

World Bank Workshop

***Technology Innovation and Economic
Growth
Korean Experiences***

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Objective

- Objective of the presentation
 - ❖ To overview the process of building technological capability within the framework of economic development
 - ❖ To assess the Korean innovation system in view of regional development
 - ❖ To derive lessons for late-comers

Structure

Industrialization and S&T development

- To review how Korea has been able to attain S&T capability
- How Korea acquired technology for industrialization
- How Korea built up an indigenous R&D capability

Key features of the Korean innovation system

- Key features
- Policy incentives
- Weakness of industrial R&D

5. Policy lessons

- Strength and weakness of KIS
- Lessons for late-comers

Industrialization and S&T development

1. Geo-political and geo-economic conditions

- ❑ A small divided country relying on foreign countries for security
- ❑ A resource-poor, densely populated country with small domestic market and weak technological base : Human resource was the only asset for economic development

⇒ *Korea opted for an outward-looking development strategy based on human resources and technology*

2. Where Korea was in the 1960s?

□ Economic situation (1961)

❖ GNP : \$ 2.3 billion (1980 prices), GNP P/C : \$87

❖ Exports : \$55 million, Imports : \$ 390 million

❖ Share of manufacturing in GNP : 15%

❖ Unemployment rate : 22.3%

⇒ ***One of the poorest counties in the world: Development priority was on eradicating poverty rather than regional balance***

□ S&T situation

- ❖ R&D manpower (1969) : 5,337
 - ❖ R&D investment (1963) : \$ 9.5 million (Gov't: \$ 9.2 million)
 - ❖ R&D organization : National Defence R&D Institute (1953)
Korea Atomic Energy Research Institute (1959)
- ⇒ *A barren land as far as S&T is concerned: Linked S&T development to industrialization*

3. How Korea acquired technology for industrialization?

- Industrial development in the early stage : '60s and '70s

“A process of learning how to absorb and improve upon imported foreign technologies for industrial development....

Throughout the development periods, policy has been directed toward promoting technology transfer as a means of technology acquisition, as opposed to indigenous technology development.”

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- ❑ Acquisition of technologies for development : '60s and '70s
 - ❖ Development of light industries and heavy chemical industries for import substitution and export-expansion
 - ⇒ *Generated enormous demand for technologies that were not available from domestic sources*
 - ❖ Policy responses
 - ⇒ *Promotion of inward transfer of technologies*
 - ⇒ *Developing domestic absorptive capacity to digest, assimilate and improve upon the transferred technologies*

❑ Promotion of technology transfer

❖ Policy constraints : shortage of foreign exchanges, strong desire for economic independence

⇒ *Restrictive stance toward DFI and FL*

⇒ *Policy relying on long-term foreign loans to finance industrial investment : “Gov’t brought in large-scale foreign loans and allocated them for investments in selected industries, which led to massive importation of foreign capital goods and turn-key plant. Industries later reverse-engineered the imported capital goods for the purpose of acquiring the necessary technologies.”*

❑ Private industries' responses

❖ Light industries (shoes, clothing, textile...)

⇒ *Relied on OEM production arrangements*

❖ Chemical industries

⇒ *Resorted to turn key-plant importation with technical training*

❖ Electric and machineries

⇒ *Relatively more reliant on FL*

➤ *DFI and FL played relatively less important role in TT in the process of industrialization of Korea.*

Korea relied on its HR for learning from foreign technologies transferred through informal channels.

❑ Development of S&T base

- ❖ Creation of KIST (1966)

- ❖ Creation of MOST (1967)

- ❖ Legal framework: Legislative support for S&T development

- ❖ Institutions to compensate domestic for their weakness in technology : KIMM, KRICT, ETRI, KRISS, KIER, KORDI, etc.

4. How Korea built up an indigenous R&D system?

□ R&D investment for the development of high-tech industries : '80s ~

❖ Korean economic growth

⇒ *Increased demand for complex and sophisticated technologies*

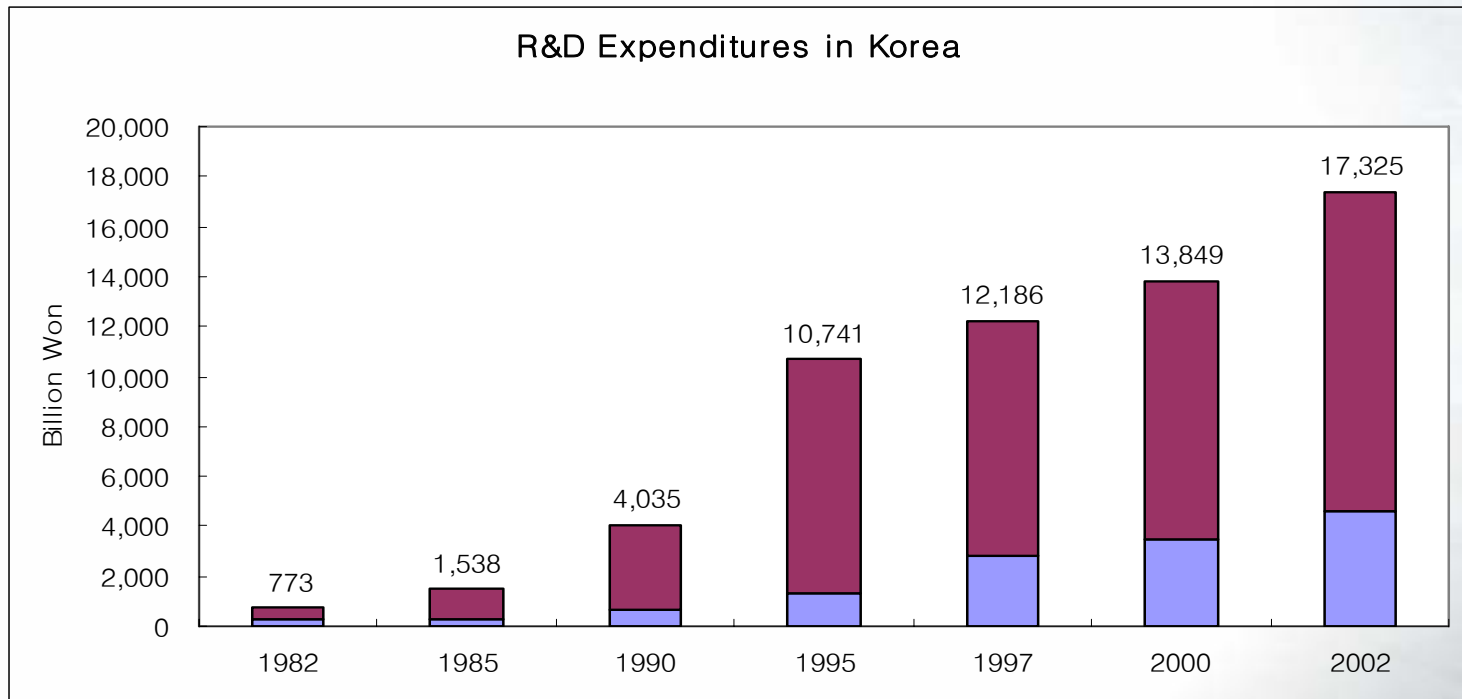
⇒ *Increasing reluctance of foreign countries to transfer technologies to Korea*

❖ Policy response : Launched the NRDP and promoted private industrial R&D

⇒ *NRDP in 1982*

⇒ *Policy incentives for industrial R&D : financial, fiscal, tax, etc*

□ Growth of R&D investment



Note: Upper portion of the bar refers to industry contribution, and the lower parts that of the government.

⇒ 6th largest R&D investor among OECD countries

□ R&D structure

	1980	1985	1990	1996	2000	2002
R&D Expenditures (billion won)						
Government	282.5	1,237.1	3,349.9	10,878	13,849	17,325
Private	180.0	306.8	651.0	2,398	3,435	4,557
Gov : private	102.5	930.3	2,698.9	8,467	10,387	12,699
	64 : 36	25 : 75	19 : 81	22 : 78	24.8 : 75	26.3 : 73.3
R&D/GNP(%)	0.77	1.58	1.95	2.79	2.65	2.91
R&D Performers(%)						
Industry	28.8	65.4	74.9	73.2	74.0	74.9
Universities	9.2	10.3	7.6	9.4	11.3	10.4
GRI* [*]	62.0	24.3	18.5	17.4	14.7	14.7
R&D by Nature(%)						
Basic Research	-	16.8	16.1	13.2	12.6	13.7
Applies Research	-	29.2	24.4	26.9	24.3	21.7
Development	-	54.0	59.5	59.9	63.1	64.6
Industrial R&D Intensity(%)	0.47	1.23	1.72	2.13	1.98	2.19

Note : * including national labs.

Source : MOST(1997a, 1998b), KITA(1998)

□ R&D Outputs

❖ Number of SCI Publications

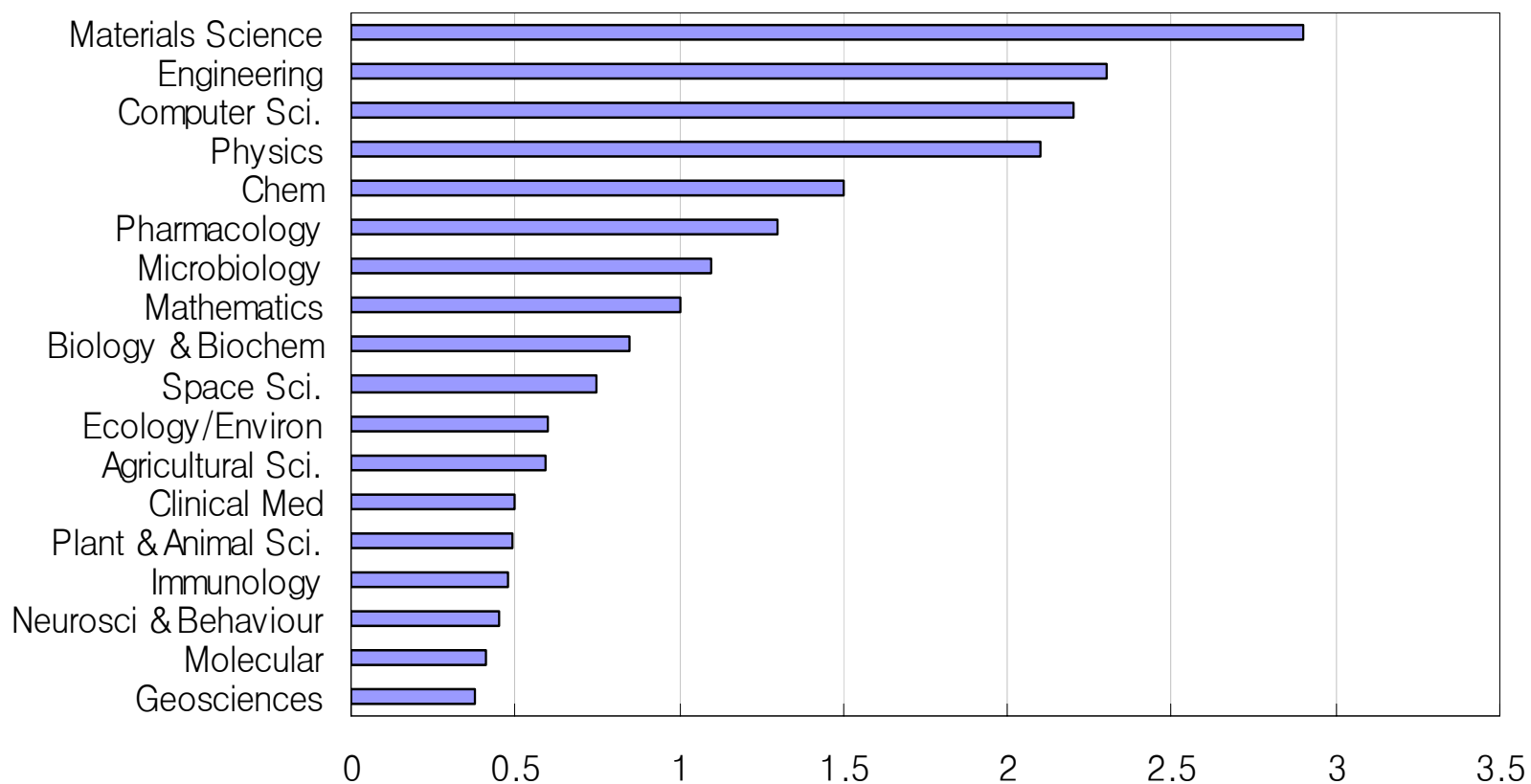
	1980	1985	1993	1997	2000	2001
Number	171	1,227	2,997	9,124	12,245	14,673
World ranking	-	37	27	17	16	15

⇒ Fastest growing in the world

❖ Established world prominence in such areas as : LCD, semi-conductors, PDP, cellular phones, etc

□ R&D Outputs

❖ Korea's share in publication by area: 1991-2001



□ R&D Outputs

❖ Number of KPO patents granted

	1981	1985	1990	1995	2000	2002
Number	1,808	2,687	7,620	12,512	34,579	45,298
Korean share	12.8	13.0	33.5	52.5	65.6	66.7

❖ Number of US patents granted to Koreans

	1992	1995	1997	2000	2001
Number	543	1,175	1,891	3,472	3,763
World ranking	11	9	9	7	7

□ Factors behind the growth

- ❖ Demand side : Outward looking development → export-orientation of industries → pressure from international market for technological competitiveness → increased demand for R&D investment
- ❖ Supply side
 - Financial resources : Large-firm-oriented industrial development → chaebol system → increased abilities of private industries to finance long-term, risky R&D projects
 - Human resource : Korea prepared itself well for R&D by investing heavily in education and HRD

Key characteristics of KIS

- ❑ Export-oriented economy: Under strong pressure for R&D
- ❑ Dynamism: Highly- motivated private industries with strong supports from the gov't
- ❑ High absorptive capacity: Rich pool of HRST
- ❑ Imbalances
 - o Industrial technology vs basic sciences
 - o Large firm vs SMEs
 - o Regional imbalance: High concentration in Seoul area
 - o Industrial imbalance: High concentration in IT, etc

□ Imbalance in favor of industrial technology: Gove't R&D

Objectives	Korea	U.S.A.	Japan
Agriculture	8.4	2.4	3.4
Industrial tech	32.5	0.6	3.4
Energy	9.3	3.6	23.3
Health	8.6	17.6	3.5
Knowledge	17.5	4.1	48.6
Defence	0.6	54.7	5.9

* Korea : 2002, U.S. and Japan : 1996

□ Regional distribution of R&D activities, 2002

Region	R&D Personnel (000 person, %)	R&D expenditures (billion won, %)
Seoul, Gyeonggi	161.0 (57.4)	10,650 (62.2)
Chungcheong	42.8 (15.3)	3,124 (18.3)
Cheolla	17.7 (6.3)	735 (4.3)
Gyeongbuk	21.7 (7.7)	974 (5.7)
Gyeongnam	29.7 (10.6)	1,515 (8.9)
Others *	7.4 (2.7)	113 (0.6)
Total	280.4 (100) **	17,111 (100.0)

* Cheju and Gangwon

** Number of persons involved in R&D, including part-time researchers.

□ Imbalance between LE and SME: Industrial R&D concentration, 2002

(%)

	Top 20	Top 10	Top 5
All industries	49.55	43.24	37.5
Agriculture	100.0	100.0	96.9
Mining	100.0	100.0	100.0
Manufacturing	65.6	50.4	43.8
Communication equipment	67.6	61.4	56.1
Transportation equipment	85.9	81.2	75.4
Construction	78.2	64.6	46.6
Services	29.7	24.1	19.9

□ Concentration in ICT: Imbalance between areas

Gov't R&D Investment by Area : 2002

Technology Area	% of the Total Investment 997.5 billion won	
	1997	2002
Bio-science	18.9	20.9
Transportation	15.2	6.3
Information/Communication	13.7	33.5
Nuclear Energy	9.7	6.3
Machinery	9.3	7.8
Chemicals	8.1	4.7
Energy and Resources	7.2	35.
Environment	6.4	4.0
Materials	5.1	4.3
Others	6.4	

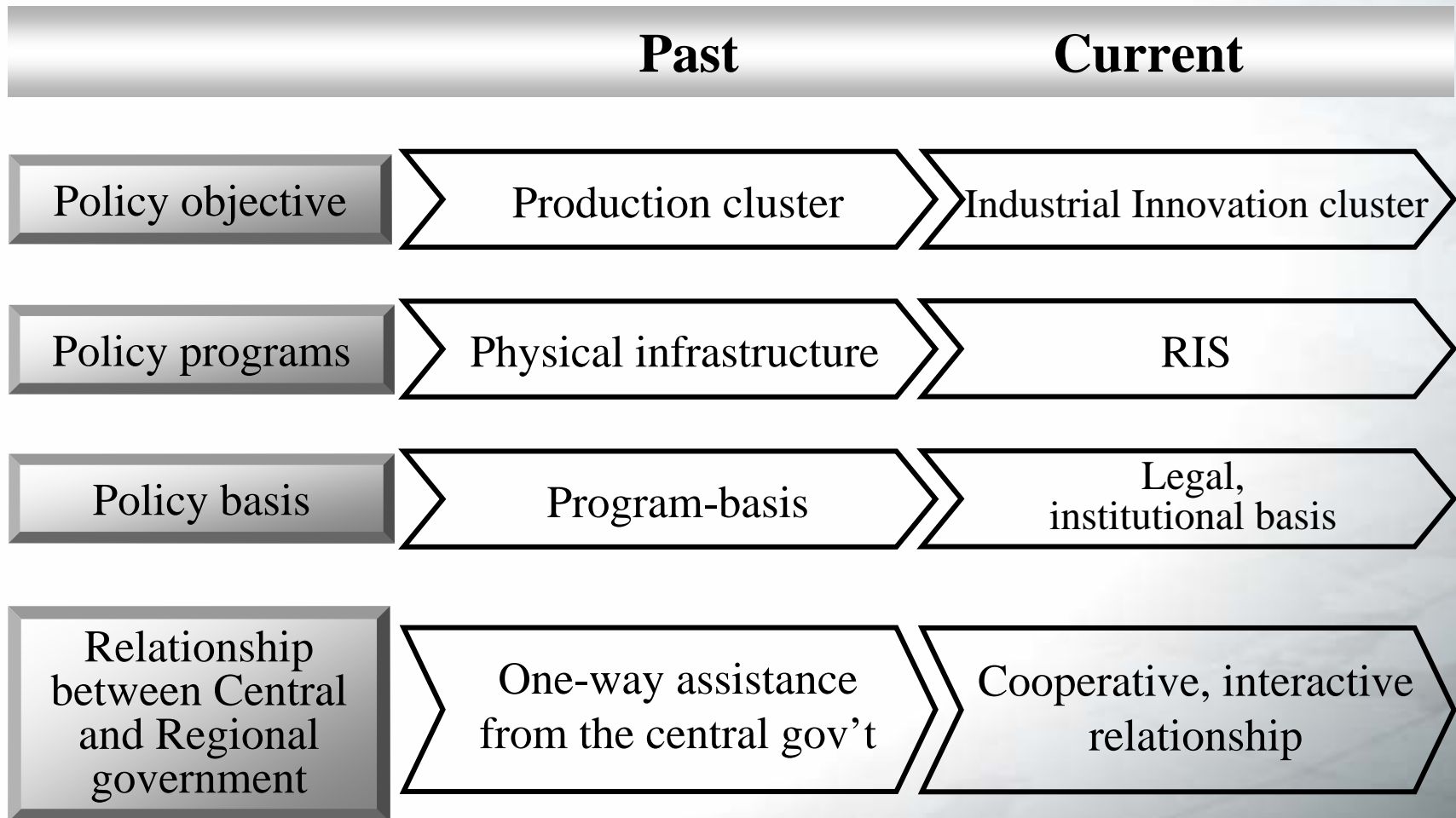
Current RIS in Korea

1. Key features

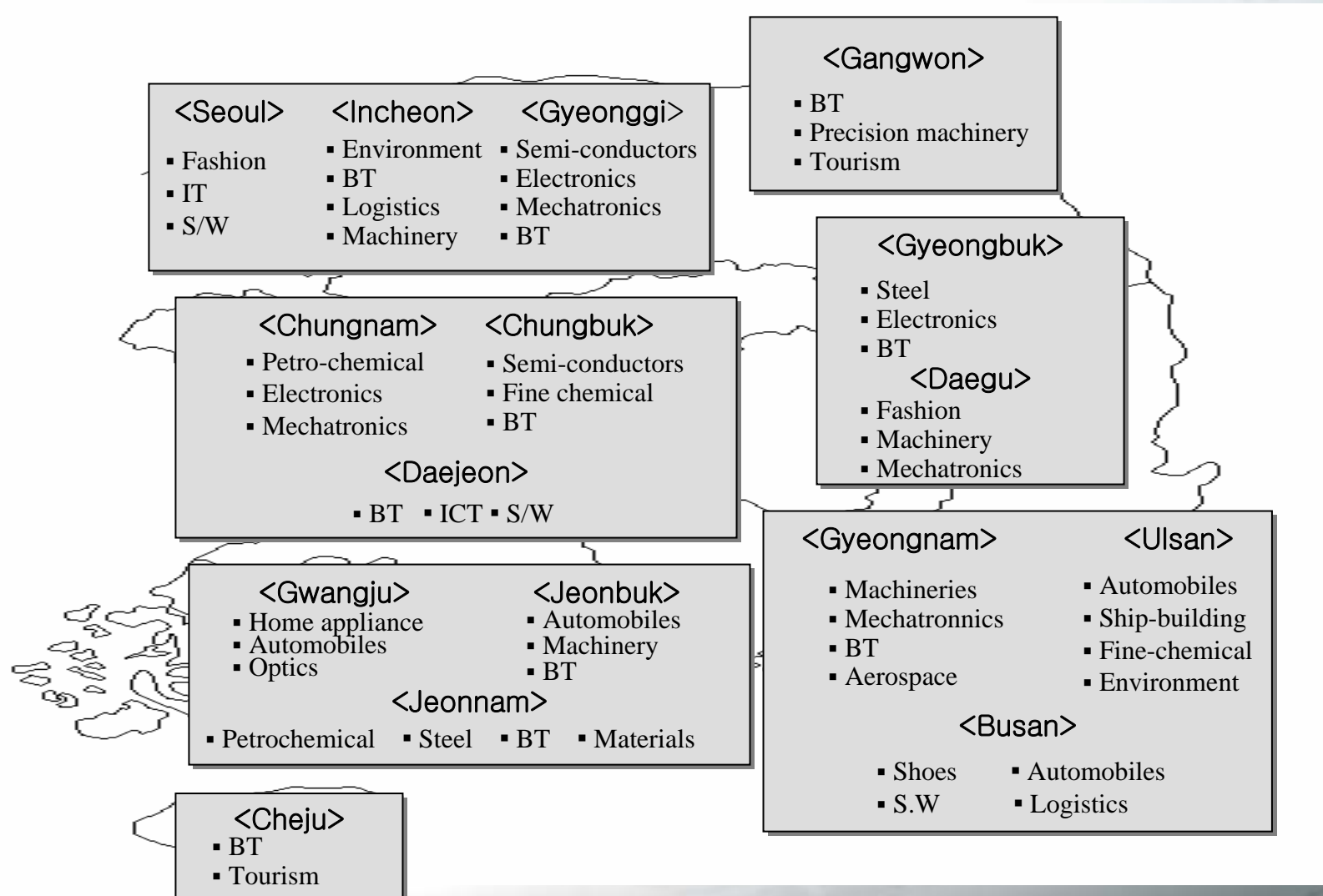
- ❑ Concentration of R&D resources and activities in the Seoul region
- ❑ Weak innovation-support systems of regional governments
 - * The share of R&D budgets in the regional govts' total budgets remains at 0.93%
 - * Less than 9% of the central gov't's R&D budget
- ❑ Regional development initiated by the central gov't :
insufficient reflection of regional interests

Objective	<ul style="list-style-type: none">o Regional balance in development⇒ Enhancing competitiveness based on national integration
Policy Paradigm	<ul style="list-style-type: none">o From input-based to innovation-based developmento Priority given to regional development
Actions	<ul style="list-style-type: none">① Special law for regional balance in development② Movement of the Central Administrative Branch of the gov't to the Chungcheong area③ Increased allocation of R&D funds to regions④ Strengthening RIS⑤ Five-year plan for balanced development of the nation⑥ Development of regional specialty zones⑦ Increased support for less developed regions

❑ Development of regional clusters



Regional clusters



□ Key factors that influence the KIS

- ❖ Outward-looking development strategy ⇒ Pressure for R&D investment
- ❖ Government policy toward FDI and TT ⇒ Focus on indigenous R&D
- ❖ Government-led industrial development
 - Industry-targeting ⇒ Inter-industry R&D imbalance
 - Favoring large enterprises ⇒ R&D system biased for large firms/Financial capability to invest in R&D
 - S&T for industrialization ⇒ R&D system biased toward technology development
- ❖ Rich pool of well educate HRST ⇒ High absorptive capacity
- ❖ Government-led development of S&T infrastructure ⇒ Relative importance of GRIs

□ Strength and weakness

❖ Strength

- ⇒ Dynamism fuelled by the strong commitment of the government and private industries' efforts for competitiveness
 - ⇒ Domestic firms' exposure to international markets: pressure for R&D
 - ⇒ Chaebol system: ability to invest in long-term risky projects
 - ⇒ Human resources
- ### ❖ Growing scientific achievements: publications, IPR, etc
- ### ❖ Attained technological leadership in selected areas

❖ Weakness

⇒ Disadvantage of being small

⇒ Imbalances in innovation system

1. Basic scientific research vs technological development

2. Large firms vs SMEs

3. Regional concentration

⇒ Excessive reliance on private investment: vulnerable to changes in markets

⇒ Weak industry-science relationship

⇒ Insufficient internationalization: insufficient R&D DFI, international co-invention, etc.

VII. Lessons for late-comers

□ Lessons for late-comers

❖ Market competition is the very source of motivation for innovation

⇒ *Pressure for technological competitiveness*

⇒ *Effectiveness of the outward-looking development strategy for small economies*

❖ Human resource is the key to learning

❖ Government can play effectively the role of facilitator and promoter at the early stage of development

❖ The efficiency of an NIS hinges very much upon ISR