. Product perform	V
2. Price	V
3. Production	V
4. Compl prod/serv	V
5. Network of supply	V
6. Customers	X
7. Institutions	V

Model of relevant (F)actors	Score
1. Product perform	X
2. Price	X
3. Production	X
4. Compl prod/serv	X
5. Network of supply	X
6. Customers	X
7. Institutions	X

TU Delft



MOT 2421 lecture

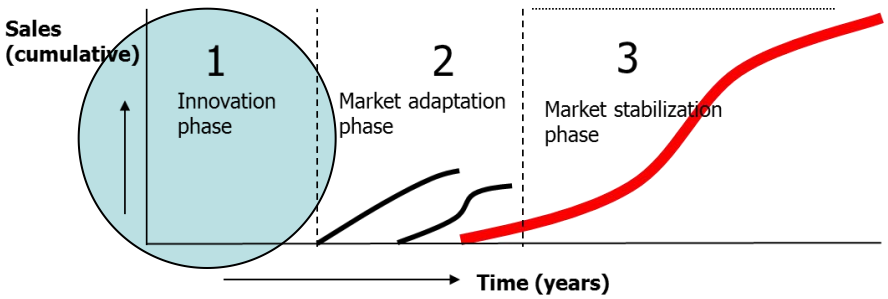
Actors and factors during the pattern: contents (part 2)

1. Introduction
2. Describe (f)actors that explain the emergence of stabilization phase.
3. Describe (f)actors that explain the emergence of adaptation phase.
4. Describe (f)actors that explain the emergence of innovation phase.
5. Compare the three pattern models in terms of (implicit) assumptions
6. Describe a mechanisms/interaction in each phase.

Intro	**Factors** explaining stabilization phase	**Factors** explaining adaptation phase	**Factors** explaining innovation phase	**Assumptions** 3 models	**Mechanisms** during phases

Factors explaining innovation phase

Goal: Explain (predict) start or length of the innovation phase



Theoretical perspectives:

Psychologists: The work of researchers and developers

Sociologists: Vision-formation and communication within and across different subgroups of stakeholders

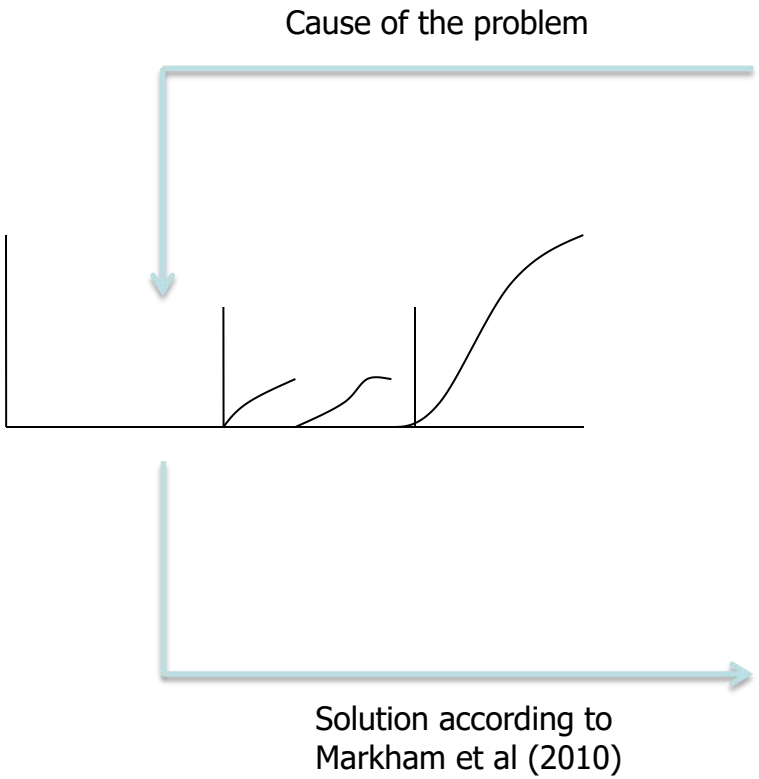
Economists: Research and development funding (supply) and demand, barriers to market formation

Engineers: Problems in turning principle in reliable product

Schroeder et al., 1986

Factors explaining innovation phase

Ad 2. Why does it take so long?



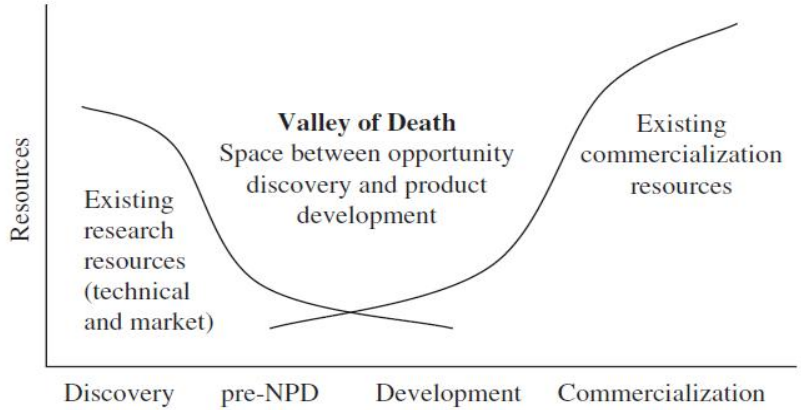


Figure 1. Valley of Death

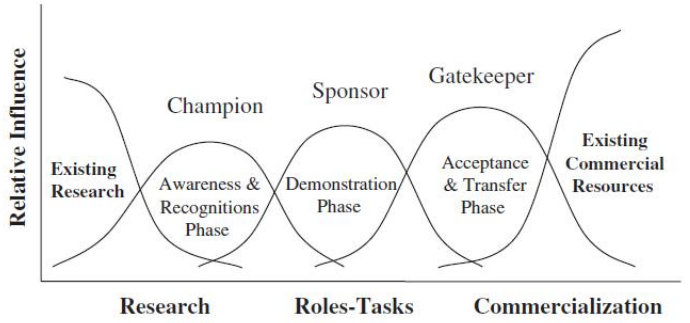


Figure 3. Model of Roles and Activities to Cross the Valley of Death

TU Delft

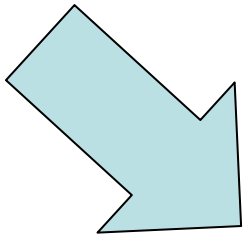
Factors explaining innovation phase

Ad 3. What are the activities and barriers or problems in the phase?

Activities

Basic research to improve principle (scientific development).
Basic research on subprinciples in the larger system (scientific development).
Applied research required to complete the system (technology development).
NPD-process (product/service, marketing-mix, production, organization).
Pilot/testing.
Formation of network of actors with complementary competences/resources.
Vision on the system (function, type of use, type of product type of users).
Choice product/market combination(s).
Competition with other new or incumbent (existing) systems.

Intro = start phase 2



Problems to tackle

1. Funding problem
2. Principle technology immaturity problem; uncertainty performance competitive systems
3. (Shared) vision is lacking
4. Network of actors willing to learn and build up vision is lacking or scattered

TU Delft

Factors explaining innovation phase

Ad 3. What are the activities and barriers or problems in the phase?

Effect Name problem cause	1 Funding	2 Principle	3 Vision	4 Network
1. Funding problem		X Development efforts are delayed.	-	X Network formation is delayed.
2. Technological Principle immaturity problem	X Immature technology affects funding		-	X Actors tend to wait.
3. (Shared) vision is lacking	X Visions compete for funding. No vision blocks funding.	X Development efforts are delayed.		X Alternative networks compete.
4. Network of actors willing to learn and build up vision is lacking or scattered	X Funding is difficult with no network or scattered with multiple networks.	X Learning/ development is scattered and delayed.	X Vision formation is scattered and delayed.	

→ Risk

Factors explaining innovation phase

Why is the innovation phase not just a project?

- The innovation phase lasts longer than a typical project
- In contrast with a project activities can either involve many projects in parallel or no project activity for prolonged periods of time.
- Instead of a coordinated program of activities the innovation often shows parallel unrelated sets of projects in different companies. Innovation phase is not a project because in this phase many actors tend to work in parallel in different projects.

Minnesota studies and not a project

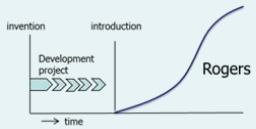
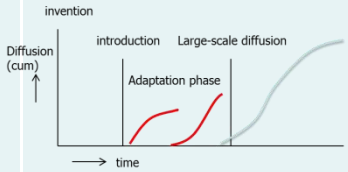
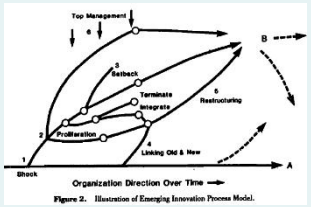
Lastly, innovation is chaotic. The Minnesota studies show that six key characteristics influence the innovation process. These are shock, branching of the innovation, unpredictable setbacks, linkage of old and new technology, top management involvement and the organizational change. These factors will greatly disturb project planning.

Markam roles and problems during innovation phase

The champion is needed to establish a (shared) vision of the product and create the network of actors. Their contribution is to become aware of the value of the idea and then come up with ideas for acceptance by selling the ideas to others. He solves problem 3 and 4. A sponsor is needed to solve the funding problem (problem 1) by providing resources. The gatekeeper needs to keep track of the performance and thereby solving problem 2.

innovation processes on pattern level

Alternative theories and their assumptions

Pattern (level 2)	innovation-diffusion paradigm	Pattern development and diffusion	Minnesota studies
			
	Model of relevant (F)actors — Score 1. Product perform V 2. Price V 3. Production V 4. Compl prod/serv V 5. Network of supply V 6. Customers X 7. Institutions V 1. Unit constant (vision known/shared upfront no hindsight bias) 2. Hallmarks exist 3. Uncertainty hallmarks limited	Model of relevant (F)actors — Score 1. Product perform X 2. Price X 3. Production X 4. Compl prod/serv X 5. Network of supply X 6. Customers X 7. Institutions X 1. Unit constant (vision known/shared upfront no hindsight bias) 2. Hallmarks exist 3. Uncertainty hallmarks limited	1. No general hallmarks 2. (Hence uncertainty around hallmarks is not relevant) 3. No hindsight bias **No hindsight bias** - i.e., no focus on one (pre-defined) technology - Invention is not obvious sometimes **Company instead of technology focus** provides a lot of (confusing) detail

TU Delft

MOT 2421

After a short break

we will start again at 14.50

The market mechanisms in the early phases

(according to the literature)

Market mechanism is a particular type of interaction between different market actors/factors

Innovation phase

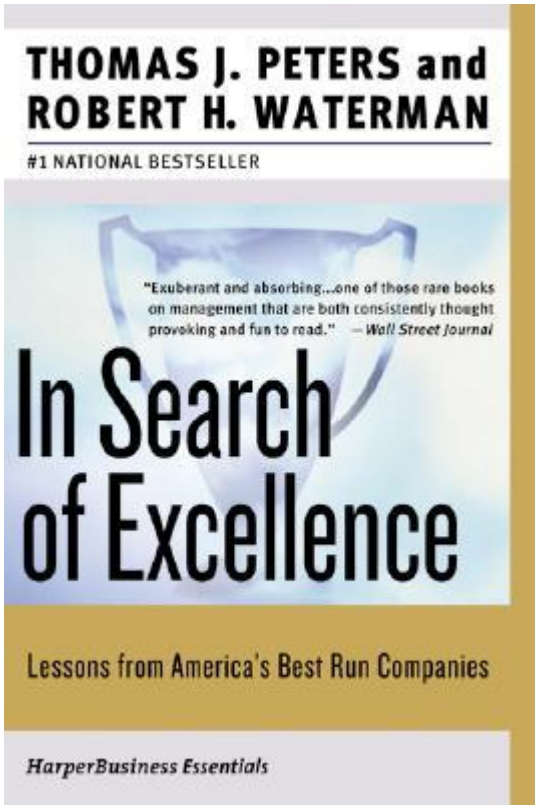
- Market for basic research (pre-competitive governmental sponsoring, corporate investment in R&D)
- Uncertainty, different visions, interests, resistance, accidents, social rumour
- …..

Adaptation phase

- The innovators dilemma
- Competition & Substitution
- Network effects: The critical mass or chicken and egg dilemma
- Emergence of a dominant design
- …..

The market mechanisms: Innovators dilemma (a)

problem: interference innovation/standard operations.



10 years later almost all of the successful companies demised

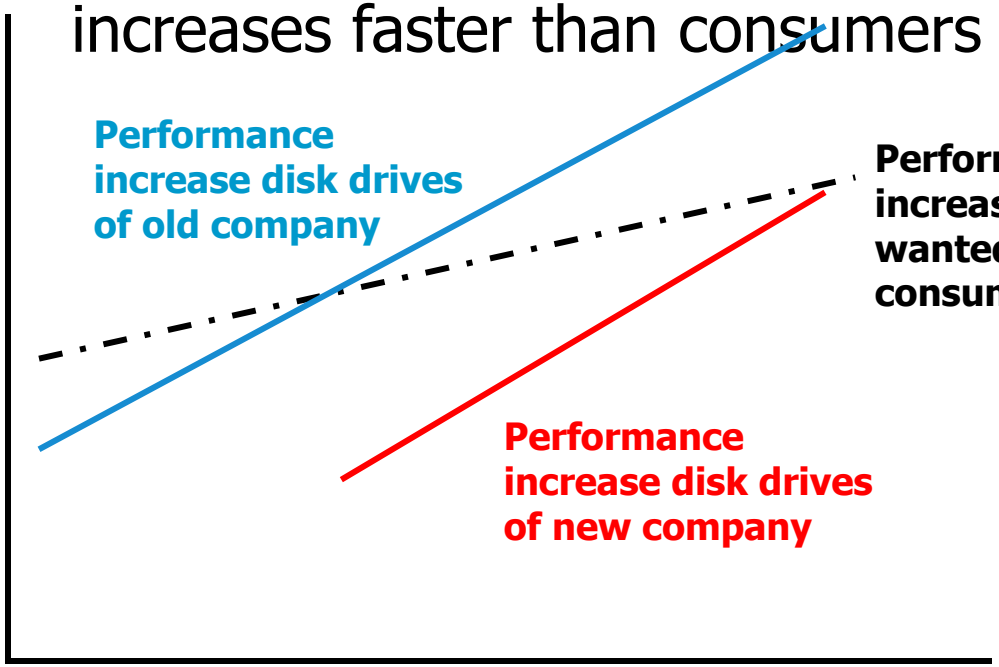
Why?

The market mechanisms: Innovators dilemma (b)

problem: interference innovation/standard operations.

Christensen

Effect 1: performance technology (of incumbent company) increases faster than consumers want



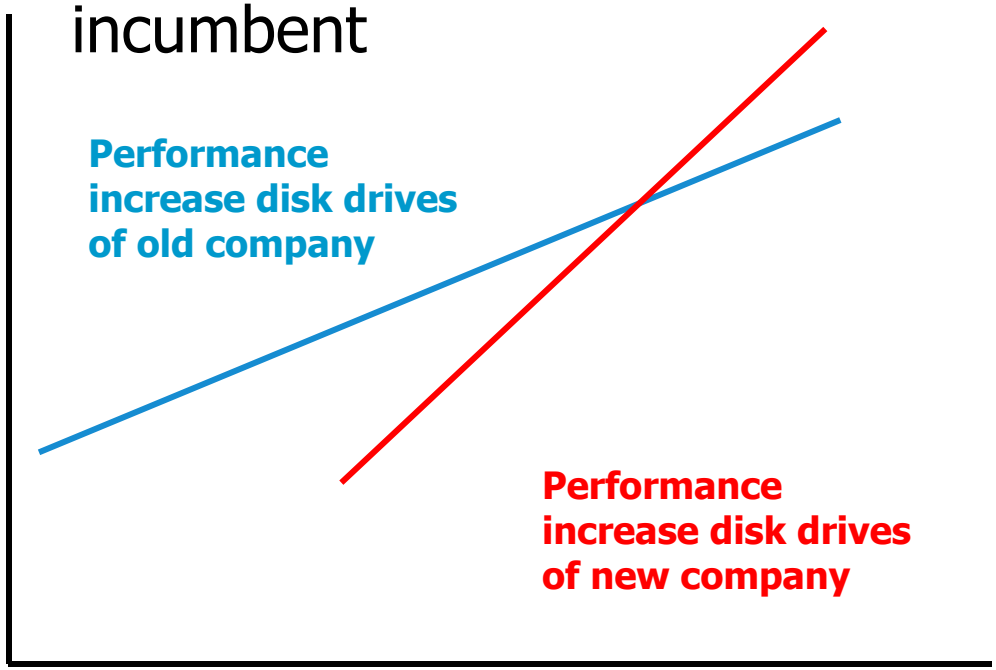
Intro	**Factors** explaining stabilization phase	**Factors** explaining adaptation phase	**Factors** explaining innovation phase	**Assumptions** 3 models	**Mechanisms** during phases

The market mechanisms: Innovators dilemma (c)

problem: interference innovation/standard operations.

Christensen

Effect 2 : performance of new entrant increases faster than incumbent



The market mechanisms: Innovators dilemma (d)

Learning points

1. Excellent companies do not become lazy
2. Competence destroying technologies are not always breakthrough but can be inferior at first sight.

Multiple reasons why smart managers would not invest

uncertainty about performance of old and new technology (see sailing boat/motor boat principle)

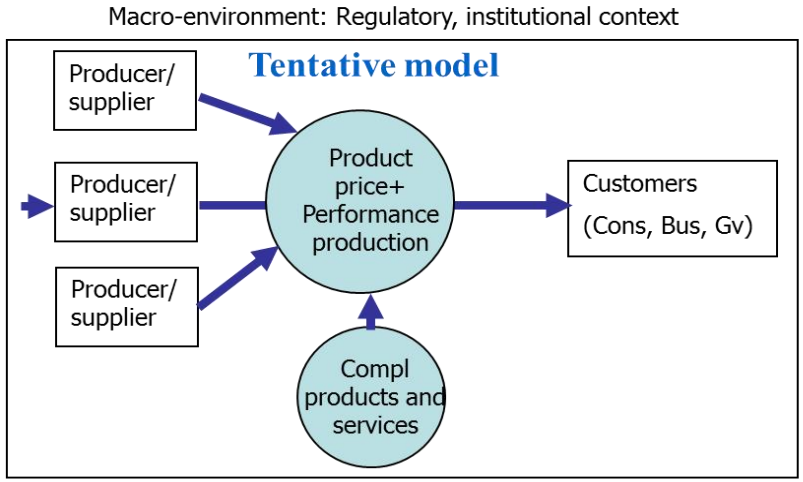
current clients do not like it

investment is too risky

organization is not designed to deal with the new market

The market mechanisms: Innovators dilemma (e)

How does innovator dilemma market mechanism fit in the market?



Factors based on findings reported in IAMOT 2008 (Ortt & Delgoshaie, 2008)

Effect 1: Different suppliers (incumbent versus new entrant/spin-off) differ in capability to provide performance and increase performance.
Effect 2: Suppliers capabilities to provide increased performance is not matching wanted performance increase by customers

Questions?


See you next lecture

Assignment

Three types of assignment
Form a group and choose an assignment

	Project-level	Pattern-level	Discipline-level
1. Define topic			
2. Literature search (interview)			
3. Pattern, process description			
4. Actors, factors involved			
…			