

ESF Member Organisation Forum, 2<sup>nd</sup> Workshop  
19-20 January 2011, Madrid  
Scientific Foresight for Joint Strategy Development

## Foresight Methodology and Experiences in Finland

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Innovation Policy Studies

# Content



- Foresight in Finland
- Methodologies
- Examples
- Conclusions

## Definition of foresight e.g.

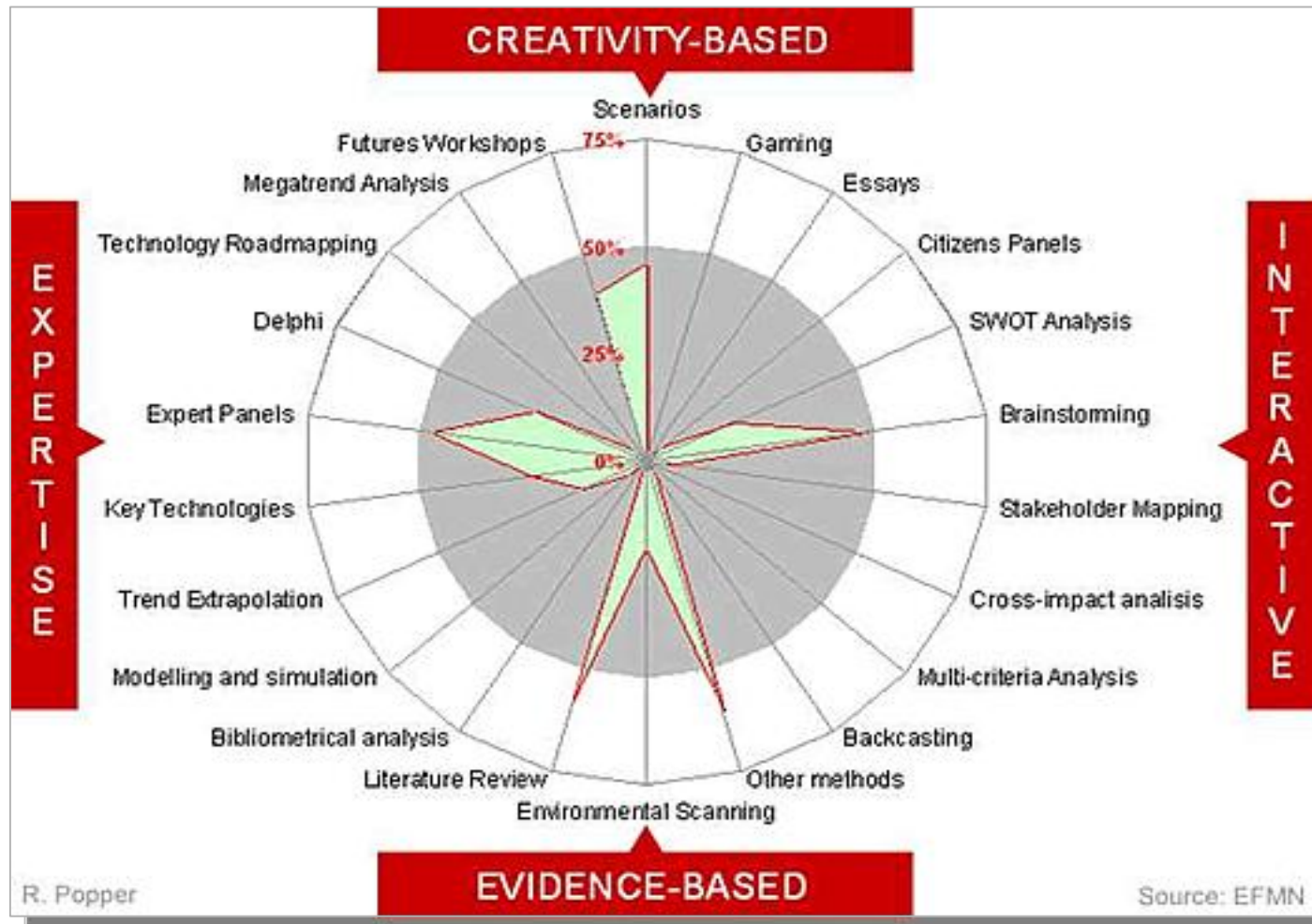
Foresight is a systematic, participatory, future-intelligence-gathering and medium-to-long-term vision-building process aimed at present-day decisions and mobilizing joint actions.

Research and innovation policies are based on (implicit or explicit) visions of the future of science, technology and society.

## Foresight activities relatively widely used in Finland

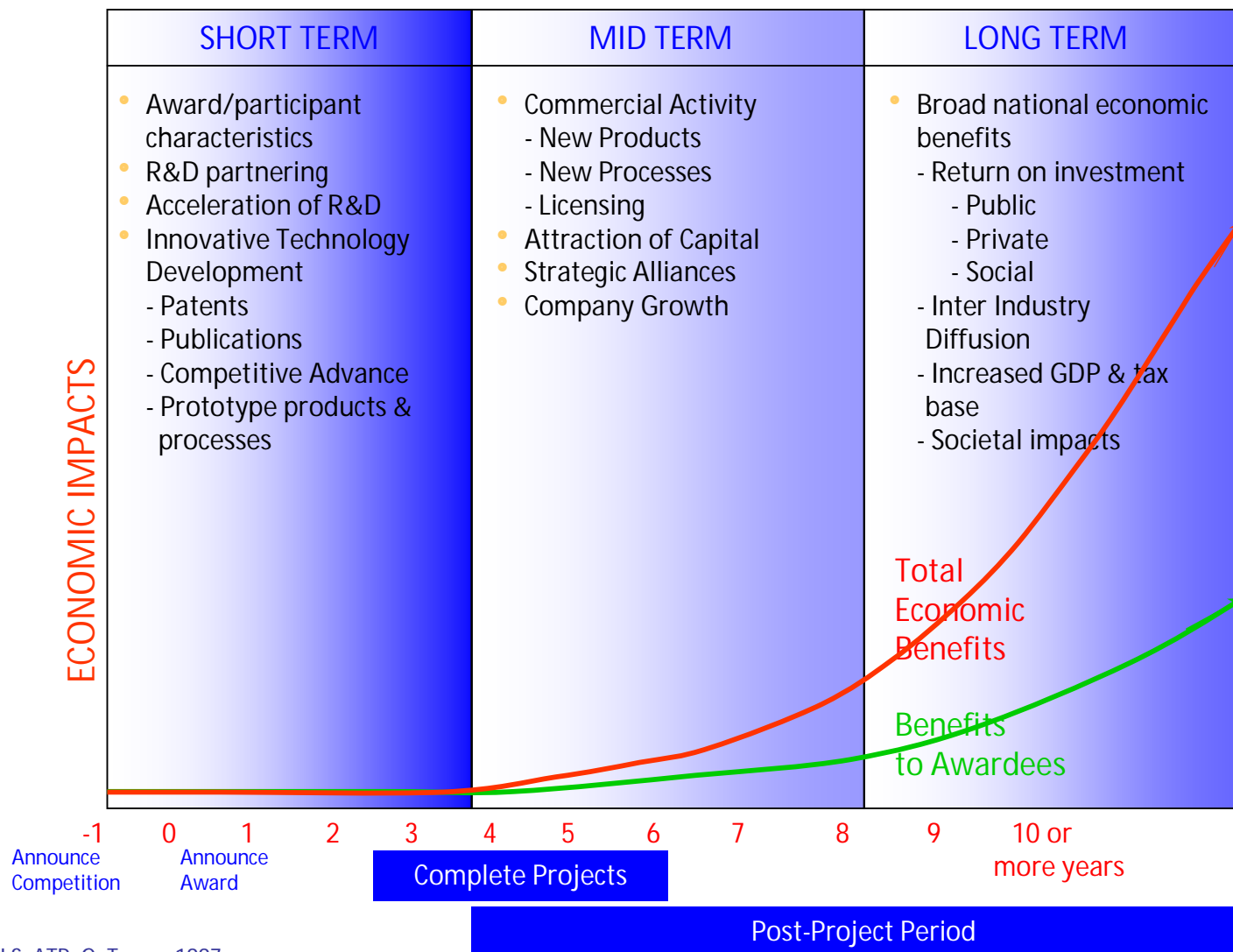
- Parliament – Committee for the Future of established 1993 – first permanent futures committee in the world
- Government – national outlooks, foresight platforms
- Key funding agencies for science, technology and innovation
  - Research landscape (Academy of Finland)
  - Priorities for innovation programme funding (TEKES)
- Industry – technology roadmaps, scenarios, etc. (e.g. by VTT)
- Industry federations – foresight and roadmaps in clustering initiatives
- Universities and research centres (e.g. VTT) – technology expertise and methodological support for foresight and technology roadmaps
- European and Nordic initiatives – active international collaboration

## Foresight methodologies -- taxonomy by EFMN



The shape inside the circle shows how often each method has been used within a set of exercises collected and analyzed by the European Foresight Monitoring Network.

## Foresight and Impact Assessment: What We Measure When

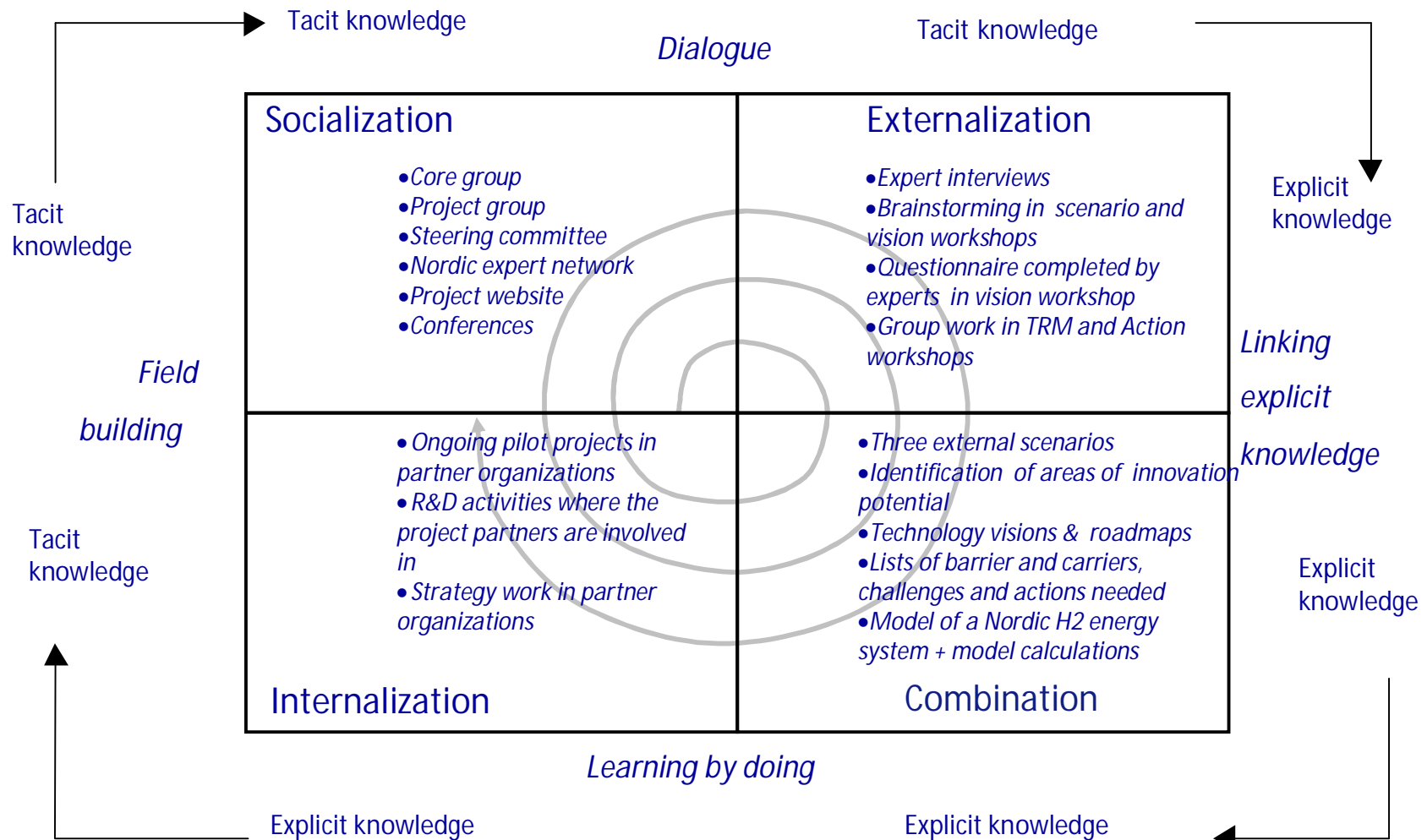




## A mix of approaches in STI context

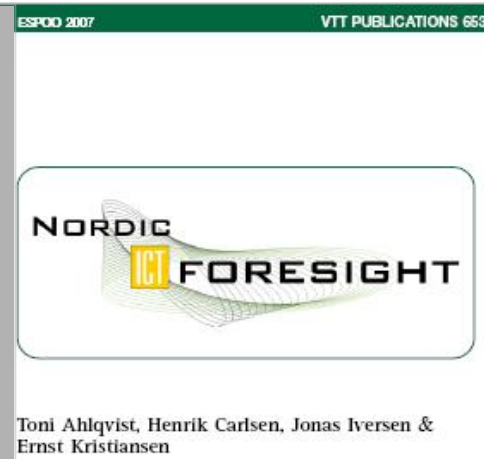
- Economic Cluster Analysis: Value chains, value networks, global to the local scale, economic indicators.
- Innovation Studies: Dynamics of science, technology and innovation; institutions for knowledge creation, dissemination and commercialization; customer needs, market development, and regulatory environment; innovation indicators, analysis of existing and potential policy instruments
- Foresight: Emerging and converging technologies; new business concepts and new markets; disruptive technologies; interactive learning; vision building, consensus creation.
- Roadmap Techniques: Visually displaying dependencies between global business drivers, market developments, emerging innovative products and service concepts, and new technologies.

# Foresight as cumulative learning process -- Nonaka's SECI model (Adaptation for the Nordic H2 Foresight Project)





# Examples future oriented exercises in Finland



TECHBARO2007

Technology Foresight  
Hydrogen Energy Foresight in the Nordic Countries

**Objectives**

- To develop socio-technical scenarios for a future
- To maintain and develop scientific and industrial networks

**Nordic H2 Energy Foresight**

< 北欧の水素エネルギーの将来見通し (北海道開発新戦略) >

WP 1 Vision Seminar  
WP 7 S & T Roadmap Seminar  
WP 8 Action Seminar  
WP 9 World Hydrogen Energy Conference  
WP 10 Reporting  
WP 11 Nordic Conference

Nordic ICT Foresight

Futures of the ICT environment and applications on the Nordic level

Technology Roadmap  
Interface of transportation & construction machines

**Technology road map levels**

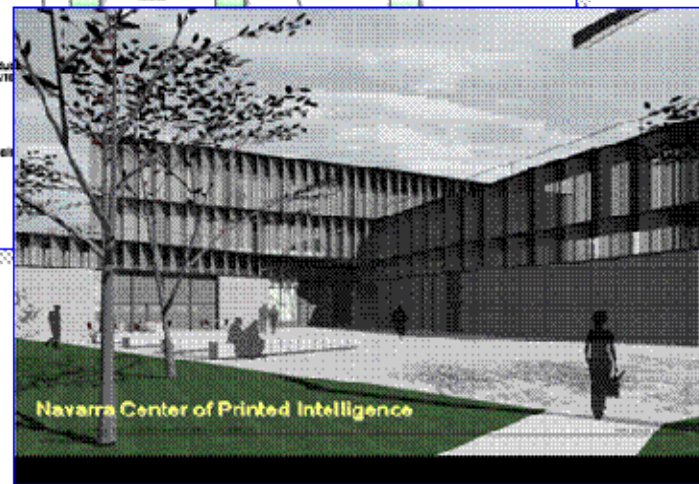
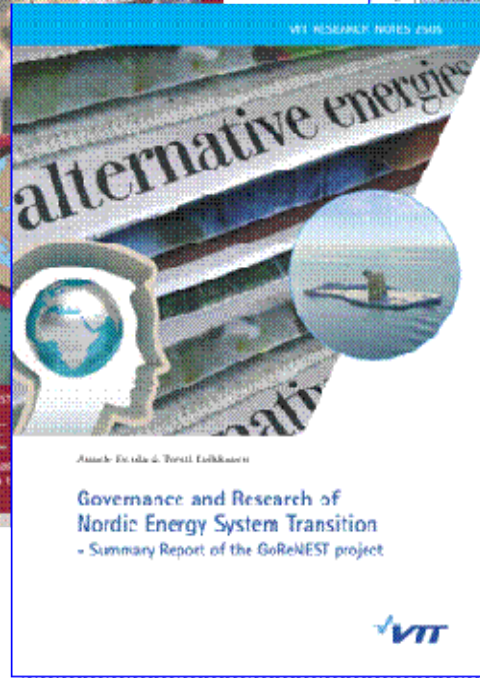
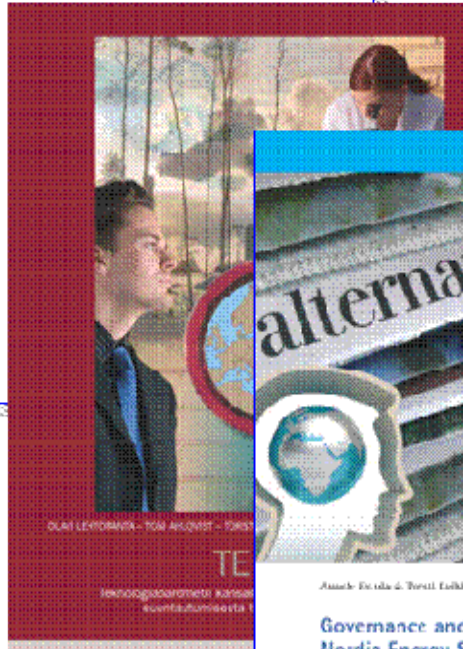
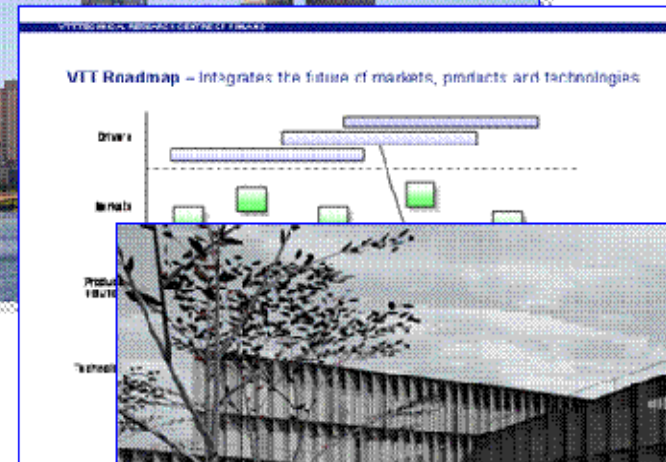
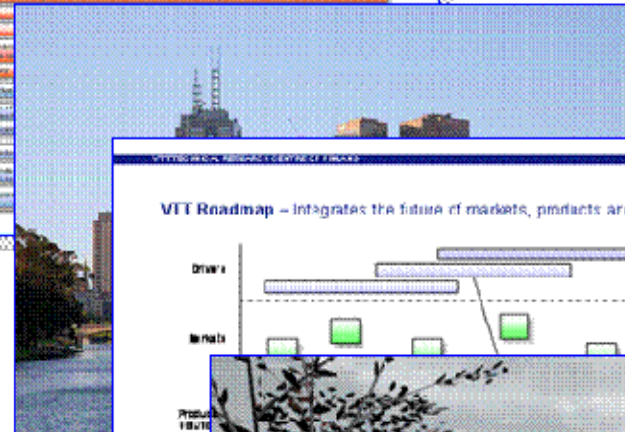
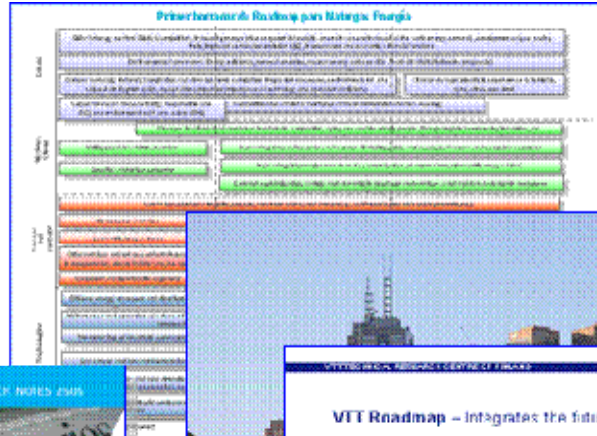
1. Ergonomic user-interface and working environment of operator / driver
2. Smooth and fluent use of machine
3. Data collection of performance and operational environment of machine
4. Role of machine in customer value chain and reliability and safety of process and product
5. Effective product planning, manufacturing and materials

Kulkuneuvojen ja liikkuvien työkohteiden käyttäjälähtyvä – teknologiaroadmap  
Mika Nuumanen  
VTT, TEKNOLOGIAN TUTKIMUSkeskus  
Elokuu 2005

**Building the Nordic Research and Innovation Area in Hydrogen**

Summary Report  
January 2005

# Examples of future oriented exercises in Finland



# National level foresight -- FinnSight 2015



**FINNSIGHT 2015**

**The Outlook for Science**

**Technology and**

**Society**



**ACADEMY OF FINLAND**  
RESEARCH FUNDING AND EXPERTISE

Funding agency for  
basic research



**Tekes**

Main public funding  
agency for R&D

## Objectives of FinnSight 2015

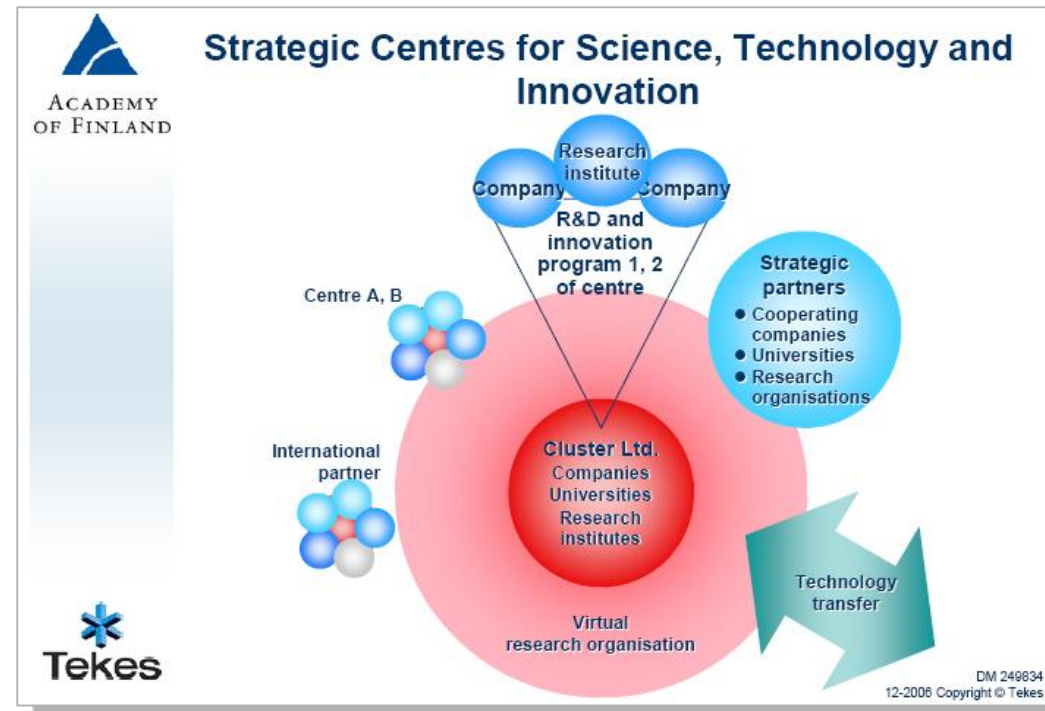
- Identifying and exploring the drivers expected to have impact on Finnish business and society
- Identifying focus areas of competence for the future in the fields of S&T, society and business, and to establish related priorities
- Defining Strategic Centres of Excellence in S&T&I in line with Government decision on development of public research system
- Support strategic work of the Academy of Finland and Tekes
- Deepening collaboration between Academy and Tekes, and fostering a climate of multidisciplinary debate
- Time span: 10 years



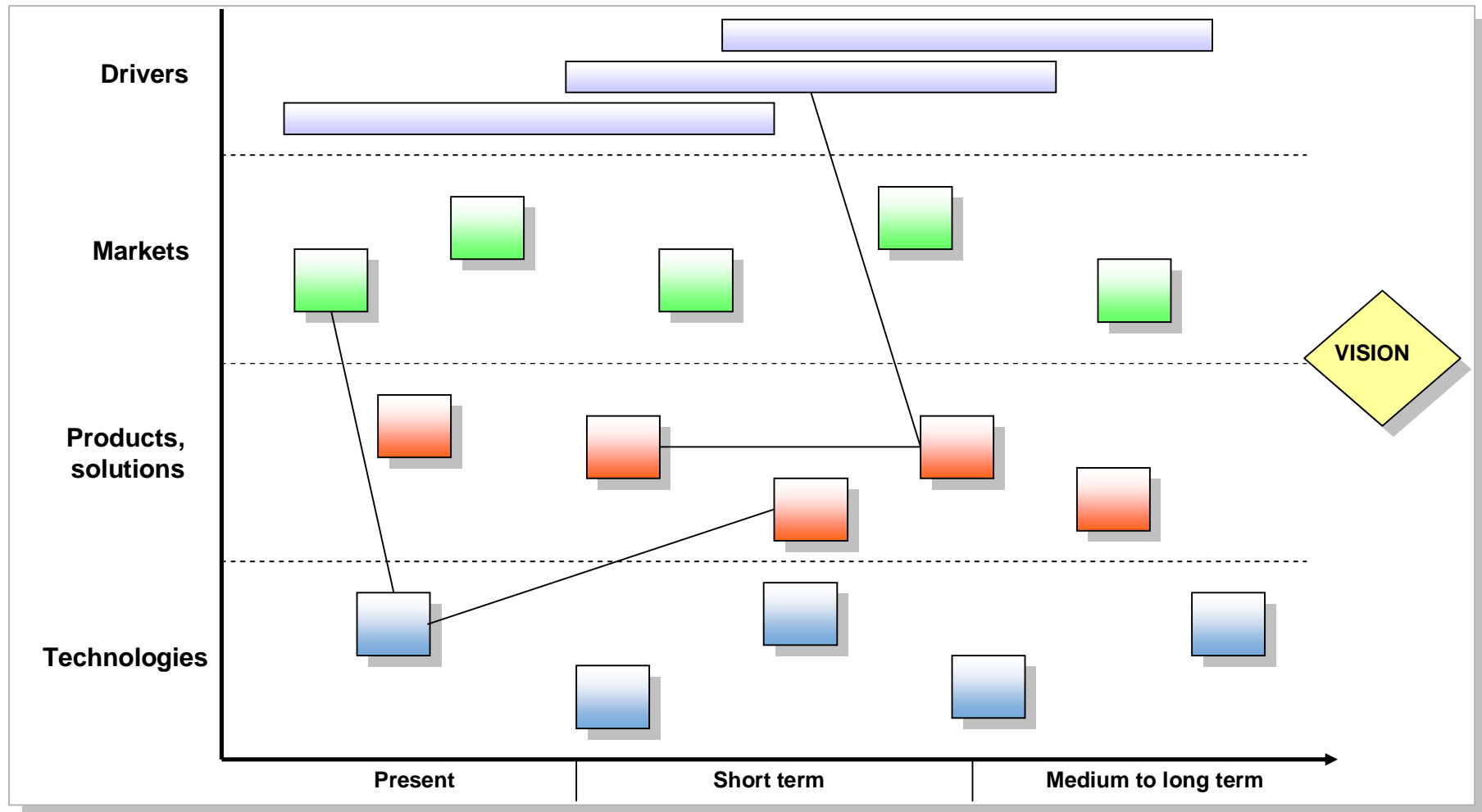
## Observable Impacts

- Executed at the time of many changes on national IP agenda -- short term impacts? – attribution to FinnSight 2015?
- Supported establishment of Strategic Centres of Excellence in S&T&I by identifying focus areas of competence
- Deepens collaboration between the Academy and Tekes
- Supports strategic work of the Academy and Tekes
- Strengthens foresight culture among the Academy, Tekes and participating experts

(<http://www.finnsight2015.fi/>)

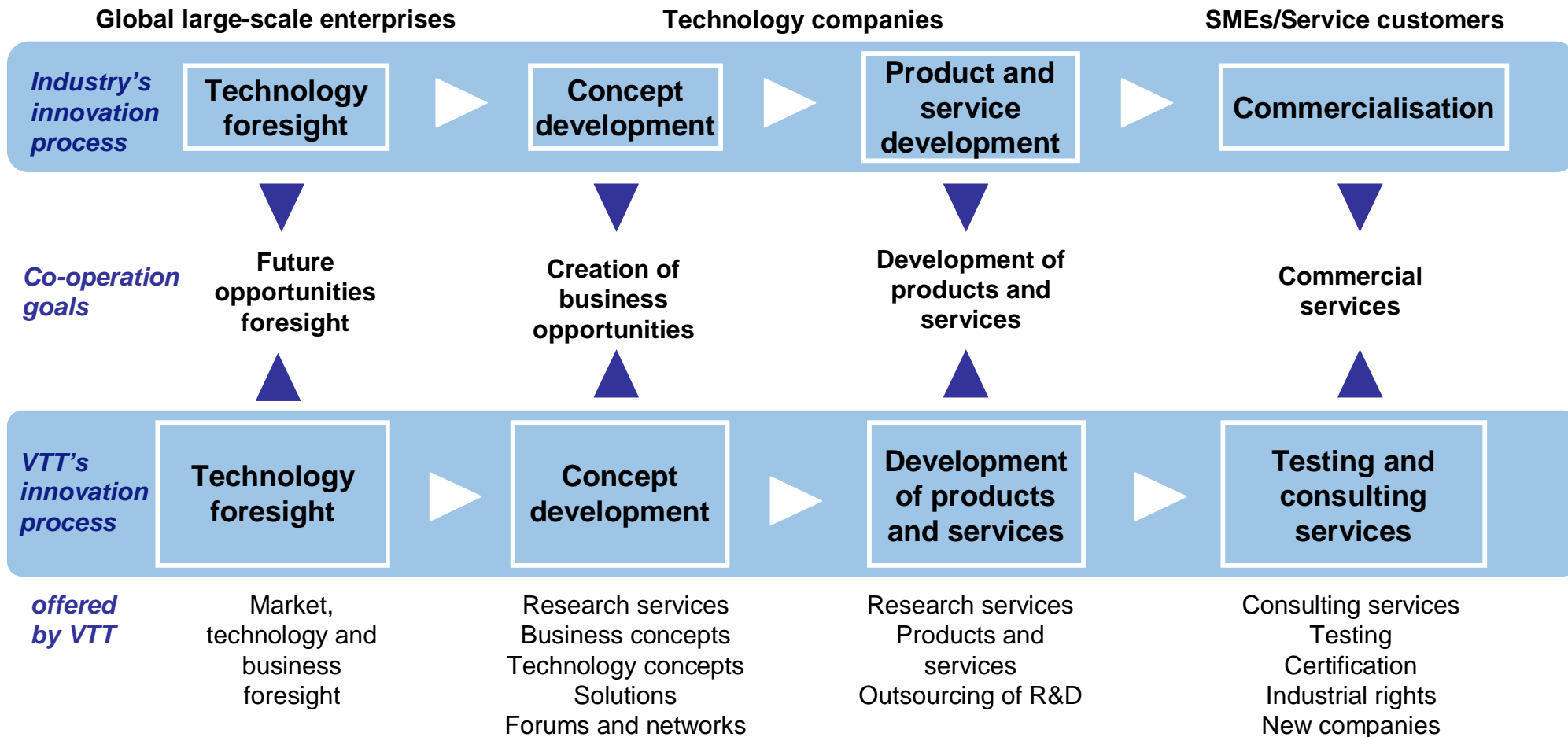


Roadmap integrates drivers, future markets, products, and technologies  
Applications on company (groups), regional, national and supranational levels

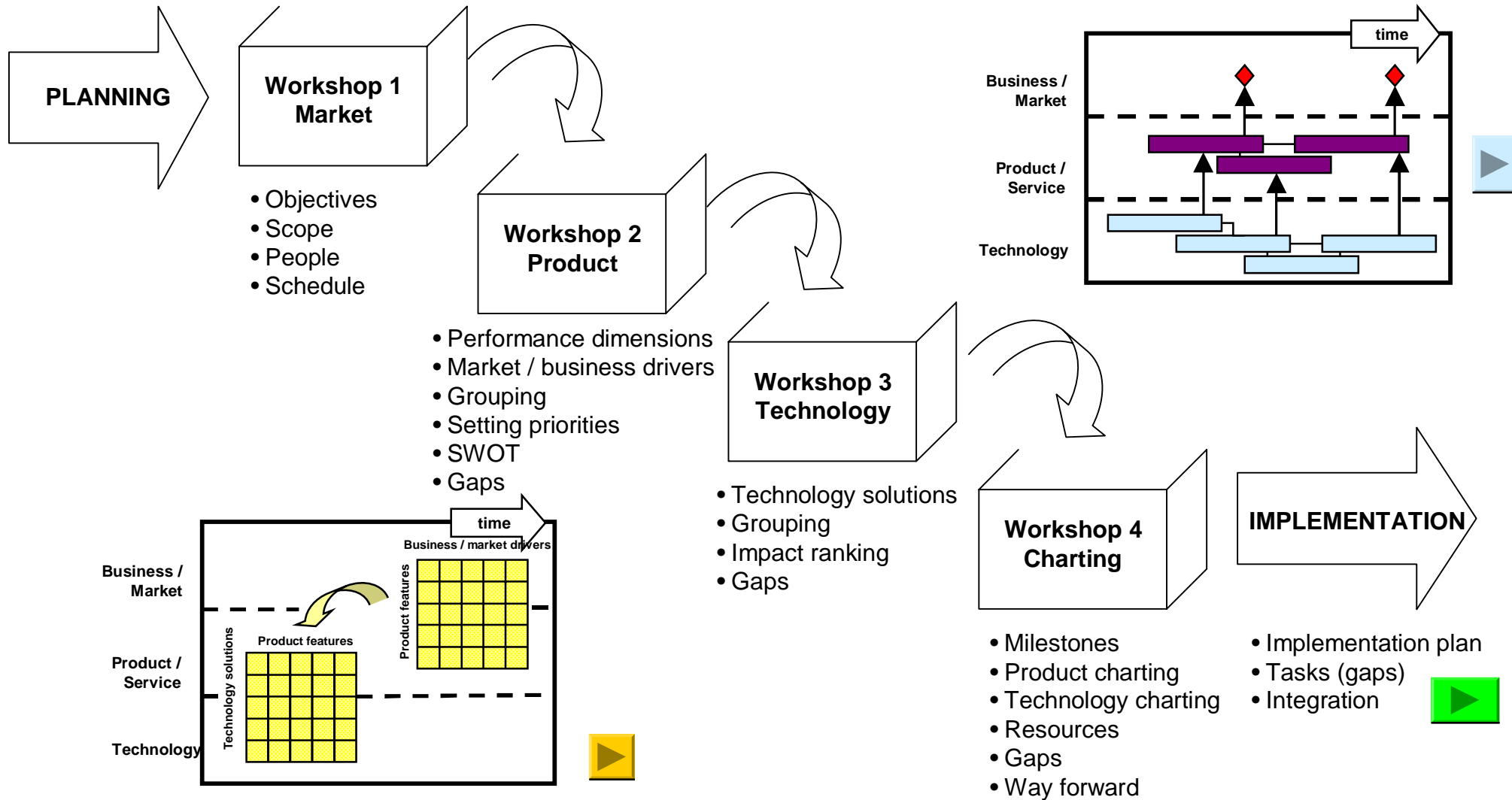




# Cluster roadmap model of VTT



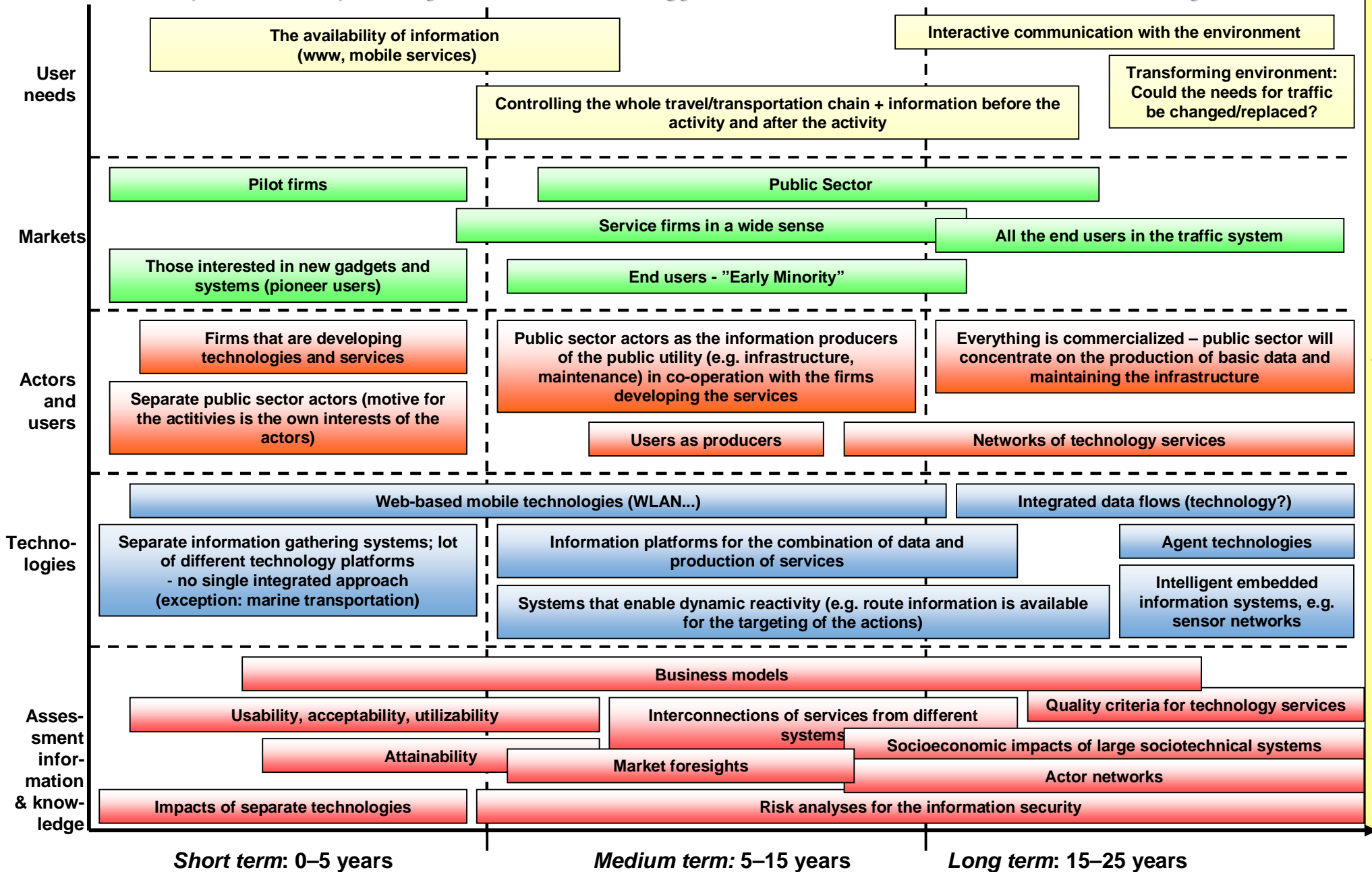
# Technology Roadmap Process



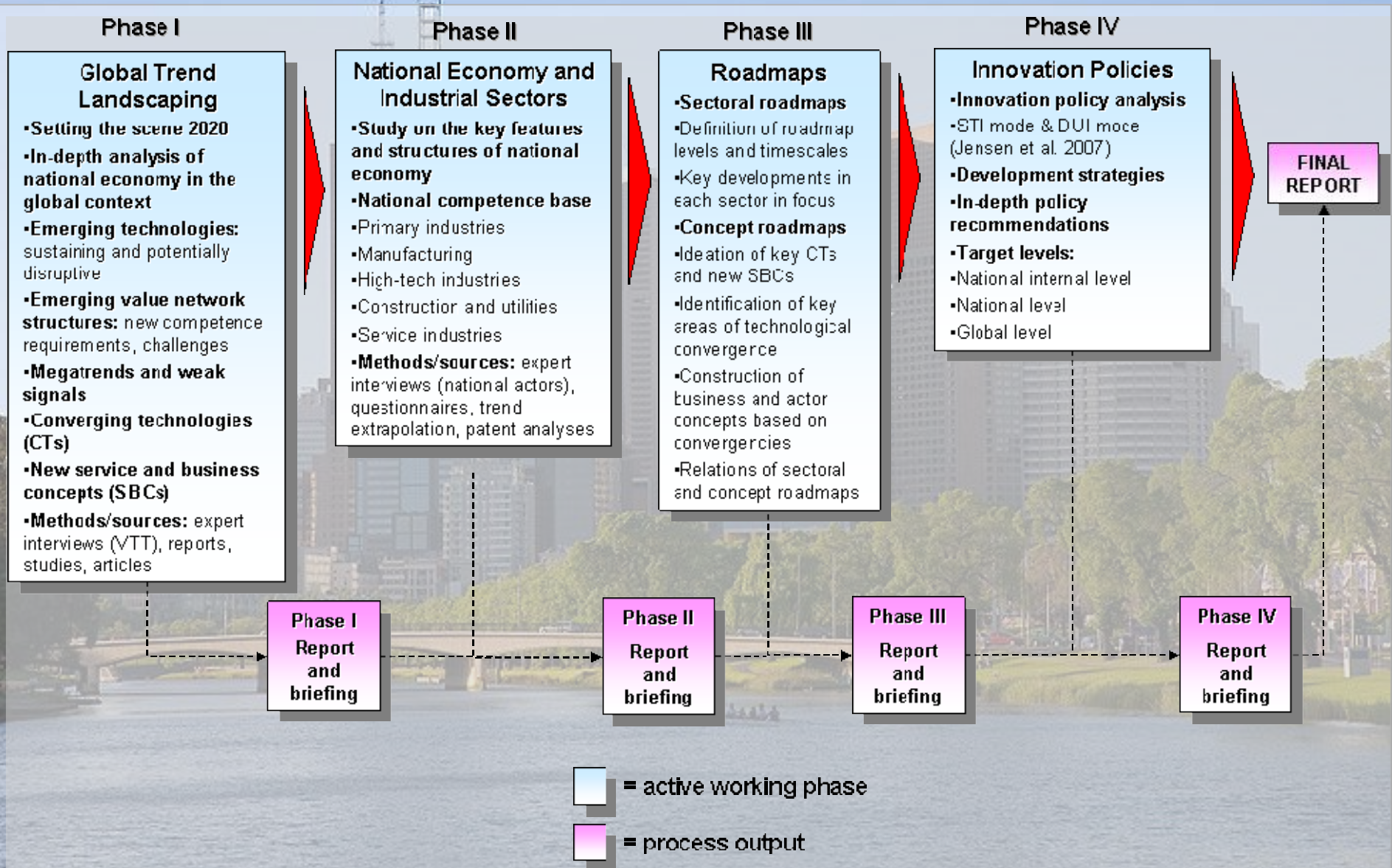
Phaal, R., Farrukh, C. & Probert, D., *Technology Roadmapping: linking technology resources to business objectives*, Univ. of Cambridge, 2001.

# Example: Transport System Technology Services – Interactive real-time systems

VISION: Interactive Traffic Systems Based on Realtime Information



# Example: Phases of national technology roadmap -2025







Technology specific roadmap example for  
creation of R&D institute:  
Navarra Center of Printed Intelligence

CENTRO TECNOLÓGICO MIGUEL DE ECHEA, LEZETA.

MFM arquitectos

Vista plaza acceso 1

## Roadmap Process for Center of Printed Intelligence in Navarra, CTEL

- Roadmap is a first phase in a development policy for the creation of center in Navarra
- Especially the following fields are emphasised
  - Healthcare
  - Food processing
  - Renewable energy
- Longer term targets for the center
  - In five years, the target size is 40-50 people
  - In the longer term, one mission of the centre is to generate spin-offs in the area of printed intelligence

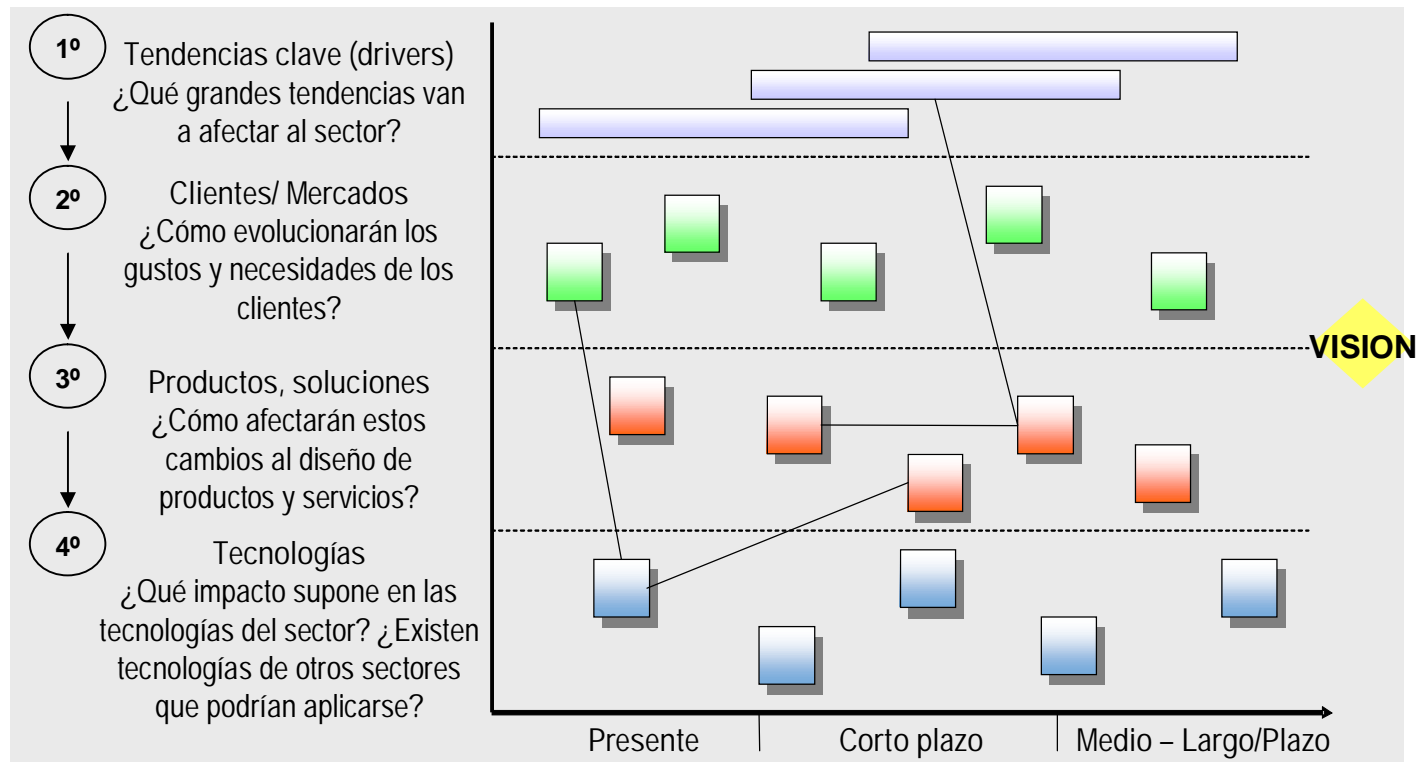


# Metodología de Roadmap Tecnológico

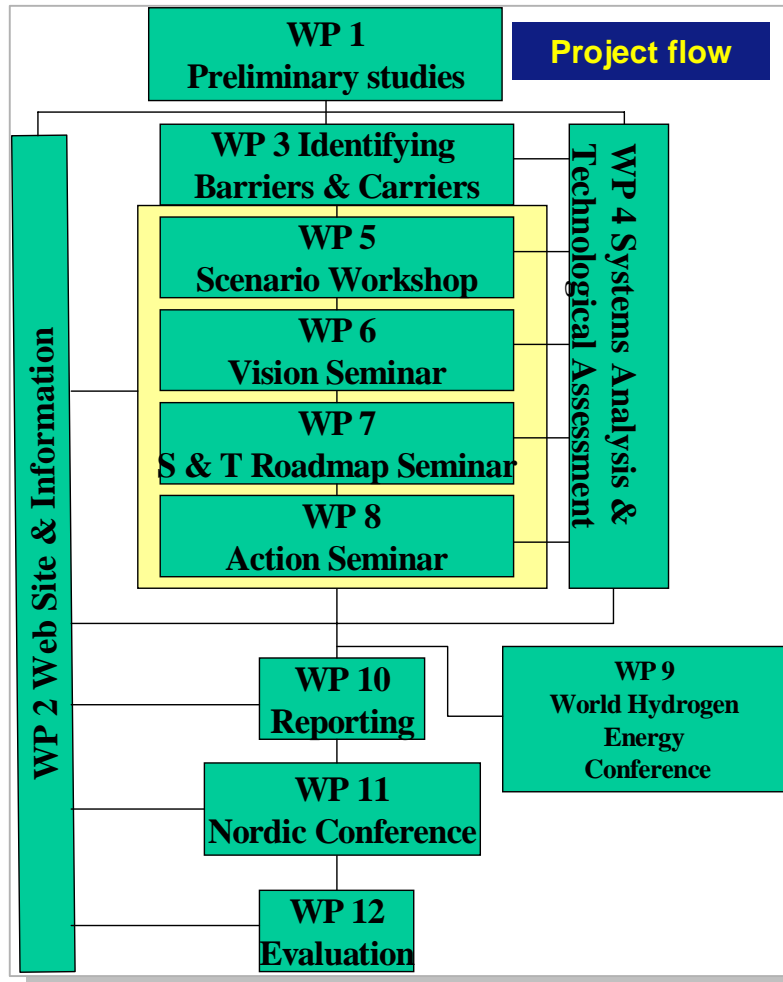
## En qué consiste el Roadmap Tecnológico

Representación estructurada de los senderos tecnológicos posibles en un determinado sector, que sirve como soporte para la toma de decisiones tecnológicas y de negocio.

**Las interrelaciones entre la tecnología y las tendencias de mercado, necesidades de cliente y producto son las bases de la metodología VTT.**



# Nordic H2 Foresight



Timeframe	2005-2010	2010-2015	2015-2020	2020-2025	2025-2030
<b>Technology</b>	<ul style="list-style-type: none"> <li>Demonstration of decentralised H<sub>2</sub> production from natural gas and decentralised storage in pressure tanks</li> <li>Demonstration of electrolysis at local filling stations</li> <li>Demonstration of gasification of biomass to H<sub>2</sub></li> <li>Demonstration of H<sub>2</sub> mixed in existing NG grid</li> </ul>	<ul style="list-style-type: none"> <li>Demonstration of H<sub>2</sub> production from NG with CO<sub>2</sub> sequestration</li> <li>Expansion of natural gas grid</li> <li>Early market for H<sub>2</sub> from electrolysis at local filling stations</li> <li>Early market for gasification of biomass to H<sub>2</sub></li> <li>Demonstration of electrolysis and storage as a buffer for wind energy</li> </ul>	<ul style="list-style-type: none"> <li>Further expansion of natural gas grid</li> <li>Build-up of H<sub>2</sub> grid and filling stations</li> <li>Large-scale plants for gasification of biomass to H<sub>2</sub></li> <li>Large-scale plants for centralised reforming of NG to H<sub>2</sub> with CO<sub>2</sub> sequestration</li> </ul>	<ul style="list-style-type: none"> <li>Nordic H<sub>2</sub> grid is further expanded</li> <li>H<sub>2</sub> NordPool is established</li> <li>Large-scale H<sub>2</sub> production from NG reforming, biomass gasification and electrolysis (water &amp; solid oxide)</li> <li>Large-scale hydro-power dedicated for liquid hydrogen production established in Greenland and Iceland</li> <li>SOEC electrolysis for production of H<sub>2</sub>, methanol or methane</li> </ul>	<ul style="list-style-type: none"> <li>First large-scale commercial storage of hydrogen</li> <li>Early production of H<sub>2</sub> from PV + electrolysis</li> <li>Advanced H<sub>2</sub> production directly from photochemical and biological processes</li> </ul>
<b>Nordic equipment market opportunities</b>	<ul style="list-style-type: none"> <li>Natural gas reformers</li> <li>Equipment for gasification of biomass (or biomass to biofuel)</li> <li>Equipment and systems technology to system integrate wind power with H<sub>2</sub> production</li> <li>Electrolysers (water electrolysis and solid oxide electrolysis SOEC)</li> <li>Infrastructure equipment; automation, compressors, pipelines, pressure tanks</li> <li>Maybe CO<sub>2</sub> sequestration equipment</li> </ul>			<ul style="list-style-type: none"> <li>Equipment to long distance transport liquid H<sub>2</sub></li> </ul>	
<b>Technical data &amp; market sizes</b>	<ul style="list-style-type: none"> <li>Demonstration projects and early niche markets</li> </ul>	<ul style="list-style-type: none"> <li>Niche markets</li> </ul>	<ul style="list-style-type: none"> <li>500-3600 MW NG reforming</li> <li>500-3000 MW biomass gasification</li> <li>200-600 MW electrolysers</li> </ul>		<ul style="list-style-type: none"> <li>1200-12000 MW NG reforming</li> <li>1300-4000 MW biomass gasification</li> <li>400-1300 MW electrolysers</li> </ul>
<b>Nordic energy market opportunities</b>	<ul style="list-style-type: none"> <li>Natural gas</li> <li>Biomass for energy</li> <li>Electricity from wind</li> <li>Other renewable energy sources</li> </ul>			<ul style="list-style-type: none"> <li>Operation of a H<sub>2</sub> Nord Pool and trading with H<sub>2</sub></li> <li>Ship transport of liquid H<sub>2</sub></li> </ul>	
<b>H<sub>2</sub> in Nordic energy system</b>	<ul style="list-style-type: none"> <li>H<sub>2</sub> introduced as energy carrier</li> </ul>	<ul style="list-style-type: none"> <li>0-2% H<sub>2</sub> in Nordic energy system</li> </ul>	<ul style="list-style-type: none"> <li>1-3% H<sub>2</sub> in Nordic energy system</li> </ul>	<ul style="list-style-type: none"> <li>2-7% H<sub>2</sub> in Nordic energy system</li> </ul>	<ul style="list-style-type: none"> <li>5-8% H<sub>2</sub> in Nordic energy system</li> </ul>

**Roadmap: H<sub>2</sub> production and transmission**

# Accuracy by combination of methodologies

## Nordic H2 Foresight

Interviews & document analysis

Website

([www.h2foresight.info](http://www.h2foresight.info))

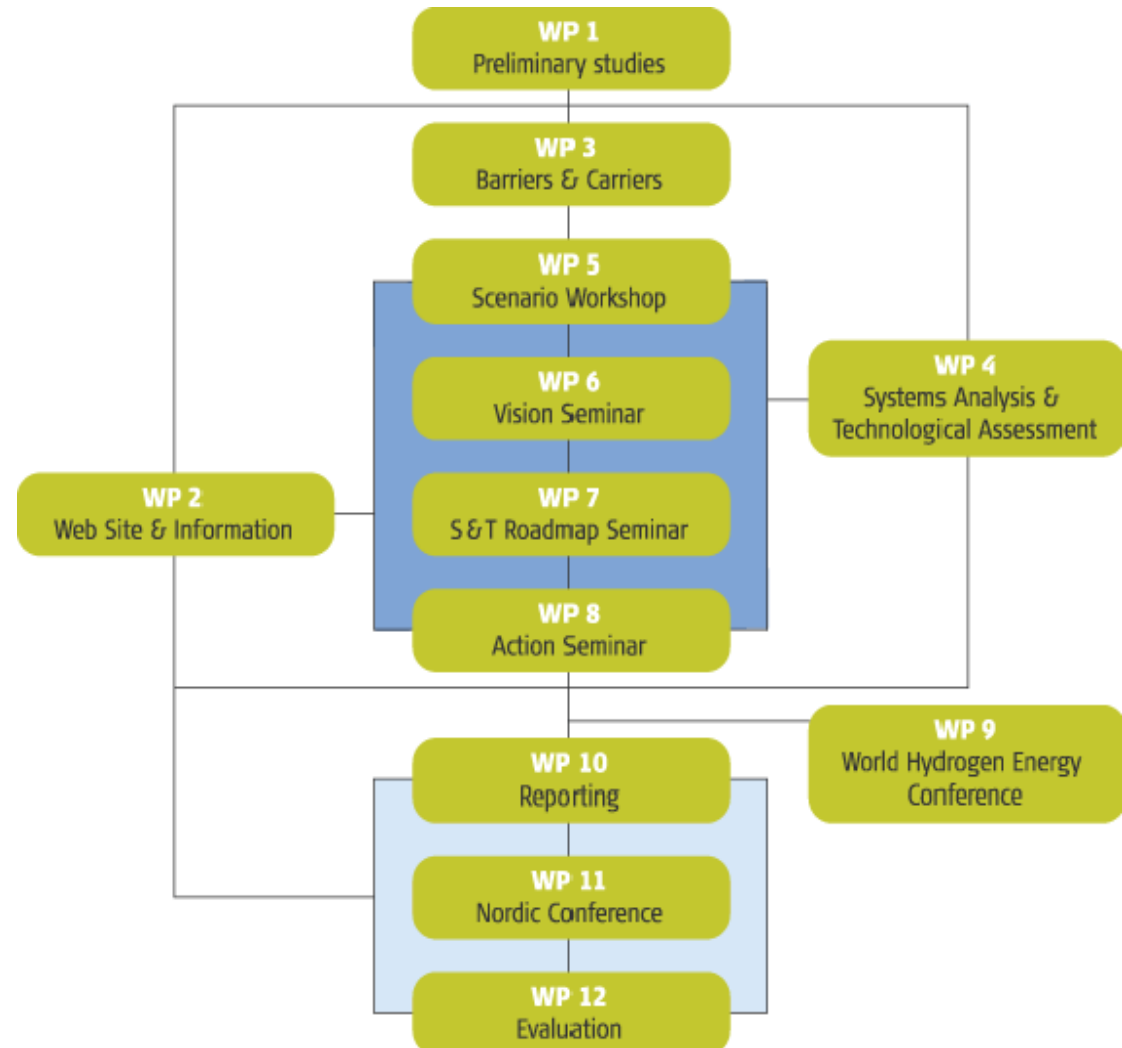
Interactive workshops

- Scenario Workshop (Reykjavik)
- Vision Workshop (Stockholm)
- Roadmap Workshop (Roskilde)
- Action Workshop in (Espoo)

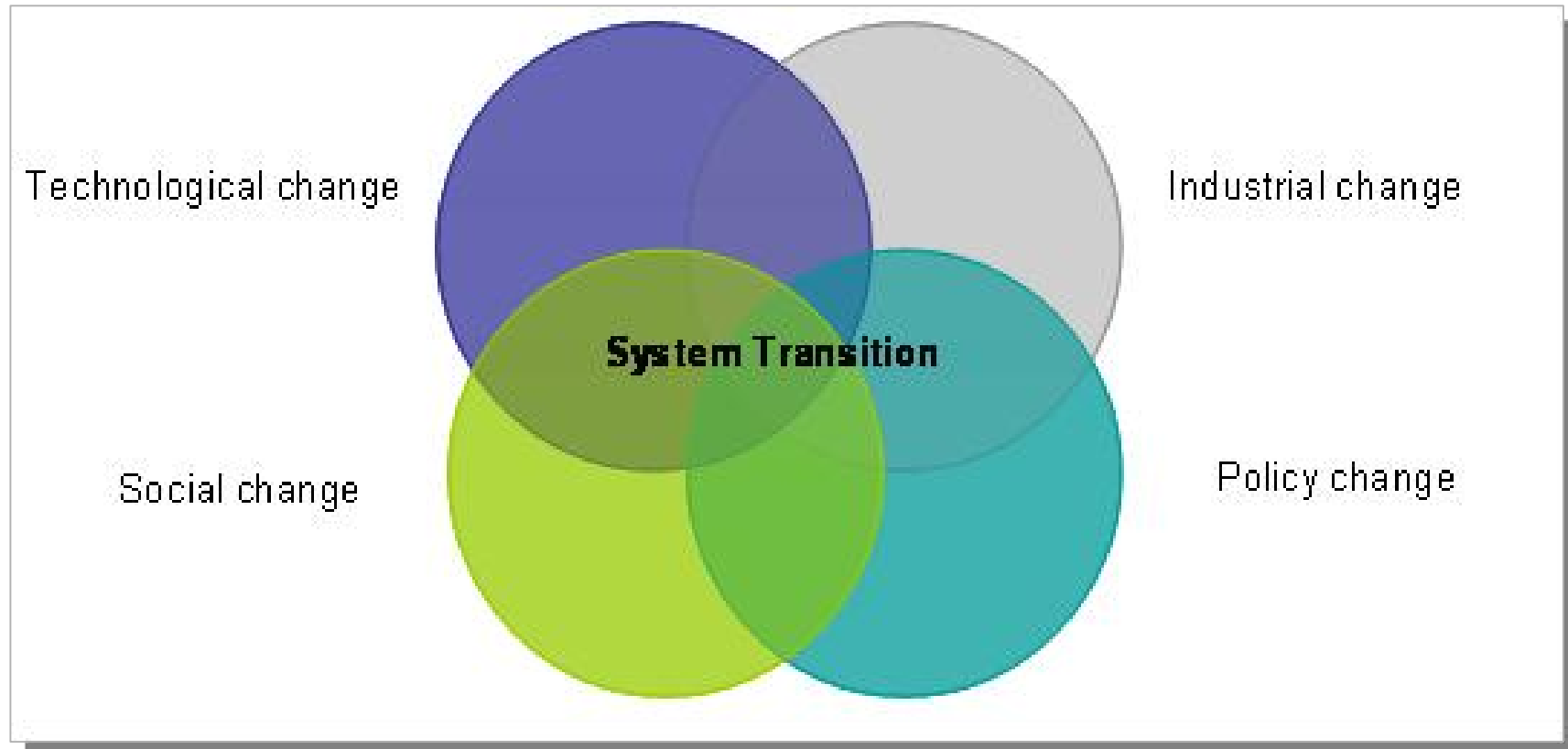
Modelling of the Nordic H<sub>2</sub> energy system

Nordic Conference

Evaluation



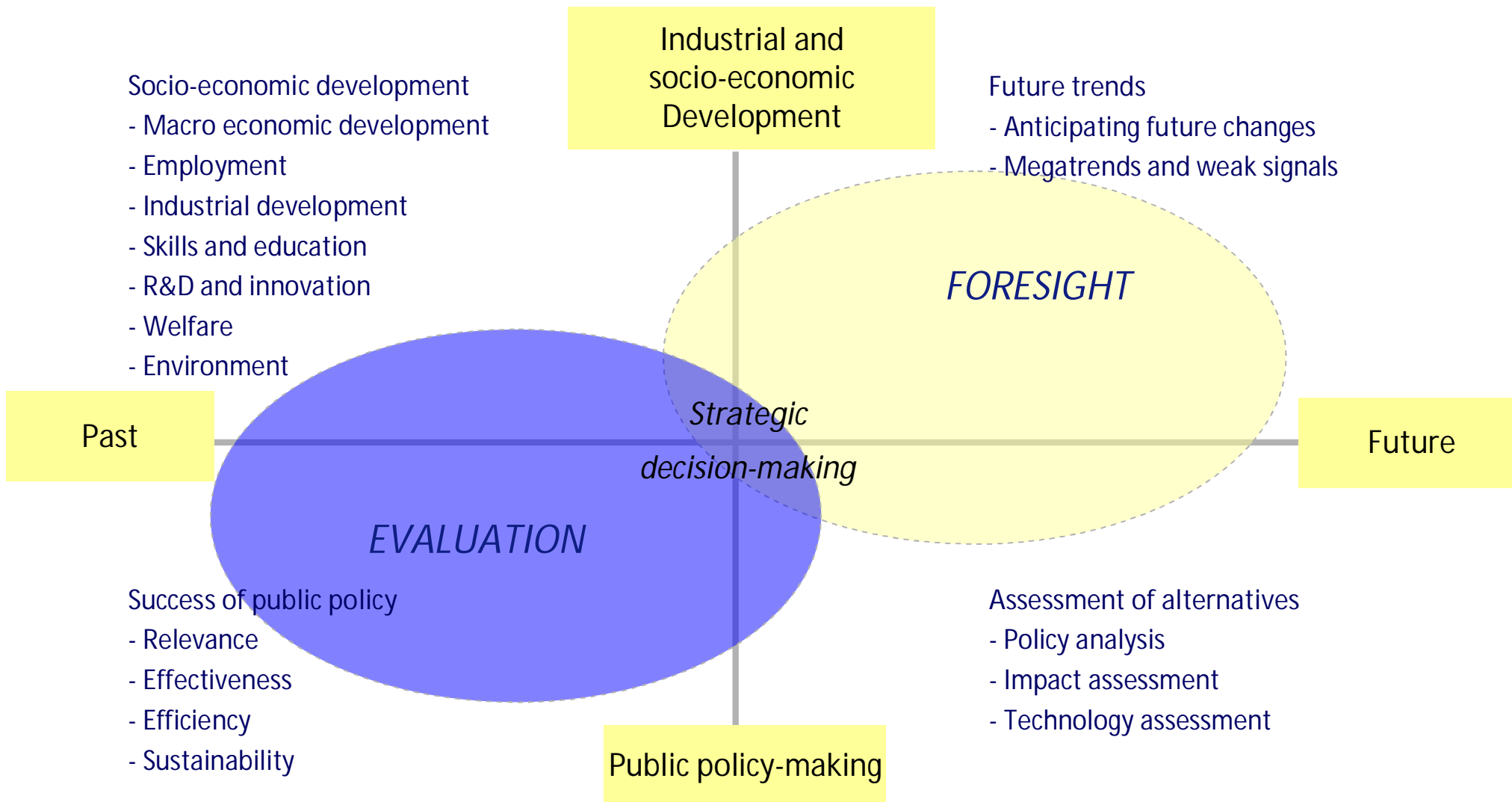
Framework: System transition builds on dynamic linkages between technological, industrial, policy and social changes



Systemic approach supporting e.g. transition towards sustainable energy structures

Towards integrated foresight and IA – ex-ante IA

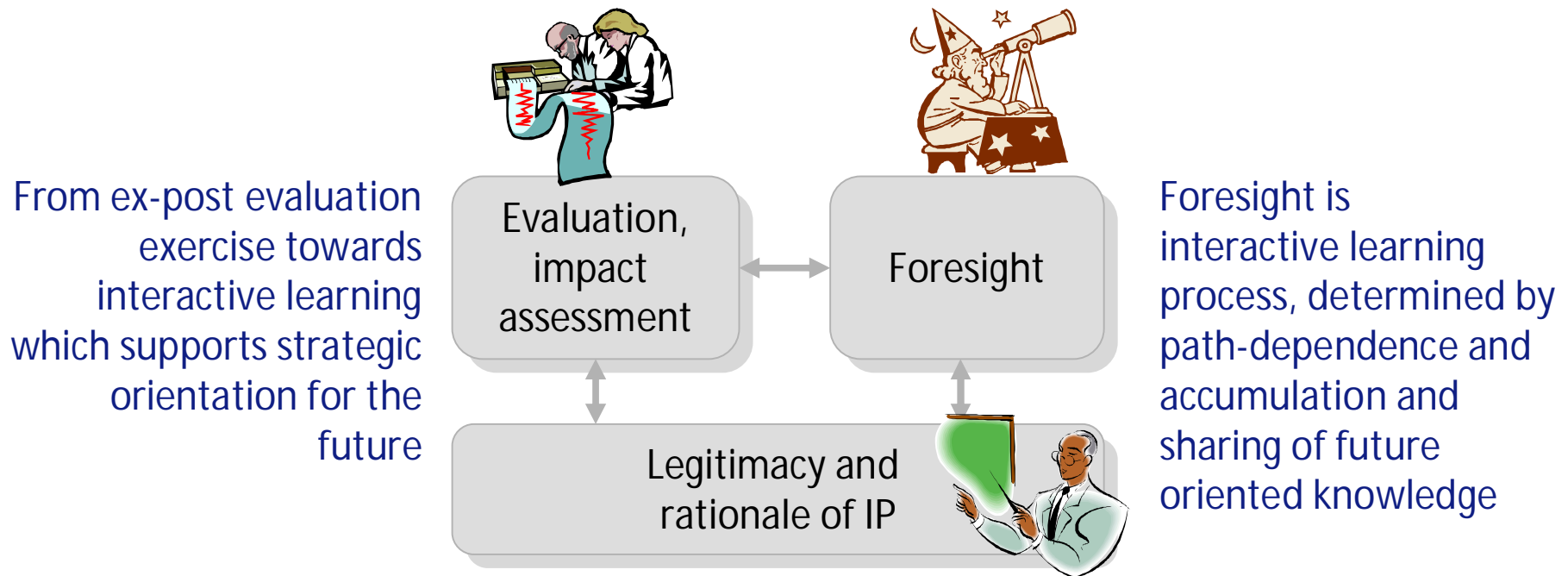
# Towards Linking of Past - Current - Future in Policy-Making



Source: Valovirta and Hjelt, 2006



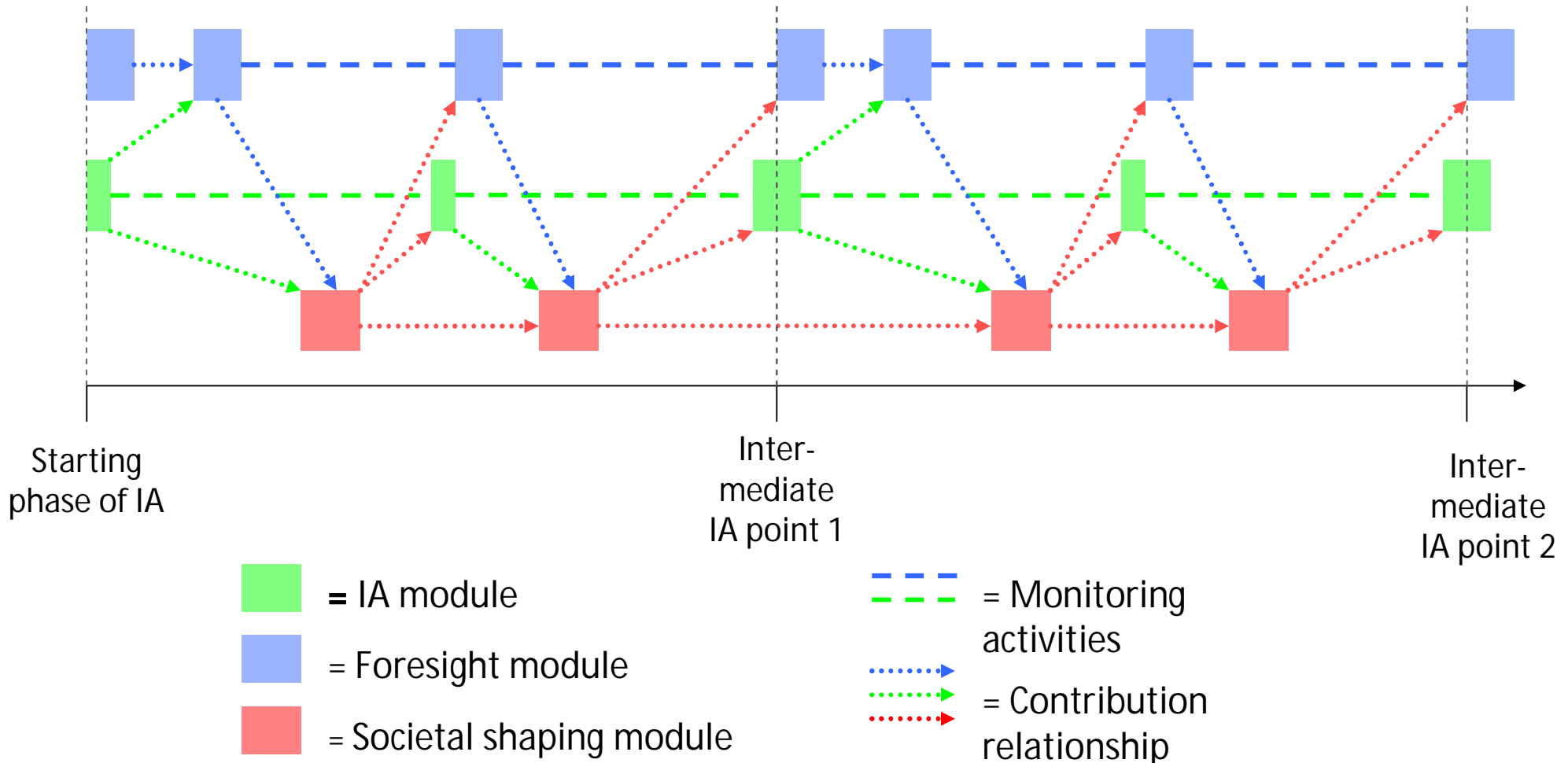
## Converging IA and foresight



Elements for enhancing strategic policy intelligence by integrating the tools among decision-makers and experts – Towards strategic Intelligence combining evaluation, technology foresight and technology assessment tools

# Setting, follow-up and re-direction of targets

## Example of Future Oriented Impact Assessment Model (FORIAS)



## Foresight activities in Finland – some conclusions

- Foresight and future oriented thinking gaining ground  
-- spurred also by globalization, various uncertainties...
- Demand in industries and confederations increasing
- Activities of innovation policy organizations -- MTI, Tekes, Academy, VTT, SITRA, national platform, etc.
- EU initiatives (7th FP, TPs, JITs) and networks (ESTO, ETEPS, ERAWATCH, FORERA, For-Learn...)
- Nordic initiatives -- NICE & NER (H<sub>2</sub>, ICT...), Foresight forum
- Legitimacy of IP and public research funding topical issues  
-- spur to conceptual development of ex-ante IA and foresight?
- Still (from service provider´s aspect): fragmented, not well-coordinated -- systematic -- well-established, inadequately resourced

## Sources and Guidelines to Foresight e.g.

The FOR-LEARN Online Foresight Guide

[http://forlearn.jrc.es/guide/0\\_home/index.htm](http://forlearn.jrc.es/guide/0_home/index.htm)

Technology Foresight Manual of UN Industrial Development Org. (UNIDO)

<http://www.unido.org/index.php?id=o45321>

Knowledge Sharing Platform

<http://cordis.europa.eu/foresight/platform.htm>

European Foresight Monitoring Network

<http://www.efmn.info/>

ForSociety ERA-Net

[http://forlearn.jrc.es/guide/A2\\_references/forsociety.htm](http://forlearn.jrc.es/guide/A2_references/forsociety.htm)

Handbook for Knowledge Society Foresight

 **Foresight Linux**

[http://forlearn.jrc.es/guide/A2\\_references/handbook.htm](http://forlearn.jrc.es/guide/A2_references/handbook.htm)

<http://www.foresightlinux.org/>



VTT creates business from technology