Why is Chip Design Moving to Asia?

Drivers and Policy Implications

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Research Methodology

- Exploratory, semi-structured interviews (since 2002)
- 70 companies & 15 research institutions (US, Taiwan, Korea, China, Malaysia) that are doing chip design in Asia
- Sample contains global and regional carriers of chip design in Asia

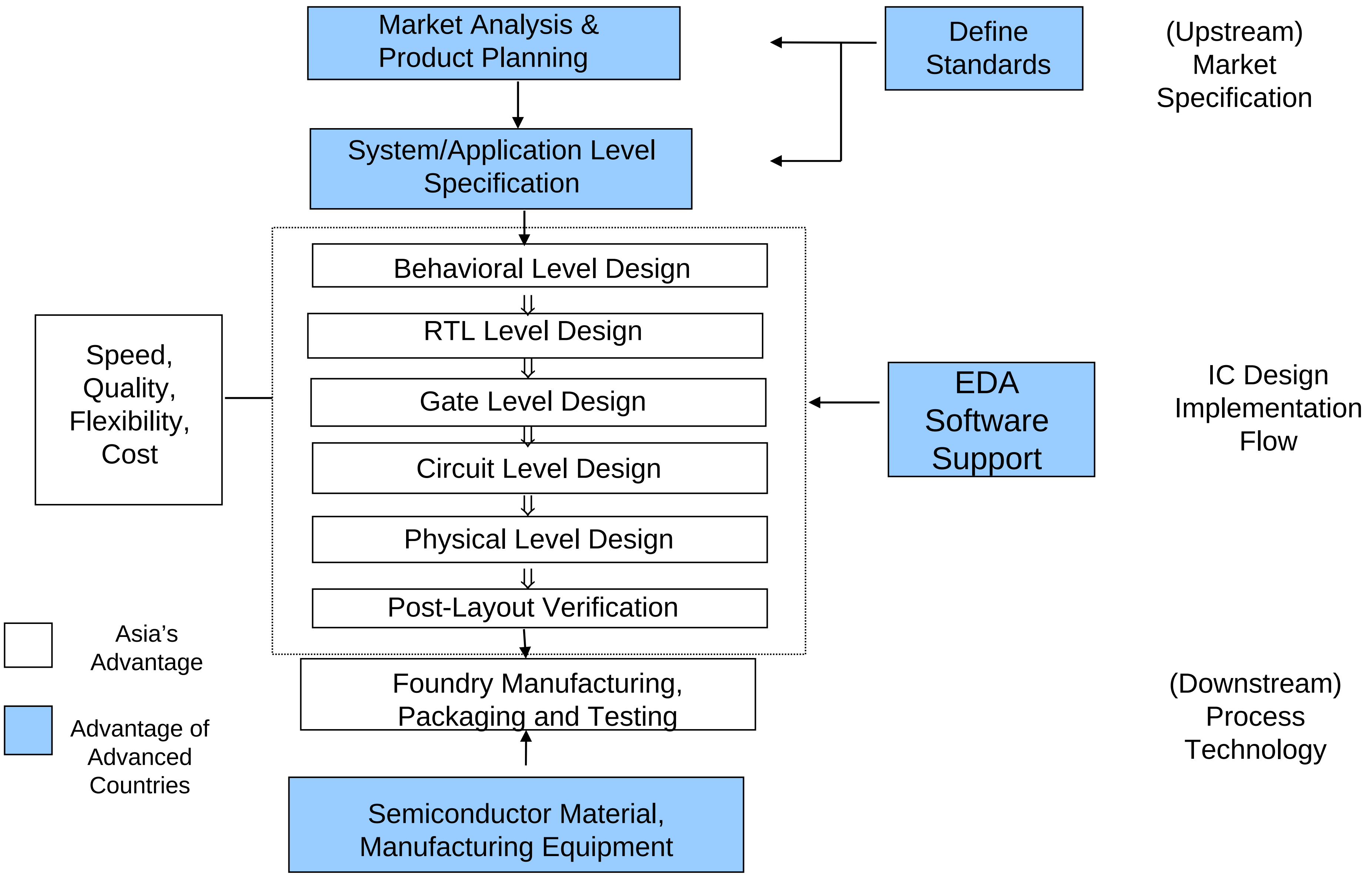
Carriers of Asian Chip Design

- **System companies**
- **Integrated device manufacturers (IDM)**
- **Contract manufacturers (EMS; ODM)**
- **'fabless' chip design houses**
- **Chip contract manufacturers ('foundries')**
- **Design implementation services**
- **Chip packaging & testing**
- **'chipless' licensors of 'silicon intellectual properties' (SIPs)**
- **Tool vendors (EDA; design testing)**

Research findings

- **Rapid growth of chip design investment in Asia**
- **All interviewed firms are planning to expand such activities**
- **Design implementation continues to play dominant role**
- **System specification is gaining in importance**
- **Substantial progress in complexity of design**

Chip Design Flow Chart



Source: Chang and Tsai, 2002

Drivers of Asian Chip Design

- Systemic combination of “pull”, “push”, and “enabling” factors is creating virtuous cycle
- “pull” factors explain what attracts design to particular locations
- "push" and “enabling” factors explain what tilts the balance in favor of geographical decentralization

“Pull” factors attract chip design to particular locations

- **Demand** (market size & sophistication)
- **Supply** (talent pool)
- **Policies** (tax rebates; regulations; IPR; infrastructure; education; legal framework)

Annual Cost of Employing a Chip Design Engineer* (US-$), 2002

Location	Annual Cost
Silicon Valley	300,000
Canada	150,000
Ireland	75,000
Taiwan	<60,000
South Korea	<65,000
China	28,000 (Shanghai) 24,000 (Suzhou)
India	30,000

*=including salary, benefits, equipment, office space and other infrastructure

Sources: PMC-Sierra, Inc. Burnaby, Canada (for Silicon Valley, Canada, Ireland, India); plus interviews (Taiwan, South Korea, China)

Skill requirements and work organization

- “designer bottleneck”: US has failed to train enough engineers for the next generation
- Global market for design training
- Asian designers are trained using the latest tools and methodologies
- Global firms seek to bypass resistance to “design automation”

China Market

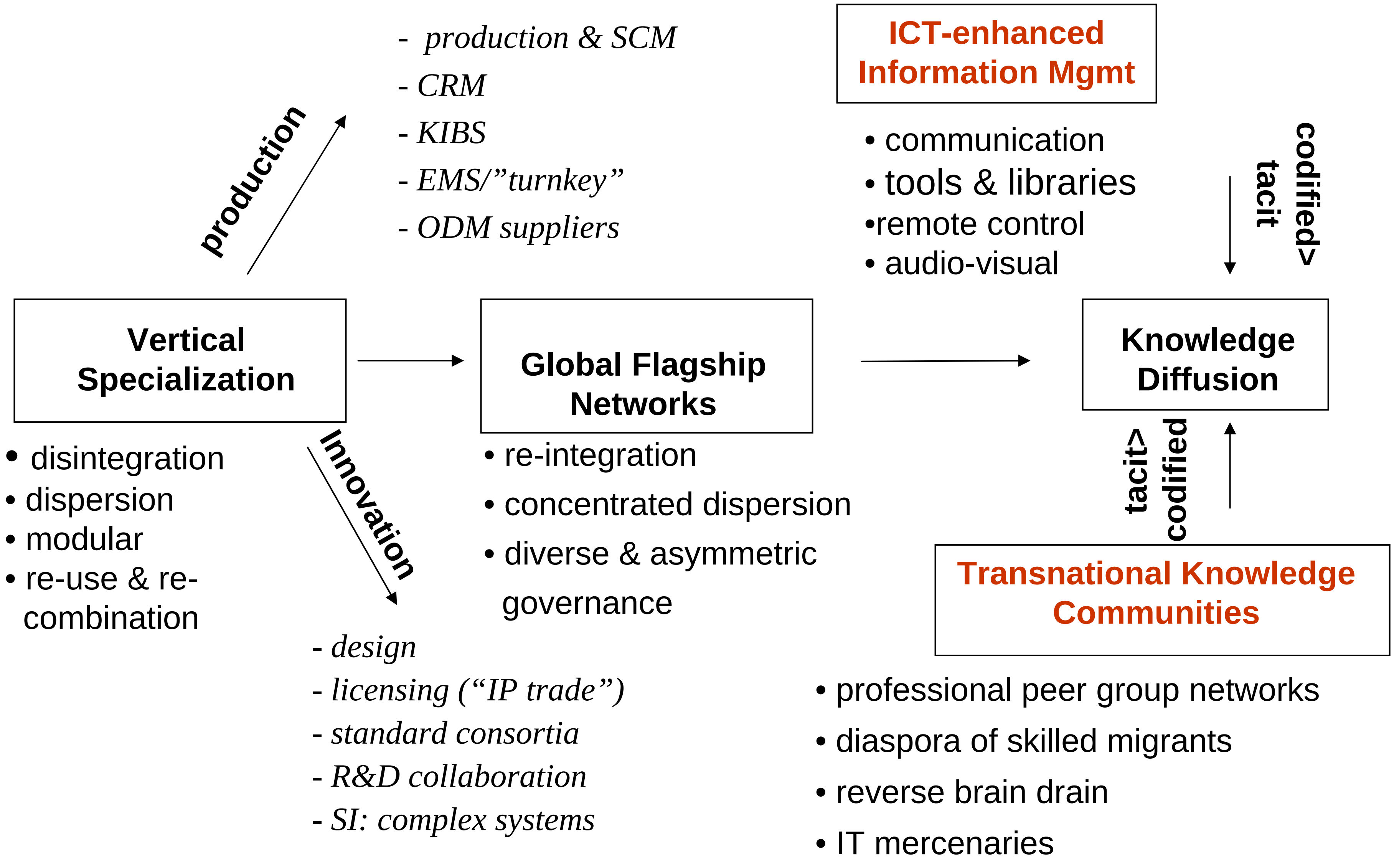
- World's largest market for telecom equipment (wired & wireless) (test bed for 3G)
- Ditto for handsets (launch market)
- Third largest market for semiconductors
- Sophisticated markets for digital CE (#2) & computers
- Leading export market for US, Japan, Taiwan and Korea

Push factors

- Global markets for technology & knowledge workers ☞ changes in design methodology & organization **("vertical specialization")**

- Firms **"outsource"** <u>stages of chip design</u> to specialized suppliers (*dis-integration of innovation value chain*) and
- **"offshore"** <u>design projects</u> to new lower-cost locations (*geographic dispersion*)

Enabling Factors



GDN diversity

- Chinese system company defines system architecture
- contract manufacturing of electronic equipment (Taiwan)
- American IDM provides design platform
- European SIP provider
- fabless design houses (US; Taiwan)
- foundries (Taiwan, Singapore and China)
- chip packaging companies (Taiwan; China)
- tool vendors for design automation and testing from the US and India
- design support service providers(various Asian countries)

Who controls Global Design Networks? (1) General criteria

- rent distribution
- ownership
- who defines strategic direction?

Who controls Global Design Networks? (2) Design-specific criteria

Which of the following functions are performed *by whom* and *where*?

- architecting
- business model
- platforms
- system integration
- bottleneck capabilities

Conclusions (1)

- Complexity is no longer an absolute constraint to internationalization of innovation
- Geographic proximity can be a disadvantage when design requires a large number of designers with diverse capabilities
- Pull and policy factors explain what attracts design to particular locations
- Changes in design methodology and organization explain what tilts the balance in favor of geographic decentralization

Conclusions (2) Open Questions

Talent pool	**Can East Asian countries replicate the US model of attracting top talent from the global market for knowledge workers?**
Innovative Capabilities	**Can East Asian firms enter the "global innovation race" as sources of new technology and global standards?**
Strategy	**• from "fast follower" to " technology diversification" • "technology leadership" ?**

Strategies	Definition	Capabilities	Comments
Catching-up	• enter after growth stage • lower-cost producer	• operational •assimilate & improve foreign tech's	• decreasing returns • razor-thin margins
Fast-Follower	• enter early during growth stage • quick market response • flexible production system •cost control	• process development • prototype development	• footloose investment • weak marketing skills • where to move to? (paradigm shift)

Strategies	Definition	Capabilities	Comments
Technology Diversification	• recombine (mostly known) technologies to create new products & services • economics of scope (technology)	• applied research •international knowledge sourcing •build on proven capabilities •IPs	• higher margins & limited uncertainty • new opportunities (vertical specialization in GFNs) • latecomer advantages
Technology Leader	• sets standard during introduction of new products/service	• basic research • pure science • defining standards •superior IPs	• higher margins •strong entry deterrents • high cost (R&D; regulations) •lower-cost imitators •“disruptive technologies”

Thank you

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