China’s Computer Industry: Manufacturing to Product Development

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Sloan Foundation Workshop on China
Worcester, MA
June 16-17, 2005
Agenda

- China’s computer industry
- Role of Taiwanese companies
- Knowledge work: New product development in notebook PCs
- Location of NPD activities and shift to China
- Implications
China’s computer industry

- Largest hardware producer in 2004 (est’d). Production and exports dominated by Taiwanese firms.
- Second largest PC market. Domestic PC companies are top three sellers
Leading computer producing countries

Hardware production in US$ millions and share of total global production

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td></td>
<td>Value</td>
<td>Share</td>
<td>Value</td>
<td>Share</td>
</tr>
<tr>
<td>US</td>
<td>76,284</td>
<td>26.5%</td>
<td>90,430</td>
<td>24.0%</td>
</tr>
<tr>
<td>Japan</td>
<td>72,678</td>
<td>25.2%</td>
<td>65,130</td>
<td>17.3%</td>
</tr>
<tr>
<td>Singapore</td>
<td>21,127</td>
<td>7.3%</td>
<td>22,209</td>
<td>5.9%</td>
</tr>
<tr>
<td>Taiwan</td>
<td>16,007</td>
<td>5.6%</td>
<td>27,212</td>
<td>7.2%</td>
</tr>
<tr>
<td>China</td>
<td>5,600</td>
<td>1.9%</td>
<td>27,500</td>
<td>7.3%</td>
</tr>
<tr>
<td>Malaysia</td>
<td>5,280</td>
<td>1.8%</td>
<td>17,368</td>
<td>4.6%</td>
</tr>
<tr>
<td>S. Korea</td>
<td>6,795</td>
<td>2.4%</td>
<td>15,241</td>
<td>4.0%</td>
</tr>
</tbody>
</table>

Source: Reed Electronics Research, *Yearbook of World Electronics Data*
## China’s PC market

<table>
<thead>
<tr>
<th>Company</th>
<th>2004 Market share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lenovo</td>
<td>25.1</td>
</tr>
<tr>
<td>Beijing Founder</td>
<td>9.9</td>
</tr>
<tr>
<td>Tsinghua Tongfang</td>
<td>7.8</td>
</tr>
<tr>
<td>Dell</td>
<td>7.2</td>
</tr>
<tr>
<td>IBM</td>
<td>5.1</td>
</tr>
<tr>
<td>HP</td>
<td>4.8</td>
</tr>
</tbody>
</table>
Greater China and the role of Taiwanese companies

- #1 makers of notebook PCs, motherboards, scanners, keyboards, add-on cards, optical drives, monitors, some network equipment.
- Original design manufacturers (ODMs) develop and manufacture over half the world’s notebook PCs.
- Customers include all major branded PC vendors (OEMs).
## Taiwan’s top notebook ODMs

<table>
<thead>
<tr>
<th>Name</th>
<th>2003 volume (thousands)</th>
<th>Major OEM partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Quanta</td>
<td>8,500</td>
<td>Gateway, Dell, HP, IBM, Apple, Sharp, Sony, Fujitsu-Siemens (F/S)</td>
</tr>
<tr>
<td>2. Compal</td>
<td>6,000</td>
<td>Dell, HP, F/S Toshiba, Acer</td>
</tr>
<tr>
<td>3. Wistron</td>
<td>2,500</td>
<td>IBM, Dell, Acer, Hitachi, F/S</td>
</tr>
<tr>
<td>4. Inventa</td>
<td>1,800</td>
<td>HP, Toshiba</td>
</tr>
<tr>
<td>5. Arima</td>
<td>1,500</td>
<td>NEC, Gateway</td>
</tr>
<tr>
<td>6. FIC</td>
<td>1,500</td>
<td>NEC, Legend</td>
</tr>
<tr>
<td>7. Asus</td>
<td>1,500</td>
<td>Epson, Canon, Sony, Apple, Trigem</td>
</tr>
<tr>
<td>8. Mitac</td>
<td>1,100</td>
<td>Sharp, F/S, NEC, JVC</td>
</tr>
<tr>
<td>9. Uniwill</td>
<td>1,000</td>
<td>Clone, F/S, Actebis, Samsung</td>
</tr>
<tr>
<td>10. ECS</td>
<td>1,000</td>
<td>Apple</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>23,900</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: Taiwan Ministry of Economic Affairs, 2003 (table provided to authors)
New product development

- Manufacturing has shifted from U.S. to Taiwan and SE Asia, then to China
- Will knowledge work follow?
- Case study of new product development in notebook PCs illustrates factors and trends in knowledge-intensive part of the PC industry
Notebook NPD process

- Design
  - Concept design
    - Analyze need
    - Create concept
    - Set brand image
  - Product planning
    - Business case
    - Specifications
    - Industrial design
    - Sourcing strategy
  - Design review
    - Mock-ups
    - Electrical test
    - DVT
  - Prototype build
    - Commercial samples
    - Integrated system test
    - EVT

- Development
  - Pilot production
    - Production process design
    - Pilot assembly
    - PVT
  - Mass production
    - Ramp-up
    - Volume production
    - Production testing
    - Global distribution

- Production
  - Sustaining support
    - Speed bump
    - Component replacement
    - Technical support
    - Warranty support
Interdependencies

- Development and manufacturing are closely linked, need manufacturability, testing of sample products.
- Concept design and product planning stay together in lead markets and branded vendors.
- Design and development can be separated organizationally and geographically. Product spec’s can be handed off with limited human interaction.
Organizational forms

- Notebook NPD follows three patterns
  - Inhouse design/development (IBM, Toshiba): vertically integrated within one PC company
  - Joint design/development – (Dell, HP): PC maker does design, ODM does development and mfg.
  - Pure ODM design – (low-end products, small PC vendors): PC makers choose products off-the-shelf to sell.

- Estimated share of products sold: 30% designed in-house; 50% joint vendor/ODM; 20% ODM

- Trend is toward more joint design/development
Joint development model

- PC makers retain control of key decisions.
  - Product management, marketing, brand image
  - Architecture, standards, key components. Interact with Intel, MS, key component makers.
  - Decide on specific product features

- ODMs
  - Develop products to match their mfg. processes.
  - Choose suppliers of many parts, components
  - Responsible for quality, support
Skill and proximity factors

- Concept design and product planning.
  - Knowledge of market, skill in translating market needs into product concepts, and proximity to market. Analytical and management skills.

- Development
  - Specialized engineering skills, e.g. thermal, EMI, shock and vibration, power management, materials, radio frequency, software. Hands-on skills.

- Production engineering and sustaining support
  - Process engineering skills and proximity to production processes. Hands-on skills.
Skills and costs by location

- Fully-loaded cost for design engineers
  - U.S. or Japan: $120K
  - Taiwan: $60K
  - China: $20-40K

- Characteristics
  - U.S./Japan: strong analytical skills, good management skills, creative problem solving
  - Taiwan: strong hands-on experience, weaker analytical and management skills but learning
  - China: core skills vary, gaining hands-on experience, weak analytical and independent problem solving skills.
Production “pull” of NPD activities

Concept design ← Product planning ← Design review ← Prototype build ← Pilot production ← Mass production ← Sustaining support
Shifting location of NPD activities

2003
- United States
- Japan
- Taiwan
- China

2006
- United States
- Japan
- Taiwan
- China
China’s role in NPD

- Solve problems related to production process.
- Sustaining support for existing products while new product teams move on.
- Taking over pilot production and testing, likely to move to prototype and design review in some cases.
Trends and Implications

- Overall, number of jobs is small (<20K).
- Notebook market growing—now 50% of PC sales.
- Beyond notebooks
  - Design and development important in other IT products, e.g. cell phones, game machines, PDAs, MP3 players.
  - May see similar patterns in other industries where more jobs are involved, e.g., 45,000 chip designers in U.S.
Impacts of China

- Availability and cost of engineering talent can’t be ignored. Experience will provide hands-on skills and work out cross-cultural management issues.
- Biggest impact on Taiwan and Japan as development moves. U.S. has lost this already.
- China will only take over concept design stages if it becomes a leading market and source of innovation.