Technology Roadmapping as a foresight instrument

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Byeongwon Park

Technology Foresight Center
Korea Inst. S&T Evaluation and Planning

What is Technology Foresight?

- B. Martin (1995):- Research foresight is “the process involved in systematically attempting to look into the longer-term future of science, technology, the economy and society with the aim of identifying the areas of strategic research and the emerging generic technologies likely to yield the greatest economic and social benefits”

- L. Georghiou (1996):- Technology foresight is “a systematic means of ass essing those scientific and technological developments which could have a strong impact on industrial competitiveness, wealth creation and quality of life”

- Foresight Handbook(2002): Systematic, participatory process, involving gathering intelligence and building visions for the medium-to-long-term future and aimed at informing present-day decisions and mobilizing joint actions

Chronology of Technology Foresight Studies

Year	Delphi	Mixed	Panel/Scenario
1970-	Japan		
1989			Netherlands
1990	1st Germany 5th Japan		OECD(→Present)
1991			1st USA Critical Technology
1992			New Zealand, UN(→Present)
1993	1st Korea		2nd USA-Critical Tech, Germany-21C Tech
1994	France, Japan, Germany	1st UK	Netherlands
1995	6th Japan		France-100 Core Tech, 3rd USA- Critical Tech
1996	Japan Germany		Australia-ASTEC, Finland(1996-98),India, Philippines Netherlands, Italy Industry Tech ACUNU Millennium Projects, Nigeria
1997		Spain-OPTI	Ireland
1998	Austria, Germany USA George-Washington Uinv.		South Africa, NewAealand Sweden, 4th USA-Critical Tech, Norway, APEC EU-IPTS Futures, Netherlands, Spain
1999	2nd Korea Spain	APEC Hungary-TEP	2nd UK, Germany-FUTUR(→Present), Ireland, Italy, Spain
2000		Venezuela	2nd France-100 Core Tech Italy 2nd Industry Foresight, China, Portugal, Brazil, Spain
2001	7th Japan		Czech, Malta, Cyprus, Estonia,Denmark
2002		Turkey	Bulgaria, Rumania, 3rd UK(→Present)
2003-4	China	3rd Korea (→2004) 8th Japan(→2004)	EU(FP 6 →2006) Germany(every year), UN, OECD,Slovakia, Sweden
2005-7	China	3rd (revision) Korea Japan (Innovation 2025)	Austria, France, APEC, OPEC, EU(FP 7), UNIDO(TF tutorial), IPTS, OECD, UN etc
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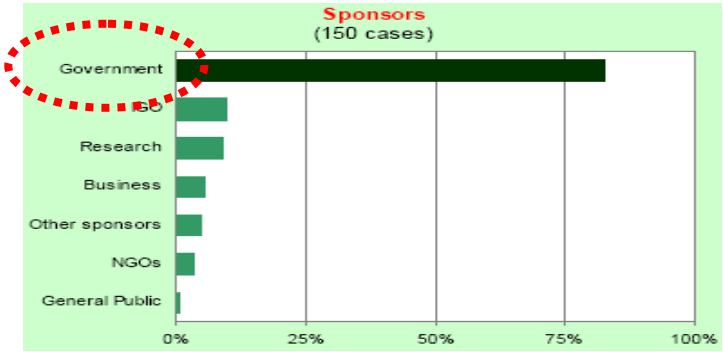
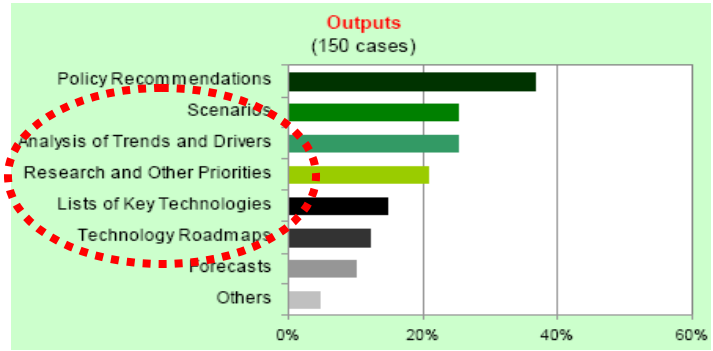
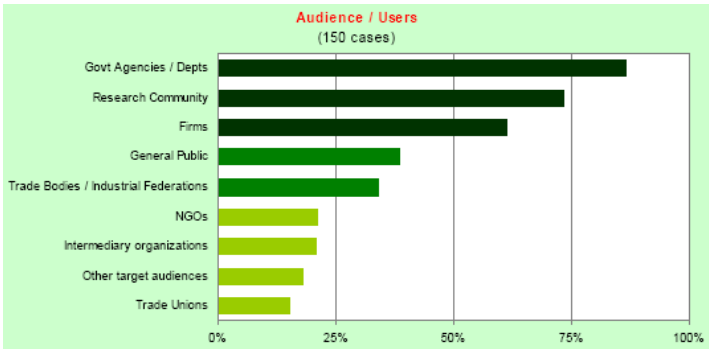
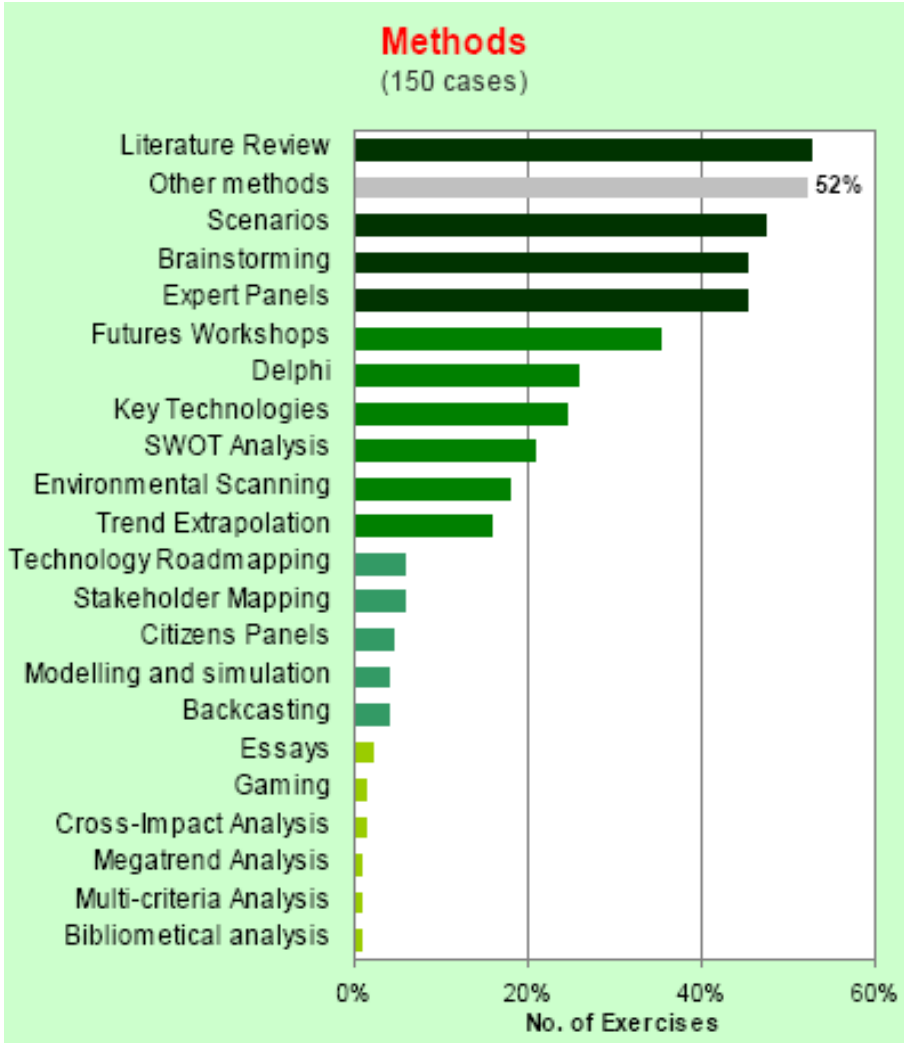
Mapping of Foresight Activities



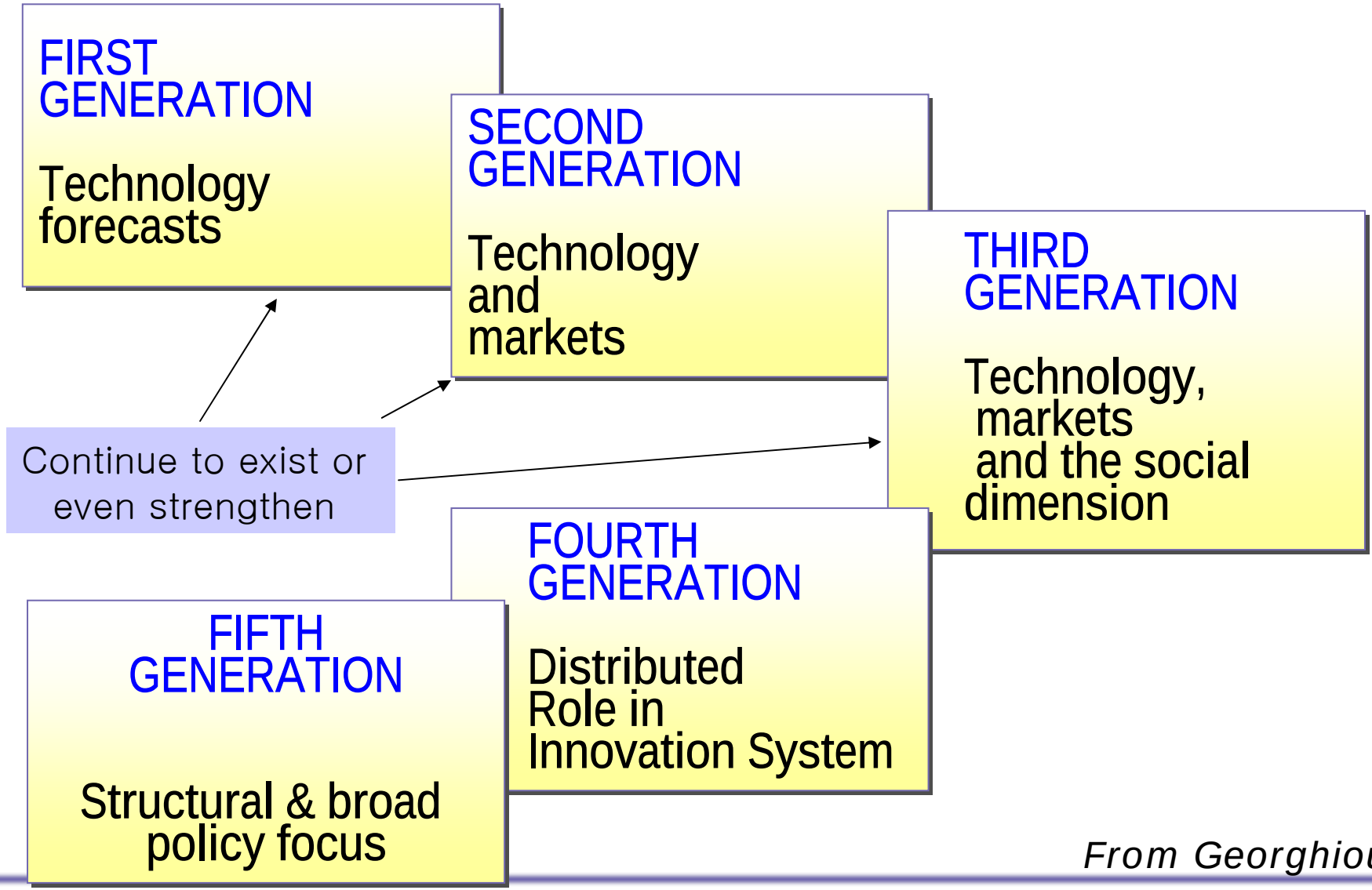






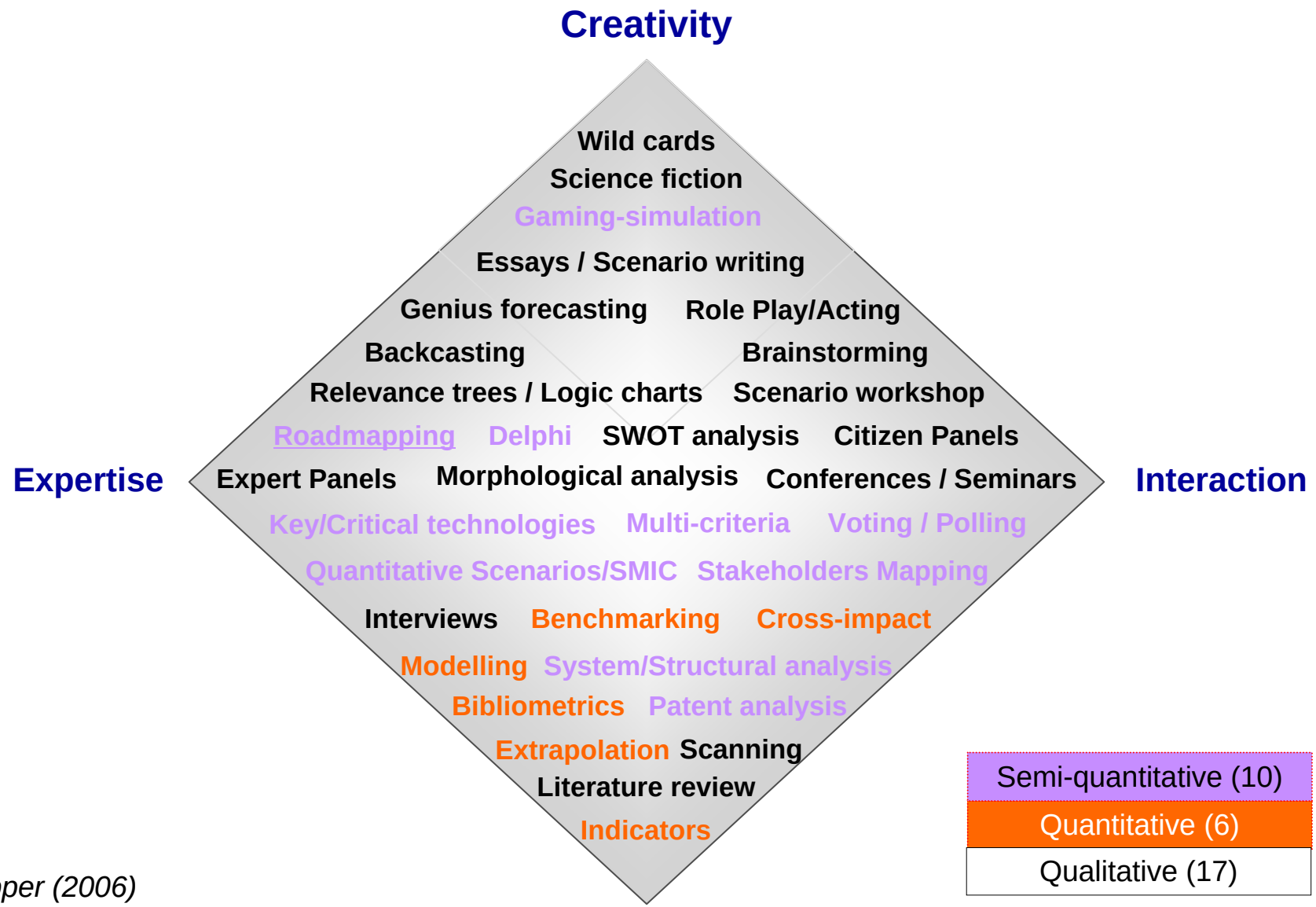
*from EFMN **2005 Foresight Mapping Report***

Five Generations of Foresight



From Georghiou

Foresight Methods(1)

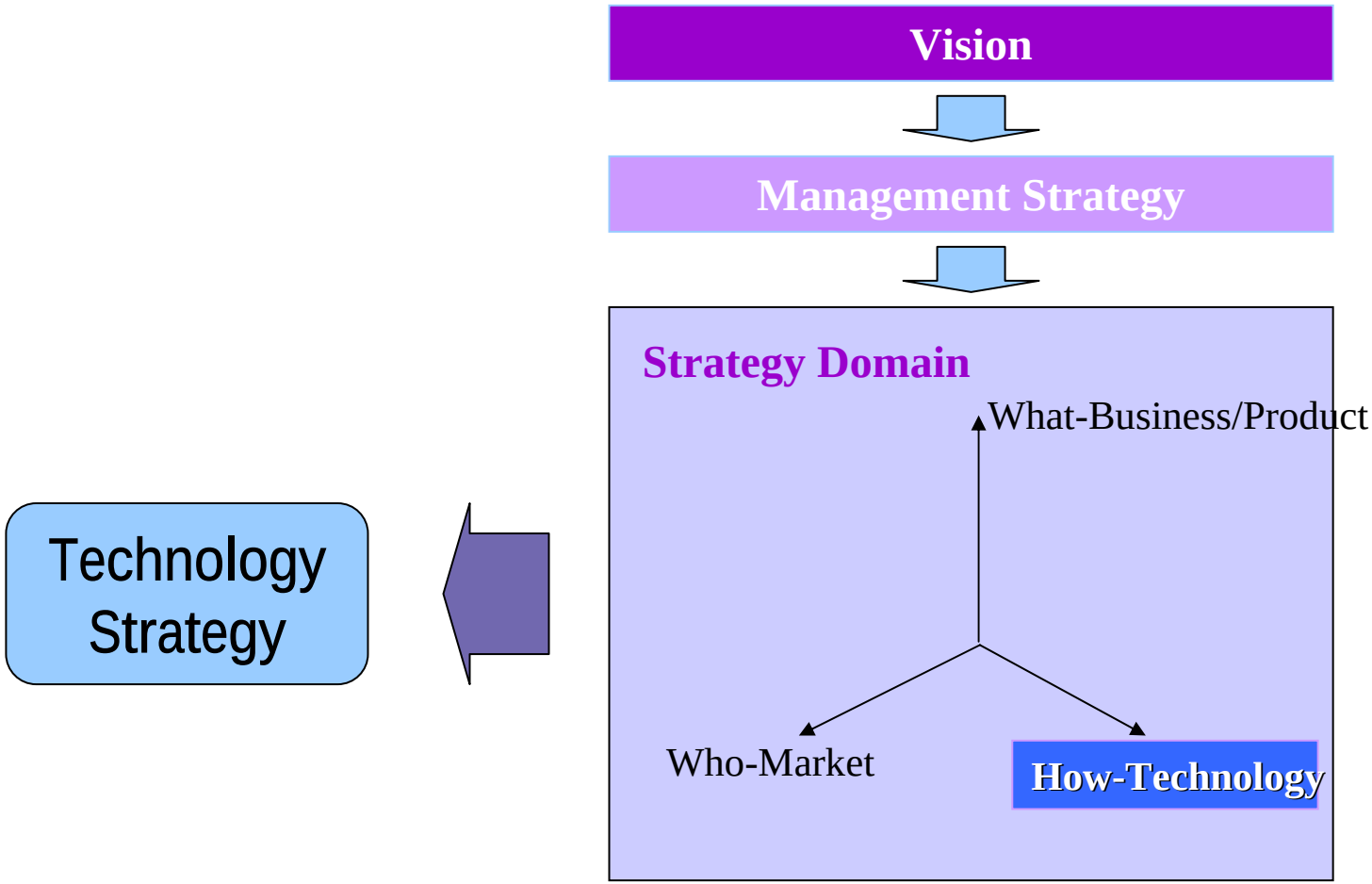


From R. Popper (2006)

Foresight Methods(2)

Methods & Tools	Diagnosis		Prescription		Qualitative		Exploratory		Open
		Prognosis		Quantitative		Normative		Predictive	
Environmental Scanning & Watching	XX			X	X				
System Dynamics	XX			X	X		X	X	
Structural Analysis (e.g. MICMAC)	XX			X	X		X	X	
Agent Modelling (e.g. MACTOR)	XX				X		X	X	
SWOT Analysis	XX	X			X		X	X	
Trend Intra & Extrapolation	X	XX		X	X		X	X	
Modelling & Simulation	X	XX		X			X	X	
Gaming	X	XX			X		X		X
Creativity Methods (Brainstorming, Mindmapping…)	X	XX	X		X	X	X		X
Expert Panels		XX	X		X	X	X		X
Delphi survey	X	X	X	X	X	X	XX	X	
Backcasting		X	XX	X	X	X		X	
S&T Roadmapping		X	X		X	XX	X	X	
Critical & Key Technology Study	X	X	XX	X	X	X		X	
Scenario Building		XX			X	X	X		X
Morphological Analysis & Relevance Trees		XX	X		X	X			X
Cross-Impact Analysis (e.g. SMIC)		XX		X	X		X		X
Multi-Criteria Analysis (e.g. MULTIPOL)			XX	X	X	X		X	

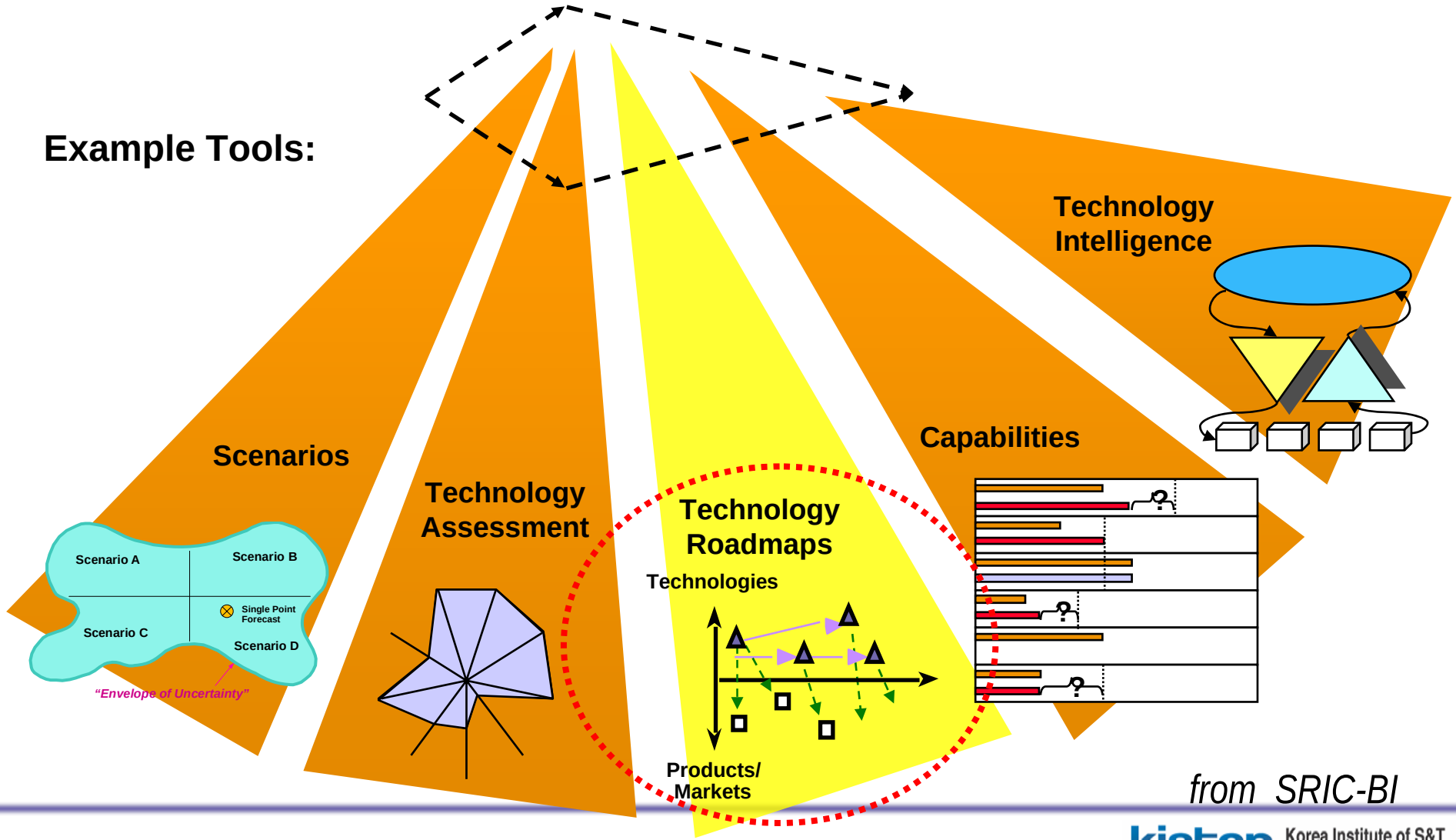
Technology Strategy: Domain



Technology Strategy: Development

Various Tools for Each Stage of Development

Example Tools:



from SRIC-BI

TRM and Technology Roadmapping

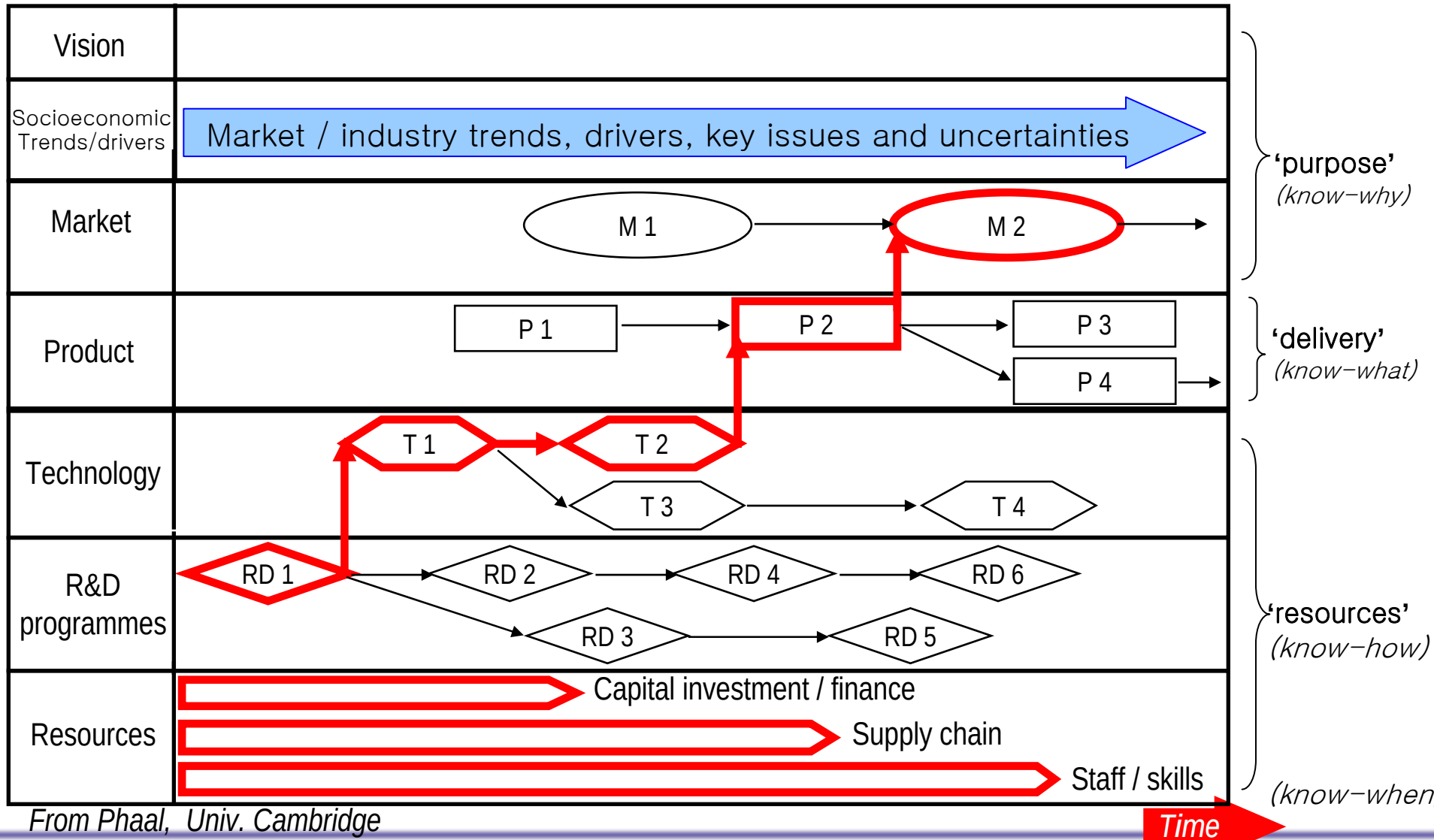
- Technology Roadmap
  - is a group's view of how to get where they want to go, in order to achieve their desired objectives.
  - Is a needs-driven technology planning process to help identify, select and develop technology alternatives to satisfy identified needs
  - helps the group assess and cultivate the capabilities to achieve their objectives are in place at the time needed.

- Technology Roadmapping
  - is a learning process.
  - is a consensus building process.

Characteristics of TRM

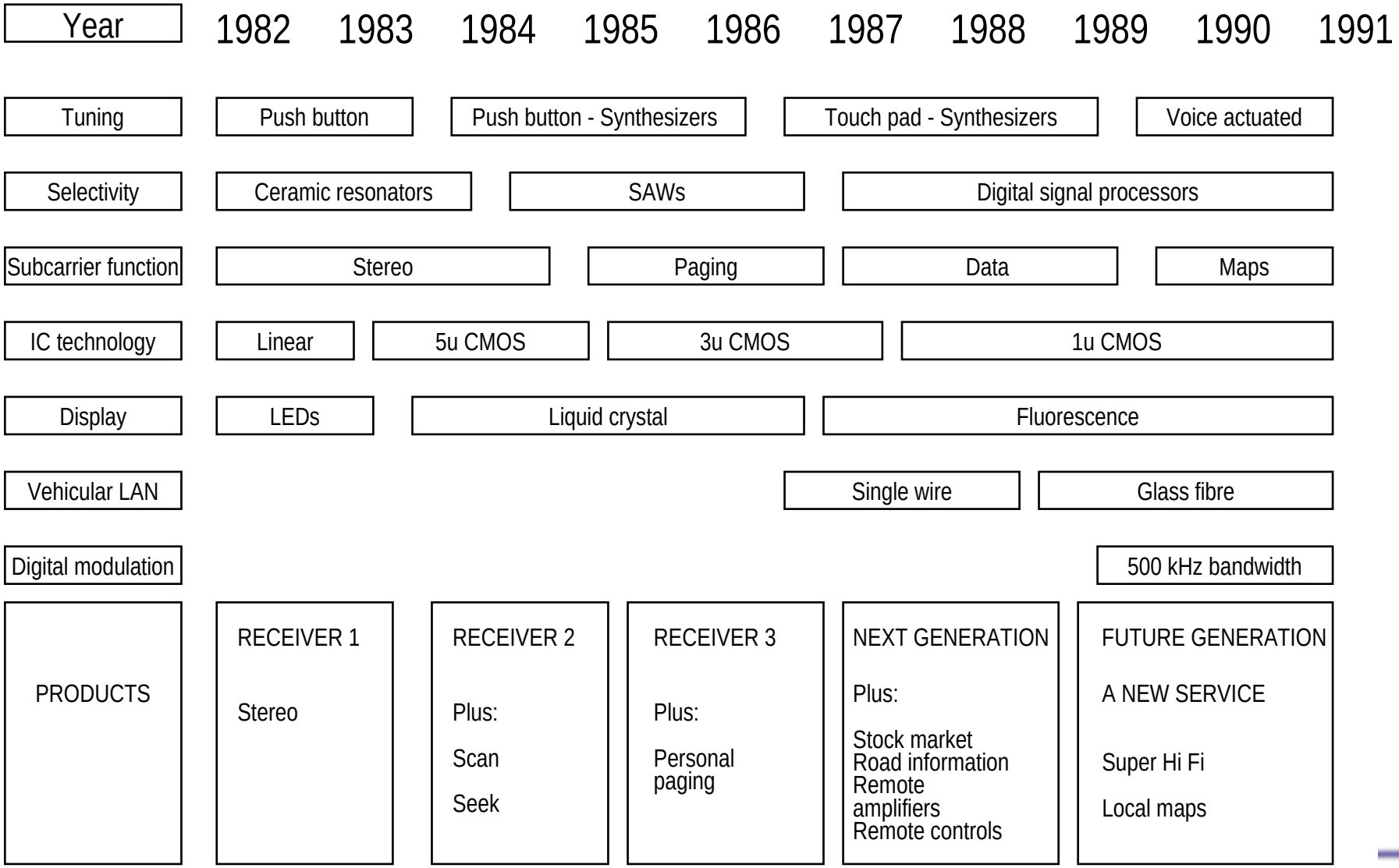
- The essential of the TRM process
  - Is Normative foresight tools requiring agreement be reached about future that should be achieved
  - Is Industry and/or market driven
  - Has a time horizon of 5-15 years
  - Requires assembly of experts
- TRM provides
  - A means to develop a consensus about a set of needs and the technologies required to satisfy those needs
  - A mechanism to help experts forecast technology developments in targeted areas
- TRM helps to
  - Identify critical product needs that will drive technology selection and development decision
  - Determine the technology alternatives
  - Select appropriate technology alternatives
  - Generate and implement a plan to develop deploy appropriate technology alternatives

Roadmapping - Planning for the Future

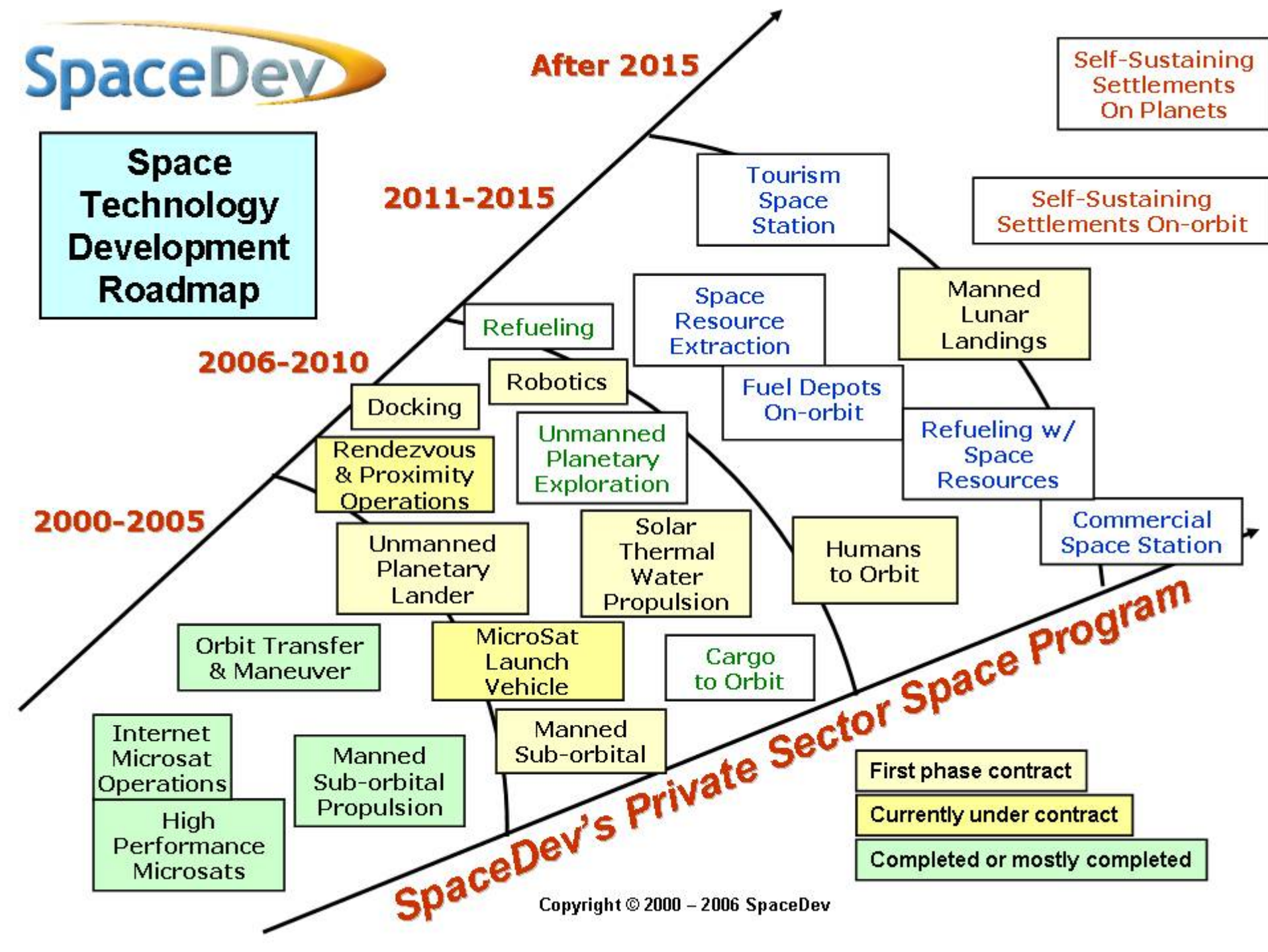


From Phaal, Univ. Cambridge

Motorola Roadmap Matrix : product plans and technology forecast



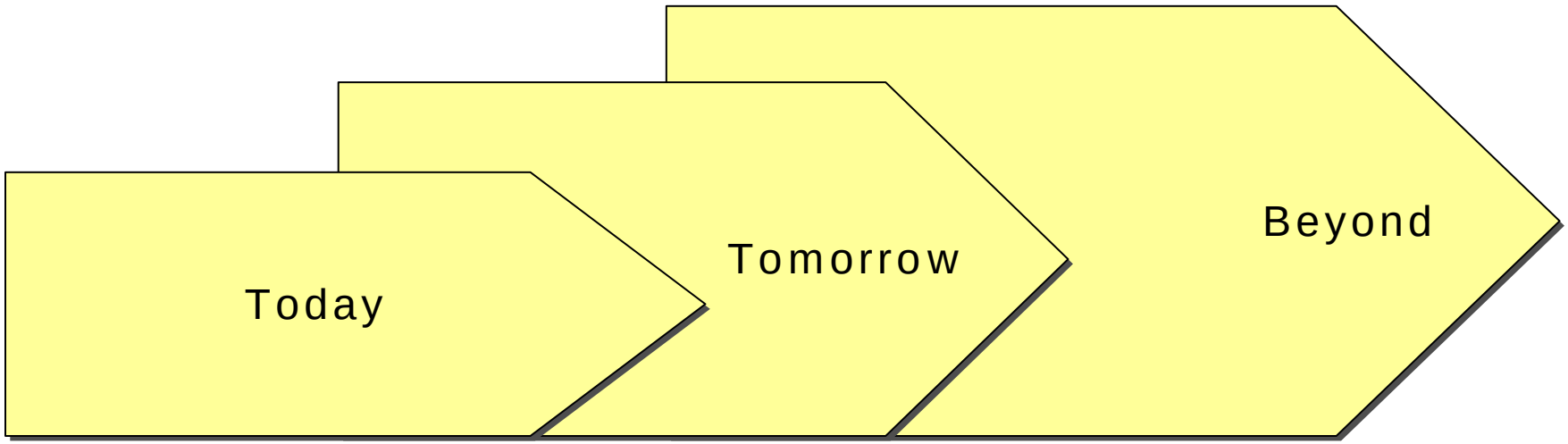
Source: Willyard & McClees, 1987



TRM for Human Language Technology

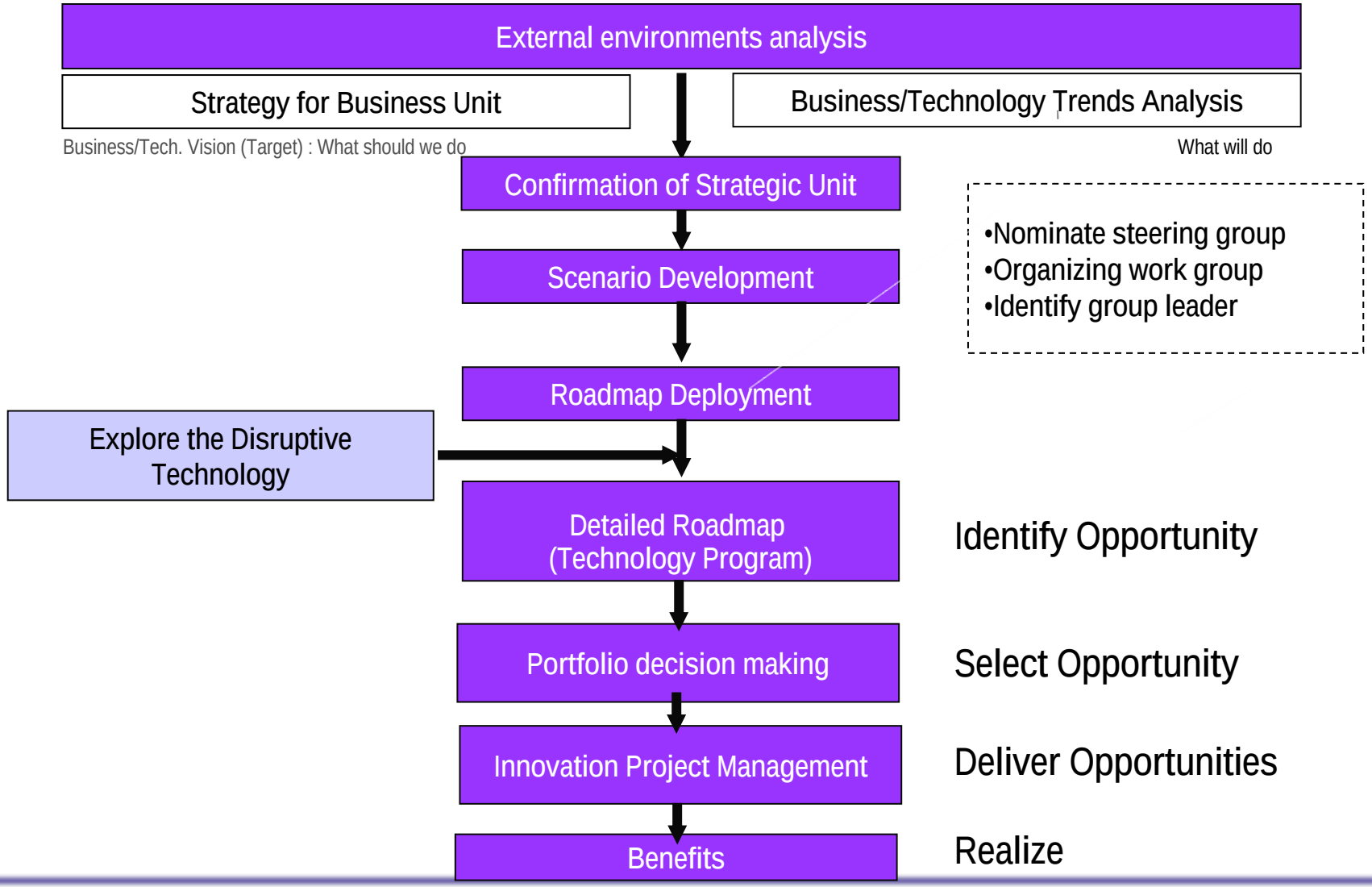
from http://elsnet.dfki.de/

Identifying Future Opportunities



Expanding businesses	Anticipating business needs	Creating major opportunities together
execution	Opportunity	Break out

Vision-Driven Technology Roadmapping Process



Identifying Future Opportunities

Make the future "Visible"

What industry Events can we forecast - When?
What competitor Events might take place - When?
What technology Events are possible - When?
What regulatory/legislated Events - When?

Discuss the potential implications of future Events

What trends have we surfaced - implication?
What drivers have we identified - implication?

Identify potential opportunities

Where and when do existing products/attributes fall short of meeting needs or solving problems?
Where and when do existing technologies fail to deliver the forecast attribute performance?
What discontinuities come to light?

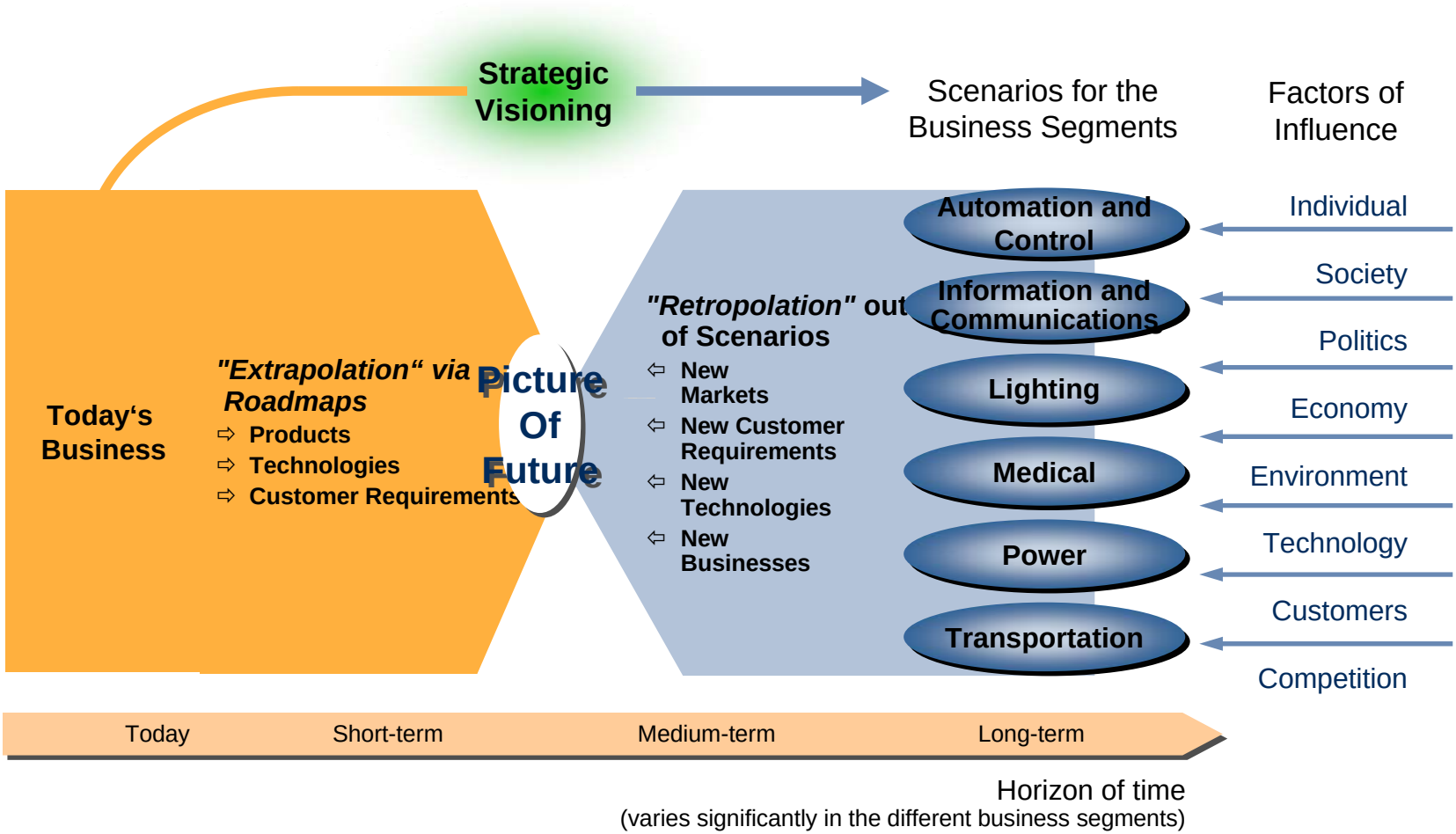
Prioritize and choose which opportunities to pursue

Standard Portfolio approaches
Assure balance
Assure fit with existing/future competencies

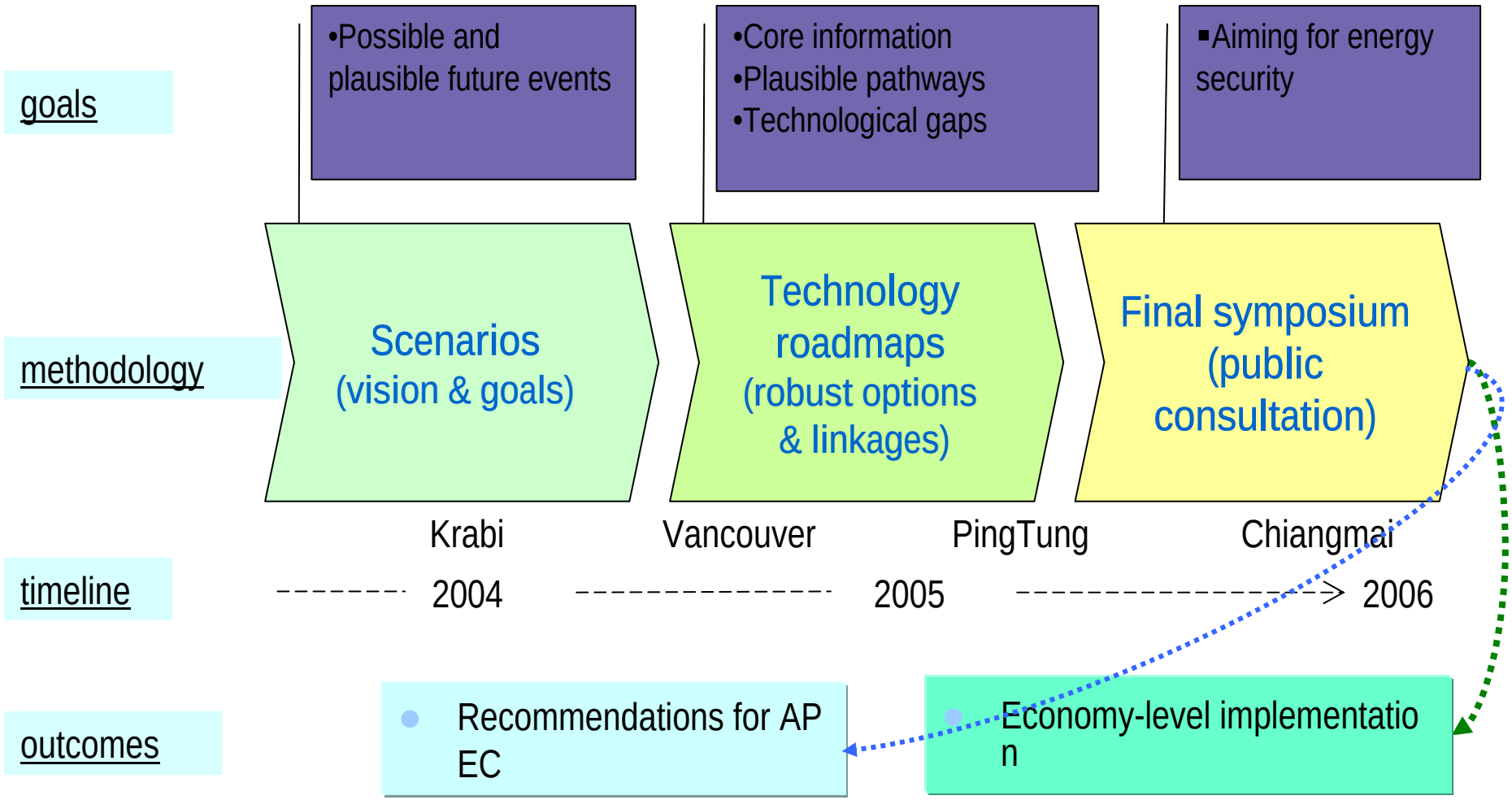
Develop coordinated roadmaps to achieve the opportunities

Market Events, Trends, Drivers
Needs, Problems, Opportunities
Product, Attribute performance
Technology
Project, Resource planning, Manufacturing

Siemens : Strategic Planning of Innovations & Technologies



Future Fuel Technology Scenario and Roadmapping for Asia-Pacific

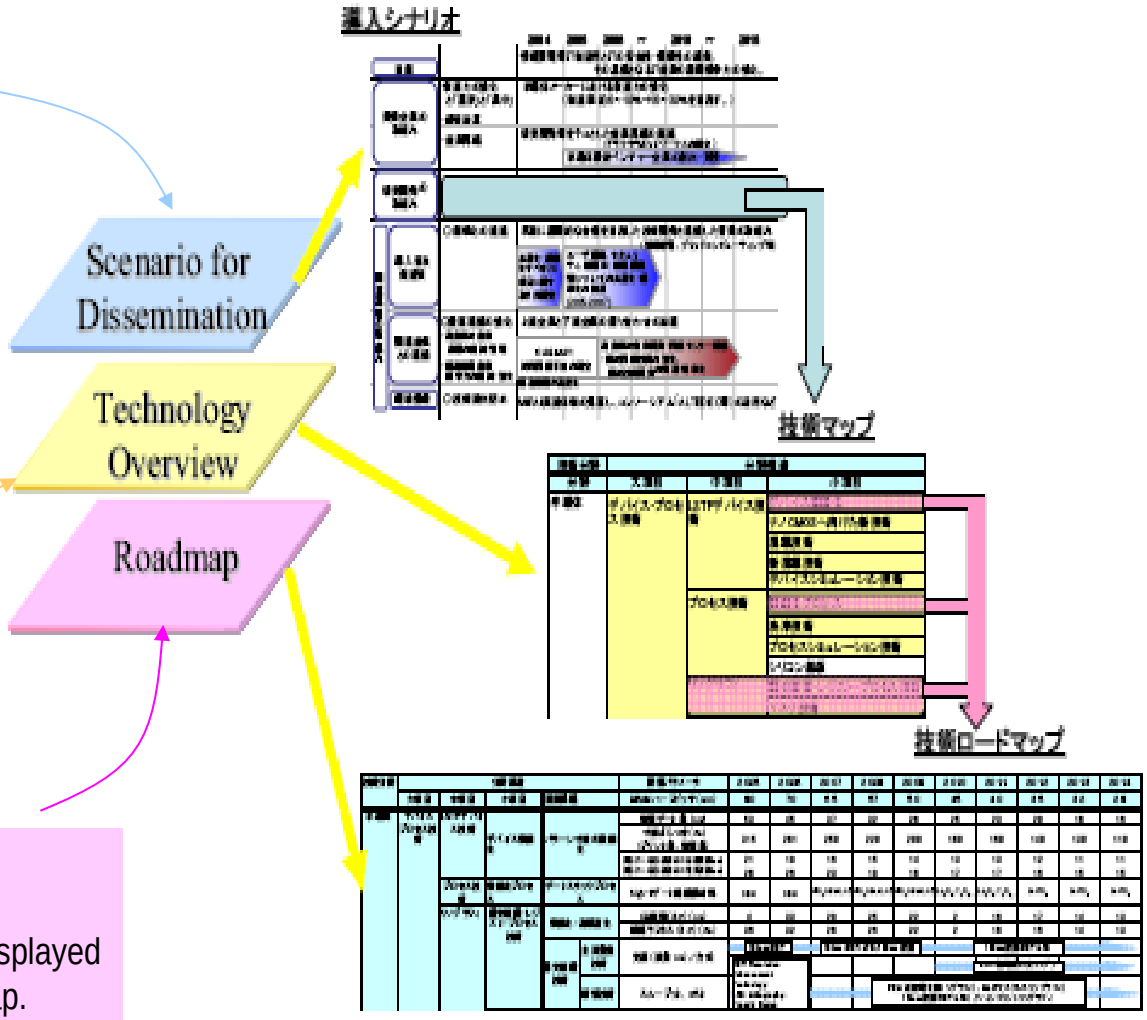


Japan NEDO's "Strategic Technology Roadmap (STR)"

The Scenario for Introduction includes relevant policies that should be dealt with in order to provide the public with findings of R&D as products and services.

Prioritized critical technologies are sescribed in the Technology Overview in addition to technological challenges, elemental technologies, and desired functions in order to satisfy market and social needs.

Improvement and progress of elemental technologies generated from R&D, and the enhancement of the desired functions are displayed on a time axis as milestones in The Roadmap.



Korea's National Technology Roadmap

Analysis of Industrial Need ⇨ 5 visions ⇨ 13 Directions ⇨
49 Strategic Product/Functions ⇨ 99 Key Technologies ⇨ NTRM

- ❖ Incorporate existing TRMs into NTRM with necessary modifications
- ❖ Handle basic S&T separately from NTRM based on bottom-up approach

- ❖ NTRM include Macro Roadmaps for strategic product/functions and detailed TRM for chosen key technologies

VISION 1 : Building an information-knowledge-intelligence society
VISION 2 : Aiming at Bio-Healthtopia
VISION 3 : Advancing the E2 Frontier
VISION 4 : Upgrading the Value of Major Industries of Korea Today
VISION 5 : Improving National Safety and Prestige

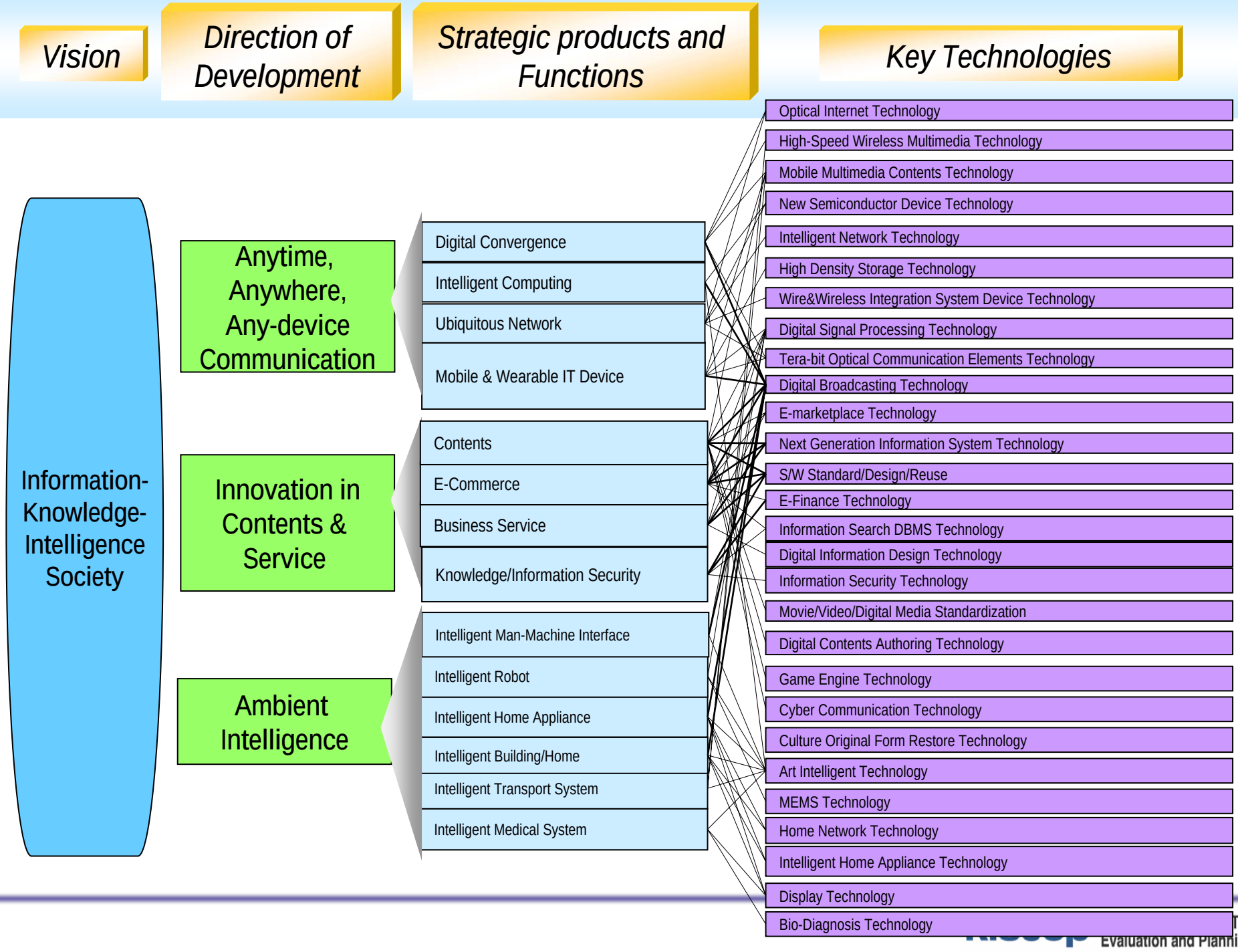
VISION 1. Building an Information-Knowledge-Intelligence Society

Meeting a variety of human needs in all areas of life by making IT service more intelligent, mobile, and user-friendly

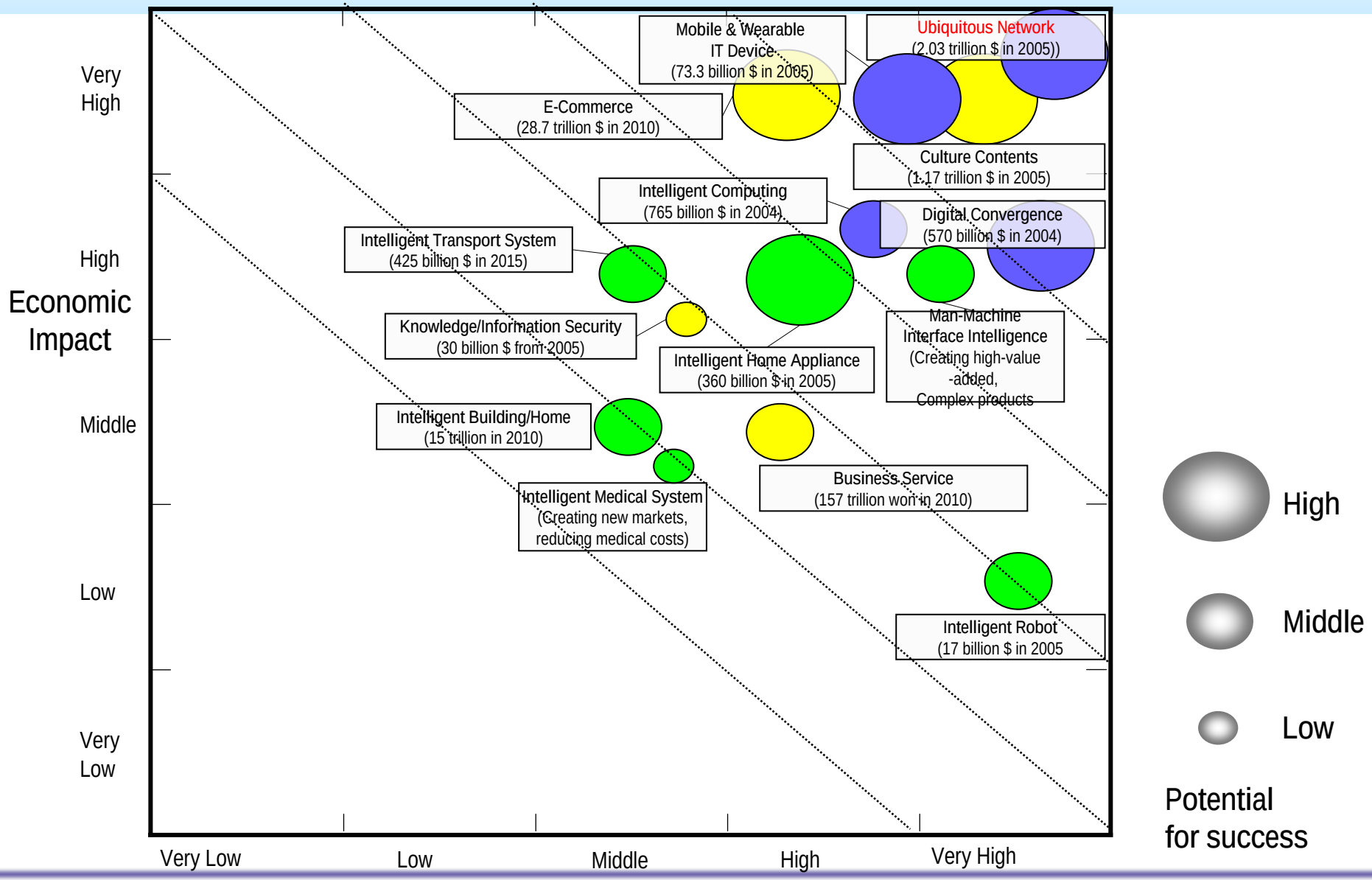
Anytime, Anywhere, Any-device Communication

Innovation in Contents & Service

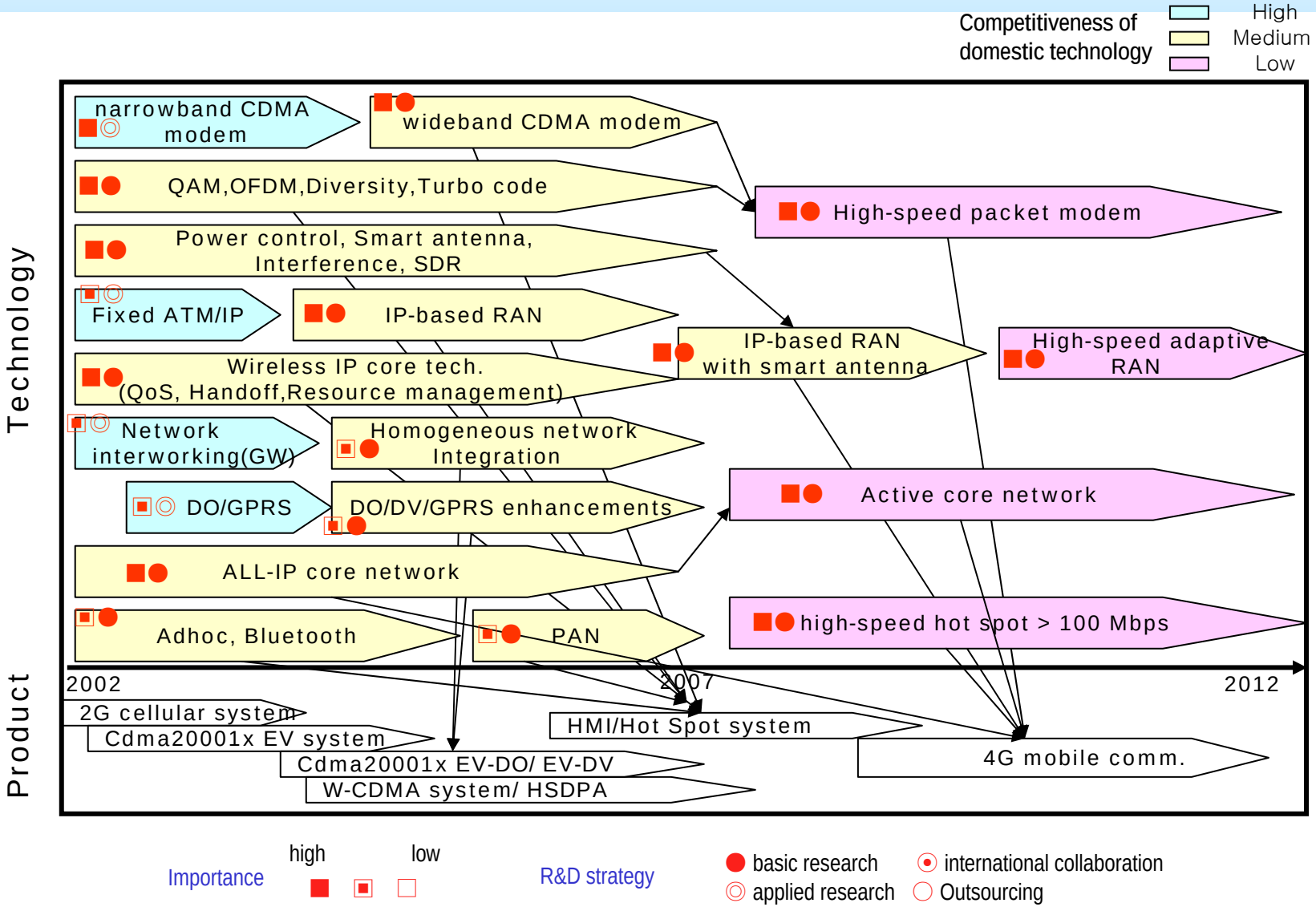
Ambient Intelligence


Vision
Direction of Development
Strategic products and Functions
Key Technologies
Information-Knowledge-Intelligence Society
Anytime, Anywhere, Any-device Communication
Innovation in Contents & Service
Ambient Intelligence
Digital Convergence
Intelligent Computing
Ubiquitous Network
Mobile & Wearable IT Device
Contents
E-Commerce
Business Service
Knowledge/Information Security
Intelligent Man-Machine Interface
Intelligent Robot
Intelligent Home Appliance
Intelligent Building/Home
Intelligent Transport System
Intelligent Medical System
Optical Internet Technology
High-Speed Wireless Multimedia Technology
Mobile Multimedia Contents Technology
New Semiconductor Device Technology
Intelligent Network Technology
High Density Storage Technology
Wire&Wireless Integration System Device Technology
Digital Signal Processing Technology
Tera-bit Optical Communication Elements Technology
Digital Broadcasting Technology
E-marketplace Technology
Next Generation Information System Technology
S/W Standard/Design/Reuse
E-Finance Technology
Information Search DBMS Technology
Digital Information Design Technology
Information Security Technology
Movie/Video/Digital Media Standardization
Digital Contents Authoring Technology
Game Engine Technology
Cyber Communication Technology
Culture Original Form Restore Technology
Art Intelligent Technology
MEMS Technology
Home Network Technology
Intelligent Home Appliance Technology
Display Technology
Bio-Diagnosis Technology

Portfolio Analysis of Strategic Products and Functions



High-speed Wireless Multimedia/ 4G Mobile Communication



Roadmap and Foresight Tools

Brainstorming
For ideation

STEEPV
(Social, Technological, Economic, Environmental, Political, Value& Norm)

Cross Impact Analysis

Porter's Five Forces

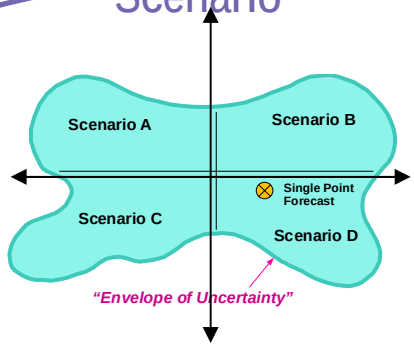
Technology Intelligence (Bibliometrics, Scanning)

Delphi/Expert Panel
For ideation & Prioritization

Vision
Trends/Driver
Market
Business
Product
Service
System
Technology
Resources
t

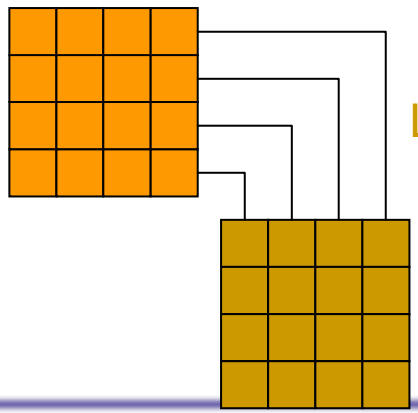
Innovation System
Structure
(taxonomy)
Scaleable
(hierarchy)

Scenario

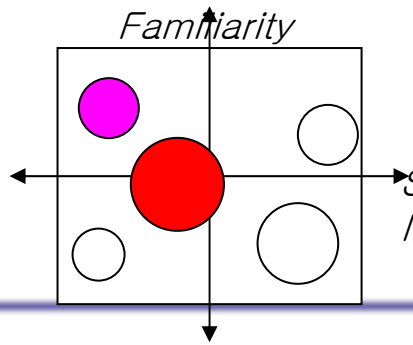


Valuation / Balanced scorecard

Linking grids



Portfolio



Conclusion

- The main aim of national and regional foresight is to inform agenda setting in research and development program
- The methods employed for this purpose covers a broad range and are not limited to a single method
- Technology Roadmapping is one of Technology Foresight activities and a useful tool to identify the business opportunities through normative approach for desirable futures