

DSB Task Force on High Performance Microchip Supply

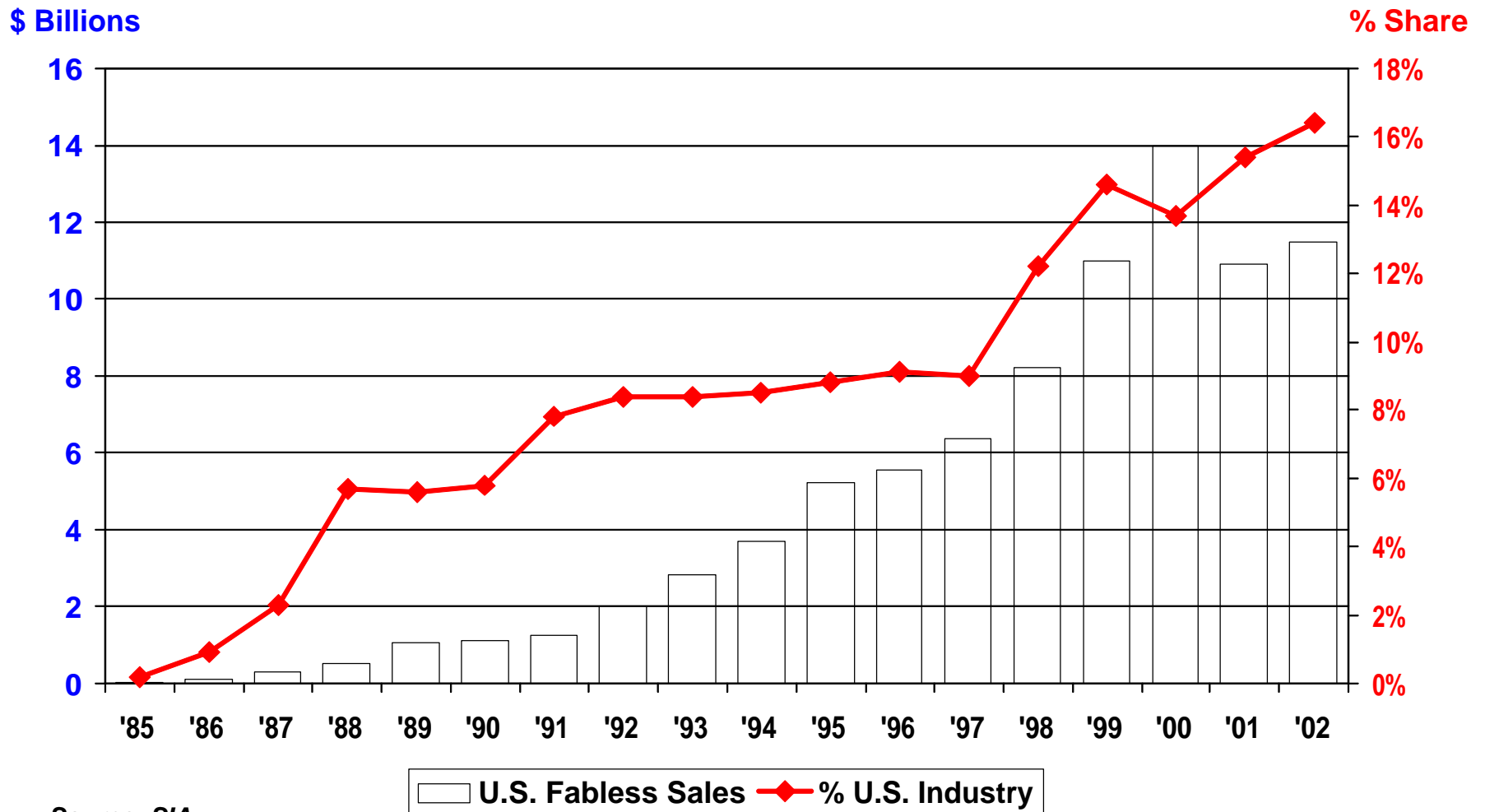
Trusted Foundry Needs of the
Department of Defense

The microelectronics industry, supplier of hardware capability that underlies much of America's modern military leadership technology, is well into a profound restructuring. One unintended result of this otherwise sound industry change is the relocation of critical microelectronics manufacturing capabilities from the United States to countries with lower cost capital and operating environments. From a U.S. national security view, the potential effects of this restructuring are so perverse and far reaching and have such opportunities for mischief that, had the United States not significantly contributed to this migration, it would have been considered a major triumph of an adversary nation's strategy to undermine U.S. military capabilities.

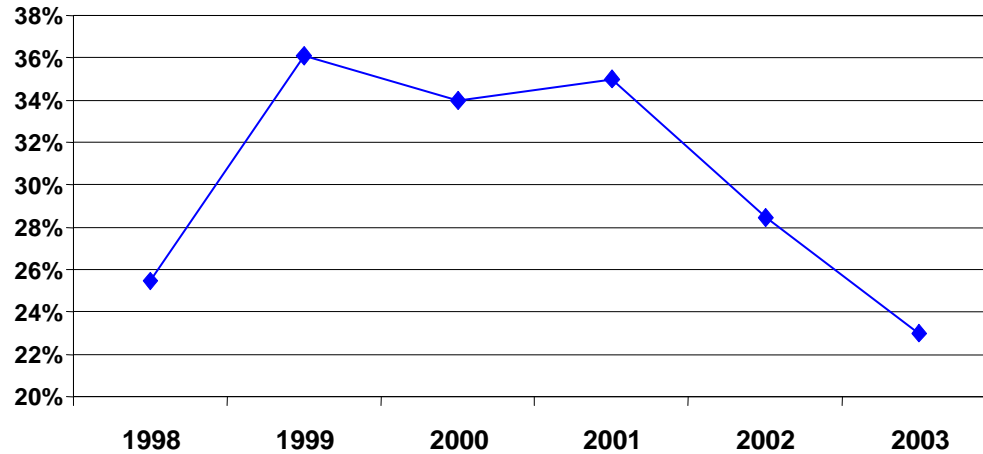
Several Major Changes Are Well Underway In The Semiconductor Industry:

- Classical vertically integrated companies are rapidly being replaced by hollow “fabless” firms that contract out manufacturing
 - Driven by dramatic increases in investment required to manufacture advanced technologies and market demand for much better returns on capital investment

The fabless/foundry business model has grown to 16% of the U.S. chip industry. The trend is strongest in the leading process technology portion of the industry



U.S. industry's share of capital expenditures falling in leading edge semiconductor manufacturing capacity.



Leading Edge	< 0.4 μ	< 0.3 μ	< 0.3 μ	< 0.2 μ	< 0.2 μ	< 0.16
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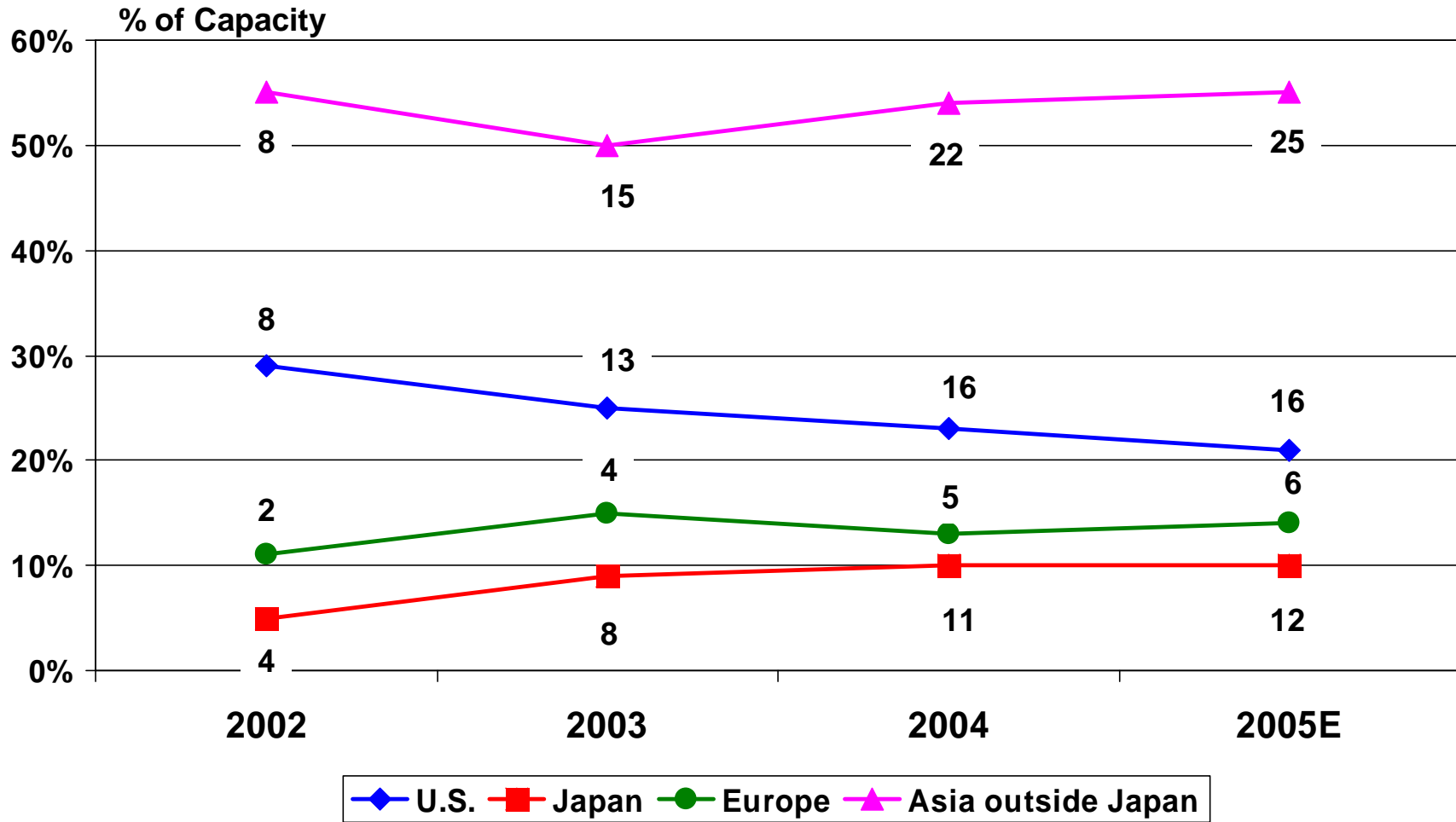
Source: SICAS/SIA

Early indications are that this trend continued downward in 2004 – this is a structural shift, not a result of short-term business fluctuations

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- **Expensive manufacturing capacity is moving abroad, mostly to Taiwan, China and Singapore**
 - Packaging and testing already well-established
 - Design is beginning to follow
 - Driven by national decisions that native semiconductor industries are strategically important, warranting strong capital investment incentives

300MM Wafer Fabrication Plants



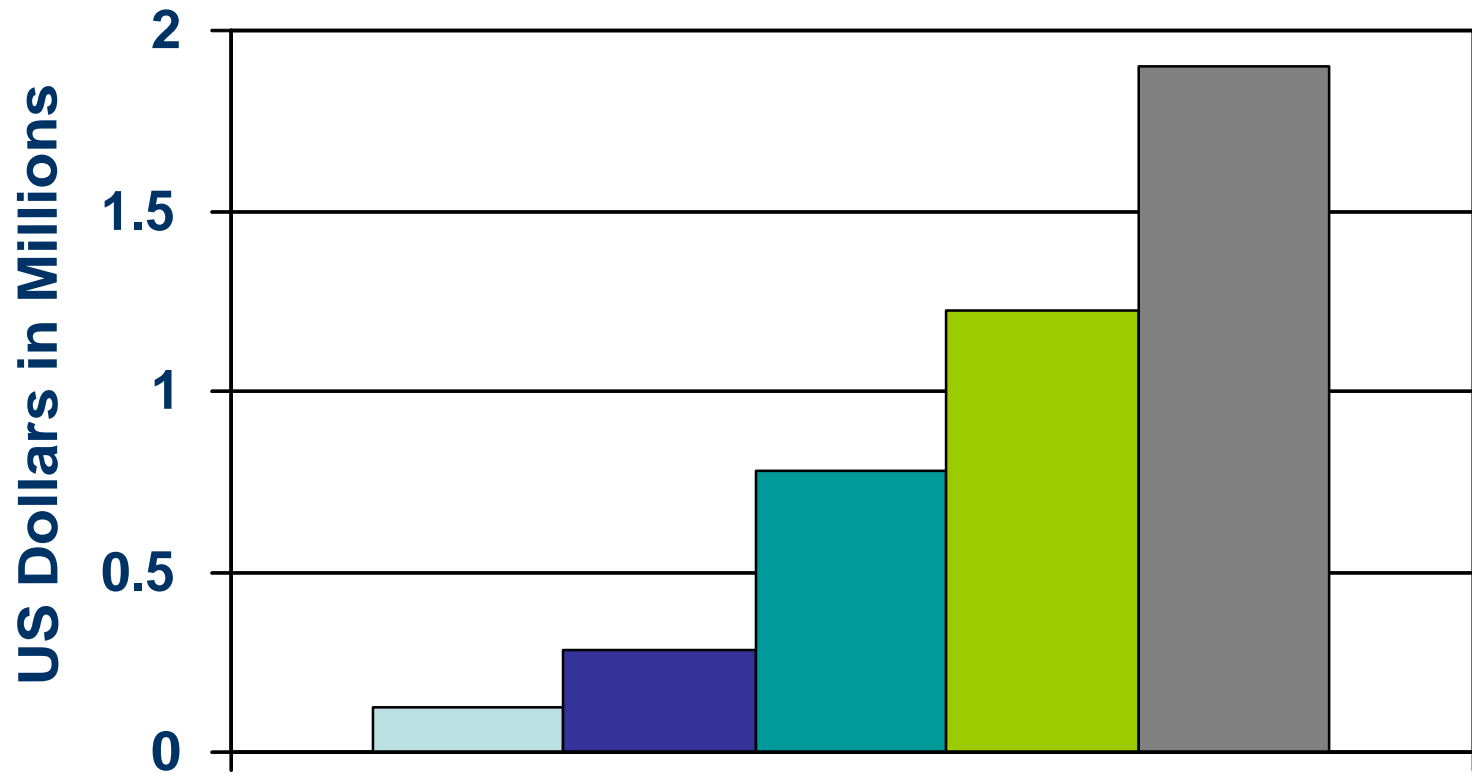
Note: Number of fabs is cumulative. These figures include R&D fabs; which operate at a much lower capacity than a production fab.

Source: International SEMATECH

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Mask Costs



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- **The rapid rate of technology change quickly makes chip designs obsolete**

These Changes are not in the best interests of DoD:

- DoD requires trusted and assured sources of IC components:
 - Trusted to ensure protection of classified designs, integrity of mission-critical components and long operating life
 - Assured to guarantee access to special military technologies, quick response for time-critical designs, parts availability for the life of the system
- **KEY POINT: TRUST CANNOT BE ADDED TO ICs AFTER FABRICATION (i.e., modifications to designs cannot reliably be detected)**
 - Electrical or imaging testing or reverse engineering are neither practical nor economically feasible.
 - Applies to both ASICs and COTS

DoD Has Responded To These Challenges

By:

- **Past reliance on the US IC industry and captive foundries for supplies of sensitive components**
 - US Industry down to three onshore, leading edge IC logic fabricators (IBM, Intel, possibly TI) only two of which will accept foundry business
 - NSA, Sandia and defense contractor facilities are too costly to keep up to the state-of-the-art
- **Establishing a Radiation-Hardened IC program at two US defense firms (BAE and Honeywell)**
- **Establishing a “Trusted Foundry” program with three tiers:**
 - Tier I: leading edge – contract with IBM for take-or-pay services
 - Expanding to Tier II and III where there is more competition
- **There are serious risks inherent in these ad hoc efforts**

Recommendations - 1

Industry Environment

- Take a strong advocacy position within the US government for policies and actions that ensure the US offers as good an environment for semiconductor investment as anywhere else in the world

Defense Vision

- Formulate a forecast-based vision on which to base transformation of the microelectronics supply environment

Size the Problem

- Identify classes, technologies and volumes of ICs that require trusted and assured supply

Recommendations - 2

DoD Acquisition Strategy

- Be seen as a desirable customer in the future.

Custom IC Design and Production Models and Technology

- Take another look at the economics of manufacturing limited production volume ASICs with the goal of mounting an effort, like SEMATECH, to meet the need for leading edge technology, low production volume critical parts.

SME Export Controls

- Strengthen the Wassenaar Arrangement with bilateral agreements with major SME supplier nations and Taiwan to ensure that SME exports to potential adversary nations are suitably regulated.

Recommendations - 3

Programmable Hardware and Software

- DDR&E should:
 - Partner with industry and other US government agencies (e.g., NSF and DHS) to support continued university research to ensure an adequate supply of skilled scientists and engineers in the field
 - Foster interchange of the best counter-tamper practices to assure integrity of government and commercial design through courseware and industry information programs
 - Institute a targeted program in the area of firmware integrity to rapidly develop, disseminate, and encourage adoption of improvements in this trust-related aspect of programmable designs, and
 - In conjunction with the above, encourage research in “Design for Trust Evaluation”

DoD-Unique Technologies

- Continue special technology R&D and, in addition,
 - Reduce controls on international trade in radiation-tolerant “standard” designs that discourage commercial firms from evaluating their hardness.
 - Increase efforts to develop tamper protection technology, and
 - Develop design and production technologies to disguise the true function of sensitive ICs

Adversarial Clandestine Operational Opportunities

- Assemble an accurate characterization and assessment of adversaries’ “dirty tricks” to facilitate developing an effective US counter-tamper strategy. Develop risk mitigating technical approaches to support the risk management process.