Intellectual Capital in Taiwan

Intellectual Capital for Communities in the Knowledge Economy

University of Marne-La-Vall’ee & World Bank

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Topics

• I. Previous Research
  – Knowledge Economy Index

• II. Current Research
  – TICRC Project

• III. Future Research
  – Intellectual Capital for Communities
I. Previous Research

Knowledge Economy Index (KEI)
The Introduction of Knowledge Economy Index in Taiwan

• Taiwan government declared 2001 as the first year of Knowledge Economy (KE) and has put a series of plans into action since then.

• The Knowledge Economy Promotion Committee comprised by 23 opinion leaders such as Morris Chang (TSMC) and Stan Shih (Acer), was established to promote the concept of Knowledge Economy.

• A two-year research project supported by the Knowledge Economy Promotion Committee and the Council for Economic Planning and Development was launched in 2001 to develop a knowledge assessment framework for Knowledge Economy.
Conceptual Framework of KE

Knowledge Capital
- Intellectual property
- Human capital
- Intellectual machinery and equipment
- Human-machine complex system of the society

Innovation Capability
- Individual creativity
- Innovation mechanism
- Execution of ideas

Information Technology Application
- IT infrastructure
- IT application to life

Knowledge Economy Infrastructure
- Business ethics
- Administration and legal systems
- Education and culture
- Internationalization
- Social security
- Value of sustainable development
Knowledge Capital

- Intellectual property
- Human capital
- Intellectual machinery and equipment
- Human-machine complex system of the society

Knowledge Economy Society

Instruction

Information Technology Application
## Knowledge Capital

| 1.1 Intellectual Property | 1.1.1 Quality and quantity of invention and design patents  
1.1.2 Number of original literature and art publications and performances, and sales ensued  
1.1.3 Novelty and originality of commercial designs  
1.1.4 Global awareness of corporate brands  
1.1.5 Net value and balance of technology trading |
|--------------------------|-----------------------------------------------------------------------------------------------------|
| 1.2 Human Capital        | 1.2.1 Quantity and quality of human resources  
1.2.2 Technology and humanities accomplishments of the people  
1.2.3 On-the-job training and development |
| 1.3 Intellectual Machinery and Equipment | 1.3.1 Production and utilization of machinery and equipment with embedded knowledge |
| 1.4 Human-machine Complex System of the Society | 1.4.1 The speed of commodity, capital, and manpower flow within and across borders |
Innovation Capability

Individual creativity
Innovation mechanism
Execution of ideas
## Innovation Capability

| 2.1 Individual Creativity | 2.1.1 Creativity demonstrated by the general public in various fields  
2.1.2 Quality and quantity of research institutions |
|--------------------------|---------------------------------------------------------------------------------------------------|
| 2.2 Innovation Mechanism | 2.2.1 Incubation mechanism and industry clusters  
2.2.2 Incentives for entrepreneurship and innovative activities  
2.2.3 Knowledge exchanges among industrial, academic, and research circles  
2.2.4 International collaboration of innovative research and development  
4.2.5 The comprehensiveness of the intellectual property promotion and transaction mechanisms |
| 2.3 Execution of Ideas | 2.3.1 The speed and success rate of new product introduction  
2.3.2 Demonstration of entrepreneurship |
Information Technology Application
## Information Technology Application

| 3.1 IT infrastructure | 3.1.1 Penetration rate of broadband  
|                       | 3.1.2 Penetration rate of wireless communication  
|                       | 3.1.3 Internet prevalence  
| 3.2 IT application to life | 3.2.1 Level of e-business  
|                       | 3.2.2 Level of government e-service  
|                       | 3.2.3 E-commerce prevalence  
|                       | 3.2.4 E-learning prevalence at home/school/others  
|                       | 3.2.5 Richness of digital contents  
|                       | 3.2.6 Quality of information network |
Knowledge Economy Infrastructure

- Business ethics
- Administration and legal systems
- Education and culture
- Internationalization
- Social security
- Value of sustainable development
<table>
<thead>
<tr>
<th>Section</th>
<th>Subsections</th>
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<tr>
<td>4.1 Business ethics</td>
<td>4.1.1 Transparency and impartiality of corporate governance</td>
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<td>4.2 Administration and legal systems</td>
<td>4.2.1 Transparency and efficiency of government administration</td>
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<td></td>
<td>4.2.2 The comprehensiveness and enforcement of regulatory systems related to intellectual property and technology</td>
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<td>4.3 Education and culture</td>
<td>4.3.1 Dynamics of creative teaching and educational innovations</td>
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<td>4.3.2 Comprehensiveness of lifetime learning environment</td>
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<td>4.3.3 Press freedom and justice</td>
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<td>4.4 Internationalization</td>
<td>4.4.1 Internationalization level of the society</td>
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<td>4.5 Social security</td>
<td>4.5.1 Disparity in the distribution of wealth</td>
</tr>
<tr>
<td></td>
<td>4.5.2 Digital discrepancy and network security</td>
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<tr>
<td></td>
<td>4.5.3 Security and support for the unemployed and job changers</td>
</tr>
<tr>
<td>4.6 Value of sustainable development</td>
<td>4.6.1 Ecosystem, environmental protection, and the utilization efficiency of natural resources</td>
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## Statistics information

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<th>Variable</th>
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<th>2001</th>
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<td><strong>Knowledge Capital</strong></td>
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<tr>
<td>1.1.1 Quality and quantity of invention and design patents</td>
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<td>4526(4)</td>
<td>5802(4)</td>
<td>6539(4)</td>
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<td></td>
<td>8944(19)</td>
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<td></td>
<td>1.02</td>
<td>1.19</td>
<td>1.14</td>
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<td>1.1.2 Number of original literature and art publications and performances, and sales ensued</td>
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<td>16350</td>
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<td>-</td>
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<td><strong>Human Capital</strong></td>
<td></td>
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<td>1.2 Number of researchers per 10,000 people (NSC)</td>
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<td>90.4</td>
<td>88.5</td>
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<td>2. Number of researchers per 10,000 workers (NSC)</td>
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<td>33.5(8)</td>
<td>-</td>
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<td>3. Percentage of the population with higher education (IMD)</td>
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<td>4.721(13)</td>
<td>4.673(15)</td>
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<td>4. Number of R&amp;D (FTE) workers per 1,000 people (IMD)</td>
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Note: ( ) refers to the source of the data
### Knowledge Economy Satisfaction Survey – Findings

<table>
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<th>Indicator</th>
<th>Opinion Leaders*</th>
<th>Intellectuals**</th>
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<td>Innovation Capability</td>
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<td>5.11</td>
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<td>Information Technology Application</td>
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<td>4.47</td>
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<td>0.52</td>
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* Opinion leaders refer to the 23 members of Knowledge Economy Promotion Committee.
** Intellectuals refer to the selective senior managers aged over 40.
*** Score from 1 to 10.
II. Current Research

TICRC Project
Creation, Control, Accumulation & Management of IC

The Creation and Accumulation of IC in Organizations
- Collect qualitative and longitudinal data in supplement to other quantitative projects
- Explore the interactions among various components of intellectual capital
- Investigate the change of intellectual capital over the four years
  Compare and contrast qualitative vs. quantitative research results

The Integration between Balanced Scorecard and Intellectual Capital
- The Linkage between process perspective and process & innovation capital
- The Linkage between learning perspective and IT & organizational capital
- Lead the formation of IC & Strengthen the management of IC

Accounting Principle Modification & IC Report
Objective: to propose accounting standards and disclosure requirements for reporting firms’ intellectual capital.

Three layers of IC information:
- Financial statements—conform with GAAP.
- Pro forma IC statements—those IC expensed (e.g., R&D expenditures) or not recognized (e.g., employee compensation contracts) in financial statements may be re-capitalized in pro forma IC statements, provided some criteria are met.
- Disclosures—provide a common set of IC metric disclosures, relating firms’ strategy to important IC components.
IC Valuation & Risk Assessment

The IC Valuation Models & Risk Assessment

As no sufficient secondary data is available for relevant IC markets, there is a need to develop consistent and empirically testable models for the measurement and valuation of IC.

IC valuation approach

- IC valuation models
- IC measurement indices

1. Tobin’s Q
2. Market-to-book ratio, M/B ratio
3. Economic Value Added, EVA™
4. Calculated Intangible Value, CIV
5. Knowledge Capital Earnings, KCE
6. Value Added Intellectual Coefficient, VAIC™
7. Financial Method of Intangible Assets Measuring, FiMIAM
8. Technology Broker
9. Citation-Weighted Patents
10. Skandia Navigator™
11. IC-Index™
12. Intangible Assets Monitor
13. Balanced Scorecard

Improvement

1. Discount cash flow method, DCF
2. P/E multiple
3. Real Option

The Integration of Human Resource and IC:

- Fitness survey: Human Capita Indicators (10 suitable and 10 unsuitable)

Process Capital:

- Operation management, Customer management, Innovation management, Knowledge management
IC Valuation & Risk Assessment

The Integration of Customer Capital and IC: Construct Customer Capital through Relation Management

- How to create and increase customer capital?
- How to correctly measure customer capital and using it as a guideline to develop business and management strategies?
- How to effectively integrate customer capital and other aspects of intellectual capital in order to create a synergy to upgrade organizational competence?
- Case studies on what is the best management mechanism practice for a market-oriented company in order to develop research hypotheses.
- Studying empirically the relationships among management mechanism, customer knowledge competence, and performance by means of survey.

IC Deploying Strategy & Policy Environment

Discoveries

- Consolidating the human capital of employee is the most important thing for firms to manage IC.
- There are dynamic interaction between human capital and organizational capital.
- Firms will lock in employee by building up specific organizational capital which is complementary to the human capital of employee.
- Employee will utilized the organizational capital by their own way to address their benefits.

Utilizing Capability of IC

- With the same IC stock, different utilizing strategies will lead to different performance.
- Firms may have different Utilizing Capability to carry out the strategy.
- Utilizing Capability is the key to Utilize IC
TICRC Activities

Activities for Business
(1) Workshops of IC Theory and IC Practice for Business
(2) Cross-industry IC survey
(3) Cross-industry IC Case Studies
(4) Interaction with Taiwanese Industries
(5) NCCU EMBA Popularizing Courses
(6) Book: IC of Taiwan
(7) Brochure: IC Concept Popularization

Meeting
(1) Knowledge Sharing Meeting (monthly)

International Activities
(1) IC Researchers’ Visit
(2) 2004 International Conference on Intellectual Capital in Taiwan
(3) 26th Annual McMaster World Congress
(4) Intellectual capital for communities & JIC (Vol. 6, No. 2) - Tiger Brainpower

Digital Information
(1) English & Chinese Website (http://www.ticrc.nccu.edu.tw)
(2) English & Chinese Epaper
(3) Literatures & Industrial Database

Research Reports
(1) Research Reports (quarterly)
(2) PowerPoint of Knowledge Sharing Meeting
(3) Academic Papers
(4) Records of Activities
(5) Executive Reports

Meeting
(1) Knowledge Sharing Meeting (monthly)
III. Future Research

Intellectual Capital for Communities
Taiwan Economy

• Formally in WTO, Customs Territory of Taiwan, Penghu, Kinmen and Matsu.
• Population=22,715,030 (2005/5)
• GDP >200 billion Dollars (after 1990)
• Growth rate= 3.63% (2005)
• Unemployed rate= 4.04% (2005)
• After 1960, Manufacturing sector leads the growth.
• After 1990, Service sector (with knowledge intensive industries) dominates the economy.
Scale of Taiwan Economy

GDP

Billion $ |
<table>
<thead>
<tr>
<th>S. Korea</th>
<th>Taiwan</th>
<th>H.K.</th>
<th>Singaport</th>
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<tr>
<td>547</td>
<td>315</td>
<td>282</td>
<td>212</td>
</tr>
<tr>
<td>160</td>
<td>102</td>
<td>102</td>
<td>50</td>
</tr>
<tr>
<td>88</td>
<td>50</td>
<td>50</td>
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</tbody>
</table>
The Shifting of Industrial Structure in Taiwan

Source: Statistics Dep. Of MOEA
Intellectual Capital of Taiwan

• Human Capital
  – Education
  – Human Network

• Structural Capital
  – Intellectual Property
  – IT Infrastructure
  – City Infrastructure –Taipei
  – Institutions-ITRI/HSIP

• Social Capital
  – Venture Capital
  – Industrial Network
  – International links:
    • Brands,
    • MNC’s R&D centers/IPO
    • Trade Shows
Human Capital

-Education

• Higher educations continue to grow
• High Quality Human Capital focus on Science and Technology
• Chinese culture of industriousness:
  – Working hour=2280hr/year
  – 24-hours working factory
  – 24-hours convenient store (not just 7-11)
Sufficient Human Input

Statistics of student amount in public and private universities

<table>
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<tr>
<th>Year</th>
<th>Public Universities</th>
<th>Private Universities</th>
<th>Total Graduated</th>
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<td>1976</td>
<td>13</td>
<td>12</td>
<td>64057</td>
</tr>
<tr>
<td>1981</td>
<td>14</td>
<td>13</td>
<td>75128</td>
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<td>1999</td>
<td>46</td>
<td>59</td>
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<td>2000</td>
<td>50</td>
<td>77</td>
<td>266561</td>
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<td>2001</td>
<td>50</td>
<td>85</td>
<td>296884</td>
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<td>2002</td>
<td>50</td>
<td>89</td>
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Statistics of students study abroad within government support

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<th>Year</th>
<th>Humanities</th>
<th>Total</th>
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<th>Science &amp; Technology</th>
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<td>18</td>
<td>115</td>
<td>37</td>
<td>60</td>
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<td>20</td>
<td>94</td>
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<td>2001</td>
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<td>94</td>
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High Quality Human Capital
focus on Science and Technology

Profile of Academy Domain

Percentage of Student profile

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<th>Year</th>
<th>PhD students</th>
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<th>College students</th>
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<td>1981</td>
<td>800</td>
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<td>1986</td>
<td>2,143</td>
<td>11,294</td>
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<td>5,481</td>
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<td>1996</td>
<td>9,365</td>
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<td>1999</td>
<td>12,253</td>
<td>54,980</td>
<td>470,030</td>
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<td>2000</td>
<td>13,822</td>
<td>70,039</td>
<td>564,059</td>
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<tr>
<td>2001</td>
<td>15,962</td>
<td>87,251</td>
<td>677,171</td>
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<tr>
<td>2002</td>
<td>18,705</td>
<td>103,425</td>
<td>770,915</td>
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Human Capital
-Human Network

- Intelligence flows within and between Knowledge Capital Clusters of Taiwan, U.S., Japan and Mainland China.
- Taiwanese students were eager to study abroad and returned to work after learning the international working experiences.

→ How to develop intelligence flows within and between knowledge capital clusters
Talents with Entrepreneurship

• Start-ups
• Originality
• Market

Contract Outsourcing

Management Skills

Product

Marketing

Mainland

China

Taiwan

US, Silicon Valley

Mainland

China

Taiwan

Japan
Taiwan Students Abroad-United State

People


People

Share

Source: Ministry of Education

*Share is ratio to total students abroad
Taiwan Students Abroad - Japan

Source: Ministry of Education

*Share is ratio to total students abroad
The Number and percentage of Employee Coming back from Oversea to HSIP

Source: Administration Bureau of HSIP
Structural Capital
-R&D, IP

• R&D Investments are steadily increasing.
• R&D/GDP ratio is around 2%
• R&D output grows dramatically
  – Papers in SCI (2001) : Ranking No.17
  – Papers in EI (2001) : Ranking No.10
R&D Investment of Taiwan

- **R&D/GDP**
  - 1990 = 1.66%

- **Total R&D**
  - 1986: 28.7
  - 1990: 71.6
  - 1995: 11.5
  - 2000: 200.0

- **Public R&D**
  - 1986: 11.5
  - 1990: 38.8
  - 1995: 71.6
  - 2000: 123.5

- **Private R&D**
  - 1986: 17.2
  - 1990: 32.8
  - 1995: 40.0
  - 2000: 96.5

- **R&D Investment of Taiwan**
## The Percentage of Taiwanese Patents Granted in US

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<td>%</td>
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<td>%</td>
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</tr>
<tr>
<td>1 US</td>
<td>60.75</td>
<td>1 US</td>
<td>64.02</td>
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<td>61.42</td>
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<td>2 Japan</td>
<td>20.94</td>
<td>2 Japan</td>
<td>19.08</td>
<td>2 Japan</td>
<td>19.33</td>
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<tr>
<td>3 German</td>
<td>5.39</td>
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<td>3.90</td>
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<tr>
<td>4 UK</td>
<td>2.48</td>
<td>4 UK</td>
<td>1.90</td>
<td>4 Taiwan</td>
<td>2.68</td>
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<tr>
<td>5 France</td>
<td>2.24</td>
<td>5 France</td>
<td>1.84</td>
<td>5 S. Korea</td>
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<td>6 Canada</td>
<td>1.83</td>
<td>6 Canada</td>
<td>1.83</td>
<td>6 Canada</td>
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<tr>
<td>7 Swiss</td>
<td>0.94</td>
<td>7 Taiwan</td>
<td>1.50</td>
<td>7 UK</td>
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<td>8 Italy</td>
<td>0.84</td>
<td>8 S. Korea</td>
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<td>9 Netherlands</td>
<td>0.74</td>
<td>9 Swiss</td>
<td>0.66</td>
<td>9 Sweden</td>
<td>0.69</td>
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<tr>
<td>10 Taiwan</td>
<td>0.66</td>
<td>10 Sweden</td>
<td>0.62</td>
<td>10 Italy</td>
<td>0.57</td>
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Source: Computed from Data of US PTO
Structural Capital
- Infrastructure

- S & T Infrastructure of Taiwan
  - Taiwan: Worldwide top 5

- Well-equipped ICT infrastructure
  - Taiwan: Worldwide top 5, Asia top 3

- E-Government
  - Taiwan: Worldwide top 2
S & T Infrastructure of Taiwan

• According to IMD (2003)
  - Science Infrastructure : Ranking No. 5
  - Technology Infrastructure : Ranking No. 6

• According to WEF (2002/2003)
  • S&T Index: Ranking No. 2
  • Innovation Index: Ranking No. 2
Well-equipped ICT infrastructure

2002 Digital Access Index (DAI)

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<td>Dutch</td>
<td>11</td>
<td>5 ↓</td>
<td>U.S.</td>
</tr>
<tr>
<td>2</td>
<td>7 ↑</td>
<td>Demark</td>
<td>7</td>
<td>13 ↑</td>
<td>H.K.</td>
<td>12</td>
<td></td>
<td>U.K.</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Iceland</td>
<td>8</td>
<td></td>
<td>Finland</td>
<td>13</td>
<td></td>
<td>Swiss</td>
</tr>
<tr>
<td>4</td>
<td>24 ↑</td>
<td>Korea</td>
<td>9</td>
<td>22 ↑</td>
<td>Taiwan</td>
<td>14</td>
<td>20 ↑</td>
<td>Singapore</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Norway</td>
<td>10</td>
<td></td>
<td>Canada</td>
<td>15</td>
<td></td>
<td>Japan</td>
</tr>
</tbody>
</table>

Source: ITU, 2003/11

<table>
<thead>
<tr>
<th>Items</th>
<th>Taiwan</th>
<th>H.K.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>0.98</td>
<td>0.93</td>
</tr>
<tr>
<td>Consuming ability</td>
<td>0.99</td>
<td>0.998</td>
</tr>
<tr>
<td>Education</td>
<td>0.95</td>
<td>0.83</td>
</tr>
<tr>
<td>ICT service quality</td>
<td>0.56</td>
<td>0.68</td>
</tr>
<tr>
<td>Internet usage</td>
<td>0.45</td>
<td>0.51</td>
</tr>
</tbody>
</table>
## Wideband density: worldwide top 6

<table>
<thead>
<tr>
<th>No.</th>
<th>Country</th>
<th>Units (thousand)</th>
<th>01~02 Growth%</th>
<th>Density%</th>
<th>Penetration %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Korea</td>
<td>10,405</td>
<td>33%</td>
<td>21.9%</td>
<td>96%</td>
</tr>
<tr>
<td>2</td>
<td>H.K.</td>
<td>989</td>
<td>38%</td>
<td>14.6%</td>
<td>42%</td>
</tr>
<tr>
<td>3</td>
<td>Canada</td>
<td>3,500</td>
<td>23%</td>
<td>11.1%</td>
<td>50%</td>
</tr>
<tr>
<td>4</td>
<td>Iceland</td>
<td>25</td>
<td>140%</td>
<td>8.7%</td>
<td>21%</td>
</tr>
<tr>
<td>5</td>
<td>Belgium</td>
<td>870</td>
<td>90%</td>
<td>8.4%</td>
<td>51%</td>
</tr>
<tr>
<td>6</td>
<td>Taiwan</td>
<td>1,825</td>
<td>62%</td>
<td>8.1%</td>
<td>27%</td>
</tr>
<tr>
<td>7</td>
<td>Sweden</td>
<td>700</td>
<td>96%</td>
<td>7.8%</td>
<td>23%</td>
</tr>
<tr>
<td>8</td>
<td>Demark</td>
<td>360</td>
<td>61%</td>
<td>6.7%</td>
<td>11%</td>
</tr>
<tr>
<td>9</td>
<td>Australia</td>
<td>540</td>
<td>123%</td>
<td>6.5%</td>
<td>22%</td>
</tr>
<tr>
<td>10</td>
<td>Dutch</td>
<td>1,060</td>
<td>127%</td>
<td>6.5%</td>
<td>10%</td>
</tr>
<tr>
<td>11</td>
<td>U.S.</td>
<td>18,000</td>
<td>41%</td>
<td>6.2%</td>
<td>18%</td>
</tr>
<tr>
<td>12</td>
<td>Japan</td>
<td>7,806</td>
<td>104%</td>
<td>6.1%</td>
<td>27%</td>
</tr>
</tbody>
</table>

Source: ITU
ITU Digital Access Index (DAI)
World’s First Global ICT Ranking

Digital access index
1 = highest access, selected countries, 2002

Sweden
South Korea
Hong Kong
Taiwan
United States
Singapore
Japan
Slovenia
Israel
Czech Republic
Poland
Chile
Malaysia
Argentina
Russia
Mexico
Brazil
Thailand
Turkey
South Africa
Colombia
Peru
China
Philippines
Egypt
Indonesia
India
Pakistan

Source: ITU

Top 5 in developed Asia Pacific

<table>
<thead>
<tr>
<th>RANK</th>
<th>OVERALL</th>
<th>ECONOMY</th>
<th>DAI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>South Korea</td>
<td>0.82</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>Hong Kong</td>
<td>0.79</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>Taiwan</td>
<td>0.79</td>
</tr>
<tr>
<td>4</td>
<td>14</td>
<td>Singapore</td>
<td>0.75</td>
</tr>
<tr>
<td>5</td>
<td>15</td>
<td>Japan</td>
<td>0.75</td>
</tr>
</tbody>
</table>

Top 5 gains in ranking

<table>
<thead>
<tr>
<th>RANK ’98</th>
<th>RANK ’02</th>
<th>ECONOMY</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>4</td>
<td>South Korea</td>
</tr>
<tr>
<td>22</td>
<td>9</td>
<td>Taiwan</td>
</tr>
<tr>
<td>20</td>
<td>14</td>
<td>Singapore</td>
</tr>
<tr>
<td>13</td>
<td>7</td>
<td>Hong Kong</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>Denmark</td>
</tr>
</tbody>
</table>

Source: ITU

Note:
http://www.itu.int/ITU-D/ict/dai/index.html

# E-Government index for Taiwan

<table>
<thead>
<tr>
<th>e-Government</th>
<th>US</th>
<th>UK</th>
<th>Japan</th>
<th>S.Korea</th>
<th>Singaport</th>
<th>Taiwan</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  IMD index</td>
<td>5.9</td>
<td>3.9</td>
<td>3.2</td>
<td>3.1</td>
<td>7.4</td>
<td>4.6</td>
<td>0-10</td>
</tr>
<tr>
<td>2  E-Ledership</td>
<td>7</td>
<td>8</td>
<td>4</td>
<td>1</td>
<td>7</td>
<td>3</td>
<td>Rank</td>
</tr>
<tr>
<td>3  E-Services, G2B, G2C</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>Rank</td>
</tr>
<tr>
<td>4  E-Operation, G2G, G2E</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>Rank</td>
</tr>
<tr>
<td>IT application</td>
<td>52</td>
<td>47</td>
<td>31</td>
<td>15</td>
<td>61</td>
<td>29</td>
<td>0-100</td>
</tr>
</tbody>
</table>

Source: ITU
Structure Capital
-City Infrastructure

Intellectual Capital: Taipei City

• Creative Taipei
  – Culture innovation
  – Software Park

• Wireless Taipei
  – the world’s first mobile city

→ How to make cities “intelligent”
Creative Taipei
Infrastructure for Culture Innovation

• Huashan Creative Culture Center
  • Renovated from old winery into modern theatres for artists to perform various kinds of arts.
Creative Taipei
Infrastructure for Software Creation

- NanKang Software Park
- One stop for all services related to idea creation
Wireless Taipei

• Currently 86.2% of the city’s households are equipped with personal computers, among which 89.4% have Internet access and 69% broadband usage rate.

• The Main hot point with “100% WLAN Coverage,” “Anytime, Anywhere, Any-device Access” will create new value-added applications and business opportunities.
Structure Capital Institutions

• For example:
  R&D Cluster : ITRI/HSP
    – ITRI=Industrial Technology Research Institute
      • http://www.itri.org.tw/eng/index.jsp
    – HSP=Hsinchu Science Park
      • http://eweb.sipa.gov.tw/en/visitor/about/

→ How to capitalize on knowledge capital, by new innovative social systems, in terms of the collective wealth of nations
→ How to cultivate efficiency and renewal of the knowledge capital of regions
ITRI as a Hub of R&D Cluster

• Roles
  – Establish ITRI as the go-between for itself and the private sector
  – ITRI play important role as “bridge” and “partner”
    • Lead in National R&D projects
    • Facilitate technological diffusion & spillovers
    • Human capital flow

• Ways of Technology Sharing
  – Spin-off company
  – Incubation center
  – Open Lab for technology R&D sharing
  – Bridging foreign technology and partners
ITRI’s Contribution to Taiwan IT Industry

- **UMC**: spin-off company from ERSO/ITRI
  1st 4” Wafer Fab in TWN, 1979 (1,843M US$, 2001)

- **TSMC**: spin-off company from ERSO/ITRI
  1st 6” Wafer Fab in TWN, 1987 (3,597M US$, 2001)

- **TMC**: spin-off company from ERSO/ITRI
  1st Mask Fab in TWN, 1988 (76M US$, 2001)

- **VISC**: spin-off company from ERSO/ITRI
  1st 8” Wafer Fab in TWN, 1994 (260M US$, 2001)

- **TTLA**: 1st TFT LCD Alliance in TWN, 2001

- IC process and design technology was transferred from RCA, 1976
The Cluster and Network of Experts in HSP

- Technology Transfer
- Spin-off
- Strategy Alliances
- Open Lab/Incubator

Research Institutes e.g.: ITRI

Industrial Associations

The Returnees

HSP

TSIA
TEEMA
AAISIP
Social Capital

• Venture Capital
• Industrial Network
• International links:
  – Brands of Taiwan
  – MNC’s R&D centers/IPO
  – Trade shows
Prosperous entrepreneur environment

The Rise and Fall of SME in Taiwan

<table>
<thead>
<tr>
<th>Year</th>
<th>New Business</th>
<th>Closed Business</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>37,239</td>
<td>11,909</td>
</tr>
<tr>
<td>1995</td>
<td>35,367</td>
<td>20,347</td>
</tr>
<tr>
<td>1999</td>
<td>34,404</td>
<td>22,681</td>
</tr>
<tr>
<td>2000</td>
<td>39,347</td>
<td>29,921</td>
</tr>
<tr>
<td>2001</td>
<td>34,569</td>
<td>34,552</td>
</tr>
<tr>
<td>2002</td>
<td>44,552</td>
<td>38,596</td>
</tr>
<tr>
<td>2003</td>
<td>40,837</td>
<td>33,330</td>
</tr>
</tbody>
</table>

Source: MOEA (Mar. 2004)
Social Capital
-Venture Capital

- 2004 IMD Index for Venture Capital
  1. US  7.95
  2. Hong Kong  7.06
  3. Finland  6.8
  4. Taiwan  6.76
  Average  4.72

- 241 Venture Funds, 8719 investment cases with 4 Billion Euro Investment (Up to 2003).
- 92% fund from domestic relationship
- 56.34% of funds come from industries
- Focus on IT and semiconductor-related industries.
- Leverage the relationships among Taiwan, US and Mainland China
Capital Formation of Venture Funds

(1984-2002)
Shareholder Structure of VC Funds

- 92% of fund come from domestic relationships
- Room for growth for foreign investors: 39% of funds of Asian VC funds come from outside of Asia, versus 7.3% for Taiwan.

![Pie chart showing shareholder structure](image-url)
**Strong Industry Connections**

- 56.34% of funds come from industries.

<table>
<thead>
<tr>
<th>Source: TVCA 2001, CDIB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industries</strong></td>
</tr>
<tr>
<td><strong>Insurance Co. and Bank</strong></td>
</tr>
<tr>
<td><strong>Foreign Investors</strong></td>
</tr>
<tr>
<td><strong>Government Agencies</strong></td>
</tr>
</tbody>
</table>
Grow with IT and Semiconductor Industries

- Focus on IT and semiconductor-related industries.
- Telecom and opto-electronics will see most growth in near future.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Semiconductor</td>
<td>27.84%</td>
<td>15.77%</td>
<td>18.67%</td>
<td>20.52%</td>
<td>18.40%</td>
<td>22.30%</td>
</tr>
<tr>
<td>Information</td>
<td>30.52%</td>
<td>21.57%</td>
<td>15.13%</td>
<td>18.25%</td>
<td>17.60%</td>
<td>2.80%</td>
</tr>
<tr>
<td>Telecom</td>
<td>8.75%</td>
<td>4.64%</td>
<td>15.44%</td>
<td>12.18%</td>
<td>12.30%</td>
<td>16.30%</td>
</tr>
<tr>
<td>Opto-Electronics</td>
<td>6.22%</td>
<td>12.23%</td>
<td>10.34%</td>
<td>10.33%</td>
<td>9.80%</td>
<td>23.60%</td>
</tr>
<tr>
<td>Software</td>
<td>2.86%</td>
<td>5.01%</td>
<td>9.06%</td>
<td>5.78%</td>
<td>6.20%</td>
<td>4.20%</td>
</tr>
<tr>
<td>Biotech</td>
<td>0.34%</td>
<td>2.64%</td>
<td>3.23%</td>
<td>2.18%</td>
<td>2.90%</td>
<td>5.20%</td>
</tr>
<tr>
<td>Others</td>
<td>23.47%</td>
<td>38.14%</td>
<td>28.13%</td>
<td>30.76%</td>
<td>32.90%</td>
<td>25.60%</td>
</tr>
</tbody>
</table>

Source: tvca 2001
Future Trend: Globalization

• Taiwan VCs are actively pursuing global diversification

• Capital and technology flow toward the best opportunities wherever they are

Accumulated Overseas Investment

(US$M)

Source: TVCA 2001
Venture Capital’s Role in Hi-Tech Development

- China
- Silicon Valley
- Taiwan

VC
Talents with Entrepreneurship

- Start-ups
- Originality
- Market

Contract Outsourcing
Management Skills
Talents with Entrepreneurship

Product
Marketing

Mainland
China
Taiwan

Japan

US, Silicon Valley

- Start-ups
- Originality
- Market
Leverage by Region for Future Cooperation in Hi-Tech Industry

• Taiwan
  – Experience
  – Product Commercialization
  – Market & Sales

• China
  – Resources
  – Local Market Opportunity

• Silicon Valley
  – Innovation
  – Technology
Taiwanese Investments in Mainland China

Approved Investment Amount  Share of Total Outward Investment

Source: Directorate General of Budget and Accounting (Nov. 2004)
Social Capital
- Industrial Network

• Semiconductor
  – Spin-off from ITRI planted the seeds of key companies, like UMC and TSMC.
  – Specialized foundry of Taiwan initiated the vertical disintegration of IC industry

• R&D Alliance of PC
  – Technology Transfer from ITRI fostered the R&D Alliance of PC
  – Above 60% of PC and Notebook are made in Taiwan.
Vertical Disintegration of IC Industry

- System
  - IC Design
  - IDM Fab
  - Assembly
  - Test
- IC-ASSP
- IC-ASIC
- SOC-IP
The Growth of Semi-conductor Industry in Taiwan

Sales

Source: 2003 Yearbook of Taiwan IC Industry
R&D Alliance of PC

- In 1982, ERSO/ITRI launched a research project of IBM PC/XT compatible PC.
- In 1983, ERSO developed PC compatible to IBM PC/XT and obtained the licensing of DOS from Microsoft.
- Government supported ERSO to transfer technology and formed a R&D Alliance with industry.
- 9 local firms participated the R&D Alliance, including Acer.
- ASUS and BENQ are spin-off from Acer latterly.
- In 1982, Taiwan imported 92% PC; after 10 years, Taiwan exported 95% PC to the world.
Social Capital - International Link

• Customer Capital
  – International Brands
  – Reputation to International Purchasing Offices
• Market share around the world
• R&D centers established by MNC’s
• Trade shows
High-Tech Brands of Taiwan
Reputation of Taiwan
Evaluated by International Purchasing Office

Comparison between Taiwan firms and others: Speed & Flexibility

Taiwan firms
☑ Price
☑ Flexibility
☐ Finance
☑ Delivery lead time
☐ Logistic
☐ Time to market
☑ Quality
☑ Service
☐ Payment term

Others
☐ Price
☐ Flexibility
☐ Finance
☐ Delivery lead time
☐ Logistic
☐ Time to market
☐ Quality
☐ Service
☐ Payment term

Source: III-MIC, 2000
Note: N=25, 10 represent its satisfaction
The Global Market Share of Taiwanese Products

**IC**
- **NO.1** Foundry: US$ 6,070M (72.9%)
  - Mask ROM: US$ 400M (56.7%)
  - IC Packaging: US$ 2,285M (30.4%)
- **NO.2** IC Design: US$ 3,616M (25.9%)
- **NO.3** DRAM: US$ 1,896M (16.9%)

**Computer & Peripheral Devices**
- **NO.1**
  - Notebook PC: US$ 11.6B (23.9%)
  - LCD Monitor: US$ 2,308M (41.1%)
  - CD-R Disk: 4.68B Pcs (83.3%)
  - CD-RW Disk: 167.2M Pcs (70.3%)
  - DVD Disk: 257M Pcs (74.5%)
  - PC Camera: 8.7M Sets (58.0%)
- **NO.2**
  - Mother Board: US$ 2,640M (33.9%)
  - Digital Camera: US$ 678M (9.0%)
- **NO.3**
  - S&M Scale TN/STN LCD module: US$ 703M (16.0%)
  - Large Scale TFT-LCD Panel: US$ 2,524M (23.3%)

**Networking Products**
- **NO.1**
  - Ethernet Card: 35.8M Ports (66.0%)
  - Hub: 41.9M Ports (74.8%)
  - ADSL Modem: 5.1M Sets (59.6%)
  - Wireless LAN: US$ 482M (29.5%)
  - Analog Modem: 38.8M Sets (41.7%)
- **NO.2**
  - Ethernet Switch: 45.6M Ports (24.5%)
  - Cable Modem: 3.3M Sets (39.9%)

**Other**
- **NO.1**
  - Hand Tools: Export US$ 1,196M (16.8%)
  - ABS Resin: 982K M.T (22.4%), etc.
- **NO.2**
  - Polyester filament: 1,525K M.T (14.0%)
  - Nylon Fiber: 391K M.T (10.6%), etc.
- **NO.3**
  - Bicycle: 4,750K Sets (4.0%)
  - Polyester Staple: 830K M.T (10.4%), etc.

Note: Excluding overseas production, source: ITIS (2002)

B: Billion
M: Million
K: Thousand
M.T: Metric Ton
( ): World Penetration
MNC that established R&D centers in Taiwan.

Ten more foreign enterprises are currently looking into or are engaged in negotiations to establish R&D centers.
Trade Shows

• For Example:

The 25th anniversary of COMPUTEX TAIPEI, now the world's second most important IT show and the largest in Asia.

Conclusion

• From the experiences of Taiwan, we provide the primitive answers to the four questions of this conference
How to develop intelligence flows within and between knowledge capital clusters?

• Encourage students to study abroad and facilitate the environment for returnee.
• Attract the foreign student from oversea.
• Improve the living environment and the convenience for foreign experts to live.
  – May start from specific community, like HSP.
• Promote various kinds of trade show.
How to make cities “intelligent”?

• Software
  – Creative Culture
    • City life with security but without limits.
    • Easy to work and relax (live) 24 hrs a day, 7 day a week.
  – Creative Education
    • Creative Education Projects in Taiwan, 2000-2004

• Hardware—wireless wideband
  – Convenient transportation for people to move.
  – Bookstore and Coffee stop for people to meet.
  – Easy to surf on the web anywhere and anytime.
How to capitalize on knowledge capital, by new innovative social systems, in terms of the collective wealth of nations?

• Encourage the venture capital industry by tax incentives or co-funding the innovative projects by public funds to share the risk.

• Facilitate the mutual investment among vertically related firms to increase the possibility of cooperation and successful commercialization.
How to cultivate efficiency and renewal of the knowledge capital of regions?

• Provide higher education
  – Sustainable supply of high-quality human capital

• Establish R&D center - Knowledge Capital of firm
  – Encourage firms, especially MNCs, to establish R&D center or training center here.

• Create the R&D hub, like ITRI
  – To facilitate the flow of human capital and accommodate its temporary shock/stock.
  – By R&D alliance, spin-off, technology transfer and seminar.
Reference

- Teresa Yang (2005), Venture Capital in Taiwan, Secretary-General of tvca, Nov 5, 2003

The data and help from MIC of III are highly appreciated.
| Conference | 27 |
| Journal    | 10 |

### Academic Papers

- An Empirical Investigation of the Relation between Intellectual Capital and Firms' Market Value and Financial Performance
- An Exploratory Set of Indicators between Information Technology And Process Capital & Innovation Capital--Based on A Simple Case Study
- Building customer capital through relationship marketing
- Building Customer Capital through Relationship Marketing Activities-the Case of Taiwanese Multilevel Marketing Companies
- Computer-integrated manufacturing and human capital-enhancing human resource management
- Do Capital Markets Value Intellectual Capital?
- How Corporate Government Structure Affects the Performance of Insurance Companies
- IC dynamic capabilities, and organizational innovation performance
- Intellectual capital and Performance in Causal Models: Evidence from the Information Technology Industry in Taiwan
- Intertemporal Stable Pension Funding
- Mobilizing Factors of Intellectual Capital
- Noise Trading and Market Quality
- On the relation of Systematic Risk and Accounting Variables
- Progression Of IC: EEEC Model
- Re-examining the Association between IT Investments and Firm Profitability: A Component--Based Approach.
- Successful organizational transformation: The perspective of bifurcation and self-organization
- The Achieving Factors Model of Intellectual Capital Management
- The Effects of Green Intellectual Capital upon Competitive Advantage of Enterprises
- The Role of Social in the Relationship between Human Capital and Career Mobility: Moderator or Mediator
- Top Management Team Social Capital in Taiwan: Impact on Firm Value in an Emerging Economy
- ......
Mr. Leif Edvinsson

Mr. Nick Bontis & Giovanni Schiuma
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ming-Chin Chen</td>
<td>An empirical investigation of intellectual capital, market value and financial performance</td>
</tr>
<tr>
<td>Shu-Ju Cheng</td>
<td>Top management team social capital in Taiwan: Impact on firm value in an emerging economy</td>
</tr>
<tr>
<td>Yuhchang Hwang</td>
<td>The role of social capital in the relationship of human capital and career mobility: Moderator or mediator?</td>
</tr>
<tr>
<td>Chaur-Shiuh Young</td>
<td>Intellectual capital and performance in causal models: Evidence from the information technology industry in Taiwan</td>
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<tr>
<td>Shu-Chi Lin</td>
<td>Building customer capital through relationship marketing activities in Taiwanese multilevel marketing companies</td>
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<td>Yin-Mei Huang</td>
<td>The integration between balanced scorecard and intellectual capital</td>
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