

The Evolution of Korean Science & Technology Policy

Science and Technology Policy Institute 

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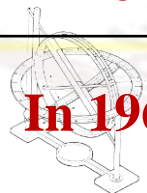
The Challenges That Korea Has Faced



I. How to Escape from the Poverty?

	GDP Growth Rate	Composition of Industry			
		Agriculture	Manufacturing	Light	Heavy
1953	-	47.3	9.0	78.9	21.1
1954	5.6	39.8	11.8	78.4	21.6
1955	4.5	44.5	11.6	79.9	20.1
1956	-1.3	46.9	11.6	80.2	19.8
1957	7.6	45.2	11.2	80.5	19.5
1958	5.5	40.7	12.8	78.6	21.4
1959	3.9	33.8	14.1	78.4	21.6
1960	1.2	36.8	13.8	76.6	23.4
1961	5.9	39.1	13.6	-	-
Average	4.1	41.6	12.2	78.9	21.1

In 1961, the GDP per capita was about 90 USD



The Poverty (Cont.)

Foreign exchange reserve (1960)

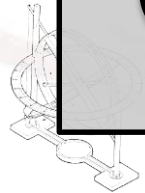
- 160 Million USD (34.3 Billion USD 2013)

50% of government budget comes from US aid

Government revenue was 17% of GNP (1961)

Domestic saving was 5% of GNP

GNP was ranked at 101st in the world



II. How to Secure the Social Safety?

1945

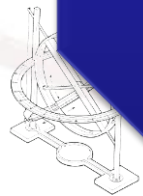
- **Independent from Japanese colony**
- **Divided into two Korea (North & South)**

1950s

- **The Korean War between 1950-1953**
- **The front-line of the Cold-war since then,**

Then,

- **Has faced the North Korean military power**
- **North Korean economy had been better until 1970s**



III. How to Build the Infrastructure?



Gwanghwamun Gate in Seoul 1960s



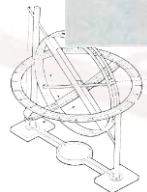
Railroad construction sites



Han River in 1960s



Line for water supply



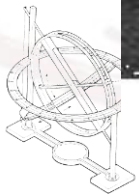


Han River, 1964

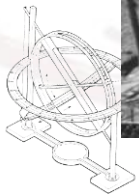
한강 1964



Downtown Seoul : 1960s



The South Gate : 1960s

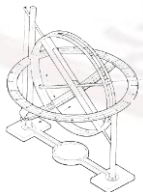


Then, Science & Technology?



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Money? Equipment and Facility? Institute? Manpower?



No! in Seoul 1960

Challenge – Liberation from Poverty

The most urgent challenge for Korea was,

- ⦿ How to liberate its own people from the chronic poverty?
- ⦿ However, Korea did not have enough tools or resources to propel industrialization

Yet, Korea has had the most important elements ; human resources

- ⦿ 29% of illiteracy rate, 29.2% of college enrollment rate
- ⦿ Educational level was far higher compared to the level of income
- ⦿ Consensus on the necessity of industrialization & ‘Can Do’ spirit among the people

Outward –looking development strategy

- ⦿ Korea had to look outward for resources, technology and market
- ⦿ Development strategy based on human resources
- ⦿ Industrialization has been an evolution from imitation to innovation



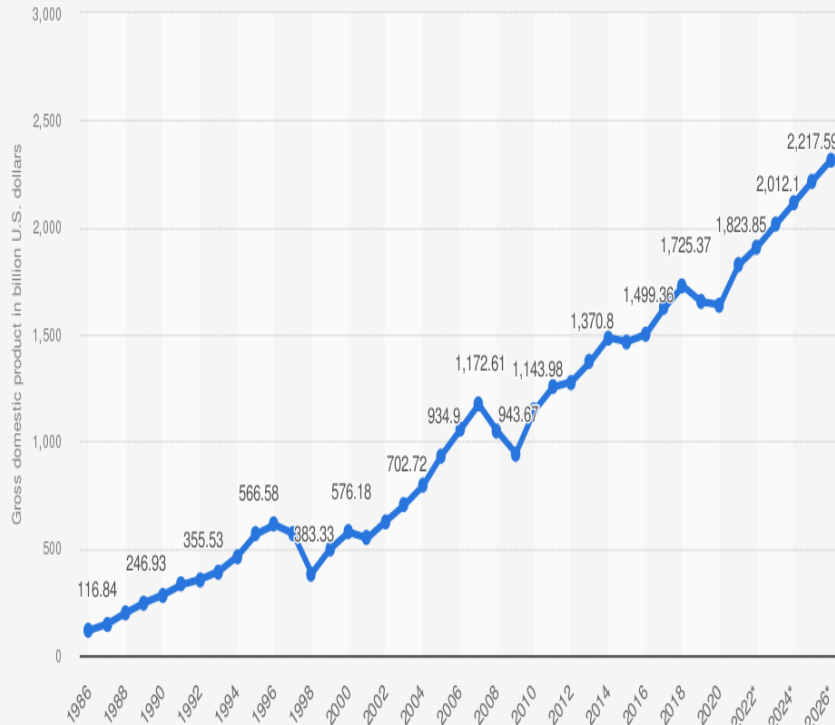


Economic Development
-Miracle of Han River-



Remarkable Economic Growth in Korea

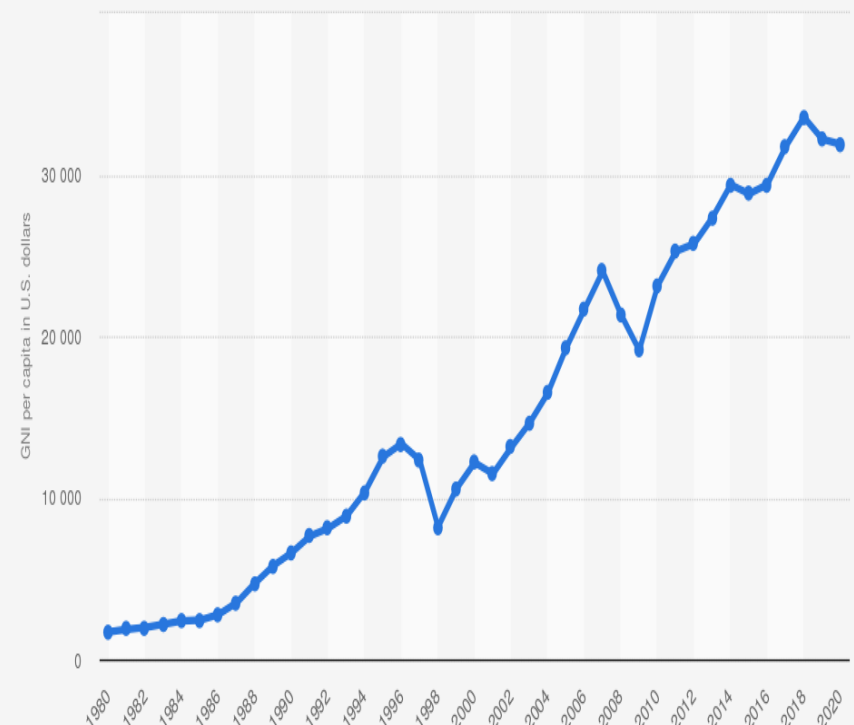
South Korea: Gross domestic product (GDP) in current prices from 1986 to 2026 (in billion U.S. dollars)



Source
IMF
© Statista 2021

Additional Information:
South Korea; IMF

Gross national income (GNI) per capita of South Korea from 1980 to 2020 (in U.S. dollars)

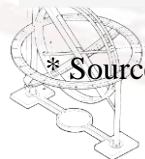


Source
Bank of Korea
© Statista 2021

Additional Information:
South Korea; 1980 to 2020

* Source: IMF (Statista 2021) 1.82 trillion USD in 2021

* Source: Bank of Korea (Statista 2021) 31,489 USD in 2020



Seoul, 2022

260M 5055



Han River, 2022

한강 야경 5055



Automobile

IONIQ Electric



Wheels

The Nuts and Bolts of Whatever Moves You

January 9, 2012, 8:40 am 44 Comments

Hyundai Elantra Is Car of the Year; Range Rover Evoque Is Truck of the Year

By PAUL STENQUIST



- Hyundai is a top 6 automobile maker in US market

Mobile Phone (* Pictures from Google)



Top Five Smartphone Vendors, Shipments, and Market Share, 2012 Q3

(Units in Millions)

Samsung	56.3	31.3%	28.1	22.7%	100.4%
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Vendor	Shipments	Share	Shipments	Share	year Change
Samsung	56.3	31.3%	28.1	22.7%	100.4%
Apple	26.9	15.0%	17.1	13.8%	57.3%
Research In Motion	7.7	4.3%	11.8	9.6%	-34.7%
ZTE	7.5	4.2%	4.1	3.3%	82.9%
HTC	7.3	4.0%	12.7	10.3%	-42.5%
Others	74.0	41.2%	49.9	40.3%	48.3%
Total	179.7	100.0%	123.7	100.0%	45.3%

Source: IDC Worldwide Mobile Phone Tracker, October 25, 2012

Note: Data are preliminary and subject to change. Vendor shipments are branded shipments and exclude OEM sales for all vendors.

Samsung Mobile Phone (Galaxy)

Top 2 in the world market

Rivalry with Apple I-Phone

Galaxy Z Fold3 | Flip3



Ship-building Industry

South Korea claims top spot in 2020 global shipbuilding orders



Korea accounted for
42.6%
of the global orders



World's top shipbuilders

※Based on residual value of attained contracts:
3rd: Imabari Shipbuilding, Japan; 4th: Fincantieri, Ital
Source: Clarksons (British research firm on shipbuilding)

11.15 millionCGT
(279ships)



Hyundai Heavy Industries Group
(including Samho and Mipo)

5.84 millionCGT
(86ships)



Daewoo Shipbuilding
and Marine Engineering

4.72 millionCGT
(88ships)



Samsung
Heavy Industries

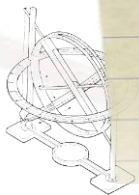


Steel Industry



▣ **World top 6 in steel production**

▣ **World #1 in per capital steel consumption**



Semiconductor Industry

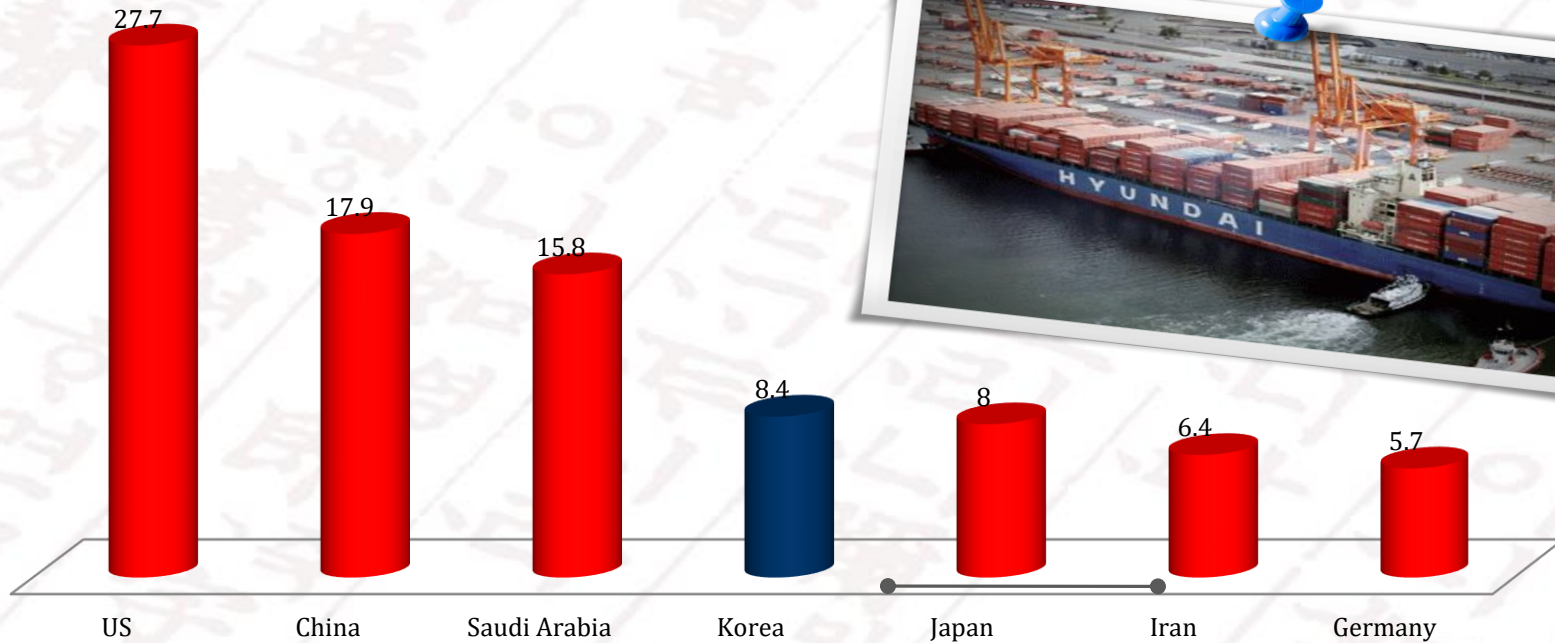


Samsung & SK Hynix are ranked at #1 & #4 in the world (2021)
- In semiconductor production capability (Ref. from IC Insights)

Petrochemical Industry

Ethylene Production Capacity

Unit: MT/Year



The 4th largest production capacity in Ethylene production (2017)

- Ethylene production : 9,005,000 ton/year



Development Strategy
-East Asian Model-



Export-Led Economic Growth

❑ Why?

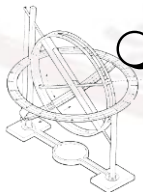
- Why did Korea adopt the strategy of export-led growth?

❑ Market condition

- Lack of purchasing power in domestic market
 - Could not sell its own goods nor imported goods –not profitable
- per capita GDP – around 90 USD in early 1960s

❑ Resource condition

- Korea did not have the natural resources (gas & oil etc.)
 - Could not export any tradable natural resources
- Korea did not have enough production in agricultural sector
 - Could not export agricultural products such as rice, vegetables or fruit
- Only human resources were available
 - Korea had to figure out how to utilize relatively qualified human resources



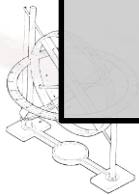
Industrialization – Manufacturing Sector

❑ OEM/ODM Production

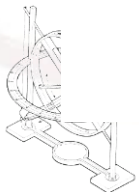
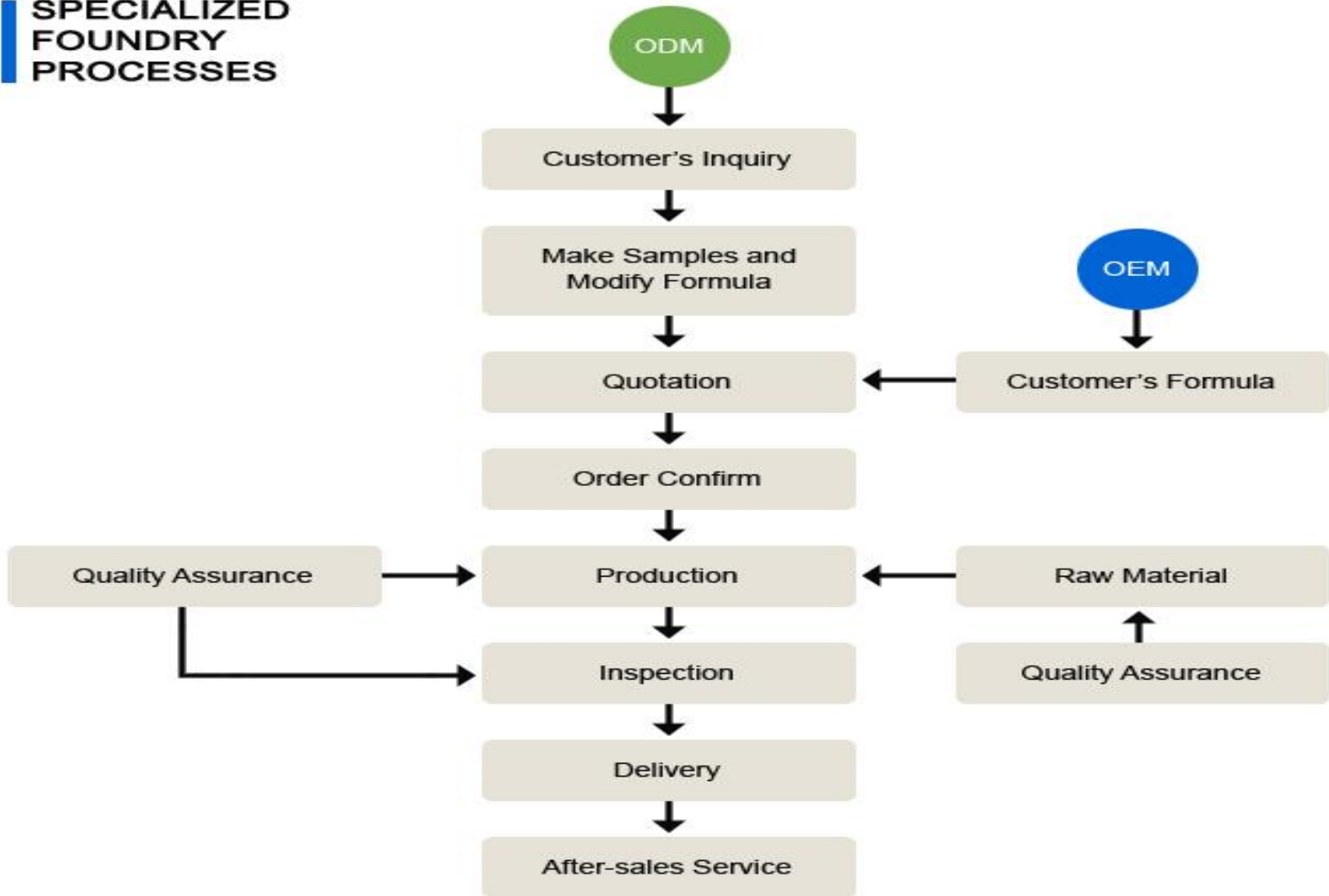
- **Korean companies could not export their own products**
- **There was no market competitiveness and brand-value**
 - **Could not make or export their own products**
 - **Lack of brand, technology and quality**
- **Adopted the way of OEM/ODM**
 - **Received order from other advanced countries and produced the items**
 - **It was a delivery to the final goods producers but it was an export at the same time**
 - **The transaction was made across the border**

Original Equipment Manufacturer

Original Design Manufacturing



SPECIALIZED FOUNDRY PROCESSES



Why Manufacturing? Two Birds with One Stone

**Manufacturing Sector
Development**

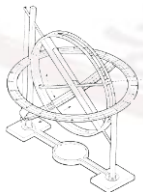
'Technology'

**Goal of
Industrialization**

**Goal of
National Security**



**Automobile
Industry**



Production by the Indigenous Firms

▣ Importance of indigenous enterprises

- Tried to develop domestic firms from the first stage
- Tried to develop manufacturing sector and firms
- Let private firms produce for the market



Global competence

Quality Productivity

Tech. & Manpower

Internal supply chain



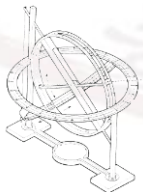
- ▣ Support via industrial policy
- ▣ Carrot & stick
- ▣ Public goods by public sector



Global enterprises developed

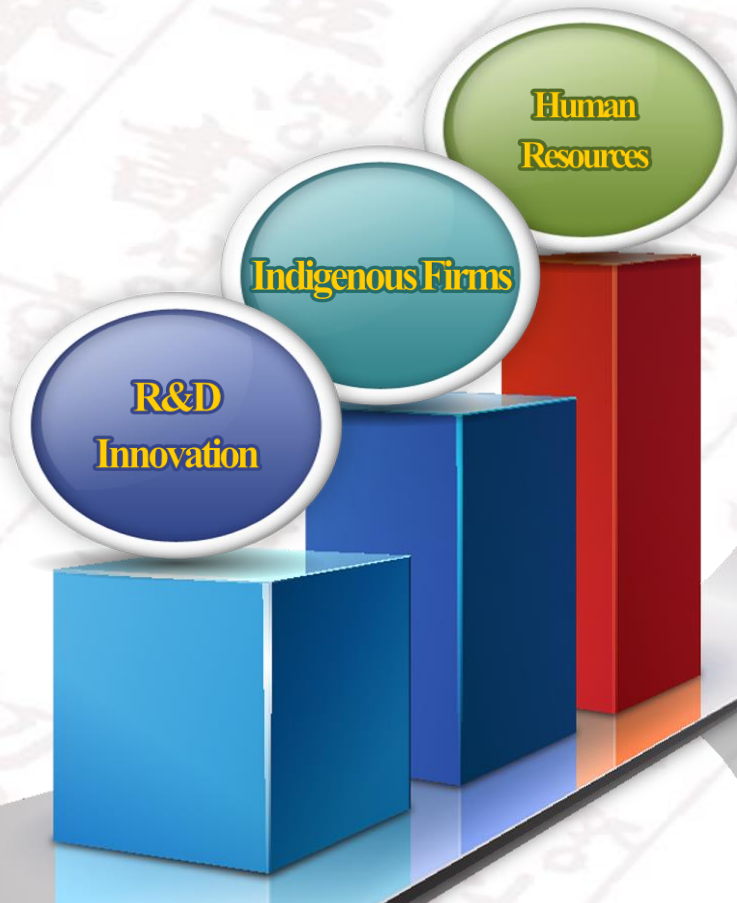


Government Policy



East Asian Model of Econ. Development

Three Main Factors



**Market
Industrialization
Export**

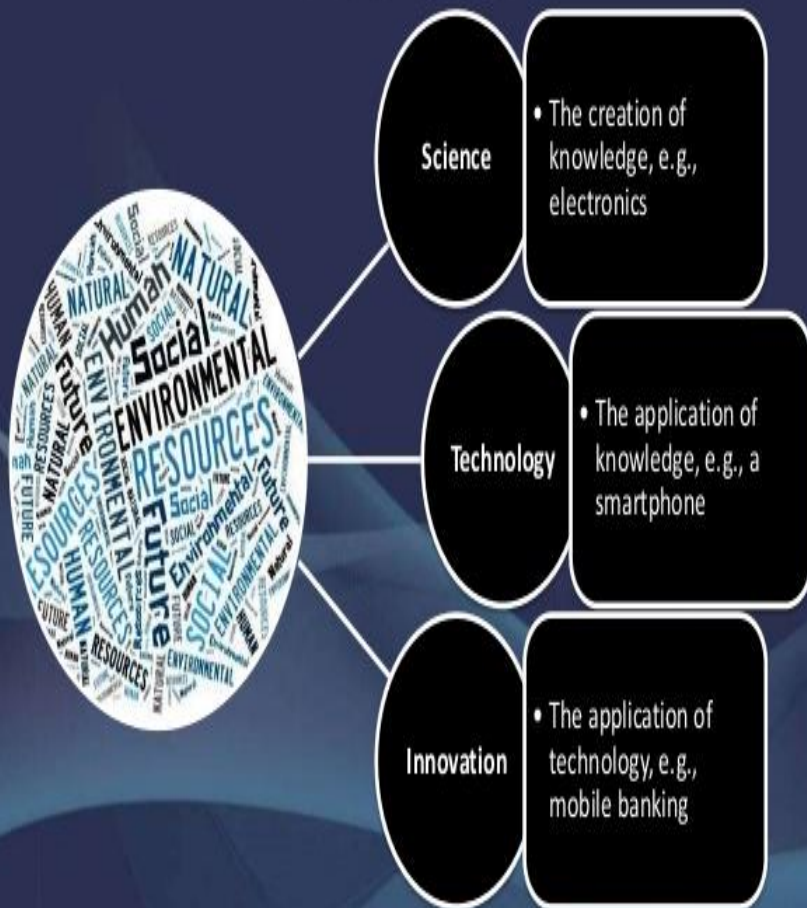




Science, Technology & Innovation



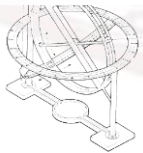
Define: Science, Technology, and Innovation



WHY IS

TECHNOLOGY

SO IMPORTANT?





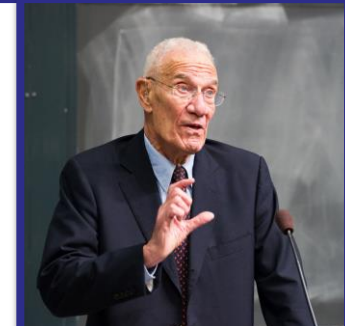
*The Economics and
Sociology*

Joseph A. Schumpeter

'Innovation Theory'

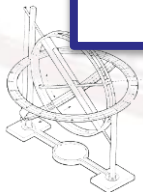
Robert M. Solow

'Neoclassical Growth Theory'



Paul M. Romer

'Endogenous Growth Theory'



Creative Destruction

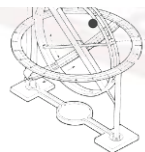


Joseph Schumpeter
(1883-1950)

❖ “Creative destruction” as a process of creating new and destroying old as innovative firms drive established companies of the market

- Technological innovation comes from the entrepreneurs
- Established companies drive innovation using its capital
- Innovation creates new monopolies with abnormal profits to be succeeded by rivals

(http://en.wikipedia.org/wiki/Joseph_Schumpeter)



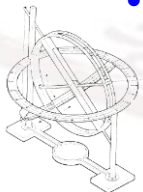
The Solow Growth Model

In the long run, economies converge to their steady state equilibrium

- Steady state economy
 - Consists of constant stock of K and population size
 - Does not grow in the course of time

Permanent growth is achievable only through technological progress

- Technological progress is determined exogenously
- Poor countries can catch up richer countries
- If they receive better technology and information



ENDOGENOUS GROWTH THEORY



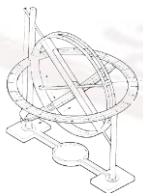
Final output sector

Capital goods sector



Research sector

By Paul Romer <2018 Nobel Prize Winner>
(Former Chief Economist & Vice President of the World Bank)

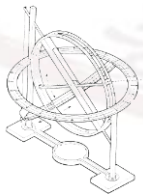


The Role of Research Sector

**Human
Capital**

**Existing stock of
Knowledge**

New Knowledge
- New Designs
(Produce Durables)



Critical Feature – Role of Knowledge

New knowledge



New capital goods



Final goods quality

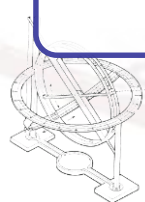
New knowledge



Total stock of knowledge



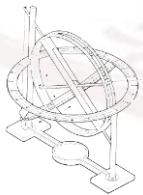
Human capital

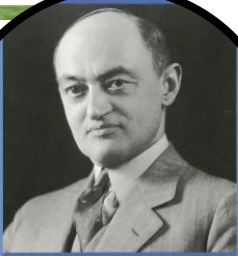


Yes, Technology is Important

But How to Develop?

How to Get?





*The Economics and
Sociology*

*** Entrepreneurship and market power**

- Monopoly profit (temporary)



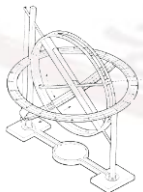
*** Solow residual (productivity)**

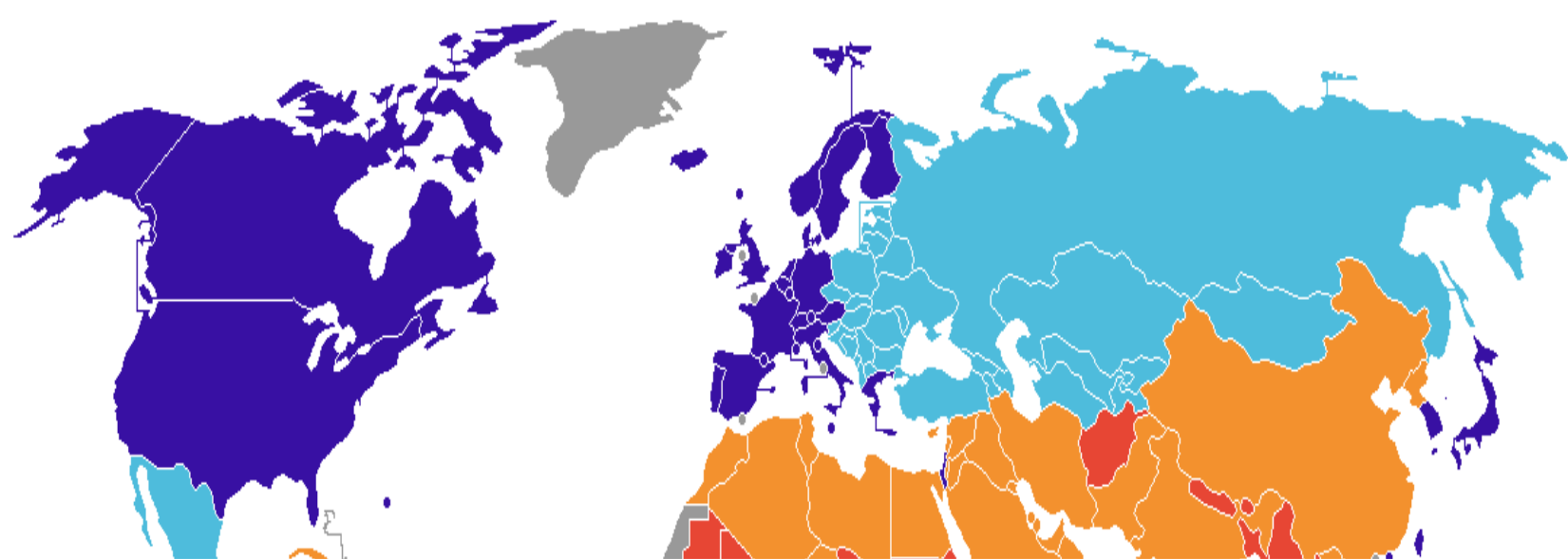
- Unexplained change (exogenous)
- Academic achievement?



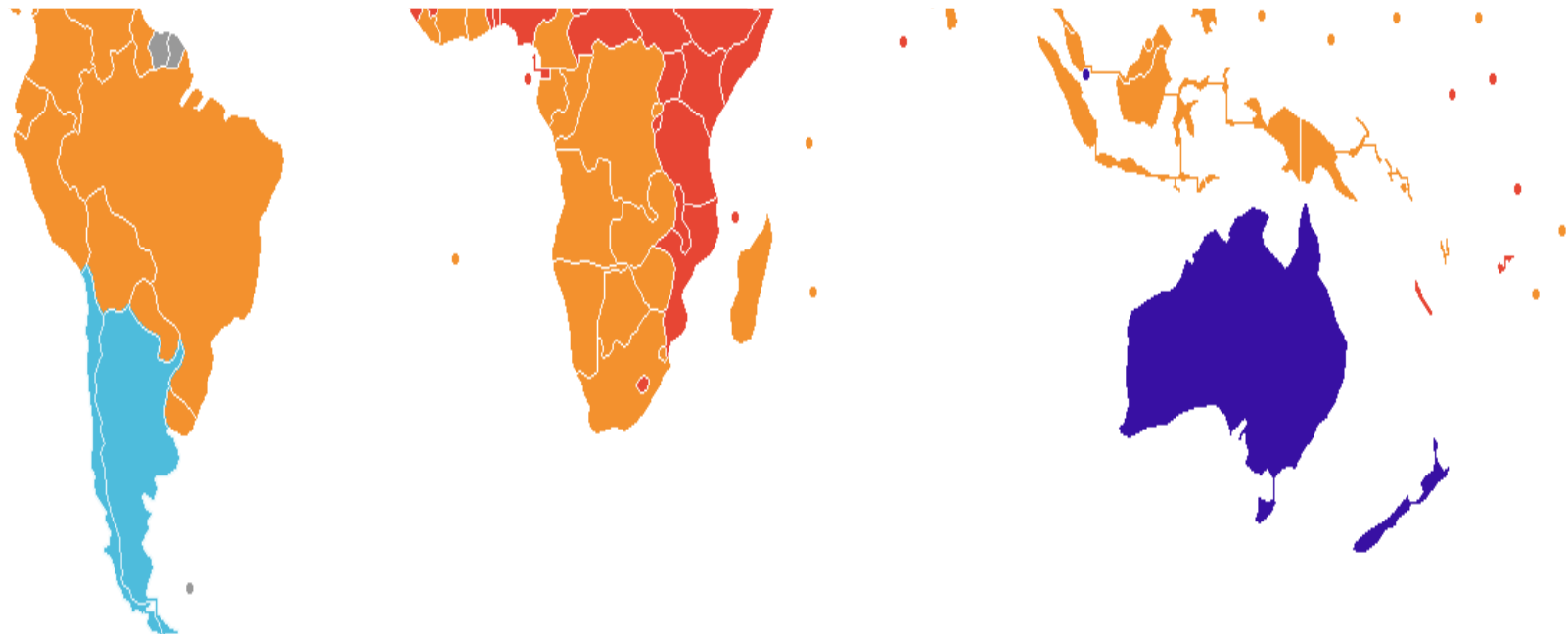
*** Knowledge production function**

- Role of research (R&D) sector





How about Developing Countries?



- Advanced economies
- In transition
- Less developed
- Least developed

Challenges for Developing Countries



How to build up the three sectors?

- Industrialization & tech. progress



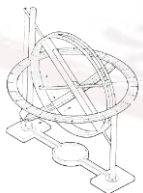
How to build up the research sector?

- R&D/human capital



How to build up the bridge?

- Knowledge/technology transfer



Big Push Theory by Rosenstein-Rodan



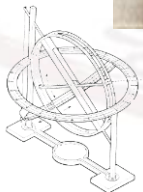
Balance & Coordination



Critical ground speed



Investment – critical mass



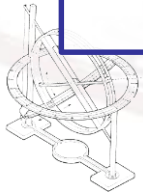
'Big Push' for the Research Sector

R&D – important but not affordable

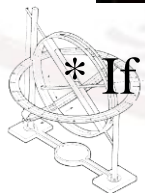
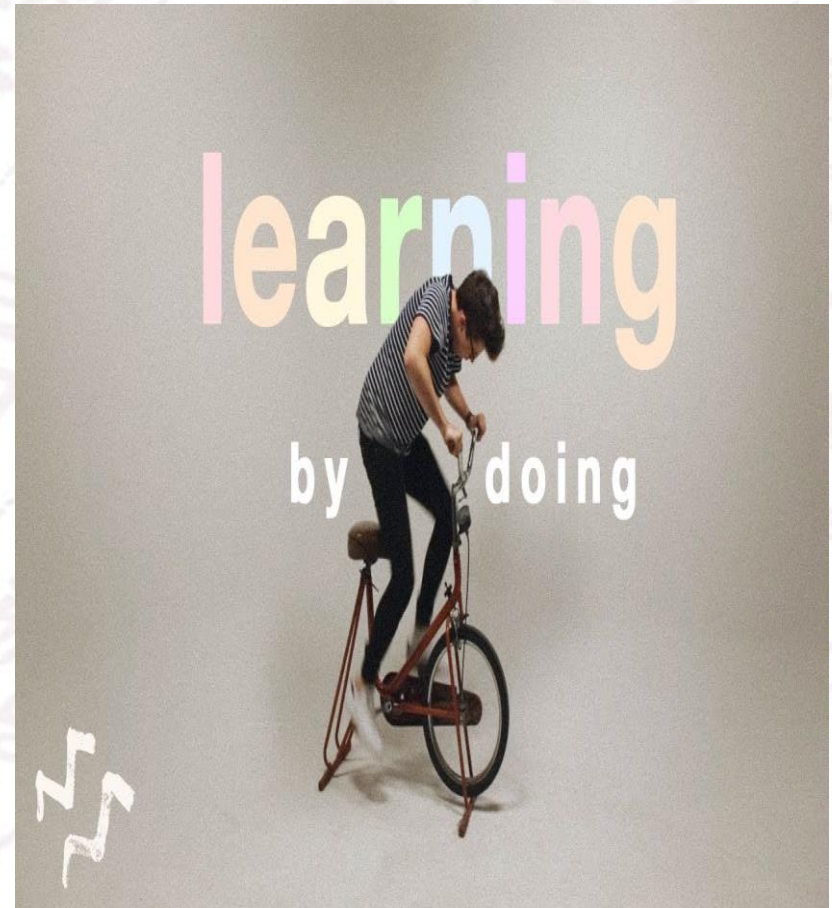
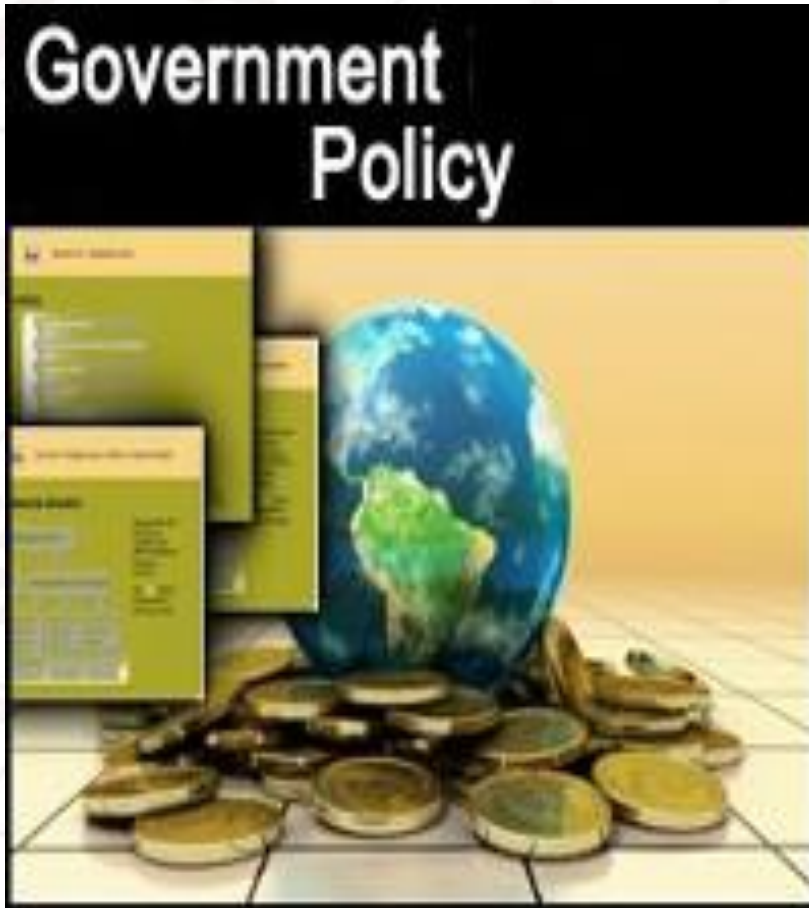
** Public goods characteristics & sunk cost*

Government' mission – S&T policy

** For promoting R&D activity*



How to Produce Knowledge?



* If no government policy, knowledge can be produced only via learning by doing

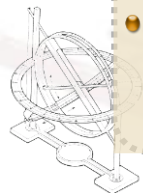
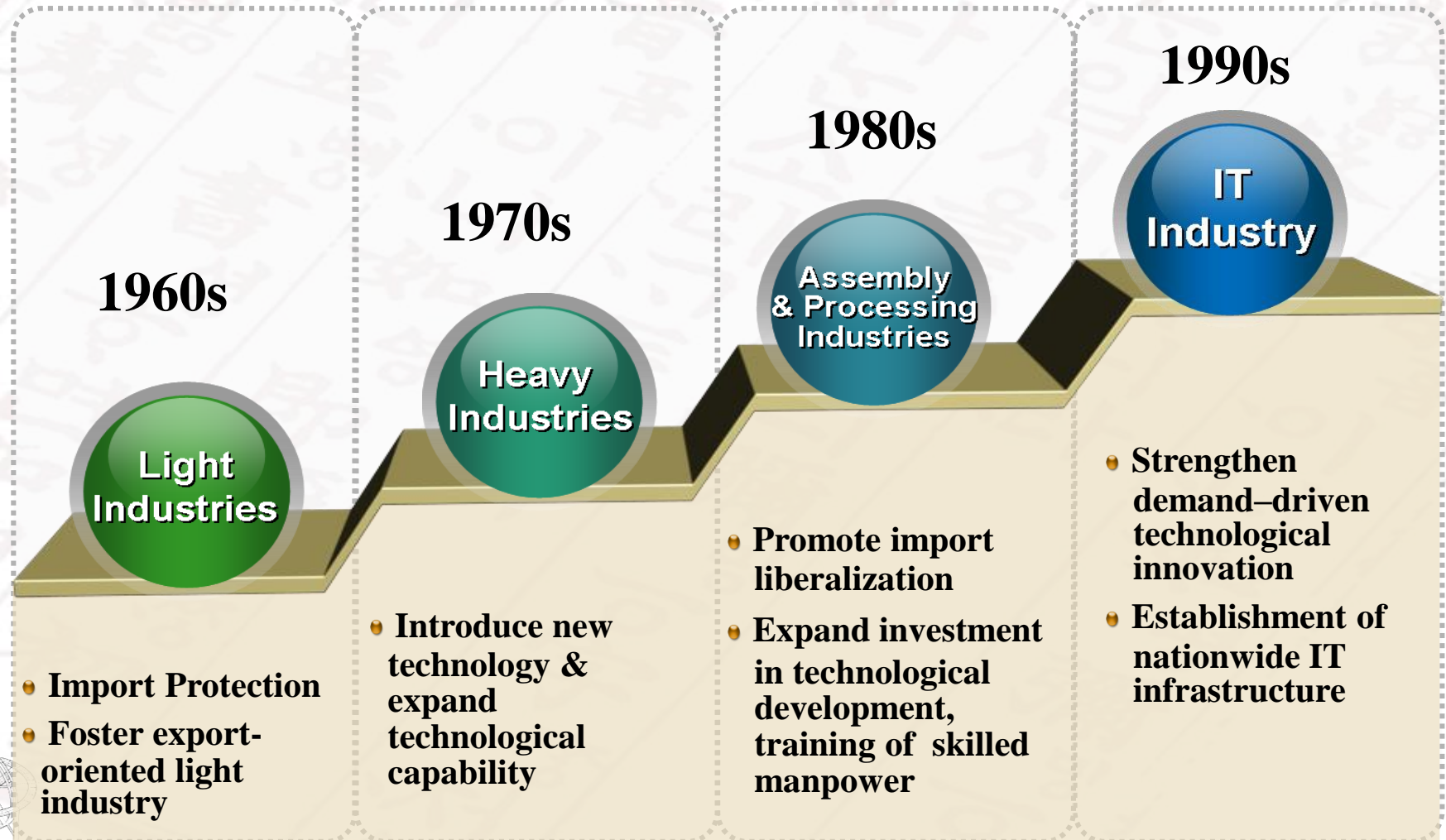


Big Push By Korea
In the Context of S&T Policy



Industrialization W/ S&T Development

“Select and Focus” Strategy



Innovation Strategy

1960s

1970s

1980s

1990s

2000s

Strategy

Catch-up

Innovation

S&T policy direction

Building R&D infrastructure

Developing technologies for key export industries

Promoting R&D

Developing technologies for high-tech industries

Enhancing technology innovation

Developing basic and fundamental technologies

Key industries

Primary goods

Light industry goods

Light & heavy industry goods

Heavy industry goods & electronic products

Electronic & cutting-edge products

Leading sector

Government-funded research institutes (GRIs)

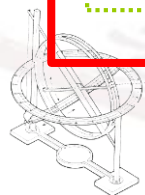
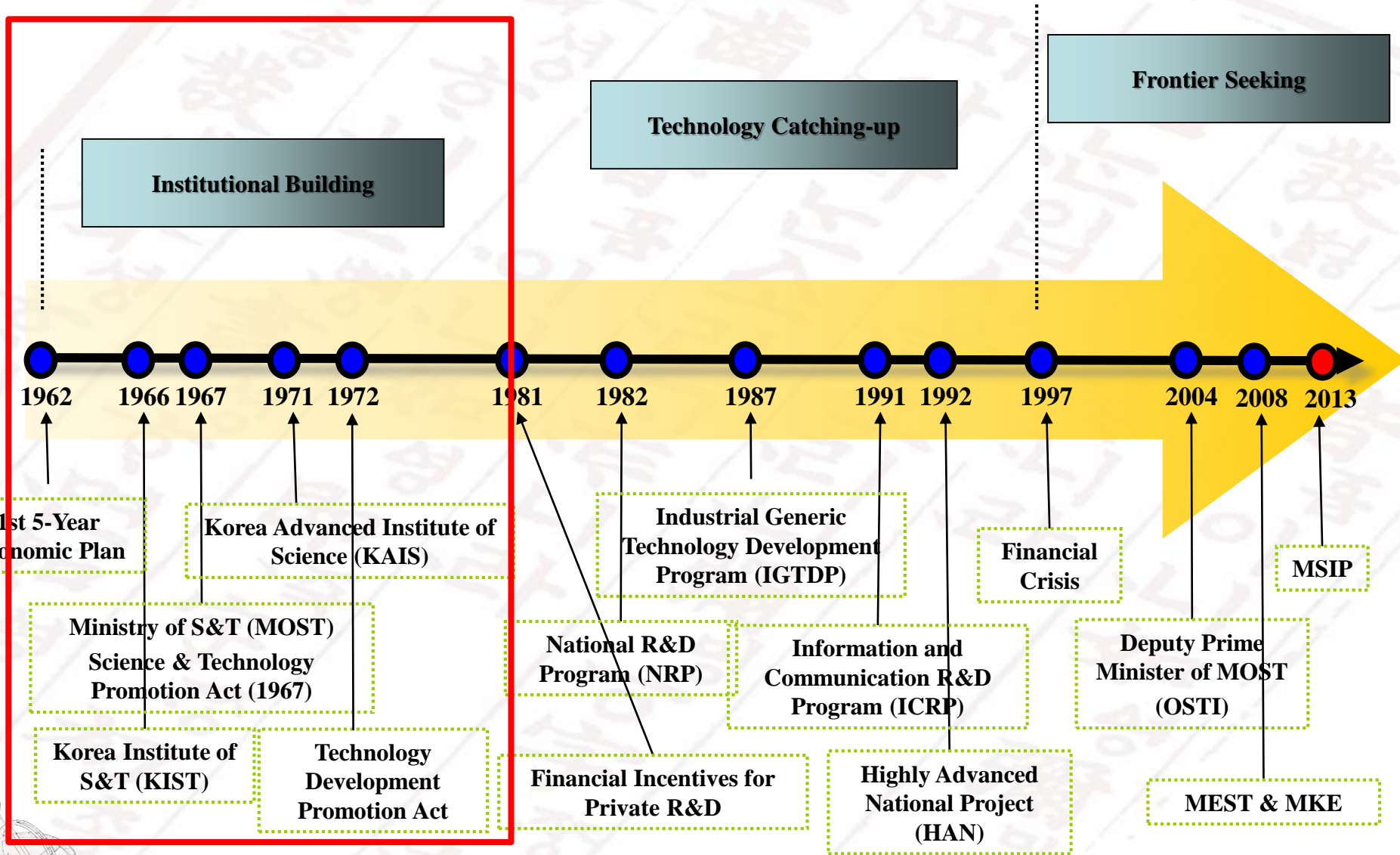
Private enterprises, GRIs, Universities

Private enterprises, GRIs, Universities



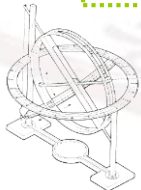
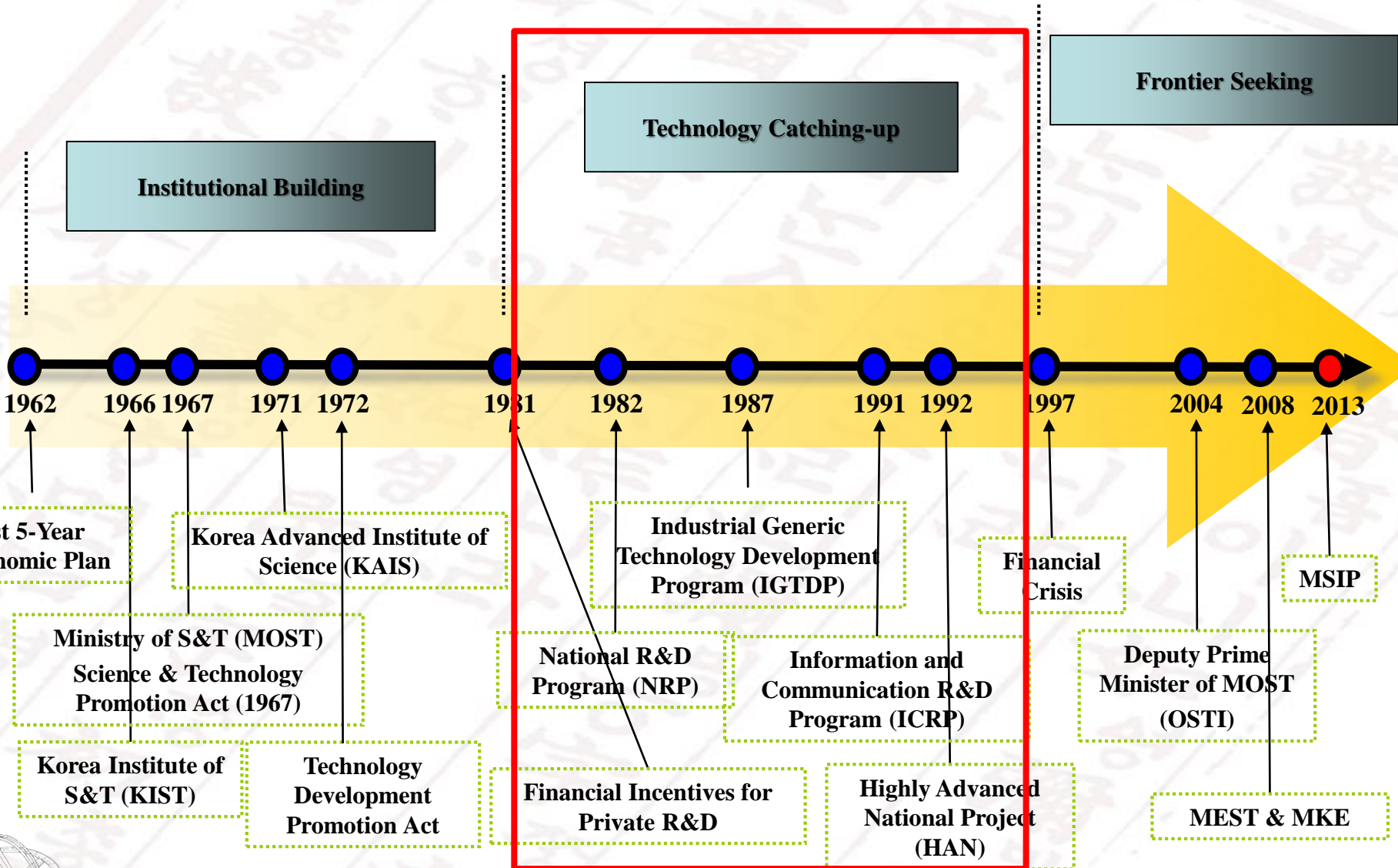
Chronological Outlook

SIIP

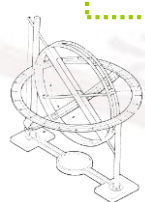
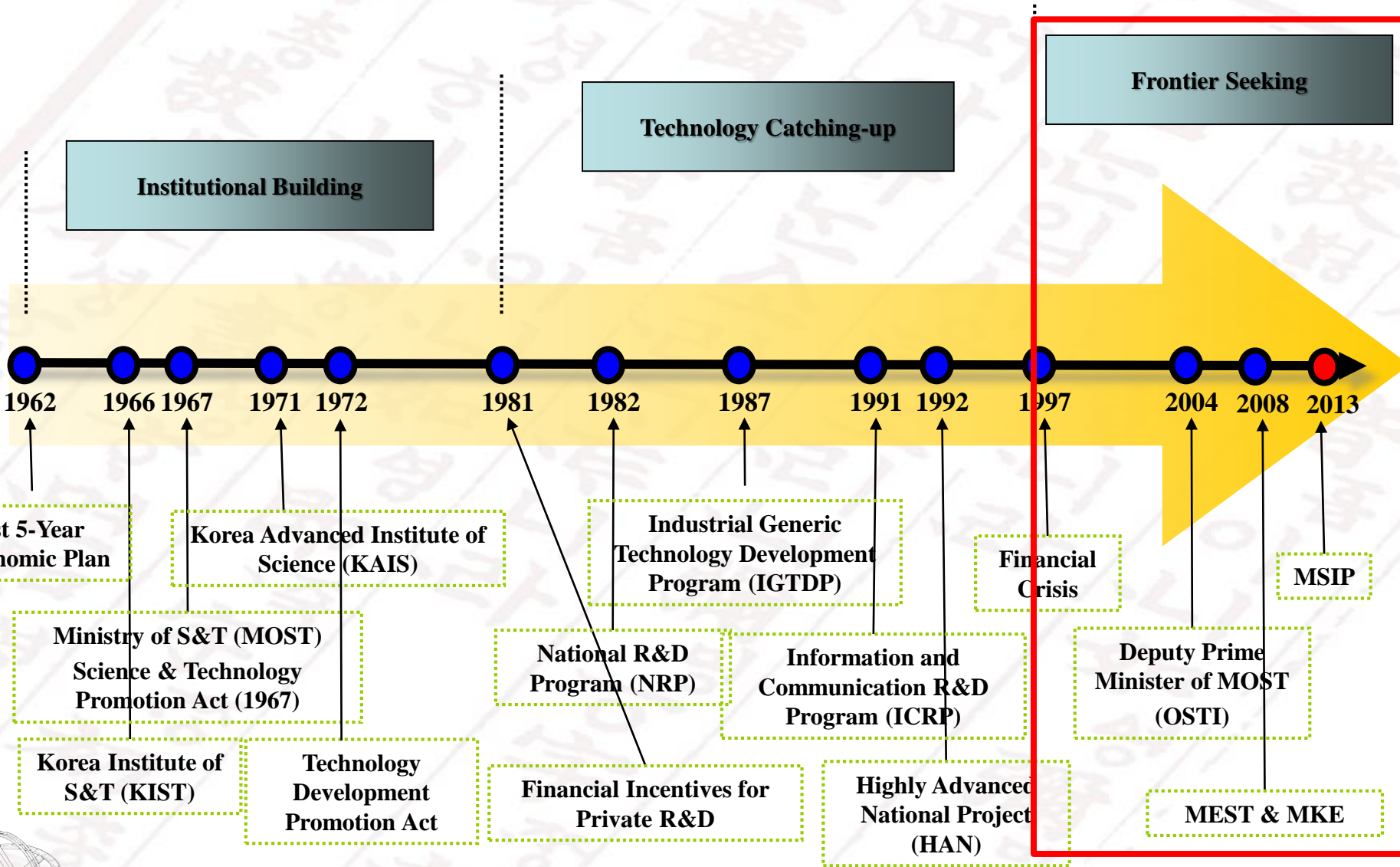


Chronological Outlook

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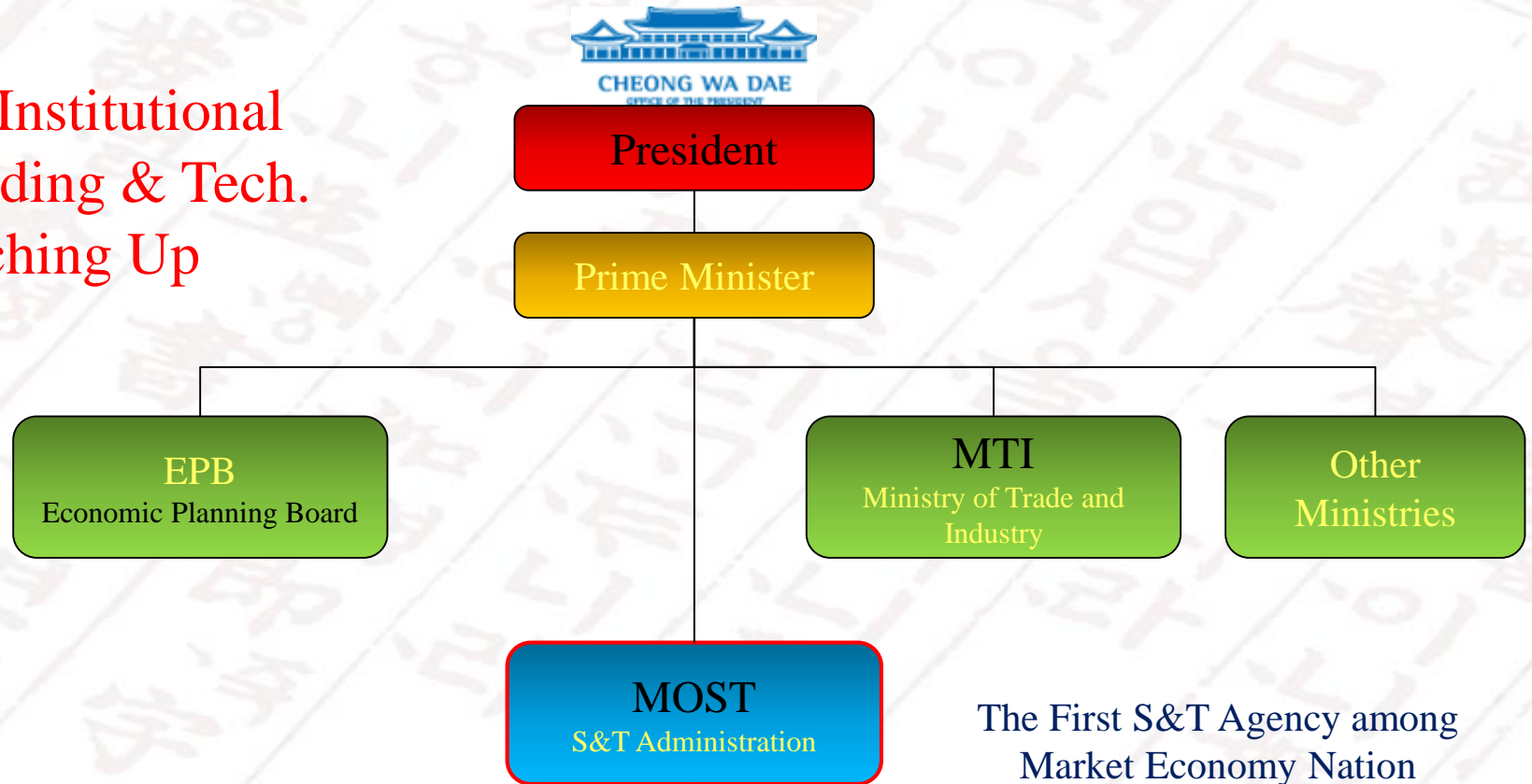


Chronological Outlook



Establishment of MOST in 1967

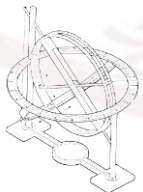
For Institutional
Building & Tech.
Catching Up



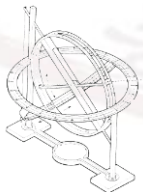
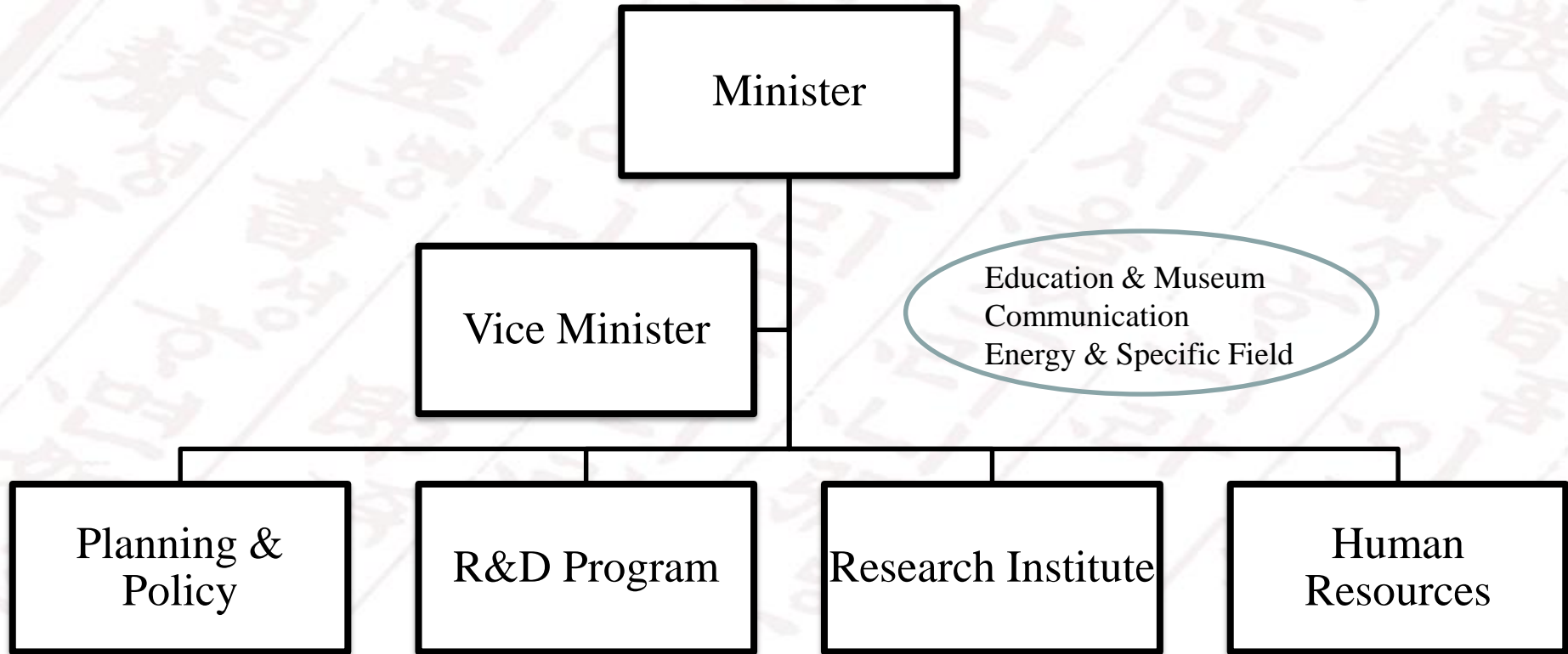
The First S&T Agency among
Market Economy Nation



The First Korean GRI (1966)

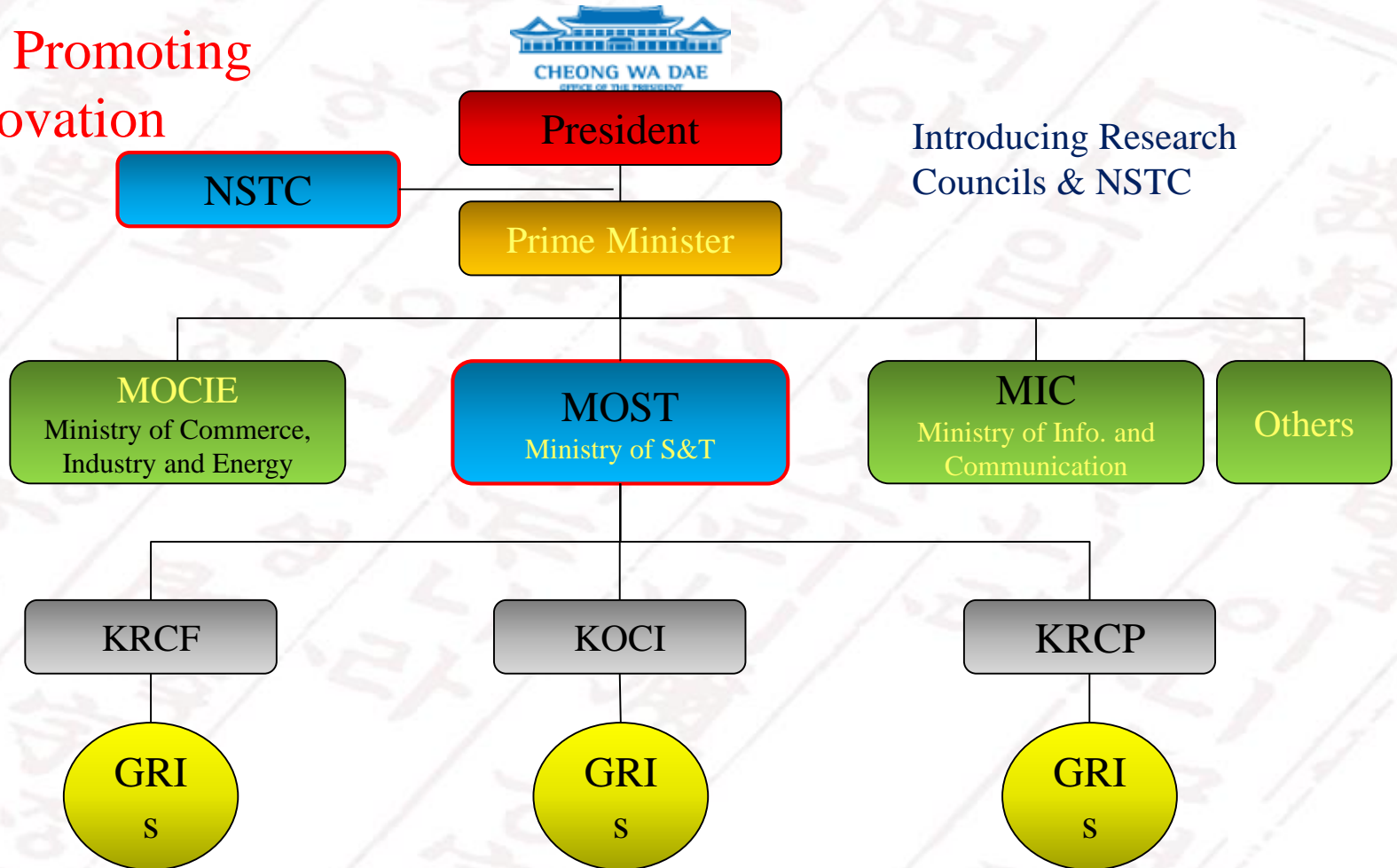


Structure of MOST



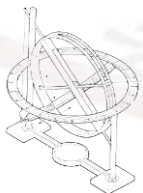
Upgrade of MOST in 1998

For Promoting
Innovation



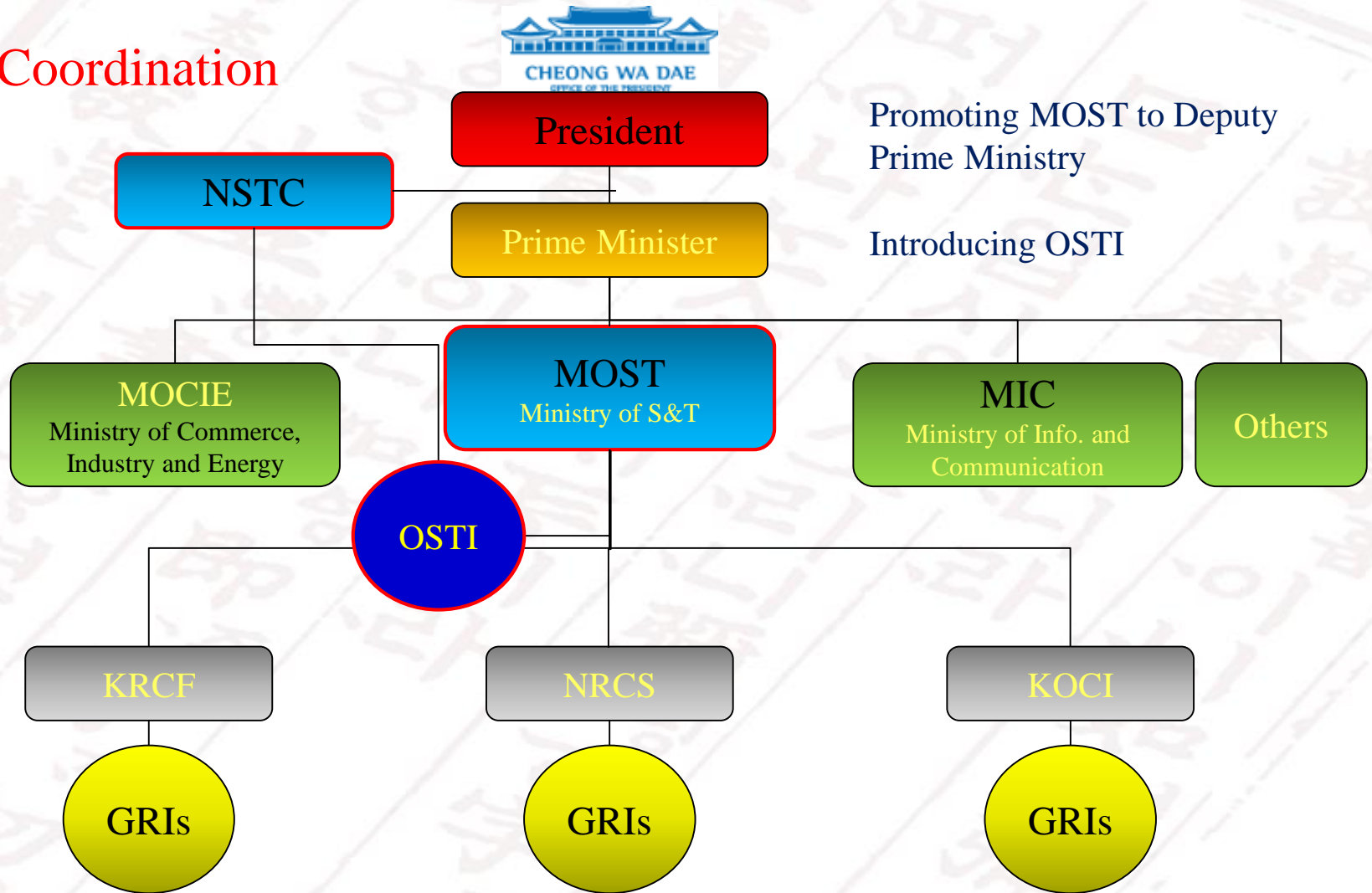
Introducing Research
Councils & NSTC

- KRCF: Korea Research Council for Fundamental Science and Technology
- KOCI: Korea Research Council for Industrial Science and Technology
- KRCP: Korea Research Council for Public Science and Technology



Promotion of MOST in 2004

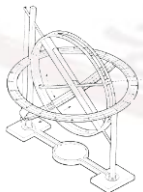
For Coordination



Promoting MOST to Deputy
Prime Minister

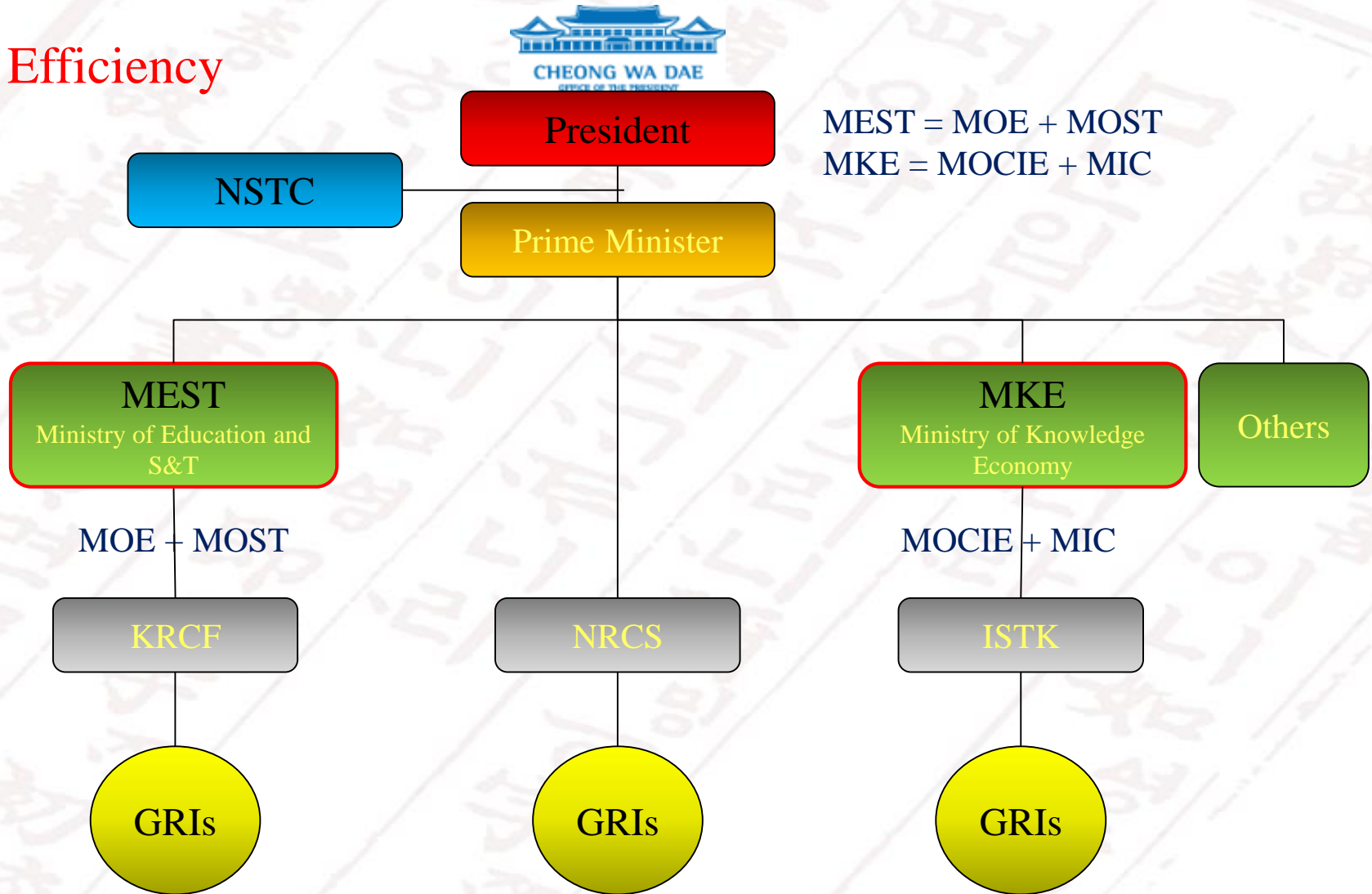
Introducing OSTI

- NRCS: National Research Council for Social Science

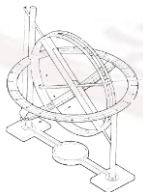


Twin Tower System in 2008

For Efficiency

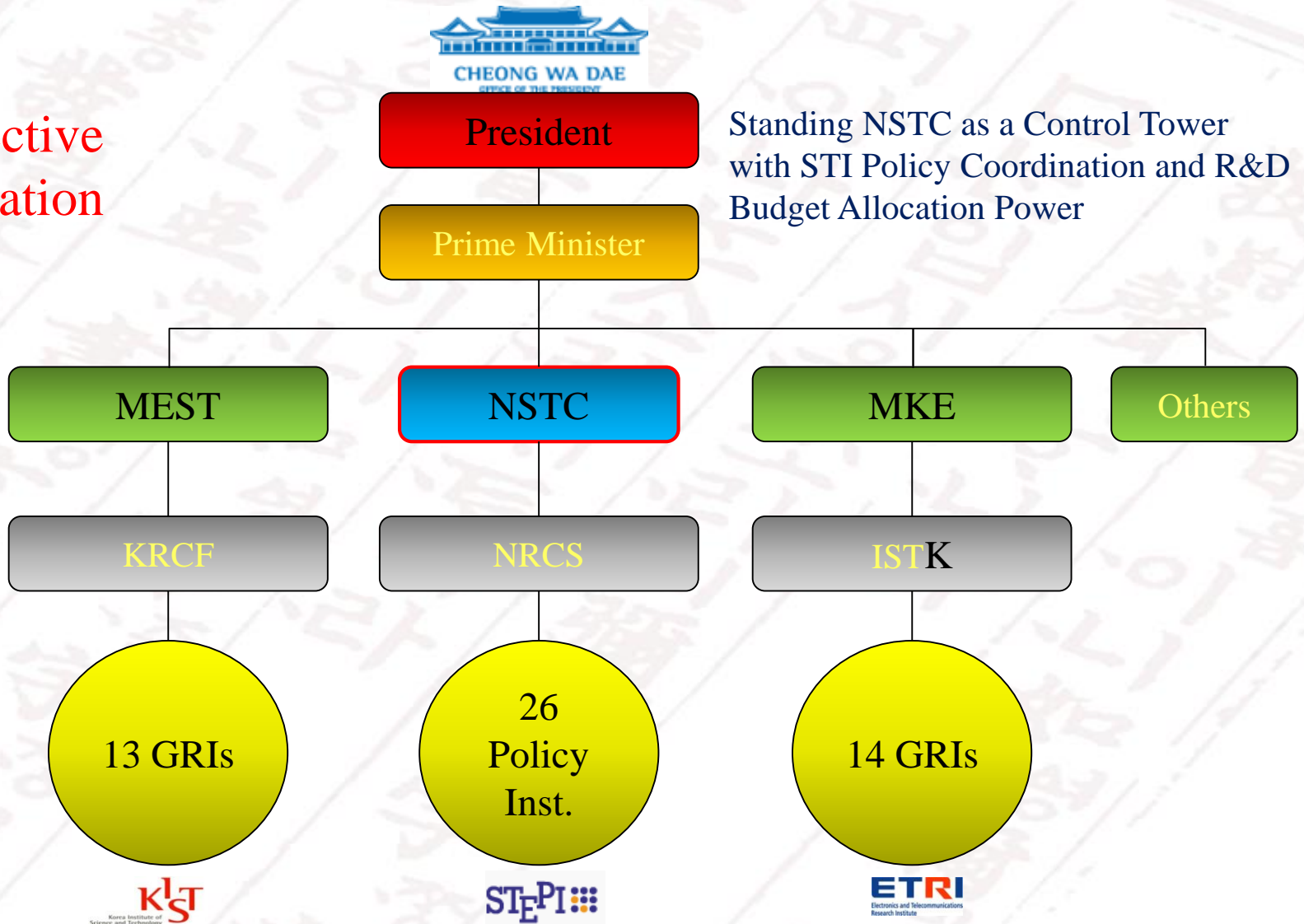


- KOCI changed to ISTK

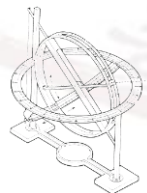


Three-Headed Monster in 2011

For Effective
Coordination

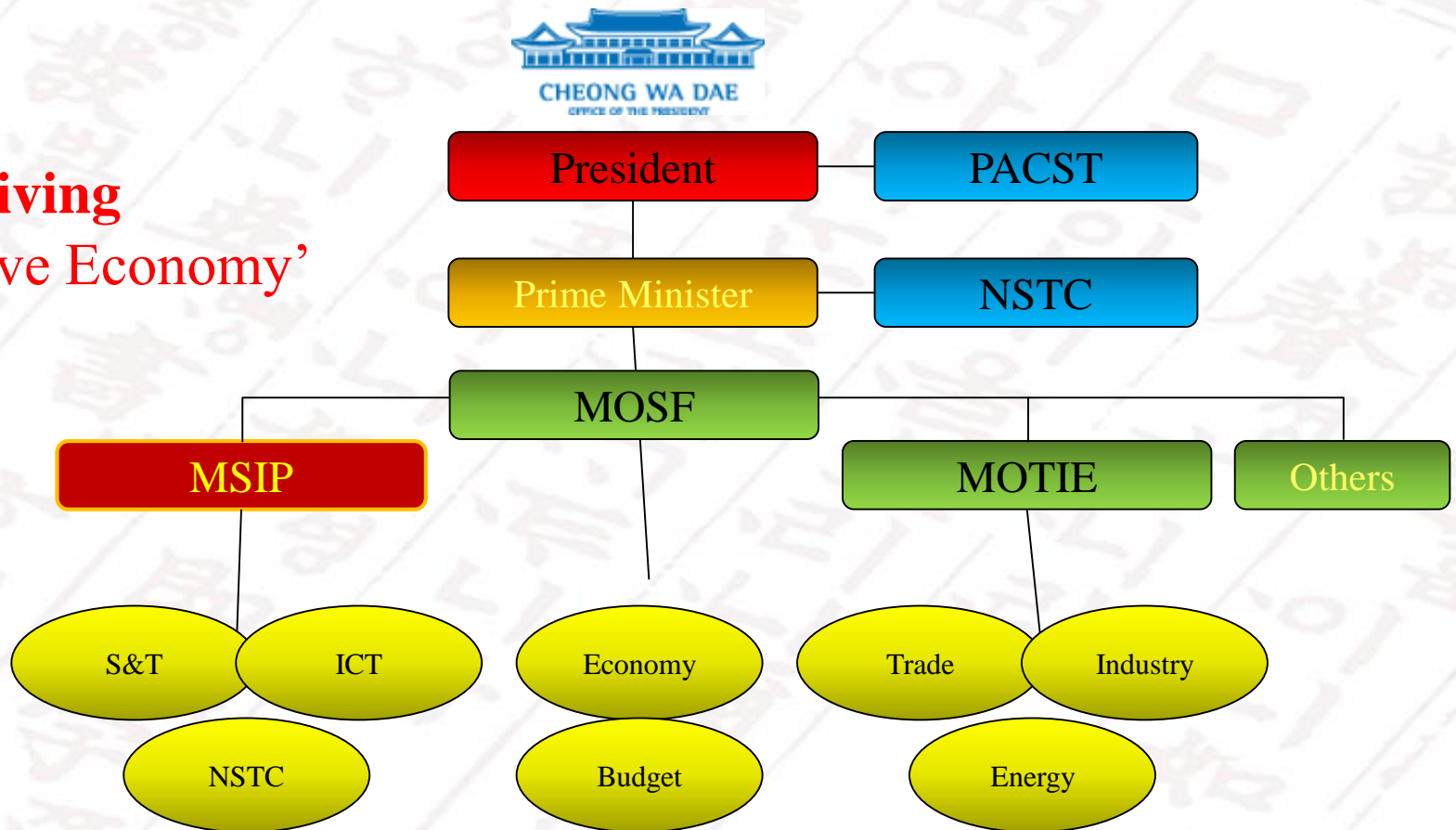


- NSTC: National Science and Technology Commission



The Creative One (2013~)

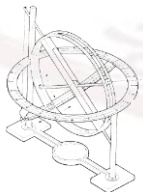
For Driving
'Creative Economy'



* MOSF: Deputy Prime Minister and Ministry of Strategy and Finance

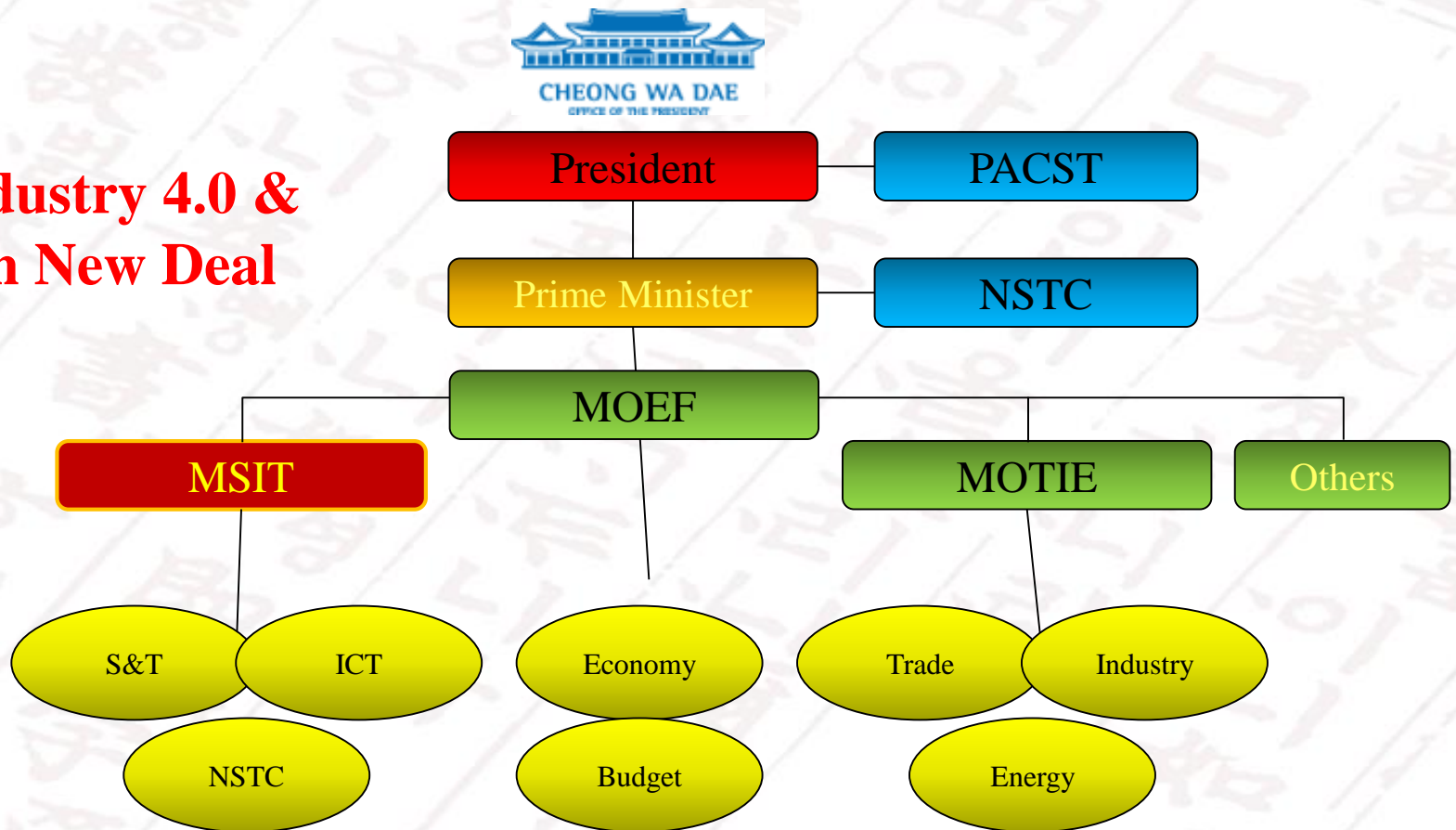
* MSIP: Ministry of Science, ICT and Future Planning

* MOTIE: Ministry of Trade, Industry and Energy



Return to Tradition (2017~)

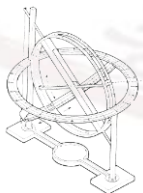
For Industry 4.0 &
Korean New Deal



* MOEF: Deputy Prime Minister and Ministry of Economy and Finance

* MSIP: Ministry of Science

* MOTIE: Ministry of Trade, Industry and Energy



Science & Technology Policy

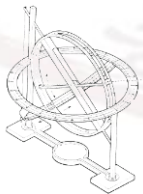
- * The 5-year Technology Promotion Plan by EPB (1962)
 - Strategic foresight on tech. & HR supply and demand
-

- * The Science & Technology Promotion Act (1967)
 - To provide legal foundation for STI activities
-

- * Long-term Master Plan for S&T Development (1967)
 - From 1967 to 1986
 - R&D/GNP up to 2.5% until 1986 (4.23% at 2015)
-

- * The Technology Development Promotion Act (1972)
 - To promote private R&D activities
-

- * The National R&D Program (1982)
 - To strengthen the bridge b/w the research & the industry
 - ^ Provide various financial incentives to the private sector
-



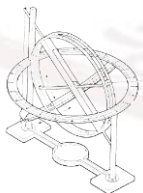
Building R&D Sector

Government Research Institutes (GRIs)

- * *GRIs rather than Universities until 1990s*
- * **KIST (Korea Institute of Science & Technology)**
- * **The first GRI in this context**
 - **KAERI (1959)**

- * **KIST (1966)**
 - *9 million USD investment in early 1960s*
 - **Applied technology rather than fundamental science**
 - **Assist the private sector directly (tech. services)**

- * **DaeDeok Science Park (Innopolis) established in 1970s**
- * **Research units under KIST became independent GRIs**
- * **Currently 25 GRIs under the NST**
 - **Most of them are located at DaeDeok Science Park**

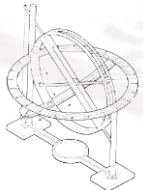
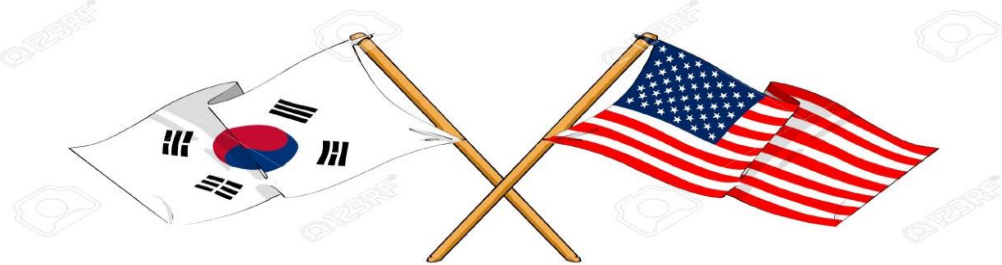




Battelle Memorial Institute

Report on Establishment & Organization of KIST
Technological & Administrative Assistanes

Global Cooperation



Three-Headed Monster

KIST

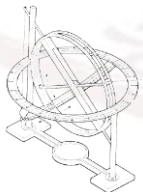
- **Korea Institute of Science & Technology (1966)**
- **Industrial technology development**

KAERI

- **Korea Atomic Energy Research Institute (1959)**
- **Nuclear energy R&D**

ADD

- **Agency for Defense Development (1970)**
- **Defense R&D**



Applied Technology First!

Most advanced countries

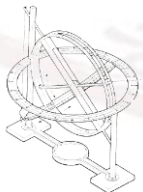
Foundation of fundamental research

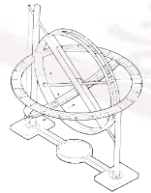
Then, develop industrial applied technology

Korea

No foundation of fundamental research

Jump to the industrial applied technology directly







**Bio (1990s)
science/engineering**



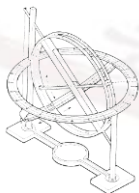
**Computer science
(1980s)**



**Chemical
engineering (1970s)**



**KAIS (KAIST)
1972**



Cluster – Science Park & Techno Park

* Industrial Complex

- *Export Processing Zone (Guro & Gumi)*

* Seoul R&D Complex

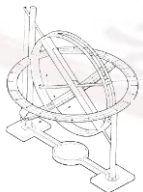
- *KIST, KDI, KORSTIC, KAIS, ADD, KAERI*

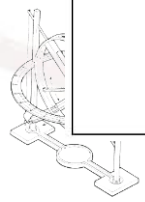
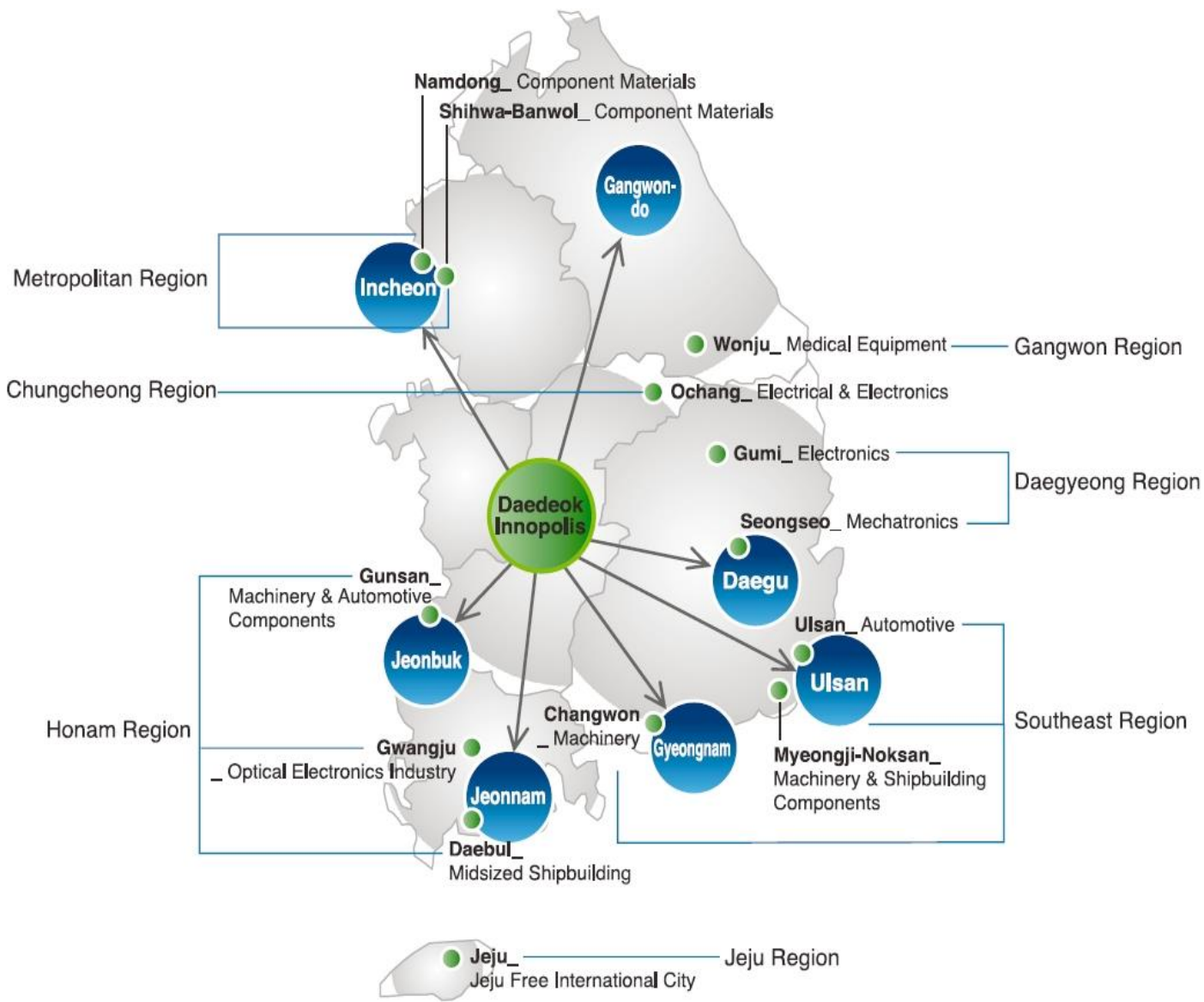
* Daedeok Science Park

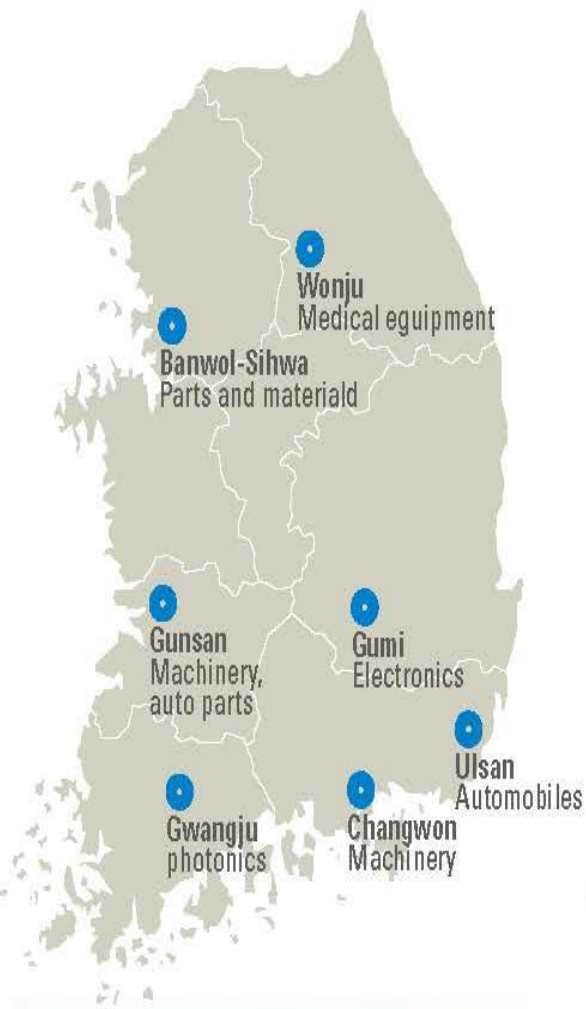
- *Scientific research & technology development*
- *Currently 25 GRIs*

* Technopark

- *Regional innovation via Triple-Helix*
- *Currently 18 technoparks*







7 pilot complexes



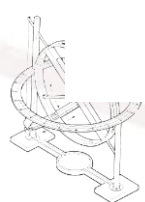
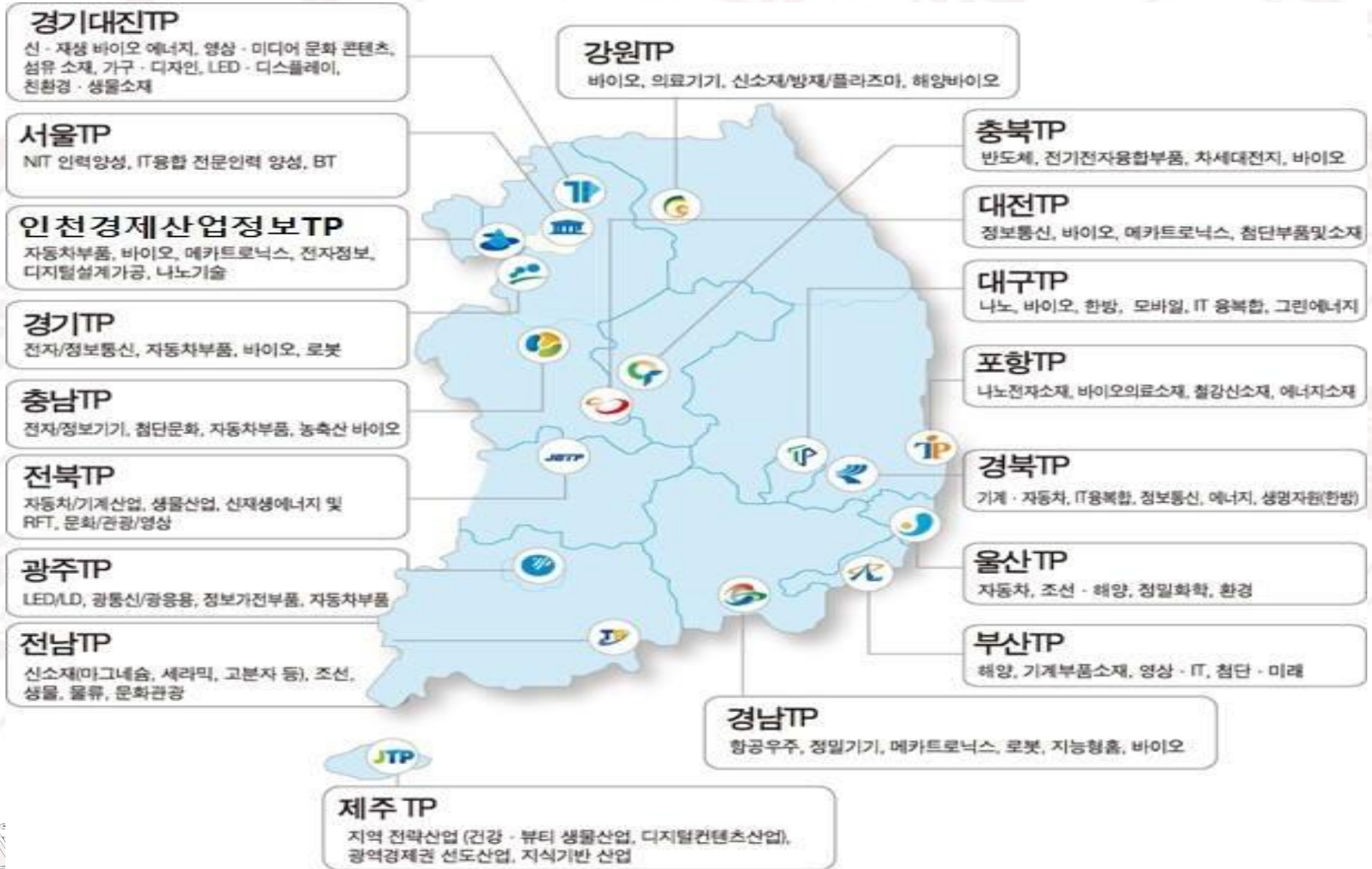
12 industrial complexes



5+2 pan regional clusters



18 Techno Parks in Korea





National R&D Program

Total R&D Expenditures in Korea



Year	Total R&D Expenditures (unit: Hundred Million KRW)
1976	609
1980	2,117
1984	8,339
1988	23,474
1992	49,890
1996	108,781
2000	138,485
2004	221,853
2008	344,981
2012	554,501
2016	694,055
2020	930,717



* Total R&D expenditures in 2020 was 93.07 trillion KRW (Approximately 78 billion USD)

1982 – The Turning Point of Korean R&D Scheme

□ Until 1981

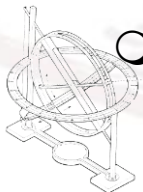
- The R&D activity has been executed by GRIs (Gov't Research Institutes)
 - 10 GRIs were established in 1970s
 - KAERI (1959), KISTI (1962) & KIST (1966)
 - # of GRIs, # of researchers, infrastructure & research-industry cooperation?
 - Did the GRIs' R&D really promote industrialization or innovation?

□ Introduction of the Specified R&D Program

- To Promote the R&D activity by Academia & Industry
- The beginning of National R&D Program

□ Operation of the Specific R&D Program

- Main area
 - Energy & resources; nuclear energy, renewable energy, marine technology
 - Industrial technology; semiconductor, computer, machinery, automobile, shipbuilding
- Consortium
 - MOST, GRI (project leading) & private company; trilateral association



National R&D Program (1)

Specific National R&D Programs

**Initiated by MOST in 1982
Based on the Technology Development Promotion Law**

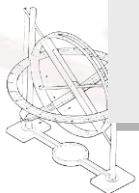
**To develop
new promising
technologies
for future industry**

**To promote
R&D activities in
the private sector**

**To develop
technology for
the public sector**

**To improve
the efficiency of
national R&D
programs**

- The Highly Advanced National Project (The HAN Project), 1992 : a large-scale R&D project with funding from government and industry
- The Creative Research Initiative (CRI), 1997
- The National Research Laboratory (NRL), 1999
- Biotechnology Development Program, 2001
- Global Frontier R&D Program, 2010



National R&D Program (2)

Expansion of National R&D Programs



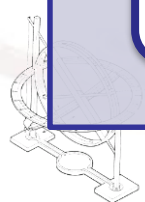
Main Features of 1982 Regime of NRDP

- * Participation of private companies & universities
 - # of actors has increased substantially

- * R&D budget has increased dramatically

- * Multi-ministerial business
 - Individual ministry has operated its own R&D projects

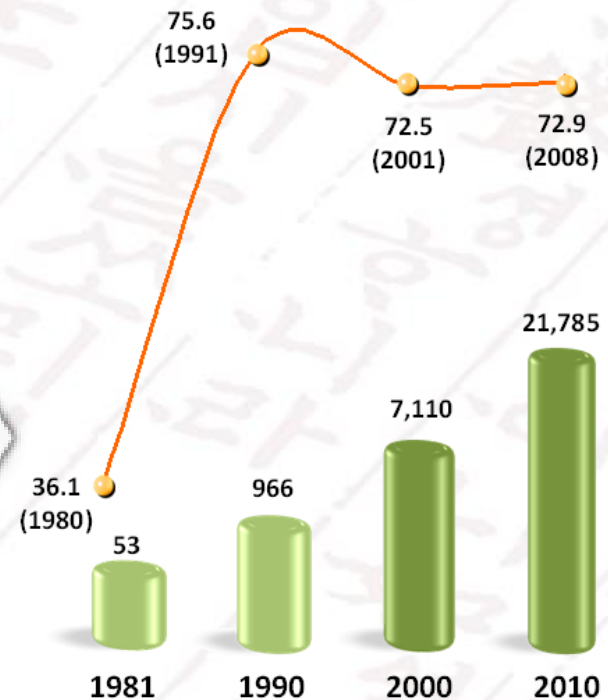
- * How to manage the mega scale NRDP?
 - Institutionalization (agency setting) for M&E



Encouraging R&D in Private Sector

Government established support systems for facilitating technology development in the private sector (1980s)

- Tax support system for technology development
 - tariff reduction for supplies for R&D,
 - exemption of tax on samples for research
- Financial incentive to stimulate R&D investments
- Private sector's R&D investment increased by 8.4 times since 1982
 - \$2.7 billion (1982) → \$22.8 billion (2008)



■ Number of corporate R&D centers
● Contribution of private sector to national R&D investment

In 2018, More than 40,000 Corporate R&D Center*



**Share our Knowledge
for Co-prosperity
Thank You!**

