



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
- Lenovo buys IBM PC business in 2004.



Leading computer producing countries

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

World region	1995		2000		2003		
	Value	Share	Value	Share	Value	Share	Global Rank
US	76,284	26.5%	90,430	24.0%	69,102	21.7%	1
Japan	72,678	25.2%	65,130	17.3%	33,403	10.5%	3
Singapore	21,127	7.3%	22,209	5.9%	15,912	5.0%	5
Taiwan	16,007	5.6%	27,212	7.2%	21,512	6.8%	4
China	5,600	1.9%	27,500	7.3%	65,000	20.5%	2
Malaysia	5,280	1.8%	17,368	4.6%	13,553	4.3%	7
S. Korea	6,795	2.4%	15,241	4.0%	14,280	4.5%	6

Source: Reed Electronics Research, *Yearbook of World Electronics Data*



China's PC market

Company	2004 Market share (%)
Lenovo	25.1
Beijing Founder	9.9
Tsinghua Tongfang	7.8
Dell	7.2
IBM	5.1
HP	4.8



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

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

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

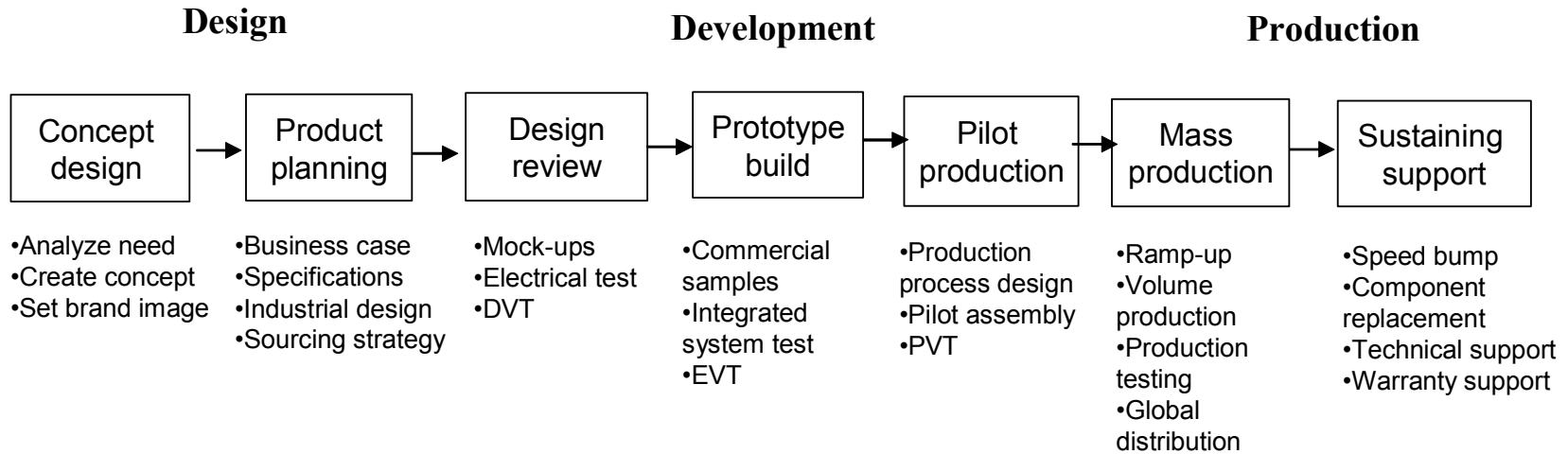


New product development

- 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





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.

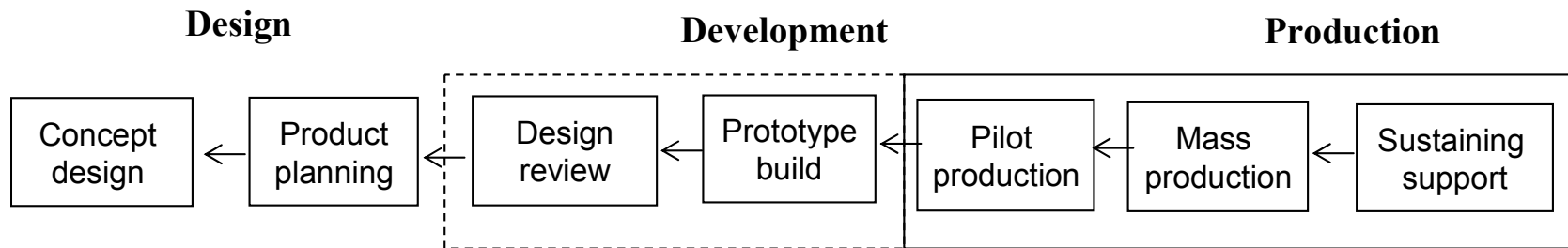


Skills and costs by location

- 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.

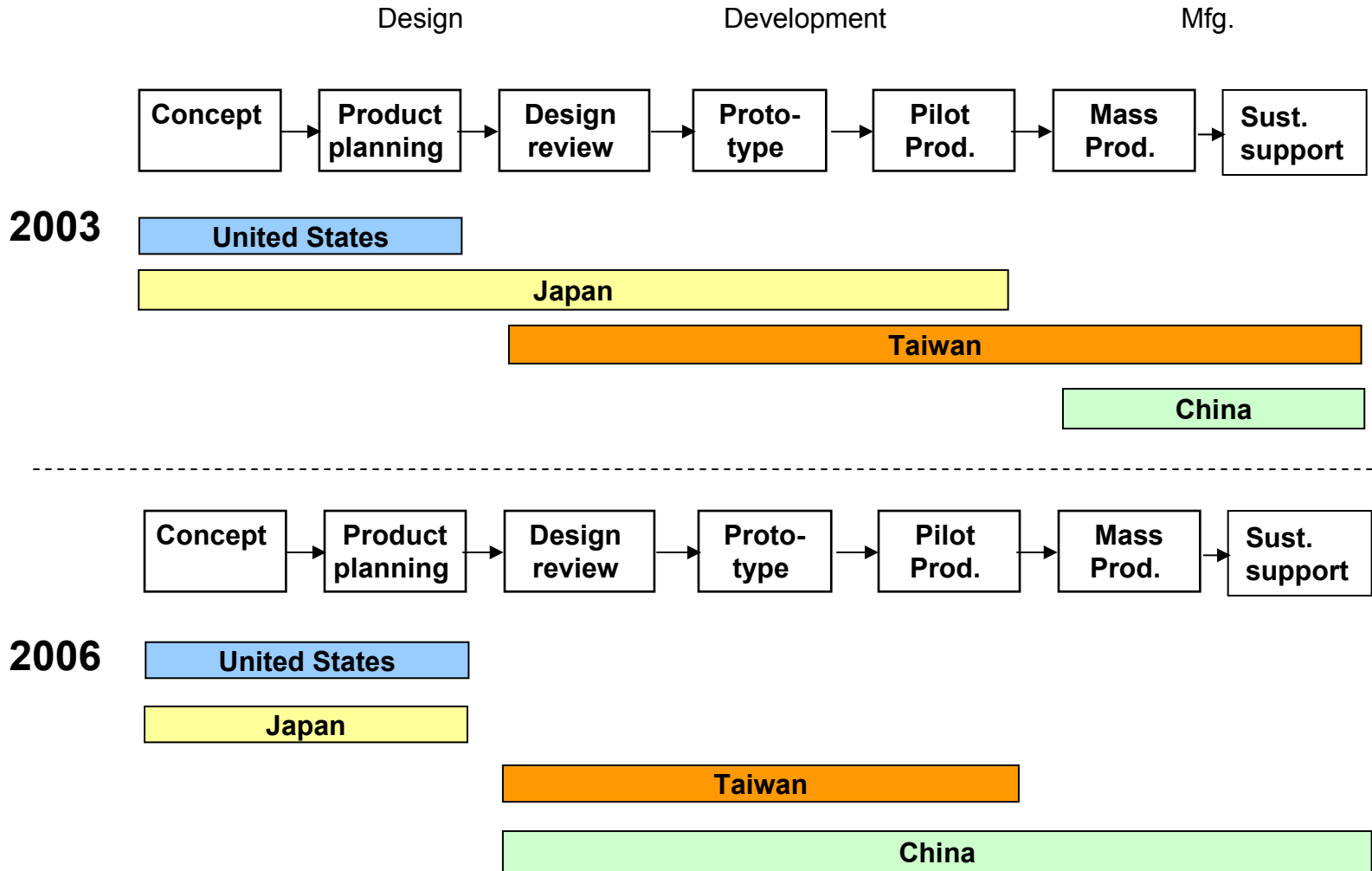


Production “pull” of NPD activities





Shifting location of NPD activities





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.