

LOBELICS ACADEMY
Lecture 2

Towards a Unified Conception of Innovation Systems

Mammo Muchie

NRF/DST Research Professor of Innovation and Development at IERI, TUT,
Pretoria, South Africa

&

Angathevar Baskaran

Senior Lecturer, Middlesex University

Inspiration

- *“With regard to the awkwardness and ‘inelegance’ of expression in the analysis to come, we may remark that it is one thing to give a report in which we tell about entities, but another to grasp entities in their Being. For the latter task we lack not only most of the words but, above all, the grammar”* Martin Heidegger

Inspiration

- "Neither sociologists, nor economists, nor political scientists have satisfactory theories of social change and it is unlikely that they will develop them unless they overcome their fragmentation into separate jealously guarded kingdoms and learn to cooperate with each other and with natural scientists". (Freeman, 1973)

What moved us into this thought?:

- We have been listening and reading about the use of innovation systems concept in different ways as the concept gets diffused across the world.
- This made us think that it may be both useful and necessary to reflect how to re-conceptualise and re-clarify the use of the innovation system approach to research in order to inject much needed rigour to the way the concept can be used appropriately.

Main Objectives:

- What has been explicitly recognised as central and peripheral within the systems of innovation concept?
- Much of the theory emerged as a critique of neo-classical economics
- The inclusion or exclusion of the factors that are important in understanding the political economy of innovation systems.
- The themes, issues and range of actors and spaces that must be included in NSI types of appreciative theory or modelling.



Main concern:

- We suspect that those who focus narrowly on econcentricism tend to exclude important variables that must be included in the understanding of the making and development of innovation systems.
- Conversely, those who focus broadly on political economy may include factors that may not be helpful in creating clarity of conception and understanding of the innovation systems application to the problems and challenges of development.



Seeking a robust framing:

- It is thus important to reflect and review the variety of ways the system of innovation has been used by the researchers who have used the NSI perspective
- That is, in their search to develop alternative frameworks to understand the problems and challenges of economic system dynamics in general and economic development in particular.



Formal theory and Appreciative theory for developing an Alternative Economics Framework

- “A theory defines the economic variables and the relationships that are important to understand, gives a language for discussing these, and provides a mode of acceptable explanation” (Nelson & Winter, 1982, p.46).
- Theory selects some phenomena as important or unimportant, peripheral or central, by setting boundaries for inclusion and exclusion based on the relevance of the body of knowledge being sought to be generated.



Formal theory and Appreciative theory for developing an Alternative Economics Framework

- When theory provides a 'framework for appreciation,' it serves as a 'tool of inquiry'. The focus is on the **“endeavour in which the theoretical tools are applied”** (ibid.) In formal theory, **“the focus is on improving or extending or corroborating the tool itself...”** (ibid.).
- Formal theory is a source of ideas for appreciative theory and the vice versa. In general, drawing linkages or connection between these distinct forms of theorising can enrich understanding of economic enquiry.

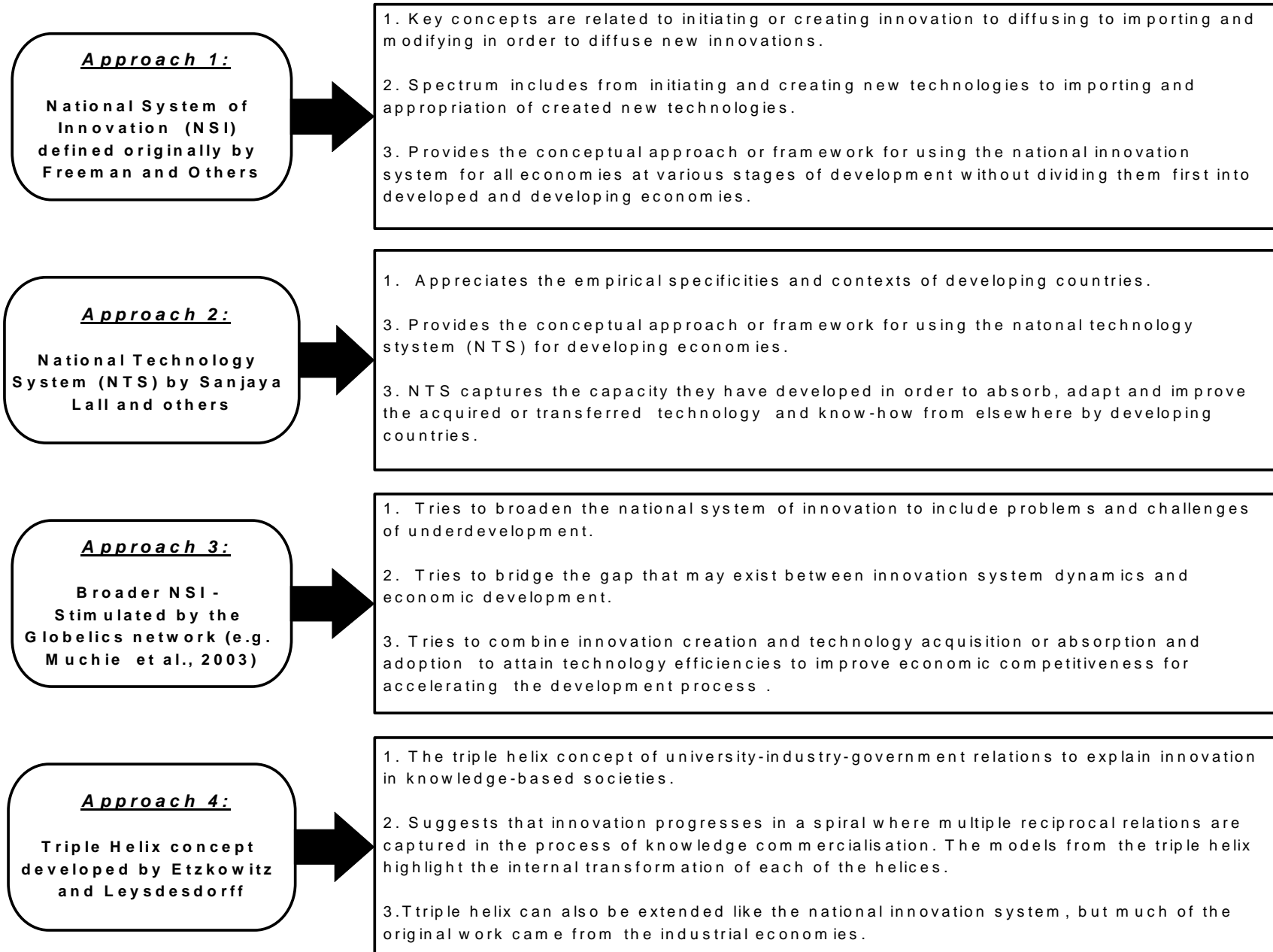


Formal theory and Appreciative theory for developing an Alternative Economics Framework

- Nelson and Winter have proposed boldly an innovation framework to economic theory as an alternative to neo-classical framework (Nelson & Winter, 1982, pp.128-130) building on earlier criticisms of mainstream economic thinking mainly from the writings of Veblen (1909), and Schumpeter (1911, 1942) on modern dynamic economic theory building.
- Today it appears that the formal theory is mainly pursued by the evolutionary economists and is concentrated mainly on economic structure.
- Appreciative theories focus mainly on system of innovation actors in their role in the processes of the development of economics of innovation dynamics and systems. They are based on empirical studies and research for policy selection or application, pursued by the national innovation system perspectives and by those who are empirically and policy orientated.



Figure 1: Appreciative Approaches In the Innovation Studies Literature

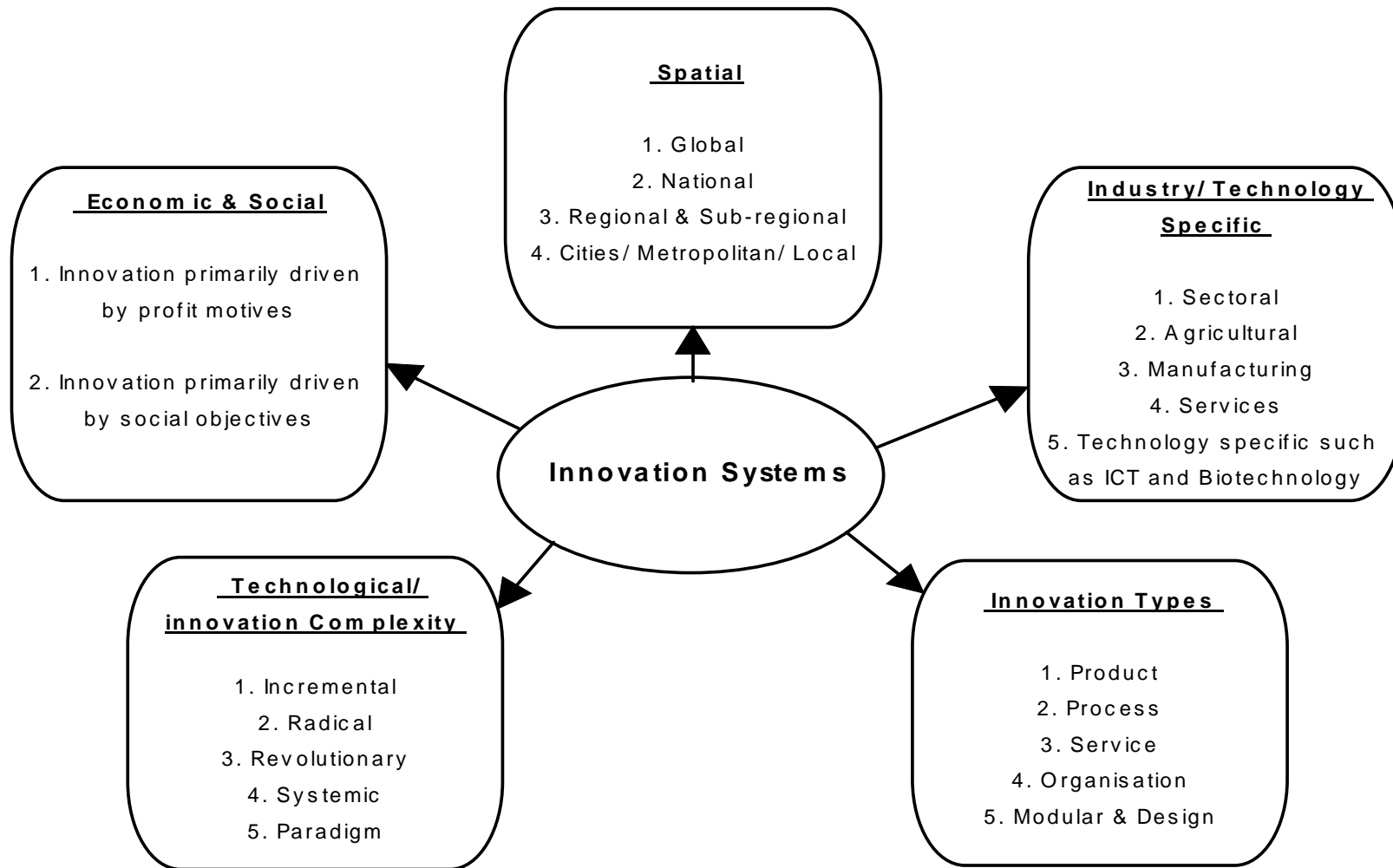


Varieties in the presentation of systems of innovation perspectives

- Since 1980s theories on innovation and their use have gradually expanded their focus and complexity.
- This can be traced in four major areas: (i) spatial; (ii) industry and technology specific; (iii) in terms of innovation types; (iv) in terms of level of technology/ innovation complexity; and (v) in terms of economic and social objectives.
- Figure next illustrates how the use of the concept of systems of innovation has grown and evolved over the years.



Figure 1: Innovation Systems - Theories/ Concepts/ Typologies/ Taxonomies



Varieties in the presentation of systems of innovation perspectives

- Theories on innovation emerged initially with the main focus on the firm and entrepreneur.
- Then they gradually expanded their focus to the environment and industry in which a firm operates.
- This led to the emergence of the national system of innovation (NSI) that includes regulations, institutions, human capital and government policy regimes. NSI framework further led to the sub-national (regional/ local/ city or metropolitan) and sectoral innovation system approaches.



Figure 2: Firm-level Innovation System/ Process

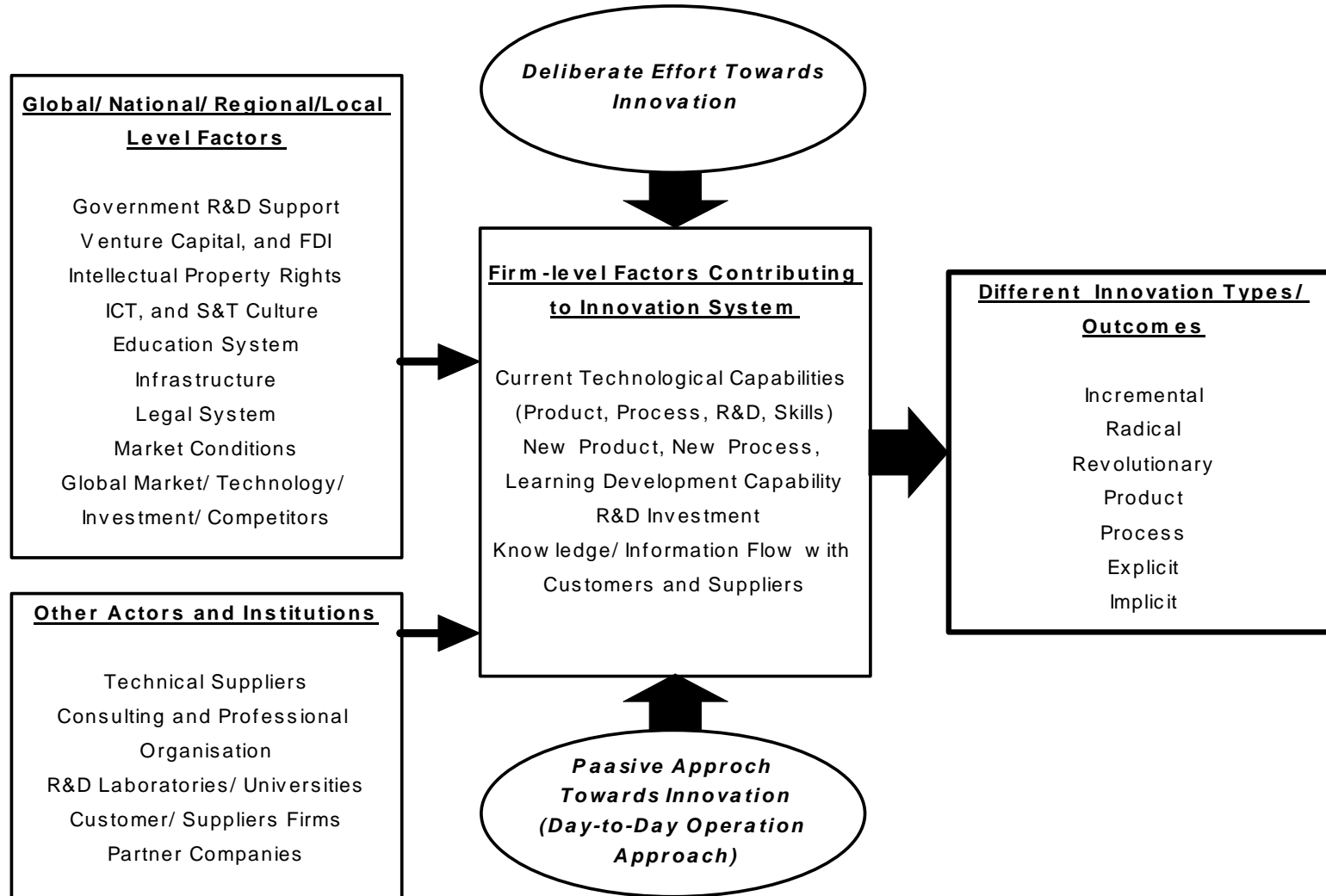


Figure 3: Major Elements of National Innovation System (NIS)

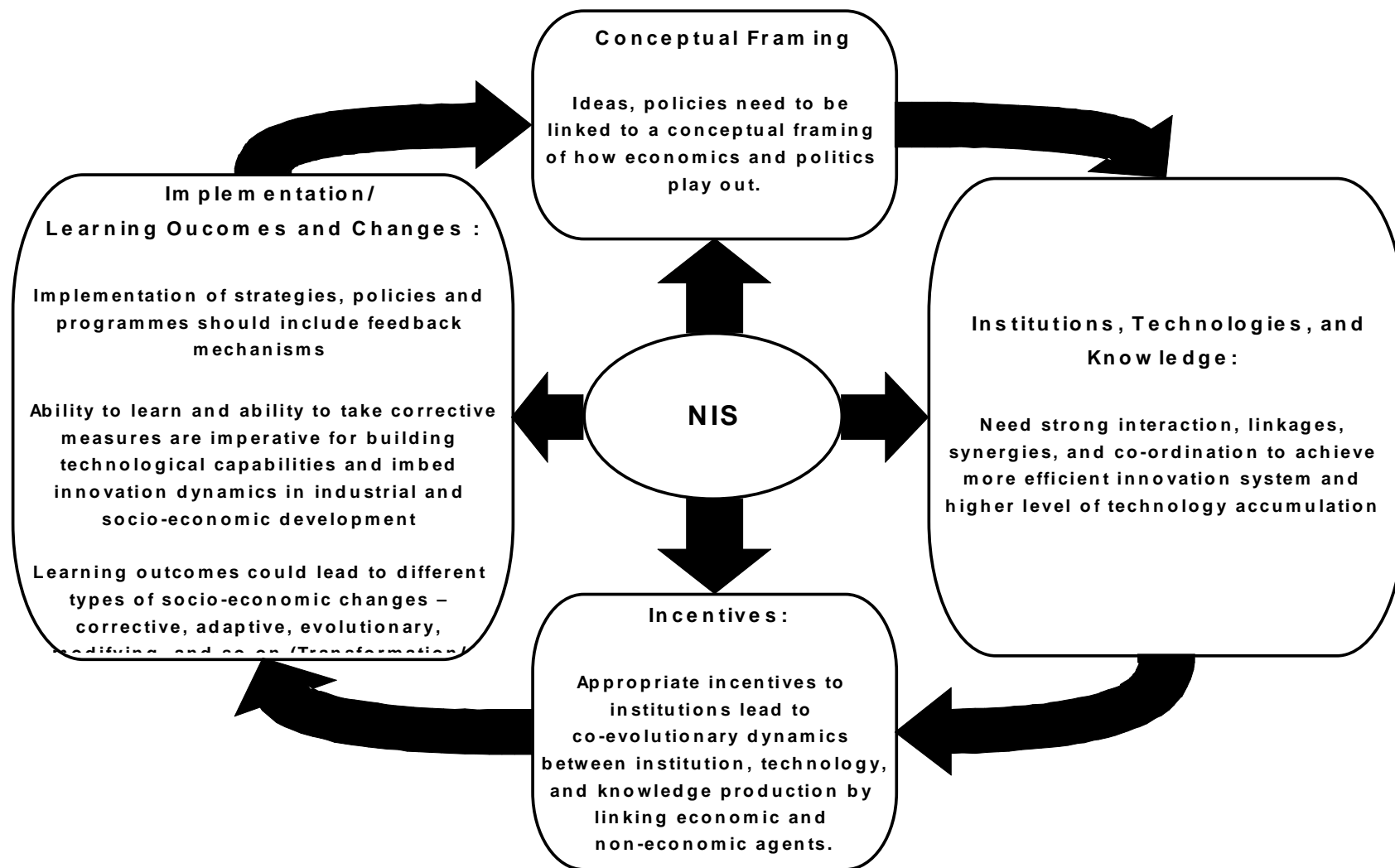
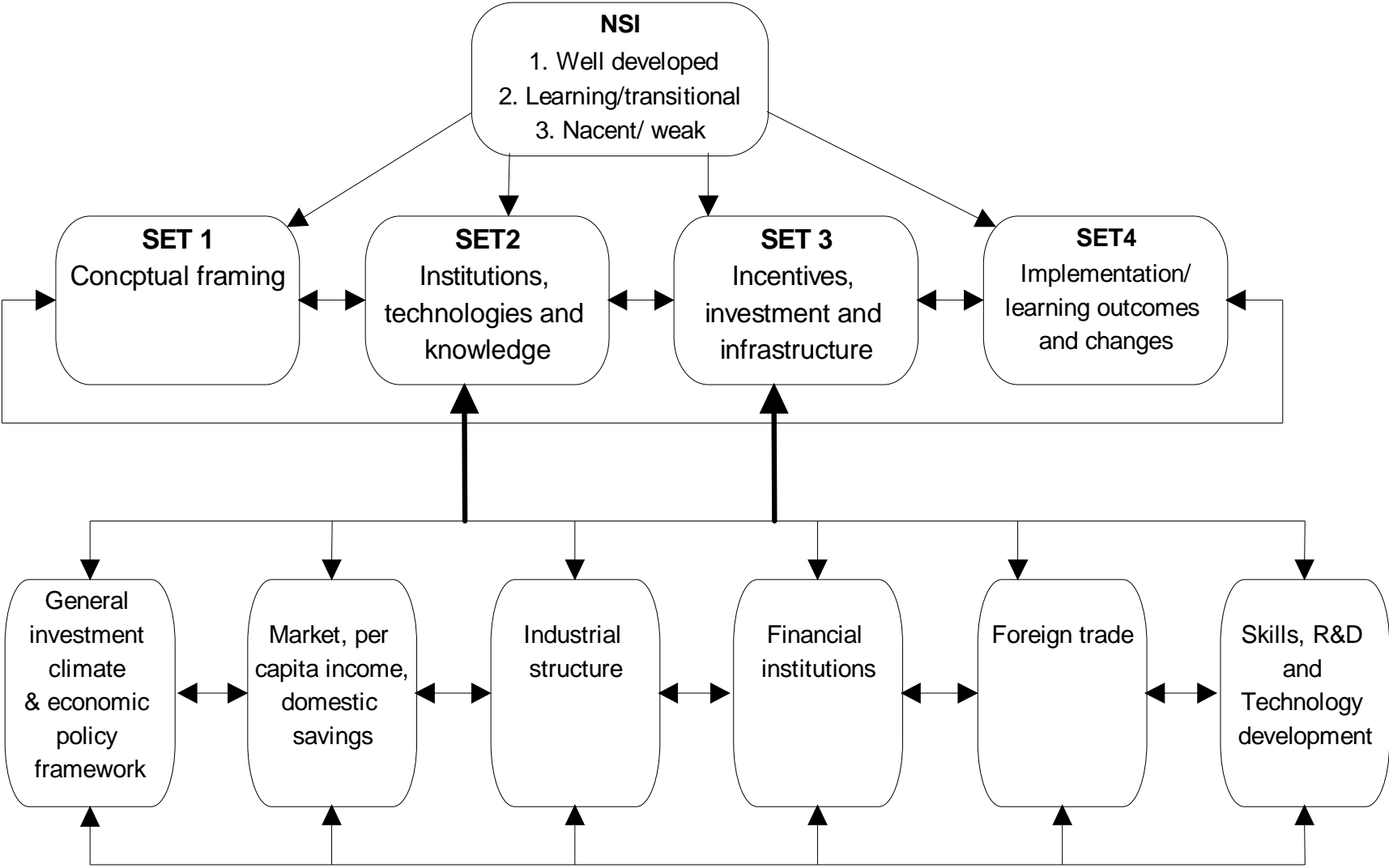


Figure 1: National System of Innovation (Wider Setting): A Conceptual Framework



6 Major Components of NSI Element Set 2 & 3

Figure 5: NSI and FDI in R&D - A Conceptual Framework

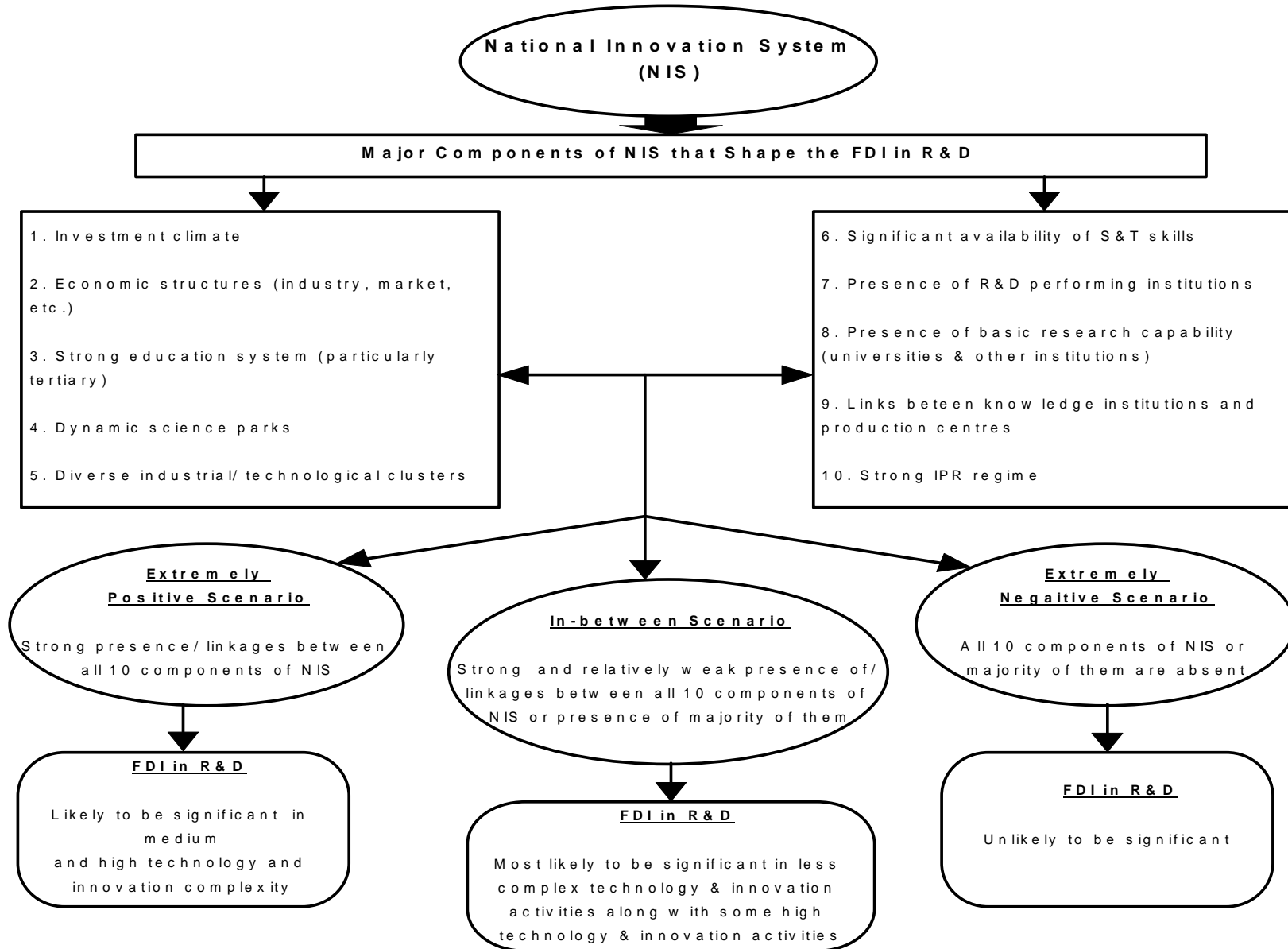


Figure 2: Strength of National System of Innovation and its Mitigating Impact on Recession: A Conceptual Framework

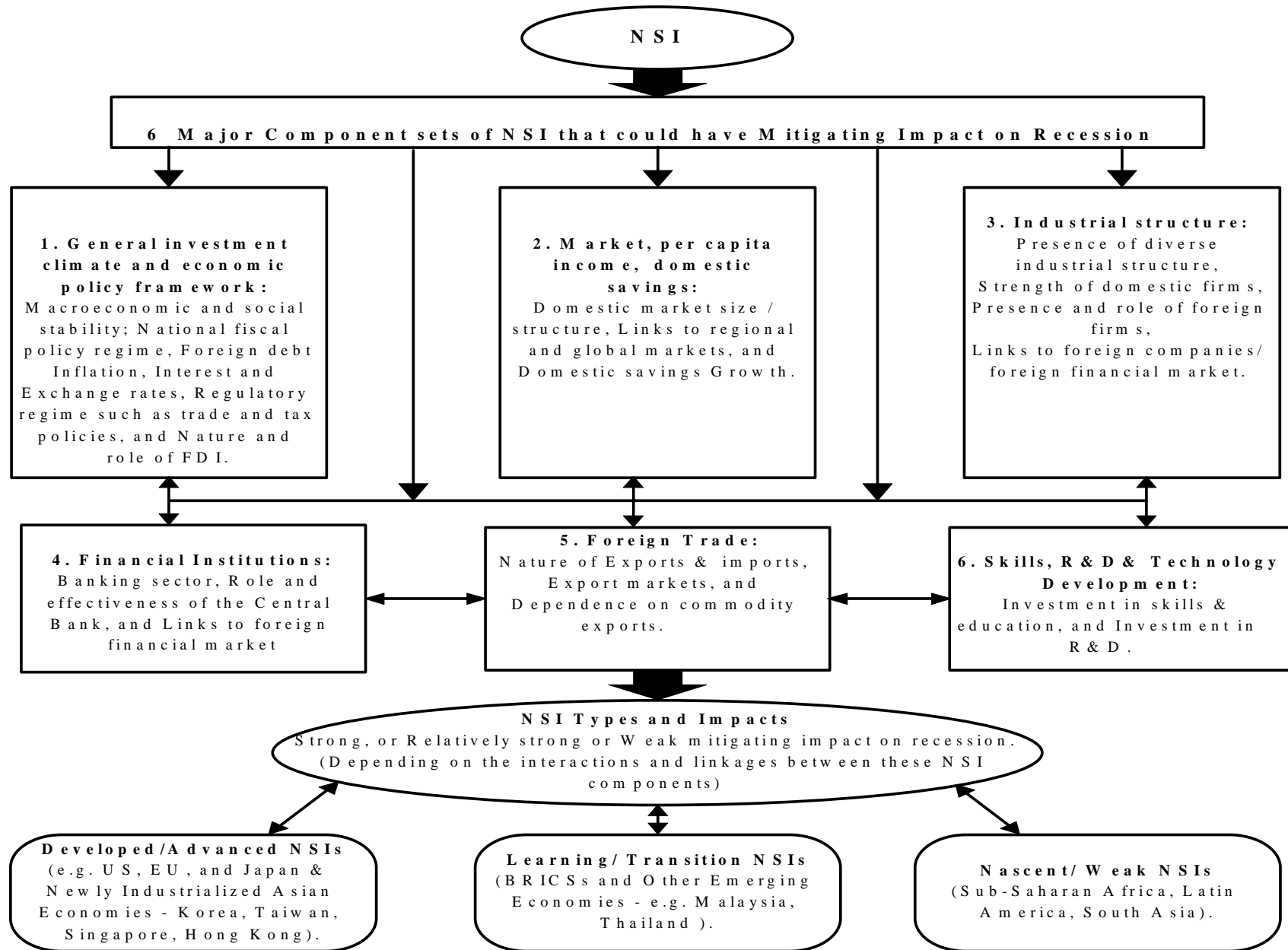
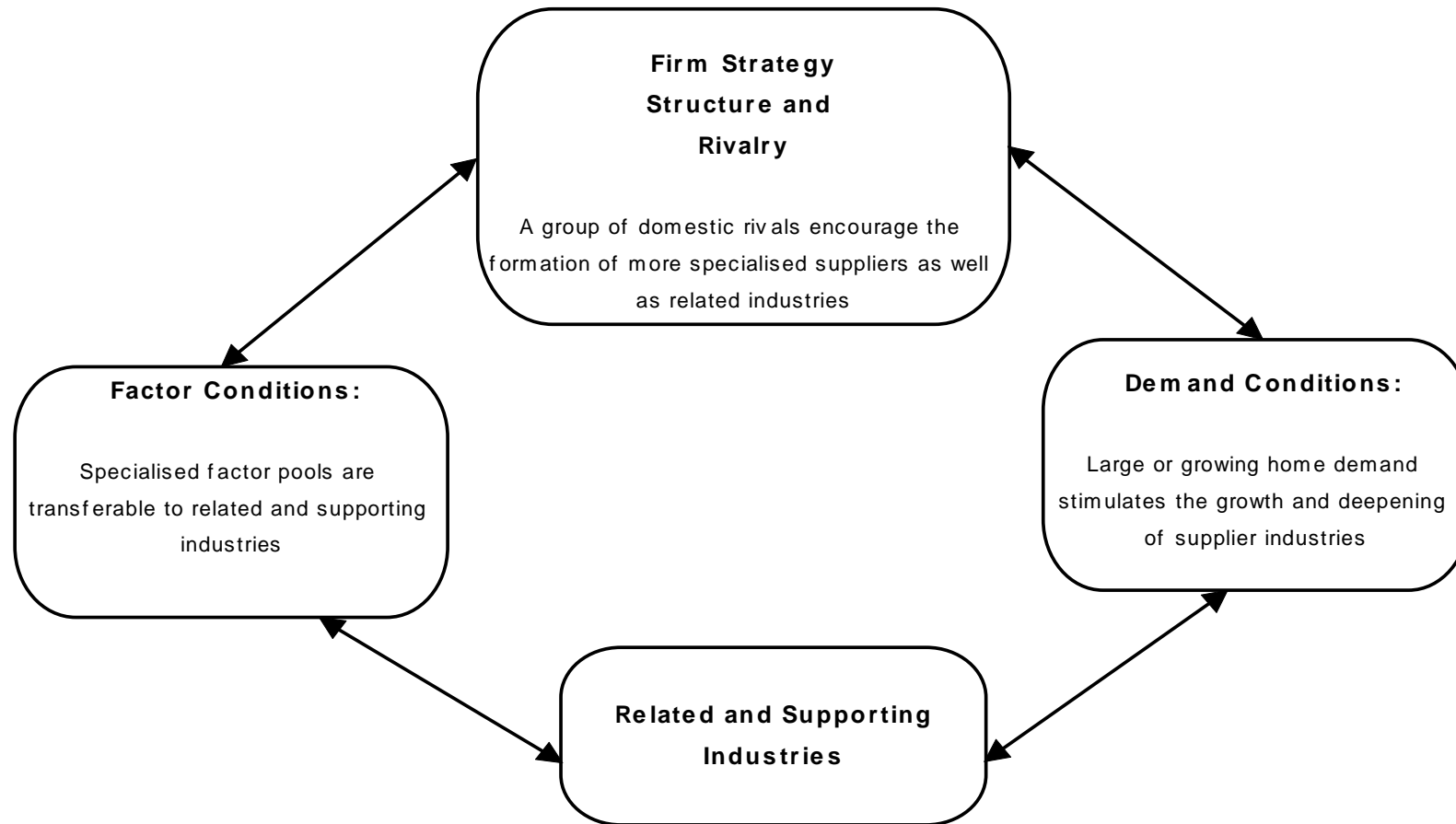
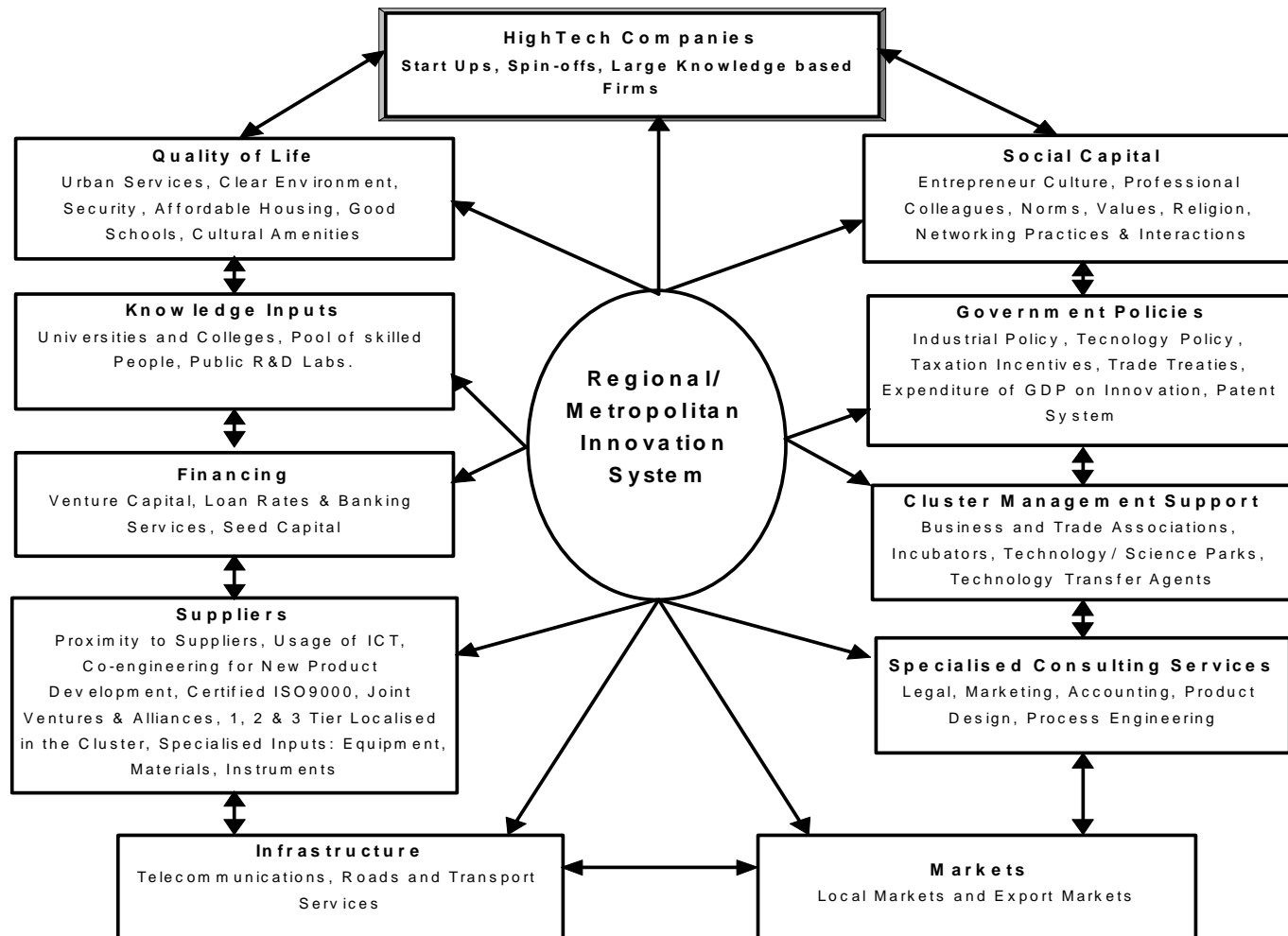


Figure 6: Innovation system - The Concept of Cluster



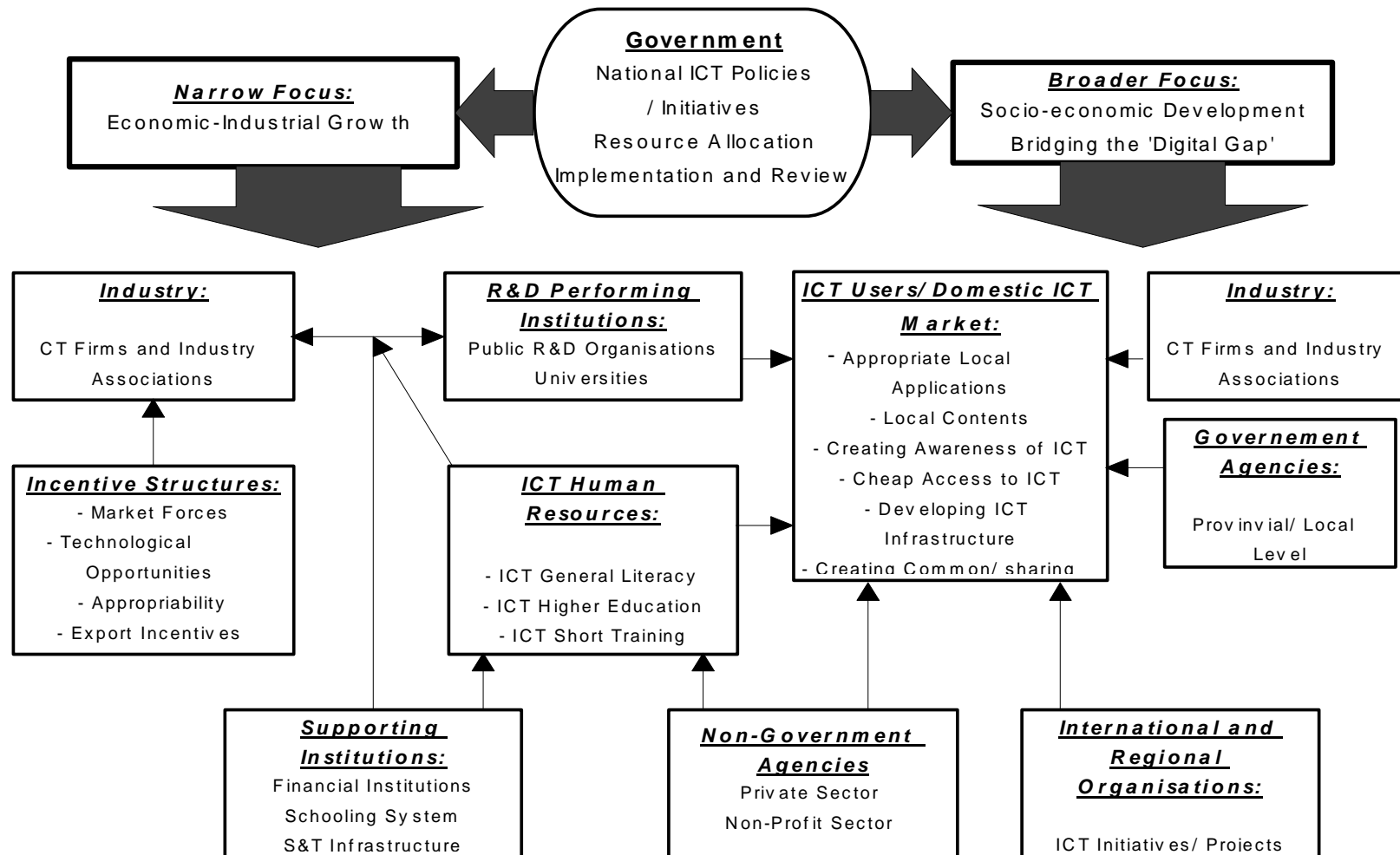
Source: OECD (1997), *National Innovation System*, p. 26 (Original source: Porter, 1992)

Figure 7: Regional/ Metropolitan Innovation System - A Conceptual Framework



Source: Drawn from: Flores, M (2004), "Proximity and Learning in Metropolitan Innovation Systems, Towards the Formation of High Tech Clusters in Monterrey and Milan," (Research Proposal), Globelics Academy, Lisbon. Originally adopted from: Isabel Bortagaray and Scott Tiffin (2002), National Governors Association (2002), *A Governors Guide to Cluster-based Economic Development*, and Lundvall (1994).

Figure 8: Sectoral/ Technology Specific System of Innovation - Agents Involved in an ICT Innovation System



Source: Baskaran and Muchie, 2006.

Table 1: Comparison of Strengths and Weaknesses of Innovation Systems

Innovation System/ Type	Actors/ Institutions/ Activities/ Linkages	Strengths/ Advantages	Weaknesses/ Disadvantages
Firm Level	<p>1. Technical Suppliers Consulting and Professional Organisations R&D Laboratories/ Universities Customer/ Suppliers Firms Partner Companies</p> <p>2. Government R&D Support Venture Capital, and FDI Intellectual Property Rights ICT, and S&T Culture Education System Infrastructure Legal System Market Conditions Global Market/Technology/ Investment/Competitors</p> <p>3. Current Technological Capabilities (Product, Process, R&D, Skills) New Product, New Process, Learning Development Capability R&D Investment Knowledge/ Information Flow with Customers and Suppliers</p>	<p>1. Firm and entrepreneur are central focus in theories on innovation.</p> <p>2. Firm level approach helps understanding of innovation capacity at firm level and a nation's industrial capacity and competitiveness</p> <p>3. Helps understanding that firms are drivers of technological innovation in a national economy.</p> <p>4. Helps understanding differences in firms' performances.</p> <p>5. Some scales and measures are employed for measuring firm's innovation performance.</p>	<p>1. Although models based on industrially advanced countries are found useful in analysing the management of innovation processes within firms, there is insufficient empirical evidence to verify these models.</p> <p>2. Weak theoretical underpinnings and also a failure to take into account the diversity and unpredictability of innovation processes.</p> <p>3. Also, innovation is not merely an individual act of learning by a firm or entrepreneur, but is situated within a larger national innovation system where a number of actors and institutions are linked and connected.</p> <p>4. Innovation process is not linear, as it involves "continuous interactivity between various actors, institutions and activities.</p>

Innovation System/ Type	Actors/ Institutions/ Activities/ Linkages	Strengths/ Advantages	Weaknesses/ Disadvantages
National	<p>1. OECD identified five institutions in NIS:</p> <ul style="list-style-type: none"> (i) Governments (local, regional, national and international, with different weights by country) (ii) Bridging institutions, such as research councils and research associations; iii) Private enterprises and the research institutes they finance; (iv) Universities and related institutions that provide key knowledge and skills; (v) Other public and private organizations that play a role in the national innovation system (public laboratories, technology transfer organizations, joint research institutes, patent offices, training organizations and so on) <p>2. Network of these institutions in the public and private sectors interact and initiate development and production of science and technology within national borders.</p> <p>3. Continuous interactivity between suppliers, clients, universities, R&D organisations, standard setting bodies, financial institutions and other critical social and economic actors.</p> <p>4. Interaction among these units may be technical, commercial, legal, social, and financial with the main goal of the development, protection, financing or regulation of new science and technology.</p>	<p>1. NIS helps to study not only developed economies, but also developing economies, although there are significant socio-economic and political differences and variations.</p> <p>2. NIS approach provides an alternative to neo-classical economic theories of growth. Innovation is rooted in processes of interactive learning that is problematic in pure markets.</p> <p>3. NIS provides a flexible conceptual framework to study the problem of “technological gap” between the developed and developing nations (particularly the advanced and emerging developing economies).</p> <p>4. NIS provides different approaches to study innovation process in developing countries such as Charles Edquist’s (2001) Systems of Innovation for Development (SID) concept. Others emphasis more on learning than innovation - passive learning to absorb technological capabilities for production and active learning where deliberate effort is made to master technology.</p> <p>5. Despite the inevitable question as to the appropriateness of the concept of NIS due to the emergence of globalized economy, it is widely accepted that domestic policies, actors and institutions still play an important role.</p> <p>6. NIS also helps to capture the uneven economic development dynamics in developing economies. Also, it helps to identify the linkages between innovation systems and industrial economic narrowly, and more broadly structural social and economic development/transformation. NIS model also enables elaboration and variations to analyse and capture particular aspects of innovation process (e.g. NIS’s impact on FDI, and FDI in R & D).</p>	<p>1. In the era of globalisation the question is: how relevant is the NIS which emphasises on the national level? One can argue that there are factors that are beyond the control of national governments which can influence the innovation system.</p> <p>2. International knowledge and technology flows, information and capital flows and international collaborations are increasing in volume. There are constraints imposed on nation states and NISs by: intellectual property regimes, international al trade regimes and labour systems, regional economic alliances, influence of transnational corporations on the structure of markets, and investment in R&D.</p> <p>3. There is still knowledge gap in understanding fully the impact of TNCs on local learning and innovation and also the role of international institutions that shape both the strategies of firms and the policies of national governments</p> <p>4. There are still problems in applying the NIS concept to large number of small and least developed economies in Asia, Africa, and Latin America, as the institutions and actors that are central to NIS are hardly present in these economies.</p> <p>5. Another fundamental problem with NIS is determining its scope within the national boundary. That is, an analytical distinction between a “narrow” NIS concept, and a “broad” NIS perspective.</p> <p>6. Although there are strong measures such as R&D expenditure and patents, there are still problems in measuring the linkages, flows and outcomes in the NIS.</p>

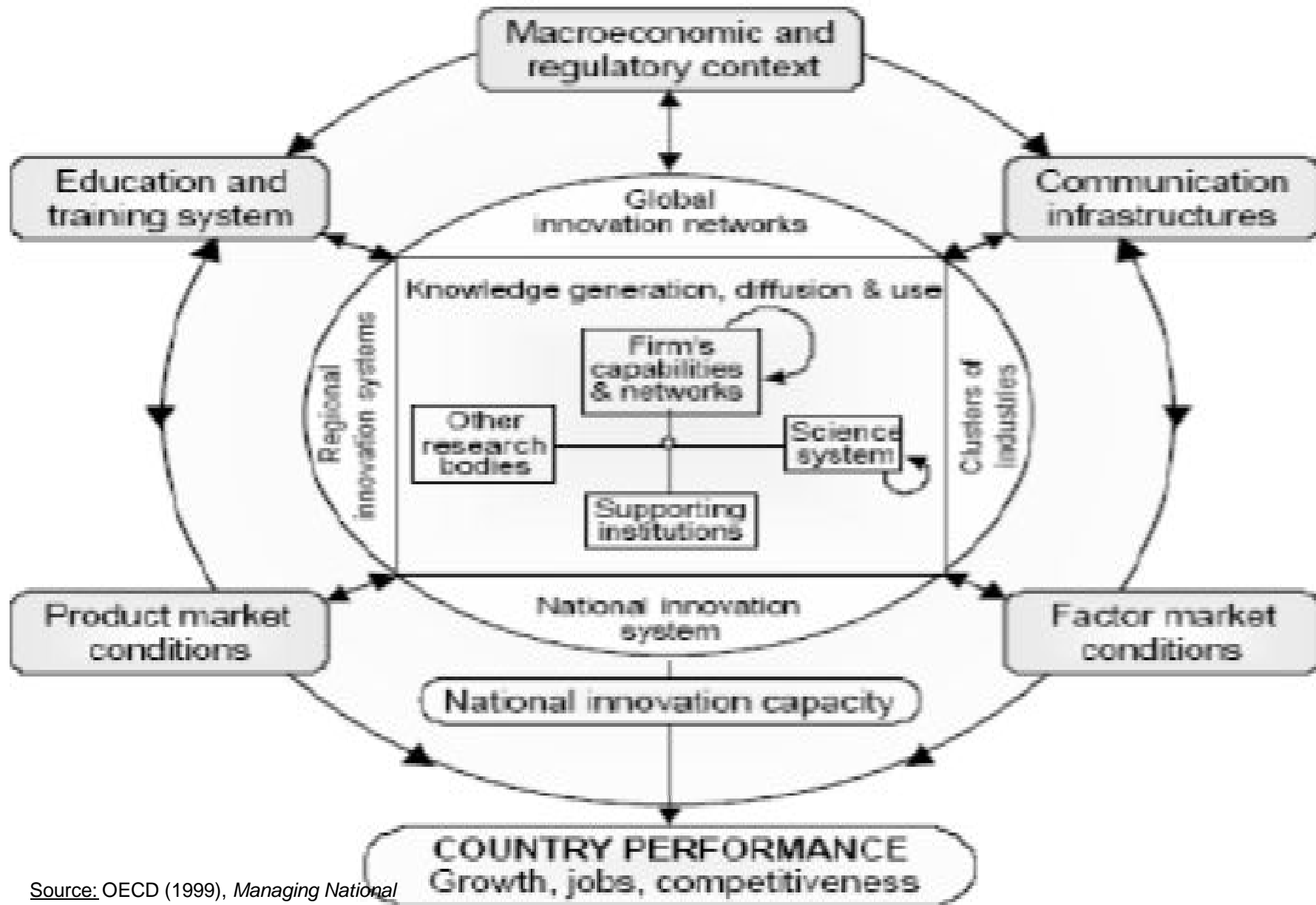
Innovation System/ Type	Actors/ Institutions/ Activities/ Linkages	Strengths/ Advantages	Weaknesses/ Disadvantages
Regional/ Local/ City/ Metropolitan	<ol style="list-style-type: none"> 1. Local innovation networks are considered to play an important role in the innovation process and economic growth of regions and cities. 2. Local/ regional innovation process results due to interactions at economic and social levels between different institutions located in a particular region. 3. To understand the efficiency or performance of a regional/ local innovation system, it is important to examine not only the horizontal and vertical relations among firms but also the linkages between firms and other institutions such as universities, research institutions, supporting industry, provincial/ local government policies, and financial institutions. 	<ol style="list-style-type: none"> 1. Nation innovation system does not fully explain why there is an uneven development across different regions in a country. Regional innovation system concept helps to address this problem. It helps to understand the gap between advanced regions and less advanced regions. 2. It provided an alternative to growth without employment at national level. 3. It emphasises more on networking and linkages among regional actors and institutions which helps to understand better problems associated with regional/ local development. 4. Regional innovation system approach helps to understand to some extent why many of the leading firms in 'new economy' industries which need to innovate at a rapid pace have emerged in the same few locations across the world. 5. Regional innovation system helps to understand not only the region-level interaction to promote innovation in traditional industrial sectors such as manufacturing, but also in service-related sectors. 6. Analysis at sub-national innovation system level helps to understand the factors that help sustainable competitiveness of SMEs and their technological capacity-building. 	<ol style="list-style-type: none"> 1. Due to differences across regions within national boundaries and across different countries it is difficult to device 'common solutions' or general 'best practices' for regions. This creates problems towards policy formulations and learning from other regions. 2. Due to differences across regions, one of the major problems with regional innovation systems is the lack of comparability across regions. It seems every region aims to develop an innovation system based on some successful models which may not be appropriate for them. 3. The concept of regional innovation system can lead to confusion, as 'region' is interpreted in different ways (global region, or supranational region, metropolitan or city region, sub-nation region or local). 4. Although it can be argued that innovation is strongly influenced by region-specific factors, the ability of and incentives for firms to innovate are mainly linked to national level factors such as intellectual property right laws, taxation, corporate governance, tariffs and so on. Also by global factors such as increasing competition in the global market.

Innovation System/ Type	Actors/ Institutions/ Activities/ Linkages	Strengths/ Advantages	Weaknesses/ Disadvantages
Sectoral/ Technology Specific	<ol style="list-style-type: none"> 1. A sector is composed by various agents and organisations such as consumers, entrepreneurs, users, producers and input suppliers, firms, universities, financial institutions, and government institutions. 2. These actors and organisations interact through both market and non-market relationships to generate and exchange knowledge relevant to innovation and its commercialisation. 3. The nature of relationships and networks differ across different sectoral systems. 4. It is likely that during the evolution of sectoral systems the technological and learning regimes will experience changes. Such change is also likely to result in a co evolutionary process of various actors, institutions and knowledge flow 	<ol style="list-style-type: none"> 1. It provides an alternative analytical framework to the traditional concept of sector used in industrial economics, as it helps analyse other agents in addition to firms and brings in to focus the importance of knowledge flows, boundaries, market and non market factors and their interactions, and different institutions. 2. It recognises that firms are active actors in shaping their technological and market environment; unlike the traditional industrial economic view that they are passive (they transform inputs into outputs in response to market price signals). 3. It is useful to: (a) analyse the differences and similarities in the structure, organisation and boundaries of sectors; (b) understand the differences and similarities in the working, dynamics and transformation of sectors; (c) identify the factors affecting innovation, commercial performance and international competitiveness of firms and countries across different sectors; and (iv) for the development of public policy. 4. Sectoral system of innovation approach helps to understand why some sectoral systems become far more important in a national economy than others. 5. Emphasis on the diversity of sectoral systems helps to formulate different policy measures for different sectors. 	<ol style="list-style-type: none"> 1. Interactions between various agents in the sectoral system of innovation are shaped by institutions at both sectoral and national levels. Many institutions such as patent system are national. It is not easy to distinguish the boundary between national and sectoral. Also, the characteristics of these institutions (norms, routines, common habits, established practices, rules, laws, standards) at both levels are nearly indistinguishable. 2. Sectoral innovation systems are also shaped by institutions at global level. In some cases the relevant geographical boundaries are global as well as sectoral. In such cases it is not easy to distinguish the boundary between global and sectoral. 3. The relationship between national institutions and sectoral systems could be different in different countries. That is, the same institution may take different features in different countries, and thus may affect the same sectoral system differently in different countries. 4. The nature of relationships and networks differ across sectoral systems and therefore it can be difficult and complex to compare them to each other.

Summary: Comparison of Strengths and Weaknesses of Innovation Systems

- Table 1 compares the actors, activities and linkages between different types of innovation systems and also their strengths and weaknesses.
- It clearly illustrates that although there are some clear differences in the characteristics and emphasises among different types of innovation systems, there are also a number of common characteristics among them.
- These two aspects have to be reconciled if we attempt to develop a conceptual model that unifies different innovation systems.
- OECD (1999) has presented a model to unify the innovation systems, which is illustrated by Figure 9.

Figure 9: Actors and Linkages in the Innovation System (OECD)



Source: OECD (1999), *Managing National Innovation Systems*.

Innovation Systems: OECD Model

- Although the OECD model addresses the issue of global factors that influence the innovation systems at different levels, it has not addressed the importance of political factors at the national/ regional/ local levels that could play a major role in creating and developing an efficient system of innovation.
- We attempt to include this in our model as illustrated by Figure 10.



Innovation Systems: Our Unifying Model

Our model attempts to clarify four major aspects of systems of innovation:

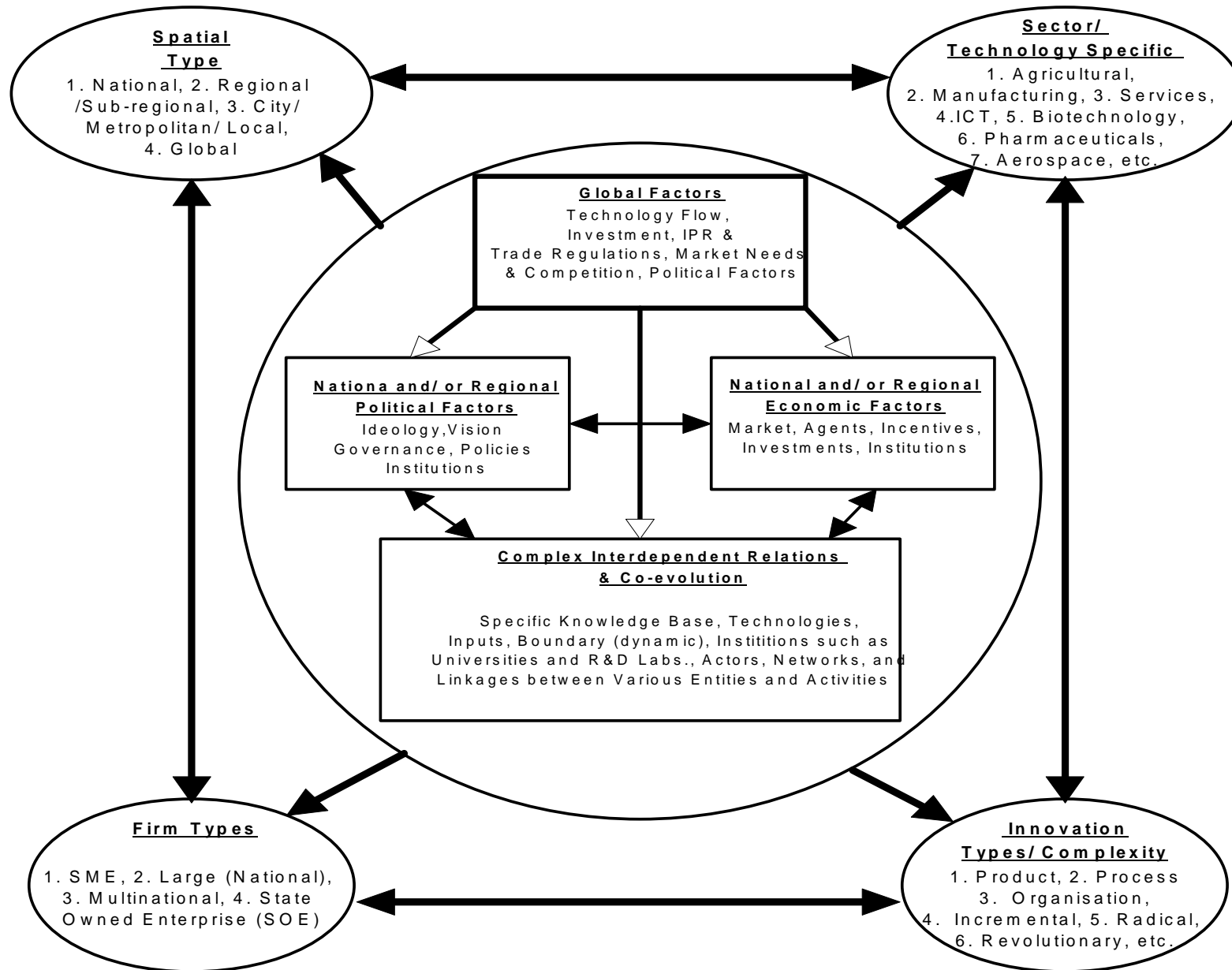
- (i) Complex interdependent relations and co-evolution of actors, institutions, and activities that are common to all types of innovation systems (specific knowledge base, technologies, institutions such as public R&D organisations, and universities, investment and trade and economic policies) ;
- (ii) National and / or regional political factors (ideology, vision, governance, policies, and institutions) which have been proved to have played a major role in creating and developing efficient innovation systems at national/ regional/ local level;
- (iii) National and / or regional economic factors (markets, agents, incentives, and institutions) which have been proved to have played a major role in creating and developing efficient innovation systems at national/ regional/ local level; and
- (iv) Global factors such as technology flow, global market competition, trade regimes, intellectual property regimes and global political factors that can impact on not only national innovation systems but also at regional/ local and sectoral innovation systems.

Innovation Systems: Our Unifying Model

- We emphasise on the role of political factors such as political vision and governance because it is evident from the history of innovation systems that these factors play important role particularly in the context of developing economies.
- For example, the creation and the subsequent role of MITI in Japan, *Chaebols* in Korea, large and sustained investment in higher education and S&T sectors in India, transformation of command economy to more open economy in China can be taken as initiatives of political vision by policy makers in these countries.



Figure 10: Unified Conceptualisation of Innovation Systems



Some Conclusions

- Both evolutionary economics theory and systems of innovation perspectives have been used to frame alternative conceptual frameworks to neo-classical economic theory.
- We think that there is an even more relevant role to them in providing alternative frameworks to the problems and challenges of development and underdevelopment.
- For the system of innovation to play a creative and insightful role, its use and application needs to be understood with clarity where the relevant non-economic and economic structures, institutions and actors and their co-evolutions are well specified, and those that need to be included are included, and those that do not need to be included are excluded.



Some Conclusions

- There is always the risk of misuse and abuse of a conceptual framework when it is extended to new terrain and endeavors. In order to avoid such a mishap the review and exploration of how the system of innovation has evolved and been used has been undertaken.
- The aim was to identify the core and peripheral themes that are allowed in the making of innovation systems by identifying those allowable variables from those that are excluded.
- Such a reflexive take on systems of innovation is likely to improve the way it may be productively used especially when the innovation system framework is applied increasingly to the problems of development and underdevelopment.
- We are still working on this paper, as it needs a lot of refinement

THANK YOU
FOR YOUR TIME AND INTEREST

