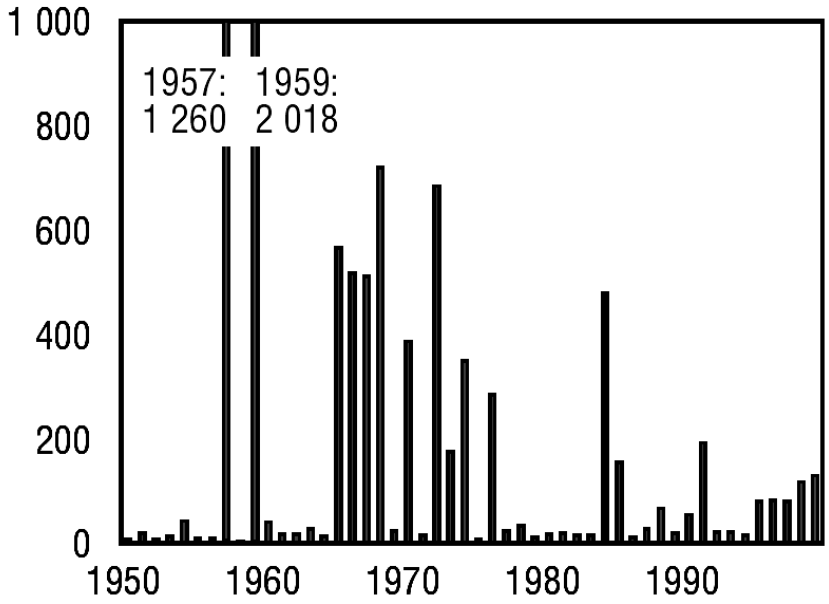
D-MTEC, Chair of Technology and Innovation Management
Diffusion of wireless technologies and technological lock-in

Science Brunch 8

Belvoirpark, May 22th 2008

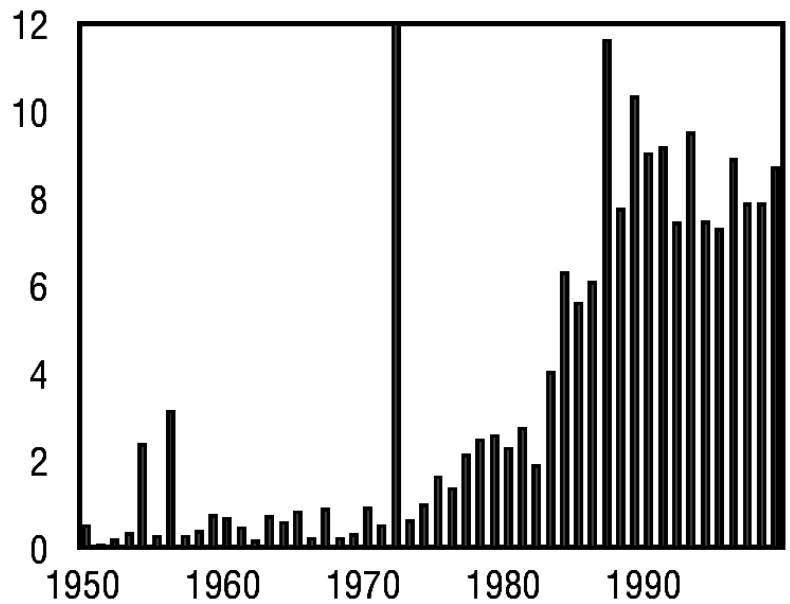
Prof. Dr. Roman Boutellier
Nicolas Rohner

Rising number of fatalities caused by technological disasters
Public perception: Man made



Fatalities caused by natural disasters

(in thousands)



Fatalities caused by technological disasters

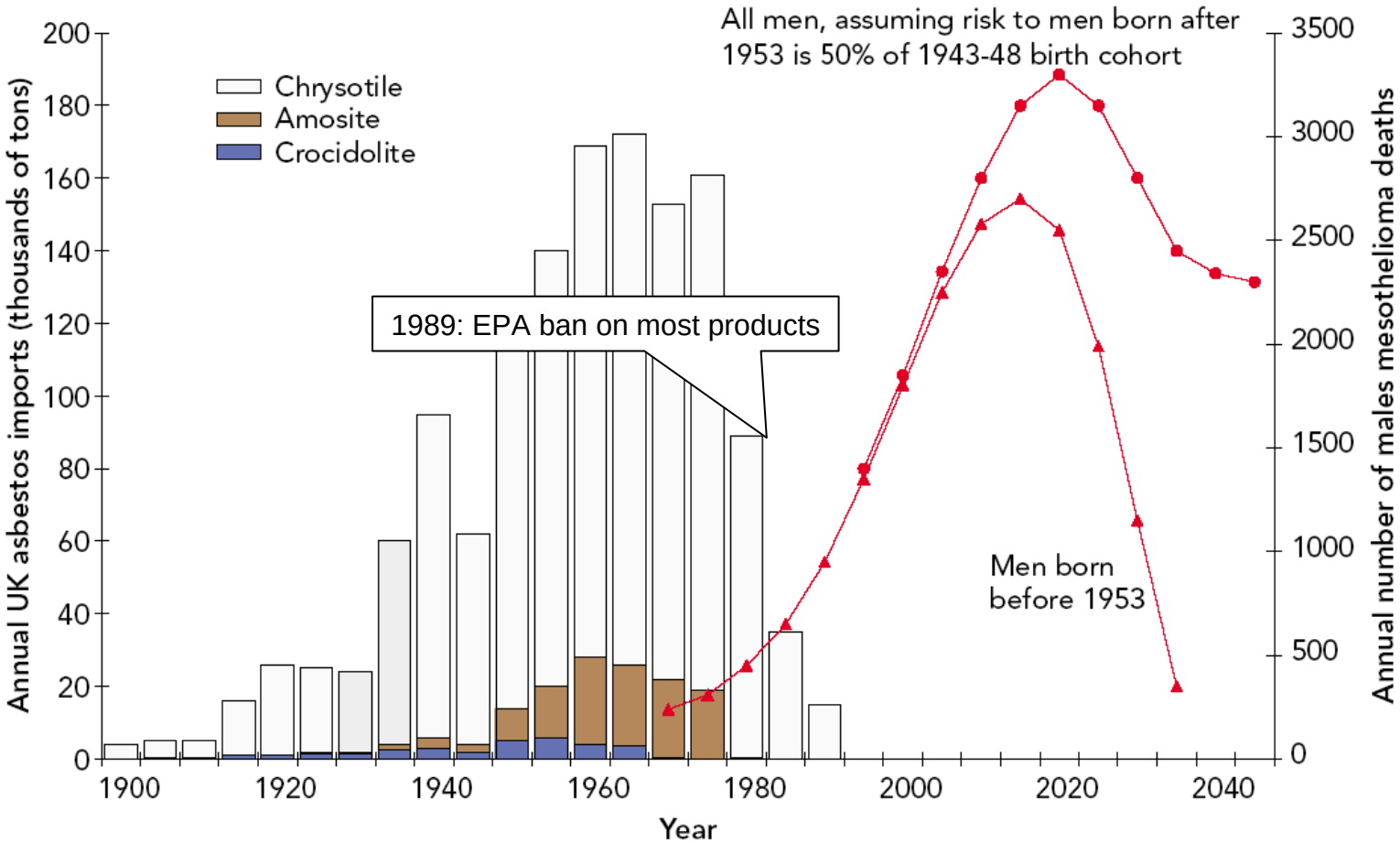
(in thousands)

OECD (2003)

Controversial Technologies: Today and tomorrow
List gets longer and longer

Phase-out decided	Phase-out possible
Chlorofluorocarbons (CFC) Aerosol cans: ozone depletion	**Bisphenol A** Plastics: endocrine disruptor (?)
Asbestos Brake pads: cancer	**Electromagnetic radiation** Mobiles: heating of brain (?)
Polychlorinated Biphenyls Sealing: endocrine disruptors	**Phthalates** Floor covering: cancer (?)
Mercury Cells Chlorine: mercury in biosphere	**Printer Toners** Laser Printers: allergies (?)
Lead in Electronics PCs: lead in biosphere	**……**

Asbestos in United Kingdom
Delay of 50 years between cause and effect



Gee et al. (2001)

Asbestos in CH
Total cost ~1 billion SFr. for SUVA alone

1939:	Occupational disease			
1995:	Ban			
2006:	285 cases	Cancer:	lung	7
			pleura	101
1939 – 2006:	2014 cases inclusive: pleura 1038			
	472 mio SFr. payed by SUVA including 360 mio SFr. for rents			
2010 – 2015:	Maximum expected			

Appenzeller Voksfreund 17.5.2008, p.13 (public intrest)

Phase-Out: Timing has to be chosen carefully: Big uncertainty

Technology
Chlorine production with mercury

↓

Accidents, late effects
Minamata, Iraq

↓

Pressure to phase out

Early Change
+ conformity with law
+ (public perception)
- cost (innovation)

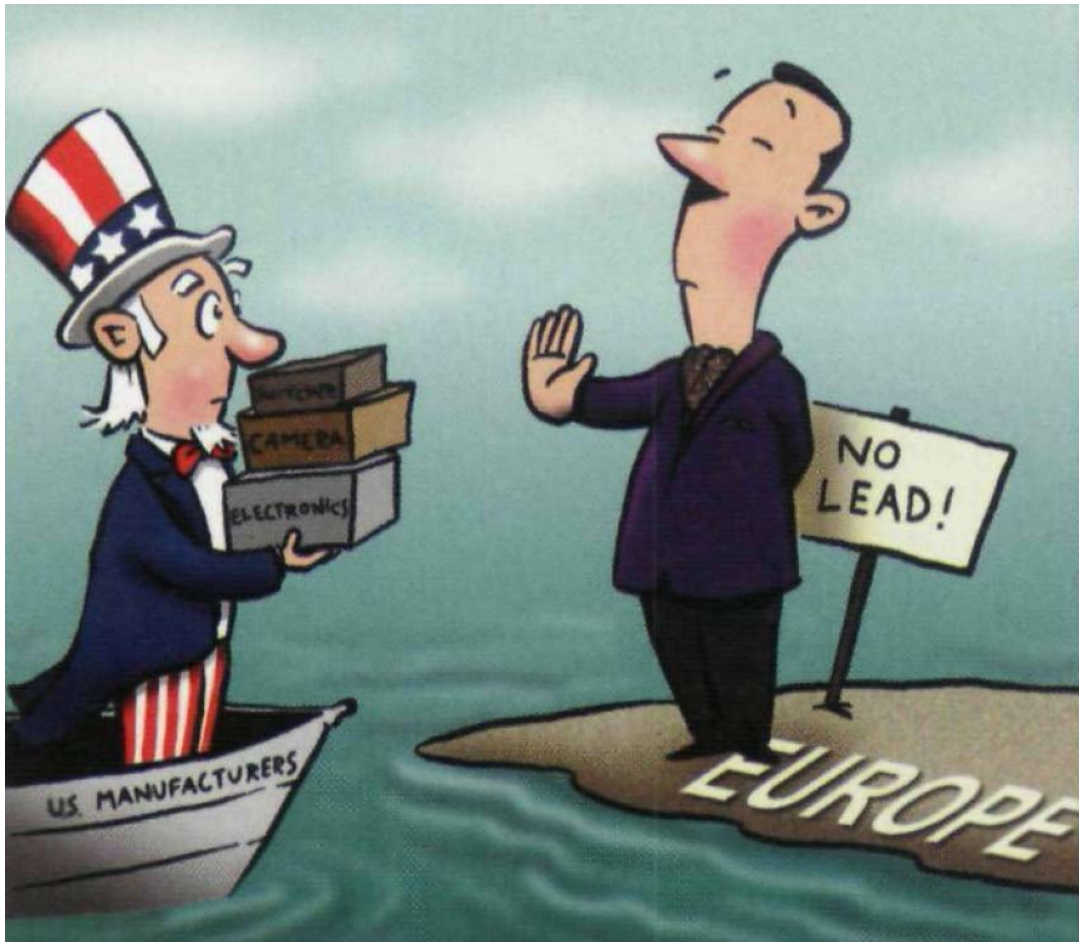
Late Change
+ more information available
+ cost (mature technology)
- public perception

Uncertain scientific results about adverse effects

Test conditions		Reality
Laboratory animals	→	Wild animals, humans, biological systems
Small samples	→	Huge populations
Isolated effects	→	Compound effects
Short-term tests	→	Long-term effects
Defined Model	→	Fuzzy effects, placebo

Scientific uncertainty has to be accepted

Not every region has the same policy: Trade wars



Broadcastengineering.com, August 2005

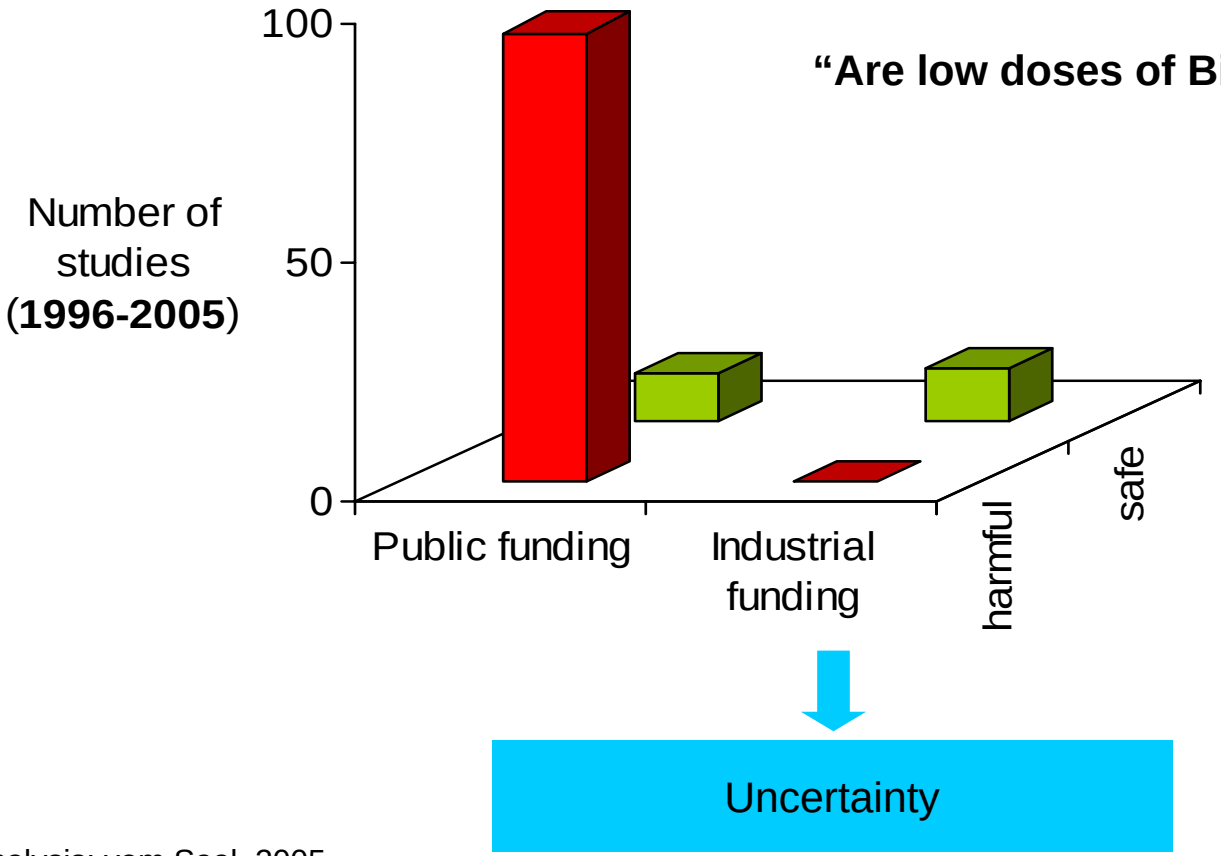
Liability gets ever more stringent: Changing, changing…

Fault liability Intention or negligence	Swiss Code of Obligations (Art. 41, 1911)
↓	
Causal liability	EU: Liability for Defective Products (Art. 1, 1985)
↓	
Stringent causal liability (in general) No irregularity required	German Environmental Liability Act (§1 & 6, 1990)
↓	
Stringent causal liability (specific) Dangerous circumstances trigger liability	Possible for GMOs contaminating bio-quality crops.
↓	
Application of civil-law liability standards	EU proposal: Liability for biological diversity (2000)
↓	
Retroactive application of liability	Tendency, especially in environmental liability

according to SwissRe, 2001

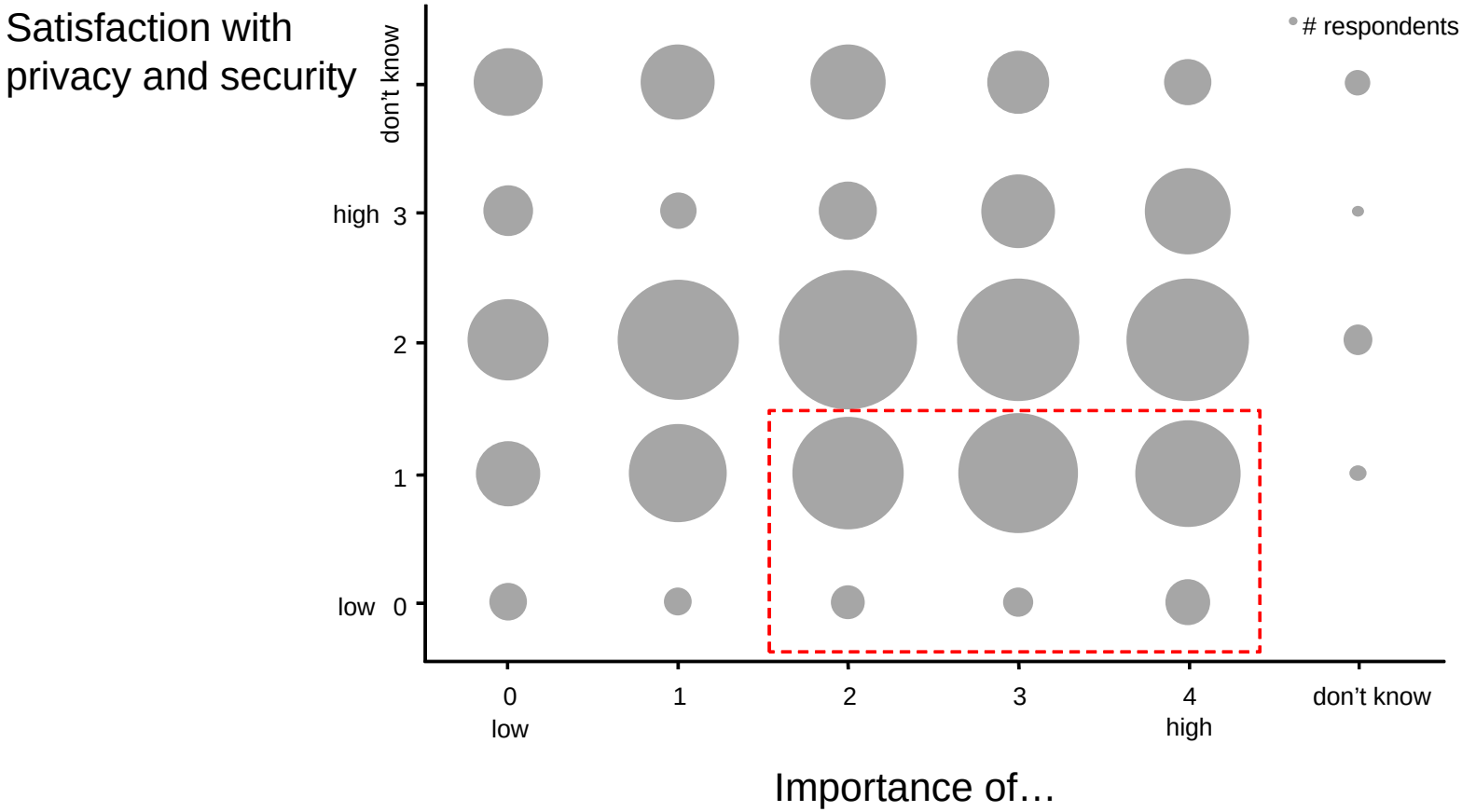
Scientific results depend on who pays!

Estrogenic activity of Bisphenol A mentioned in 1936:
21 years prior to first industrial application



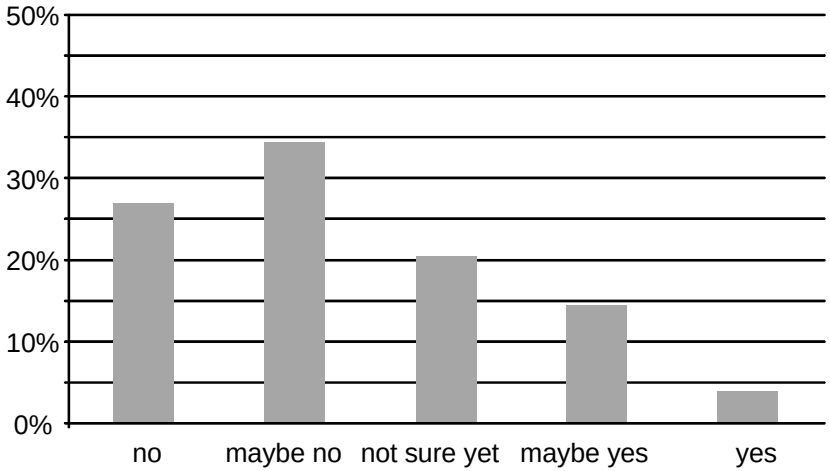
Analysis: vom Saal, 2005

Potential for a possible refusal of wireless technologies but technologies are hardly known: ZigBee, DECT, RFID

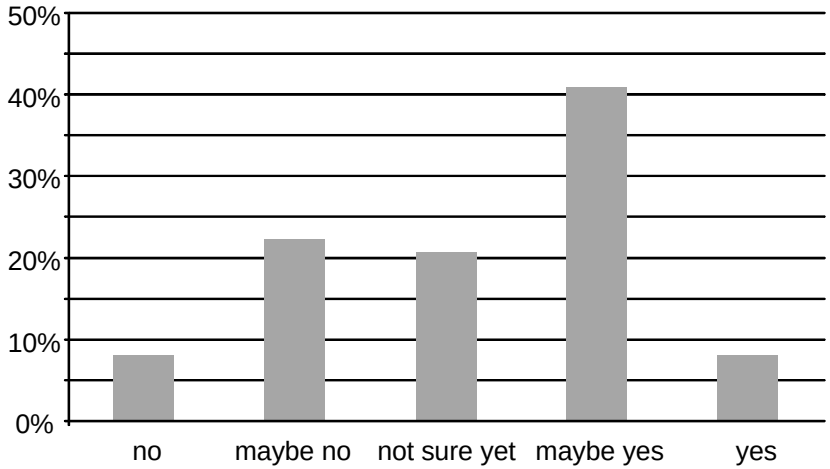


n = 1321 ETH students, 2007

Additional functionality cannot compensate for radiation concerns



Acceptance of increased radiation for additional functionality

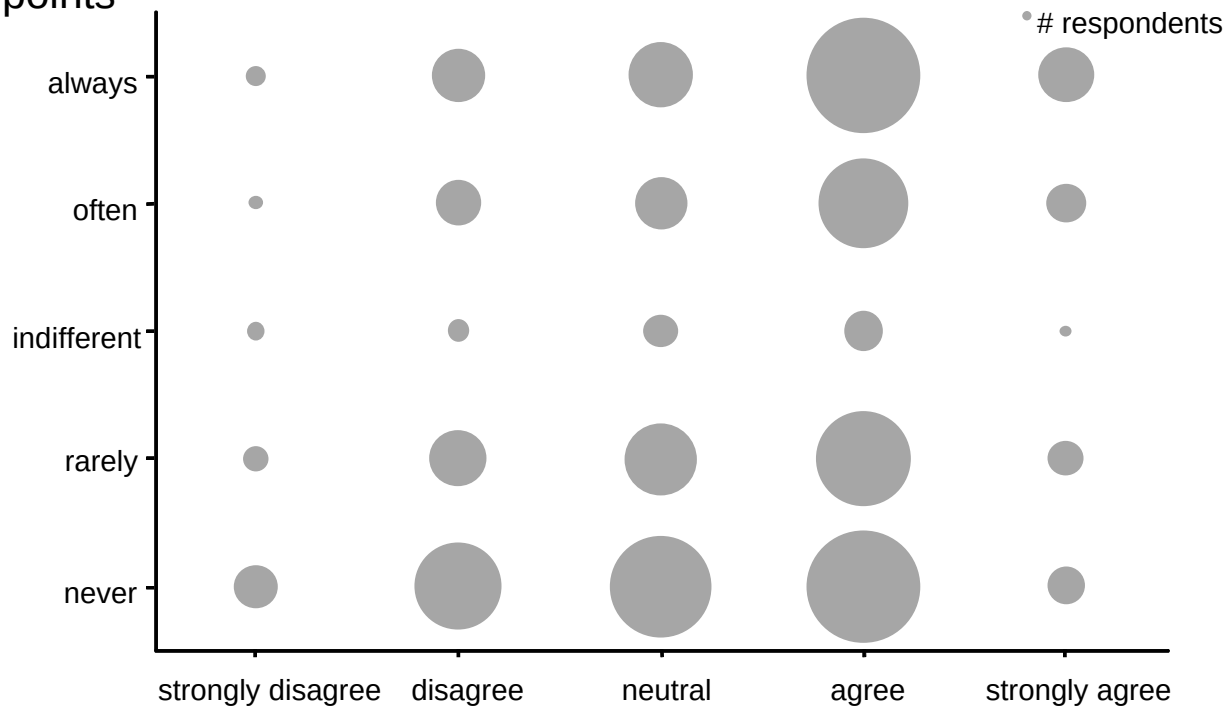


Acceptance of less functionality in favor of reduced radiation

n = 1321 ETH students, 2007

Mushroomers and Stuntmen – even among rational engineers

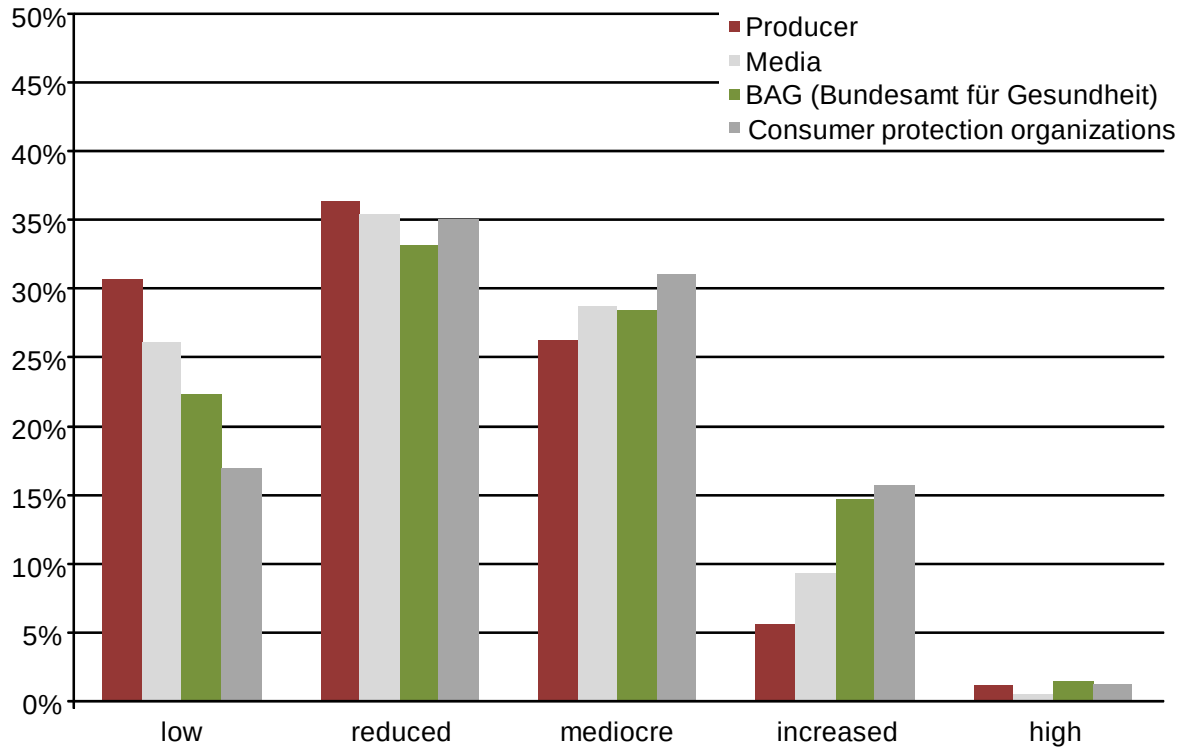
Switching off access points during night time



Possibility to influence exposure by personal attitude

n = 1321 ETH students, 2007

Absence of evidence is not evidence of absence
Trust makes the difference



Credibility of respondents attributed to different information channels

n = 1321 ETH students, 2007

Summary: Radiation makes the difference

Security and privacy

Minority unhappy with current situation, no opinion leaders

Any form of radiation

Radiation is the tipping point for customers, but technologies not known

Activities for self-protection

Hassle-free avoidance accepted

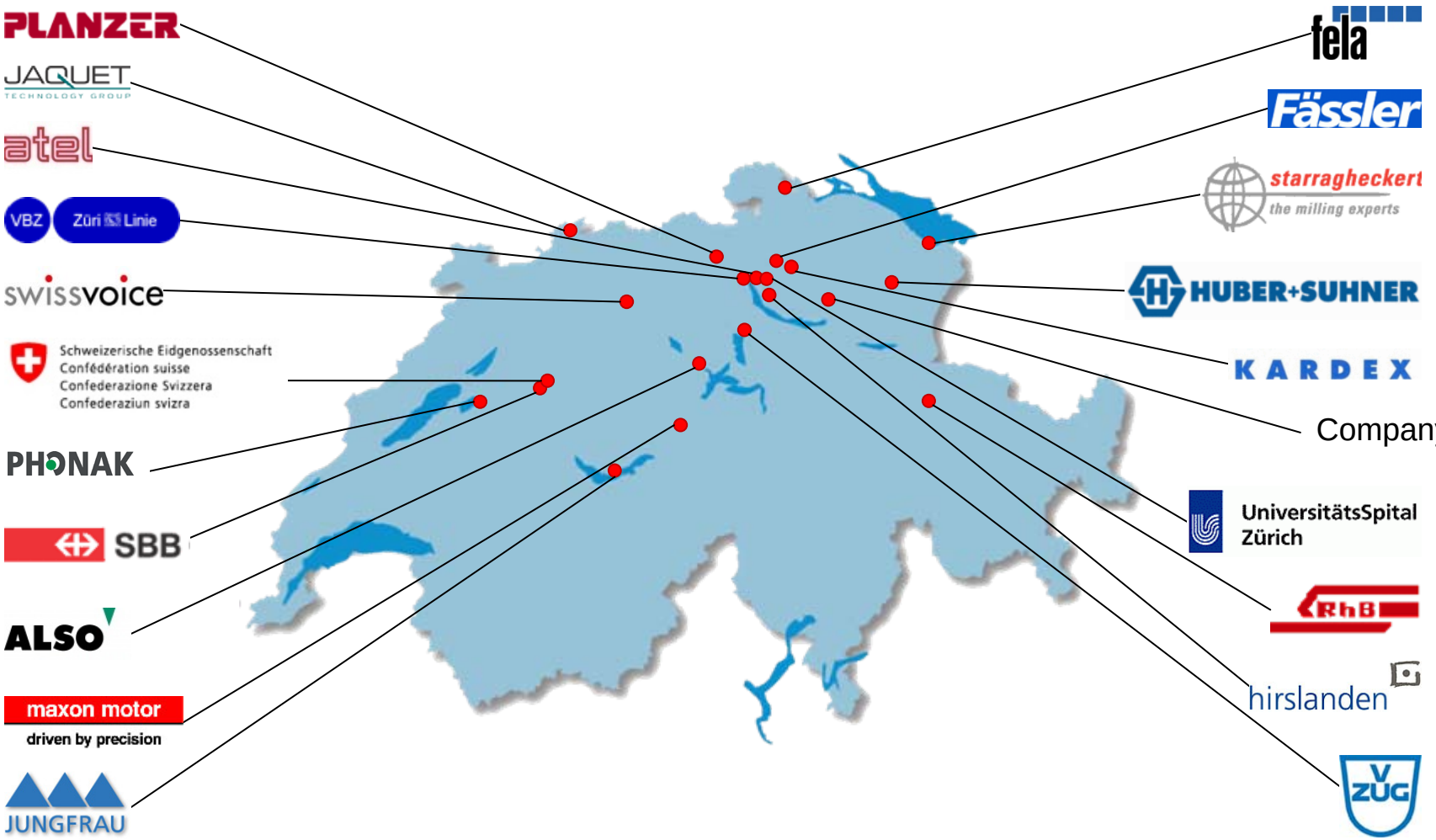
Trust

Media important but credibility is low: Ongoing use – more confidence?

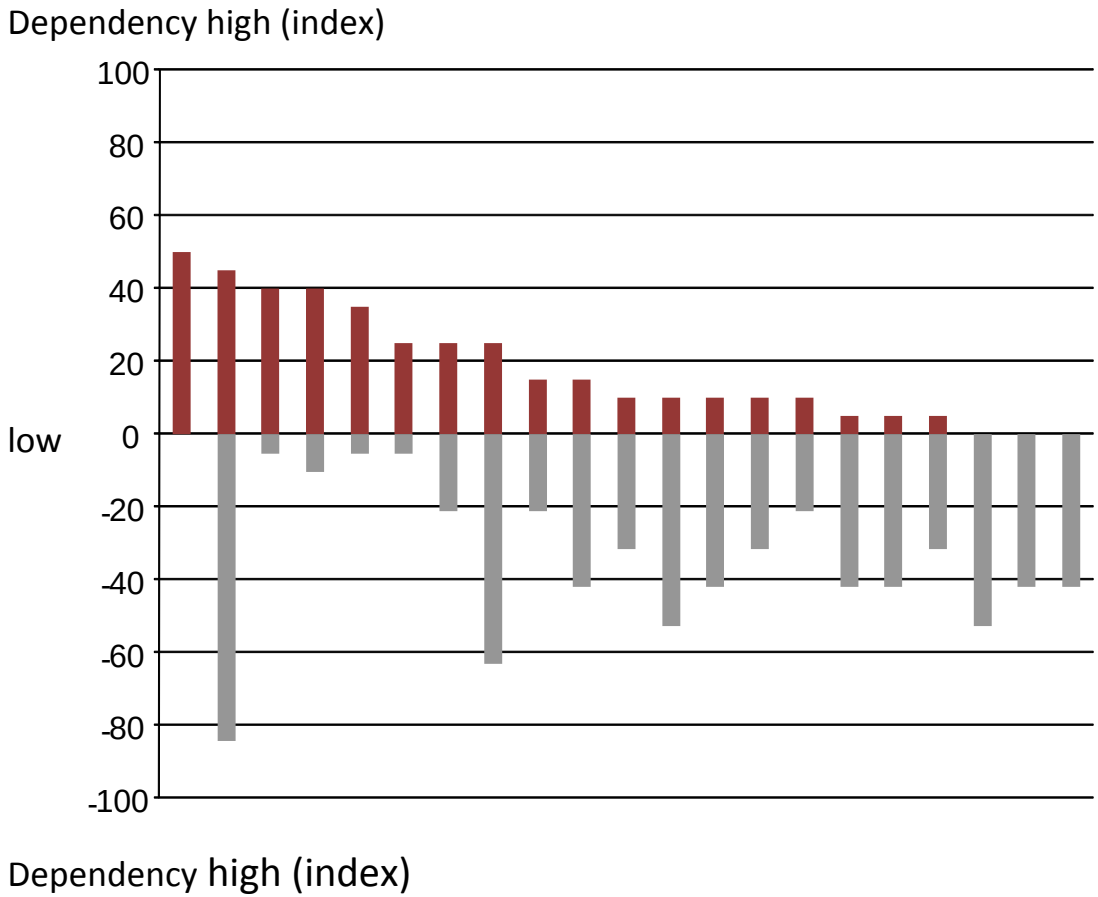
Negative externalities

Feasibility and ideologies drive attitudes and actions.

Case studies: 21 companies, 28 interviews



Dependency is growing: Sunk costs perceived as investments



Focus: process application

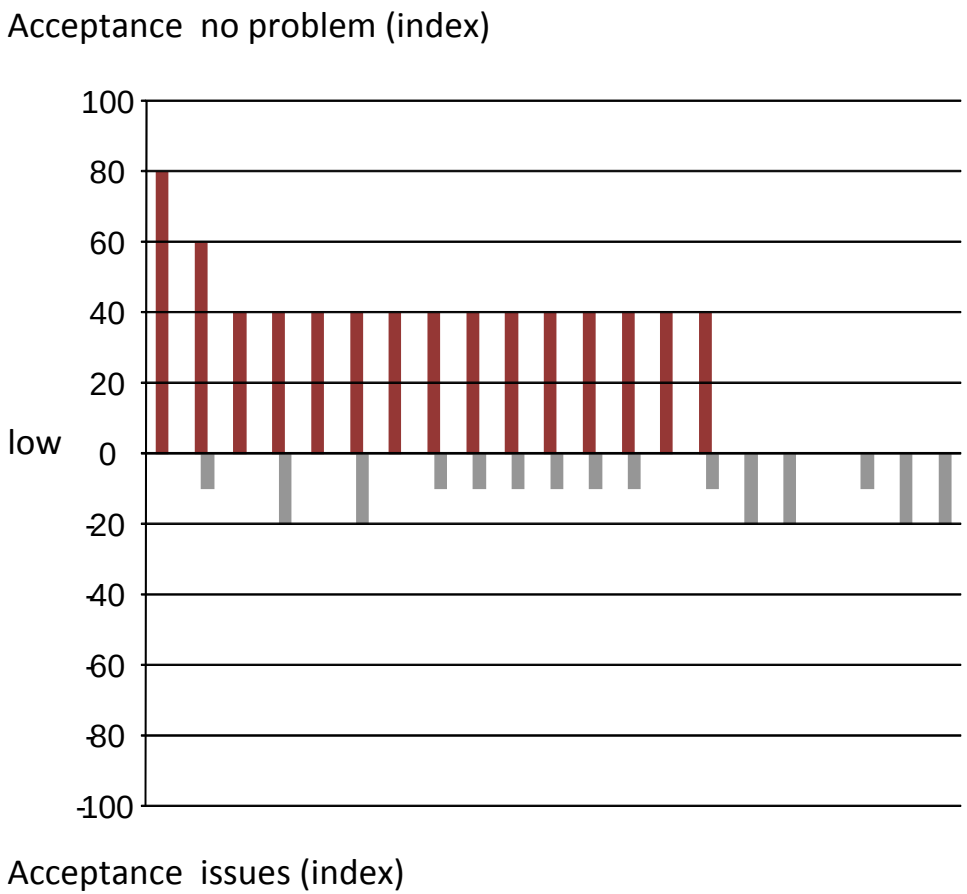
Prices: low

Band width: reasonable

Diffusion of WCT: high

n = 21 Companies, 2007/2008

Acceptance is high: Utility outweighs adverse effects, but…
…acceptance depends on the position in the value chain

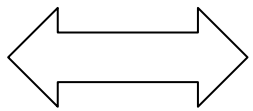


n = 21 Companies, 2007/2008

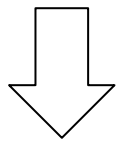
- Retail customers complain about radiation
- Information about acceptance problems: Not transferred upstream in value chain
- Business to Business customers: Security and privacy concerns
- Ready-to-use sellers made “responsible”. Selling only components makes responsibility more diffuse.
- Component sellers: Not questioned by end-users
- Functionality outweighs adverse effects

Acceptance of WCT is rather a question of privacy and security than of radiation

Privacy + Security
Immediate effect
Personal damage
Protection possible

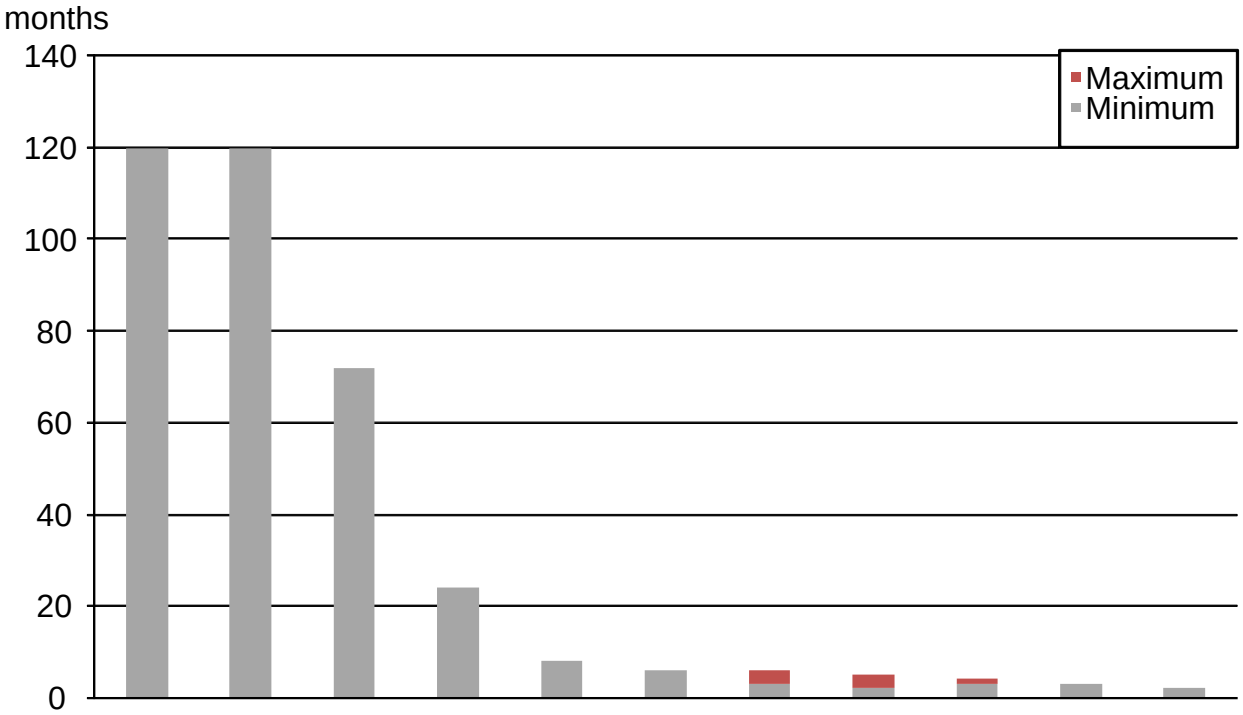


Radiation
Long term effect
Potential damage (1:n)
Immediate benefit
Negative externality (1:n)



Trust = Reputation of provider

Flexibility is fragile and perception illusory

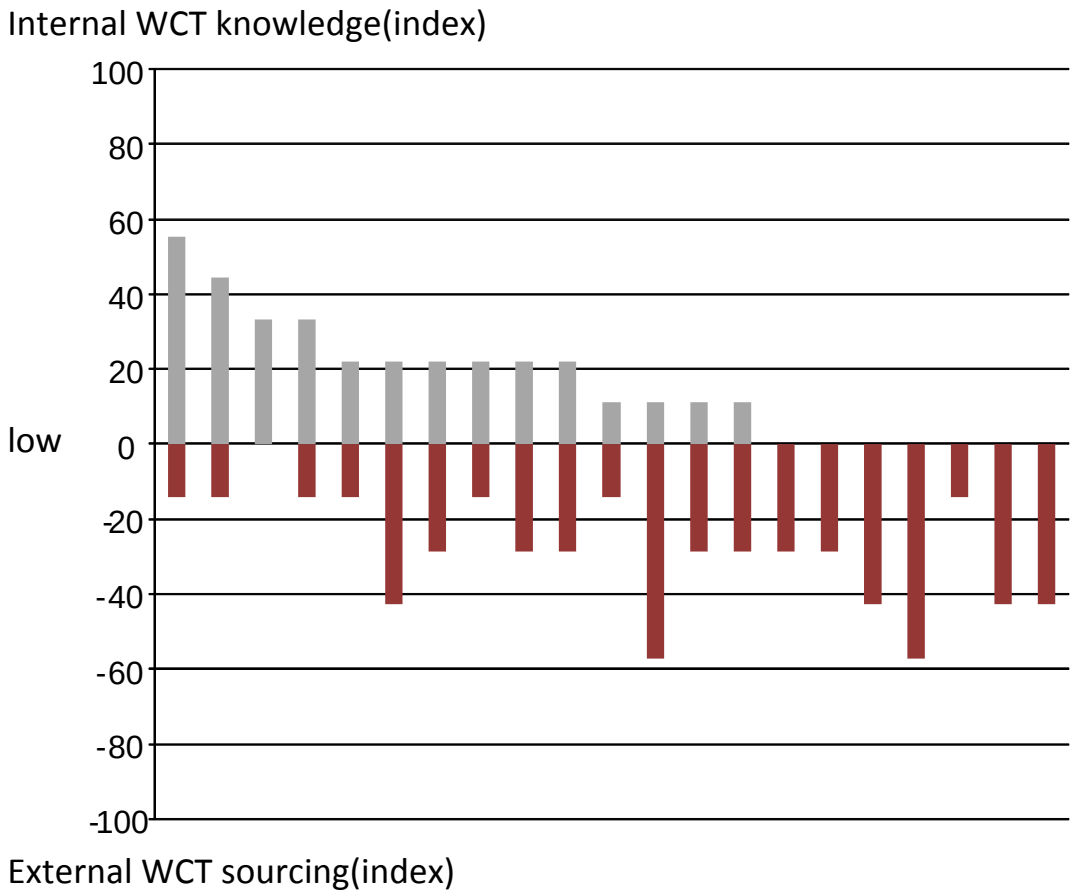


Time needed for major adaptations in frequency or modulation

n = 21 Companies, 2007/2008

- Regulations and standardization: time consuming
- Black-box phenomenon: flexibility = availability of substitutes (expected from suppliers)
- But: Big changes in frequency and modulation expensive
- 8 go for cables
  5 go back to old technology
  1 gives up WCT
  5 need WCT urgently

Standardization facilitates diffusion



WCT is a proven technology

Diffusion

Cheap components

=

WCT standard

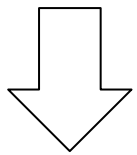
WCT modules everywhere

n = 21 Companies, 2007/2008

Low technology-intelligence: No systematic technology screening

WCT = standard technology

No systematic intelligence



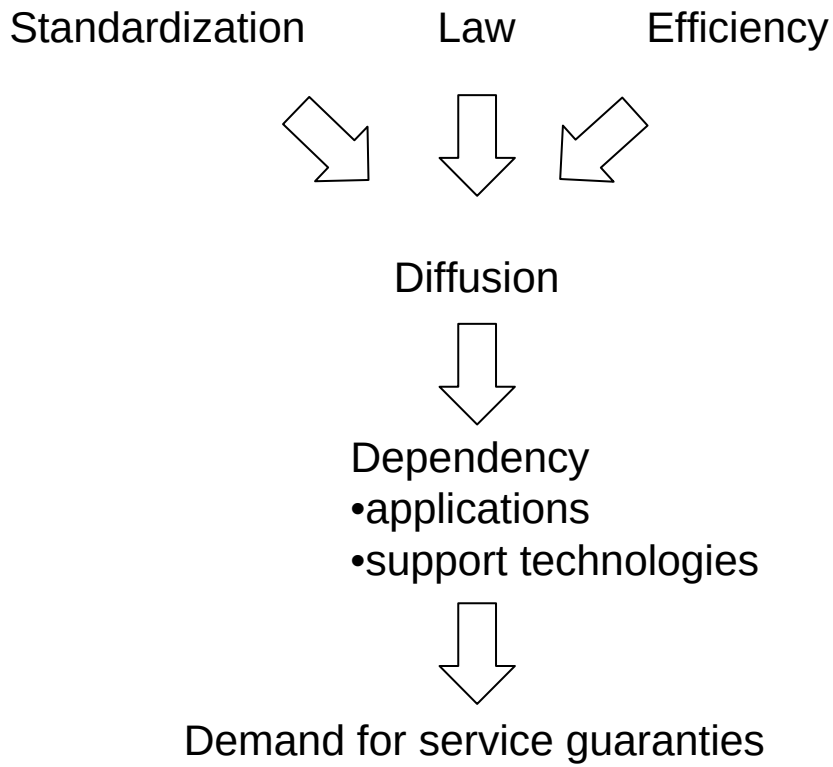
Technology is benign

No one responsible

Technology owner outside company

No management of public perception

Invisible WCT: High acceptance



WCT users have problems with antennas

8 accept mobile communication antennas on their sites

Some do not accept: reputational risks

4 report internal discussions about antennas

⇩

Visibility is important

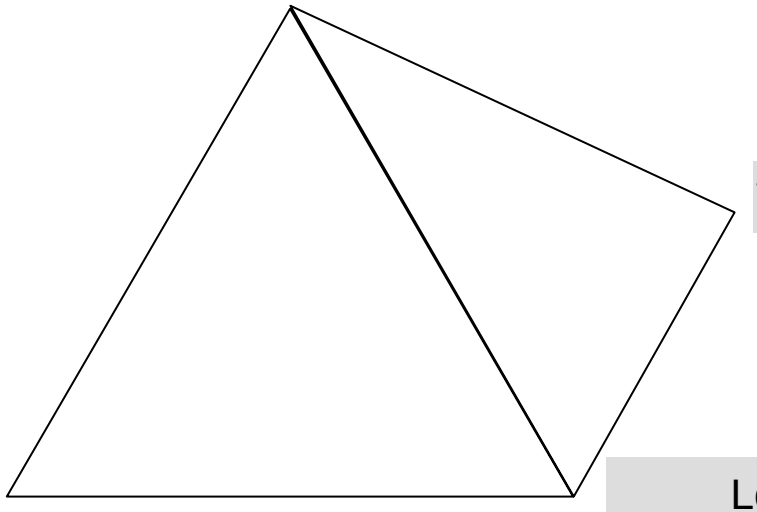
GSM-antenna at the railway station of Chur

n = 21 Companies, 2007/2008

Lock-in effects in WCT – problematic coincidence

Low Acceptance

reputational risks, visible installations



WCT missing understanding

no intelligence

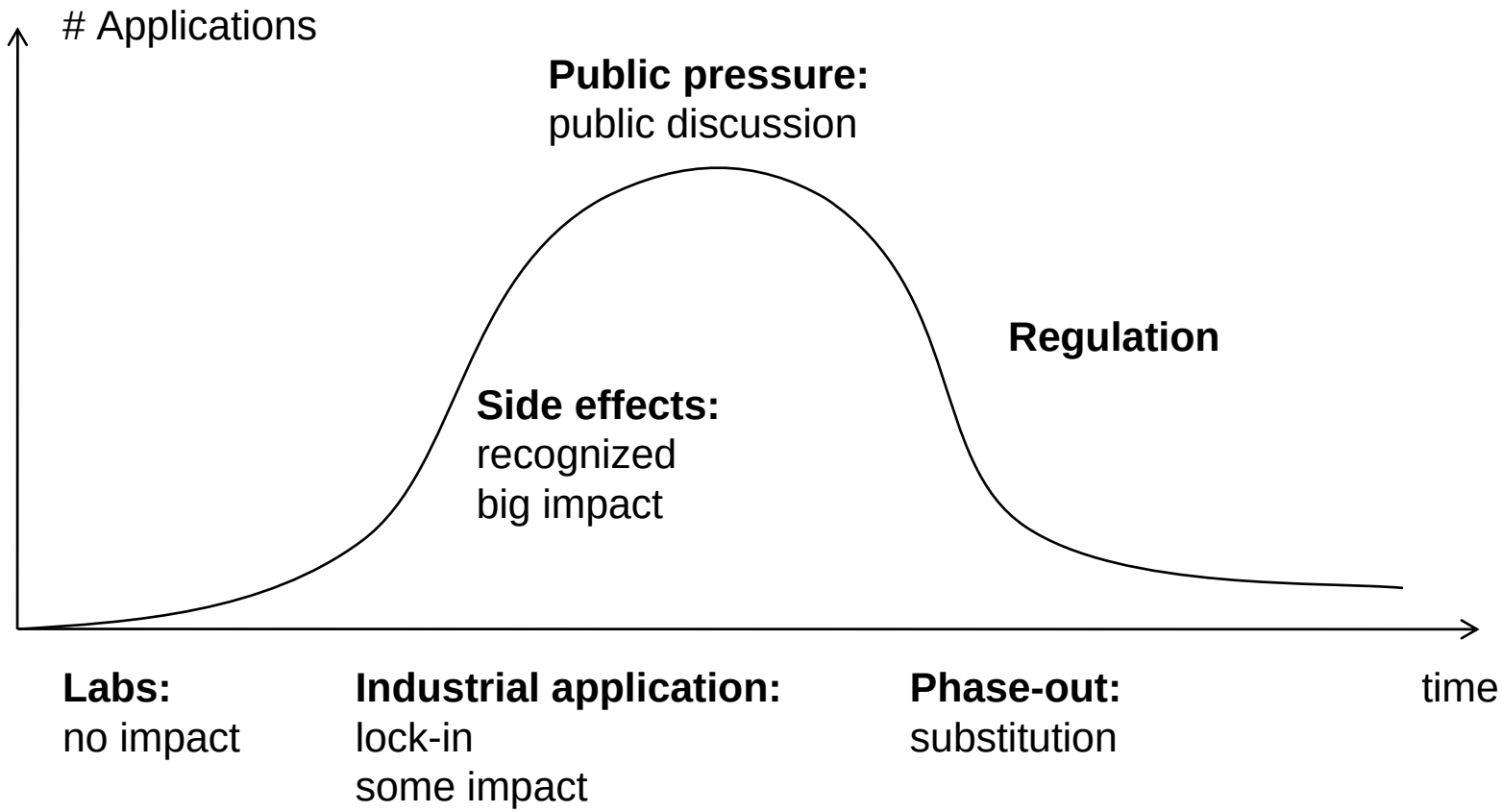
High Dependency

core product functionality affected
support technologies

Low Flexibility

questionable substitutes

Some Technologies follow a typical cycle: From lab to lock-in and forced phase-out



A single photograph may have done more to halt Vietnam war than all the writings of moral philosophers

Hung Cong Ut, Accidental Napalm Attack, Vietnam, 1972

Vietnam War
1954 – 1975
- 2 million civilians
- 1 million Viet Cong fighters
- 200 000 South Vietnamese soldiers
- 57 939 US soldiers

⇩

Public perception

Most companies follow a pragmatic approach