Evolution of the Korean NIS and Technological Capability Building

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Contents

1. Introduction

- The Korean innovation policy system in the past and present is hardly regarded as one based on the concept of horizontal innovation policy.

- Rather, it is characterized by a strong hierarchical structure in decision-making. Although the system was relatively successful in mobilizing resources in the past, recently the system has been severely criticized to be inefficient for the new era of knowledge-based economy, where innovation is the most important factor.

- Korea has been facing a serious challenge: Creating a new governance scheme for more efficient and democratic science, technology and innovation policy.

- The system needed substantial reforms towards a horizontal innovation policy system in which genuine cooperation and coordination among branches of the government and the general public's participation in the policy formulation are incorporated.

- The new administration, so-called "Participatory Government"has been formulating a grand strategy for reforming the Korean NIS in terms of structure, resource allocation, and balanced regional development.

- In relation to the strategy, the national innovation system was reformed. The purpose of this presentation is to review: the historical development of the Korean NIS; the background, basic directions, measures and initiatives for the new NIS; technological capability building in Korea.

Stages Of Economic Development

o Basic factor conditions (low cost labor, natural resources, geographic location) are the dominant sources of competitive advantage

o Technology is assimilated through imports, FDI, and imitation

o Companies have limited roles in the value chain, and focus on assembly, labor intensive manufacturing, and resource extraction

o The economy is highly sensitive to world economic cycles, commodity prices, and exchange rates

o Efficiency in producing standard products and services is the dominant source of competitive advantage

o Foreign technology is accessed through licensing, joint ventures, FDI, and imitation

o The nation is not only assimilating foreign technology, but has the capacity to improve on it

o Heavy investment is made in efficient infrastructure, modern production processes, and ease of doing business

o innovative products and services at the global technology frontier are the dominant sources of competitive advantage

o Characterized by strengths in all areas together with the presence of deep clusters

o Companies compete with unique strategies that are often global in scope

o The economy has a high service share, and is resilient to external shocks

Source: Porter, Michael E. *Competitive Advantage of Nations*. 1990.

2. Technology Catch-up and Economic Development

1) Development of Industry and Technology Policy

	Industrial Development	Technology Development	Highlight
1960s	- Develop import-substitution industries - Expand export-oriented light industries -Support producer goods industries	- Strengthen S&T education - Deepen scientific and technological infrastructure - Promote foreign technology imports	1960: $79/capita Labor
1970s	-Expand heavy and chemical industries - Shift emphasis from capital import to technology import - Strengthen export-oriented industrial competitiveness.	- Expand technical training - Improve institutional mechanism for adapting imported technology - Promote research applicable to industrial needs	1970: $253/capita Labor and Capital

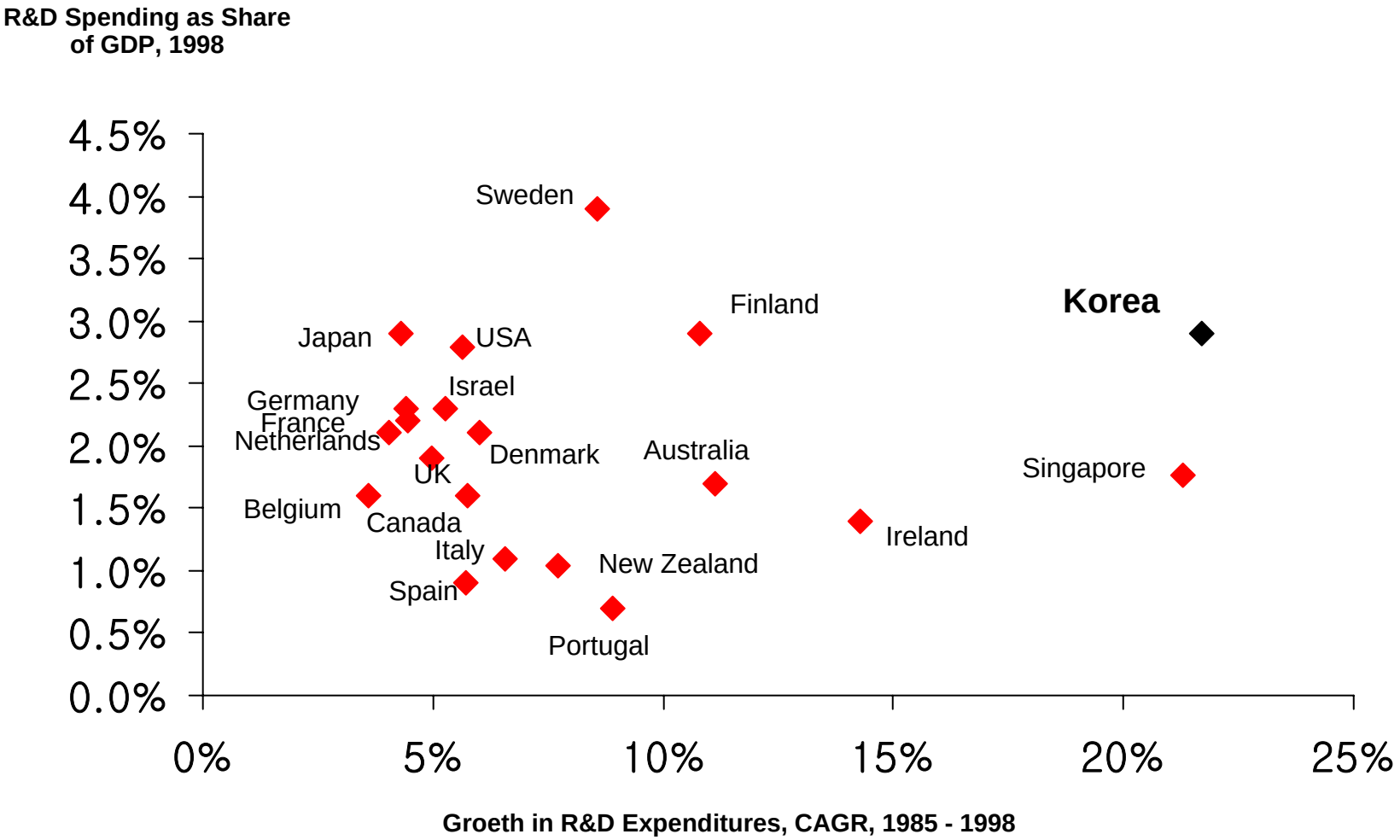
(Continued)

	Industrial Development	Technology Development	Highlight
1980s	- Transform industrial structure to one of comparative advantage - Expand technology-intensive industry - Encourage manpower development and improve productivity of industries	- Develop and acquire top-level scientists and engineers - Perform national R&D projects efficiently - Promote industrial technology development	1980:$1,655/capita Capital and Technology
1990s	- Promote industrial restructuring and technical innovation - Promote efficient use of human and other resources - Improve information networks	- Reinforce national R&D projects - Strengthen demand-oriented technology development system - Institutional reforms	1990:$5,890/capita Technology and Innovation
2000-2003	- Move towards High tech and high value-added industries - Develop IT industry - Search the next generation	- Strengthen national and regional innovation systems - Internationalize R&D systems and information networks - R&D increase in IT, BT, NT,	2000: $9,823/capita Innovation and KBE

2) History of Government R&D Programs

Decade	Emphasis and Initiatives	Remarks
1960 Infant Stage of ST Policy	- Imports of foreign technology - Laws for ST promotion - Established MOST, KIST, etc.	R&D/GDP = 0.3%
1970 Building Institutions	- Imitation and reverse engineering - Laws for R&D promotion - Established 16 GRIs	R&D/GDP = 0.4~0.8% Public : Private = 50 : 50
1980 National R&D Program	- Development of indigenous technology - Started National R&D program - Promotion of private sector's laboratories	R&D/GDP = 0.8~2% Public : Private = 20 : 80
1990 Diversification of Gov't R&D	- Development of high-tech - Promotion of university research - Started Highly Advanced National (HAN) Project	R&D/GDP = 2~3%
2000 Elaboration of Gov't R&D	- Development of knowledge-base economy - Started Creative Research program, National Research Laboratory Program, The 21st Century Frontier Program, etc.	R&D/GDP = 3~5%

Korea's R&D Relative to Other Countries



Source: OECD Science, Technology and Industry Scoreboard 2001.

National Innovative Capacity Rankings (2002)

Country	Innovative Capacity Rank	Innovative Capacity Index	S&E Rank	Inn. Policy Rank	Cluster Innovation Rank	Linkages Rank	Comp. Rank
United States	1	31.0	4	7	1	1	1
United Kingdom	2	29.7	15	10	2	2	2
Finland	3	29.1	8	4	5	3	9
Japan	5	28.3	2	13	6	17	7
Taiwan	8	27.8	16	5	4	15	14
Singapore	10	27.6	17	1	12	22	10
France	13	27.1	14	15	18	10	11
Australia	17	26.6	9	9	15	18	22
Italy	21	26.0	37	38	3	20	16
Korea	22	25.9	23	20	10	25	21
Spain	23	24.9	30	25	22	23	23
China	36	21.9	43	26	30	42	38

The Rate of Economic Growth in Major Countries

(GDP, %)

	1998	1999	2000	2001	2002	2003	2004 (IQ)
Korea	−6.9	9.5	8.5	3.8	7.0	3.1	5.3 (?)
China	7.8	7.1	8.0	7.3	8.0	9.1	9.7
Japan	−1.1	0.1	2.8	0.4	−0.4	2.7	5.6
Singapore	−0.9	6.4	9.4	−2.4	2.2	1.8	7.3
Thailand	−10.2	4.2	4.3	1.0	4.9	6.7	6.5
U.S.A	4.2	4.5	3.7	0.5	2.2	3.1	4.2

Source: ADB, IMF, Statistics Yearbook of China.

Development of High-Tech Industries in Korea

□ Dominance of IT-related Industries

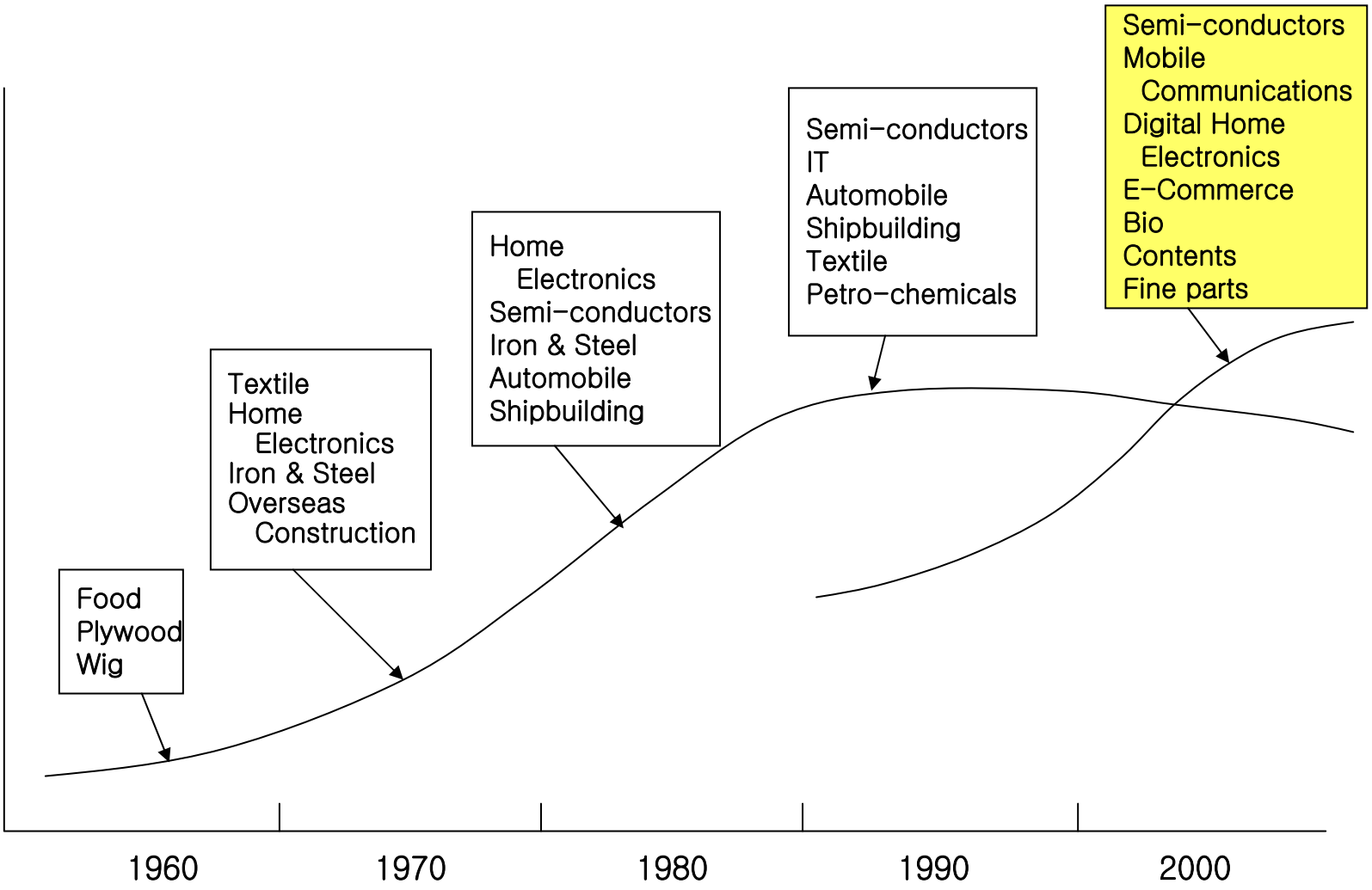
- The recent annual growth rate of IT-related industries was over 20% in 1998-2000, although it decreased to over 6% in 2001-2002.

- The top 10 exports of Korea are dominated by IT-related products.

□ Weak Basic Research and Core Technology

- Korean high-tech producers are still weak in basic research and marketing, evaluated as about 50% of the level of advanced countries.

Dominant Industries in Korea



World Market Share of Major High- and Medium-Tech Industries in Korea, 2001

	Share in the world market (%)	Rank
Automobile	5.2	5
Machinery	1.4	15
Semiconductors	5.7	3
Digital electronics	5.1	4
Electronic medical equipment	1.5	13
Bio	1.4	14
Aerospace	0.4	15
Environment	1.2	16
Shipbuilding	32.4	2

Source: Ministry of Industry and Energy. 2002. Internal Document.

Contributing Factors to the Growth in Korea

(%)

	Lee (2001)	Collins and Bosworth (1996)	Young (1995)	Kim and Lau Ⅰ	Kim and Lau Ⅱ
Period	**1966~96**	**1960~94**	**1966~90**	**1960~90**	**1960~90**
Capital share	**0.33**	**0.35**	**0.297**	**0.564**	**0.35**
Sources of Growth					
Capital	**44.3**	**57.9**	**50.3**	**98.4**	**61.1**
Human Capital	**15.0**	**14.0**	**14.3**	**3.2**	**6.4**
TFT	**22.1**	**26.3**	**34.7**	**-0.0**	**32.5**
R&D Effect	**21.7**	**-**	**-**	**-**	**-**

Source: KIEP. Mimeograph.2001.

3. The NIS and Governance before the 2004 Reform

1) Main Characteristics of the NIS

- The NIS (=National System of Innovation) is the network of institutions in the public and private sectors whose activities and interactions initiate generate, modify and diffuse new technologies.

- The Korean NIS before the 2004 reform was for the era of the catch-up period.

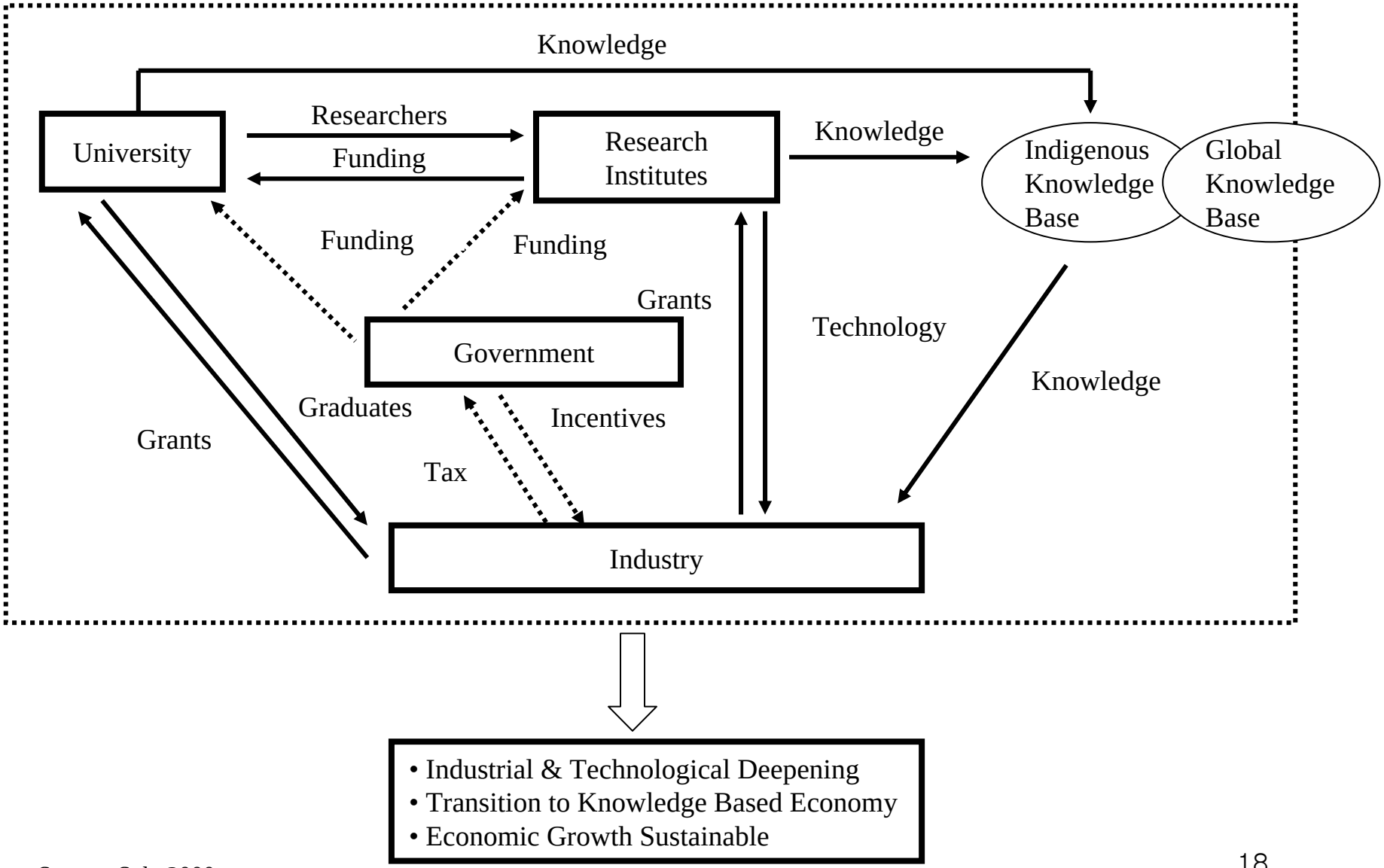
- The private sector in general had concentrated on the rapid commercialization of outside technologies and imitating global front-runners. The private sector's R&D share of the national total was 74 percent in 2002, a proportion much higher than the OECD average.

- The Korean NIS achieved rapid technological capability building. However, it became relatively inefficient and inadequate for the innovative economy. The output/input ratio of the system, whether measured by patents, academic papers or others, usually relatively lower than the OECD average.

- Not only the private sector but also universities and public research institutes have problems and shortcomings due to a low level of knowledge creation or basic research.

- The share of the private business sector has steadily increased whereas that of research institutes has decreased.This reflects more active R&D role of the private sector.

National Innovation System in Korea



Source: Suh. 2000

Overall R&D Expenditures by Organization in Korea in 2002

(Unit: $mil.)

	1998	1999	2000	2001	2002	Share (%)
Private Company	5,689	7,159	9,062	9,507	10,809	74.9
University	903	1,204	1,381	1,299	1,497	10.4
Research Institute	1,497	1,665	1,797	1,673	2,127	14.7
Total	8,089	10,028	12,245	12,479	14,433	100.0

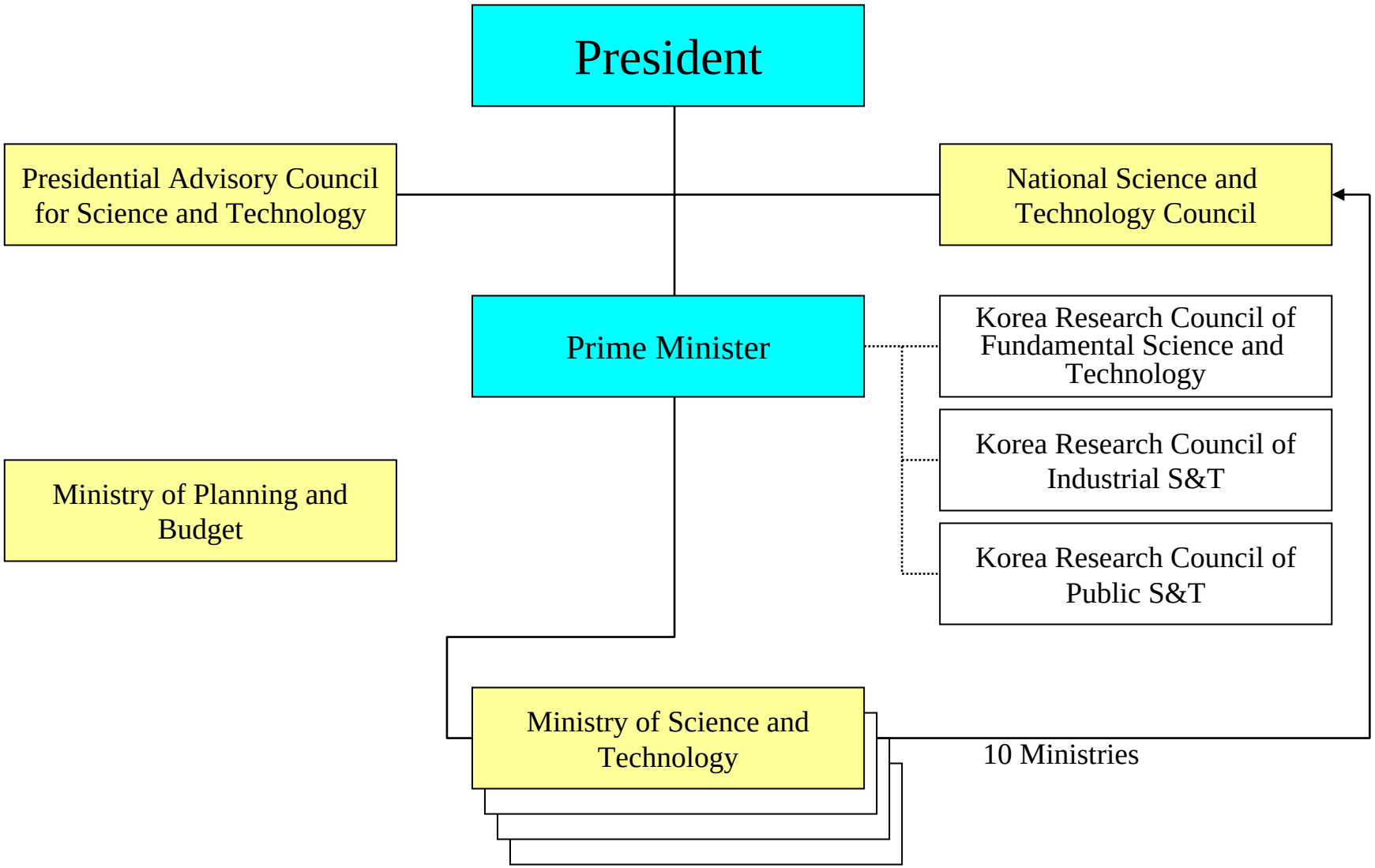
Source: MOST

2) STI Administration System in Korea

– There were three organizations undertaking ST coordinating function in different ways: the National Science and Technology Council (NSTC), the Presidential Advisory Council for Science and Technology(PACST) and the Ministry of Planning and Budget. The NSTC consists of 10 ministers and is chaired by the President. The Ministry of Science and Technology served as the secretariat of the council. The main function of the council was short-term and long-term policy coordination, while its member ministries were in charge of implementation.

– The role of the Presidential Advisory Council for Science Technology was to recommend long-term science, technology and innovation strategies to the president. The ministry of Planning and Budget allocates the yearly budget for R&D and related activities in the public sector, as well as for supporting the private sector.

STI Administration System in Korea

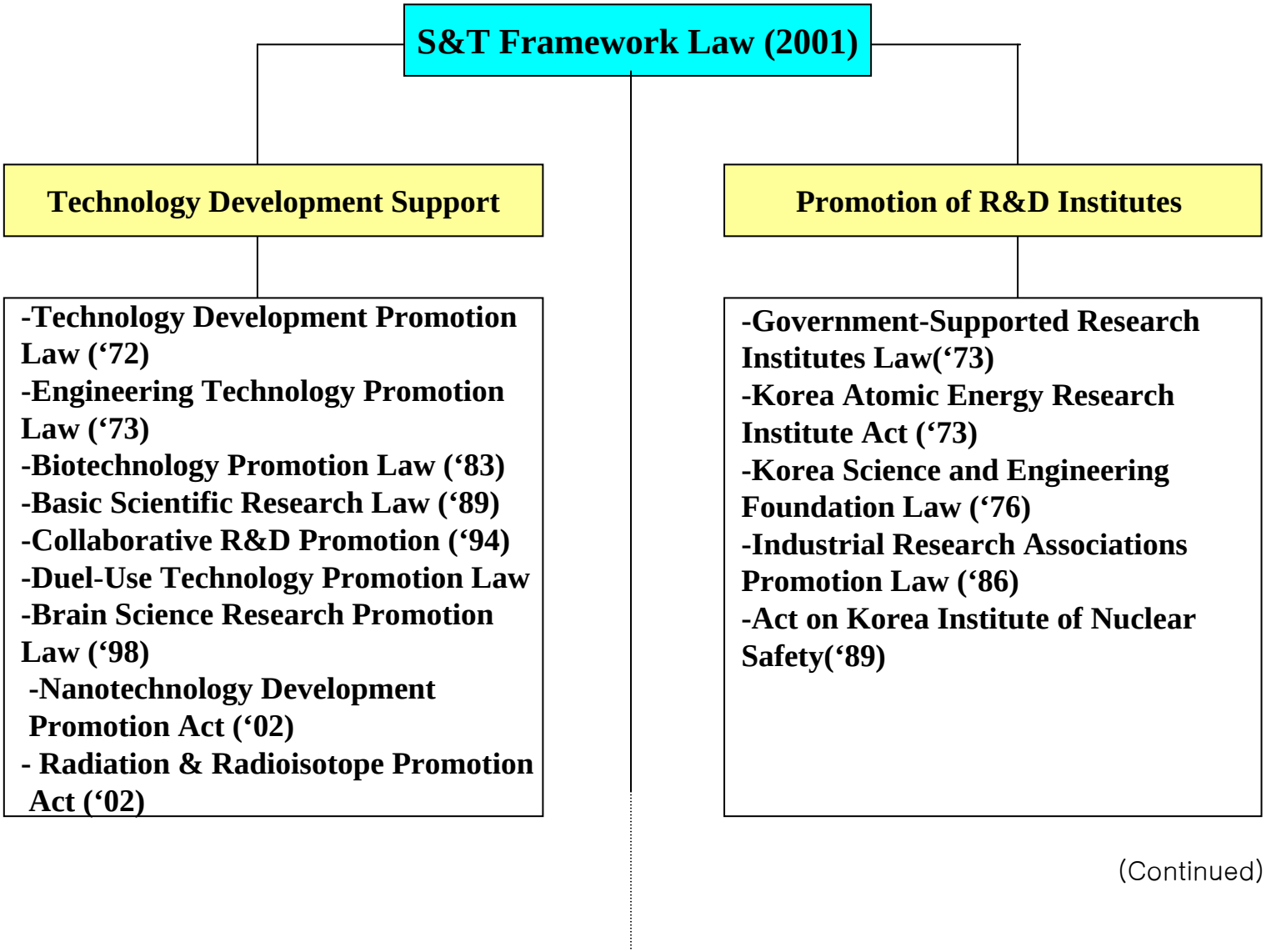


3) Laws and Institutions

- The Science and Technology Framework Law, enacted in 2001, is the most influential and comprehensive law, as indicated by its title. It provides an institutional framework to govern all the rules and regulations on science, technology and innovation. Other laws can be grouped into five areas: Technology development support; promotion of R&D institutes; nuclear and energy; improving manpower; and others.

- There is a complicated set of laws and regulations for science, technology and innovation. This fact may reflect the government's active role and leadership, but, at the same time, it may indicate duplications and authoritative intervention. Indeed, excessive regulations and duplications of R&D programs are problematic.

Laws for STI in Korea



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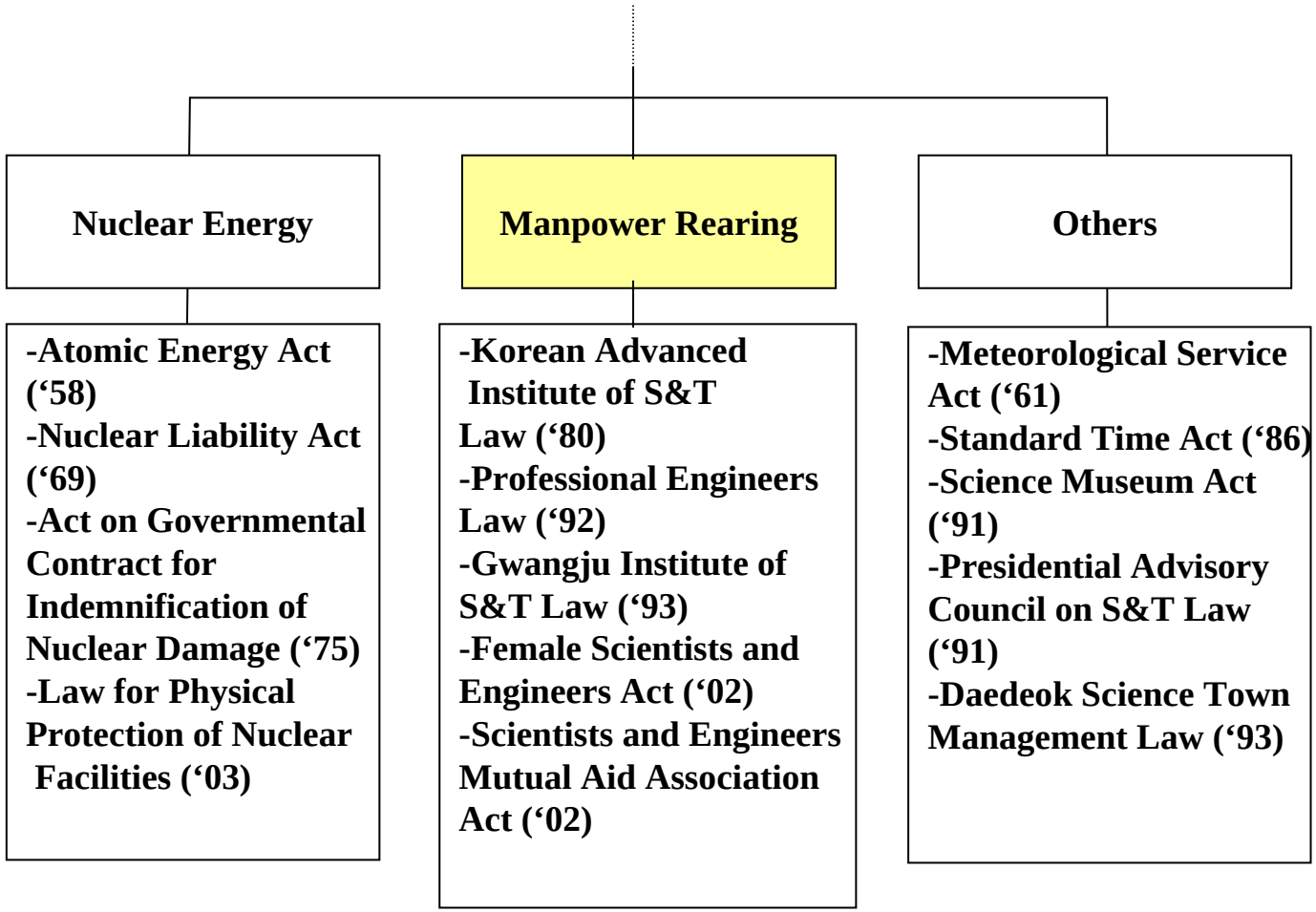


Note: Figures in parentheses are the years the listed law were enacted.

Source: MOST

4) Government R&D Budget

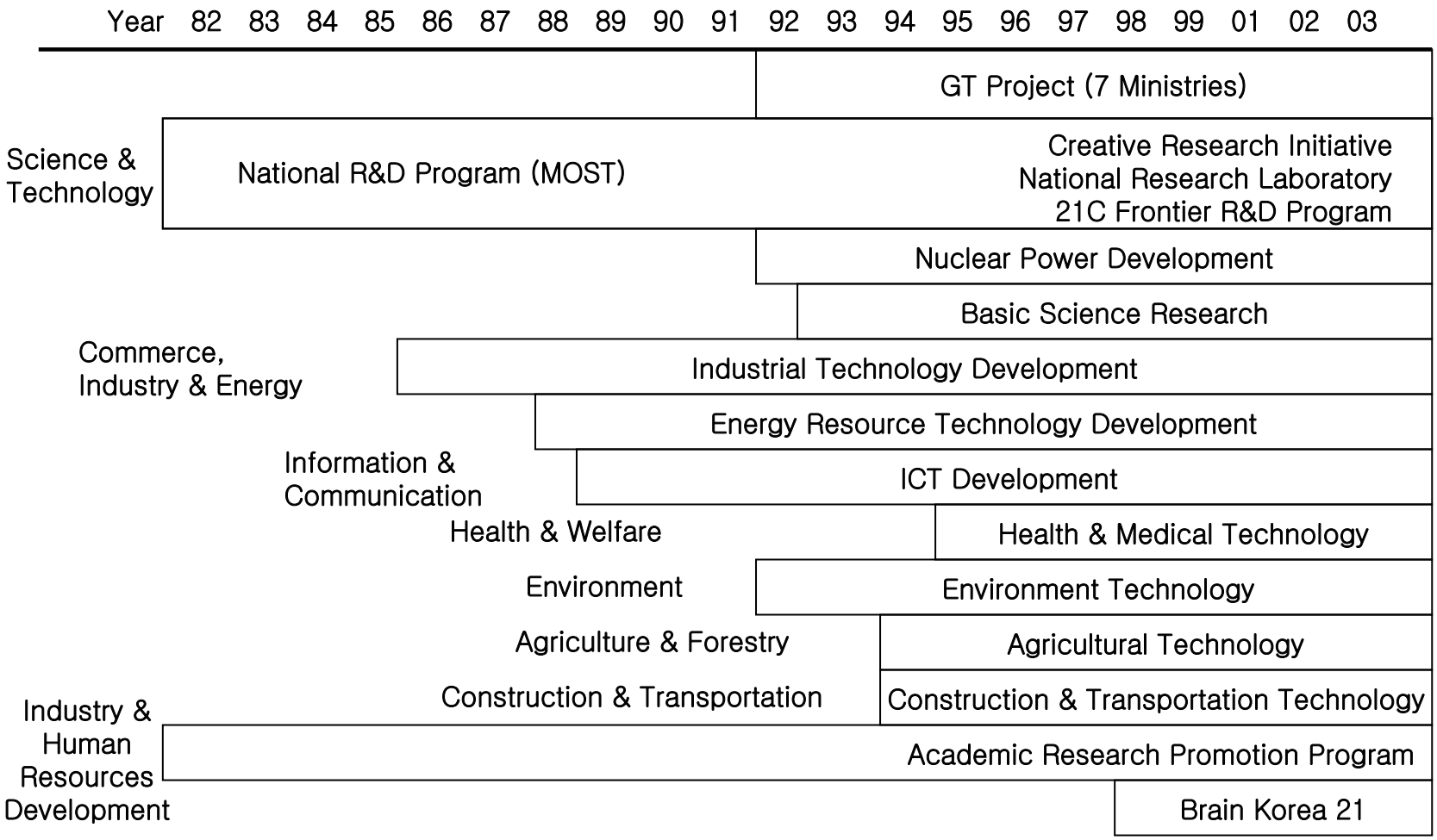
– Although the share of the national total taken by government R&D funding has not changed significantly, the share of R&D budget of the total government budget, in fact, has steady increased.
– R&D investment by the private sector has increased more rapidly even though the government has tried to allocate a larger portion of its budget to R&D activities.

Government R&D Budget in Korea **(Unit: $mil.)**

	1998	1999	2000	2001	2002
Government Budget (A)	70,393	78,461	76,825	91,328	94,477
R&D Budget (B)	2,581	3,187	3,307	4,128	4,490
Ratio (B/A)	3.7	4.1	4.3	4.5	4.8

Source: MOST.

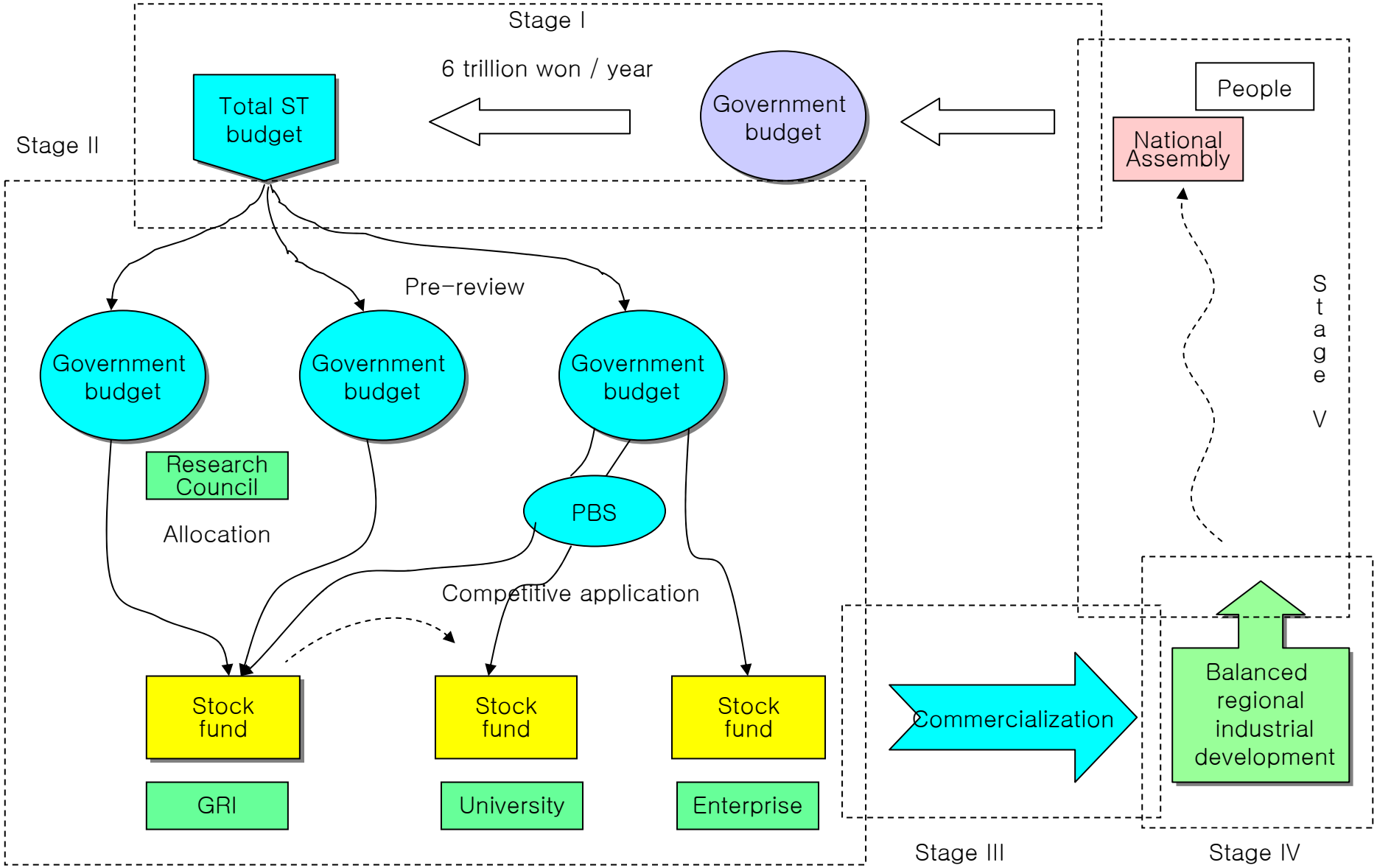
Government R&D Programs by Ministry



- Each ministry has operated own R&D programs independently. Only three R&D programs of the government are operated jointly. These are ① the G7 Project, ② the 21 Century Frontier R&D Program and ③ the Civilian and Military Dual-Purpose Technology Development Program.

- Recent drastic changes in the ST paradigm demand a fundamental change in the existing ST and R&D system. In addition, such changes as the rapid increase in the government R&D budget, increasing scale of R&D projects, increasing R&D time require further breakdown of program by area and function, differentiation of development content and nature, systemization of R&D implementation process, avoiding duplicative wastes of limited R&D resources and so on.

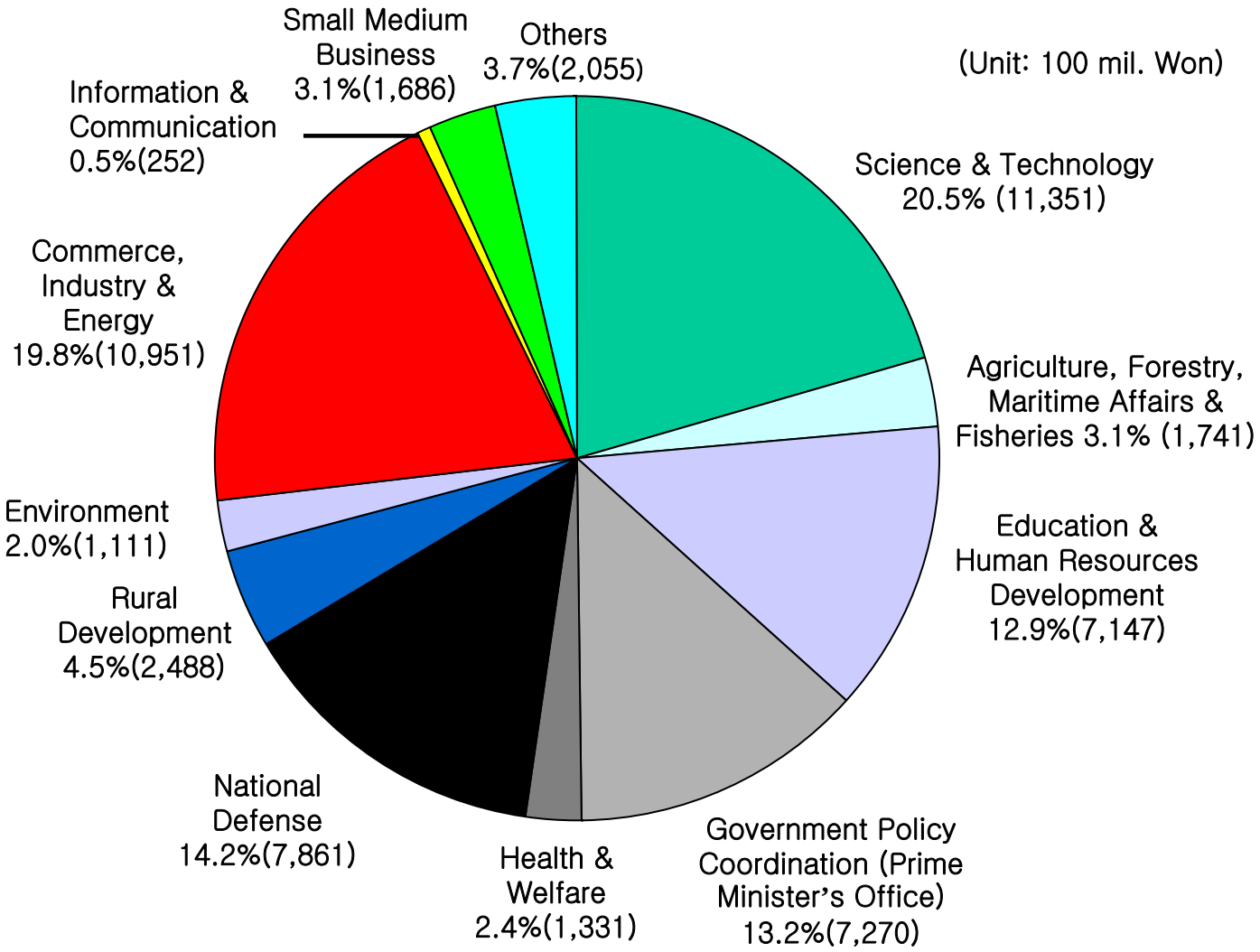
Flow of Government R&D Budget



Note: PBS=Project Base System

National R&D Budget by Ministry (2003)

R&D budget in 2003 : 5.5 trillion won



Trends in Government R&D Budget Allocation by Technology Area

(Unit: %)

	2000	2001	2002	Variation (2001-2002)
IT	15.7	14.3	15.0	17.1
BT	9.5	10.6	11.5	21.7
NT	1.2	1.3	3.2	164.0
ET	3.8	4.2	4.4	16.4
ST	2.8	3.8	3.8	12.0
Engineering	8.4	9.0	9.0	11.5
Energy	8.1	7.3	6.7	2.6
Basic Science	6.9	6.2	8.7	55.6
Material	10.3	12.6	10.3	- 9.4
Agriculture	12.3	8.9	8.7	9.8
Others	21.0	21.7	18.6	-4.5
Sum	100.0	100.0	100.0	11.5

Source: KISTEP. 2002.

5) The Governance in Science and Technology Policy in Korea

- Strong leadership or intervention from the government and a relatively weak private sector are the main feature of the ST governance.

- The government directly or indirectly affects the major decision process of leading government-sponsored research institutes (GRIs).

- The participation of scientists, engineers and researchers (the science and technology community) in the ST policy process has been passive.

- The participation of NGOs or the public in the science and technology policy process has been almost nonexistent.

- As Korea moves toward becoming a knowledge-based economy, a new paradigm of science and technology governance is needed.

6) Problems and Shortcomings of the Korean NIS

(1) Lack of comprehensive coordination

(2) Weak link between ST policy and government budget

(3) Excessive competition among ministries

(4) Weak function of planning and evaluation of the National R&D Program

(5) Problems in management of GRIs

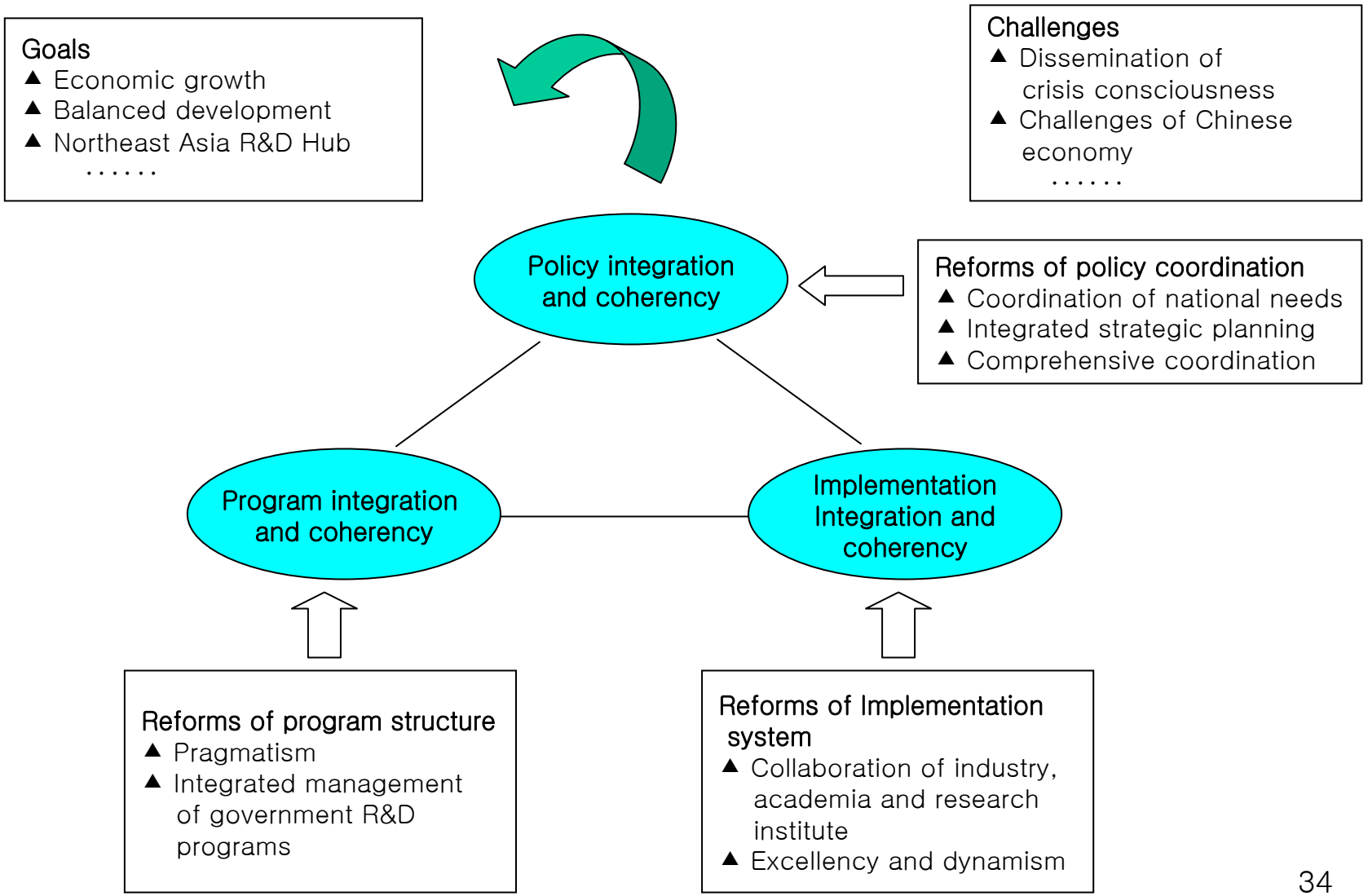
(6) Weak regional innovation systems

4. The New NIS and Governance

1) Basic Direction and Objects (Key Concepts)

- Integration
- Coherency
- Increasing efficiency and productivity
- Selection and concentration
- Innovation-driven economy

Direction of the NIS Reform in Korea



2) Strengthening the STI Governance

(1) Strengthened role of NSTC

- The government plans to strengthening the role and authority of the National Science & Technology Council by:

○ Monitoring and coordinating strategies for new growth technology development

○ Ensuring the results of NSTC's evaluation and coordination be reflected in budget-allocation

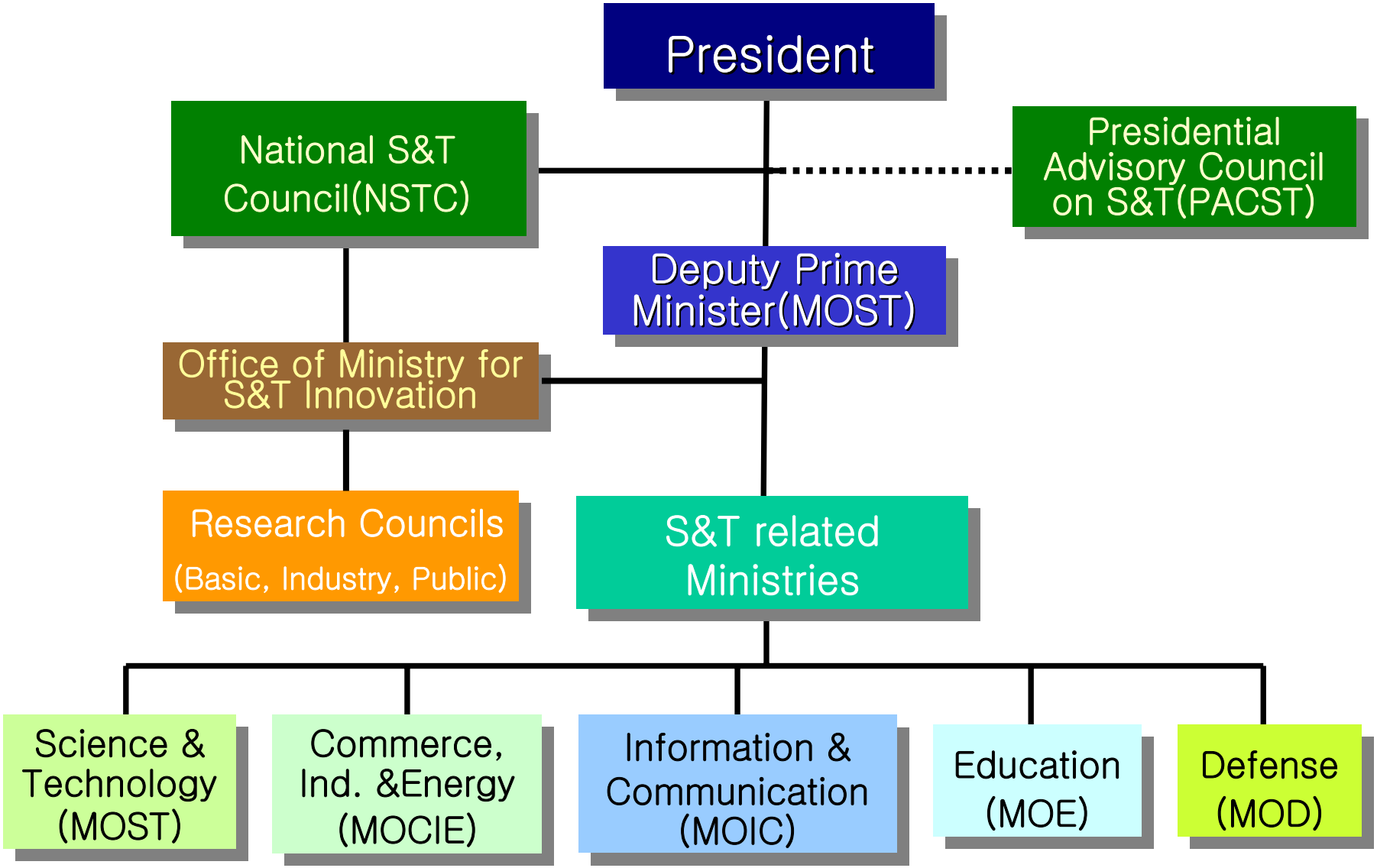
○ Enhancing fairness and objectivity of coordination through active participation of experts from the private sector

(2) Enhanced Role of MOST

- By the 2004 reform MOST was given the mission and power for coordinating major STI policies of the government and the Minister of Science and Technology became a deputy prime minister.

- Accordingly, the jurisdictions and missions of the Ministry of Commerce, Industry and Energy (MOCIE), and the Ministry of Information and Communication (MOIC) and other ST-related ministries were also changed.

National Science and Technology Council (NSTC)



3) Main Features of R&D Reforms

(1) Realignment of STI policy jurisdictions

- Machinery, electronics, aero-technology to the Ministry of Commerce, Trade and Energy (MOCIE)
- Basic programs such as basic science and research, strengthening science and engineering education, enhancing the people's understanding of science and technology culture to MOST
- Big and fusion technology programs such as space, atomic power, etc. also to MOST

(2) Deputy Prime Minister of Science and Technology

- Elevate the authority of the Minister of Science and Technology to be a Deputy Prime Minister and the Vice Chairman of the National S&T Committee
- Legal power is given to the MOST to coordinate other ministries.

(3) Operational improvement

- Strengthening pan-national function of planning, coordination, and evaluation by the MOST
- MOST became to have the review and adjusting power of the government S&T budget.
- Efficient allocation and use of the government R&D budget in line with national development goals

○ Strengthening strategic allocation and coordination of the government R&D budget

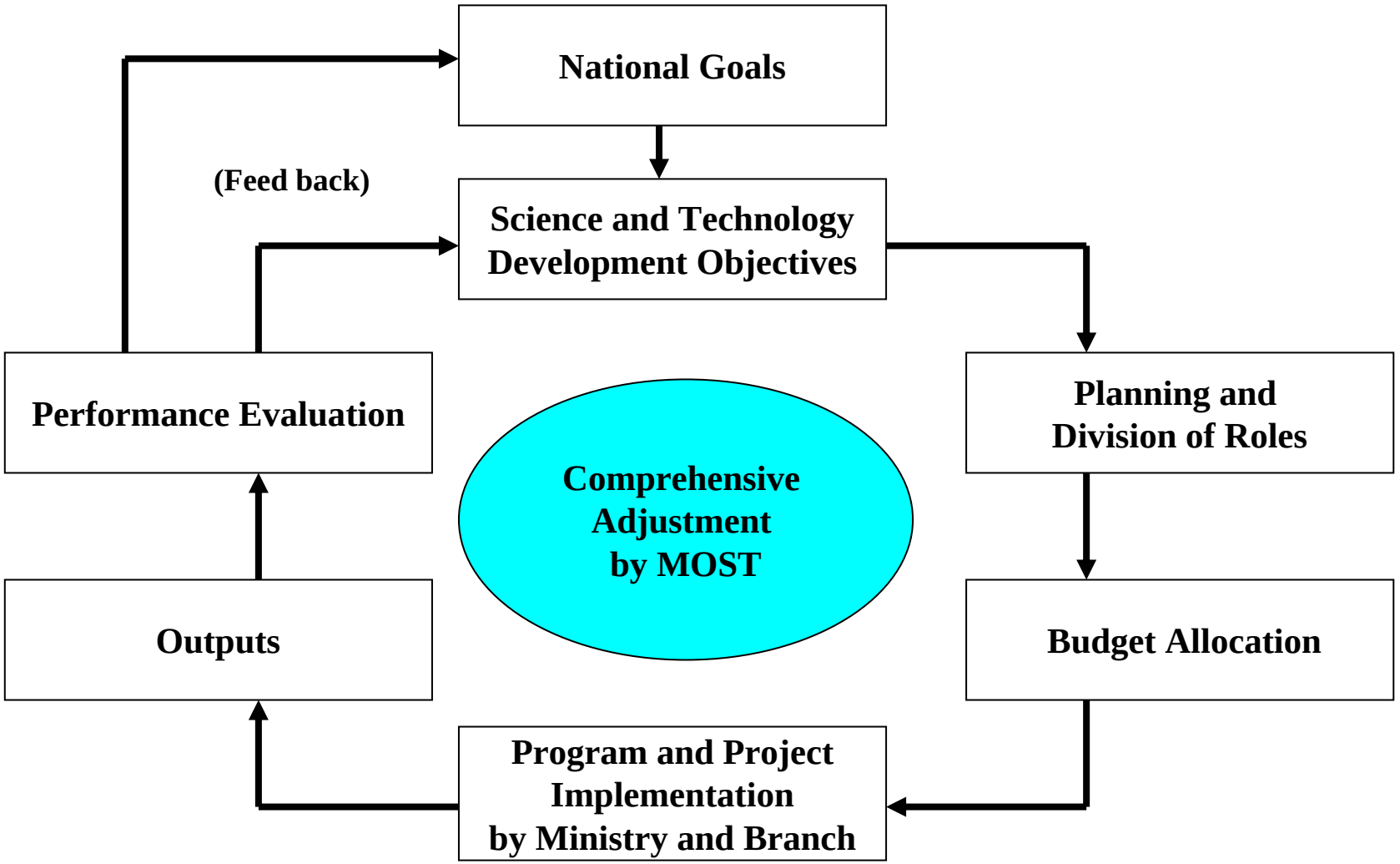
○ Reflect MOST's review opinion on the total of the of R&D budget to the Ministry of Planning and Budget in the process of budget planning

○ MOST was endorsed the allocation of the budget to individual projects after reviewing of the total ST budget by the Ministry of Planning and Budget.

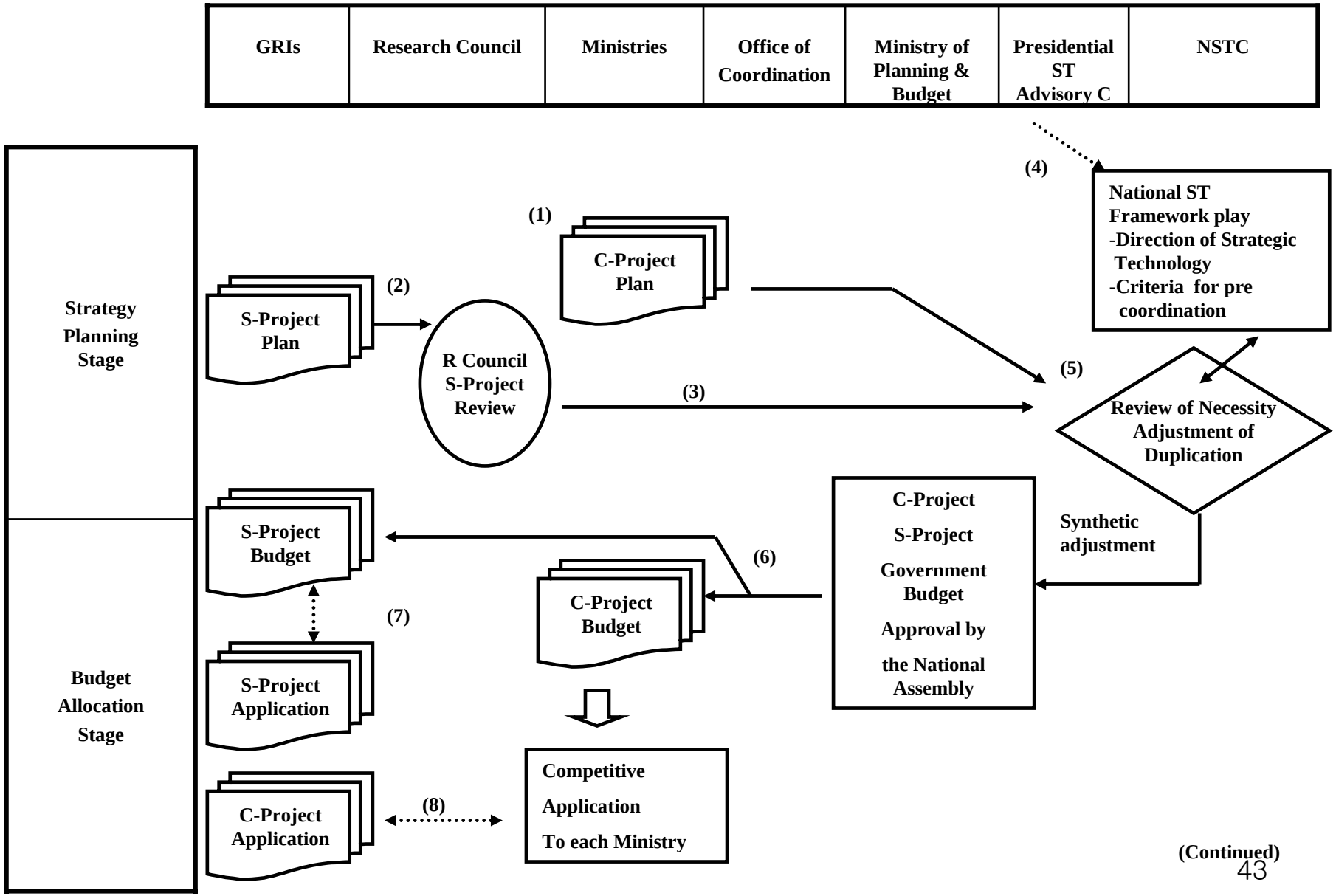
(4) Improvement of government-sponsored research institutes (GRIs)

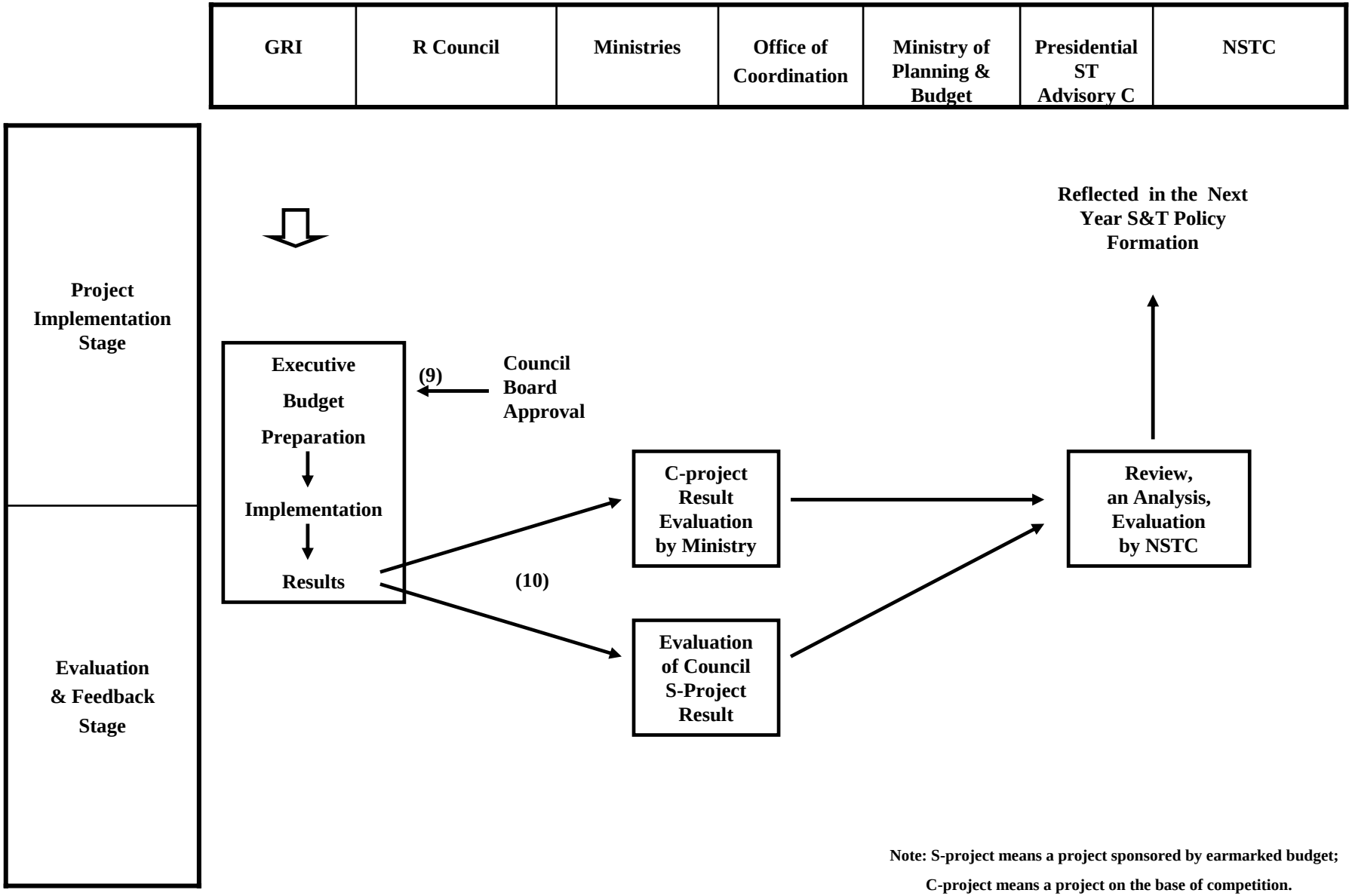
- ○ New role as the core institution of national science and technology innovation
- ○ Stability in GRI operation and improvement of welfare of researchers
- ○ Linking national science and technology policy and promotion of GRIs
- ○ Each Research Group will have autonomous budget allocation.
- ○ Open research system with flexible mobility of researchers between GRIs

Basic Scheme for the New NIS



A New model for National R&D Process





Note: S-project means a project sponsored by earmarked budget;
C-project means a project on the base of competition.

Source: STEPI. 2003.

5. National STI Strategy and Policies

1) Basic Direction

- For realizing the “Science- and Technology- Driven Society”
  - ○ A system for successful new growth engine, based on science and technology
  - ○ Integration of science, technology and innovation, HRD and industrial technology policy

2) ST Framework Planning

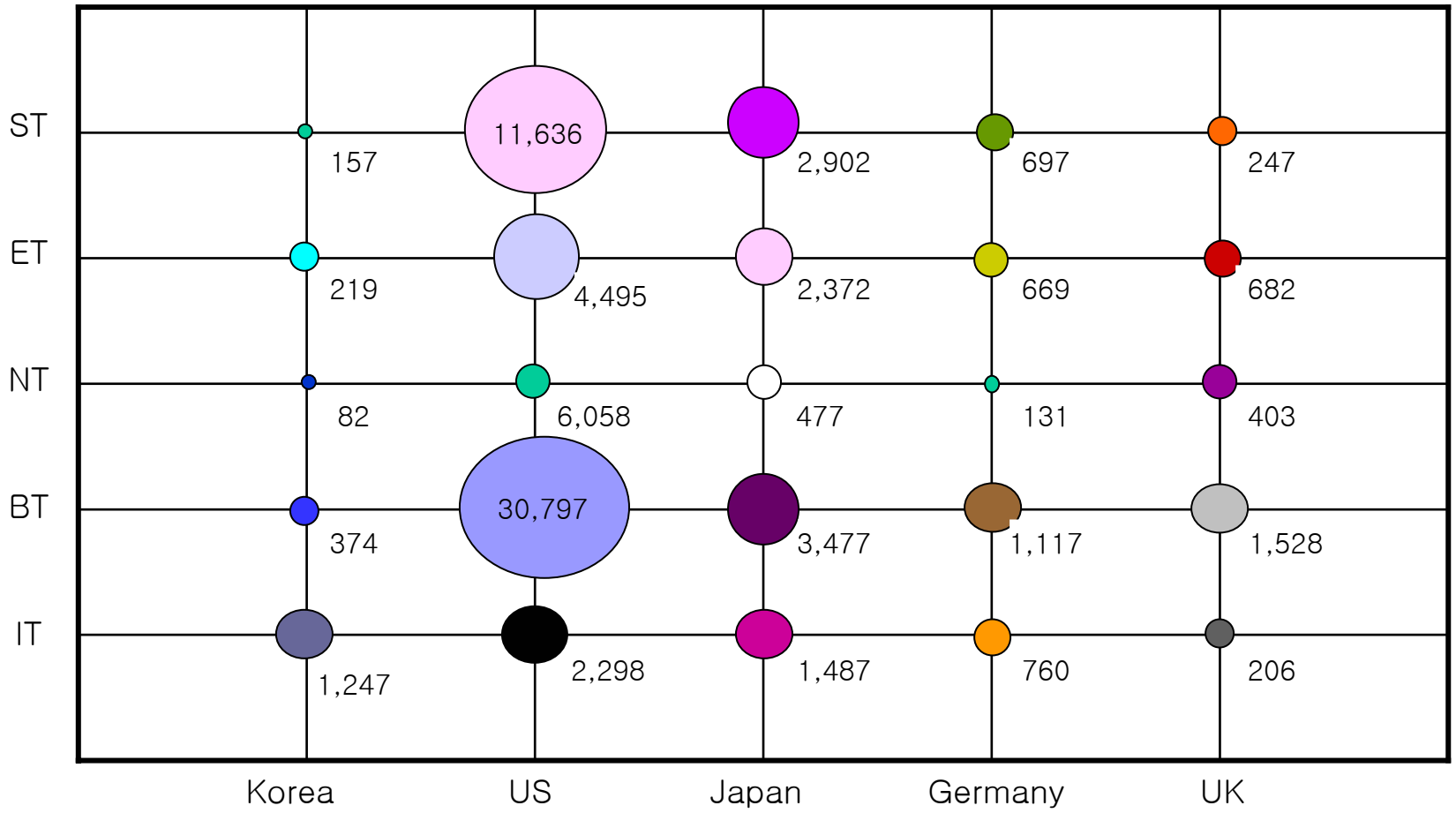
- Since the introduction of the “Law of S&T Framework,” the basic direction and framework of the STI Policy in Korea have been formulated by the “Five Year ST Framework Plan”.

ST Policy Priorities

Tasks	Policy Objectives
Future growth engine creation	1. Selective and focused development of national strategic science and technologies
Strengthening bases	2. Promotion of basic science research for creative innovation capacity 3. Rearing ST manpower for knowledge-based society
Internationalization and localization	4. Internationalization of ST and establishing Northeast Asia R&D Hub 5. Regional STI for balanced national development
Advancement of the innovation system	6. Increasing ST investment and efficiency 7. Promotion of the private sector's technology development for industrial technology capacity 8. Strengthening infrastructure for higher ST productivity
Participation of the people in the ST process	9. Increase the role of ST in response to social demand 10. Dissemination of ST culture among the general public

Comparison of R&D Investment in 6T Areas (2001)

(Unit: bill. won)



3) Promotion of National R&D Projects for New Growth Technologies

- To prompt the early realization of national per capita income of 20,000 dollars, the government selected 10 new-growth industries in 2003, which will increase international competitiveness and lead job creation for the next 5~10years.

- New growth industries will be promoted through developing some 80 key technologies under the coordination of National Science & Technology Council.

The Next-Generation Growth-Engine Technologies

	Product/Technology (Non-Exhaustive)
Digital TV/Broadcasting	Broadcasting system, DTV, DMB, set top box, multi-equipment
Display	LCH, LED, PDP, glass EL, electronic paper, related material
Intelligent robot	Home service robot, IT-based service robot, micro work robot, metal robot
Future automobiles	Intelligent automobile, environment-friendly automobiles
Next-generation semiconductors	Next-generation memory, SoC, nanoelectronic chips, related material
Next-generation mobile communications	4G terminal equipment/system, telematix
Intelligent home network	Home server/home gateway, home networking, intelligent information home electronics, Ubiquity computing
Digital content/software	Digital content provision use distribution system, cultural content, embedded software, Intelligent total logistics system.
Next-generation batteries	2nd batteries, fuel batteries, related material
Biomedical products	New medicine, bio-internal organs, biochips

Source: MOST

4) Development and Provision of Creative and Qualified Researchers

- Korea plans to cope actively with future demand for the development of new technologies by establishing master plans for rearing and utilizing 10,000 researchers in promising high-tech areas.

- Korea will encourage university manpower supply system more toward demand-oriented one through establishing innovative education models for colleges of science and engineering.

- More attention will be paid to strengthening science education at school curricula, training science laboratory teachers, and securing up-to-date laboratory and teaching materials. More scientists and engineers will be appointed to government offices.

5) Expansion of National R&D Investment to Strengthen potential for Growth

- R&D budget has gradually increased from 4.8% ($4.49 billion) of the total government budget in 2003 to 7% ($8.35 billion) in 2007.

6) Promotion of Basic Science and Enhancement for Creative Innovation Capabilities

- In Korea, the portion of basic research among total R&D investment is relatively low compared to that of other advanced countries.

- The portion of basic research has been continuously increasing in the government's R&D budget. The portion of basic research in government's R&D budget of $4,490 million in 2003 was 19.5%($877 million). The portion will be increased up to 25% by 2007 in basic research in order to join a group of world's top 10countries in basic science capabilities.

- Activating creative basic research projects and support joint research with the areas of human and social sciences

○ Enhancing regional science and technology research capacities through supporting researchers at local universities

○ Supporting small-sized research groups in pure science such as mathematics, physics and chemistry

○ Developing centers of excellence for basic research in universities (currently there are 30 Science Research Centers (SRC) and 36 Engineering Research Center (ERC).

Goals for Expanding Government's R&D Budget

(Unit: $billion)

	2003	2004	2005	2006	2007
Share of R&D budget in total government budget	4.8%	5.2%	5.7%	6.3%	7.0%
Total government budget (estimate)	94.48	100.15	106.16	112.52	119.27
R&D budget (estimate) (Growth rate from the previous year)	4.49 (6.9%)	5.21 (16.0%)	6.05 (16.2%)	7.09 (17.2%)	8.35 (17.8%)

Note: The figures were attained using the assumption that the government budget would increase 6 percent annually (the 2003 figures were attained using actual figures).

Source: MOST

7) Promotion of Regional Science and Technology

- The government is promoting following policies to improve local capabilities of innovation S&T:

○ Allocates a portion of the national R&D budget to local governments and induces local governments to invest a certain portion of their budget in S&T

○ Designates major high-tech science complexes as “National R&D Special District”.

○ Executes regional R&D cluster projects aiming to support local governments

8) Support of R&D in the Private Sector

-The Technology Development Promotion Law established in 1972 supports various kinds of private industrial research organizations, such as, industrial R&D centers, industrial technology research associations, industrial research clusters, etc.

○ As of 2002, there are 9,705 industrial R&D centers, and 65 industrial technology research associations to activate mutual cooperation in R&D.

- “Industrial Research Cluster Support Program” was initiated by the MOST in 2002. It supports small and medium scale enterprises research institutes, grouped to about 10 research clusters to identify and develop common key technologies together.

6. Challenges Ahead

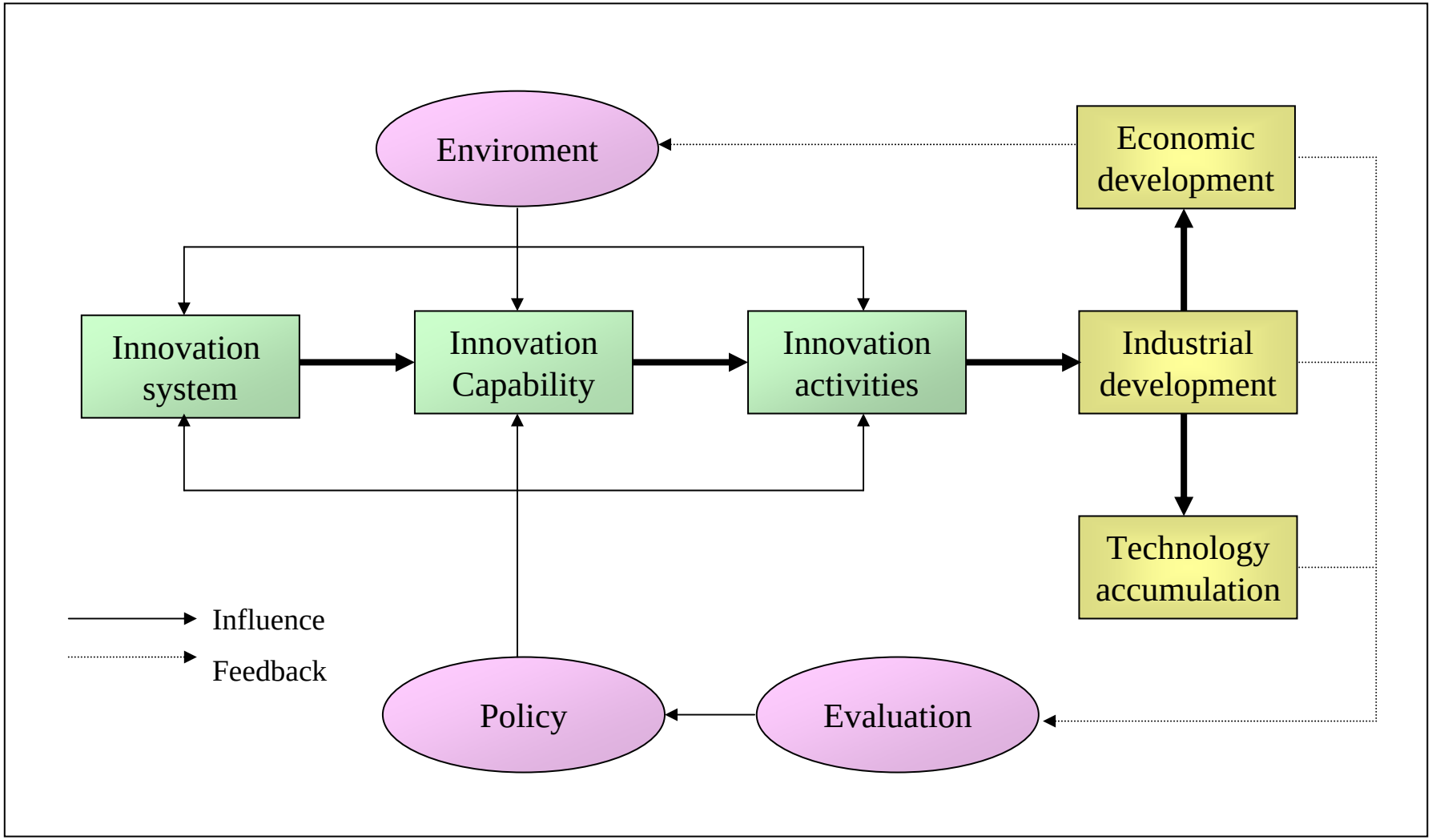
1) The Korean Economy at a Crossroads

- Presently, Korea is facing several serious domestic and international economic challenges. In fact, the Korean economy is at a crossroads. If these challenges are mishandled, the economy may lose its dynamism and growth engine, which, in turn, would result in a long-term recession like Japan in the 1990s.

2) New Paradigm and Social Integration

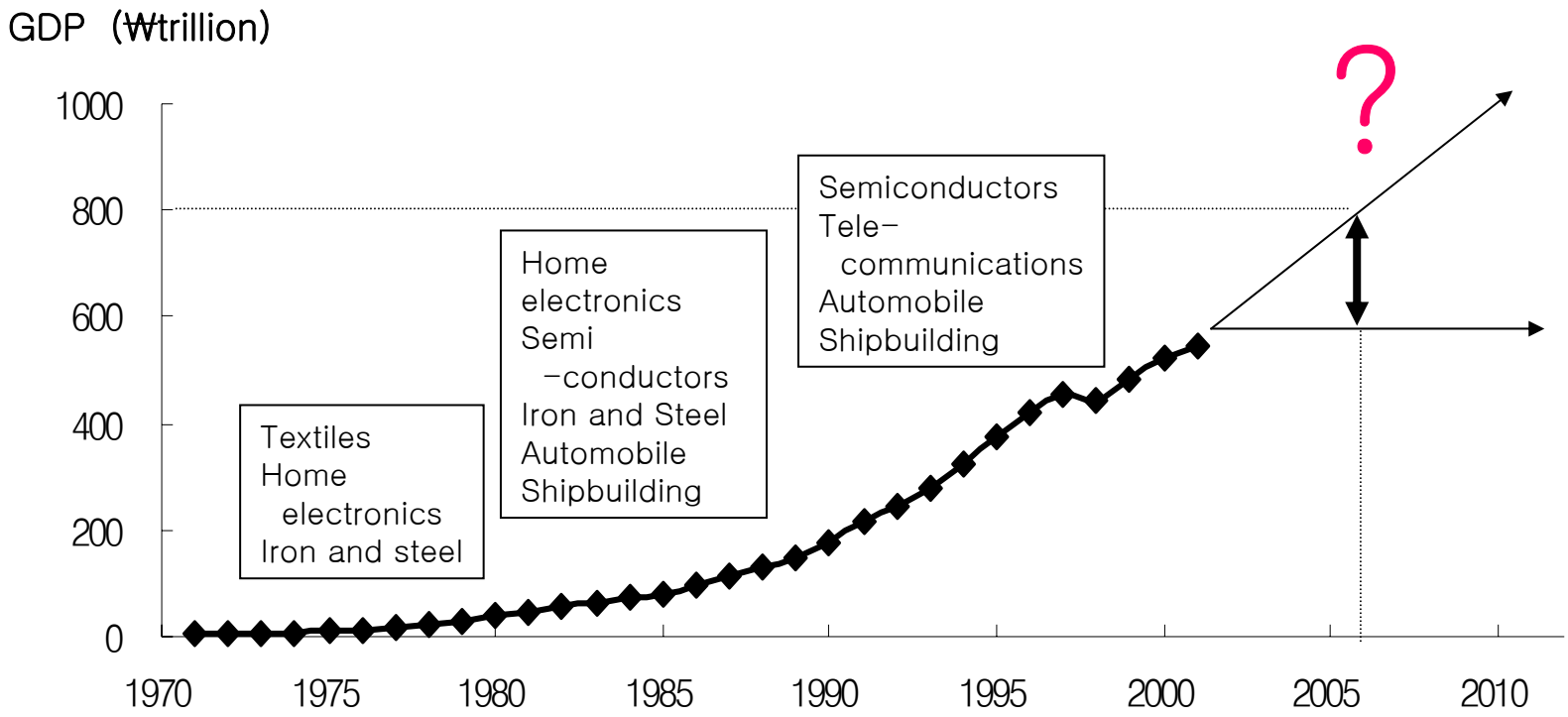
- The Korean economy needs a new paradigm. This includes building strong social capital for social integration. Without strong social capital, NIS will not be upgraded.

Core of the Innovation Economy



Source: Hong, Y. S.

□ **In order to realize GDP per capita of $20,000, new growth engines are needed. This requires upgrading the existing industrial structure.**

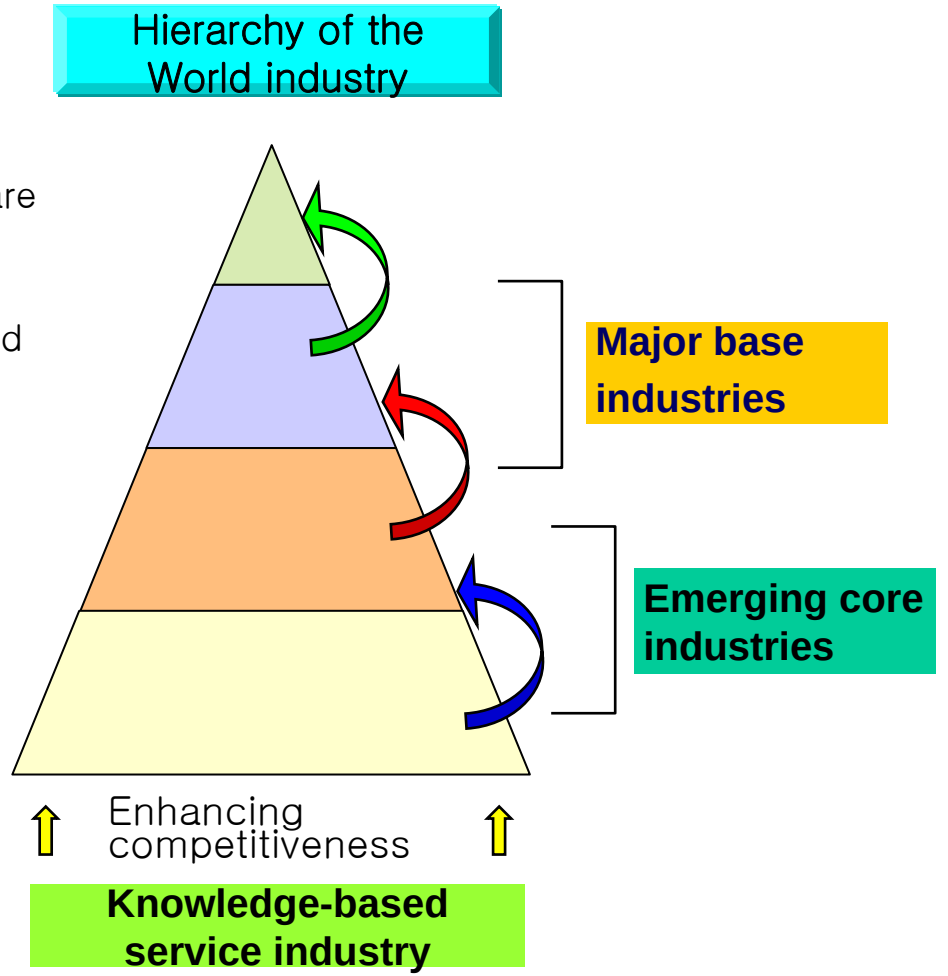


Concept of the Selection of Growth Engines

Criteria

- Domestic industrial competitiveness
- Demand projections in the world market
- Changes in the technology
- Commercialization feasibility
- Effect on employment

Next generation growth engines are the products or industries that upgrade present status in the world market

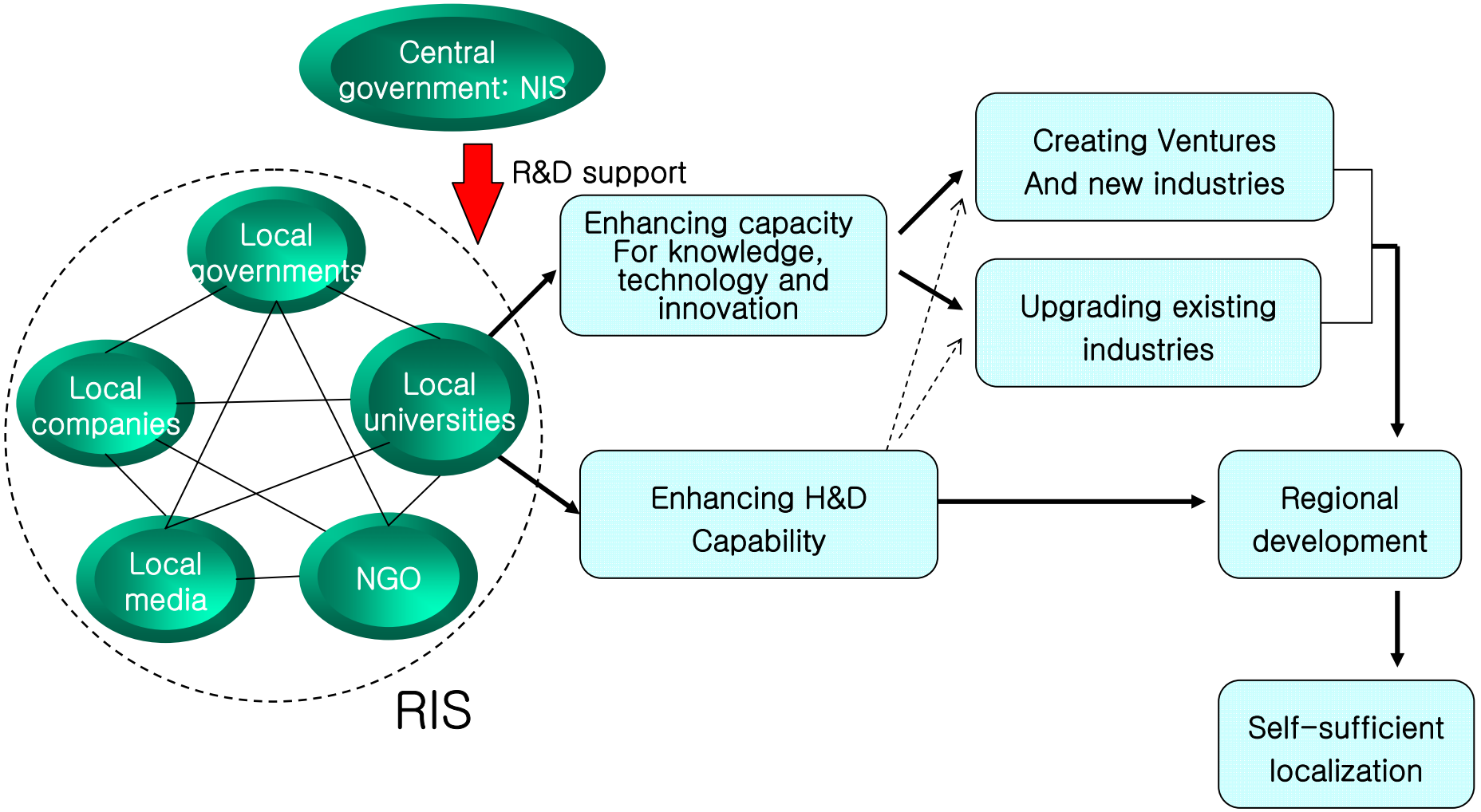


Source: Park, J. K. Mimeograph. 2003.

□ **Promotion of national R&D projects for new growth technologies**

- To prompt the early realization of national per capita income of 20,000 dollars, the government selected 10 new-growth industries in 2003, which will increase international competitiveness and lead job creation for the next 5~10years.
- New growth industries will be promoted through developing some 80 key technologies under the coordination of National Science & Technology Council.

Strengthening Regional Innovation Capacity



SWOT of Korea's High-tech Industry

Strengthes (S)	Weaknesses (W)
• Qualitative manpower with challenging spirits • Strong drive and strategic promotion of the government • Fast decision making and adaptability • Strong local demand • Commercialization ability • Excellent IT infrastructure	• Weak basic technologies and technological self sufficiency • Insufficient financial capability of investors • Complicated government policy measures • Half-finished economic, financial and industrial reforms
Opportunities (O)	**Threats (T)**
• FTAs • Transboundary strategic alliances and foreign investments • Development of the Chinese economy and market	• Discouraged venture business and SMEs • Domestic interest-group conflicts • Competitive threats from recovering Japan and rapidly growing China

7. Implications

1) Catch-up

- The most important process of catching-up is the technological imitation through which a DC learns how to industrialize. Catch-up through imitation requires conscious and policy-guided efforts of the imitating country.

- The rate of imitation and learning is much influenced by existing technological capabilities, policies and institutional arrangements.

- The learning process is also influenced by the nature of technological systems, the structure of technology market and international trading rules.

- Catching up is mainly related to the process of technological and economic competitiveness. It also is related to the speed and stages that a country masters technologies.

2) Needs for Change

- Korea's governance of its science and technology policy in the past was characterized by the strong leadership of the government and the relative weak position of the private sector. In the time of extensive growth, this kind of governance was effective. However, as the economy moves toward becoming a knowledge-based economy that is dependent more on knowledge, technology and innovation than labor and capital, a new paradigm of science and technology governance was needed.

- Although the need for reforming the NIS and governance structure has been pointed out by many experts and the media, it is the new administration which intended broad and deep reforms of the whole social system that actually materialize the NIS reform.

3) Recognition of Problems and Needs of Reforms

- It takes much long time to recognize problems of an NIS and even longer to reach a consensus on the direction and measures for reform. The recognition is a result of combined and accumulated efforts of various actors in the system. A kind of crisis consciousness is a crucial factor. In the case of Korea, the challenge of the rapidly rising Chinese economy contributed a lot to this.

4) Managing Conflicts and Vested Interests and Consensus Building

- This is the most difficult part in the process of a reform. Although the management of conflicts is an endless job, pressures for reform and capable political entrepreneurship can achieve it.

□ Problems and Shortcomings of the Korean NIS

- Lack of comprehensive coordination.
- Weak link between ST policy and government budget
- Excessive competition among ministries
- Weak function of planning and evaluation of the National R&D Program
- Problems in management of GRIs
- Weak regional innovation systems

5) Importance of Political Entrepreneurship and Change Agents

- The new administration started from 2003. The catchphrase of the new administration and its supporting political group is a creative destruction of the “ancient regime”. Many political entrepreneurs and change agents were recruited and involved in the reform process. A political power shift like this can render a critical momentum.

6) Benchmarking and Creative Approach

- The fundamental problem of the Korean NIS was that the system was designed for the imitation era, which is inefficient and a bottleneck for the innovation era. Benchmarking of many leading countries contributed to the discussion on the problem and new designing.

- Obviously, in-depth studies of OECD economies and policies have been much helpful. However, it cannot be denied that Korea had to find its own creative way to solve the amounted problems, since the Korean situation was more complicated than other advanced countries.

7) The New System

- The new direction is characterized by “integration and coherency”, which implies that STI policy is coordinated by the leadership and coordination function of restructured MOST and that projects and programs are trimmed and guided by the grand strategy of the “Science- and Technology-Based Society Building.”

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Appendix

International Comparisons

Education Level by country in Asia

	School Attendance Rate (2000) (%)			Illiteracy Rate of Age 15-25 (2001)	
	Elementary Education	Secondary Education	Higher Education	Male	Female
China	106	63	7	1	3
Japan	101	102	48	–	–
Korea	101	94	78	0	0
Chinese Taipei	100	99	77	–	–
Singapore	–	–	–	0	0
Hong Kong	–	–	–	1	0
Indonesia	110	57	15	2	3
Philippine	113	77	31	1	1
Thailand	94	82	35	1	2
Malaysia	99	70	28	2	2
Vietnam	106	67	10	5	4
United States	101	95	73	–	–
World	102	67	22	–	–

Source: World Bank, *World Development Indicators, 2001, 2002, 2003*

High-Tech Indicators by Country in Asia

	Number of Scientists (per 10,000 person)	Number of Experts (per 10,000 person)	R&D/GNI (%)	High-Tech Export		Royalty & License	
				Amount ($million)	Share of the Manufactured good (%)	Revenue ($million)	Payment ($million)
	1990-2000	1990-2001	1989-2000	2001	2001	2001	2001
China	545	187	1.00	49,427	20	110	1,938
Japan	5,093	667	2.98	99,398	26	10,462	11,099
Korea	2,319	564	2.68	40,427	29	688	3.221
Singapore	4,140	335	1.88	62,572	60	-	-
Hong Kong	93	100	0.44	3,716	20	107	461
Singapore	-	-	-	4,473	13	-	-
Philippine	156	22	-	21,032	70	1	158
Thailand	74	74	0.10	15,286	31	9	823
Malaysia	160	45	0.40	40,939	57	21	751
Vietnam	274	-	-	-	-	-	-
United States	4,099	-	2.69	178,906	32	38,660	16,360
World	-	-	2.38	-	23	72,356	73,148

Source: World Bank, *World Development Indicators, 2001, 2002, 2003*

Evaluation of Industrial Structure and Innovation Capacity

	Industrial Structure		Innovation capacity				Innovation system		Remarks
	Share of high-tech industry production	Value added of high-tech industry	Man-power	IT	R&D	Biz environ-ment	In-put	Out-put	
Japan	○	○	□	□	□	○	□	□	Good in general
Korea	○	□	□	□	□	□	□	○	Although good in general, needs system reforms
China	△	△	△	○	○	○	○	△	Low level although potential is great
Taiwan	n.a.	n.a.	□	□	□	□	□	○	Good in general
Singapore	□	○	□	□	○	□	□	n.a.	Good in general
Malaysia	□	△	△	○		□	○	n.a.	Medium level in general
Thailand	△	△	△	△	△	□	○	△	Low level in general
Philippines	△	○	△	△	△	□	△	△	Low level in general
Indonesia	△	○	△	△	△	○	△	n.a.	Low level in general

Note: □ = strong, ○ = medium, △ = low, n.a. = not available
Source: Hong. Y. S. 2003.

Evaluation of Strategies and Policies for the Development of the Innovation-driven Economy by Country

	Start year of major strategy or plan	Main target year	Core competence-related policies				Efficiency related policies		Remarks
			Man-power	IT	R&D	Business environ-ment	In-puts	Out-puts	
Japan	2000	2005	○	□	□	△	□	○	S&T, Emphasis on IT, Active strategy
Korea	1997	2010	△	□	□	△	□	○	Transitional period for a new paradigm and strategy
China	2003	2010	□	□	□	△	□	□	Acceleration of economic development
Taiwan	2000	2010	△	□	○	○	○	○	Exploring new strategies
Singapore	1991	2000	○	□	□	□	□	□	Problems of excessive foreign dependency
Malaysia	2000	2020	△	□	○	△	△	△	Entering a stable course
Thailand	n.a.	n.a.	○	○	△	○	○	△	Weak
Philippines	1998	2010	△	○	△	△	△	△	Weak
Indonesia	2001	2011	△	○	△	△	△	△	Weak

Note: □ = high, ○ = fair, △ = weak

Source: Hong. Y. S. 2003.

Overall International Competitiveness of Asian countries

(Rank)

	2000	2001	2002	2003	2004
Korea	29	29	29	37	35
Japan	21	23	27	25	23
China	24	26	28	29	24
Taiwan	17	16	20	1	12
Singapore	2	3	8	4	2
Malaysia	26	28	24	21	16
Thailand	31	34	31	30	29
Philippines	35	39	40	49	52
Indonesia	43	46	47	57	58

Source: IMD. Website.