Agenda

10.9. Introduction
17.9. Innovation process (Dogson chapters 3-4)
24.9. R&D management (Dogson 6)
1.10. Telecom R&D in Finland
8.10. Standardization (Varian 8-9)
15.10. Productization (Dogson 7)
29.10. Patenting
5.11. Technology marketing (Varian 2-7, Dogson 9)
12.11. Case: Mobile network evolution
19.11. Case: Product management
26.11. Case: Mobile cloud computing
3.12. Summary

16.12. Exam

Dynamic comparative advantage of industries

Introduction

Innovations are developed, produced and introduced to domestic markets of an industrialized country where the original invention was made.

Growth

New products are first exported to countries with similar needs. This moves partly production and R&D to other countries, usually on the basis of cost structures. Several competitive products and standards emerge.

Maturity

After the product becomes adopted and used in the global markets, production gradually moves totally away from the point of origin.

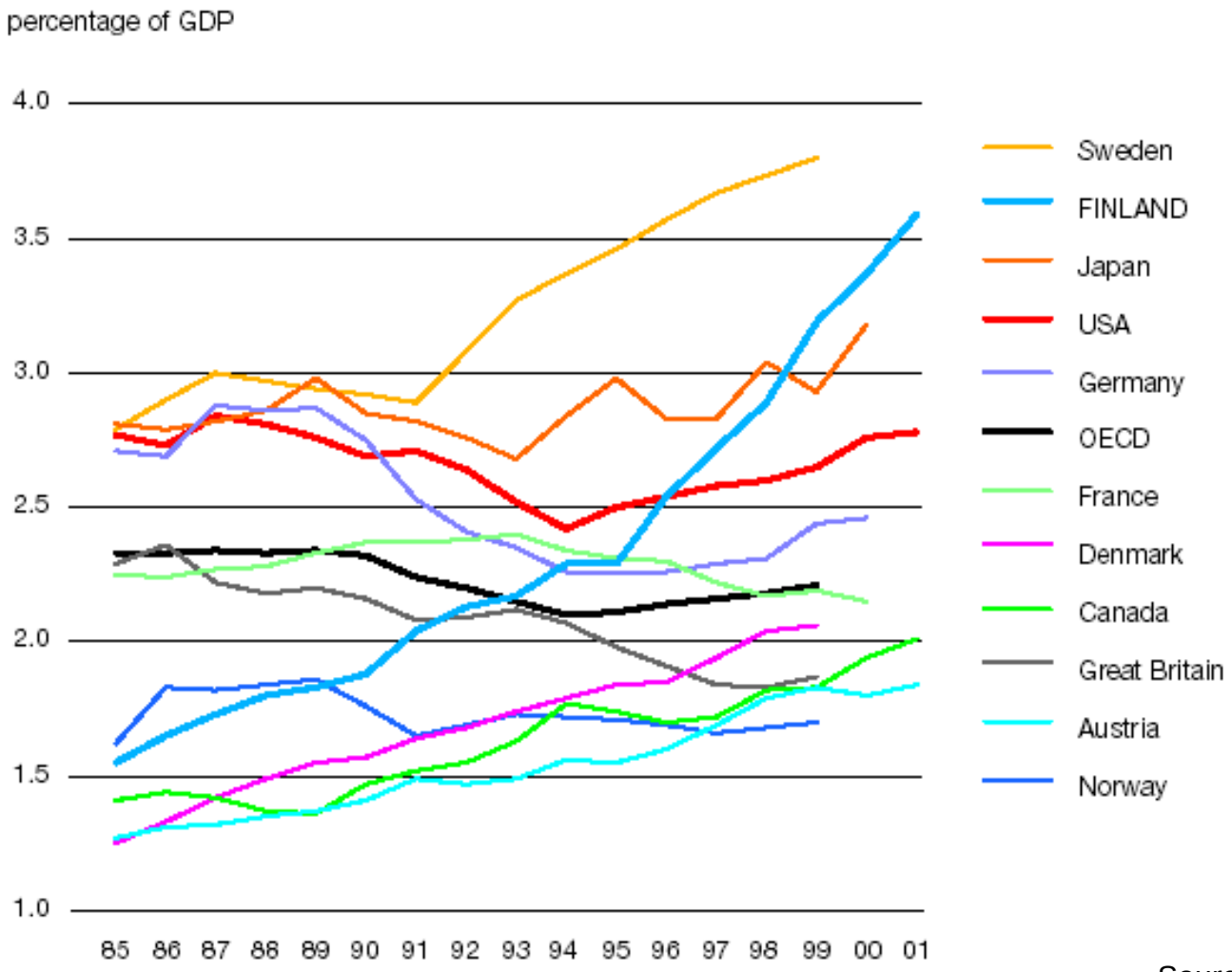
The prices decline and industry consolidates. The product becomes an import item of the original country of invention.

Decline

Developing countries constitute the most markets for the product and they are produced in developing countries.

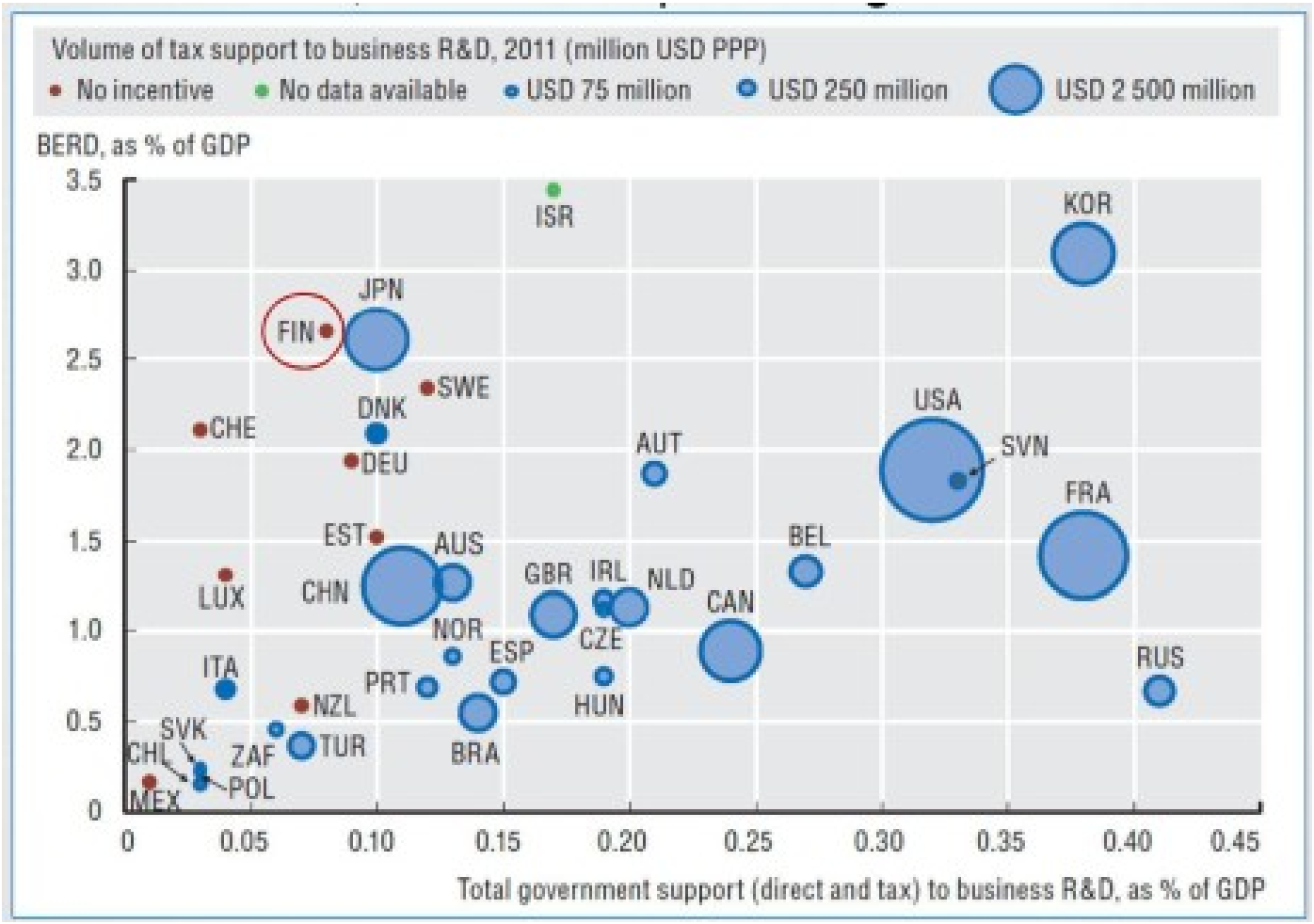
Source: Vernon 1986

R&D Intensity by Country



Source: Tekes, OECD

R&D Intensity by Country



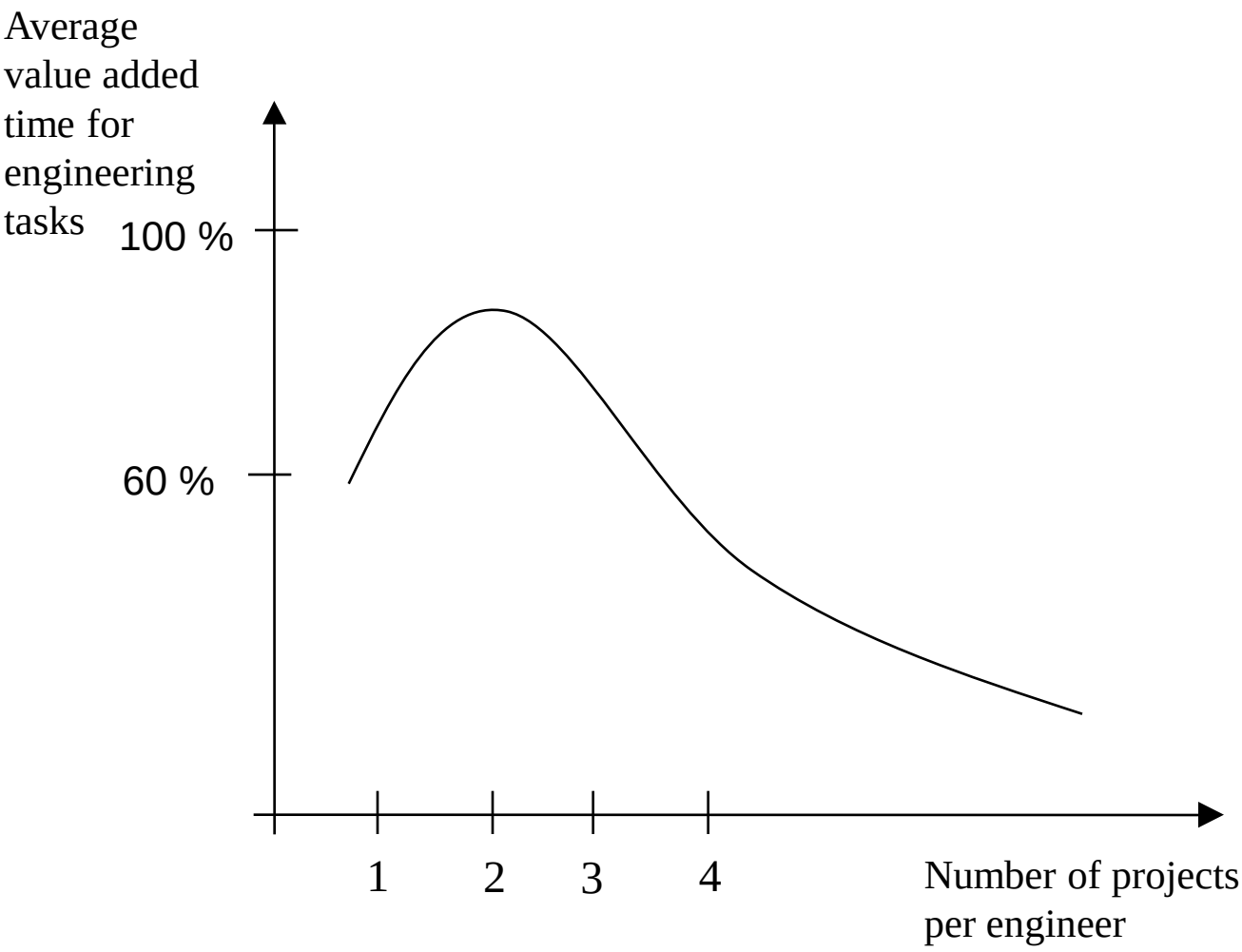
Source: OECD

Classification of R&D

Type of R&D	Incremental	Discontinuous	Fundamental
Probability of technical success	40-80%	20-40%	Small, difficult to assess
Time to completion	0,1-2 years	2-4 years	5-10 years
Competitive potential	Modest, but necessary	Large	Large, difficult to assess
Durability of competitive advantage	Short, imitable by competitors	Long, protectable by patents	Long but risky

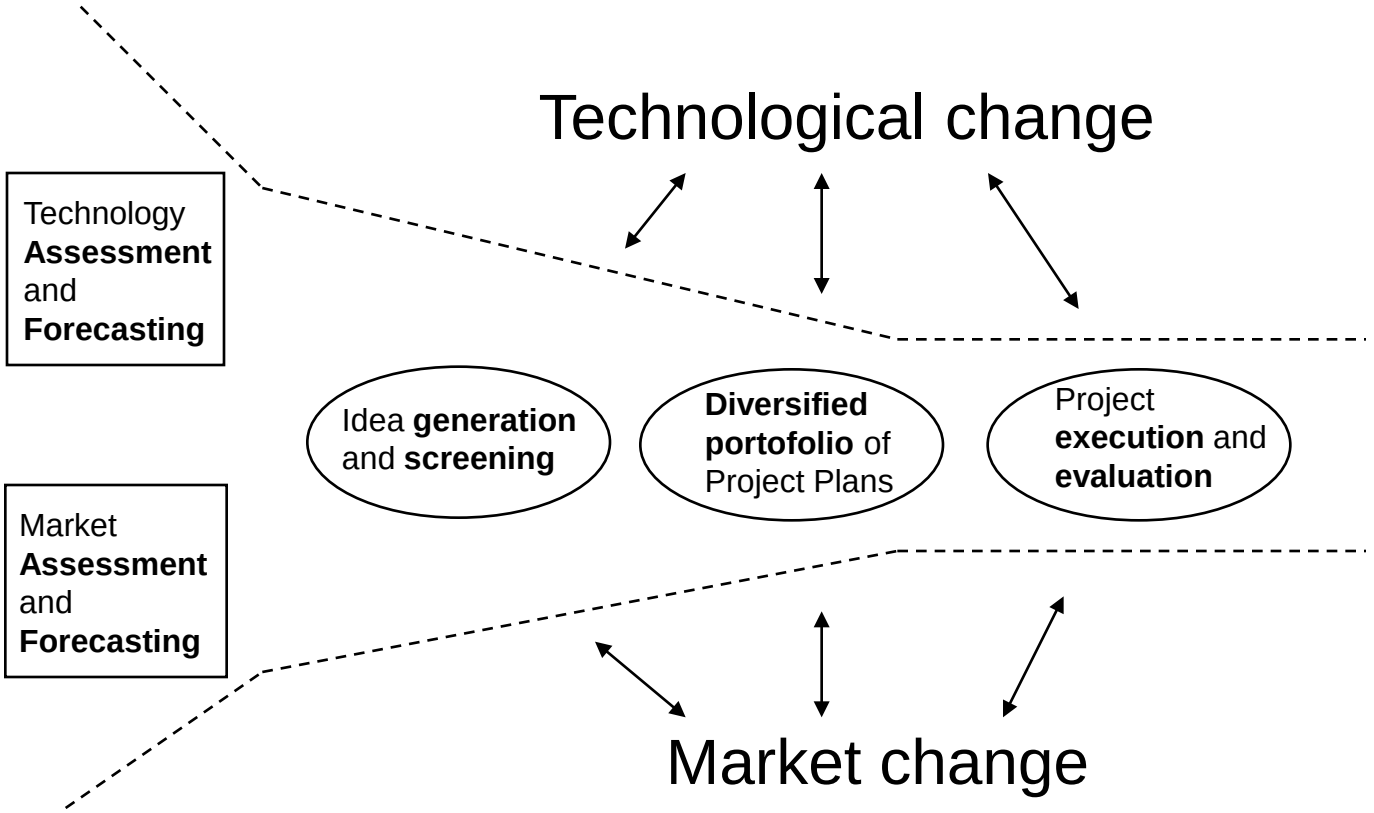
Source: adapted from Pitkänen 2000, ADL 1991

Overcommitment increase R&D cost and destroys productivity

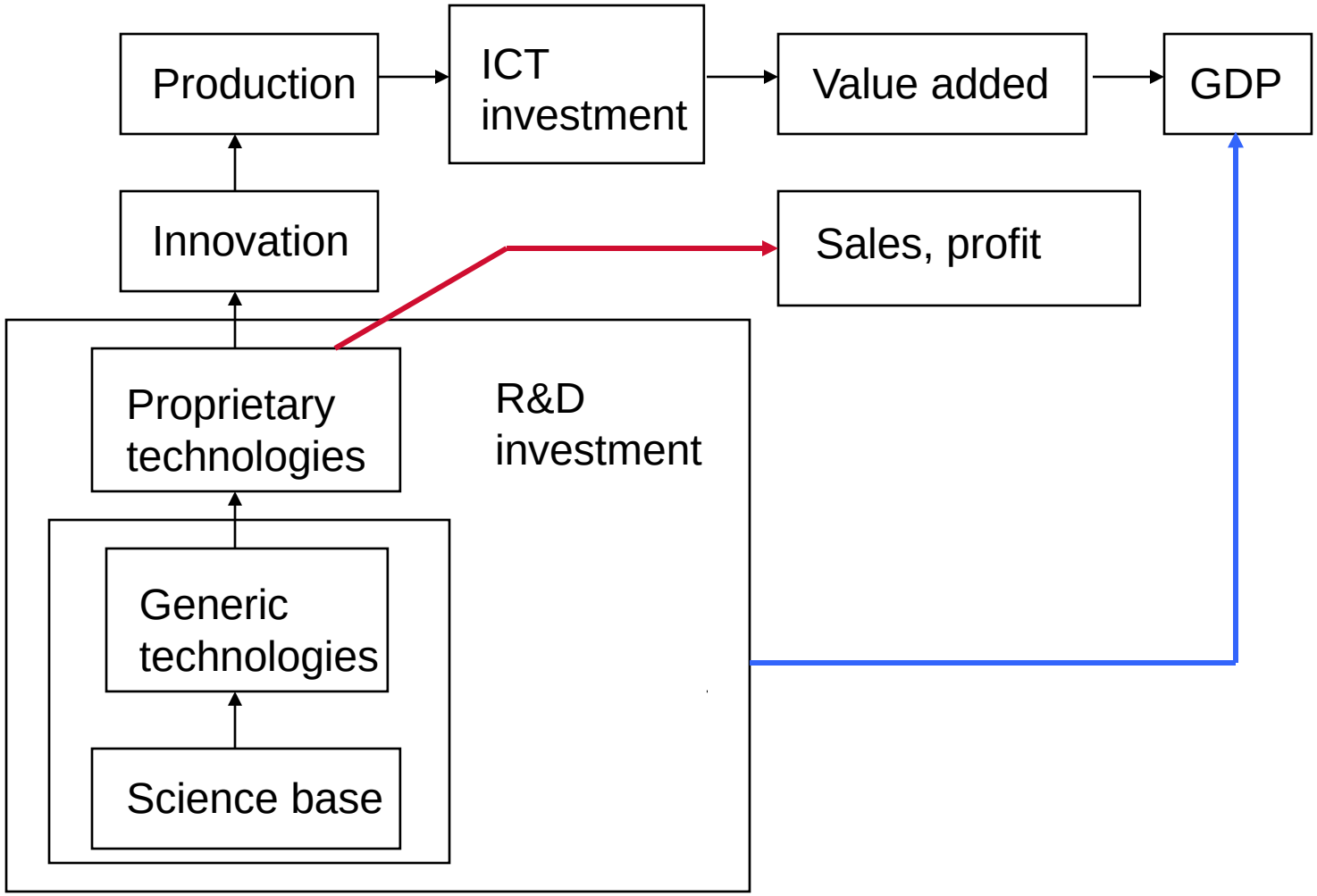


Source: Henderson

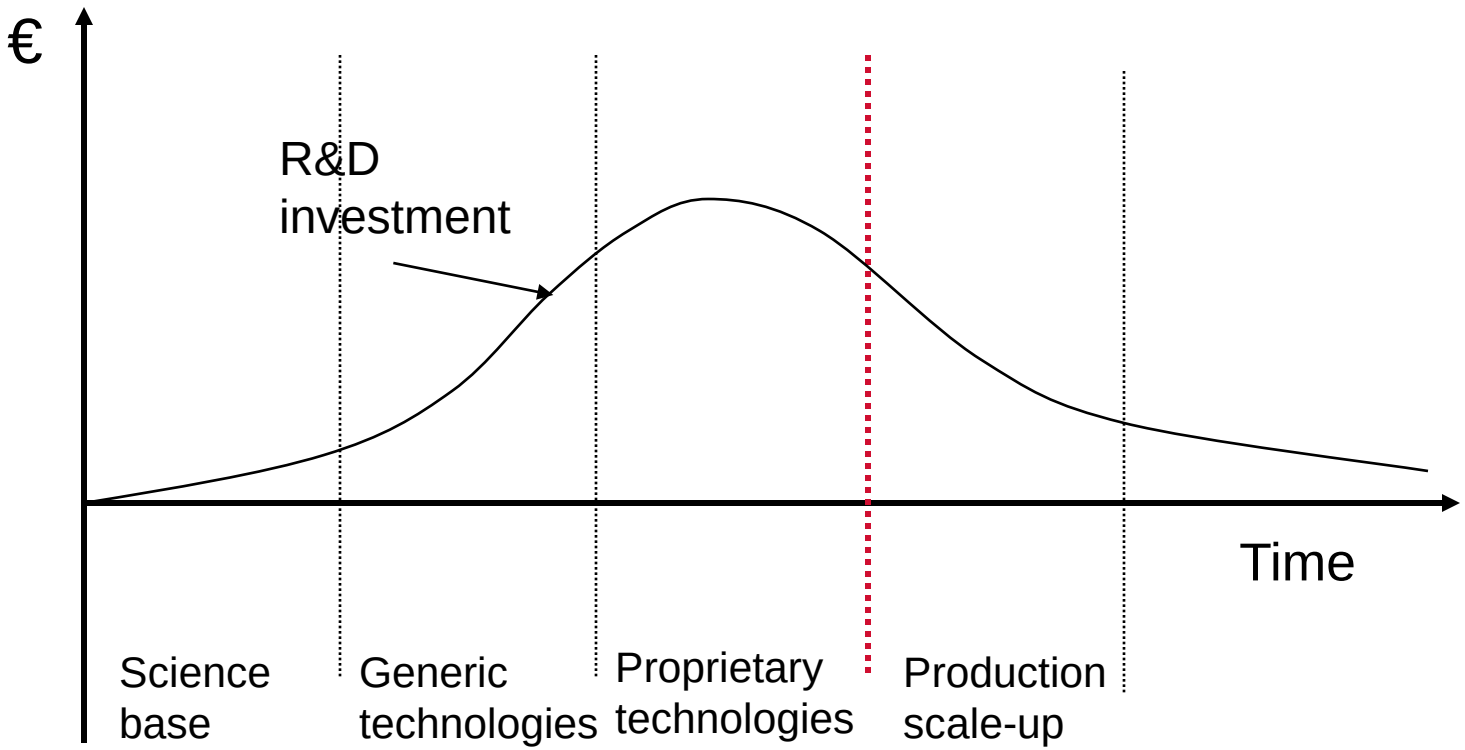
Innovation process in firms



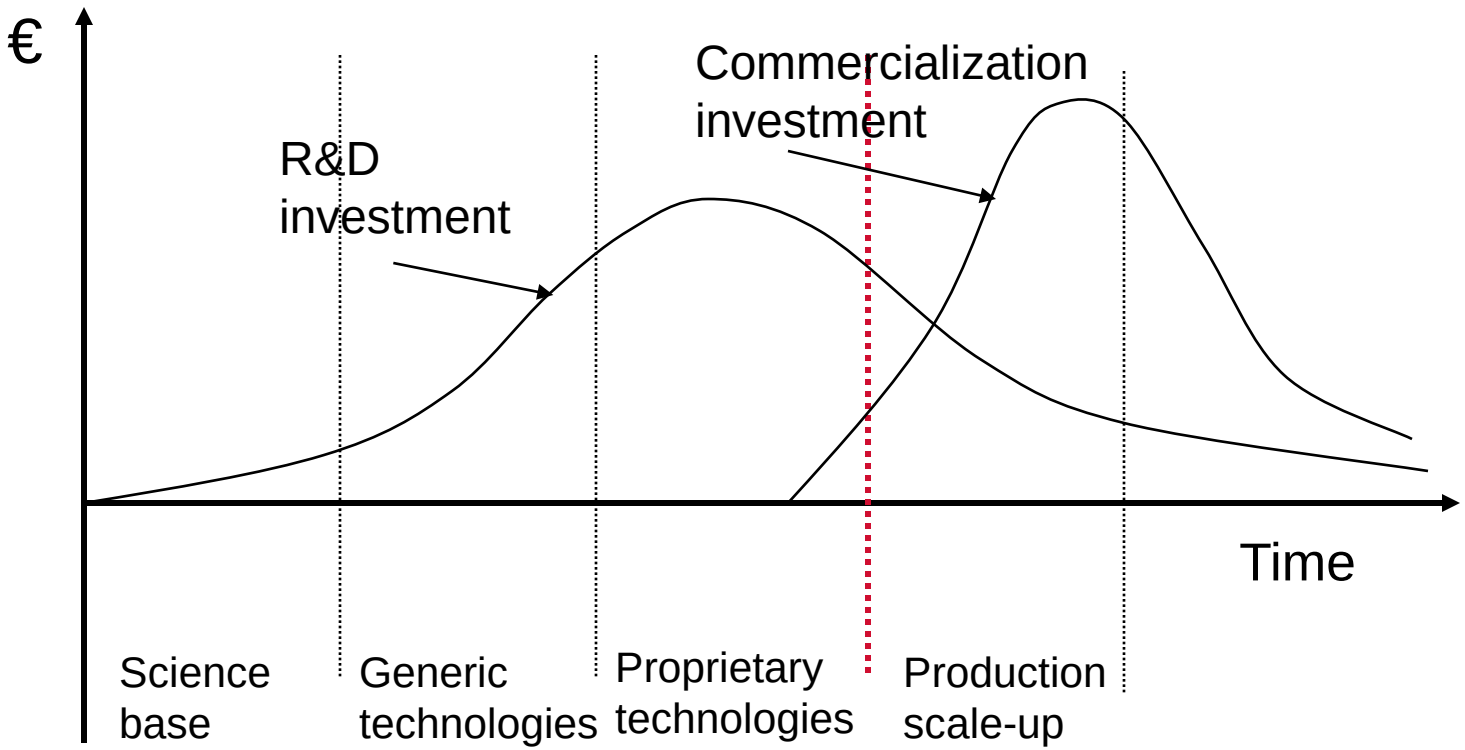
Goals of R&D Management



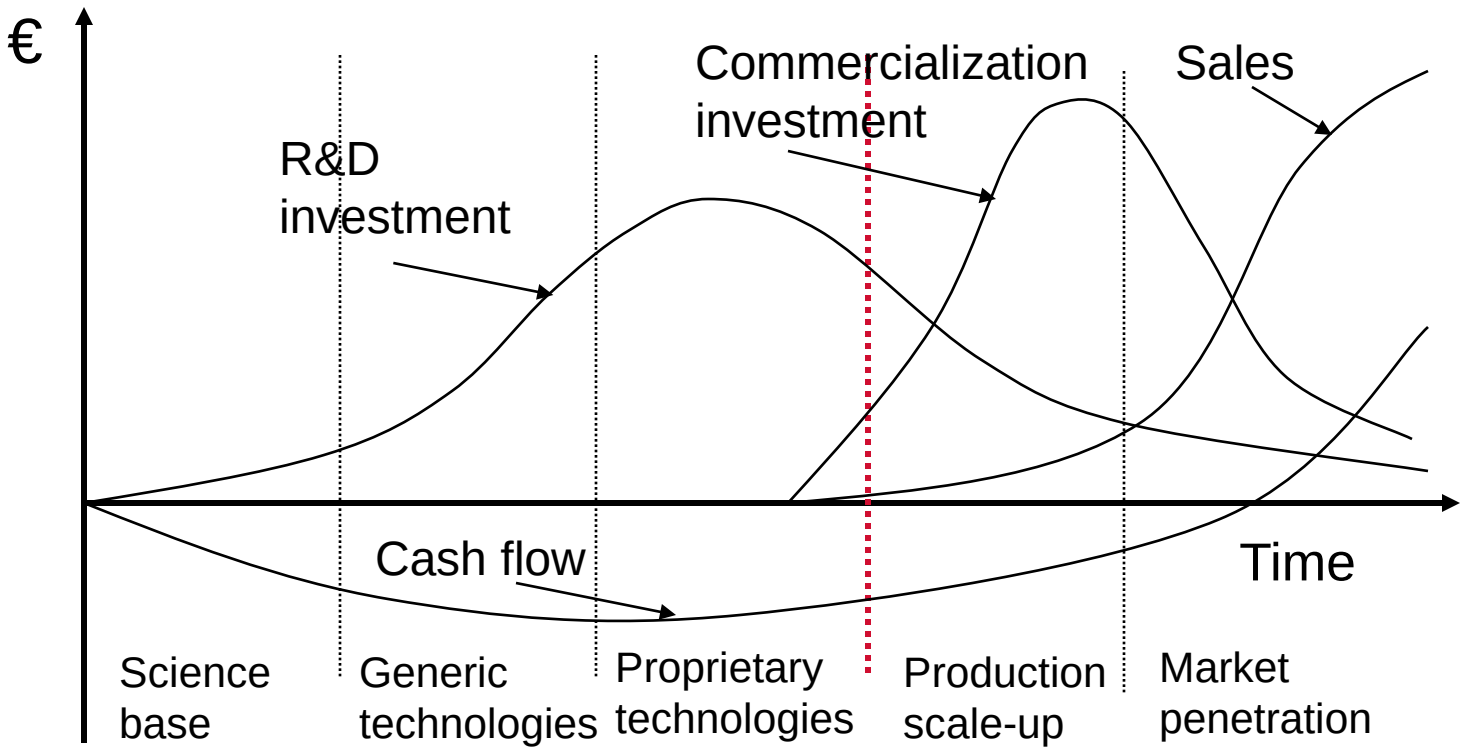
R&D Life Cycle



R&D Life Cycle



R&D Life Cycle



Technology Roadmaps

- Framework and process for forecasting, assessing and planning potential technological developments
- The aim is to build a time-based chart, which establishes likely alternative future trends in a single technological area and links these to the market information
- Likely products and services are identified in relation to these trends
- Conclusions are made for the amount of R&D investment required

R&D Investment Profitability Evaluation

Net Present Value (NPV, DCF)

$$\sum_{t=m}^{p} \frac{S_t}{(1+i)^t} + \frac{JA_p}{(1+i)^p} - \sum_{t=1}^{m} \frac{H_t}{(1+i)^t}$$

Internal Rate of Return (RoR, IRR)

$$\sum_{t=m}^{p} \frac{S_t}{(1+RoR)^t} + \frac{JA_p}{(1+RoR)^p} = \sum_{t=1}^{m} \frac{H_t}{(1+RoR)^t}$$

RoR calculation formula

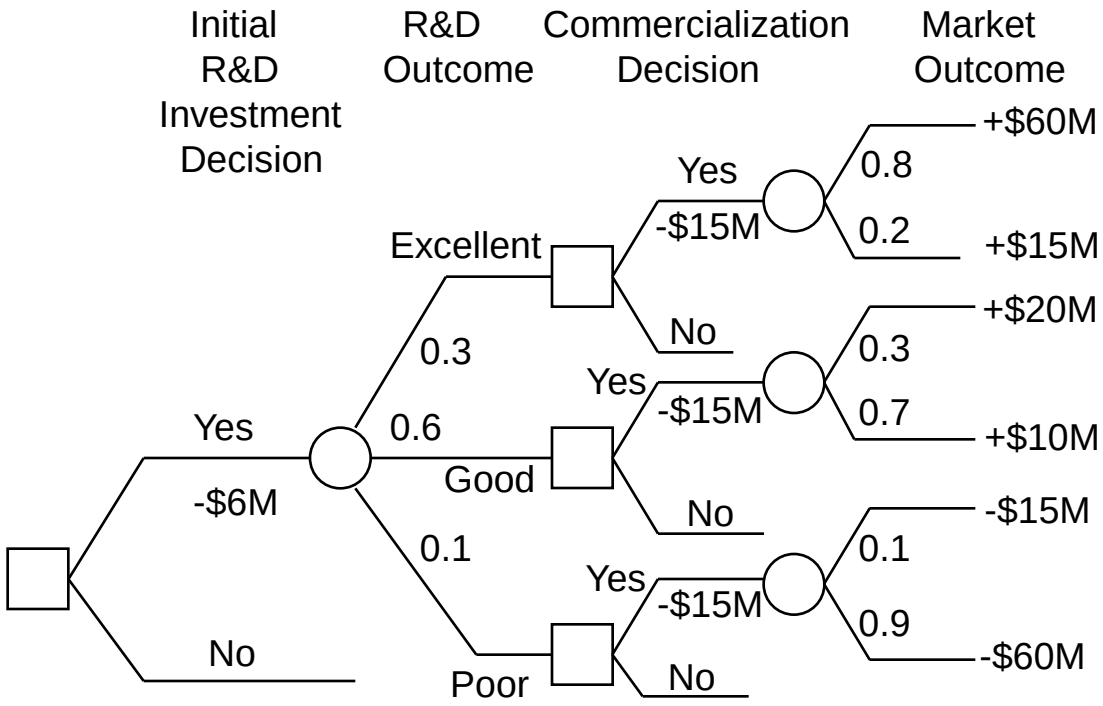
$$\sum_{t=m}^{p} \frac{S_t}{(1+RoR)^t} + \frac{JA_p}{(1+RoR)^p} = \sum_{t=1}^{m} \frac{H_t}{(1+RoR)^t}$$

m = the length of the R&D project
n = the length of the product life-cycle
p = m + n
S_t = net cash flow after the market introduction
RoR = rate of return
H_t = annual R&D expenditure
JA_p = residual value

Real option

Real options based management approach limits the downside risk of an R&D investment decision by a staged product development process without limiting the upside potential by giving increasing flexibility to target actions according to the contingent evolution of technology and related market (Amram and Kulatilaka 1999, Gaynor 2003, Faulkner 1996).

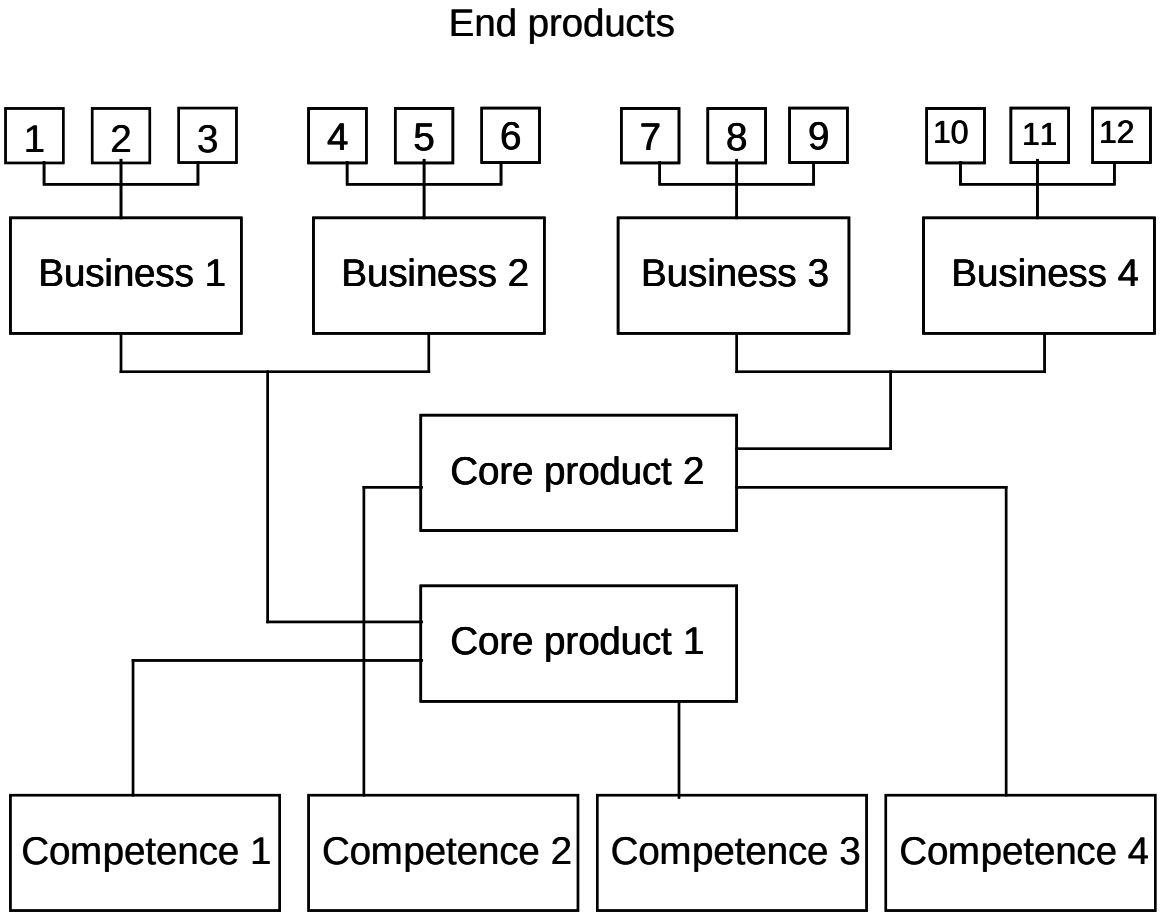
Real options R&D valuation



Valuation Method	**NPV**	**1993**	**1994**	**1995**
DCF #1: Use most likely values	- $11.4	- 6	-(15/1.12) + (10/1.12^2)	
DCF #2: Consider market uncertainty	- $9.0	- 6	-(15/1.12) + (0.3*20+0.7*10)/1.12^2	
DCF #3: Consider all uncertainties	- $5.4	- 6	-(15/1.12) + 0.3(0.8*….)/1.12^2	
Options Thinking Valuation	**+ $2.2**	- 6	-0.3*(15/1.12)+0.3*((0.8*60+0.2*15)/1.12^2))	

Source: Faulkner 1996

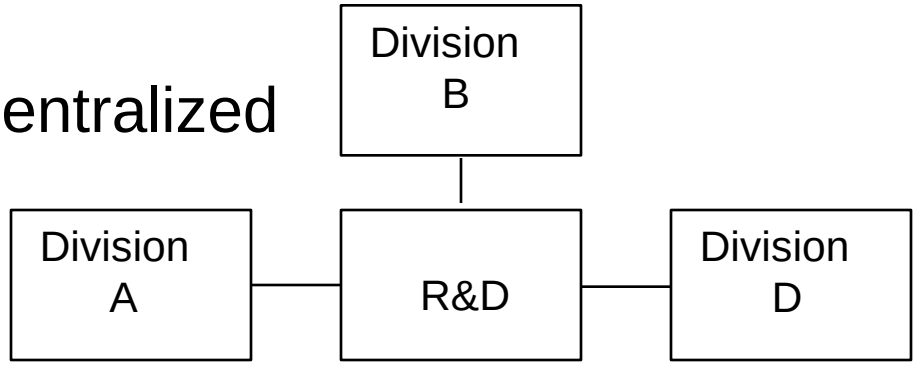
Core competencies



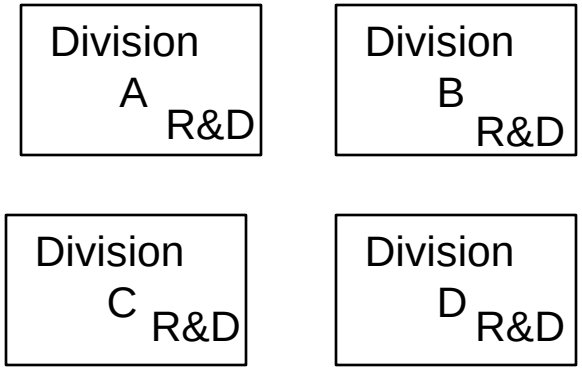
Source Prahalad & Hamel 2001

Location of R&D

Centralized

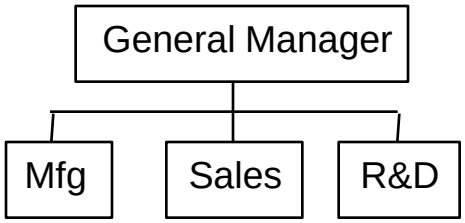


Decentralized

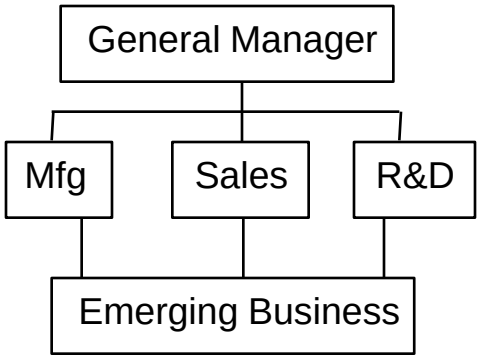


Organizing to Innovate (35 cases study)

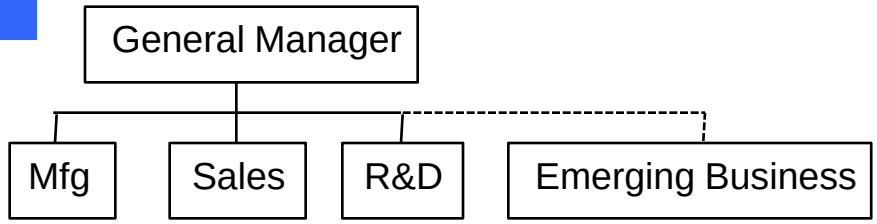
Functional designs (success 25 %)



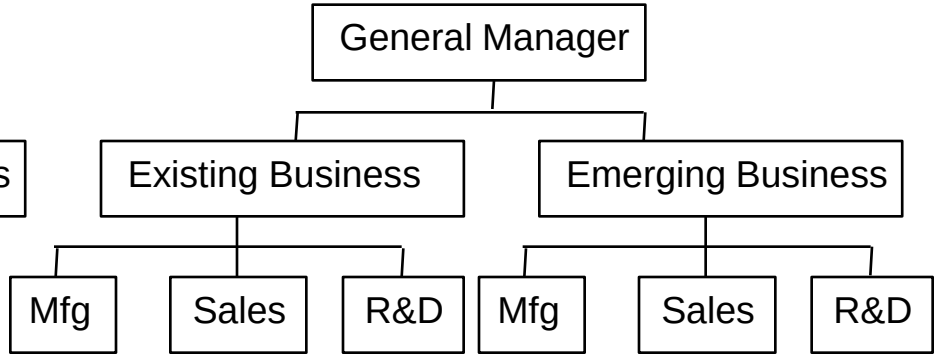
Cross-functional teams (none)



Unsupported teams (none)



Ambidextrous organizations (90 %)



Source O´Reilly and Tushman, 2004

International R&D

- Proximity to market and customers
- Support for local operations
- Responses to political factors
- Foreign R&D resources
- Parallel development
- Specialization strategies
- Multiple learning
- Network forming

Goals of Technology Policy

- Annual R&D investments in Finland are about 6,5 billion € of which was publicly financed 27 %, 3,4 % of GDP (2008)
- Technology policy differs from the other policies, because it tryis to "increase the cake" instead of sharing it
- The most important reasons for too low a level of the private R&D investments are due to the high technical and commercial risks involved
- The government´s initiative is thus emphasized in the case of R&D underinvestment in the private sector
- In order to redress this kind of ***market failure*** the industrial countries have contributed to their technological infrastructure to support the long-term competitiveness of domestic companies

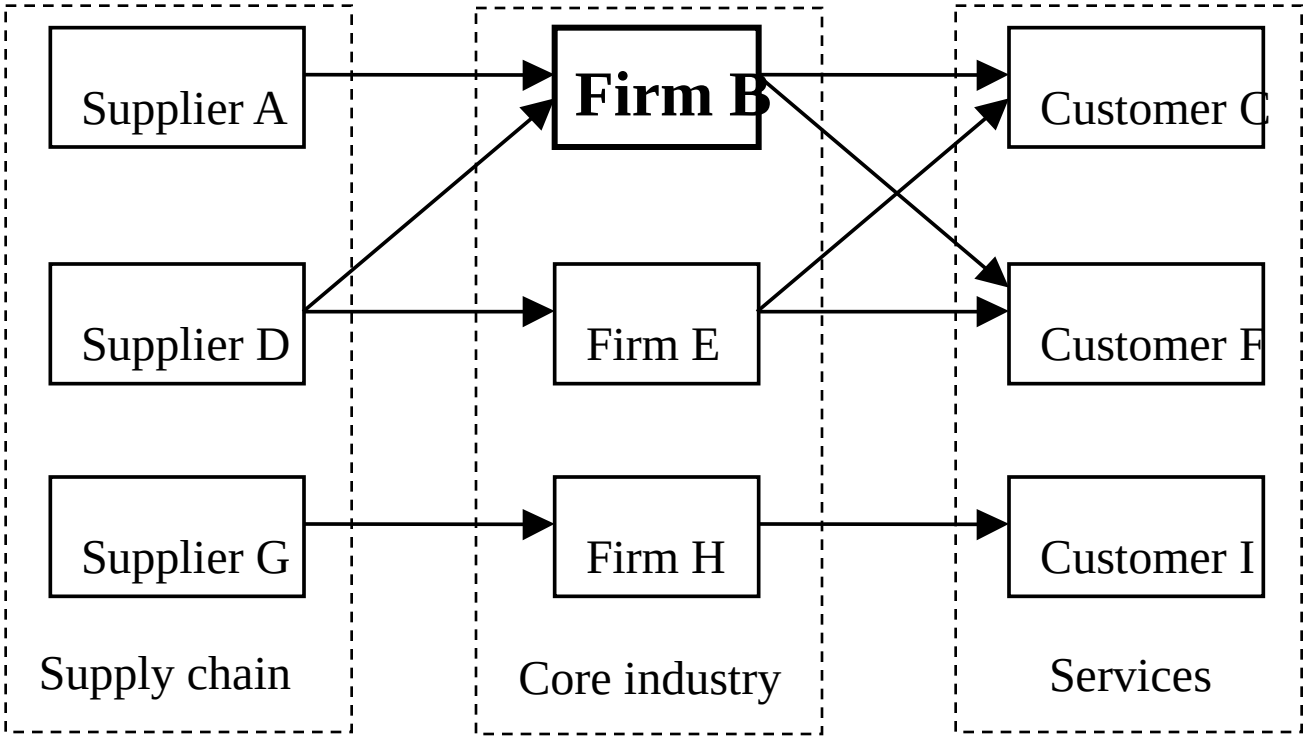
Goals of Technology Policy

- Companies make their decisions of the R&D investments aiming at maximizing profits
- Therefore, at least in big companies, the risk is divided into the portfolios of many different R&D projects, all of which are required greater profitability than other less risky projects like the expansion of the present production facilities
- This all results in the companies beginning to favour R&D projects with a short time to market influence.
- Therefore the goal of technology policy is to maximize the influence of such R&D investments on the growth of GDP, which would not be realised without support, but would greatly benefit society

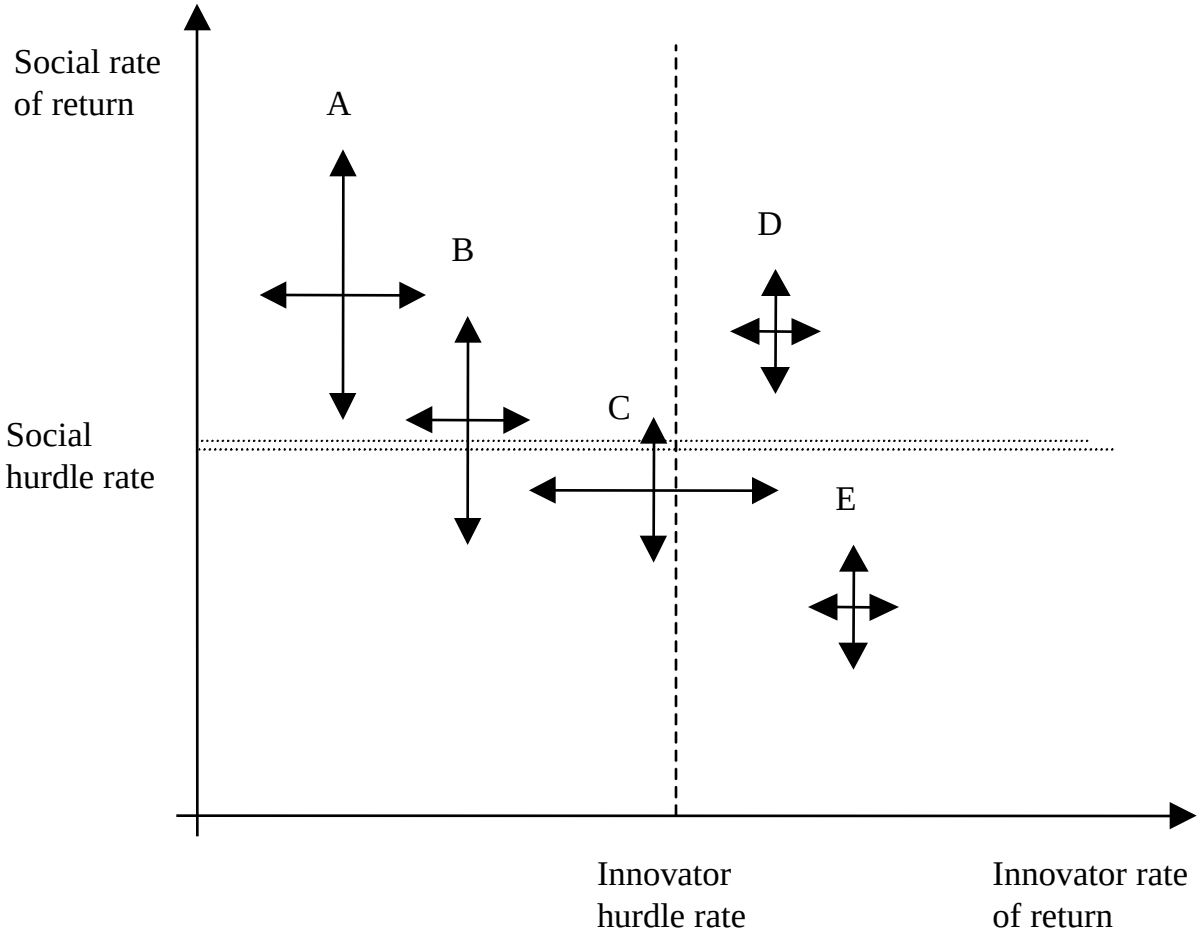
Goals of Technology Policy

- Spillover means practically a situation where investment in the technology of an innovator also benefits other companies
- Economists have demonstrated that R&D performed by the original innovating company generates widespread value in the economy through spillovers
- The key factor in the development of the industrial structure and advancement of spillovers is the efficiency of the whole domestic value chain (cluster)
- Concrete technology policy occurs in the **selection** of publicly financed R&D projects

Example value chain

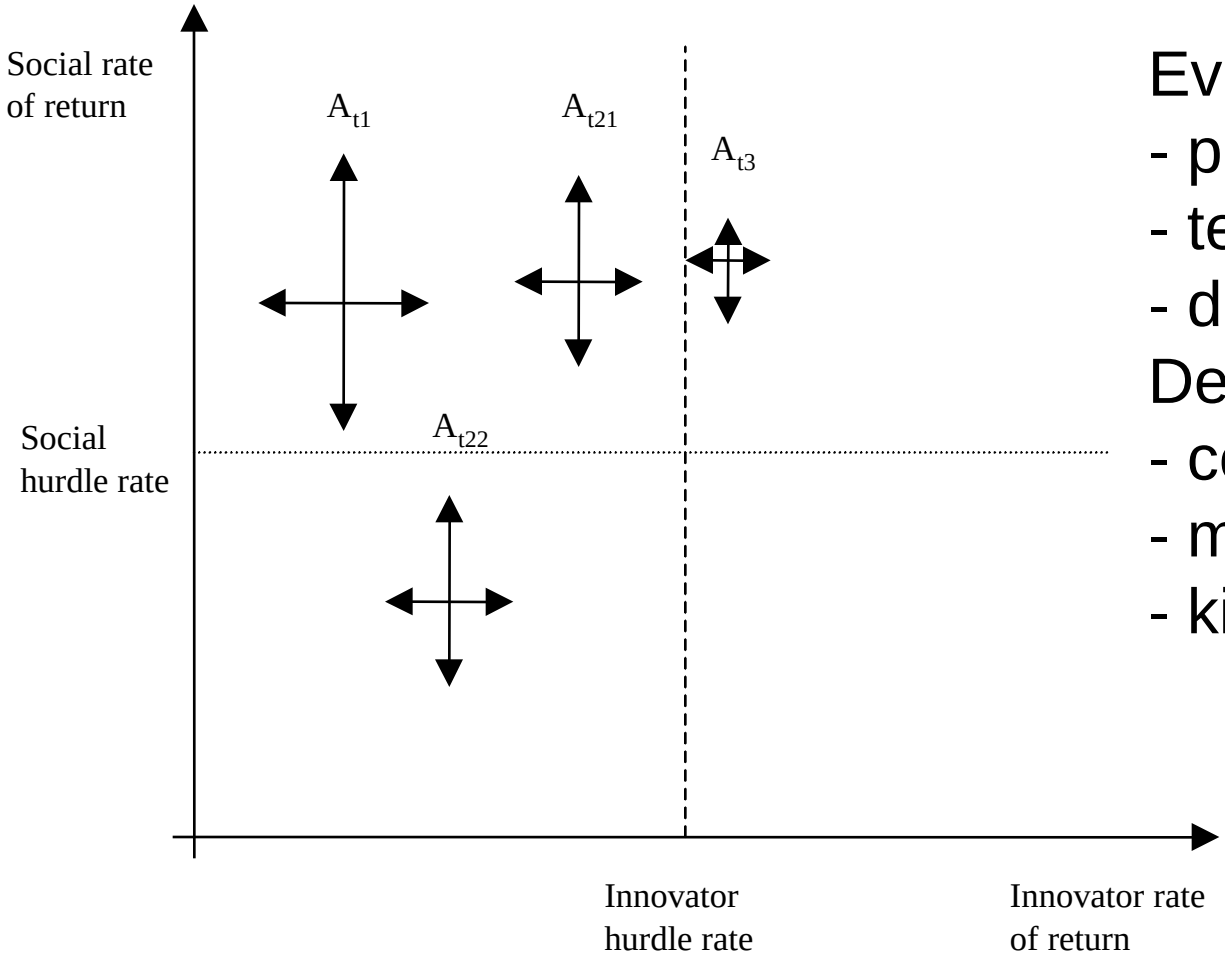


R&D financing by type of project



Source: Tassey 1997

R&D management by milestones

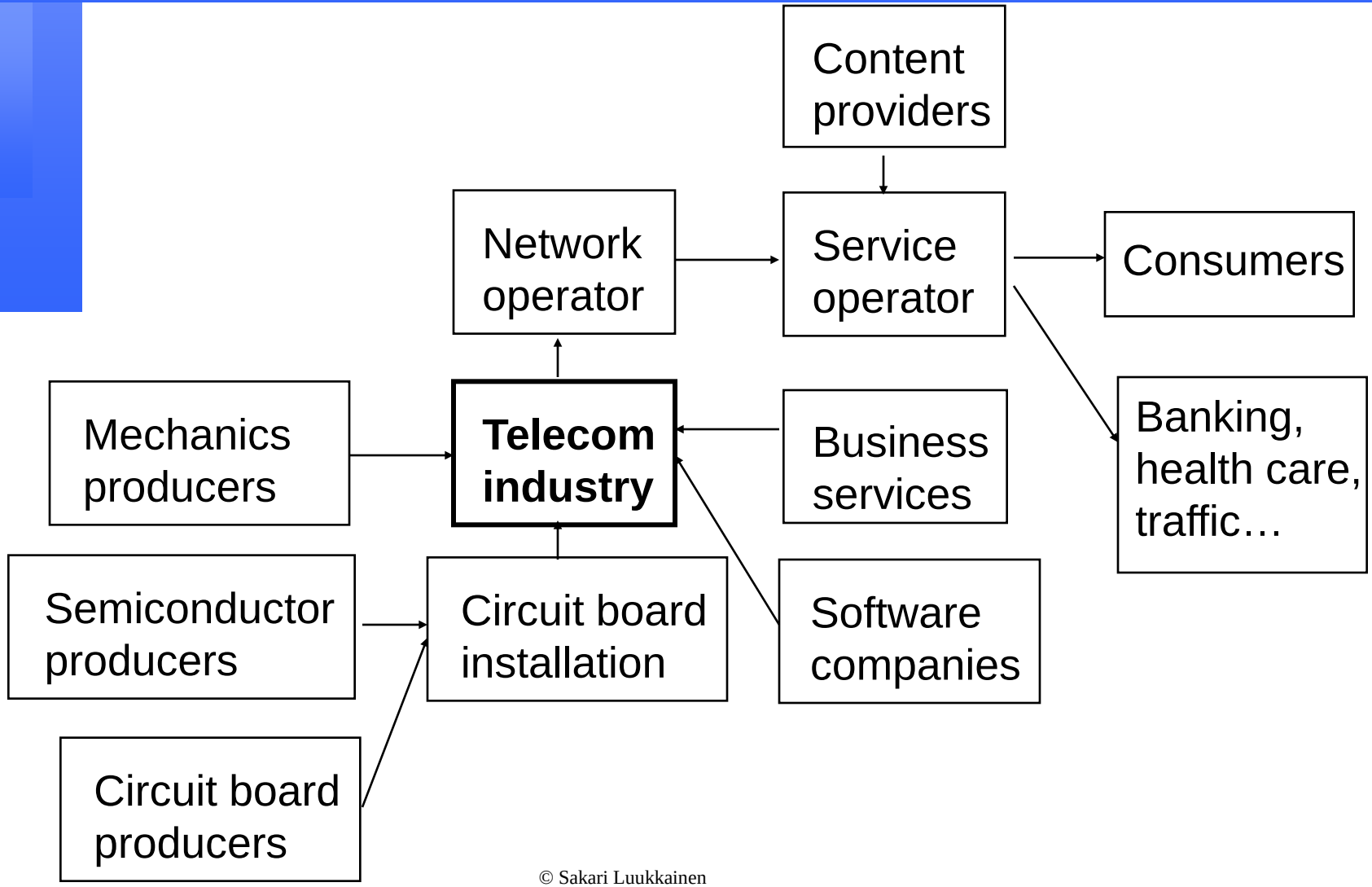


Evaluation of
- profitability
- technical risk
- delay

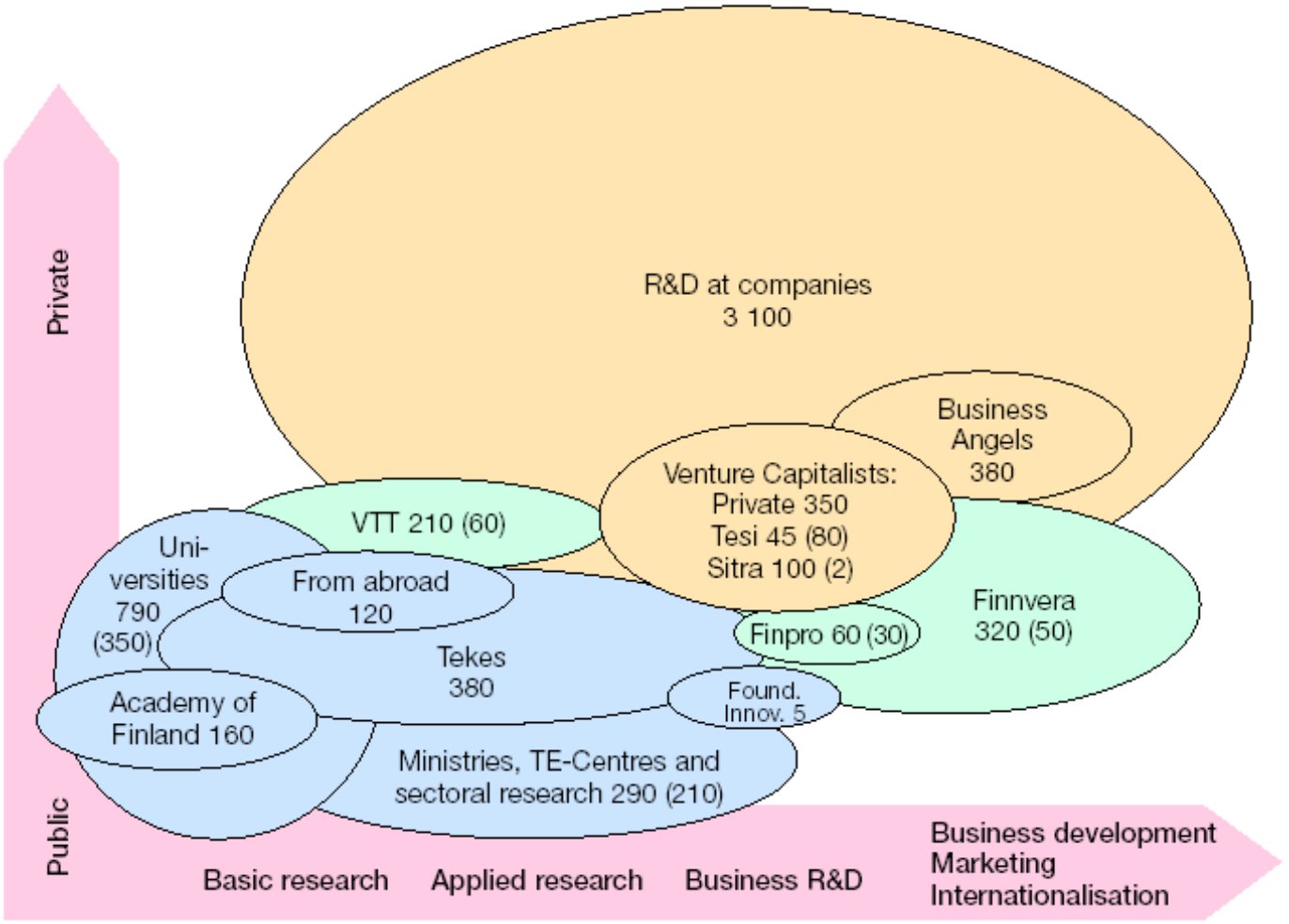
Decisions on
- continue
- modify
- kill / freeze

Source: Tassey 1997

Telecommunications value chain - Telecluster



Finnish Innovation System



Source: Tekes

Evaluation of the Innovation System

- R&D investments of industry has been successfull - R&D expenditures correlate highly with growth of sales of new products i.e. innovations
- The public support of GSM development has created a lot of direct success as well as spillovers in the telecluster
- The role of basic research has been low in the ICT business so far
- The effect of public financing has had a significant but limited effect, it works in firms that already have high R&D intensity – successful R&D requires process knowledge

Evaluation of the Innovation System

- Subsidized loans have better effect on productivity than direct support – easy money effect
- The role of liquidity constraints was negligible in determining R&D investment – steady R&D spending
- Venture capital financing has so far resulted in a very few new success stories
- Taxreductions not in use, internationally common
- Financing by own cashflow puts more pressures **to allocate R&D according to market need**