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Emergence of the Concept

- Introduced in the late 80s/early 90s
- Central Issue: Need for systemic analysis (overarching single institutions or organizations) to explain innovative performance

- Multiple levels: national, regional, sectoral innovation systems

- Various definitions; common ground: Set of relevant institutions and the interaction between
Government / Public Research Institutions
S&T Policy
Basic Research

Business Sector R&D
Development and Marketing of Technological Innovations

Innovation-related Output

Higher Education System / Universities
Technical Education
Basic Research

Financial Resources
Human Resources
Knowledge
Major stages of development

• **1950s-1970s:**
  - Technological development through import of capital goods, formation of large firms, import substitution and export promotion
  - Very limited formal R&D activities

• **1980s:**
  - Formation of industrial R&D base
  - Heavy R&D investment by conglomerates (chaebols) to boost technological competitiveness

• **since the 1990s:**
  - Formation of basic research capabilities
  - Emphasis on international co-operation and exchange
R&D intensity of leading countries (% of GDP)


- US: 964.0
- Japan: 838.4
- Germany: 657.8
- Korea: 542.8

⇒ Rapid catch-up to leading countries!
R&D expenditures by performing sector (2003)

- Business Sector, 76.1%
- Universities, 10.1%
- Public Research Institutions, 13.8%

⇒ Heavy reliance on industrial R&D!
Industrial R&D activities by industry (2003)

- Non-Manufacturing, 14.5%
- Electro Equipment, 45.5%
- Other Manufacturing, 26.3%
- Motor Vehicles, 13.7%

⇒ High concentration on IT sector!
Industrial R&D activities by firm size / type (2003)

- Large Firms, 76.4%
- SMEs, 12.6%
- Venture Firms, 11.0%

Concentration of industrial R&D activities (2003)

- Top 1, 23.9%
- Top 2-5, 13.1%
- Top 6-10, 6.7%
- Top 11-20, 8.0%
- All others, 48.3%

⇒ Dominating role of leading large firms!
Global share of triad patent families

- **US**: 34.91% (1995), 34.97% (1998), 35.13% (2001)
- **Korea**: 0.93% (1995), 1.09% (1998), 1.17% (2001)

Still weak IP position…

Technology exports /technology imports

- **1996**: 5%
- **1999**: 7%
- **2002**: 23%

Technology imports /industrial R&D exp.

- **1996**: 29%
- **1999**: 32%
- **2002**: 21%

and strong reliance on foreign technology…
Global export market share in high tech industries (2001)

…but strong competitiveness in some high tech industries!
### Governmental R&D budget by ministry (2004)

<table>
<thead>
<tr>
<th>Ministry</th>
<th>Budget Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ministry of Science &amp; Technology</td>
<td>20.5%</td>
</tr>
<tr>
<td>Ministry of Commerce, Industry &amp; Energy</td>
<td>19.3%</td>
</tr>
<tr>
<td>Office for Government Policy Coordination</td>
<td>11.9%</td>
</tr>
<tr>
<td>Ministry of Defense</td>
<td>11.4%</td>
</tr>
<tr>
<td>Ministry of Education</td>
<td>11.1%</td>
</tr>
<tr>
<td>Ministry of Information &amp; Communication</td>
<td>9.1%</td>
</tr>
<tr>
<td>Others</td>
<td>16.7%</td>
</tr>
</tbody>
</table>

- Highly fragmented S&T policy
- Increased priority of S&T policy since the 1990s
- Efforts to enhance structural change (e.g., large scale support for venture firms)
### Structural data on research institutions (2003)

<table>
<thead>
<tr>
<th>Type of institutes</th>
<th>Number of institutes</th>
<th>Number of researchers</th>
<th>Average number of researchers / institute</th>
<th>Proportion of governmental funding</th>
<th>Main orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>63</td>
<td>3,528</td>
<td>56.0</td>
<td>99.9%</td>
<td>Agriculture</td>
</tr>
<tr>
<td>Governmentally supported</td>
<td>28</td>
<td>8,559</td>
<td>305.7</td>
<td>93.3%</td>
<td>Engineering</td>
</tr>
<tr>
<td>Others</td>
<td>78</td>
<td>2,308</td>
<td>29.6</td>
<td>70.7%</td>
<td>Engineering</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>169</strong></td>
<td><strong>14,395</strong></td>
<td><strong>85.2</strong></td>
<td><strong>92.3%</strong></td>
<td>Engineering (60% of research manpower)</td>
</tr>
</tbody>
</table>

- Predominant governmental funding
- Good fit with needs of industrial sector (engineering)
- Significant capabilities accumulated since the 70s/80s
- Increased flexibility since the 1990s
Features of the Koran Higher Education System:

- Extremely strong emphasis on education in general
- Worldwide highest formal education level of the younger age groups
- Education system strongly criticized for being outdated
- “Brain drain” of high school and college students
- Higher secondary and university education undergoing major reform
  - better fit with practical needs
  - internationalization
R&D spending of universities low…

...but rapidly expanding!

- Much higher priority given to research
- Networks with firms gradually developing
- Still more investment needed to upgrade R&D infrastructure
The Financial Market:

- **Indirect financing** (banks) traditionally predominant
- Mainly oriented towards large firms, low efficiency
- Financial market reform after 1997
- Government support programs for venture capital
  - rapid expansion of venture capital sector
  - overheating, need for improved screening standards

The Labor Market:

- Strong **dualism** between large firms (stable employment, high wages) and SMEs (hire and fire, low wages) until 1997
- Increased **flexibility** in the skilled labor market after 1997
- Increased **entrepreneurial activity** as a result of restructuring and harsh employment conditions in the corporate sector
Inter-organizational and inter-sectoral knowledge flows:

- **Poorly developed** inter-organizational linkages pre-1997 (exception: firm networks within chaebols)
- Recently **gradual improvement** due to structural changes in factor markets
- Development of **university-industry linkages**, fostered by governmental support
- Still widespread **stand-alone mentality** among managers and firms
The Korean Innovation System: Overall Evaluation

**Strengths:**

- strong competitiveness in some high-tech industries
- rapid expansion and skill formation
- comprehensive structural adjustment
- strengthening science base

**Weaknesses:**

- still heavy concentration of resources on large chaebol firms
- SME/venture sector needs further development
- open network culture / inter-organizational links only gradually evolving
The Korean Innovation System: Future Perspectives

• rapid development and adjustment as a dynamic source of competitive strength

• still some way to go to become a leading country not only in technology, but also in science

• continued competitive pressure from following catch-up countries (China, South-East Asia, India)

⇒ Considerable potential for technological leadership in some areas on the base of mutual interdependence
Implications from an international viewpoint

• Korean firms to be taken seriously as innovating competitors (and sometimes technological leaders)

• Strengthening science base and ongoing internationalization make Korean organizations attractive partners for international collaboration in science & technology