Korea's National Systems of Innovation (70 Years)
: Framework and National Experience

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Ministry of Science and ICT(MSIT)

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1. The National System of Innovation Approach

Introduction

➢ **How did some developing countries acquire the necessary capabilities to use technology and even to develop it?**
How did they make their systems of innovation more sophisticated?

- **the National System of Innovation (NSI) approach** emerged in the 1980s and the 1990s as an analytical framework in **developed countries**
  - **Definitions of NIS**
    "**The system of interacting private and public firms(either large or small), universities, and government agencies** aiming at the production of S & T within national borders. **Interaction** among these units may be **technical, commercial, legal social, and financial**, in as much as the goal of the interaction is the development, protection, financing or regulation of new S & T" (Niosi et al, 1993)
  - NSI approach could help to identify **the actors** and **the mechanisms that determine the success of innovation and technological development processes**.
  - It assumes that innovations result from **interactive learning processes** and **the co-evolution of technologies, institutions and organizations**.

1. The National System of Innovation Approach

Ministry of Science and ICT

Introduction

- **Limitations of NSI approach**
  - It is based on the observation of **sophisticated and complex innovation systems in developed countries.**
  - We had to adapt it to the context of developing countries
    ① **the behavior and objectives of the corresponding organizations and institutions differ**
    ② the NSI indicators for developing countries deal with **systems under construction**
    ③ Developing countries are operating in the context of a globalized R&D where **technological alliances** can play a significant role in technology acquisition.
- **Studies on Innovation and NSI in developing countries**
  - Empirical studies in developing countries have confirmed that the **macroeconomic environment and incentives regime** determine technological and economic performance.
    In addition, **Resources like appropriate human capital, foreign technologies, industrial infrastructure, public support and funding** are crucial for the acquisition of technological capacities(Dahlman and Nelson, 1995)

1. The National System of Innovation Approach

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Introduction

- **Studies on Innovation and NSI in developing countries**
  - Arocena and Sutz's theoretical works (2002) about innovation in developing countries highlighted that developing countries **lack interactive learning spaces(ILS) which are interactive activities and processes** **where individuals and organizations generate, transfer and use systemically knowledge to enhance their ability to learn and to resolve problems.**
  - In these learning spaces, firms acquire **new technological capabilities** and **the national system of innovation emerges**. As these spaces become **systemic**, firms strengthen their **technological capabilities** and the NSI becomes more **sophisticated and effective** (Fakir, 2008)
  - STI policies are on the periphery of many countries' development strategies. The problem is compounded by **typically weak and fragmented NSI**, whereby **linkages among STI stakeholders are few and nodes of collaboration and coordination may be nearly non-existent**. It is therefore necessary to establish the centrality of technology and innovation as a development issue and connect it to other development policies (UNCTAD)

1. The National System of Innovation Approach

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Introduction

- **TEC Brief #7**
  - A **NSI** consists of

    Actors: organizations that participate in technology development and transfer (e.g. technology firms, universities and financiers)

    Institutional context: Norms, cultural practices and laws that shape actor efforts (e.g. government policies that affect how the private sector invests in a particular sector)

    Linkages: Interactions and relations between actors and the institutional context (e.g. flows of information and knowledge, and collaboration between firms, universities and research institutes)
  - **Strengthening NSI requires three key complementary actions**

    ① Develop the fundamental elements: (i) build a strong education system, (ii) invest in research, development and demonstration (RD&D) and (iii) implement enabling policies (including to support market creation)

    ② Focus on specific climate technologies that help to meet national climate and development priorities

    ③ Build strategic and coordination capabilities of play of national actors

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United Nations
Framework Convention on
Climate Change

TEC Brief #7

Technology Executive Committee

Photo: "Groundnut harvesting in Malawi" by Swathi Sridharan is licensed under CC BY-SA 2.0

Why this TEC Brief?

Technological change is one of the key arms in our arsenal of weapons to combat climate change. A country's capabilities to drive and enable this change thus take on a critical role. The implications of our ability to manage a climate technology transition are enormous: a recent study suggests that to keep the global rise in temperature to less than 2 °C, the additional cost of deploying energy technologies between 2016 and 2050 is USD 40 trillion (IEA, 2015). As developing countries may account for up to 90 per cent of energy demand growth to 2050 (IEA, 2015), the importance of their technological capabilities to manage this transition effectively and efficiently cannot be overstated.

A country's technological capabilities are determined in part by the effectiveness of its national system of innovation (NSI). An NSI is a network of actors, institutional contexts and linkages that underlie national technological change. The NSI should thus play a central role in supporting a country's efforts to enhance action on climate change mitigation and adaptation. It also helps a country to meet other developmental challenges and add value to its national economy.

An NSI consists of:

- **Actors:** Organizations that participate in technology development and transfer
  e.g. technology firms, universities and financiers
- **Institutional context:** Norms, cultural practices and laws that shape actor efforts
  e.g. government policies that affect how the private sector invests in a particular sector
- **Linkages:** Interactions and relations between the actors and the institutional context
  e.g. flows of information and knowledge, and collaboration between firms, universities and research institutes

We, the Technology Executive Committee (TEC) of the UNFCCC, acknowledge the key role that NSIs play in combating climate change. In this TEC Brief, we outline the current state of NSIs in developing countries. We then highlight how developed countries and the international community may work together to support these countries in strengthening their NSIs, enhancing both national climate action and sustainable development.

Box 1. Republic of Korea:
Building a dynamic national system of innovation

The Republic of Korea is a prominent example of a country that has successfully built a strong and dynamic innovation system in just a few decades. In the initial stages, government policies promoted the importation and assimilation of technologies and their improvement over time by learning-through-manufacturing as well as reverse engineering. The policies also promoted a focus on specific industries such as steel, shipbuilding and automobile. The Government: (i) introduced an export-oriented strategy that ensured competition and (ii) encouraged significant investments in R&D that developed competitive national firms. Government investments in education and human resource development also supported this capability-building. Notably, the Government's policies evolved over time in response to the evolving perceived needs of the economy. The Government's role also changed: at first, it set targets and helped firms to meet these targets through suitable policies and provision of finance; later, it became more of a facilitator and coordinator of policies and programmes. (Based on Chung, 2007.)

TEC's recommendation to the COP (TEC Brief #10)

To enhance the implementation of nationally determined contributions, national adaptation plans and mid-century strategies, the Technology Executive Committee recommends that the Conference of the Parties (COP) encourage Parties:

(a) To prioritize resources (human, institutional and financial) for such innovation efforts, in accordance with their needs, priorities, and capacities;

(b) To enhance public and private partnerships in the research, development and demonstration of climate technologies by increasing expenditure for it and providing a clear policy signal of a long-term commitment to act on climate change;

(c) To strengthen national systems of innovation and enabling environments, including through market creation and expansion, and capacity-building;

(d) To enhance existing and build new collaborative initiatives for climate technology innovation, including for sharing expertise, good practices and lessons learned;

(e) To create an inclusive innovation process that involves all key stakeholders, facilitating the incorporation of diverse and relevant expertise, knowledge and views and generating awareness of the benefits and impacts.

(f) To acknowledge and protect indigenous and local knowledge and technologies and incorporate them in their national innovation systems

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- **GCF**
  - **Actors/institutions** usually exist in developing countries but **lack critical mass and often remain isolated** from each other, hence **less effective** **(GCF/B.18/12)**
  - **Public sector assistance and incentives** are key to starting to **make linkages between actors in developing countries and internationally** **(GCF/B.18/12)**

References:
Options for support for technology collaborative research and development

Options for support for technology collaborative research and development - Addendum

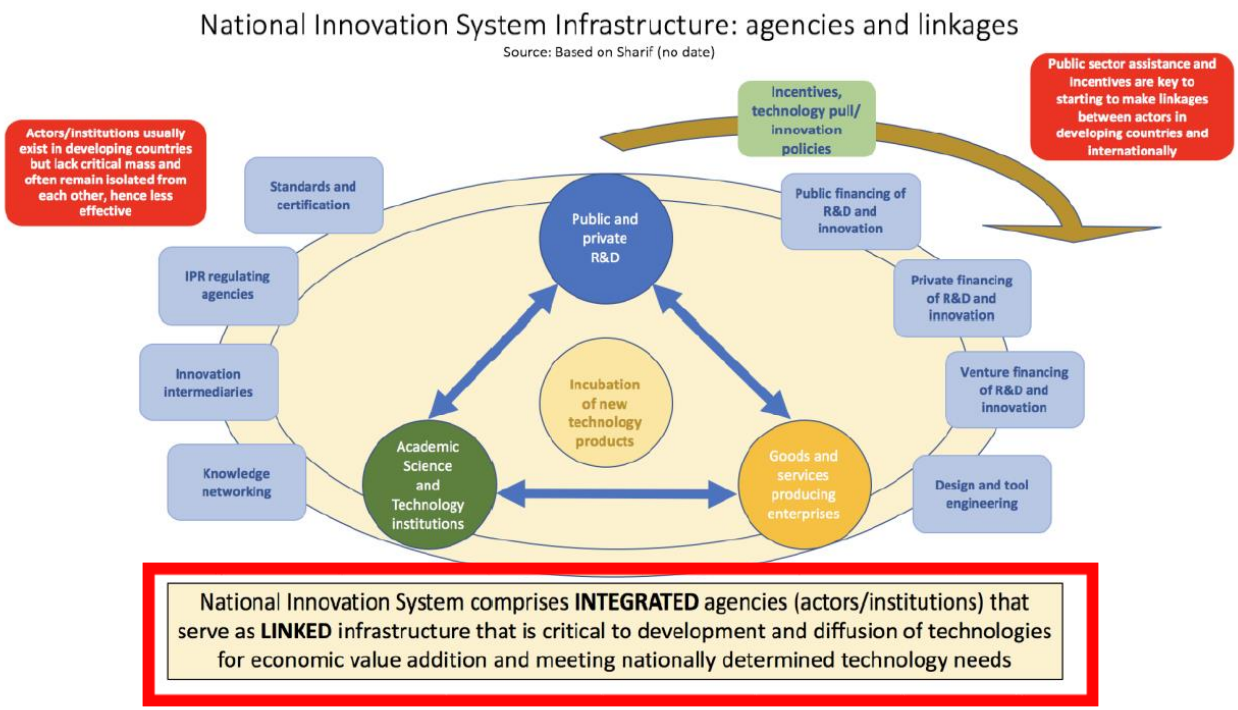

Figure 1: Components of an innovation system with reflections on developing country contexts

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Introduction

GCF Board DECISION B.18/03

(a) Takes note of **the options** outlined in document GCF/B.18/12 for the GCF **to support collaborative research, development and demonstration**, in respect of the following approaches:

(i) **Climate technology innovation systems**; and

**** Innovation system-level support***

Two components could be considered under this approach:

(1) Support for the creation and strengthening of intermediary innovation institutions and

(2) Technology-pull policies (creating enabling environments) – standards, regulations, consumer education, tenders for tranches of output, strategic public procurement policies

(ii) **Targeted climate technology research, development and demonstration support**;

(b) Encourages **national designated authorities/focal points** to collaborate with **readiness delivery partners and accredited entities** to submit readiness requests, concept notes, funding proposals and Project Preparation Facility proposals **supporting technology collaborative research and development**;

(c) Requests the Secretariat to develop for consideration by the Board at its twentieth meeting **the terms of reference for a request for proposals to support climate technology incubators and accelerators**;

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GCF Board DECISION B.18/03

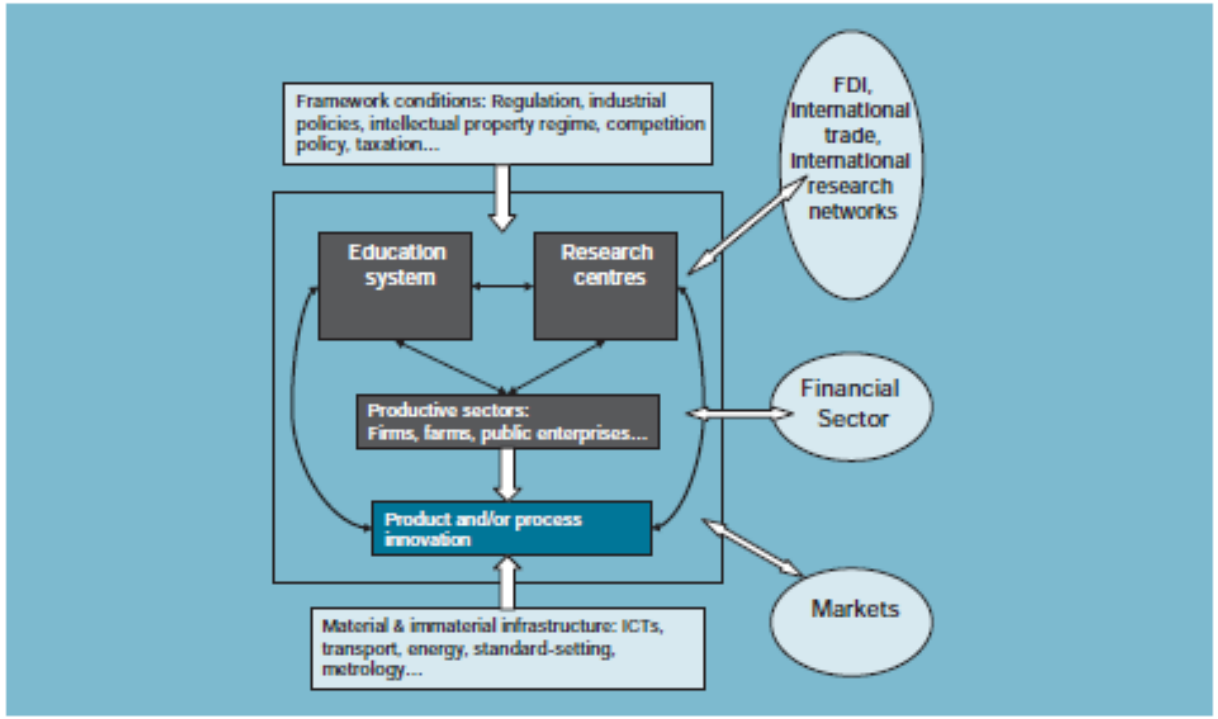
(d) Also requests the Secretariat to continue **collaborating with the Technology Executive Committee of the UNFCCC** and **the Climate Technology Centre and Network**, including in the implementation of this decision, to **enable support for technology development and transfer** for **facilitating access to environmentally sound technologies** and for **collaborative research and development for developing countries**; and

(e) Further requests the Secretariat to continue to consider **complementarity and coherence with other related technology initiatives and activities**, including **technology needs assessments and technology action plans**, and to report accordingly in the context of the Operational Framework on Complementarity and Coherence adopted in decision B.17/04.

1. The National System of Innovation Approach

Introduction

Figure 1 A schematic diagram of a national system of innovation



Source: UNCTAD.

- **UNCTAD (Conference on Trade and Development)**
  - **STI policy** is not only concerned with the strengthening of **the supply side of knowledge and technology**, but needs also to consider **the management of the demand side** as well as **the interactions between the two sides** and **the development of enabling environments**

1. The National System of Innovation Approach

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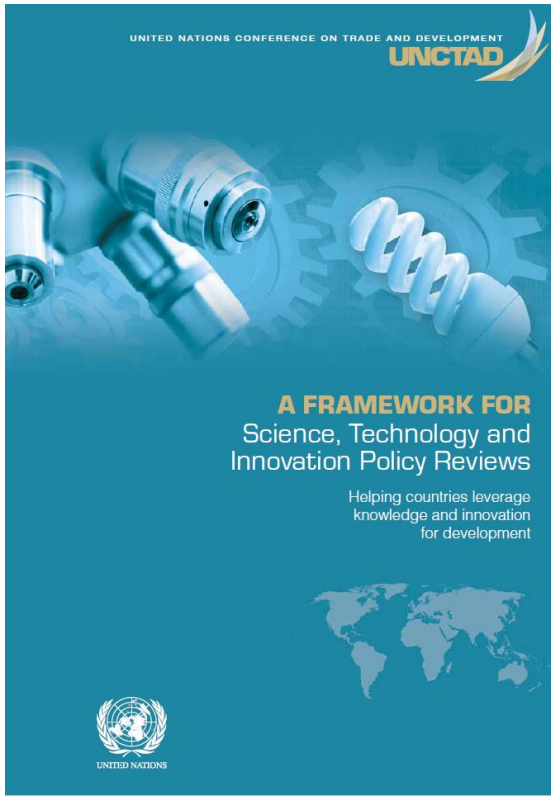
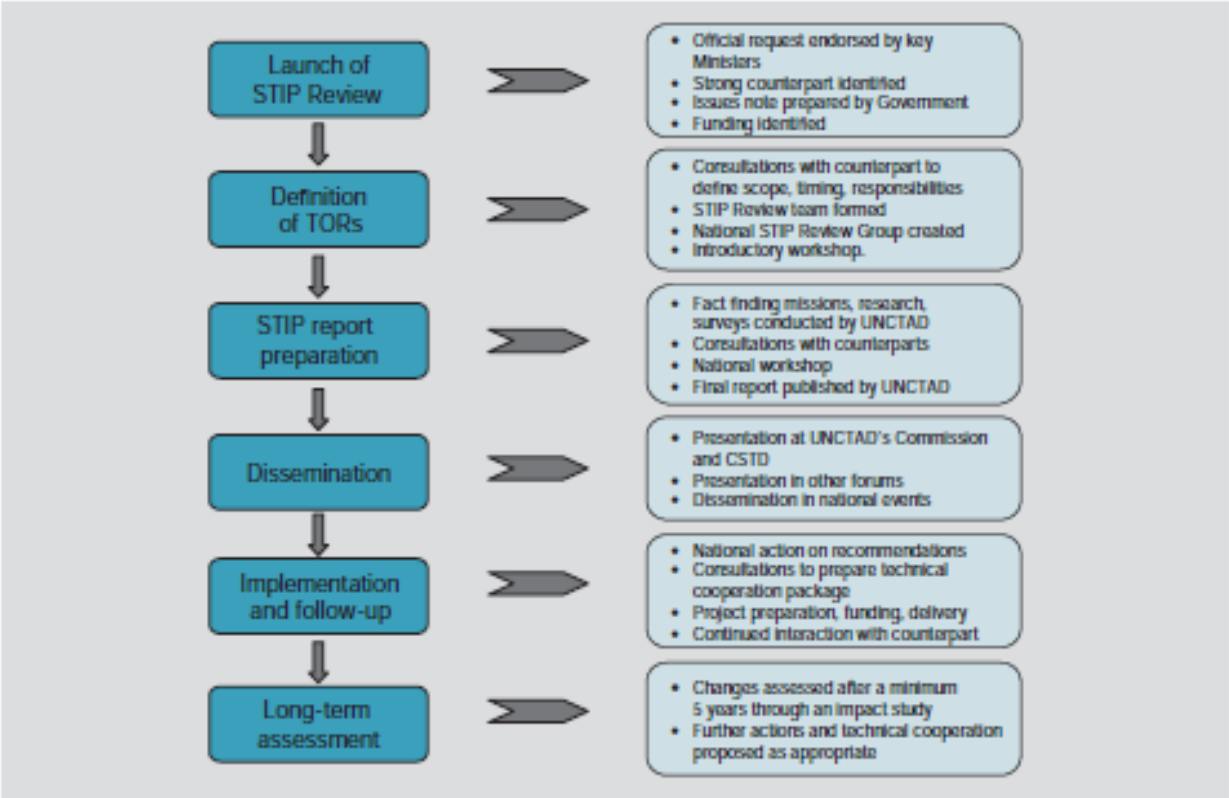
Introduction

- **UNCTAD**
  - **Strengthening national innovation systems**
    The Science, Technology and Innovation Policy Reviews (STIP Reviews)
  - **Building capacity for STI policy-making**
  - **Innovation Policy Learning Programme**





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2. Korea's National Systems of Innovation

Technology and Innovation Policy

Evaluation on Korea's NSI

- In a relatively short time, Korea has changed from a backward agricultural economy into one of the world's most modern industrial economies
  - Korea was among poorest countries in the world following the devastating Korean War (1950-1953)
  - Situation: a small market, lack of natural resources and low technological capacities
- Korea is a well-known case of successful economic catch-up achieved through a government-led manufacturing and export-oriented strategy
  - Nationalism and culture, new Confucianism encouraged personal achievement (education, discipline), family values, patriotism, harmony and community spirit

2. Korea's National Systems of Innovation

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Technology and Innovation Policy

➢ Certain lock-ins hamper its evolution

- The still dominant role of the large firms (Chaebols), despite efforts to improve the innovation capacity of SMEs
  - Long-standing policy emphasis on manufacturing and Chaebols
  - The relatively weak innovation performance of SMEs
- An over-emphasis on short-term, industrially oriented research at the expense of long-term, fundamental research
- Relatively weak internationalization of the domestic research system
- A weakly developed research capacity in the universities
- A lagging productivity in services sector compared to manufacturing
- Under-utilization of labor resources, particularly women
- Limited domestic job creation among the industrial conglomerates

2. Korea's National Systems of Innovation

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Technology and Innovation Policy

➢ Political changes

- 1910 – 1945: Japanese colonial rule/ 1945: Independence and divided
- Korean War (1950-1953)
- During 1950s, American aid was vital for the reconstruction and industrialization

1963	1973	1980	1988	1993	1998	2003	2008	2013	2017
3rd Republic 1961 Military coup: Park Chung-hee takes power	4th Republic	5th Republic 1979 Military coup: Chun Doo-hwan takes power	6th Republic 1987 First Direct presidential election (5-year, one-term)						
			Rho TW (13)	Kim YS (14)	Kim DJ (15)	Rho MH (16)	Lee MB (17)	Park GH (18)	Moon JI (19)

2. Korea's National Systems of Innovation

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➢ Policy from the 1960s to the mid-1990s

- **(Feature 1) A major policy instrument in Korea's successful catch-up has been the multi-annual plans (e.g. 7 consecutive Five-Year Plan for Economic and Social Development)**
  - **supported the creation of domestic capabilities, set clear targets and orchestrated actions across several fields (industry & tech, trade, education and infrastructure)**
  - **Each of the plans identified key objectives, introduced selective policies and directed resources to achieve them**

FYP	Principal objectives
1st (1962-66)	Building **domestic light industry: textiles, clothing, footwear etc.** Infrastructure development: power plants
2nd (1967-71)	Building key **domestic heavy and chemical industries(HCI): steel, machinery, chemicals, shipbuilding, etc.** Infrastructure development: Gyeongbu expressway (Seoul-Busan)
3rd (1972-76)	**Industrial restructuring:** Building heavy and chemical industries **(industrial complexes)**
4th (1977-81)	**Industrial restructuring**: Strengthening heavy and chemical industries (building the bases for technological capabilities)
5th (1982-86)	Economic stabilization: Industrial competitiveness by opening and rationalizing the economy
6th (1987-91)	Regulatory reforms/ **Supporting high-tech industries/ Building high-tech and innovative capabilities**
7th (1992-96)	Revitalizing the economy Establishing a basis for balanced development of industrial sectors and companies

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1963	1973	1980	1988	1993	1998	2003	2008	2013	2017
3rd Republic	4th Republic	5th Republic	6th Republic						
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Five-Year Plan (FYP) for Economic and Social Development (1962 – 1996)

- 1st FYP for Economic Development (1962 - 1966)
- 2nd FYP for Economic Development (1967 - 1971)
- 3rd FYP for Economic (No Materials)
- 4th FYP for Economic & Social Development (ESD) (1977 - 1981)
- 5th FYP for ESD (1982 - 1986)
- 6th FYP for ESD (1987 - 1991)
- 7th FYP for ESD (1992 -1996)
- FYP for New Economy (1993 – 1997)

- Creation of Presidential Advisory Council on S & T (PACST) (1991)
- Creation of National S & T Council (NSTC) (1999)
- Framework Act on Science and Technology (2001)
  - Provisions on NSTI System Promotion and S & T Basic(Master) Plan

S & T Comprehensive Plans

- 1st FYP for Technology Development (1962 - 1966)
- 2nd FYP for S & T Development (1967 - 1971)
  - Science and Technology Promotion Act (1967)
  - Science Education Act (1967)
- 3rd FYP for S & T Development (No Materials)
- S & T Section Plan of 4th FYP for ESD (1977 - 1981)
- S & T Section Plan of 5th FYP for ESD (1982 - 1986)
- S & T Section Plan of 6th FYP for ESD (1987 - 1991)
- S & T Section Plan of 7th FYP for ESD (1992 - 1996)
- Technological Strategy Section Plan of FYP for New Economy (1993 – 1997)
- FYP for S & T Innovation (1997-2002)
- The Complementary FYP for S & T Innovation (2000 -2002)
- S & T Basic Plan (2002 – 2006)
- S & T Basic Plan in Participatory Government (2003 – 2007)
- 2nd S & T Basic Plan (2008 – 2012)
- 3rd S & T Basic Plan (2013 – 2017)
- 4th S & T Basic Plan (in preparation)

2. Korea's National Systems of Innovation

- (Feature 2)During the period of 1962 to 1996, the Chaebols – family-controlled conglomerates such as Samsung, Hyundai, and LG-emerged and played a leading role in economic development.
  - The government nationalized banks so as to channel scare capital to chaebols and encouraged them to invest in industries it saw as strategic to achieving national objectives (the banks were privatized in the 1980s).
  - The government-favored chaebols had special privileges and grew larger, with may SMEs acting as subcontractors to them.

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Feature 3

Informal channels

Interactive learning spaces with foreign suppliers and experts

- capital goods, technical assistance and license (small batch industries – shipbuilding, machinery/ large batch industries- electronics, automobile)
- turnkey plants with training (industry using process production–chemicals, cement, pharmaceuticals)
- Imitative reverse-engineering of imported goods for the purpose of acquiring necessary technologies
- Korean firms benefited from Original Equipment Manufacturing (OEM) production arrangements

Formal channels

- Foreign Direct Investments

- Effective in maintaining independence from the dominance of multinationals
- less market mediation and more active roles of technology recipients
  - less costly
  - require higher capability of technology recipients in not just identifying and selecting technologies but also absorbing, assimilating and improving upon the transferred technologies

The rich pool of well-educated people

- Korea had to give up an important access to new technologies that might have been available through direct equity links with foreign firms
- Korea failed to adopt global standards in domestic business operation.

2. Korea's National Systems of Innovation

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➢ Lessons

- The characteristics of common pattern of Asian success in manufacturing

① Firms are able to integrate and evolve from an interactive learning space to another to get the technological capacities required for each stage of development

② Institutional framework and organizational arrangements supported the technological effort

* Chinese firms: joint venture with multinational companies and R&D(rapid change)

* Korean firms: informal channels

- Korean strategies were particularly effective in the assimilation, adaptation and improvement of technologies developed outside Korea.

Organizational arrangement and the institutional framework were adapted to fit the technology needs.

**A successful pattern of technological assimilation does not necessarily help in producing new technologies* and *contributing to radically new knowledge and technologies requires another set of strategies*

2. Korea's National Systems of Innovation

➢ Lessons

- Lessons for policy makers in developing countries from Korea's experience

① Education builds a nation's ability to absorb new knowledge and technology

- HR development, vocational and technical training, advanced education in S&T

② Formal channels, Informal channels → abandoned many of the technological opportunities that FDI might have offered

③ Adoption of an outward-looking development strategy

- export-oriented firms (international markets) vs import-substituting firms

2. Korea's National Systems of Innovation

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➢ 1960s: The acquisition of production technological capabilities

- Government selectively restricted foreign direct investment(FDI)
- 1st FYP for ED: focused on the development of labor intensive industries such as textiles, clothing and footwear (strategic industries)
- Brought in long-term foreign loans and investments in selected industries
  → massive importation of foreign capital goods and turn-key plants
- Government switched from import substitution to export promotion for acquisition of production capabilities in many new industries
- From the mid-1960s, several government research institutes(GRIs) were established, such as Korea Institute of Science and Technology(KIST) - aimed to carry out R&D in key technological fields, with a view to supporting the industrial upgrading strategy.
- The Ministry of Science and Technology(MOST) was established shortly after (1969) the drawing up of the Science and Technology Promotion Law (1967).

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➢ 1970s: The emergence of innovation capabilities

- Heavy and chemical industries such as petrochemicals, shipbuilding, automobile, and consumer electronics were the key sectors for the expansion of industrial exports in the late 1970s and early 1980s.
- Korean firms improved rapidly their technological capabilities in production and in product design
  - Interactions with foreign customers enhanced the know-how of local companies and new technologies were acquired
- To help the two nascent industries further, the government created GRIs, which worked with private industries to build the technological foundation for industrial developing. GRIs also contributed to the building up of indigenous R&D capabilities by bringing back many established scientists and engineers from abroad
  - KIMM (Machinery & Metals), ETRI (Electronics & Telecommunications) KRICT (Chemical Technology), KIET (Energy), KRISS (Standards & Science) KORDI (Ocean), KIET (Electrotechnology) etc.,
- R&D tax credits were introduced

2. Korea's National Systems of Innovation

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➢ 1980s: The emergence of high-tech industries and the expansion of R&D

- Korean companies (particularly Jaebols) moved from reverse engineering to international cooperation and local R&D to acquire the knowledge associated with the emerging industries
- Many emerging high-tech industries provided opportunities
  Korea: semiconductors, optical fibre, robotics, computer and aircraft
- The government looked to target core technologies that would actively lead Korean national economic growth rather than passively support industry's technological demands
- Building indigenous R & D capability by government
  - National R&D Program launching in 1982 by MOST
    * Shortly afterwards, similar R&D programmes were set up in various ministries.
      In particular, a separate directorate to support industrial R&D was set up in the Ministry of Trade and Industry
  - Various actions including tax credits for R&D investments and worker development to promote and facilitate private R&D activities

2. Korea's National Systems of Innovation

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➢ 1990s: The expansion of high-tech industries and the strengthening of innovation capabilities

- R&D investment grew rapidly and continuously until Korea was hit by the 1997 Asian financial crisis (13.5 billion USD, 2.6% of GDP in 1996)
- As private-sector R&D spending rose, government spending declined (53.5% (1981) → 19.4% (1991) → 16% (1994))
- With industry leading the way, R&D activities in Korea are focused largely on applied research and technology development, reflecting shorter-term commercialization

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2. Korea's National Systems of Innovation

1963	1973	1980	1988	1993	1998	2003	2008	2013	2017
3rd Republic	4th Republic	5th Republic	6th Republic						

Government Research Institutes(GRIs) under National Research Council of S & T (25)

1960s

- Atomic Energy (59.2.3)
- Science & Technology Information (62.1.1)
- Science & Technology (KIST, 66.2.10)

1970s

Korea Advanced Institute of Science (71, KAIST)

- Astronomy & Space Science(74.9.13)
- Standards & Science (75.12.24)
- Geoscience & Mineral Resources (76.5.10)
- Chemical Technology (76.9.2)
- Electrotechnology (76.12.29)
- Electronics and Telecommunication (76.12.30)
- Machinery & Materials (76.12.30)
- Energy (77.8.16)

1980s

- Civil Engineering & Building Technology(83.6.11)
- Biotechnology & Bioscience (85. 2.1)
- Food (87.12.31)
- Basic Science (88.8.1)
- Aerospace (89.10.12)
- Industrial Technology(89.10.12)
- Oriental Medicine (94.10.10)
- Railroad (96.3.2)

1990s

- Oriental Medicine (94.10.10)
- Railroad (96.3.2)

2000s

- Security (00.1.1)
  - under Electronics & Telecommunication
- Toxicology (02.1.1)
  - under Chemical Technology
- Fusion (05.10.1)
  - under Basic Science
- Material Science (07.4.27)
  - under Machinery & Materials

2010s

- Kimchi (10.1.1)
  - under Food
- Green Technology (13.2.1)
  - under Science & Technology

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1963	1973	1980	1988	1993	1998	2003	2008	2013	2017
3rd Republic	4th Republic	5th Republic	6th Republic						

Government Research Institutes(GRIs) under National Research Council of Economics, Humanities & Social Science (26)

1970s

- Development (71.3.11) (KDI)
- Health & Social Affairs (71.7.1)
- Education Development (72.8.30)
- Industrial Economics & Trade (76.1.7)
- Rural Economic (78.4.1)
- Human Settlements (78.9.18)

1980s

- Women's Development (83.4.21)
- Information Society Development (85.2.4)
- Energy Economics (86.9.1)
- Science & Technology Policy (87.1.5)
- Transport (87.8.25)
- Labor (88.8.25)
- Criminology (89.3.16)
- Youth Policy (89.7.1)
- International Economic Policy (80.12.29)

1990s

- Legislation (90.7.30)
- National Unification (91.2.2)
- Public Administration (91.9.27)
- Public Finance (92.7.15)
- Environment (92.7.15)
- Maritime (97.4.18)
- Vocational Education & Training (97.9.10)
- KDI School of Public Policy & Management (97.12.5)
- Curriculum & Education (98.1.1)

2000s

- Childcare & Education (05.9.30)
- Architecture & Urban (07.6.15)

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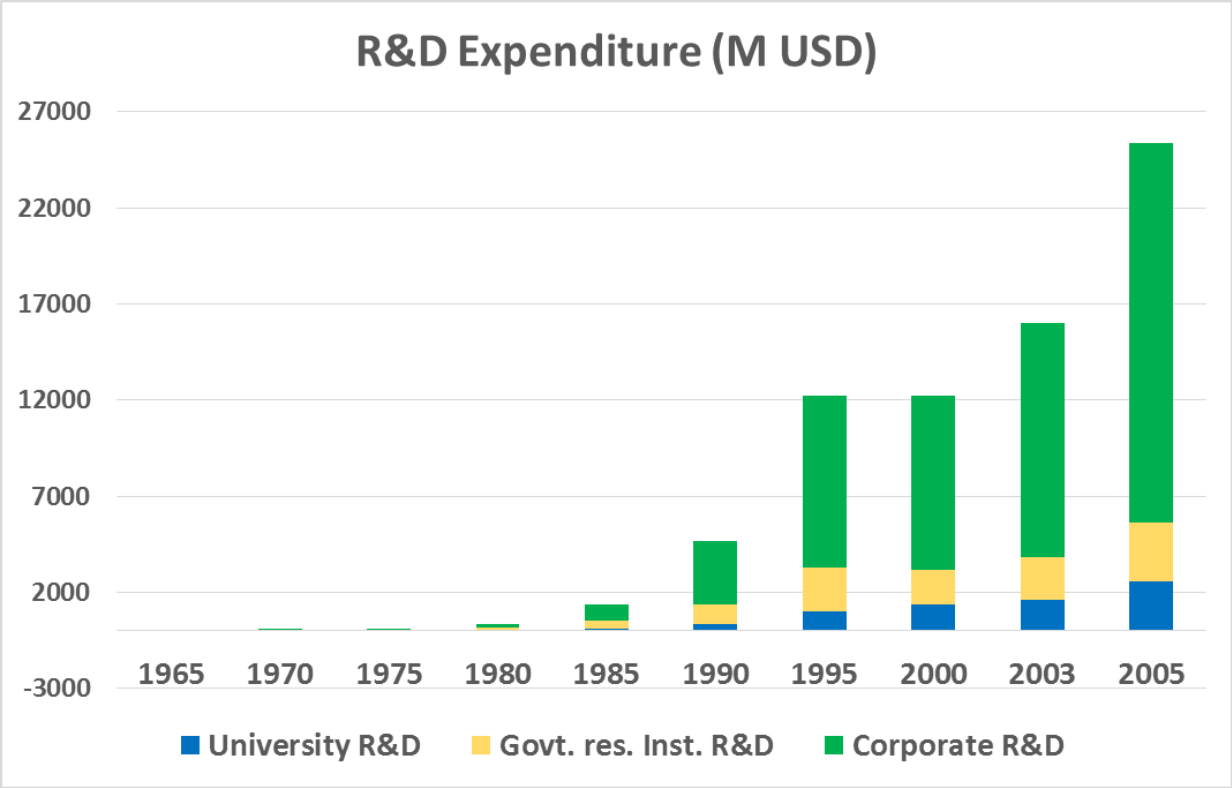

	1965	1970	1975	1980	1985	1990	1995	2000	2003	2005
R&D expenditure (million dollars)	8.0	33.0	88.0	428.0	1,390.0	4,676.0	12,244.0	12,247.0	16,002.0	23,582.0
Govt	7.2	28.9	62.4	272.7	344.7	908.7	2,309.9	3,054.7	3,913.4	5,730.7
Private sector	0.8	4.1	25.6	155.3	1,045.3	3,767.3	9,934.1	9,192.3	12,088.6	17,793.5
Govt. vs. private	61:39	97:03	71:29	64:36	25:75	19:81	19:81	25:75	25:75	24:76
R&D/GDP(%)	0.26	0.38	0.42	0.77	1.58	1.95	2.50	2.68	2.63	2.99

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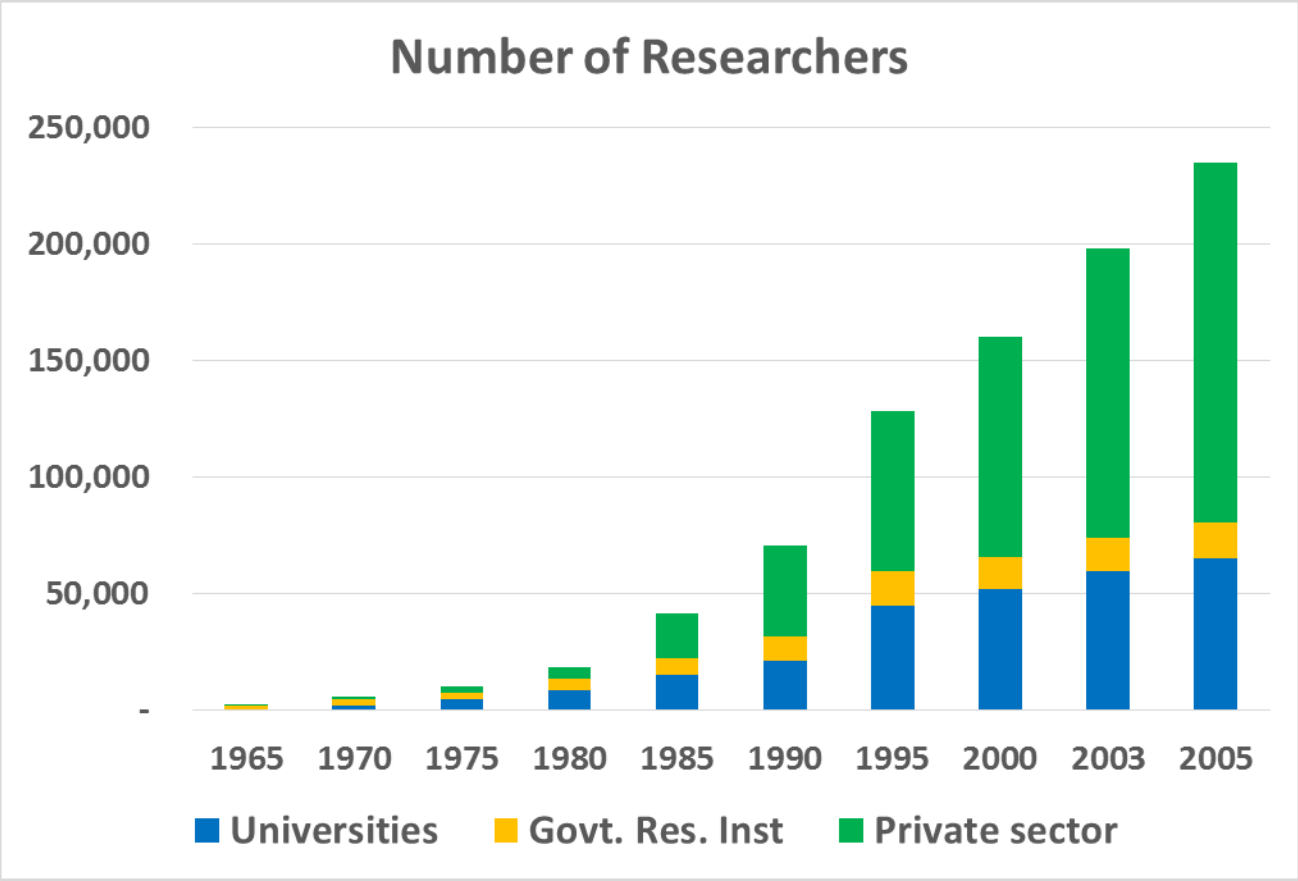

	1965	1970	1975	1980	1985	1990	1995	2000	2003	2005
Govt. Res. Inst	1,671	2,458	3,086	4,598	7,542	10,434	15,007	13,913	14,395	15,501
Universities	352	2,011	4,534	8,695	14,935	21,332	44,683	51,727	59,746	64,895
Private sector	112	1,159	2,655	5,141	18,996	38,737	68,625	94,333	124,030	154,306
Number of researchers	2,135	5,628	10,275	18,434	41,473	70,503	128,315	159,973	198,171	234,702

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     - From 1960s to the mid-1990s
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   - Technology and Innovation Policy System
3. SWOT and OECD Recommendations

2. Korea's National Systems of Innovation

Ministry of Science and ICT

Policy from the mid-1990s to the Present

➢ From mid-1990s to early 2000s

- Korea government has been pressured to change the catch-up oriented industrial development policy (extensive labor and capital input) and to seek new growth engines
  - the catch-up strategy, dominant role and sometimes alleged unfair business practices of the Chaebol (weakening the innovation capacity of SMEs), and a lagging services sector compared to manufacturing
- The Asian financial crisis in 1998 caused negative GDP growth(-5.7%) and mass unemployment
- Government made up for the decrease in industrial R&D by increasing its own R&D expenditure and it was directed in particular at small technology-based firms
- In 1998, the country launched drastic reforms in the areas of government, business and finance.
  - Korea searched for new source of growth appropriate to the knowledge economy
  - The government extensively supported ICT and creative venture companies
    * share of ICT: 13% (1997) → 33.5%(2002)
  - The pro-ICT policy also positively influenced innovative activities in other sectors

Policy from the mid-1990s to the Present

OECD Recommendations in 2005

- Many studies and reports in the 2000s have indicated that Korea is not a producer of radically new technologies
- OECD recommendations for the improvement (2005, OECD economic reviews)
  - Basic research, especially within universities must be strengthened to increase the chances of new discoveries and to develop new technologies
    * More interactions between different innovation actors (firms, GRIs, universities) are also required.
    * Scientific and technological cooperation with other countries must be intensified to take advantage of their previous experience
  - Education policy must be reformed to diversify higher education and develop creative and high quality expertise in strategic areas.
  - Industrial policy must lead to a more balanced structure between SMEs and Chaebols and to more intensive learning and innovation through more business services, venture capital development, support networks, enhancement of creativity culture and so on.

2. Korea's National Systems of Innovation

Ministry of Science and ICT

➢ Outcomes of implementation of the recommendations

- New R&D public programs and higher universities budget (to intensify basic research) lead to the rise of public expenditures
- In the early the 2000s, government restructured the NSI to encourage an innovation such as upgrading academic and industrial laboratories
- Rapid growth in R&D investment has led to a remarkable increase in patent registration
  - 1,808(1981) → 73,512 (2005), average annual growth rate = 15%
  - The growth of patents granted by Koreans: 12.8% (1981) → 72.7 % (2005)
  - The number of US patents granted to Koreans: 543 (1992) → 3,538 (2001) (7th ranking)
  - Korea has established world prominence in areas such as information and telecommunications, pharmaceuticals, advanced materials and auto manufacturing
- The remarkable increase in the number of scientific publications in internally recognized academic journals
  - 171 (1980) → 1,227 (1988) → 9,124 (1997) → 23,048 (2005)
- R&D efforts have contributed to the development of high-tech industries
  - Based on in-house R&D, Korean industries have emerged as world leaders in semiconductor memory chips, cellular phones, and liquid crystal displays, as well as establishing themselves in the world market in shipbuilding, home appliances, auto manufacturing, telecommunications, and other areas

2. Korea's National Systems of Innovation

Ministry of Science and ICT

➢ From mid-1990s to early 2000s: Kim DJ Administration

- Vision 2025, formulated in 1999, proposed fundamental shifts in technology policy
  ① moving from a government-led and development-oriented innovation system to a private industry-led and diffusion-oriented innovation system
  ② moving from a closed R&D system to a globally networked R&D system
  ③ moving from a supply-dominated investment enhancement strategy to an efficient utilization and investment-distribution strategy
  ④ moving from a short-term technology-development strategy to a long-term market creating innovation strategy
  ⑤ moving towards a science and technology-led national innovation system

- Based on Vision 2025, the Framework Act on Science and Technology was created to promote science and technology more systemically in 2001.
  - The Act is the legal basis for five-year Basic Plans of Science and Technology (2002-2006, 2003-2007, 2008-2012 and 2013-2017)
  - The Basic Plans are Korea's overarching guide for the conduct of science and technology policy

2. Korea's National Systems of Innovation

Ministry of Science and ICT

➢ 2003 – 2007: The Rho Administration

- In 2003, The Rho government initiated an extensive innovation-oriented drive in all sectors of the economy, and looked to the subnational regions - which are underdeveloped relative to the capital area - as a new source of growth
  - Four major policies for regional innovation
    ① providing the basis for the establishment of RIS (Regional Innovation Systems)
    ② strengthening the innovation capacity of universities in provinces
    ③ promoting science and technology in provincial regions
    ④ establishing industry-university-research institution network
- The convergence and integration of technologies and industries became the focus of next generation growth and future economic productivity depended more on technology convergence
- Next-generation growth engine industries received policy attention in 2003 with the development of high technologies(6 T): information, bio-, nano-, space, environment and cultural technologies
- Ten industries: digital TV and displays, intelligent robot, future car, next-generation semiconductors, next-generation mobile communication, intelligent home network, digital content and software solutions, next-generation batteries, and biomedical products

2. Korea's National Systems of Innovation

Ministry of Science and ICT

➢ 2003 – 2007: The Rho Administration

- As part of this effort, the Five Year Balanced National Development Plan (2004-2008) was introduced and implemented, and included the transfer of most ministries and public agencies to provinces outside of Seoul from 2012
- The Industrial Complex Cluster Program (ICCP) was first initiated in 2004 as one of the balanced national development policies.
  - In the beginning, seven pilot complexes were selected in 2005 and additional five complexes were designated in 2008.
  - In the process of building networks and implementing the ICCP, a mini-cluster project, an industry-university-research institution alliance built according to the industrial or technical fields played an important role.
    * Such an alliance continuously develops mutual cooperation, joint learning, and information sharing with the participation of innovation actors in the region, such as large firms, SMEs, universities, research institutions, supporting organizations, and local government units
  - the Lee government reformed the ICCP into the Pan Regional Cluster Program with the policy of 5+2 Regional Economic Area (REA) in 2010
- The government also launched a so-called "win-win" strategy between SMEs and large companies

2. Korea's National Systems of Innovation

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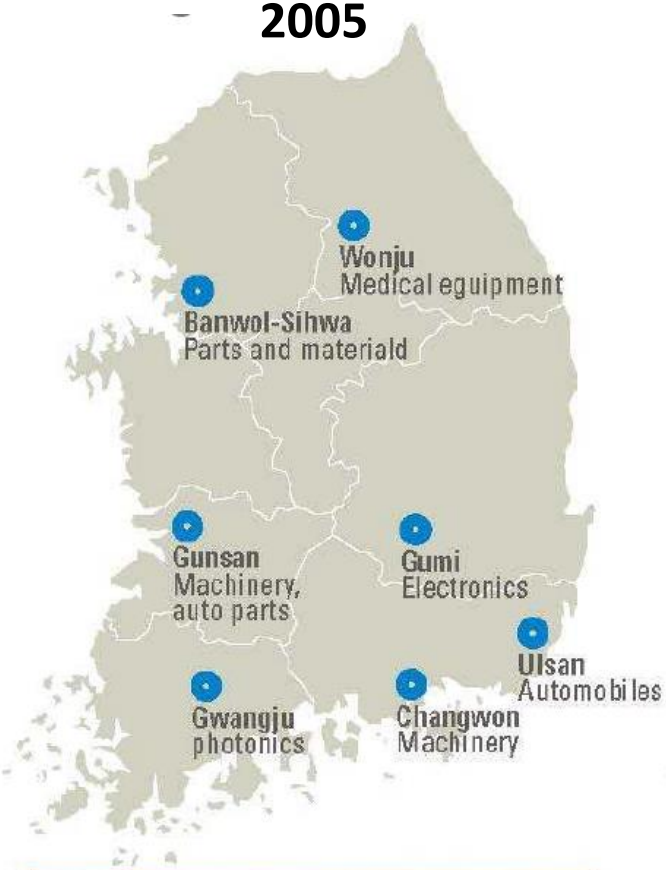
➢ 2003 – 2007: The Rho Administration

Industrial Complex Cluster Program (ICCP): The Rho Administration

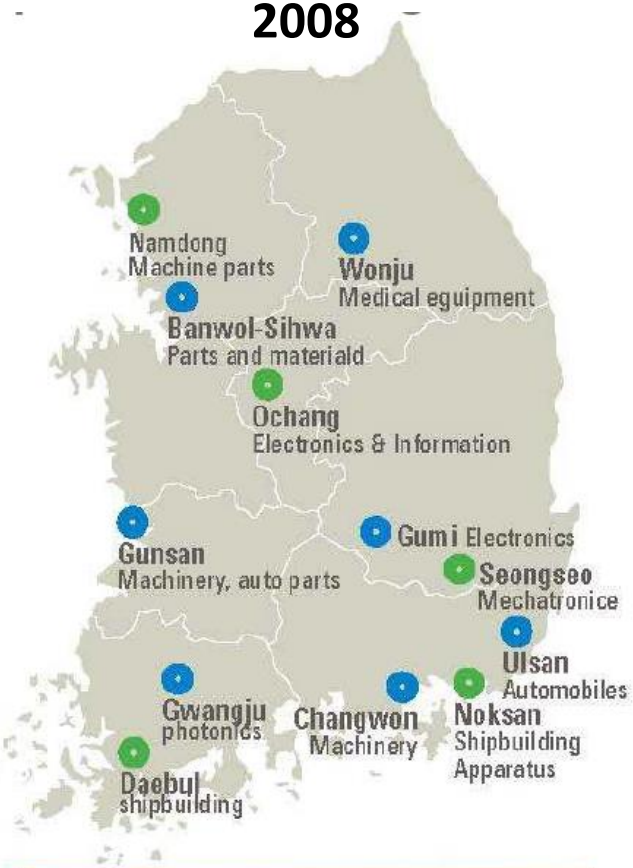
Pan Regional Cluster Program (2010): The Lee Administration

2005



7 pilot complexes

2008



12 industrial complexes

5+2 pan regional clusters

Reference: Koo, Evolution of Industrial Policies and Economic Growth in Korea: Challenges, Crises and Responses (2013)

2. Korea's National Systems of Innovation

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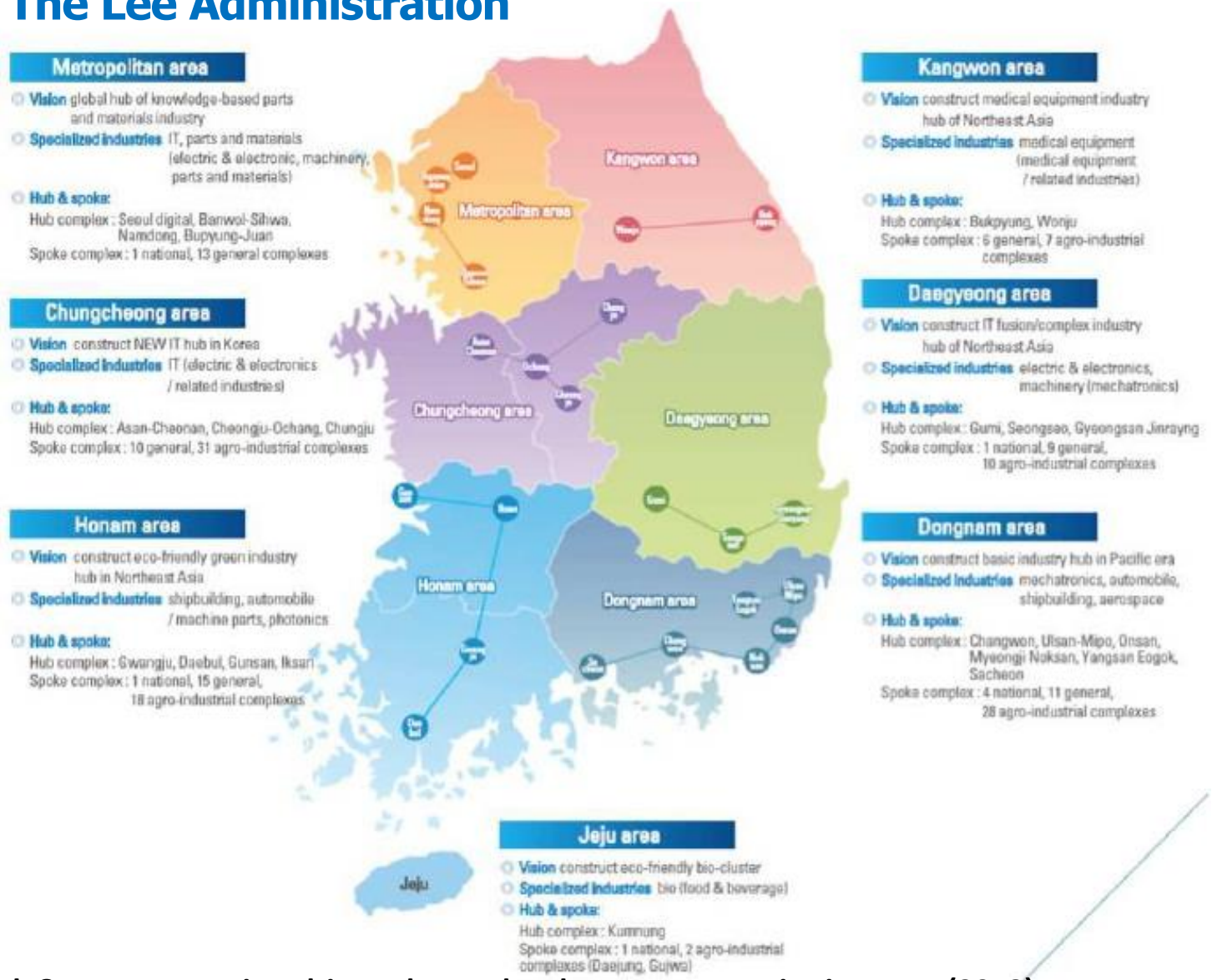
➢ 2008 – 2012: The Lee Administration

Regional Economic Area and Major Hub Regional Clusters in Lee Myung-bak Government



Reference: Park & Koo, Innovation-driven cluster development strategies in Korea (2013)

2. Korea's National Systems of Innovation

➢ 2008 – 2012: The Lee Administration

- Since 2008, the Lee government sought to strengthen potential output growth and create employment by developing a more favorable business environment, and making the economy more knowledge-based.
  - Ministry of Commerce, Industry and Energy → Ministry of Knowledge Economy
- The government searched for new sources of growth, such as "low-carbon green growth" and a selection of 17 technologies and sectors (new growth engines).
  - Green Technology (new and renewable energy, low-carbon energy, advanced water processing, LEDs, green transportation systems, and high-tech green cities)
  - High-tech Convergence (broadcasting and telecommunications, IT convergence, intelligent robots, nanotechnology, biopharmaceuticals and medical services, food industry)
  - Value-added services (health care, education, green financing, content, and conventions and tourism)
- The government continued the "win-win" strategy between SMEs and large companies (the name of policy: shared growth) through key reforms such as designating SME-suitable business areas and introducing a profit sharing system.

2. Korea's National Systems of Innovation

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➢ 2008 – 2012: The Lee Administration

- In 2008, the Lee government announced the "577 Initiative" with ambitious targets.
  - To reach an R&D intensity of 5% by 2012
  - to focus upon 7 key areas of R&D and 7 support system
    * 7 key technology areas (50 Critical technologies, 40 Candidate technologies)
      Key industrial technologies,
      Emerging industrial technologies
      Knowledge-based service technologies,
      State-led technologies
      National Issues-related technologies,
      Global Issues-related technologies
      Basic & Convergent technologies
    * 7 support systems
      World-class human resources, basic and fundamental research,
      SME innovation, science and technology globalization,
      regional innovation, science and technology infrastructure,
      science and technology culture
  - to become one of the 7 major science and technology powers in the world

2. Korea's National Systems of Innovation

Ministry of Science and ICT

2013 – 2017: The Park Administration

- The Creative Economy Plan
- "Korean creativity and imagination will be combined with science, technology and ICT to create new industries and markets, and to make existing industries stronger and thus create decent jobs" → "Ministry of Science, ICT and Future Planning(MSIP)"
- "The Korean economy has reached the limits of the catch-up strategy which had driven economic growth for the last 40 years, and the government is now working to switch the Korean economic paradigm to that of the leading type of growth founded on creativity

- A Vision
  - Realizing a new era of happiness for the Korean people through a creative economy
- Three goals
  - Create new jobs and markets through creativity and innovation
  - Strengthen Korea's global leadership through a creative economy
  - Creating a society where creativity is respected and manifested
- Six Strategies

2. Korea's National Systems of Innovation

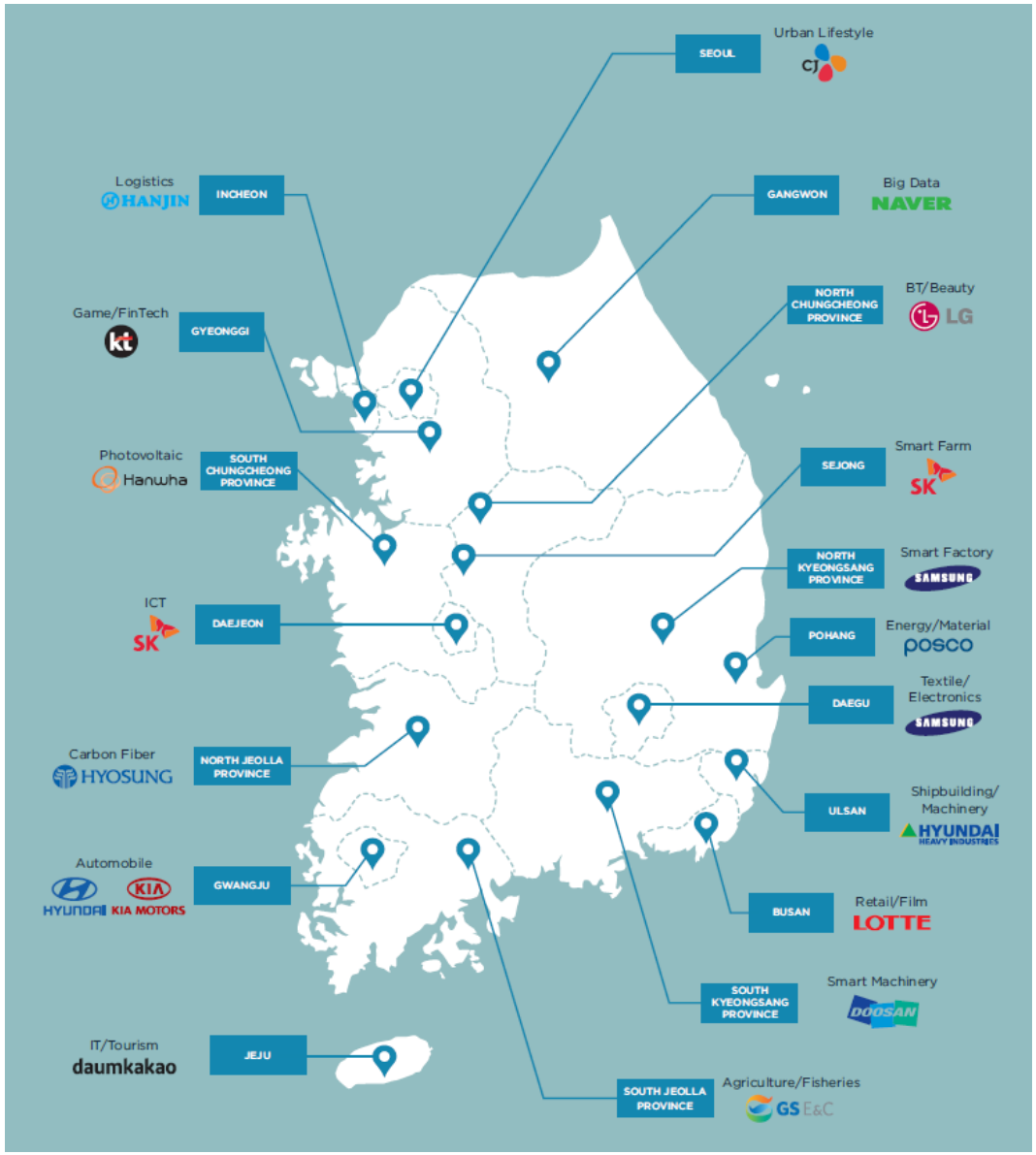
Ministry of Science and ICT

➢ 2013 – 2017: The Park Administration

- Six Strategies of the Creative Economy Plan
- Properly compensate creativity and develop an ecosystem that promotes start-up
  - For start-up (investment-based), For growth and exit stages
- Strengthen the role of venture companies and SMEs in the creative economy and support entry in global markets
- Growth engines to pioneer new markets and new industries
  - Creating new industries based on software and the Internet
  - Investment in future-oriented industries (Biomedical, nano and environment technology), large-scale national strategic industries(satellites, nuclear power)
- Fostering global creative human resources
- Strengthening the innovation capacity of science, technology and ICT
  - Government investment in basic science: increase up to 40% by 2017
  - Future Challenge Adventure Research Projects
  - 5G mobile communication and realistic media, next-generation networking industries
- Building a creative economy culture
  - enacting the Public Information Supply and Use Stimulation Act

2. Korea's National Systems of Innovation

Offline platform:
Center for Creative Economy and Innovation (CCEI) in 17 cities and provinces



2. Korea's National Systems of Innovation

Ministry of Science and ICT

➢ The Basic Plan for Science and Technology (2013-2017)

- **Vision** A New Era of Hope Fueled by Creative S&T
- **Performance Objectives**
  - *Raise the R&D contribution to economic growth to 40%*
  - *Create 640,000 jobs*
  - *Join the top 7 most innovative nations in S&T*

- **Five Strategies**
  - ***Enhancement of R&D investment and maximizing efficiency, including raising R&D support from KRW 68.0 trillion to KRW 92.4 trillion between 2013 and 2017, up 35% from the previous government***
  - ***The strategic development of technologies: 30 priority and 120 strategic technologies have been identified, covering energy, environment, ICT and healthcare fields; more specifically, priorities include smart grids, carbon capture and storage (CCS), big-data applications and personalized pharmaceuticals***
  - ***Building mid to long-term creative capability through greater funding for basic sciences and international exchange***
  - ***Greater support for SMES and venture companies in new industries, and the stimulation of intellectual property generation and commercialization***
  - ***Creating new science related jobs, in part through new measures to boost start-ups***

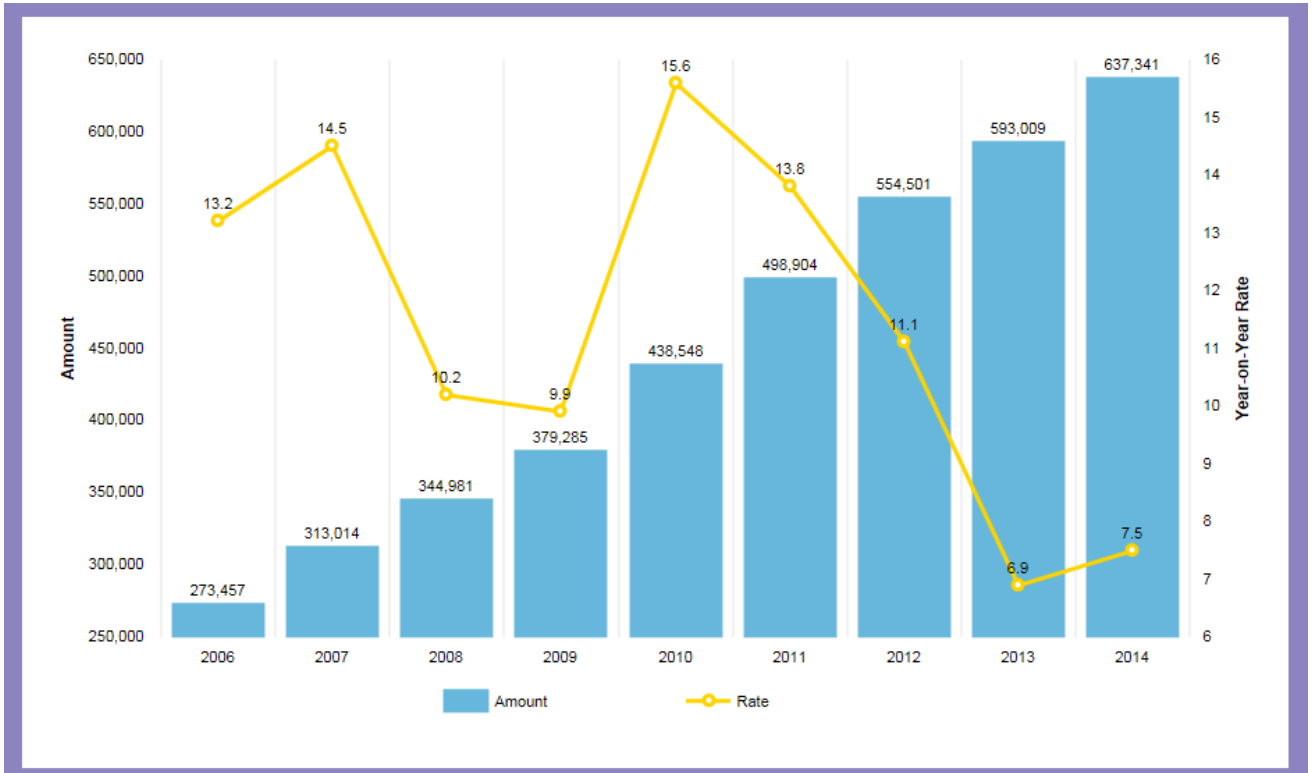
2. Korea's National Systems of Innovation

Ministry of Science and ICT

➢ 2017 - : The Moon Administration

- Human-centered Economy: an Economy where the focus of economic policies on people and households, and the fruits of growth are shared by the people
- Three pillars of Human-centered economy
  - Income-driven growth
  - Innovative growth (Innovation-led growth)
    - * The Presidential Commission on Fourth Industrial Revolution
    - * I-Korea 4.0: four Is: Intelligence, Innovation, Inclusiveness and Interaction
      invest 2.2 trillion KWR (2.02 billion USD) by 2020 on digital convergence by promoting core technologies including artificial intelligence, big data and robotics
      366,000 new jobs, 128-trillion KWR wealth, foster 46,000 R&D experts
    - * Introduction of "Regulatory Sandbox" for new industries so that companies can freely test innovative ideas, products and services without the fetters of regulations
    - * " The government will create an innovative ecosystem where startups prosper and new industries are created. The goal is to make a vibrant economy where innovative startups and new industries are created."
    - * R&D innovation
  - A fair economy

2. Korea's National Systems of Innovation



	2006	2007	2008	2009	2010	2011	2012	2013	2014
Amount (0.1billion won)	273,457	313,014	344,981	379,285	438,548	498,904	554,501	593,009	637,341
Year-on-Year Rate (%)	13.2	14.5	10.2	9.9	15.6	13.8	11.1	6.9	7.5
GDP Ratio (%)	2.83	3.00	3.12	3.29	3.47	3.74	4.03	4.15	4.29
Federal Budget (%)	24.3	26.1	26.8	28.7	28.0	26.0	25.0	24.0	24.0

* It includes the R&D budget in the area of natural science, engineering, medical and agriculture but excludes the budget in the area of social science.

R&D expenditure

2006: 27.3 Trillion (KW)

(27.3 Billion USD)

2.83 GDP ratio (%)

2014: 63.7 Trillion (KW)

4.29 GDP ratio(%)

2. Korea's National Systems of Innovation

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Amount (0.1billion won)	273,457	313,014	344,981	379,285	438,548	498,904	554,501	593,009	637,341
Public Research Institutions	34,971	41,024	46,532	55,584	63,061	66,733	69,503	72,607	81,127
Public research institute change rate(%)	9.5	17.3	13.4	19.5	13.5	5.8	4.2	4.5	11.7
University	27,219	33,341	38,447	42,043	47,455	50,338	52,769	54,803	57,670
University change rate(%)	13.5	22.5	15.3	9.4	12.9	6.1	4.8	3.9	5.2
Company	211,268	238,649	260,001	281,659	328,032	381,833	432,229	465,599	498,545
Business change rate(%)	13.8	13.0	8.9	8.3	16.5	16.4	13.2	7.7	7.1

R&D expenditure

2006: University 10.0%
PRIs 12.8%
Company 77.2%

2014: University 9.0%
PRIs 12.7%
Company 78.3%

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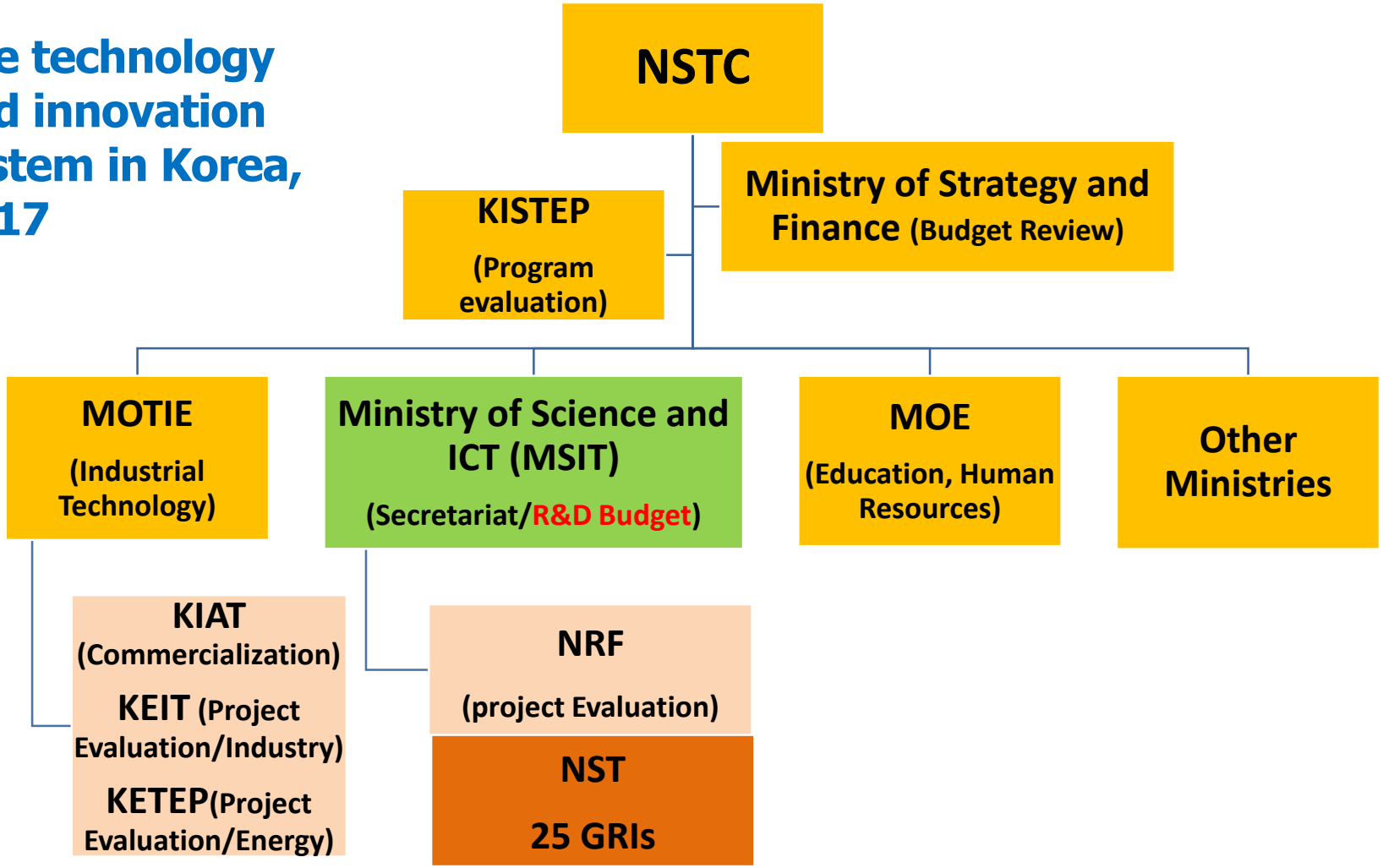
Ministry of Science and ICT

Technology and Innovation Policy System

- **The technology and innovation system in Korea, 2017**



MOTIE: Ministry of Trade, Industry and Energy

2. Korea's National Systems of Innovation

Ministry of Science and ICT

	Science & Technology	Industry & Energy
Establishment	**1969** Ministry of Science & Technology	**1948** Ministry of Trade & Industry (MTI)
1988-1992 Rho TW (13)		
1993-1997 Kim YS (14)		**Ministry of Trade, Industry and Energy (MOTIE)** (MTI + Ministry of **Energy and Resources**)
1998-2002 Kim DJ (15)		Ministry of Commerce, Industry and Energy (MOCIE)
2003-2007 Rho MH (16)	Deputy Prime Minister	
2008-2012 Lee MB (17)	Ministry of **Education**, Science & Technology **(MEST)** (MOST + Ministry of **Education**)	**Ministry of Knowledge Economy (MKE)** (MOCIE + **Ministry of Information and Communication**)
2013-2017 Park GH (18)	Ministry of Science, **ICT** and Future Planning **(MSIP)**	**Ministry of Trade, Industry and Energy (MOTIE)**
2017- Moon JI (19)	Ministry of Science and **ICT (MSIT)**	

2. Korea's National Systems of Innovation

Technology and Innovation Policy System

Ministry of Science and ICT

- Co-ordinate national science and technology policy
- Formulate, implement and evaluate basic science R&D policy
- Plan, promote, and support the development of core, future-oriented and large-scale technology
- Support basic and applied research conducted by GRIs, universities and private research institutes
- Attain technological self-reliance and the safe use of nuclear technology
- Promote public awareness of S & T
- Promote ICT infrastructure and industry

Ministry of Trade, Industry and Energy

- Formulate, implement and evaluate industrial R&D policy
- Fostering the transfer and commercialization of industrial technologies and industrial standards
- Promoting the regional innovation system
- Enhancing companies' intrinsic ability to innovate
- Facilitating private investment in R&D
- Strengthening global co-operation in joint technology development
- Formulating demand-side technology policy

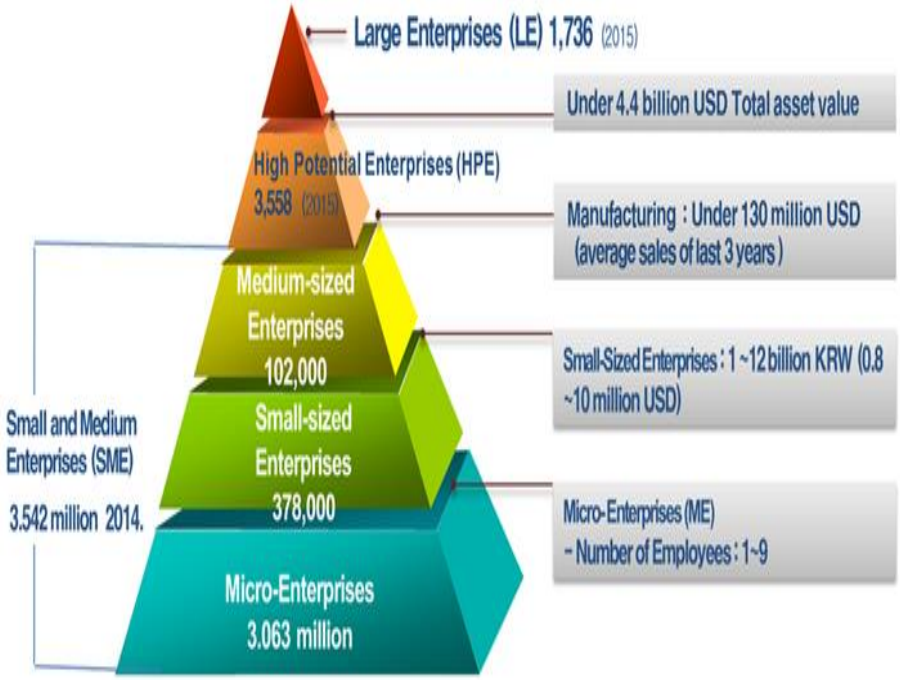
2. Korea's National Systems of Innovation

Ministry of Science and ICT

Technology and Innovation Policy System

Small & Medium Business Administration(SMBA), 1999 → **Ministry of SMEs and Startups (MSS), 2017**

- **Vision**
  Strengthen competitiveness and support innovation of Small and Medium-sized Enterprises (SMEs) and Micro Enterprises (MEs)
- **Mission**
  - ***Promoting Business Growth***
  - ***Fostering Business Start-ups***
    * strives to foster new ideas to turn into new businesses
    * creates a smooth business-funding cycle
  - ***Supporting Micro Enterprises***
    * takes policy measures that enable successful start-up, adoption of cooperation models, healthy growth, and successful turnaround



Source : Recognization & Processing of national business survey (National Statistics Office, 2014)

2. Korea's National Systems of Innovation

Ministry of Science and ICT

➢ National Science and Technology Council (NSTC)

Overall Science and Technology Review Council (1973 ~ 1996)
- Chair (Prime minster), vice chair(Deputy Prime Minister and Minister of Economy), relevant minsters (14), private sector members

Expanded Council for Science and Technology Promotion (1982 ~ 1987)
- Meetings presided over by the President, with the attendance of 250 personnel including cabinet members

Ministerial Council on Science and Technology (1996 ~ 1998)
- Chair (Minister of Finance and Economy/ Minister of Science and Technology), 14 ministers (14)

National Science and Technology Council (1999 ~ Present)

- **Co-ordination of major policies and a plan for science and technology promotion**
- **Establishment of a Basic Science and Technology Plan**
- **Distribution and co-ordination of the national R&D budget**
- **Investigation, analysis and evaluation of national R&D programmes**
- **Co-ordination of policy for science and technology human resources development**

2. Korea's National Systems of Innovation

	Organizational composition	Secretariat	Remarks
1999-2003	Chair: President Government members (14) Private sector members (3)	Ministry of Science and Technology (MOST)	
2004-2007	Chair: President Government members (14) Private sector members (3)	**Office of Science and Technology Innovation (under MOST)**	Mandated to conduct **inter-ministerial R&D budget allocation** Enacted the Law on **R&D performance evaluation**
2008-2010	Chair: President Government members (10) Private sector members (3)	Ministry of Education, Science and Technology (MEST)	Mandated to **set the priorities for R&D** as the base for R&D budget allocation Transferred the function of R&D Performance evaluation to MOSF
2011.3 - 2011.8	Chair: appointed by the President Standing commissioners(2) Private sector members (7)	Internal Secretariat	**Permanent organization with its own secretariat** Mandated to put forward **vision for S&T development**, set **R&D priorities**, and conduct **budget allocation and adjustment** Mandated to conduct **R&D performance evaluation**
2013.3 -2017	Chair: Prime Minister and Private sector Government members (10) Private sector members (9)	Ministry of Science, ICT and Future Planning (MSIP)	
2018-	Plan to be merged into **Advisory Council on Science and Technology**	**Science, Technology and Innovation Office (under MSIT)**	

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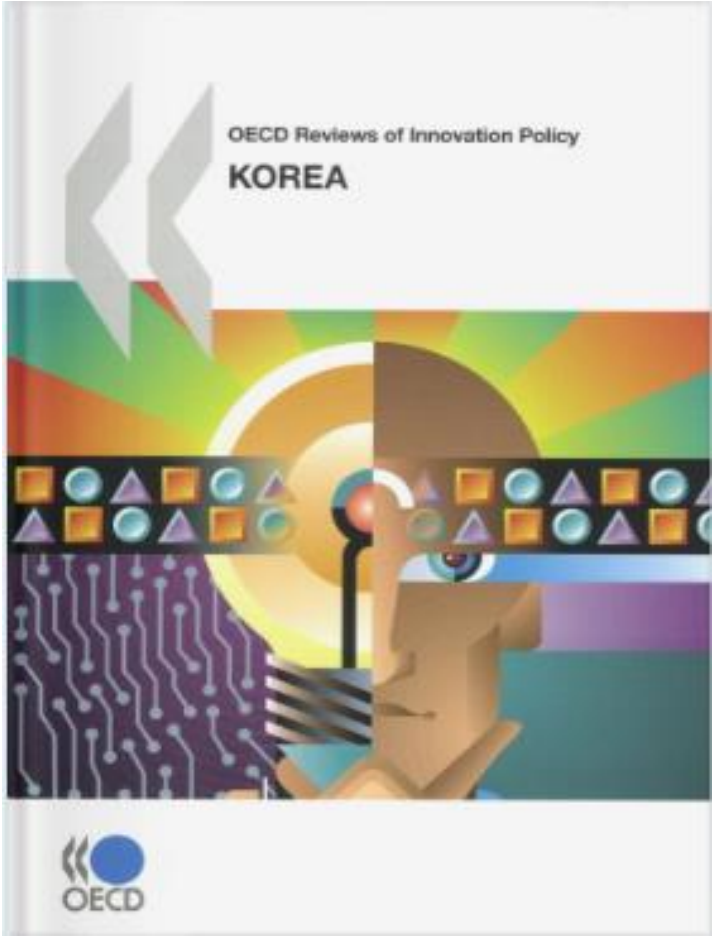
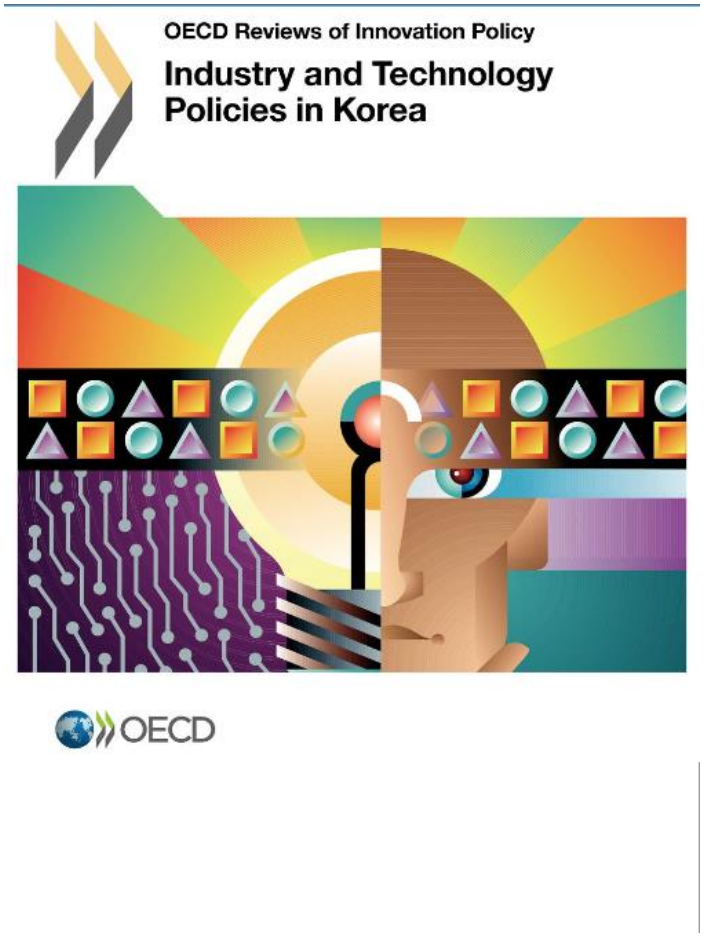


2009



2014

3. SWOTs and OECD Recommendations

Ministry of Science and ICT

OECD Recommendations (2009)

- Improve inter-ministerial co-ordination of innovation policy
- Redefine the roles of research performers
- Understand the benefits of fundamental research
- Promote innovation in the business sector
- Broaden areas of specialization
- Improve the contribution of tertiary education to innovation
- Improve female participation rates in science and engineering
- Improve the labor mobility in the research system (GRIs and Universities)
- Decentralize innovation policy in the interests of more balanced growth
- Maximize benefits from the internationalization of R&D

Ref: OECD Reviews of Innovation Policy: KOREA (2009)

3. SWOTs and OECD Recommendations

Ministry of Science and ICT

Strengths (OECD 2014)

- Strong, mobilizing national vision
- Relatively high growth of GDP, sound macro-economic policies
- Strong government support for innovation
- Relatively good framework conditions for innovation
  - a broad array of government support programmes
  - a strong government commitment to innovation-led growth
- High share of business spending on R&D in overall R&D
- Highly educated workforce and good supply of human resources for sci. and tech.
- High adoption rate of new technologies
- Highly-developed ICT infrastructure
- A significant number of internationally competitive firms
- Strong focus on policy learning, with a capacity to learn from failures and international good practices

Ref: OECD Reviews of Innovation Policy: Industry and Technology Policies in Korea (2014)

3. SWOT and OECD Recommendations

Ministry of Science and ICT

Existing and Emerging Opportunities (OECD 2014)

- Geographical position in one of the most dynamic regions of the world
- Growth of China and other newly industrializing economies, with a growing middle class, in the region and worldwide, offering new markets for Korean exports
- Free trade agreements (US in 2007, EU in 2011)
  - can access to other key markets in the global economy
- Growing globalization of economic activity, including of R&D
- Growing number of Koreans living abroad (Sci. Tech. diaspora)
- High overall population density in major cities, affording accessible markets for certain services activities
- Developments in S & T (technological change), particularly information technology, nanotechnology, biotechnology and environmental technology - and their possible fusion
- Increasing global recognition of Korea in creative industries

Ref: OECD Reviews of Innovation Policy: Industry and Technology Policies in Korea (2014)

3. SWOTs and OECD Recommendations

Ministry of Science and ICT

Weaknesses (OECD 2014)

- Relatively weak linkages, in some respects, between science and industry
  - Lack of knowledge transfer between university research and industry
- In education, overemphasis on university entrance and high cost of private education (heavily biased on rote memorization)
- Underutilization of female labor throughout the economy, including in S & T & I
- Low productivity in the services sector, with low investment in services R&D
- Imbalanced development between SMEs and large firms
- Strong government-led strategies, which may hamper the development of a more diffusion-oriented innovation policy
- Unbalanced international linkages, with low levels of international collaboration

Long-term Threats (OECD 2014)

- Low fertility rates and a rapidly ageing society
- Arrival of new competitors in fields in which Korea excels, e.g. ICTs, particularly from China
- Slow growth in a number of key markets for Korean exporters
- Potentially disruptive geopolitical developments in the region
- Disruption of the supply of imported natural resources and energy upon which the Korea economy is highly dependent

3. SWOTs and OECD Recommendations

Ministry of Science and ICT

OECD Recommendations (2014)

- Improving innovation policy
- Extending Korea's evaluation system for R&D
- Generating greater economic benefit from publicly supported research
  - Strengthening business and academic co-operation
  - Improving government support programmes
- Encouraging more start-ups and SME growth
  - Making better use of the R&D tax credit
  - Fine-tuning advice to start-up
  - Focusing incubation on enterprise development not just employment
  - Supporting youth entrepreneurship
  - Further encouraging entrepreneurship among women
  - Increasing access to finance
  - Making public procurement friendlier to innovation
  - Achieving overall coherence in public support

Ref: OECD Reviews of Innovation Policy: Industry and Technology Policies in Korea (2014)

3. SWOTs and OECD Recommendations

Ministry of Science and ICT

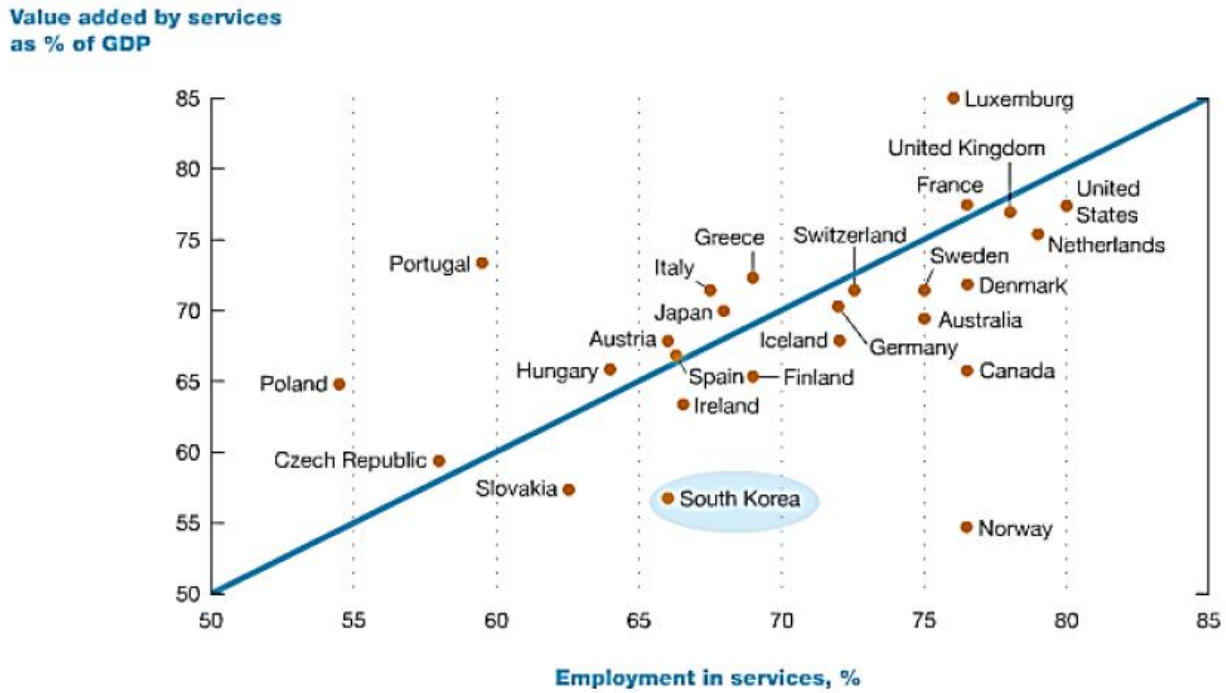
OECD Recommendations (2014)

- A new balance between manufacturing and services

  * The next phase of economic development needs to put more emphasis on manufacturing-related services and other knowledge-intensive services that help strengthen competitiveness, improve quality of life, help address social challenges and aid the creation of (high-wage) jobs

  - No number of service-specific programmes will offset the drag on service-sector development coming from unsupportive framework policies.
    Key framework conditions that require ongoing attention include education and training, labor market flexibility and competitive markets for goods and services.
  - Policies that are plainly discriminatory towards service, in their design and application, need to be identified and removed.
  - Shifting resources from manufacturing into services and undertaking structural reform in the service sector require the social safety net to be strengthened. This will ease the adjustment costs that individuals face.
  - Many service industries would gain from learning from best practice in other firms even in other sectors, yet many are relatively closed to information sharing and co-operation, partly for competitive reasons. Public support for the dissemination of best practices - for example through technical extension programmes – could complement traditional R&D subsidies in fostering more innovation in the services sectors

<u>Korea's service sector is the second smallest in the OECD area, accounting for almost 58% of its GDP</u>.
Only 4 of its 30 largest enterprises are in services; small and medium-sized companies dominate the service sector, accounting for 80% of output and 90% of employment



Source: Roach et al. (2010).

Figure 16. Value Added by Services in South Korea as Percentage of GDP

Ref: Gupta N, Healey DW, Stein AM, Shipp SS (2013) IDA D-4984, Institute for Defense Analysis

Korea faces other challenges that make it hard to build an entrepreneurial bottom up economy to complement its successful top down state-created companies that dominate the economy. The most problematic factor is policy instability followed by inefficient government bureaucracy.
Challenges for SMEs are lack of access to financing, insufficient capacity to innovate, and restrictive labor regulations.

Table 5. Most Problematic Factors for Doing Business in South Korea, 2012–2013

Factor	Percentage of Responses
Policy instability	18.3
Inefficient government bureaucracy	13.4
Access to financing	12.8
Insufficient capacity to innovate	10.3
Restrictive labor regulations	9.3
Tax regulations	6.2
Poor work ethic in national labor force	5.8
Tax rates	5.2
Inflation	5.1
Corruption	4.5
Inadequately educated workforce	3.2
Inadequate supply of infrastructure	2.8
Foreign currency regulations	1.5
Government instability/coups	1.5
Crime and theft	0.2
Poor public health	0.0

Source: From a set list of factors, respondents were asked to select the five most problematic for doing business in their country and to rank them between 1 (most problematic) (WEF 2012).

Ref: Gupta N, Healey DW, Stein AM, Shipp SS (2013) IDA D-4984, Institute for Defense Analysis

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Thank you for your attention !

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