

# Science, Technology and Innovation Policy & Strategy Development – *A Stakeholder Engagement Perspective*

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Needs to Help Develop a Sustainable and Productive  
Science and Technology Policy  
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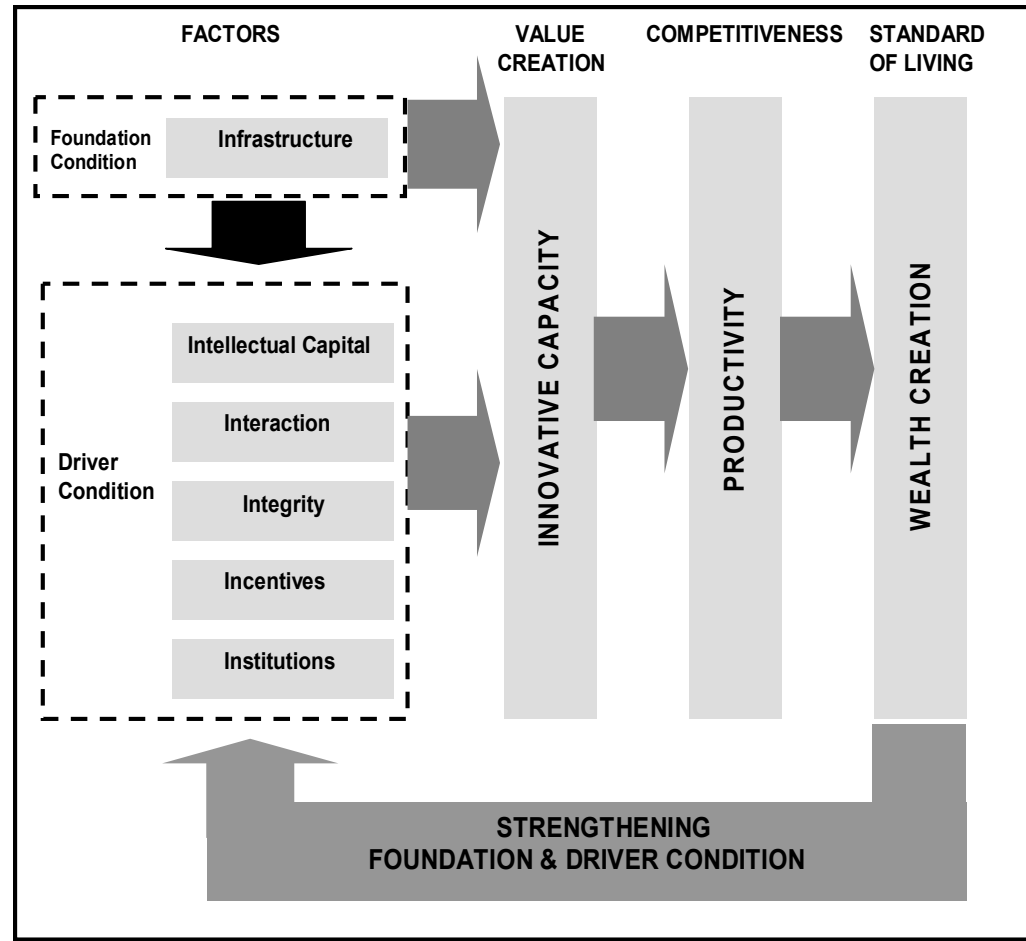
# Contents

1. The knowledge-based innovation economy
2. Innovation challenges in developing countries
3. The importance of National Innovation Ecosystem
4. A policy and strategy formulation process
5. Case study: Process flow to develop an NIE
6. Way forward

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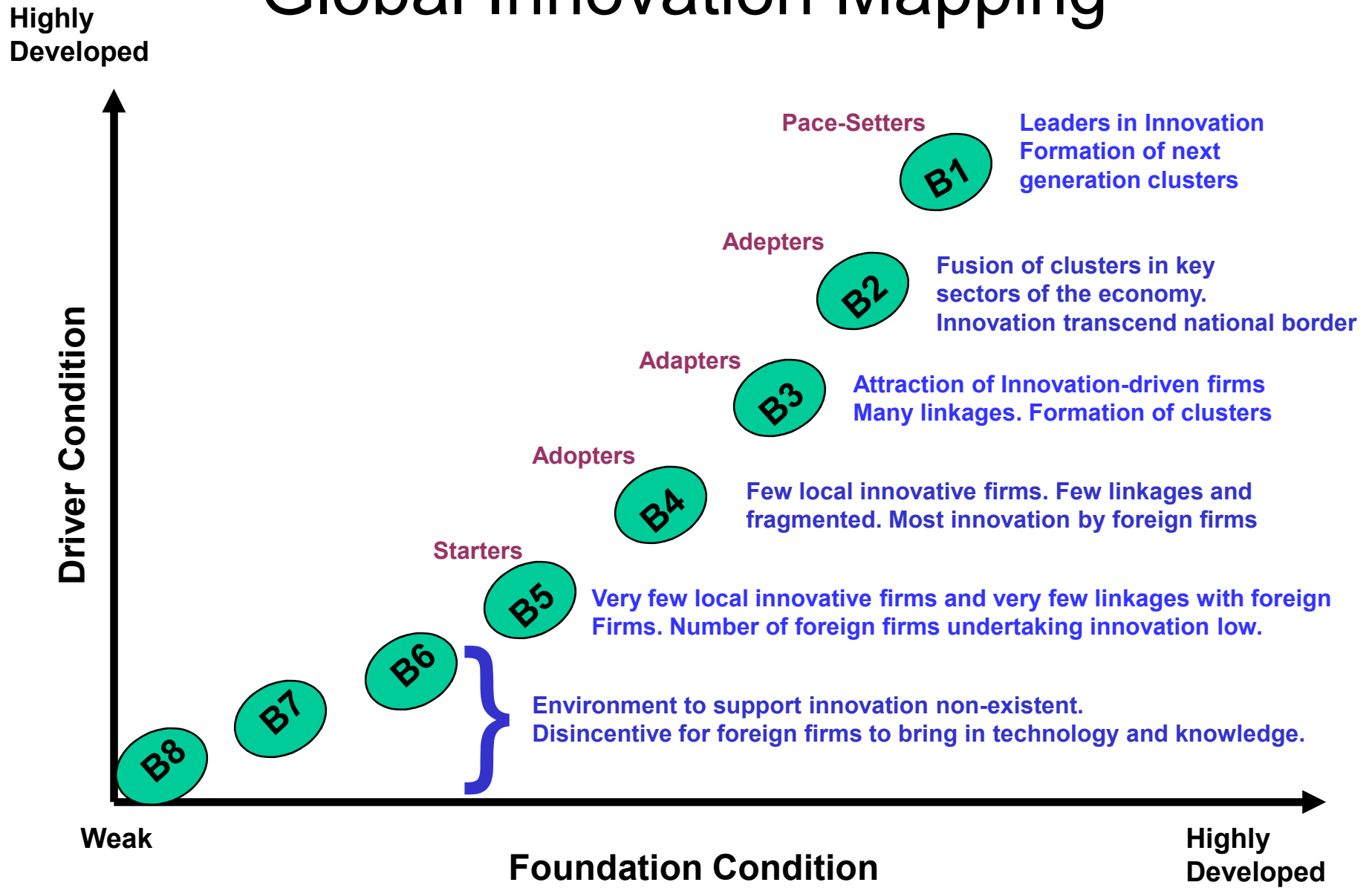
# Framing the Knowledge Economy Powered by Innovation



Source:

Nair, M. (2007), "The 'DNA' of the new economy,"  
*Economic Bulletin*, Volume 8, 27-59.

# Global Innovation Mapping



# Innovative Capacity

Band 1	Band 2	Band 3	Band 4	Band 5	Band 6	Band 7	Band 8
Germany	Denmark	Australia	Costa Rica	Malta	Pakistan	Armenia	Georgia
Japan	Austria	Slovenia	Hungary	Mexico	Trinidad and Tobago	Uganda	Moldova
Switzerland	Netherlands	Puerto Rico	Qatar	Philippines	Kazakhstan	Burkina Faso	Macedonia, FYR
Sweden	France	Spain	Uzbekistan	Croatia	Argentina	Cambodia	Albania
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Taiwan	Norway	Tunisia	Thailand	Kenya	Benin	Mali	Mongolia
Israel	Canada	Chile	Slovak Republic	Guatemala	Bulgaria	Cameroon	Paraguay
	Hong Kong SAR	United Arab Emirates	China	Barbados	Dominican Republic	Libya	Bosnia and Herzegovina
	Iceland	South Africa	Jordan	Morocco	Vietnam	Algeria	Ethiopia
	Malaysia	Kuwait.	Ukraine	Mauritius	Mauritania	Bangladesh	Bolivia
	Luxembourg	Lithuania	Azerbaijan	Bahrain	Gambia, The		Mozambique
	Ireland	Brazil	Egypt	Colombia	Serbia		Zambia
	Italy	Portugal	Romania	Peru	Tanzania		Chad
		Saudi Arabia		Syria	Venezuela		Timor-Leste
		Estonia		Jamaica	Ecuador		Zimbabwe
		Turkey		El Salvador	Madagascar		Burundi
		Indonesia		Nigeria	Botswana		Lesotho
				Senegal	Montenegro		
					Namibia		

## FACTORS

1. Firm-level technology absorption
2. Local supplier quality
3. State of cluster development
4. Nature of competitive advantage
5. Value chain breadth
6. Control of international distribution
7. Production process sophistication
8. Extent of marketing
9. Local availability of process machinery
10. Capacity of innovation
11. Utility Patents (Hard data)

Source: Mahendhiran Nair, 2008

# Why innovation?

## Endogenous growth theory

- Growth determined by stock of knowledge and its effective application, especially technology
- Land, labour and capital necessary but not sufficient
- Increasing returns to scale, not diminishing returns

## World Economic Forum Growth Competitiveness Index

- Innovation is 9<sup>th</sup> pillar
- “the only self-sustaining driver of growth”

# Drucker on **innovation**

“Innovation is the specific tool of **entrepreneurs**, the means by which they exploit **change as an opportunity** for a different business or a different service. It is capable of being presented as a **discipline**, capable of being **learned**, capable of being **practised**. Entrepreneurs need to **search purposefully** for the sources of innovation, the changes and their symptoms that indicate opportunities for successful innovation. And they need to know and to apply the **principles of successful innovation.**”

p 17, Innovation and Entrepreneurship (1985)

# Drucker on entrepreneurship

“Entrepreneurship rests on a theory of economy and society. The theory sees change as normal and indeed as healthy. And it sees the major task in society – and especially in the economy – as **doing something different** rather than doing better what is already being done. This is basically what Say, two hundred years ago, meant when he coined the term *entrepreneur*. It was intended as a manifesto and as a declaration of dissent: the entrepreneur **upsets and disorganises**. As Joseph Schumpeter formulated it, his task is ‘**creative destruction**’.”

p 22, Innovation and Entrepreneurship (1985)

# Summary of Drucker's principles

## Innovation

- Act that endows resources with new capacity to create wealth
- A discipline: can be learned and practised
- Means to exploit change as an opportunity
- Specific instrument of entrepreneur

## Entrepreneurship

- Entrepreneurs are innovators
- Change is normal and healthy
- Doing something different, not better
- Needs purposeful search for sources of innovation
- Entrepreneur upsets and disorganises: “creative destruction”

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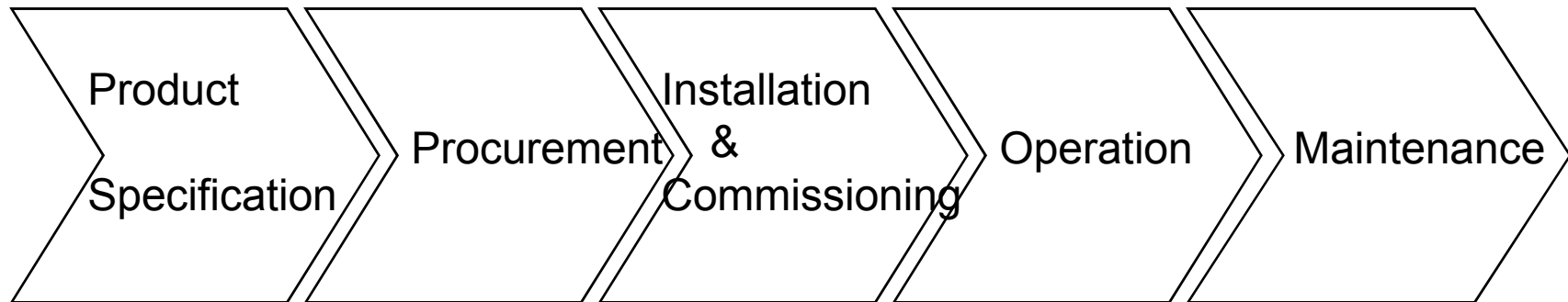
# Technology transfer

*“the process of developing practical applications from the results of scientific research”*

Distinction to be made between 2 perspectives with different objectives:

- Consumer perspective: the achievement of operational competency and efficiency
- Producer perspective: the design, production and marketing of innovative products with high value added

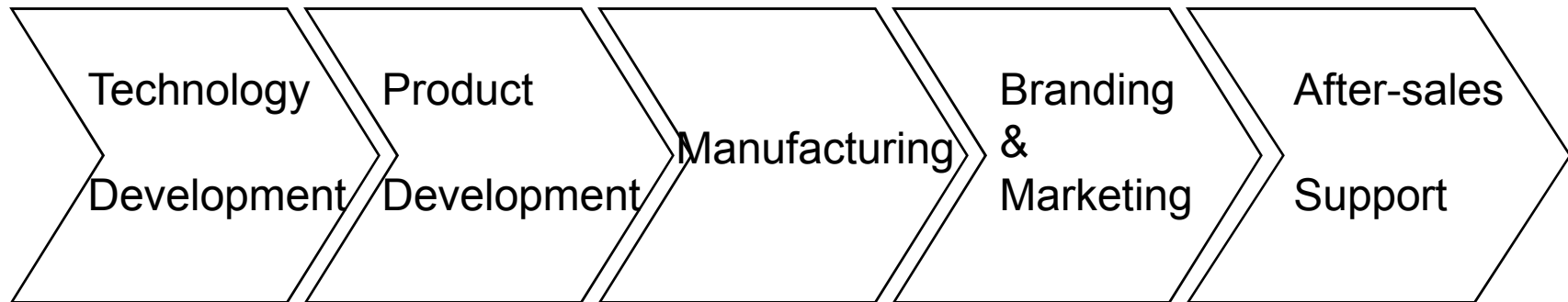
# Consumer perspective – Technology-based product *acquisition* value chain



## Key features

- Technology transferred is operational
- Limited scope for innovation or entrepreneurship

# Producer perspective – Technology-based product *development* value chain



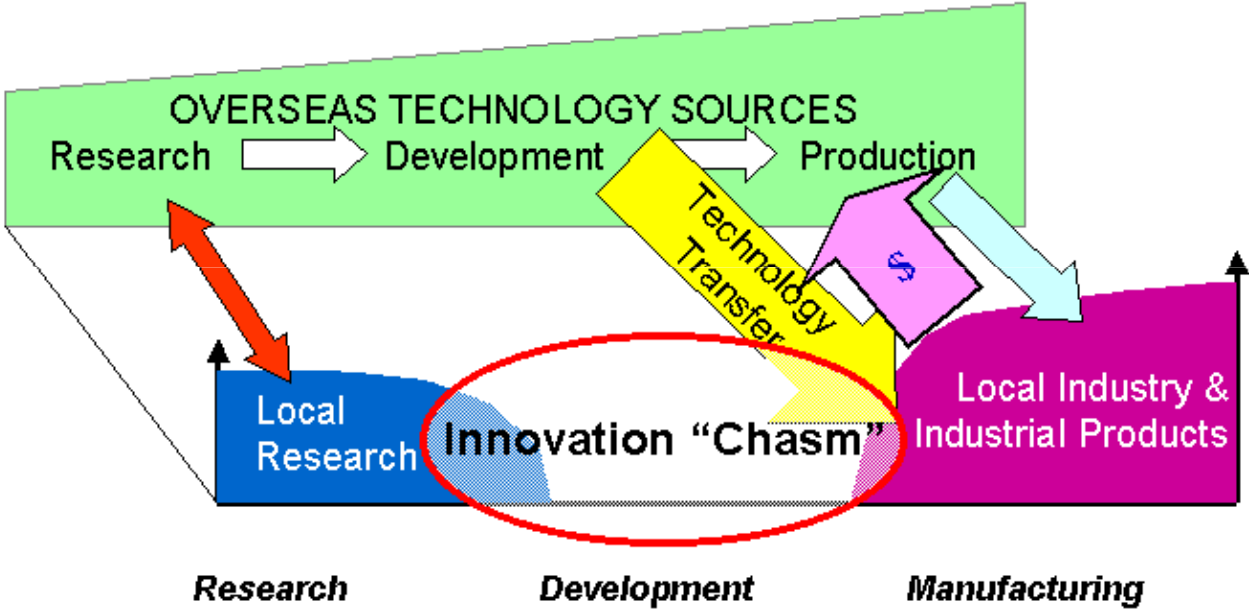
## Key features

- Producers are necessarily innovators and entrepreneurs
- Endow technology with new capacity to create wealth

Developing countries are **consumers** who need to grow by becoming **producers** in areas where they have competitive advantage...but they face major challenges

- Finding technology-based innovators and entrepreneurs and nurturing them
- Gaining access to technology
- Developing products, producing and marketing them
- Creating an environment for sustainable innovation and entrepreneurship

An "Innovation Chasm" exists which must be bridged



Adapted from: "Emerging from the technology colony: A view from the South," Gideon de Wet, UP.

# Why the innovation chasm occurs

- Producers and consumers operate in separate value chains, especially when producers are from industrialised countries selling products to developing countries
- Even if producers transfer production to consuming countries, knowledge and technology remain with them
- Consuming country's R&D not linked to product development process or markets, thus researchers not sensitive to consumer demand
- Consuming country's entrepreneurs lack skills and competencies to productize and monetize knowledge, thus have limited opportunity to become innovators
- Consuming countries do not generate surplus wealth to invest in serious R&D

# The two “failure modes”

**Failure mode 1:** R&D players in consuming countries lack knowledge of market needs

- R&D an intellectual exercise focused on generating new knowledge
- Weak linkages to product owners or to strategic national development challenges
- Poor skills in productizing and marketing knowledge: not “knowledge entrepreneurs”

**Failure mode 2:** industry players in consuming countries lack skills in commercializing R&D results

- Not focused on innovation, but trading activities
- Not “technology-based entrepreneurs”
- Lack management experience and competencies to take new products to global market
- Poor market access

# Bridging the innovation chasm to address the failure modes

- R&D players need to collaborate with technology owners and product owners to develop new knowledge with innovative potential – build global knowledge network and become knowledge hub
- Industry players need to develop in-house competencies to enable and facilitate the practice of innovation and entrepreneurship: become the champions of “creative destruction”, not its victims
- Build a National Innovation Eco-system for sustainable innovation and entrepreneurship

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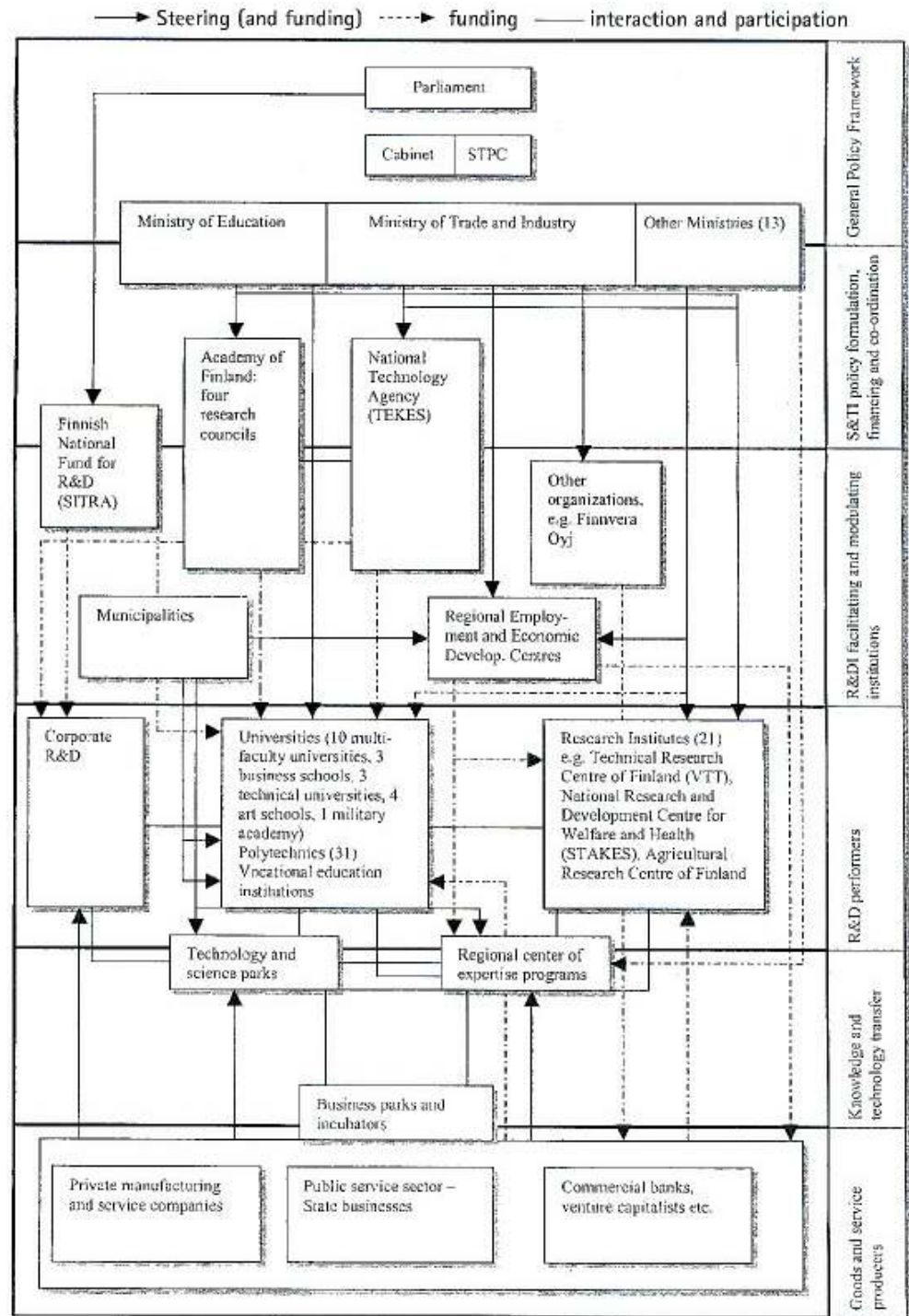
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# Institutional Coordination

## The Finnish National Innovation System

Key organisations:

- Academy of Finland
- National Technology Agency of Finland (TEKES)
- Public research & development organisations
- Technology transfer agencies
- Capital providers

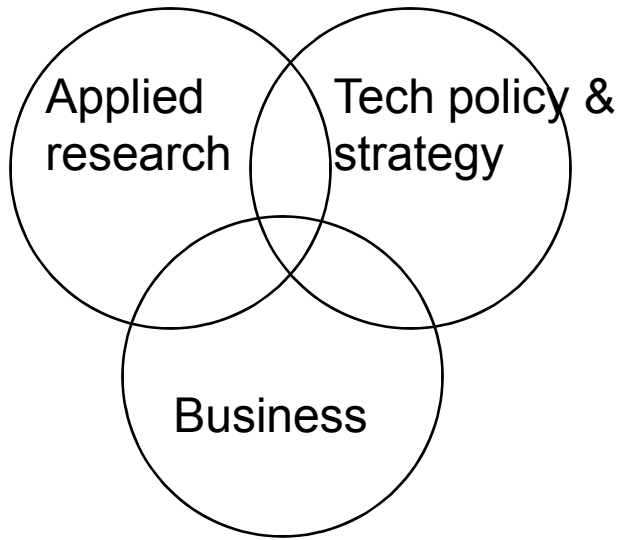
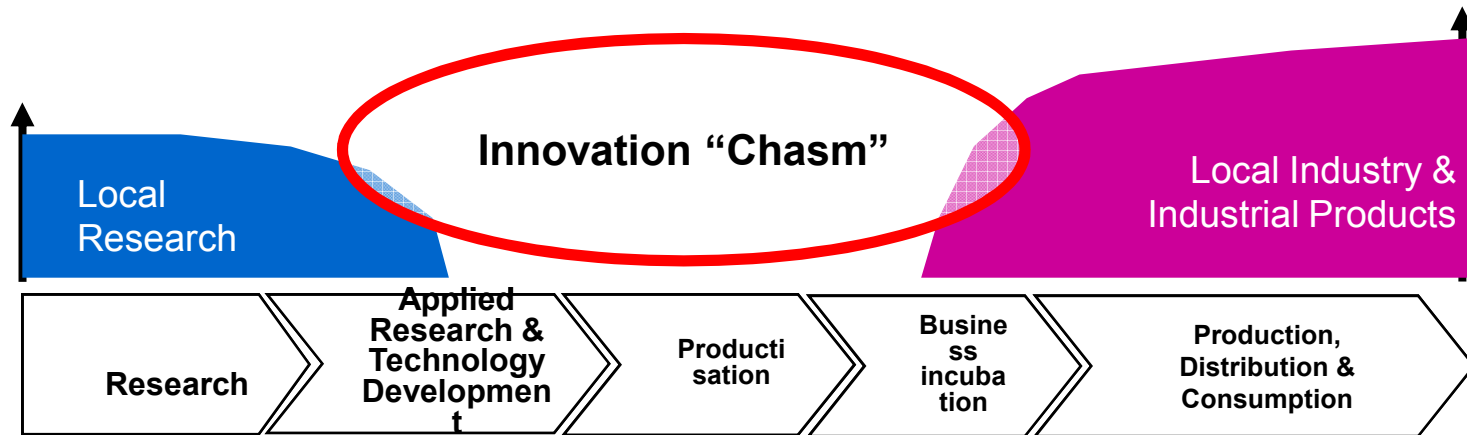


Source: Nieminen, M. and Kaukonen, E. (2001), "Universities and R&D Networking In a Knowledge-based Economy – A Glance At Finnish Development", Sitra Report Series 11, Helsinki.

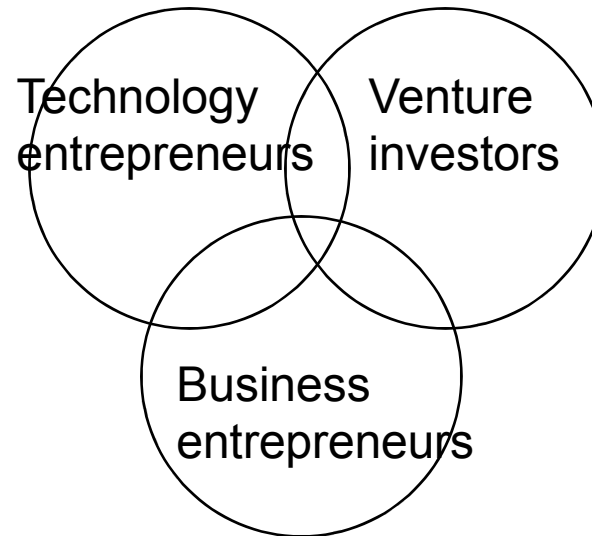
# Stakeholders and their roles

<b>Level</b>	<b>Agencies</b>	<b>Functions</b>
General Policy Framework		
STI Policy Formulation, Funding & Coordination		
RDI Financing and Modulating Institutions		
R&D Performers		
Knowledge & Technology Transfer		
Goods and Services Producers		

# Two key initiatives to bridge the Innovation Chasm



Initiative 1



Initiative 2

# Initiative 1: To jointly manage the *technology* incubation process

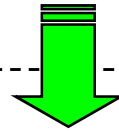
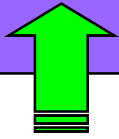
- Close interaction between researchers, policy and strategy decision-makers and business community to enhance the technology productisation process
- The end-state of this initiative is productised technology that has a validated business case
- The measure of success is that the productised technology attracts investment for full commercialisation
- Roles assumed by three key stakeholders
  - Researchers – production of technology-based creative ideas with innovative potential
  - Policy and strategy decision-makers – mediate between researchers and business community to enhance productisation of technologies that meet national priorities and create strategic synergies
  - Business community – bring business and market knowledge and experience to shape application of technology to fulfill present or anticipated customer demand

## **Initiative 2: To jointly manage the *business* incubation process**

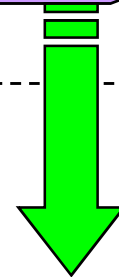
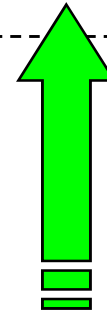
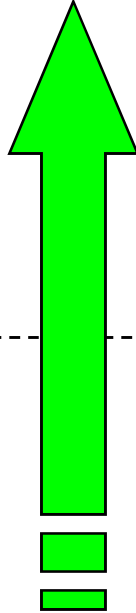
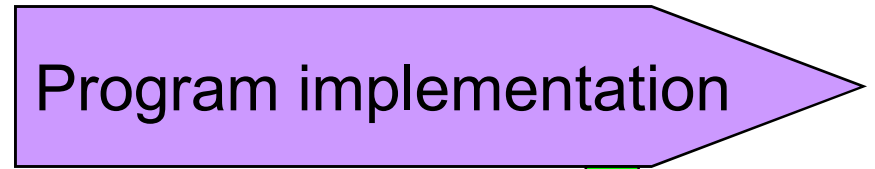
- Close interaction between technology entrepreneurs, venture investors and business entrepreneurs to build a viable business out of technology-based creative ideas
- The end-state of this initiative is an operating company with an attractive business plan, a functioning management team and a well-defined market-tested product
- The measure of success is that the company attracts investment for market expansion
- Roles assumed by three key stakeholders
  - Technology entrepreneurs – sustained production of technology-based creative ideas to adapt to changing market demand
  - Venture investors – shape companies to make them more competitive and put investments in selected companies
  - Business entrepreneurs – shape companies to make them more competitive and invest in and/or acquire selected companies

# Contents

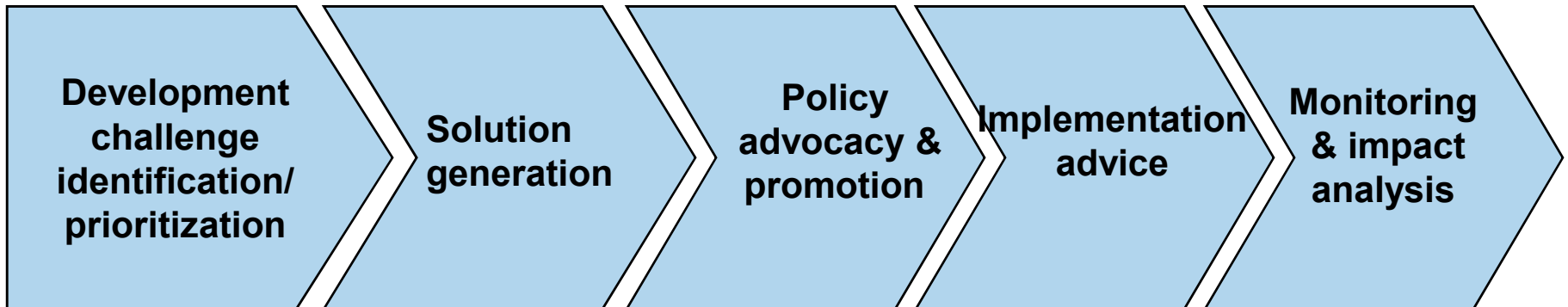
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**Implementing Agency**



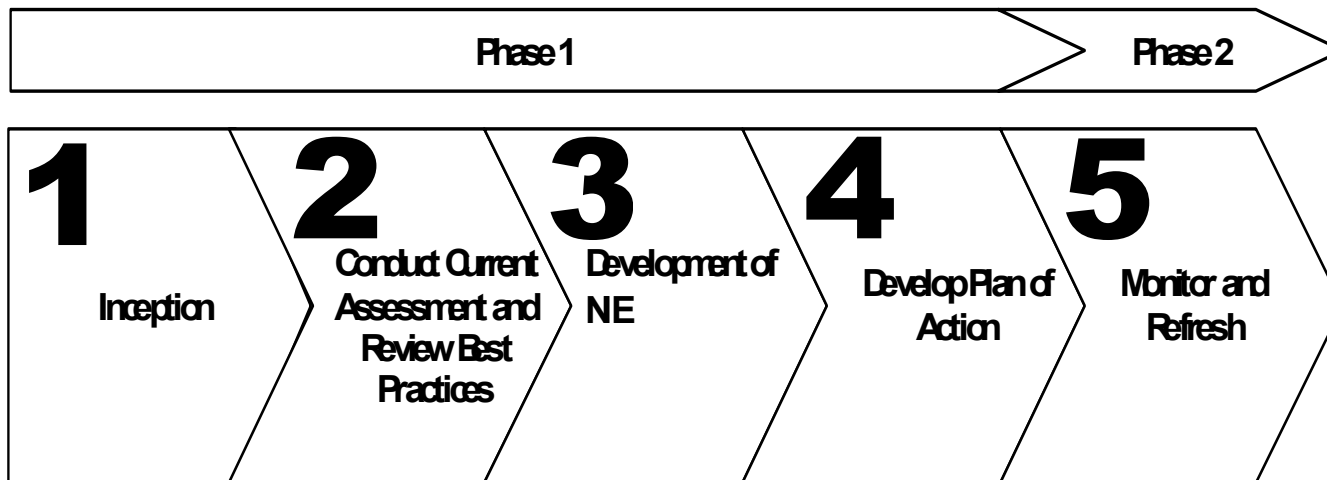
**Policy & Strategy Formulation**



# Contents

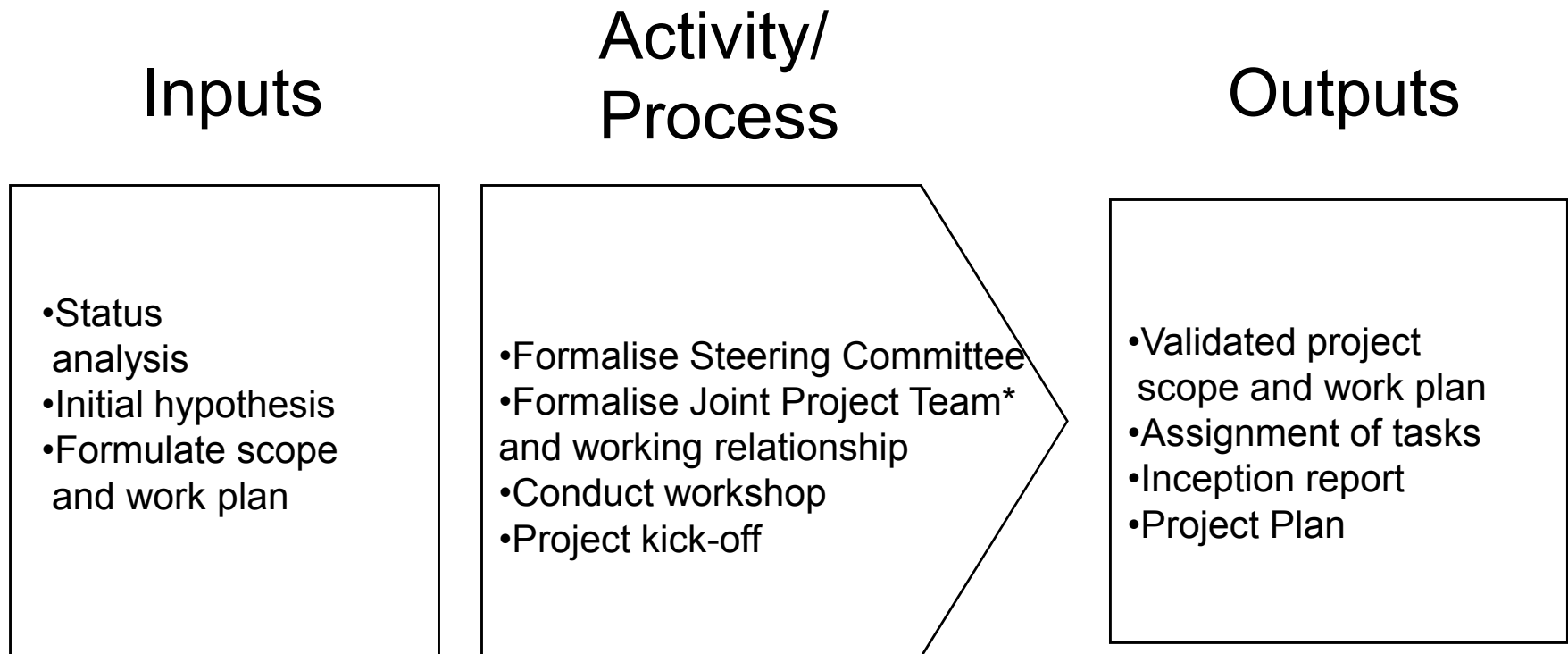
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# Overall process flow



# Study Methodology

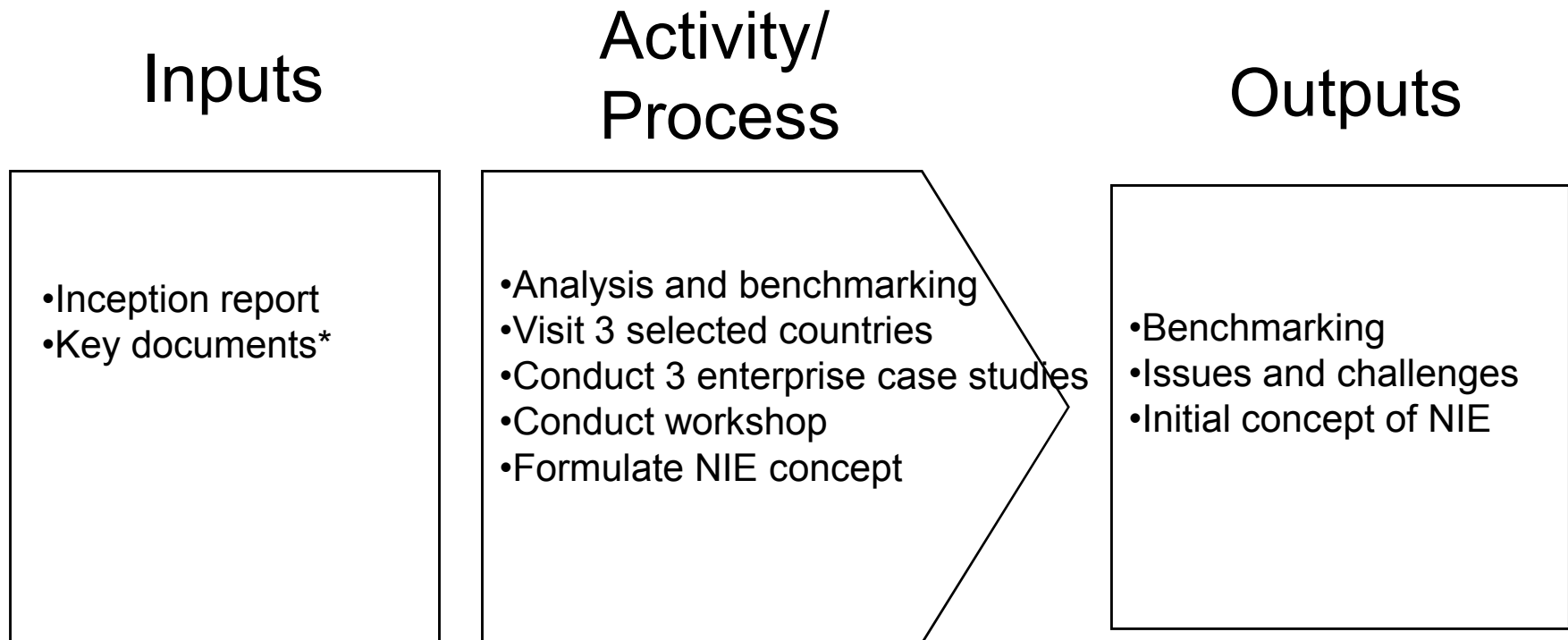
## Step 1: Project initiation



\* Joint Project Team consists of Project Advisers and local Project Team

# Study Methodology

## Step 2: Current Assessment and Best Practice Review



\*Key documents are those relating to major strategic initiatives in country concerned

# Study Methodology

## Step 3: NIE Policy and Strategy

### Inputs

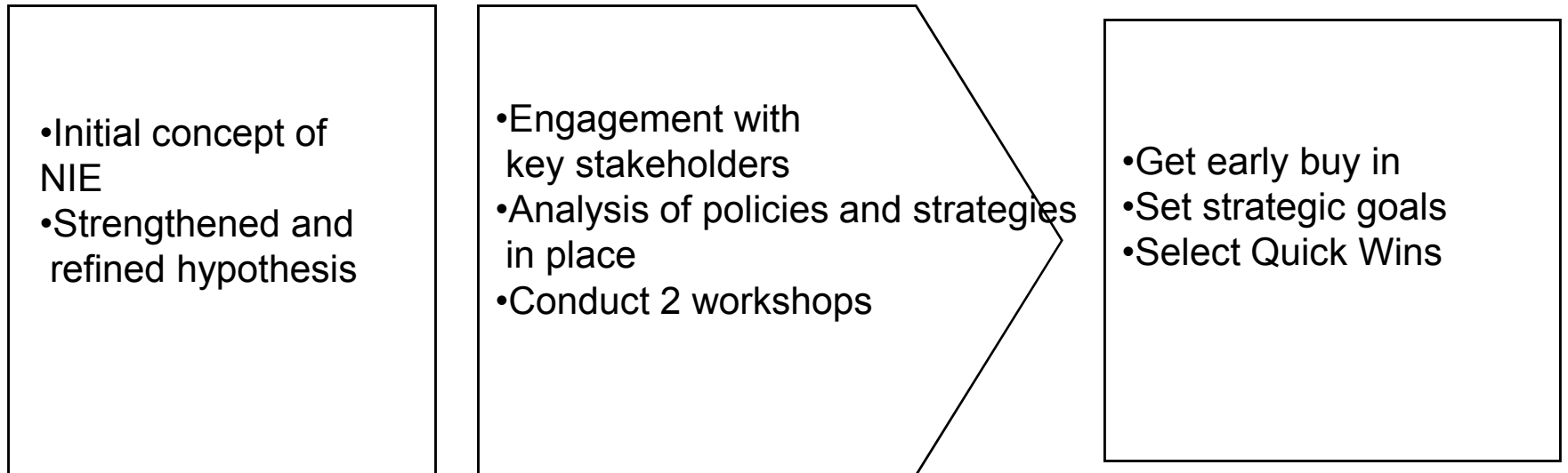
- Initial concept of NIE
- Strengthened and refined hypothesis

### Activity/ Process

- Engagement with key stakeholders
- Analysis of policies and strategies in place
- Conduct 2 workshops

### Outputs

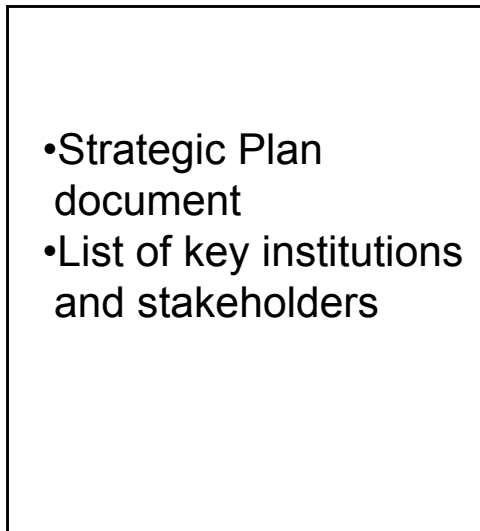
- Get early buy in
- Set strategic goals
- Select Quick Wins



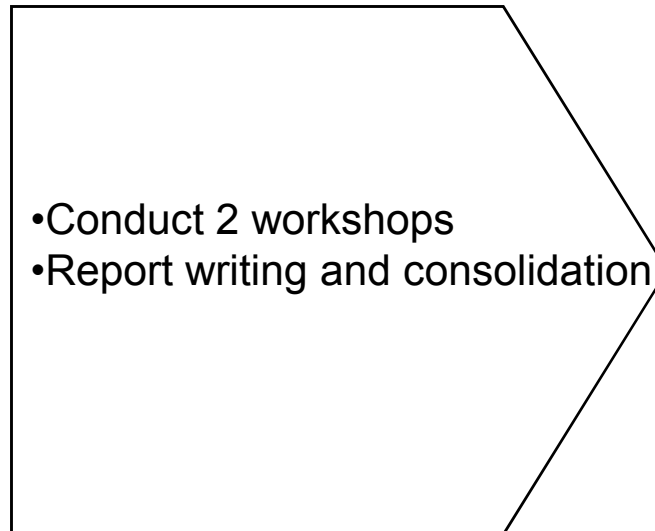
# Study Methodology

## Step 4: Action Plan

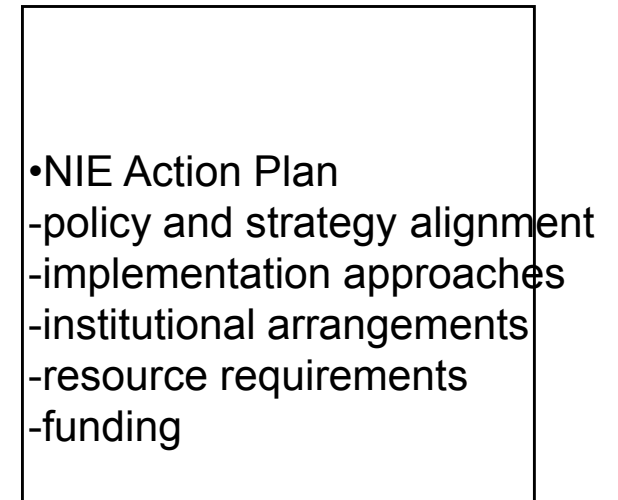
### Inputs



### Activity/ Process



### Outputs



# Step 5: Monitor and Refresh

Activities	Responsibilities	Outcome/Date
<ol style="list-style-type: none"><li>1. Review execution of plan of action</li><li>2. Measure progress</li><li>3. Update Innovation Roadmap</li><li>4. Workshop</li></ol>	stakeholders	<p>Innovative Capacity will be monitored over the next 3 years.</p> <p>Three reports will be provided in the beginning of each year outlining the following:</p> <ul style="list-style-type: none"><li>• changes in the global environment</li><li>• tracking progress vis-à-vis the global changes</li><li>• policy &amp; strategy changes to keep country innovative and competitive</li></ul>

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# Way Forward

- Countries need to embrace S&T-based innovation as a central theme of national development planning
- National Innovation Eco-system is required to orchestrate increase in innovation capacity
- Key stakeholders need to be identified and their interaction and collaboration enhanced

**END**

*thank you for your attention*

# Supplementary materials

# Physical Infrastructure

Band 1	Band 2	Band 3	Band 4	Band 5	Band 6	Band 7	Band 8
Germany	Canada	United Arab Emirates	Czech Republic	Uruguay	Serbia	Mali	Zimbabwe
France	Austria	Iceland	Estonia	Turkey	Algeria	Argentina	Tanzania
Singapore	Malaysia	Barbados	Namibia	Sri Lanka	Poland	Cambodia	Guyana
Denmark	Norway	Thailand	Slovenia	Honduras	Kazakhstan	Vietnam	Senegal
Hong Kong SAR	Korea, Rep.	New Zealand	Lithuania	Guatemala	Georgia	Ecuador	Benin
Switzerland	Taiwan	Chile	Slovak Republic	India	Zambia	Peru	Madagascar
Netherlands	United Kingdom	Oman	Latvia	Mexico	Macedonia, FYR	Burkina Faso	Bangladesh
Belgium	Luxembourg	Puerto Rico	Greece	Gambia, The	Colombia	Venezuela	Uganda
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		Jordan	Morocco	Syria	Ukraine	Mauritania	Tajikistan
		Panama	Hungary	Kenya	Costa Rica	Bosnia and Herzegovina	Mongolia
		Mauritius	Italy	Montenegro	Romania		Cameroon
		El Salvador	China				Albania
		Malta	Egypt				Burundi
		Jamaica					Paraguay
							Chad
							Timor-Leste

## FACTORS:

1. Quality of Roads
2. Quality of Railroad Infrastructure
3. Quality of Port Infrastructure
4. Quality of Air Transport
5. Quality of Electricity Supply

Source: Mahendhiran Nair, 2008

# Infostructure

Band 1	Band 2	Band 3	Band 4	Band 5	Band 6	Band 7	Band 8
Iceland	Israel	New Zealand	Lithuania	Mauritius	Poland	China	Costa Rica
Sweden	Luxembourg	Slovenia	Slovak Republic	Turkey	Serbia	Algeria	Guyana
Netherlands	Austria	Italy	United Arab Emirates	Uruguay	Macedonia, FYR	Moldova	Ecuador
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<b>Korea, Rep</b>	Estonia	Malta	<b>Malaysia</b>	Morocco	<b>Saudi Arabia</b>	Namibia	Zimbabwe
<b>Finland</b>	Australia	Puerto Rico	Croatia	Dominican Republic	Venezuela	Bolivia	Honduras
Canada	Belgium	Barbados	Chile	Jordan	South Africa	Mauritania	Armenia
United States	France		Qatar	Colombia	Trinidad and Tobago	Senegal	Kyrgyz Republic
Taiwan			Kuwait.	El Salvador	Bosnia and Herzegovina	Syria	Libya
			Greece	Panama	Oman	Indonesia	Kenya
				Philippines	Ukraine	Pakistan	Benin
				Guatemala	Gambia, The	Cambodia	
				Egypt		Nigeria	Bangladesh
				India		Uzbekistan	Burkina Faso
						Zambia	Madagascar
						Tanzania	
						Mali	
						Mozambique	
						Tajikistan	

## FACTORS:

- Quality of Telephone Infrastructure
- Mobile Telephone Subscribers (Hard data)
- Internet Users (Hard data)
- Personal Computers (Hard Data)
- Broadband Internet Subscribers (Hard data)

Source: Mahendhiran Nair, 2008

# Intellectual Capital

Band 1	Band 2	Band 3	Band 4	Band 5	Band 6	Band 7	Band 8
Switzerland	France	Estonia	Slovak Republic	Brazil	Botswana	Georgia	Dominican Republic
United States	Ireland	Indonesia	Latvia	Colombia	Vietnam	Zimbabwe	Cambodia
Finland	Iceland	Costa Rica	Croatia	Philippines	Azerbaijan	Gambia, The	Tajikistan
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United Kingdom		Malta	Trinidad and Tobago	Panama		Zambia	Mauritania
		Hungary	Italy	Nigeria		Libya	Lesotho
		Oman	Saudi Arabia	Guatemala			Burundi
		Kuwait.	Serbia				Paraguay
			Ukraine				Chad
							Timor-Leste

Source: Mahendhiran Nair, 2008

## FACTORS:

1. Quality of Education system
2. Quality of Math & Science education
3. Quality of Management schools
4. Internet Access in schools
5. Local availability of specialized research & training services
6. Extent of staff training
7. Brain drain
8. Availability of scientist & engineers
9. Quality of research institutions

# Incentives

Band 1	Band 2	Band 3	Band 4	Band 5	Band 6	Band 7	Band 8
Sweden	Hong Kong SAR	India	Jordan	El Salvador	Azerbaijan	Cambodia	Nicaragua
Germany	Singapore	Qatar	China	Vietnam	Bulgaria	Paraguay	
Denmark	Switzerland	Bahrain	Costa Rica	Croatia	Tanzania	Serbia	
Finland	United Kingdom	Czech Republic	Saudi Arabia	Poland	Namibia	Venezuela	
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	Estonia	Oman		Botswana	Argentina	Kyrgyz Republic	
	Israel	Hungary		Russian Federation		Cameroon	
	Iceland	Sri Lanka		Pakistan		Zimbabwe	
	United Arab Emirates	Malta		Jamaica		Ecuador	
	Canada	Latvia		Gambia, The		Mauritania	
	Slovak Republic	Turkey		Brazil		Mali	
		Mauritius		Montenegro		Algeria	
		Greece		Honduras		Libya	
						Zambia	
						Armenia	
						Bolivia	
						Ethiopia	
						Albania	
						Suriname	
						Mozambique	
						Lesotho	
						Burundi	
						Timor-Leste	
						Chad	

## FACTORS:

- Intensity of local competition
- Extent & effect of taxation
- Prevalence of trade barriers
- Business impact of rules on FDI
- Burden of custom procedures
- Degree of customer orientation
- Extent of regional sales
- Breath of international markets
- Flexibility of wage determination
- Pay and productivity
- Financing through equity market
- Ease of access to loans
- Venture capital availability
- Extent of incentive compensation
- Company spending on R&D

Source: Mahendhiran Nair, 2008

# Interaction

Band 1	Band 2	Band 3	Band 4	Band 5	Band 6	Band 7	Band 8
United States	Singapore	Indonesia	South Africa	Mexico	Greece	Kuwait.	Slovenia
Israel	Switzerland	Thailand	Spain	Jordan	Croatia	Oman	Russian Federation
Ireland	Sweden	Slovak Republic	Sri Lanka	Panama	Namibia	Gambia, The	Syria
United Kingdom	Taiwan	Costa Rica	Kenya	Guatemala	Poland	Mauritania	Bangladesh
Canada	Netherlands	Qatar	Brazil	Dominican Republic	Italy	El Salvador	Ukraine
Germany	Denmark	United Arab Emirates	Turkey	Philippines	Montenegro	Botswana	Mongolia
Finland	Malaysia	Puerto Rico	Uganda	Pakistan	Argentina	Kazakhstan	Benin
Australia	Hong Kong SAR	Czech Republic	Jamaica	Bahrain	Uruguay	Senegal	Tajikistan
New Zealand	Japan	Luxembourg	France	Latvia	Venezuela	Mali	Algeria
Korea, Rep	Norway	Estonia	Trinidad and Tobago	Saudi Arabia	Mozambique	Burkina Faso	Macedonia, FYR
Belgium	Austria	Tunisia	Morocco	Mauritius	Bulgaria	Georgia	Zimbabwe
	Iceland	Hungary	China	Barbados	Cambodia	Armenia	Libya
		Portugal	Nigeria	Egypt	Ethiopia	Albania	Ecuador
		India	Peru	Colombia	Guyana	Madagascar	Kyrgyz Republic
		Chile	Romania	Tanzania	Suriname	Cameroon	Bosnia and Herzegovina
		Uzbekistan	Serbia	Lithuania	Timor-Leste	Nicaragua	Bolivia
		Malta	Nepal	Zambia		Moldova	Lesotho
				Azerbaijan			Burundi
				Honduras			Paraguay
				Vietnam			Chad

## FACTORS:

1. Cooperation in labor-employer relations
2. FDI and technology transfer
3. Prevalence of foreign technology licensing
4. University-industry research collaboration

Source: Mahendhiran Nair, 2008

# Institutions

Band 1	Band 2	Band 3	Band 4	Band 5	Band 6	Band 7	Band 8
Germany	Singapore	Malta	Lithuania	Uzbekistan	Romania	Dominican Republic	Zimbabwe
Denmark	Iceland	Puerto Rico	Namibia	Gambia, The	Mali	Tajikistan	Russian Federation
Finland	Hong Kong SAR	Bahrain	Panama	Morocco	China	Macedonia, FYR	Serbia
Switzerland	United States	Barbados	Turkey	Uruguay	Benin	Nicaragua	Mozambique
Sweden	Japan	Spain	Slovak Republic	Pakistan	Honduras	Armenia	Argentina
Austria	South Africa	India	Costa Rica	Zambia	Kazakhstan	Nepal	Moldova
Netherlands	Malaysia	Jordan	Czech Republic	Egypt	Algeria	Suriname	Venezuela
Australia	Korea, Rep.	Taiwan	Saudi Arabia	Poland	Vietnam	Libya	Guyana
Norway	Israel	Mauritius	Botswana	Philippines	Syria		Ukraine
United Kingdom	Estonia	Thailand	Sri Lanka	Burkina Faso	Guatemala		Cambodia
New Zealand	Portugal	Oman	Latvia	El Salvador	Georgia		Cameroon
Canada	Chile	Hungary	Jamaica	Trinidad and Tobago	Senegal		Bosnia and Herzegovina
Ireland	Qatar	Greece	Brazil	Indonesia	Mauritania		Ecuador
France	Tunisia	Kuwait.	Italy	Tanzania	Uganda		Lesotho
Luxembourg	United Arab Emirates	Slovenia	Colombia	Kenya	Madagascar		Mongolia
Belgium			Croatia	Peru	Bulgaria		Bangladesh
			Mexico	Montenegro	Ethiopia		Albania
				Nigeria	Azerbaijan		Bolivia
							Burundi
							Kyrgyz Republic
							Paraguay
							Timor-Leste
							Chad

## FACTORS:

1. Property rights
2. IP protection
3. Judicial independence
4. Burden on government regulation
5. Efficiency of legal framework
6. Reliability of police services
7. Strengths of auditing and reporting Standards
8. Protection of minority shareholders interests
9. Stringency of environmental regulations
10. Effectiveness of anti-monopoly policy
11. Financial market sophistication
12. Soundness of banks
13. Regulation of securities exchange
14. Laws relating to ICT

Source: Mahendhiran Nair, 2008

# Integrity

Band 1	Band 2	Band 3	Band 4	Band 5	Band 6	Band 7	Band 8
Finland	United Arab Emirates	Portugal	Puerto Rico	Morocco	Colombia	Poland	Nicaragua
Denmark	United Kingdom	Bahrain	India	Georgia	El Salvador	Pakistan	Suriname
Singapore	Ireland	Jordan	Greece	Algeria	Burkina Faso	Moldova	Lesotho
New Zealand	Qatar	Oman	Slovak Republic	Kazakhstan	Mexico	Italy	Ukraine
Sweden	Canada	Estonia	Costa Rica	Vietnam	Guatemala	Cambodia	Albania
Iceland	Belgium	Malta	Latvia	Syria	Honduras	Serbia	Bulgaria
Norway	Tunisia	Taiwan	Tanzania	Ethiopia	Zambia	Macedonia, FYR	Romania
Switzerland	Malaysia	Slovenia	Turkey	Mali	Philippines	Armenia	Bosnia and Herzegovina
Germany	Barbados	Uruguay	Egypt	China	Peru	Russian Federation	Nepal
Australia	France	Saudi Arabia	Lithuania	Azerbaijan	Madagascar	Senegal	Mongolia
Netherlands	Chile	Indonesia	Croatia	Mauritania	Benin	Zimbabwe	Bolivia
Austria	Japan	Spain	Sri Lanka	Tajikistan	Jamaica	Burundi	Cameroon
Hong Kong SAR	Korea, Rep	Gambia	Czech Republic	Libya	Nigeria	Argentina	Kyrgyz Republic
Luxembourg	Israel	Botswana	Montenegro		Kenya	Mozambique	Dominican Republic
	United States	Kuwait.	Hungary		Trinidad and Tobago	Uganda	Ecuador
	South Africa	Thailand	Namibia		Guyana		Bangladesh
		Mauritius	Panama		Brazil		Timor-Leste
		Uzbekistan					Paraguay
							Chad
							Venezuela

## FACTORS

1. Diversion of public funds
2. Public trust of politicians
3. Favoritism in decisions of Government officials
4. Wasteful of government spending
5. Transparency of government policy making
6. Business costs of crime and violence
7. Organized crime
8. Ethical behavior of firms
9. Efficacy of Corporate Boards
10. Business Costs of corruption
11. Reliance on Professional Management

Source: Mahendhiran Nair, 2008