Techno-economic analysis of reliable ICT networks and services

Sofie Verbrugge

Invited talk DRCN2017
Munich, Germany, March 9th 2017

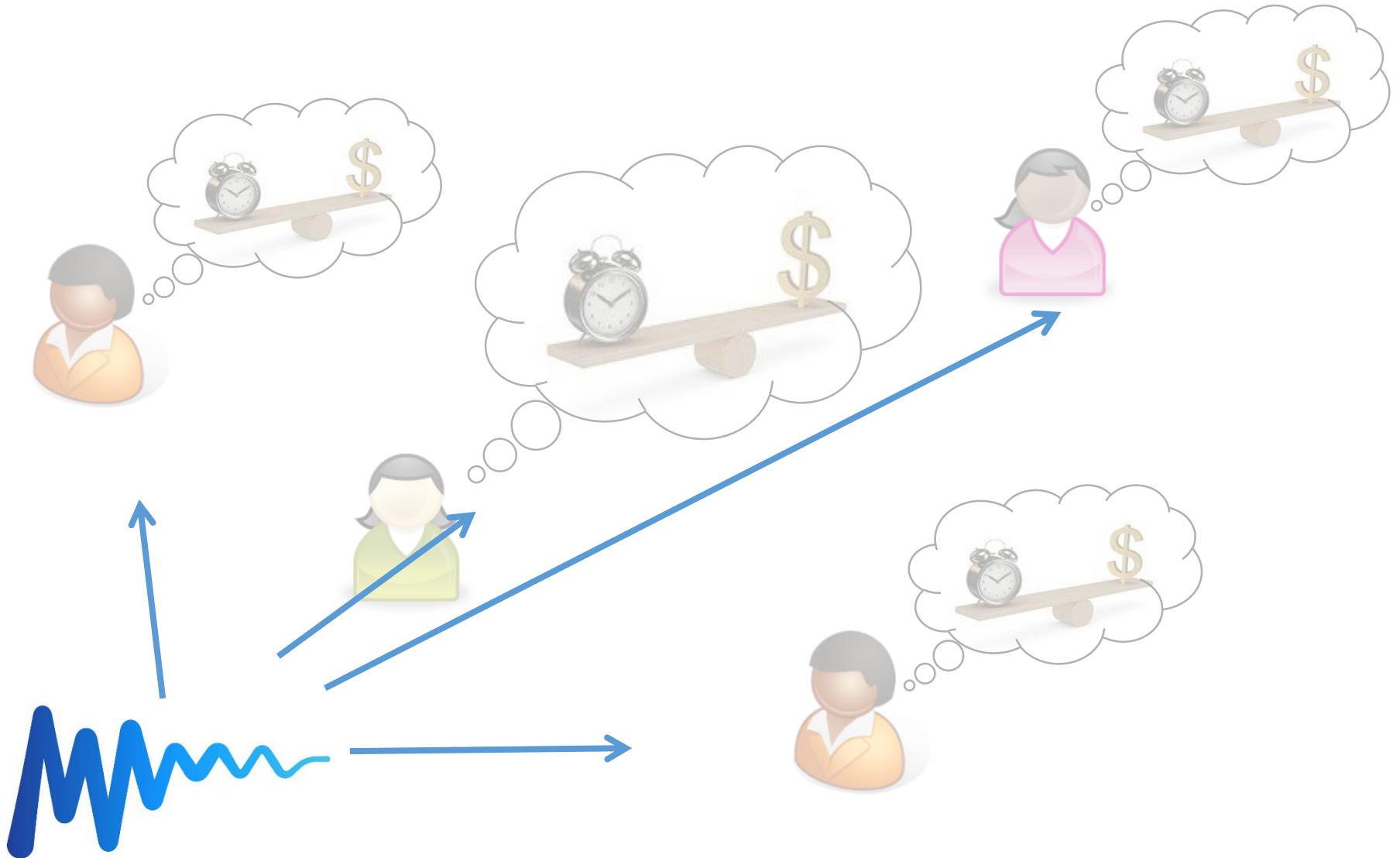# Techno-economic analysis
supports investment decisions

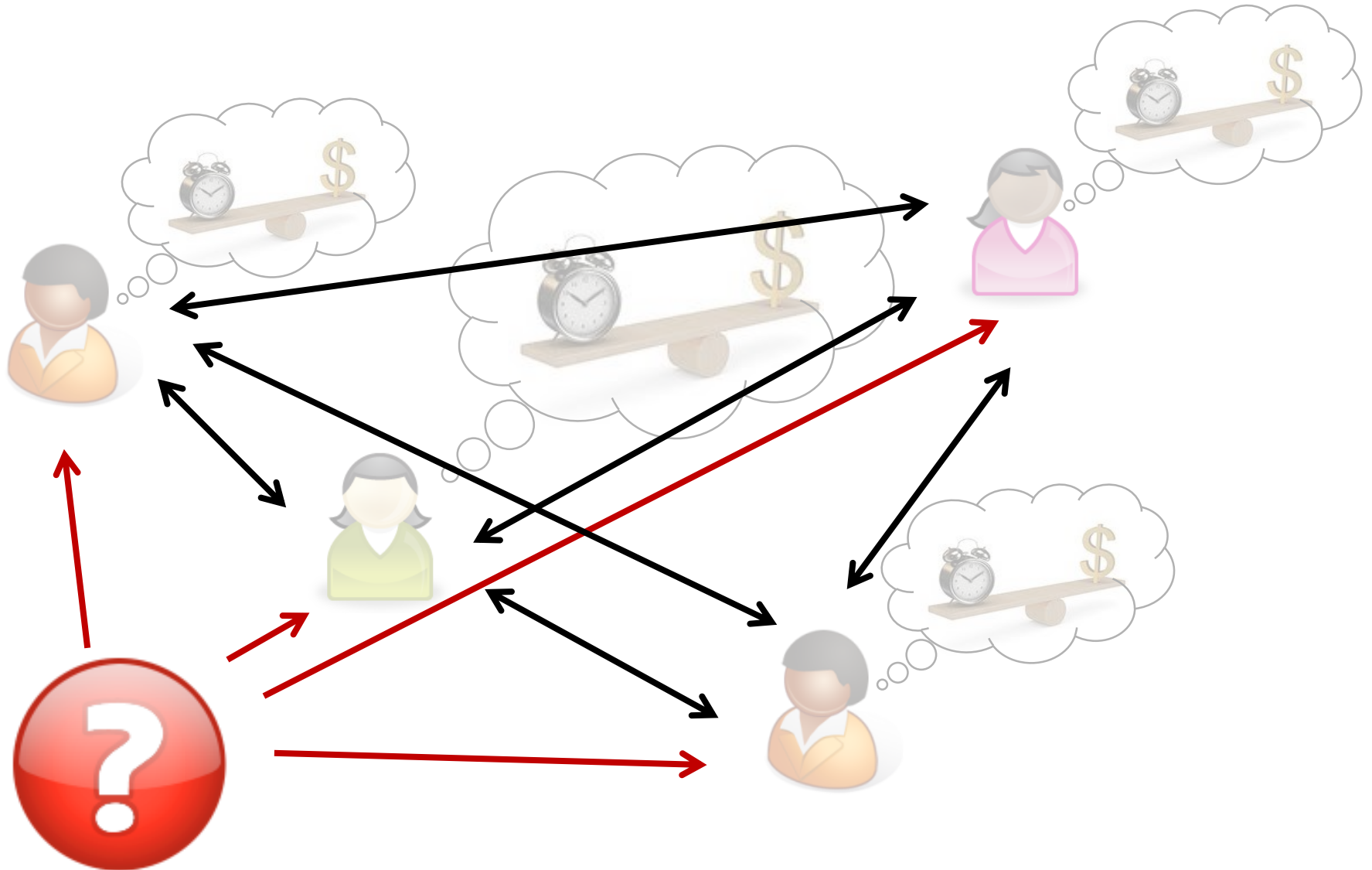# Techno-economic analysis
is always done in a multi-actor context

Techno-economics analysis
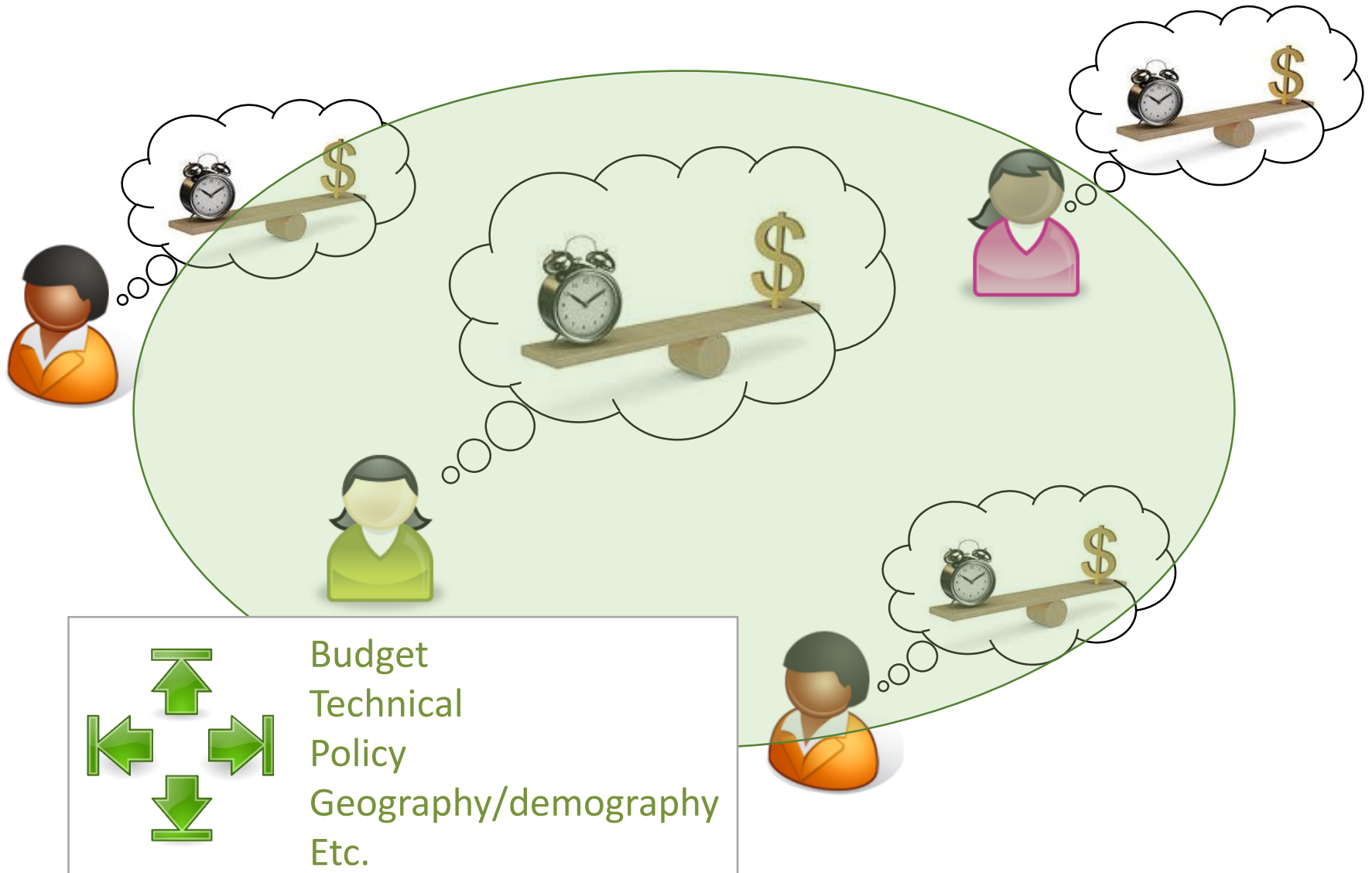deals with expected market and customer dynamics

Techno-economics analysis
takes the impact of uncertain changes into account

Techno-economics analysis
needs to adapt to boundary conditions

Budget
Technical
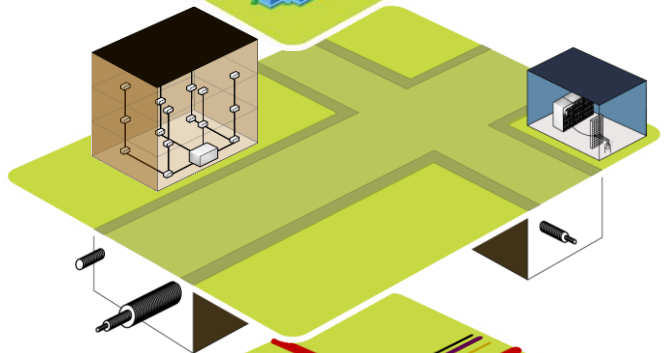Policy
Geography/demography
Etc.

Investment decision based on innovation
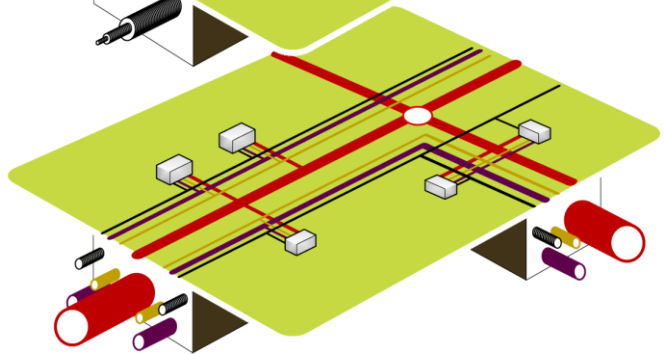## can be situated on different layers in the network stack

Service deployment
and operations
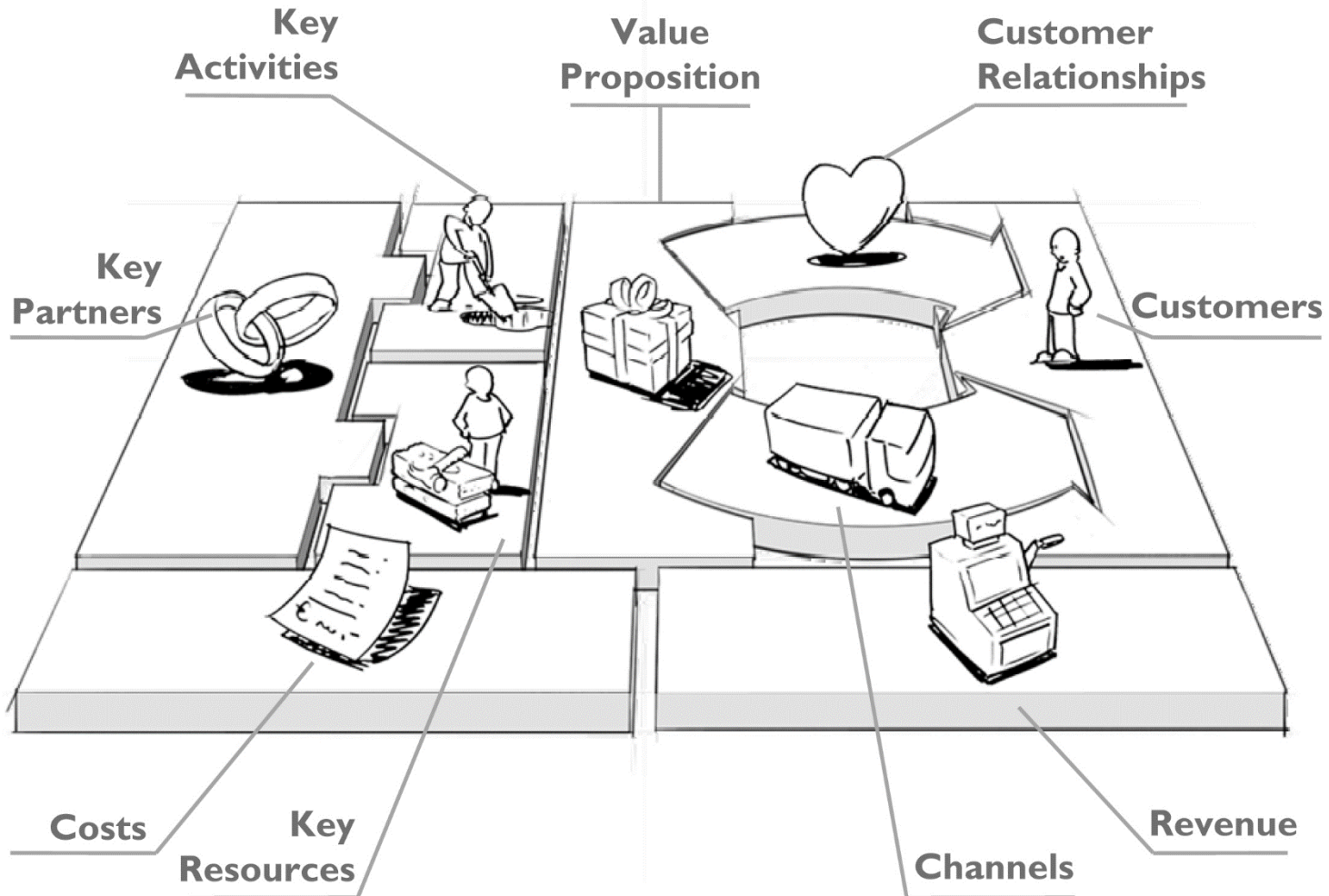
Network
deployment

Infrastructure
deployment

Outline

- What is techno-economic analysis?
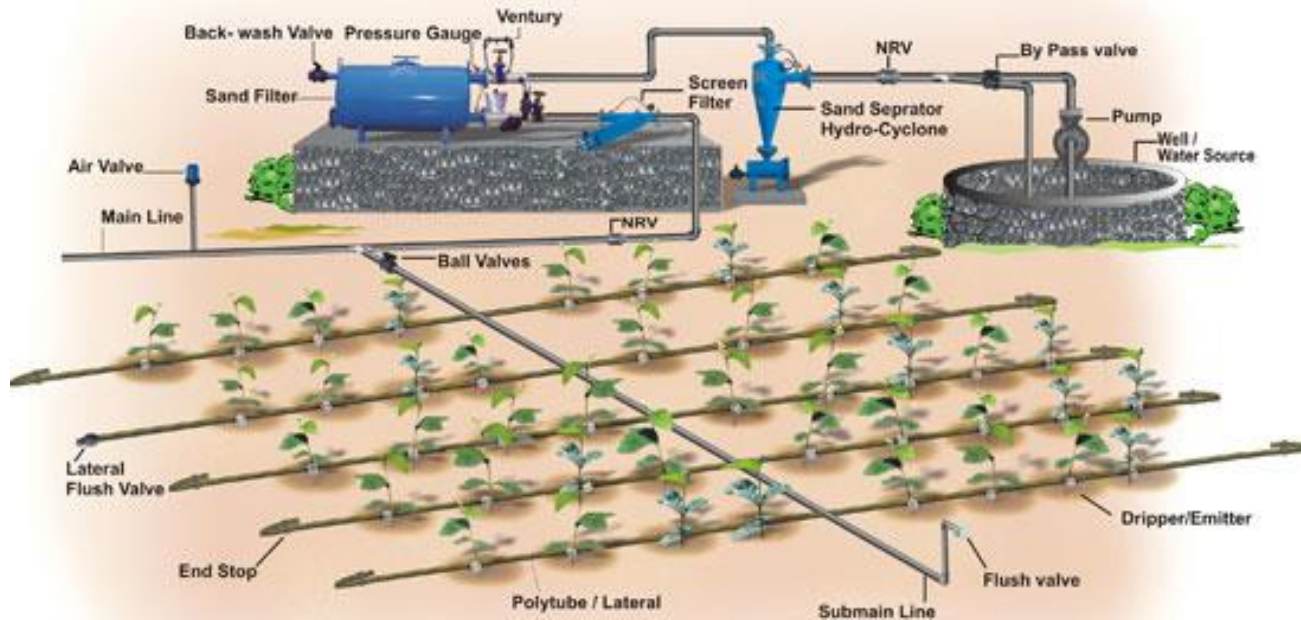
Business Model Canvas
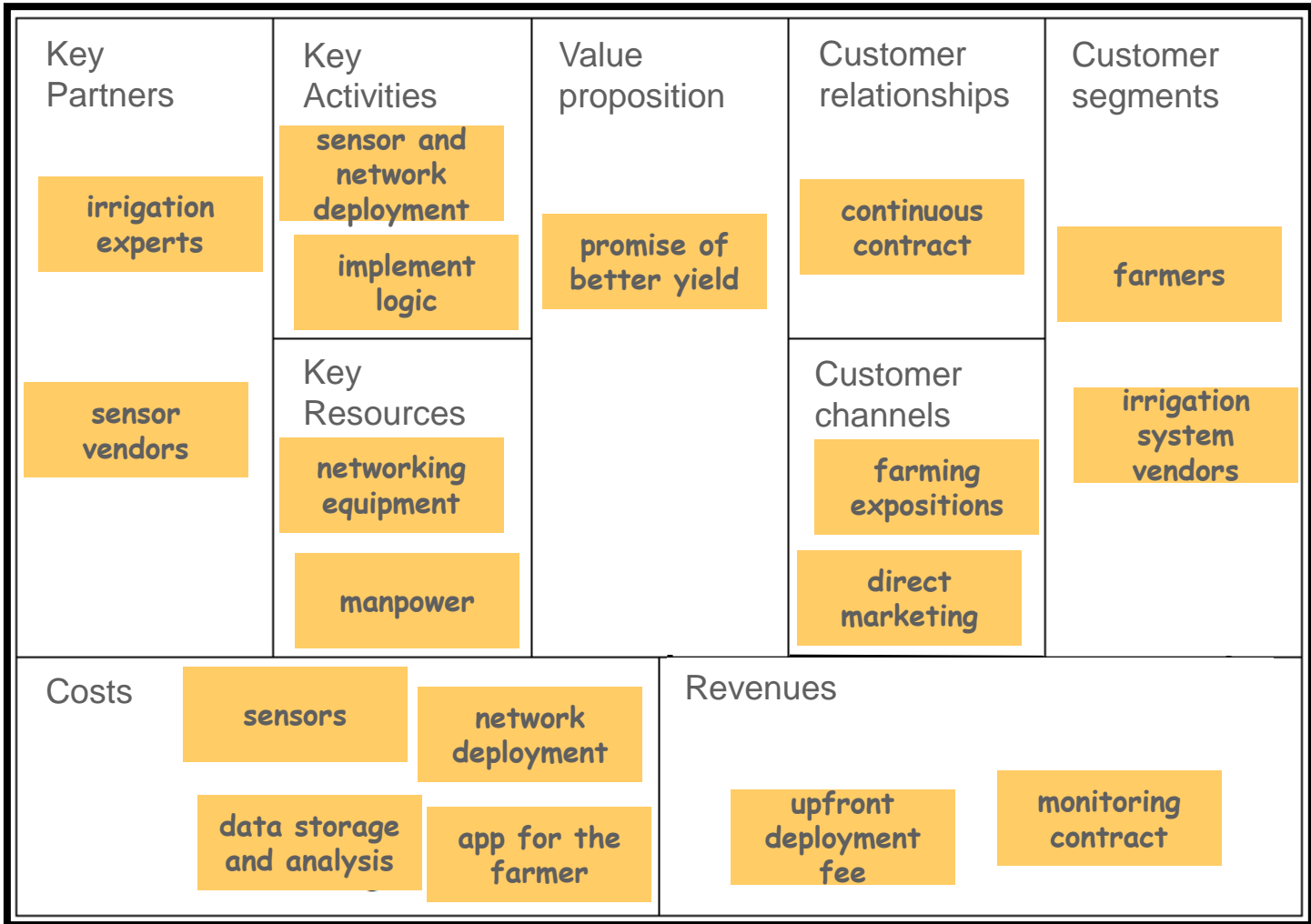## proposed by A. Osterwalder

drawings by JAM

Example: Irrigation monitoring system
smart farming solution based on IoT

Example: Irrigation monitoring system
business model canvas

Key Partners	Key Activities	Value proposition	Customer relationships	Customer segments
irrigation experts	sensor and network deployment	promise of better yield	continuous contract	farmers
sensor vendors	implement logic			irrigation system vendors
	Key Resources		**Customer channels**	
	networking equipment		farming expositions	
	manpower		direct marketing	

Costs	Revenues
sensors	upfront deployment fee
network deployment	monitoring contract
data storage and analysis	
app for the farmer	

Template and explanation available
for business model canvas

Outline

- What is techno-economic analysis?

- How to make a quick assessment?

- What are appropriate cost models in an investment analysis?

- How to integrate more advanced concepts in an easy way?

- Where to find all information?

- Wrap-up and call for action

Appropriate level of detail/abstraction
depends on available input data and goal of the model
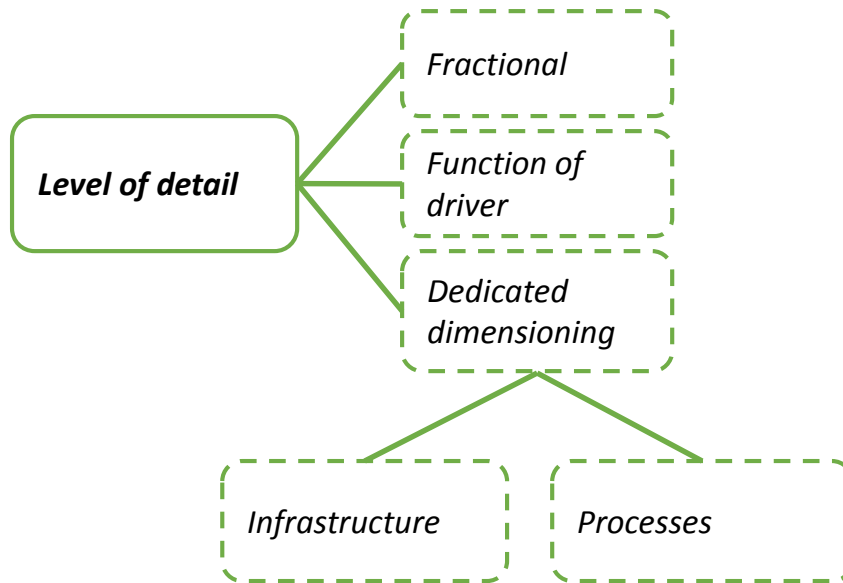
Fractional cost modeling
is on the highest abstraction level

cost structure derived from pilot phase

15%

5%

10%

60%

10%

- network and optical infrastructure
- customer connection
- customer premise equipment
- home installation
- customer acquisition, relationships with "syndics", service provisioning
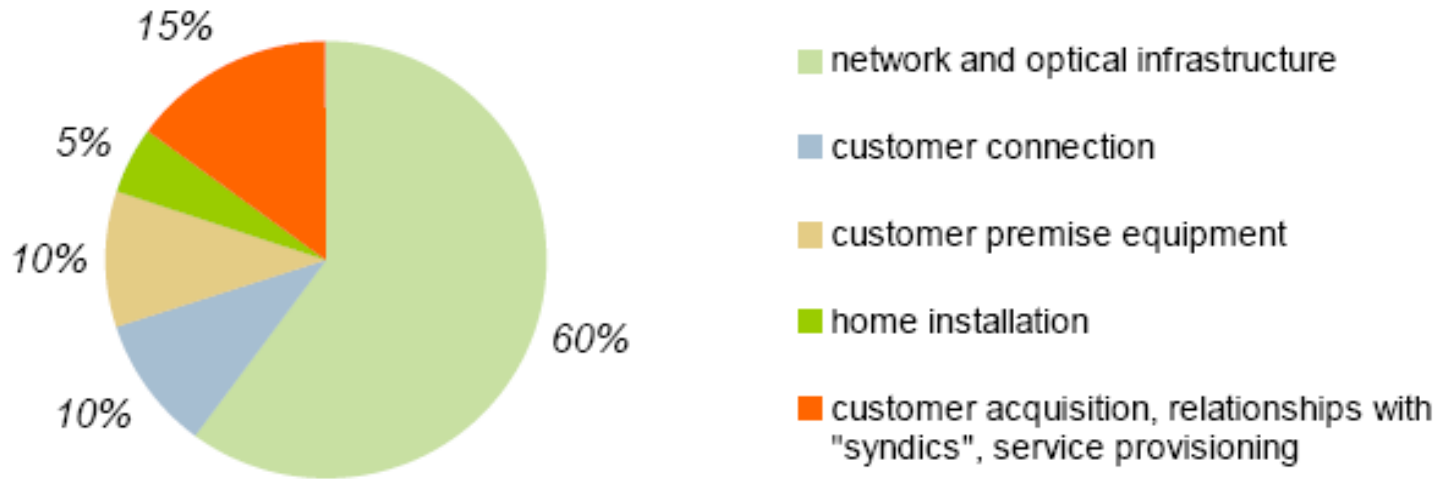
for a 10% penetration rate (subscribers / home passed)

Source: Orange – from FTTH pilot to pre-rollout in France

Determine fraction of overall costs to allocate to different parts based on previous projects (pilots, other areas, etc)

Function of driver cost modeling
is on the intermediate abstraction level

Examples of drivers:
installation length (50€/m)
customer base (1k €/cust)
…
→ combinations possible

Find the parameter that mainly drives the cost

This is the most common cost modeling approach!

Dedicated dimensioning
is on the lowest abstraction level, thus gives most detail

bill of resources

\# km fiber
\# equipment boxes
\# person hours
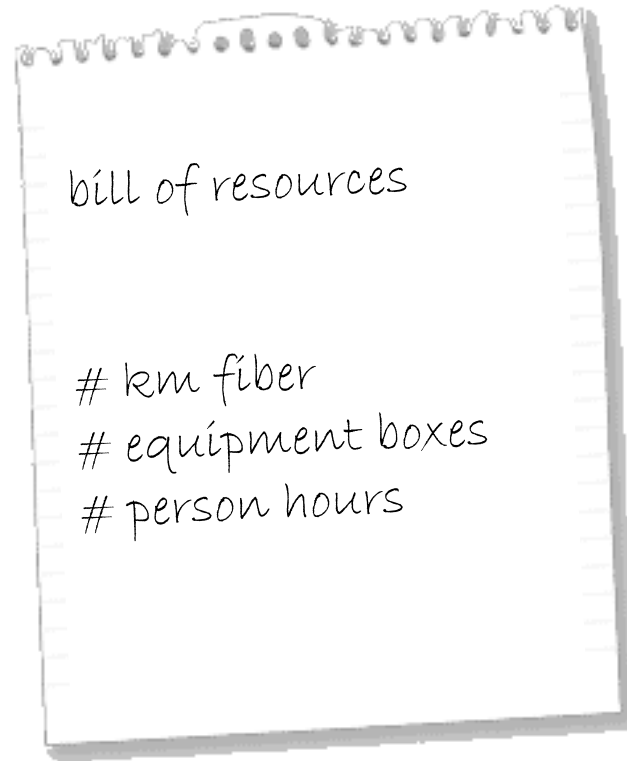
Model in detail all resources that you need
based on detailed view of actual implementation

Detailed equipment modeling using ECMN
example: FTTH network
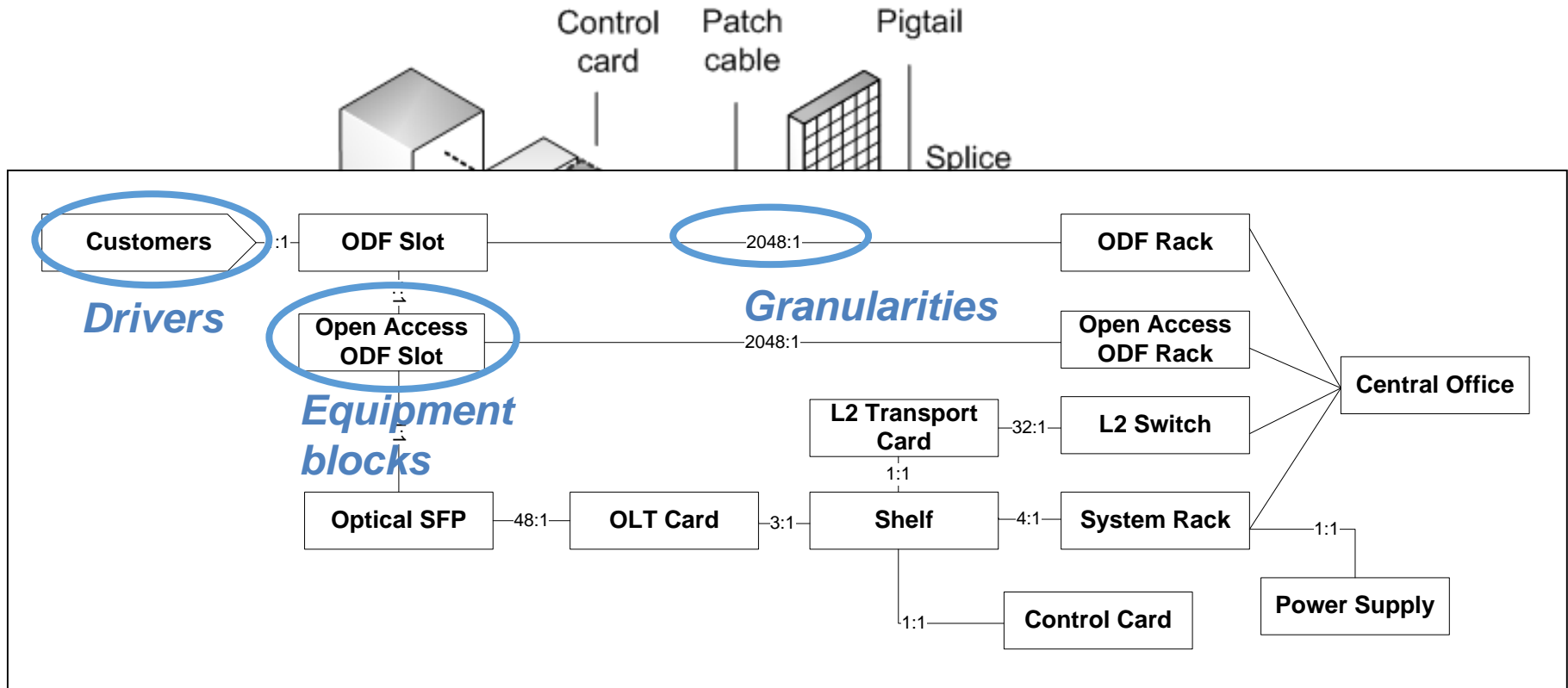
Open ECMN specification available
part of FI-ware open specification

Open Specification for
Equipment Coupling Modeling Notation
(ECMN)

developed by iMinds

Net2Plan tool available
allows to model equipment per year

- Planning and evaluation of a multilayer IP-over-WDM network
- Goal
  - Plan and allocate the resources at the IP and optical layers for a given year
  - while minimizing the capital expenditures (CAPEX) cost of the network

- Open source Java tool
- Developed at Universidad Politécnica de Cartagena
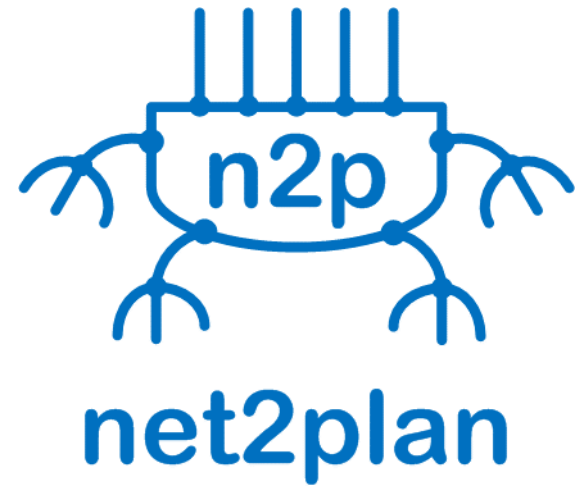
Detailed process modeling using BPMN

example: network repair process
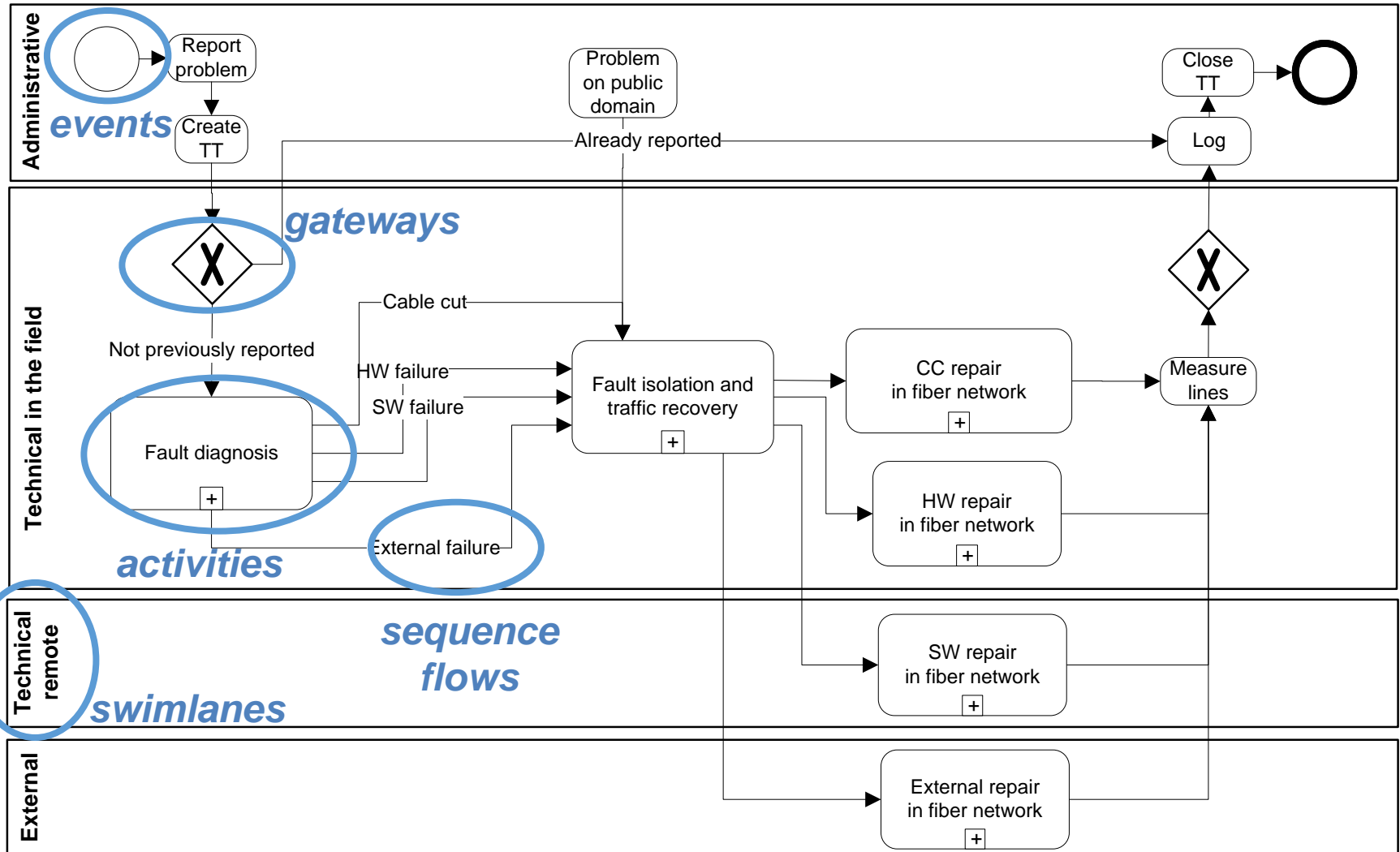
Investment decision
is about comparing incoming and outgoing cash-flows over time

2017   **2018**   **2019**   **2020**   **2021**

tijd
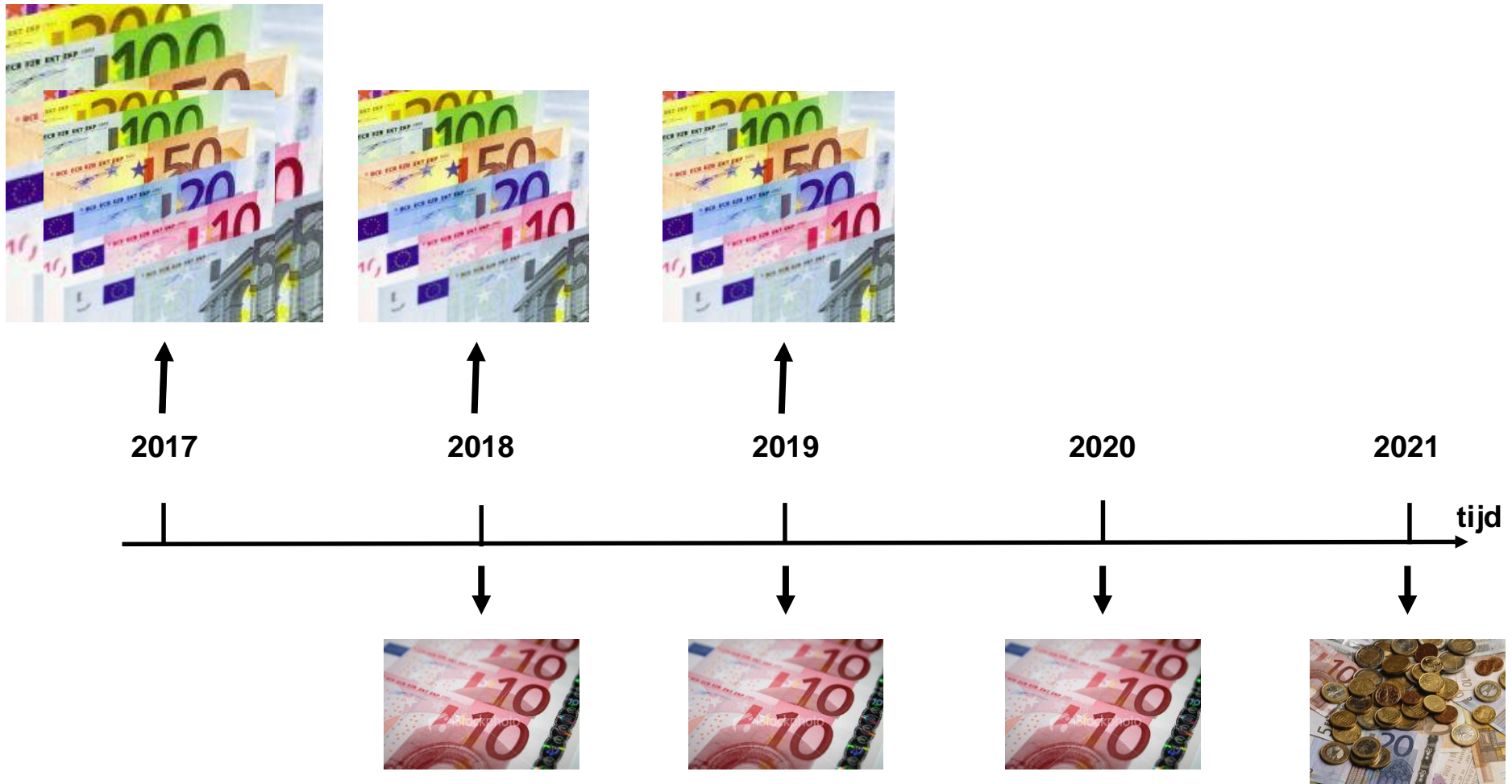
Net present value
is widely spread investment decision technique

$$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t} > 0 ?$$

current value of 100€ spent in the future

120	
100	
80	
60	
40	
20	
0	now year1 year2 year3 year 4 year5
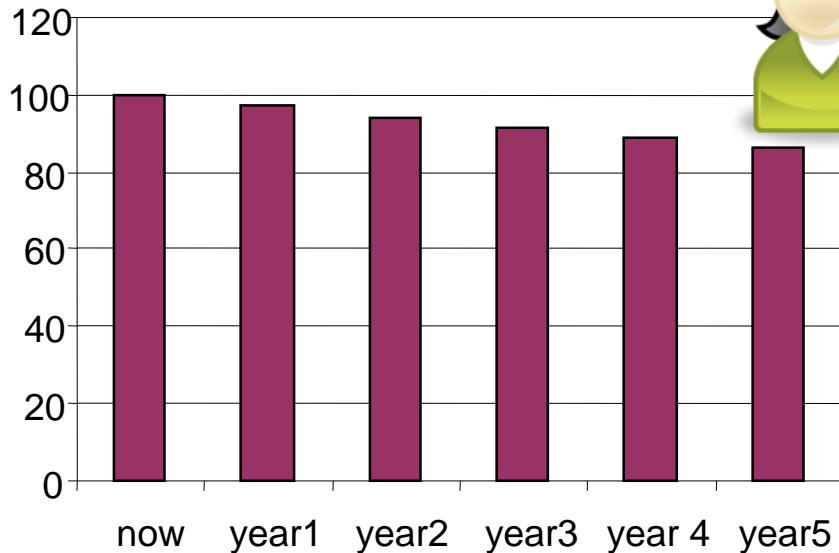
(r = 3%)

$$C = \frac{F}{(1+i)^n}$$

C = current value
F = future value
i = discount rate
n = time period (years)

White paper and tutorial available
for techno-economic analysis cycle
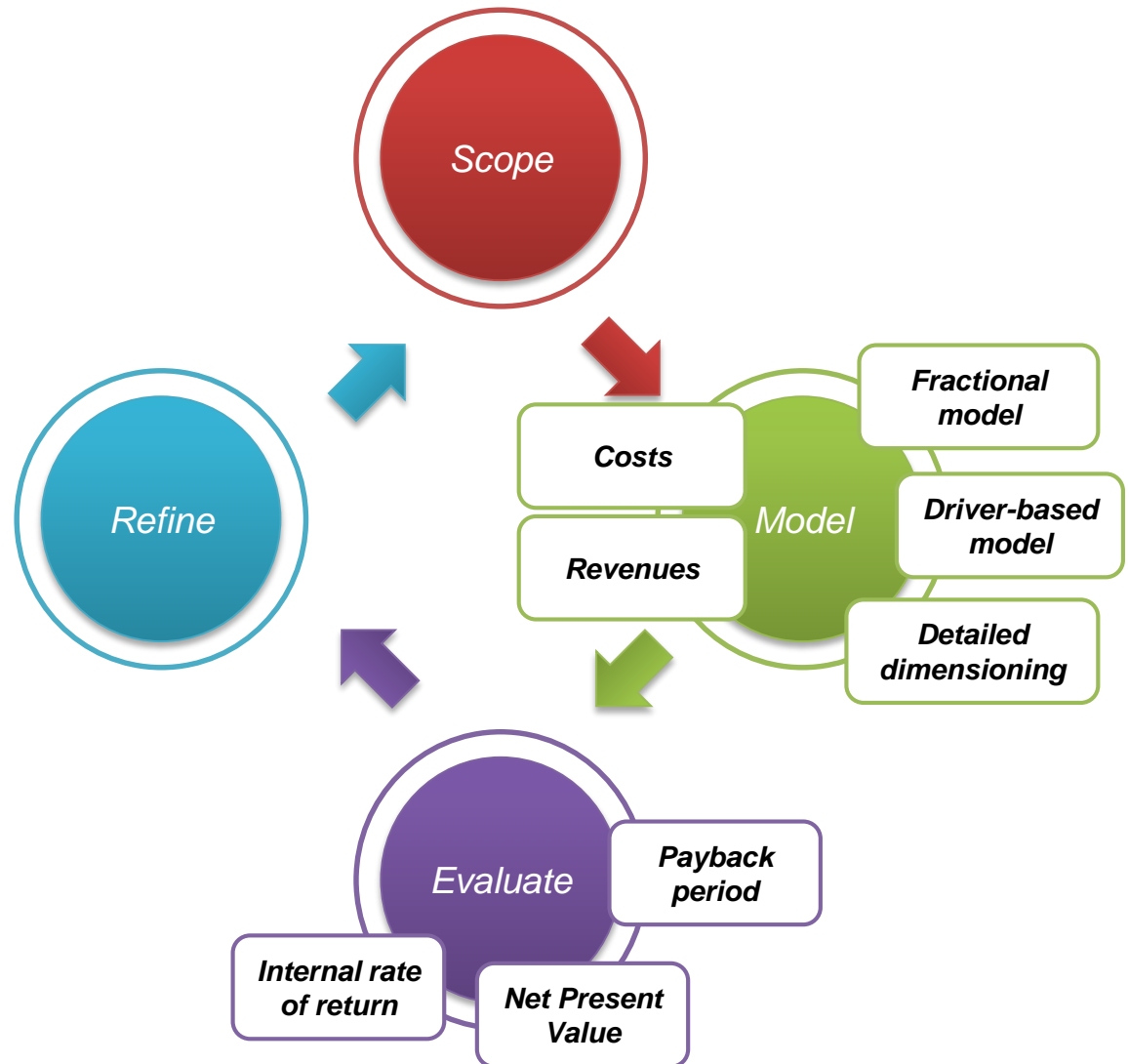
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Real option theory
makes a distinction between 7 typical types of options (7S)

INVEST
GROW

LEARN

SHRINK
DISINVEST
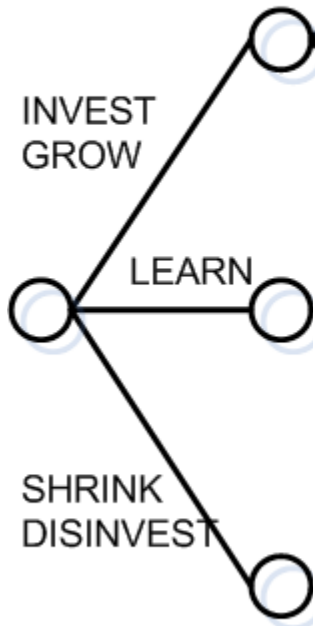
Flexible roll-out gives value
as shown by real options

phased decision vs. static roll-out

Value of flexibility = option value

Tutorial paper and presentation available
concerning practical use of real options in ICT projects

Real Options in Telecom Infrastructure Projects
- A Tutorial

Mathieu Tahon, Sofie Verbrugge, Peter J. Willis, Paul Botham, Didier Colle, Mario Pickavet,
Piet Demeester, *IEEE Fellow*

Abstract—The rapid technological change and uncertain future evolutions have a large impact on investment projects in the telecommunication sector. When new infrastructure networks are rolled out, the initial assumptions can prove to be untrue in the future, severely impacting the payoff. It is therefore extremely important that projects offer flexibility to allow the management to react to unforeseen ch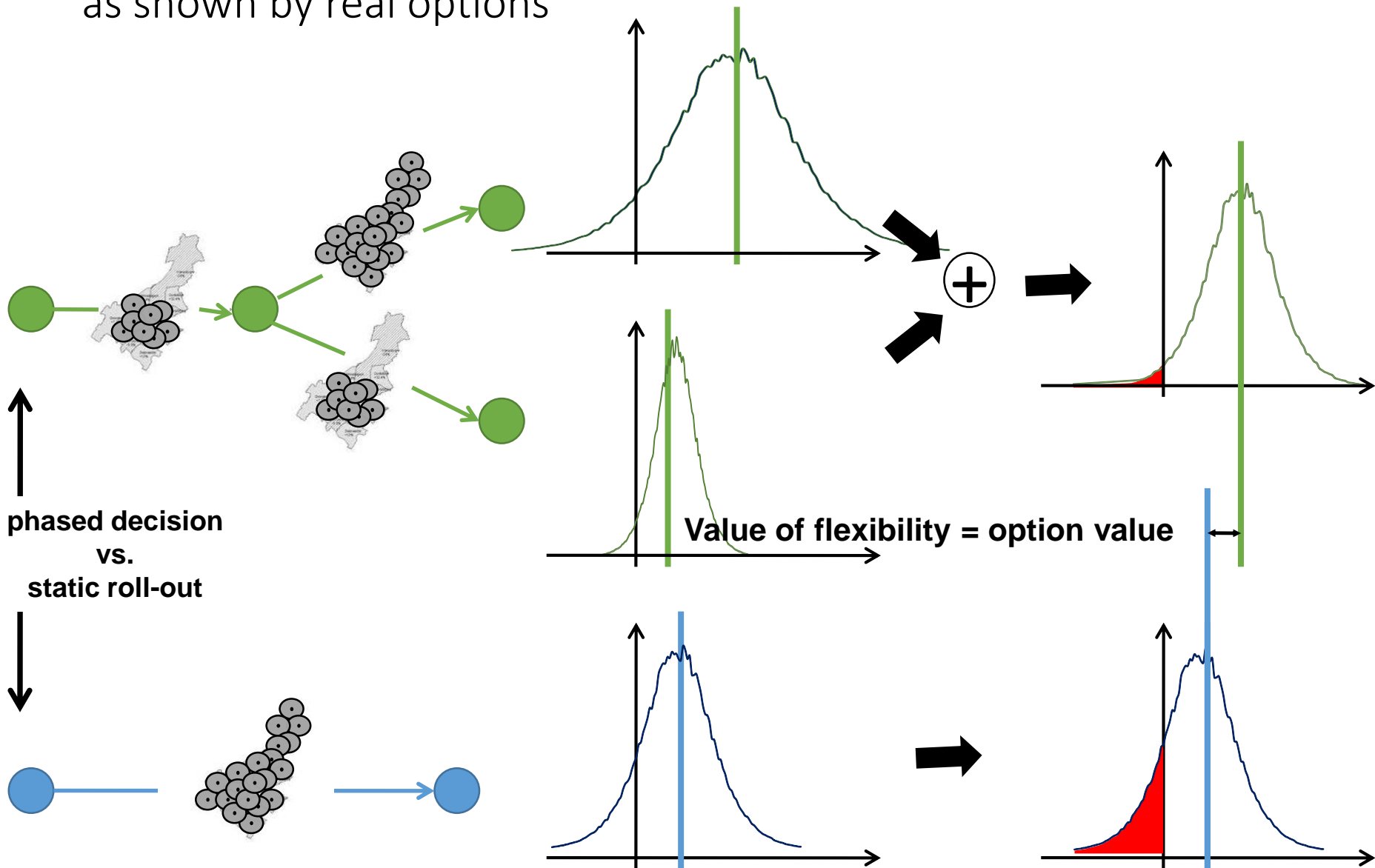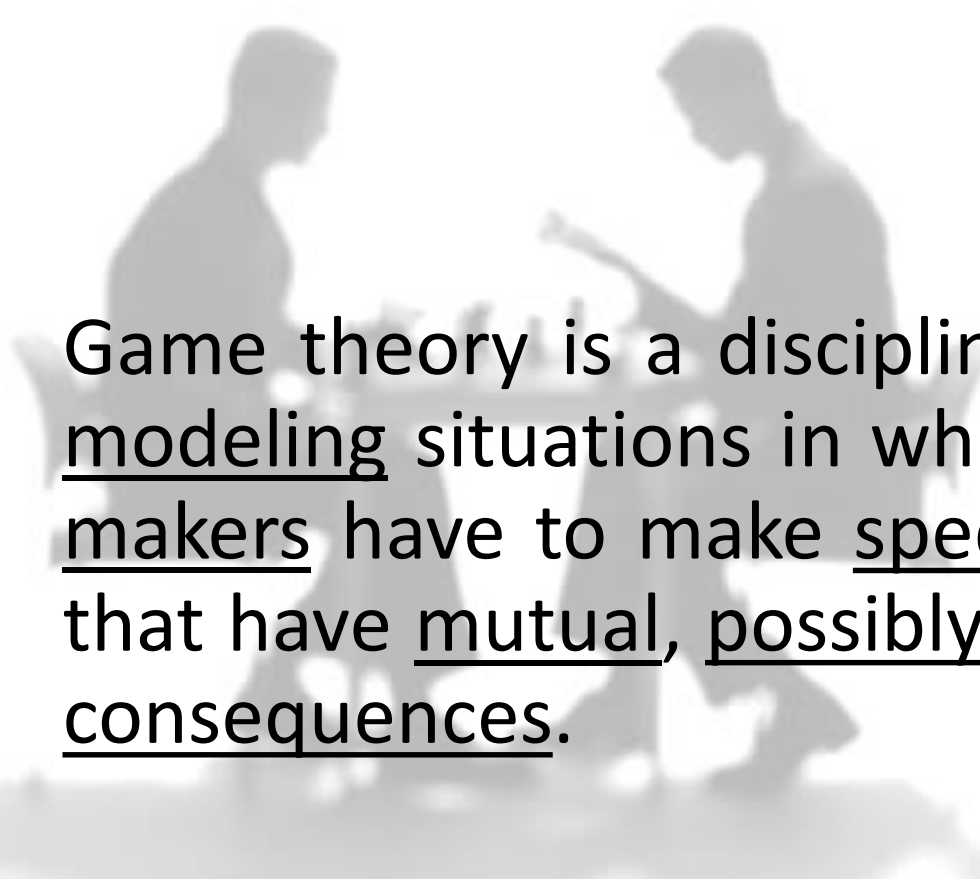anges. Management must, for example, be able to decide to speed up the project, slow it down, or even completely abandon it. However, the standard method used to evaluate investment projects, the Net Present Value analysis, is unable to capture the value of these different flexibility options. The Real Option concept, derived from financial literature, was proposed as a solution and implements this flexibility in the standard calculations. However, the Real Option Theory is only slowly getting accepted within the telecommunication sector. In this paper, we introduce the basics of real options theory and

license is a straightforward example as it offers the flexibility to decide when and where to roll out the mobile network. The 4G mobile operator can start with a study period, testing the new technology in small areas. When the uptake of 4G services proves to be exceeding initial expectations, extra investments can be made to speed up the rollout of the nationwide network. On the other hand, when a telecom project proves to be unprofitable, the management can decide to abandon it completely. For example, only one year after its launch, British Telecom decided to stop its mobile broadcast TV service in 2007.

All investment problems are economically assessed before they are started. In general, this analysis consists of predicting the future costs and revenues of the investment project.
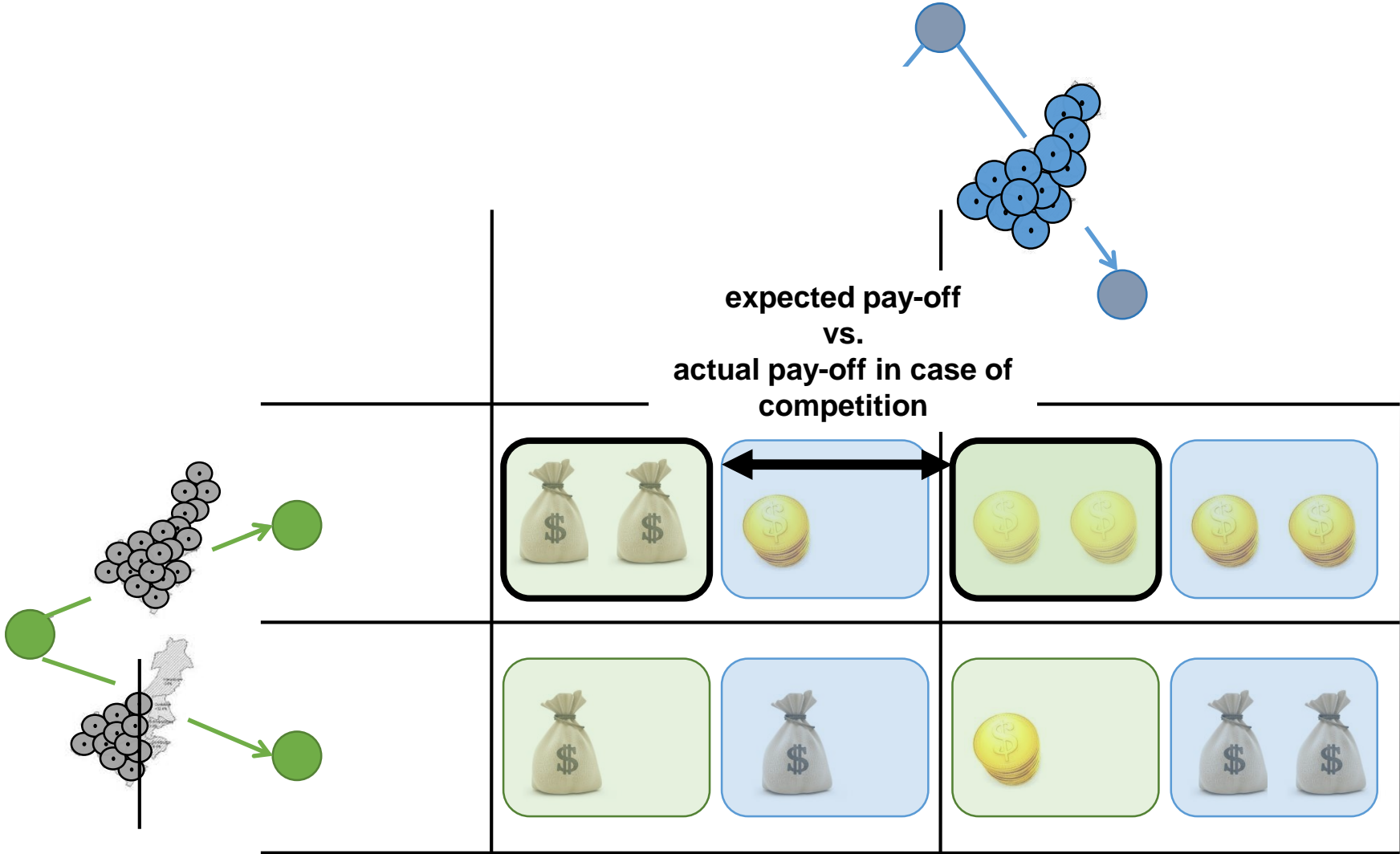
Game theory
models the impact of interaction

Game theory is a discipline aimed at modeling situations in which decision makers have to make specific actions that have mutual, possibly conflicting, consequences.

Competition has big impact
as shown by game theory

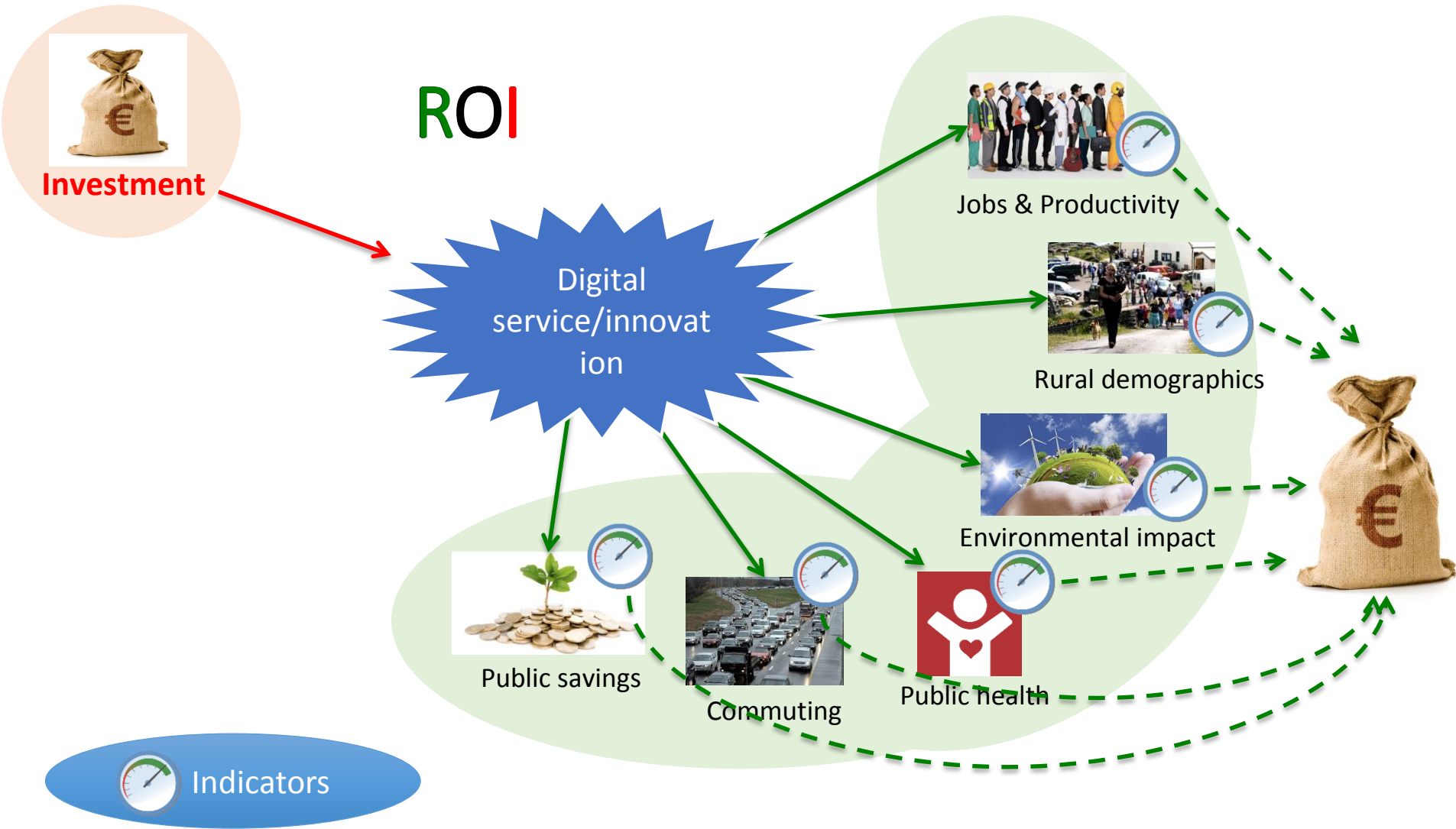expected pay-off
vs.
actual pay-off in case of
competition

Online business game available
for integration in Master course
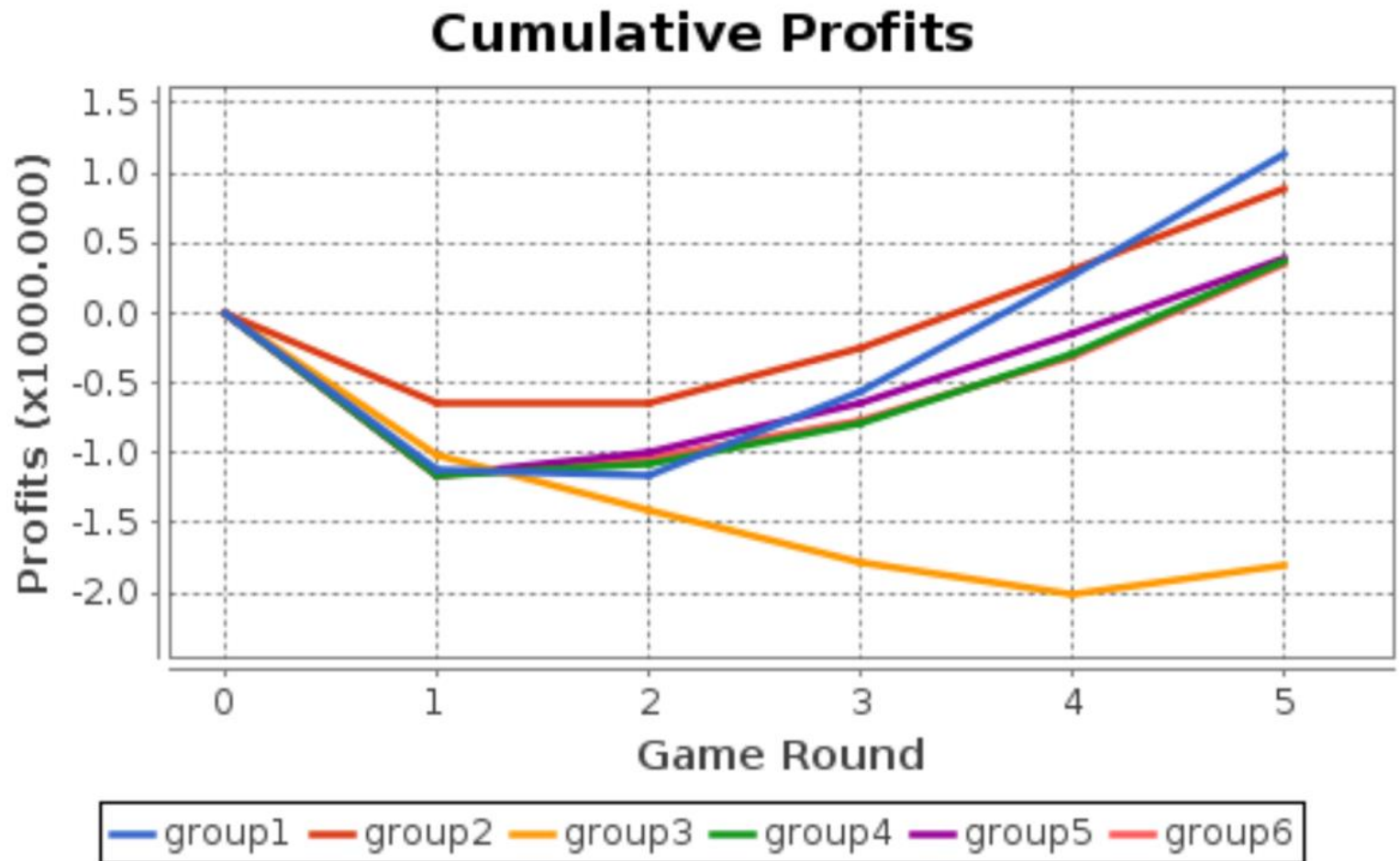
Indirect effects can be modeled
by socio-economic return on investment indicators (SEROI)

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PUBLICATIONS

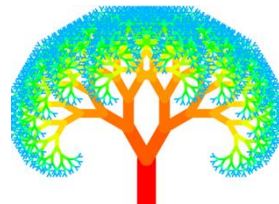**TUTORIALS & WHITEPAPERS**

TOOLS

TEMPLATES & DATA

EVENTS

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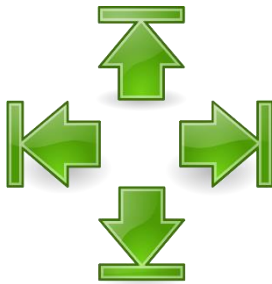
- Wrap-up and call for action

Standard approaches can help

in order to tackle difficulties in techno-economic research

Multi-actor

Uncertainty

Case-specific constraints

Dynamics

Common templates and tools
needed in order to take techno-economics research to next level

www.technoeconomicsportal.eu

Do you want to join?
Do you have any questions?

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