Korea’s Response for the Next Industrial Revolution

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Korea Institute for Industrial Economics and Trade
Outline of Today’s Presentation

I. Success Factors of Korea’s Industrial Policies
II. Current Status of Major Industries
III. Policy Change from Catching-up to Leading
IV. Policy Implications
I. Success Factors of Korea’s Industrial Policies

Policy change from government-led to private-initiated growth passage (1993)


Periodization of Korean economic development

Condensed Growth Period

Imbalance

(Source: The Bank of Korea)
I. Success Factors of Korea's Industrial Policies

From catching up to leading: Focus on Advanced technology ⇒ Knowledge-based ⇒ Environment-Friendly ⇒ Creativity

Success Factors
- Entrepreneurship + Government support
- Low cost of capital and low price of land (Industrial district)
- Hard working employees
- Technological innovation
- Vertically integrated industry structure (stable supplier base)
- Well-developed related industries

<table>
<thead>
<tr>
<th>Understanding Korean Economic Development</th>
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<tbody>
<tr>
<td><strong>Main Industry</strong></td>
</tr>
<tr>
<td>Labor-intensive</td>
</tr>
<tr>
<td><strong>Economic Growth</strong></td>
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<tr>
<td><strong>Economic Development Paradigm</strong></td>
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<td><strong>Level of Technology</strong></td>
</tr>
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<td><strong>Core Workforce</strong></td>
</tr>
</tbody>
</table>
II-1. Current Status of Major Industries

Pending issues of the Korean industrial sector

🔥 Revealed Limitations of Input Driven Growth Strategy
* Lack of production workers and high quality engineers

🔥 Low Growth Potential by Low Birth Rate and Aging
  Lowest Birth rate in 2013 : 8.6/1,000 persons

🔥 Vertically integrated industrial structure: Barriers to start-ups

🔥 Bipolarization of Industrial Structure
- Continuous growth of export industries but declining of domestic market oriented industries

< Figure > Export Share of Automobile and ICT industries

<table>
<thead>
<tr>
<th>Year</th>
<th>Auto</th>
<th>ICT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>23.1</td>
<td>9.1</td>
</tr>
<tr>
<td>2010</td>
<td>44.7</td>
<td>12.1</td>
</tr>
<tr>
<td>2011</td>
<td>43.5</td>
<td>12.8</td>
</tr>
</tbody>
</table>
II-1. Current Status of Major Industries

Automotive industry’s GDP share has been increasing but that of food and beverage industry has decreased.

Electronic industry has dominant share of manufacturing industry.

<Figure> Manufacturing share of GDP

- Chemical
- Steel
- Electronic
- Food & Beverage
- Machinery
- Shipbuilding
- Auto
- Bipolarization of firm performance and innovation capability
  - High growth rate and operating profit of Samsung and Hyundai
  - Low growth rate and operating profit of small and medium-sized companies

- Globalization of major industries including auto, electronic, apparel, textile, shipbuilding, machinery and chemical industries.
  - Weak domestic investment of those industries
II-1. Current Status of Major Industries

< Figure > Foreign Direct Investment of Manufacturing Industries

< Figure > R&D Investment of Major Industries
II-1. Current Status of Major Industries

☞ Semi-closed innovation system of conglomerates, so-called “Chaebul”.
  - Increasing production efficiency of small and medium sized suppliers

☞ Automation of manufacturing industries
  - Jobless growth and lower coefficient of employment in manufacturing industries.
  * Coefficient of employment fell to 5.48 in 2011 from 10.37 in 2000.

☞ Strategies to overcome bipolarization of industrial structure
  - Shared growth policy and strategy: Restructuring of gourd bottle shaped industrial structure
  - Strengthening competitiveness of small and medium sized companies
  - Industry Innovation 3.0: Enhancing productivity and providing management consulting to small and medium companies

☞ How to facilitate domestic investment and create employment?

☞ What will be the new growth engines of the Korean economy?
Korea auto industry has achieved not only quantitative growth but qualitative growth through the fast follower strategy.

- After launching the first car assembly in 1962, Korea has rapidly become a major global automobile producer.

Source: Lee (2012)
Note: Vehicle Production (Ten thousand unit)
- Rapid environmental changes surrounding the industry called for a focus on scientists and engineers.
  • Technological progress such as green revolution and severe competition arose from globalization.
  • College/University graduates and researchers with MA degrees and above have been playing a bigger role.
  • However, the existing higher education system is less sensitive to the changes.
  • All together, these factors foster “College/University–Industry Cooperation.”

- Also, to better respond to such changes, the industry needs technicians with the latest knowledge and skills that are most relevant and invaluable for the industry.
  • Technicians who can map out and eventually proactively improve the production process rather than machineline workers only relying on manuals
  • Suggest the value of the “Meister-high school system.”
The role of the government is key for green car development and commercialization. The Korean government continues to partner with the auto industry on research to reduce oil dependency.

- The Korean government developed a technology roadmap with related industries and provides R&D incentives to facilitate green car development and stimulate demand.
II-2. Automobile Industry

Developing an Environment Friendly Automobile Industry

**Strategy**

- **Support R&D**
  - Core & basic technology development
  - Localization of High Value-added materials
  - Secure Measure/proof tech.

- **Strengthen Parts industry**
  - Foster Tech-leadership
  - Strengthening global competence
  - Secure Standard certification & reliability

- **Build Infrastructure**
  - Standardization of Systems
  - Preoccupation of Int’l Standard of (Green) car tech.
  - Training of design & engineering experts

- **Create Market**
  - Tax & financial Incentives
  - Facilitating (Green) car demand
  - Institutional amendment of proof programs

**Action Plan**

- **Support R&D**
  - Core & basic technology development
  - Localization of High Value-added materials
  - Secure Measure/proof tech.

- **Strengthen Parts industry**
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  - Facilitating (Green) car demand
  - Institutional amendment of proof programs

Stimulate Collaboration of R&D, Develop High Quality Human Resources, Enact Green Vehicle Related Laws, Set-up Infrastructure
II-2. Automobile Industry

- Slow sales of battery electric vehicles.

<Table> Current status of BEV sales

<table>
<thead>
<tr>
<th>Year</th>
<th>Gov’t Goal</th>
<th>Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>1,000</td>
<td>372*</td>
</tr>
<tr>
<td>2012</td>
<td>2,500</td>
<td>753</td>
</tr>
<tr>
<td>2013</td>
<td>1,000</td>
<td>780</td>
</tr>
</tbody>
</table>

Note: * estimated, Include low speed BEV

<Table> Charger deployment plan

<table>
<thead>
<tr>
<th>Electric Charger</th>
<th>Year</th>
<th>2011</th>
<th>2013</th>
<th>2015</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public Slow</td>
<td></td>
<td>0.17</td>
<td>3.1</td>
<td>4.5</td>
<td>8</td>
</tr>
<tr>
<td>Public Fast</td>
<td></td>
<td>0.07</td>
<td>0.5</td>
<td>1.1</td>
<td>2.6</td>
</tr>
<tr>
<td>Private Slow</td>
<td></td>
<td>-</td>
<td>2.5</td>
<td>11.4</td>
<td>1,321.1</td>
</tr>
<tr>
<td>Private Fast</td>
<td></td>
<td>-</td>
<td>1.0</td>
<td>3.0</td>
<td>19.6</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>0.24</td>
<td>7.1</td>
<td>20</td>
<td>168</td>
</tr>
</tbody>
</table>

unit: thousand
Korea is the 10th largest energy consumption country.  
- 96% of dependence on imports  
Korea imported $184.8 billion in energy, a third of total imports, in 2012.  
Continuous increase of energy consumption due to manufacturing led growth.

### < Table > Structure of Energy Consumption

<table>
<thead>
<tr>
<th></th>
<th>Korea</th>
<th>Japan</th>
<th>OECD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth Rate of Energy Consumption (2000~2010)</td>
<td>2.7</td>
<td>△0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Industry share of energy consumption</td>
<td>59</td>
<td>38</td>
<td>31</td>
</tr>
</tbody>
</table>

(Issues) Negative Awareness for Nuclear Power Plants  
Low price competitiveness of new renewable energy
II - 3. Energy Industry

Current Supply of New and Renewable Energy

Supply Ratio of New·Renewable Energy(’11)

Share of New·Renewable Energy Supply(’11)

- Waste 67.5%
- Hydroelectric power 2.7%
- Bio 12.7%
- Solar power 2.6%
- Wind power 2.4%
- Others 2.1%

* Source : Energy Balances of OECD Countries (IEA 2013)

2.75% of Total primary energy

High growth rate of wind power and solar power

Increase ratio of new renewable energy to 11% of total primary energy by 2030
生产量比2007年增长了11.6倍 [出口增长了6.6倍]

- 小型和中型企业的增长来源
- 大型企业的新生长引擎

### Great Potential of National New Growth Engines
- 高效率微型化电能发电机的生产
- 低损耗直流输配电系统
## II - 3. Energy Industry

### Vision

*5th Largest New Renewable Energy producing country*

- World market share (2015, %): 15% Solar power and wind power

<table>
<thead>
<tr>
<th>Production (trillion won)</th>
<th>Exports (hundred million dollar)</th>
<th>Employment (accumulate) (ten thousand)</th>
<th>Private Investment (trillion won)</th>
</tr>
</thead>
<tbody>
<tr>
<td>'09 4</td>
<td>'09 20</td>
<td>'09 0.9</td>
<td>'09 3.1</td>
</tr>
<tr>
<td>'12 20</td>
<td>'12 107</td>
<td>'12 2.7</td>
<td>'12 5.7</td>
</tr>
<tr>
<td>'15 50</td>
<td>'15 362</td>
<td>'15 11</td>
<td>'15 8.6</td>
</tr>
</tbody>
</table>

### Future task

- Invest 15.6 trillion won (private 8.6, government 7) by 2015

1. **Strategic R&D, Commercialization**
2. **Create market to promote industrialization**
3. **Increase exports**
4. **Strengthening growth base of firm**
II - 3. Energy Industry

Developing green energy industry into new growth engine

Entering growth stage

<table>
<thead>
<tr>
<th>Solar power</th>
<th>Wind power</th>
<th>Fuel cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>World second largest Polysilicon producing country</td>
<td>Increased foreign orders</td>
<td>Power plant : Commercialization stage Transportation : Tech. demonstration</td>
</tr>
</tbody>
</table>

Strategic R&D

- Developing 10 major basic tech.
  - Next generation solar cell, Offshore wind power
- Developing core parts, Materials and equipment
- Establishing Test-Bed by source

Creation of market

- Implement RPS from 2012
- 10 largest green projects
  - Build in harbor, road, public facilities
- Offshore wind power
  - Construct 100MW test bed

Export Industrialization

- Holistic support
- Strengthening foreign partnerships
- Korean consortium : Joint development of foreign markets

Energy exports to 36 billion U.S. dollars by 2015
- Restructuring the food supply chain by strengthening relationship between the food industry and agricultural products.

**Korean National Food Cluster (FOODPOLIS)**

- Establishing Foodpolis of food industrial cluster and enhancing competitiveness of the domestic food industry.

- Korean National Food Cluster (FOODPOLIS) is set to lead the way of the global food industry.

- The National Food cluster will be completed in 2020.

- FOODPOLIS, is an R&D-driven and export-oriented food industry complex.

- The complex is currently being developed by the Korean government to have 2,320,000m² of industrial space, with another 1,260,000m² zoned for residential purposes for employees.
II - 4. Food Industry

Strengthening the Innovation Base of the Food Industry

- Foodpolis has its own three R&D centers, all funded by the government; The Food Quality and Safety Center, The Food Functionality Evaluation Center, and The Food Packaging Center.


- It is not just about helping businesses and residents meet their needs; it is also about protecting the environment.

- It is a clean & green city that uses renewable energy. It provides clean drinking water and industrial water for food companies.
II - 4. Food Industry

Methodical Business Supporting System

- **H/W**
  - Food Functionality Evaluation Center
  - Food Quality and Safety Center
  - Food Packaging Center
  - Pilot Plant
  - Rental plants
  - Agency for Korean National Food Cluster

- **R&D**
  - Functional product R&D support
  - High value-added food product R&D SUPPORT
  - Strengthen networks

- **S/W**
  - Export Support
    - Establish a processing trade base
    - Develop food export markets
    - Create a food logistics system
  - Support in Shared Growth
    - Shared growth between agricultural/Fisheries and food industries
    - Provide support to make food the sixth industry
  - Competency Enhancement
    - Help companies in residency to nurture talents
    - Financial/consulting assistance for companies in residency
II -4. Food Industry

Long term planning of the food industry to lead agricultural growth

- Increase R&D investment share of the total MAFRA budget: From 5% in 2012 to 10% in 2017.
  - Strengthening technology competitiveness of the food industry.

- Build infrastructure for industrialization of agri-life science.

- Transformation of the food industry by converging with IT and BT.

- Promote industrialization of regional special agricultural products and stabilize the rural economy.

- Balance trade by increasing exports of agricultural and food products.
  - From 6 billion dollars in 2013 to 10 billion dollars in 2017.

- Strategic export products: Organic and functional food using Korean traditional recipes
The paradigm shift and governmental regulations promote innovation in products, processes and services.

- Manufacturers are jointly developing new parts, components and materials.
- Universities have educated interdisciplinary students and retrained existing workers.
- Extensive inter-industry relationships and creation of collaborative ecosystems are increasing.
- Promoting creative industries and creativity of major industries

Korean companies emphasize more innovation including product, process, service, business model innovation than production efficiency.

- Developing energy efficient, environment friendly innovative products
- Enhancing productivity through clean workplaces and automation
- Nurturing manufacturing related services and strengthening service design
Finding new growth engines and developing creative industries through convergence of technology, product and industry.

- Since the foreign exchange crisis, the Korean government has focused on knowledge-intensive industries.
- Recently, it has been emphasizing creativity over imitation.
- It has also set a basic direction of developing emerging technologies and creative industries based on a private sector survey.

<table>
<thead>
<tr>
<th>&lt; Table &gt; New Growth Engine Policy of the Korean Government</th>
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</thead>
<tbody>
<tr>
<td><strong>R&amp;D</strong></td>
</tr>
<tr>
<td><strong>HRD</strong></td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
</tr>
<tr>
<td><strong>Business service</strong></td>
</tr>
</tbody>
</table>
### Developing new growth engines

#### < Table > Next Generation Growth Engine (2003~2007)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Detailed industries (10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New technology fusion</td>
<td>Bio• New Medicine•Organ, Future vehicle, Intelligence robot</td>
</tr>
<tr>
<td>Major manufacturing</td>
<td>Display, Next generation semiconductor, Next generation battery</td>
</tr>
<tr>
<td>New Service</td>
<td>Digital TV•Broadcasting, Next generation mobile communication, Intelligence home network, Digital contents•software solution</td>
</tr>
</tbody>
</table>

#### < Table > New Growth Engine (2008~2012)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Detailed industries (16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green technology</td>
<td>New renewable energy, CO2 reduction energy, High tech water treatment, LED application, Green Transportation system</td>
</tr>
<tr>
<td>Advanced convergence</td>
<td>Broadcasting Communication convergence, IT convergence system, Robot application, New materials•Nano convergence, Biopharmaceutical•Medical device, High value added food industry</td>
</tr>
<tr>
<td>High value added service</td>
<td>Global healthcare, Global education system, Green Finance, Contents•Software, MICE•Tourism</td>
</tr>
</tbody>
</table>
III. Policy change from catching-up to leading

Technology Fusion + Design Thinking = Change

- Technology fusion leads to more innovation
- Design thinking can be a protocol of problem solving
- Government plans to develop nine growth engine industries and four sustainable growth bases

<table>
<thead>
<tr>
<th>Future Growth Engines</th>
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</thead>
<tbody>
<tr>
<td>Upgrade major industries</td>
</tr>
<tr>
<td>- 5G Mobile communication, Subsea Plant</td>
</tr>
<tr>
<td>- Smart car</td>
</tr>
<tr>
<td>Preoccupancy of Future Market</td>
</tr>
<tr>
<td>- Smart service robot, Wearable smart device</td>
</tr>
<tr>
<td>- Smart tangible contents</td>
</tr>
<tr>
<td>Shared Growth of Welfare and Industry</td>
</tr>
<tr>
<td>- On demand Wellness service</td>
</tr>
<tr>
<td>- Disaster safety management smart system</td>
</tr>
<tr>
<td>- New Renewable Hybrid Power system</td>
</tr>
<tr>
<td>Build Sustainable Growth Base</td>
</tr>
<tr>
<td>- SW convergence intelligence semiconductor</td>
</tr>
<tr>
<td>- Smart convergence materials</td>
</tr>
<tr>
<td>- Internet of Things service, Big data analysis service</td>
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</tbody>
</table>
IV. Policy Implications

- Big data, 3D printing, and renewable energy will cause the next industrial revolution.

- 3D Printing, and e-commerce will also change the production system, sales and marketing channels.

- (Product innovation) Electric Power Based Autonomous Vehicles and Functional Food using Korean traditional recipes.
  - Influence on related industries including ICT, oil, logistics, insurance industries.

- (Process innovation) Decentralized Manufacturing Hubs: food and electric vehicle industries
  - The Korean government has nurtured the parts industry in the last decade and established a plan for developing the material industry.

- (Energy Revolution) Shale gas will reduce energy costs and recultivate the chemical industry in some developed countries.
IV. Policy Implications

- Big data, 3D Printing Renewable energy industries will facilitate BPR(Business process reengineering) of companies.

- Process innovation and wage increases of developing countries will change the structure of the global supply chain and promote reshoring of companies in developed countries.

An appropriate role of government for the next industrial revolution

1. Intergovernmental Coordination
   - Policy coordination for holistic support and smart regulation is the most important.

2. Long-term enough fund for Innovation
   - New growth engine industry development takes time to pay off and is affected by various factors.

3. Enhancing participation and collaboration among stakeholders
   - Needed institutional framework for enhancing industry participation in the next industrial revolution.

   - Industry stakeholders should collaborate at all levels of development and commercialization of new growth engines.
Thank you