# Driving Semiconductor Industry Optimization From U.S.-Taiwan-China Relationships


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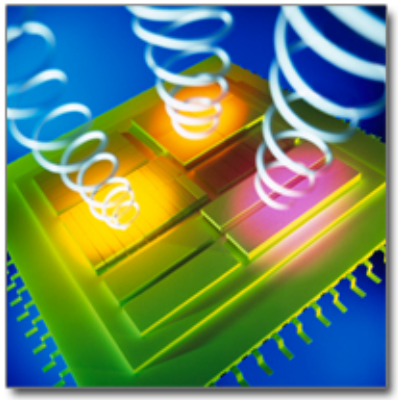
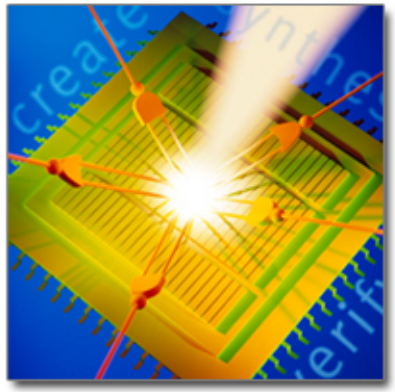
**CHAIRMAN & CEO**
**Mentor Graphics Corporation**


Mentor Graphics®

# U.S.-Taiwan-China Semiconductor Optimization

- Growing the total semiconductor market
- Efficiencies in the design of products
- Increasing the pool of innovators
- From litigation to cross-licensing





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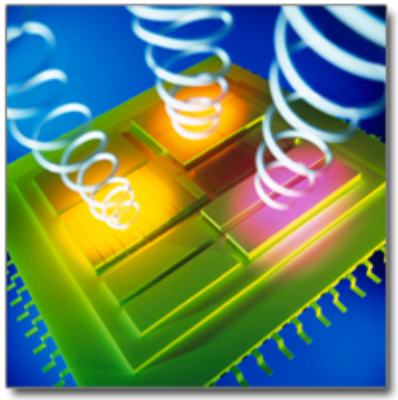
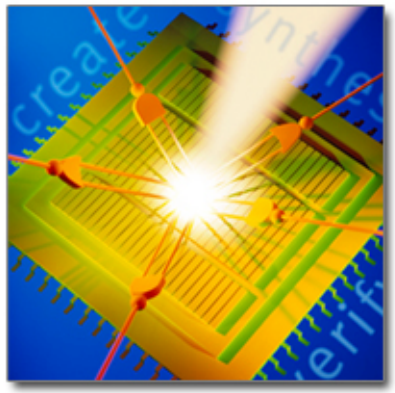
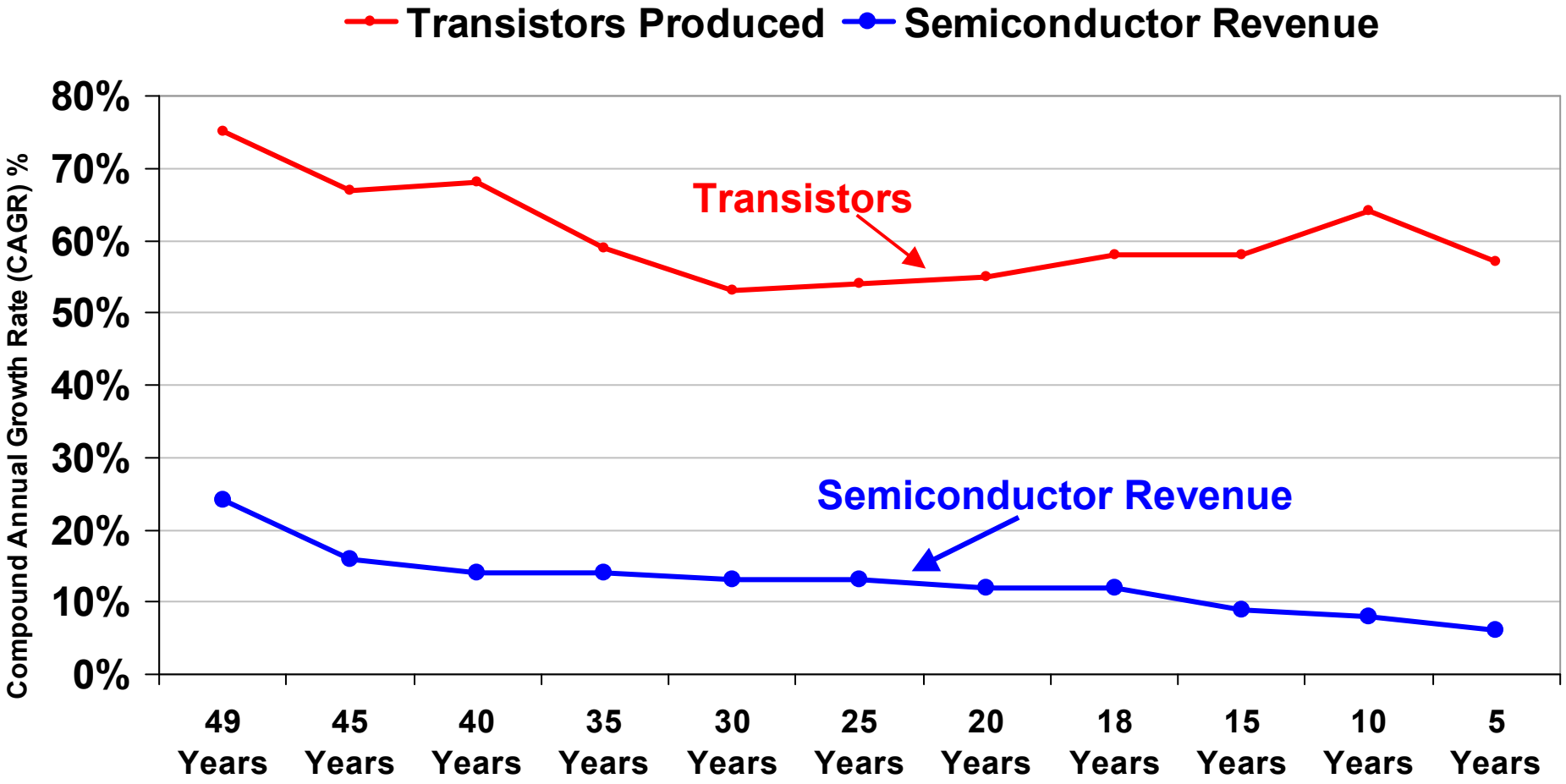




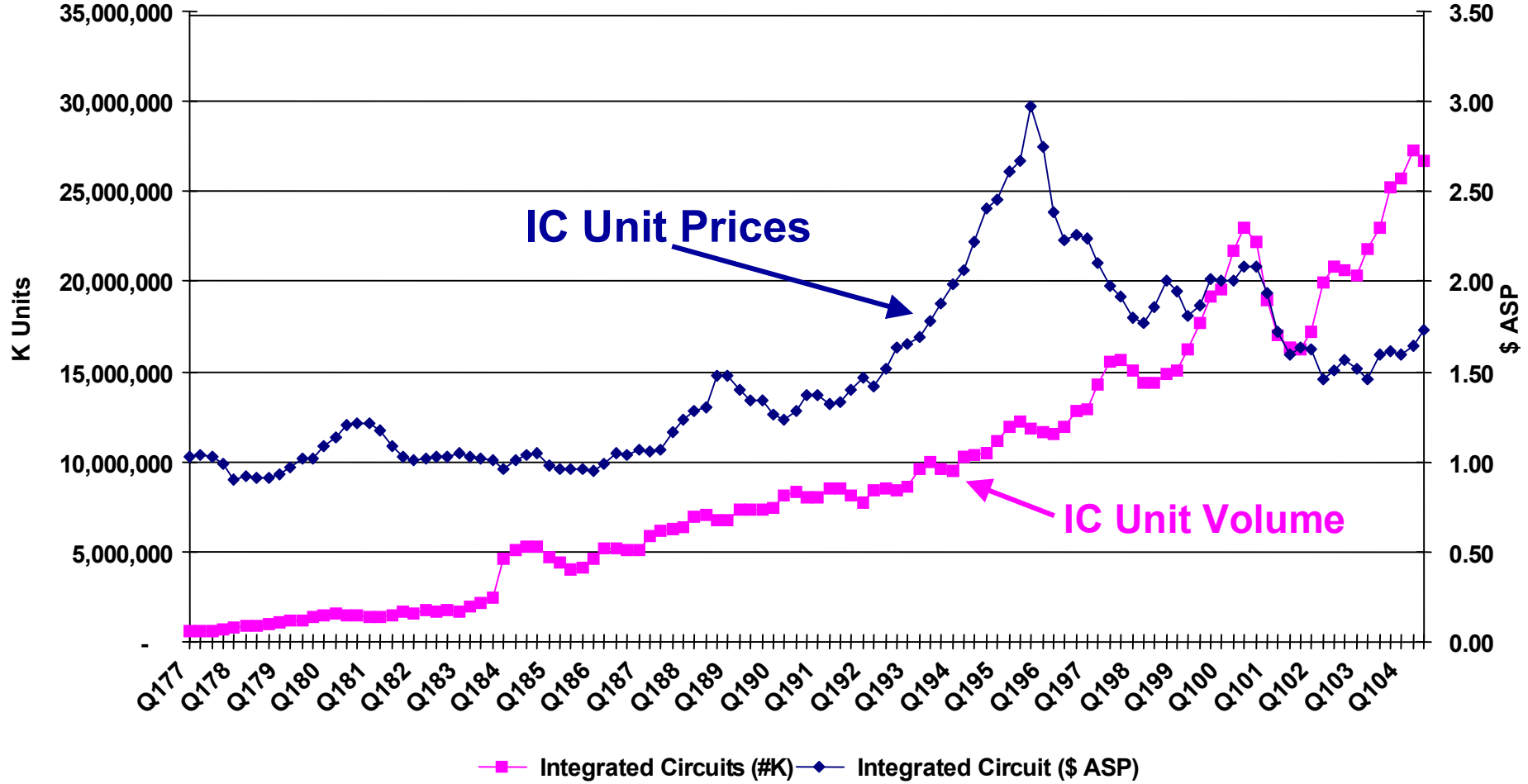
# Multi-Year Compound Growth Rate of the Semiconductor Industry is Decreasing




*Source: Transistors Produced – SIA, Semiconductor Revenue – VLSI Research*

# Integrated Circuit Unit Growth is Strong While Unit Prices are Flat

## (Q1-1977 to Q3-2004)




*Source: SIA Blue Book Market Data*

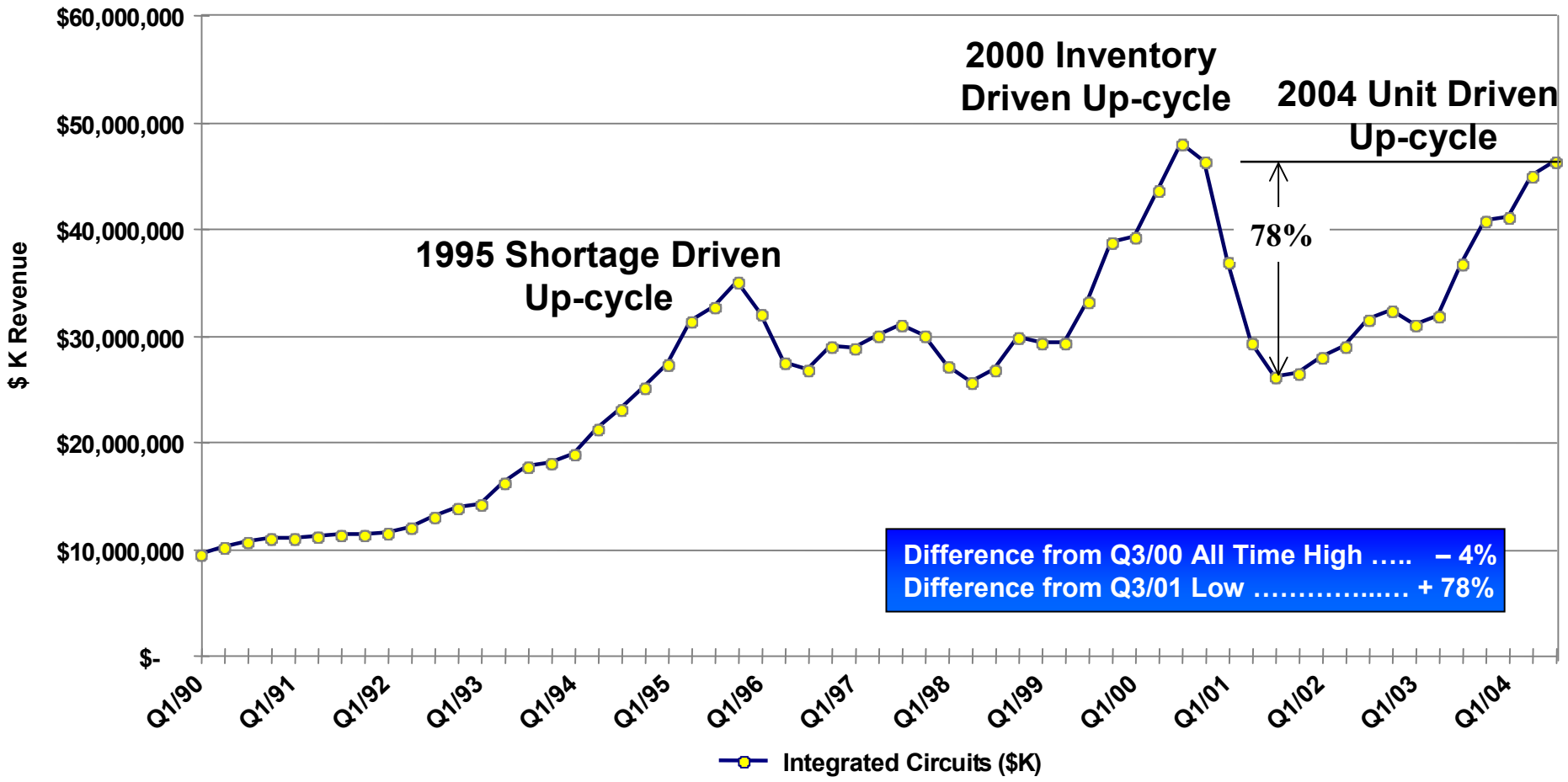
# 300 mm Fab Capacity Staged and Waiting for Demand in 2002

| | Count | WSM at Full Capacity |
|---|---|---|
| Fabs Completed to date and in volume production | 12 | 224,500 |
| Companies with fabs ready to ramp up production | 4 | 56,000 |
| Announced/In process | 10 | 225,000 -to- 245,000 |
| Others | 12 | 150,000 -to- 300,000 |
| Total Production Fabs | 38 | 655,500 -to- 825,500 |

| | | |
|---|---|---|
| R&D/Pilot | 7 | |

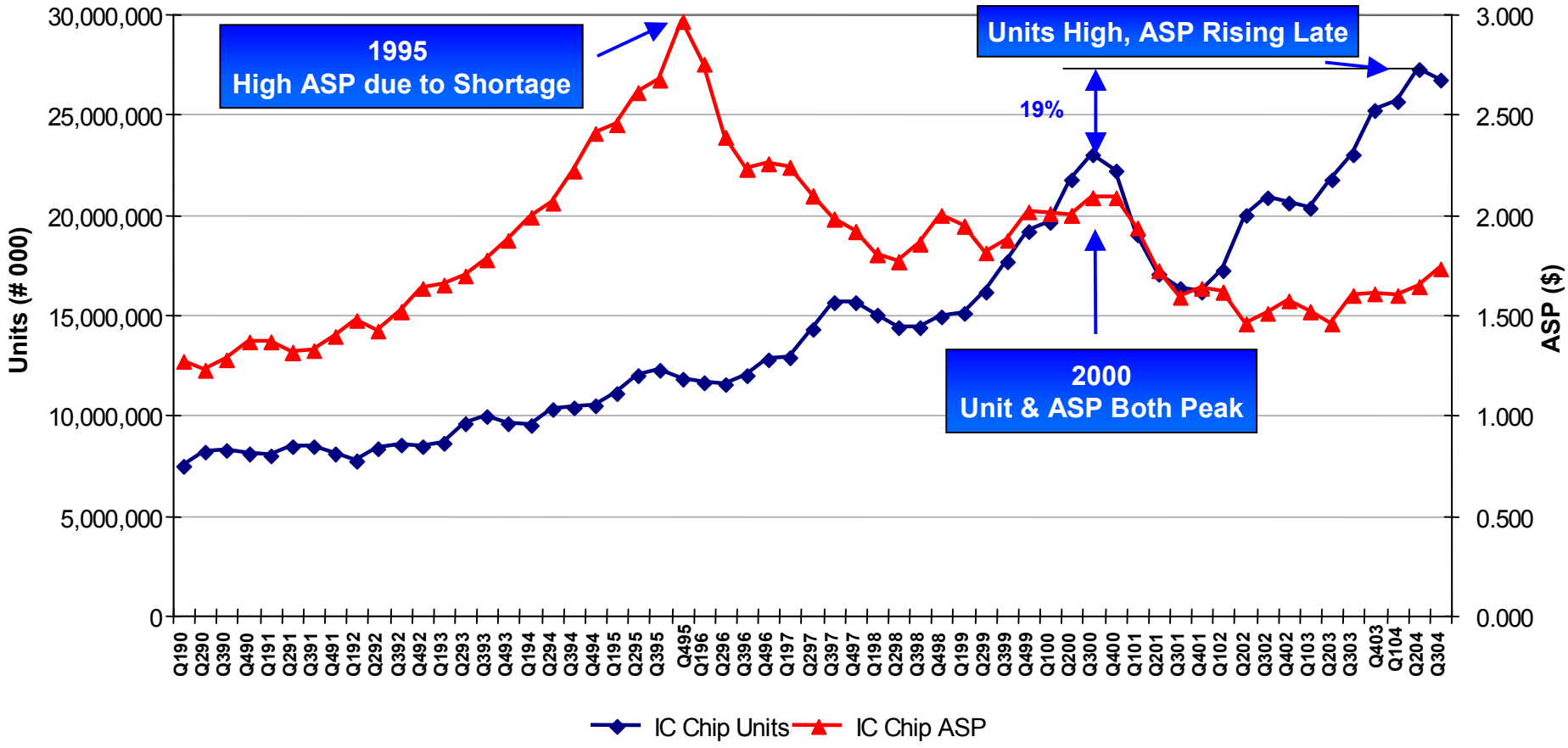
*Source: VLSI Research & Mentor Graphics*

# Semiconductor Integrated Circuit Revenue is Near an All-time High Level



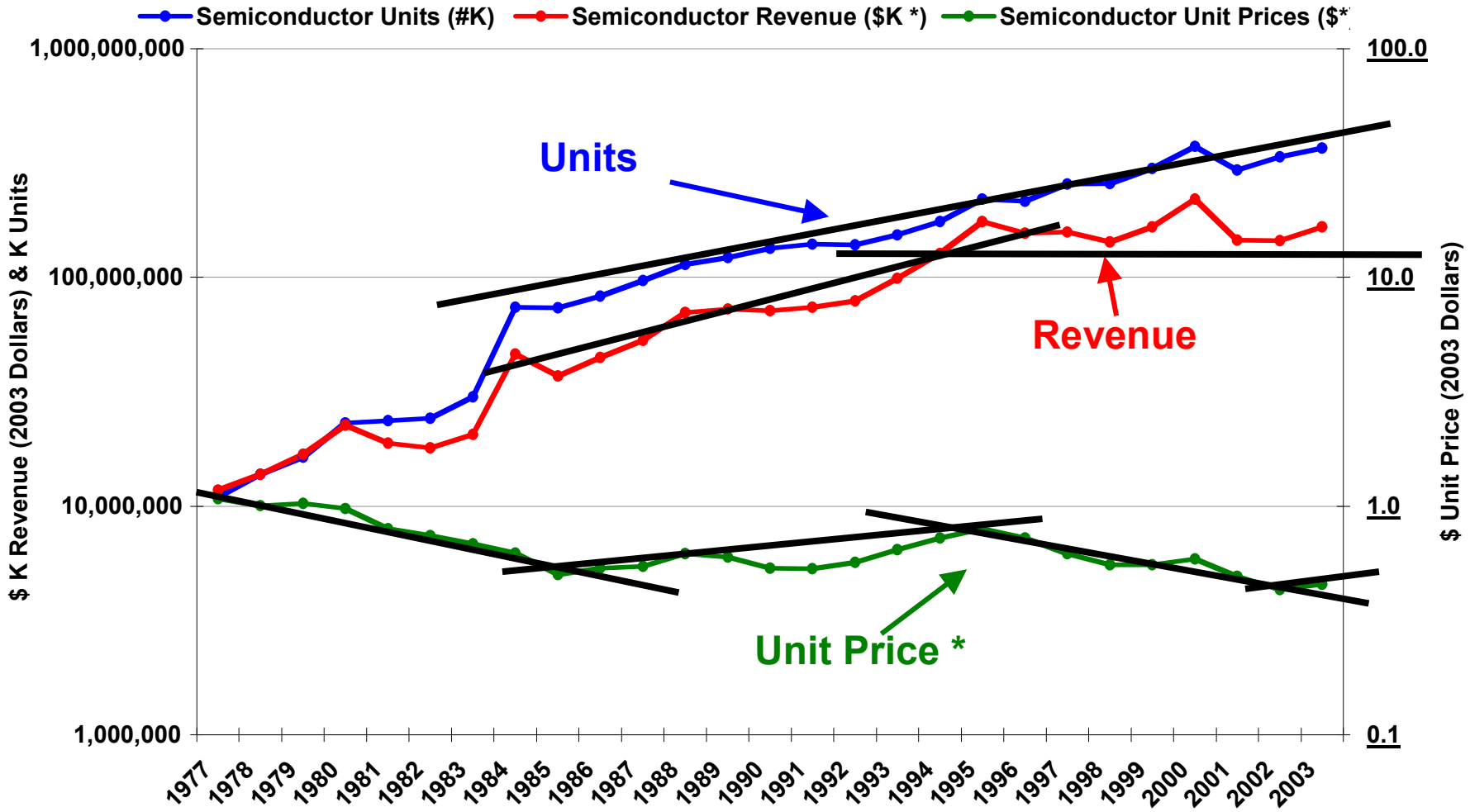

*Source: SIA Blue Book Market Data*

# Unit Volume Growing Faster than Revenue, Driven by Consumer and Wireless



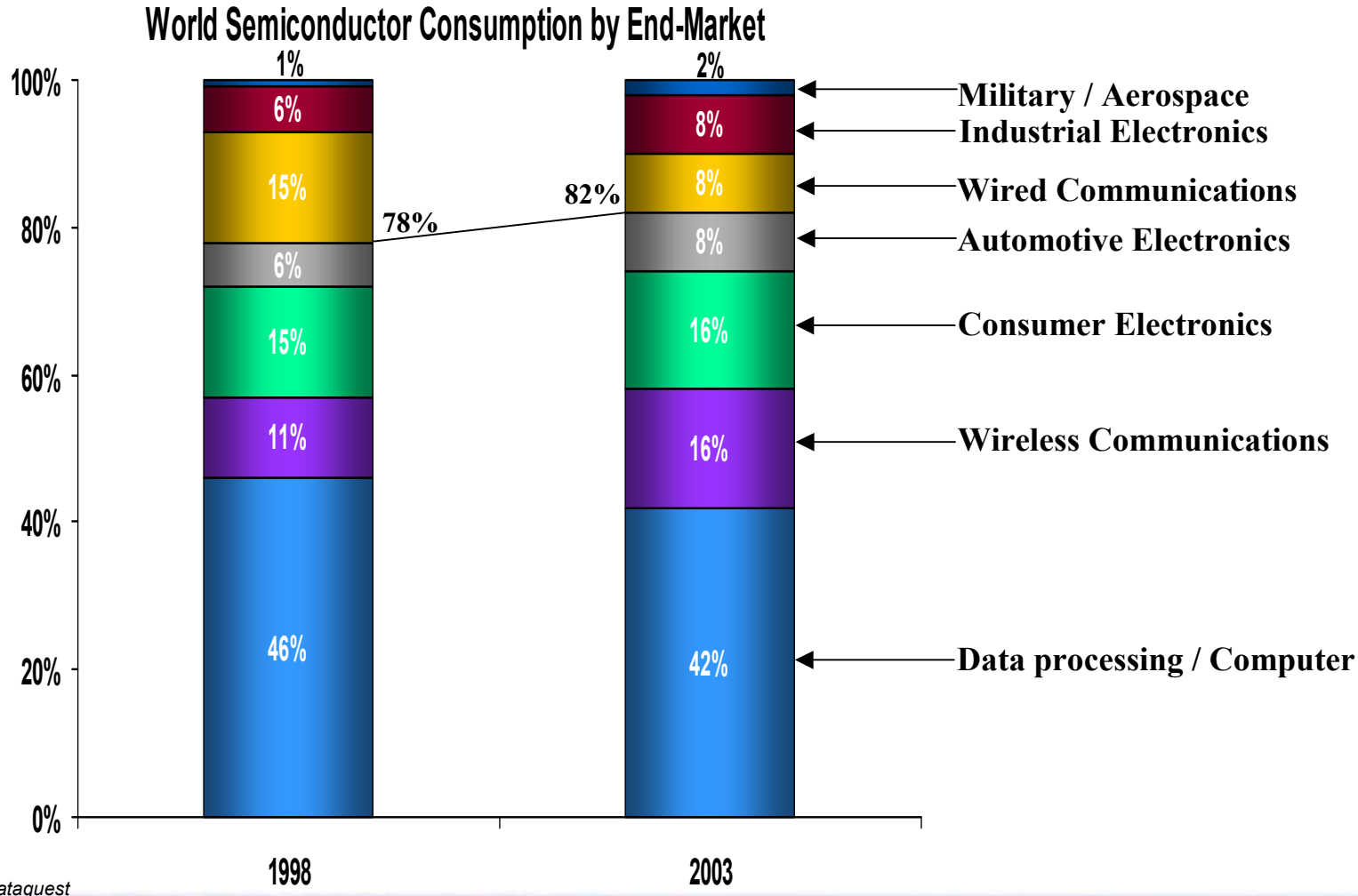

*Source: SIA Blue Book Market Data*

# As Unit Prices Stabilize, Semiconductor Revenue Growth Should Increase




** Note: Adjusted for Inflation* *Source: SIA, Federal Reserve Bank*

# Semiconductor Driven by Consumer Oriented End-Markets



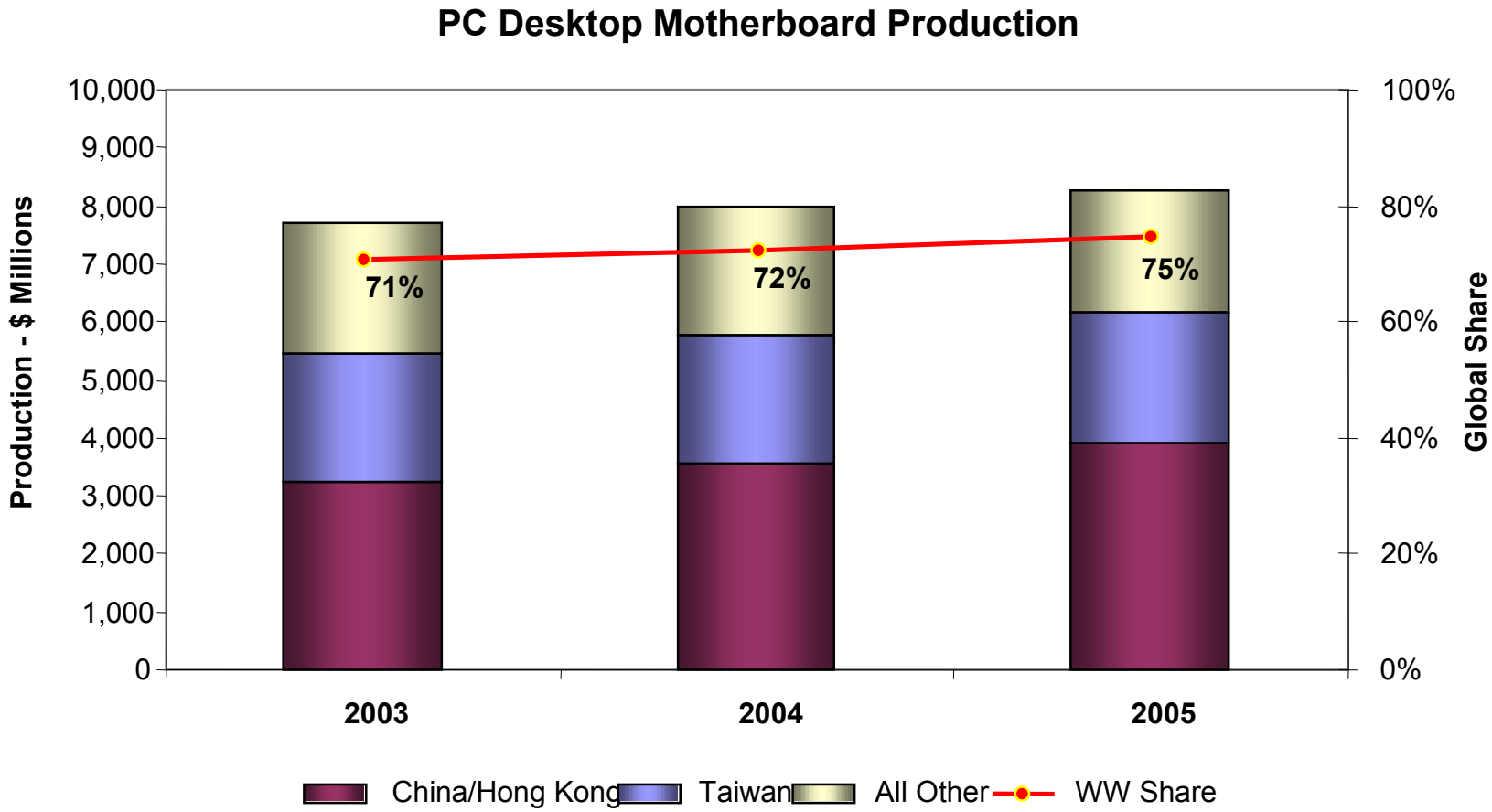

*Source: Gartner/Dataquest*

# Taiwan Has Been Leading the Consumer Growth Markets

| | |
|---|---|
| Foundry Services | 71.0% |
| Mask ROM | 48.0% |
| IC Packaging | 30.4% |
| Notebook OEM | 49.0% |
| LCD Monitor | 39.2% |
| CD-R | 83.3% |
| CD-RW | 70.3% |
| DVD | 74.5% |
| PC Camera | 58.0% |
| Ethernet Card | 66.0% |
| HUB | 74.8% |
| ADSL Modem | 59.6% |
| Wireless LAN (WLAN) | 60.0% |
| Analog Modem | 41.7% |

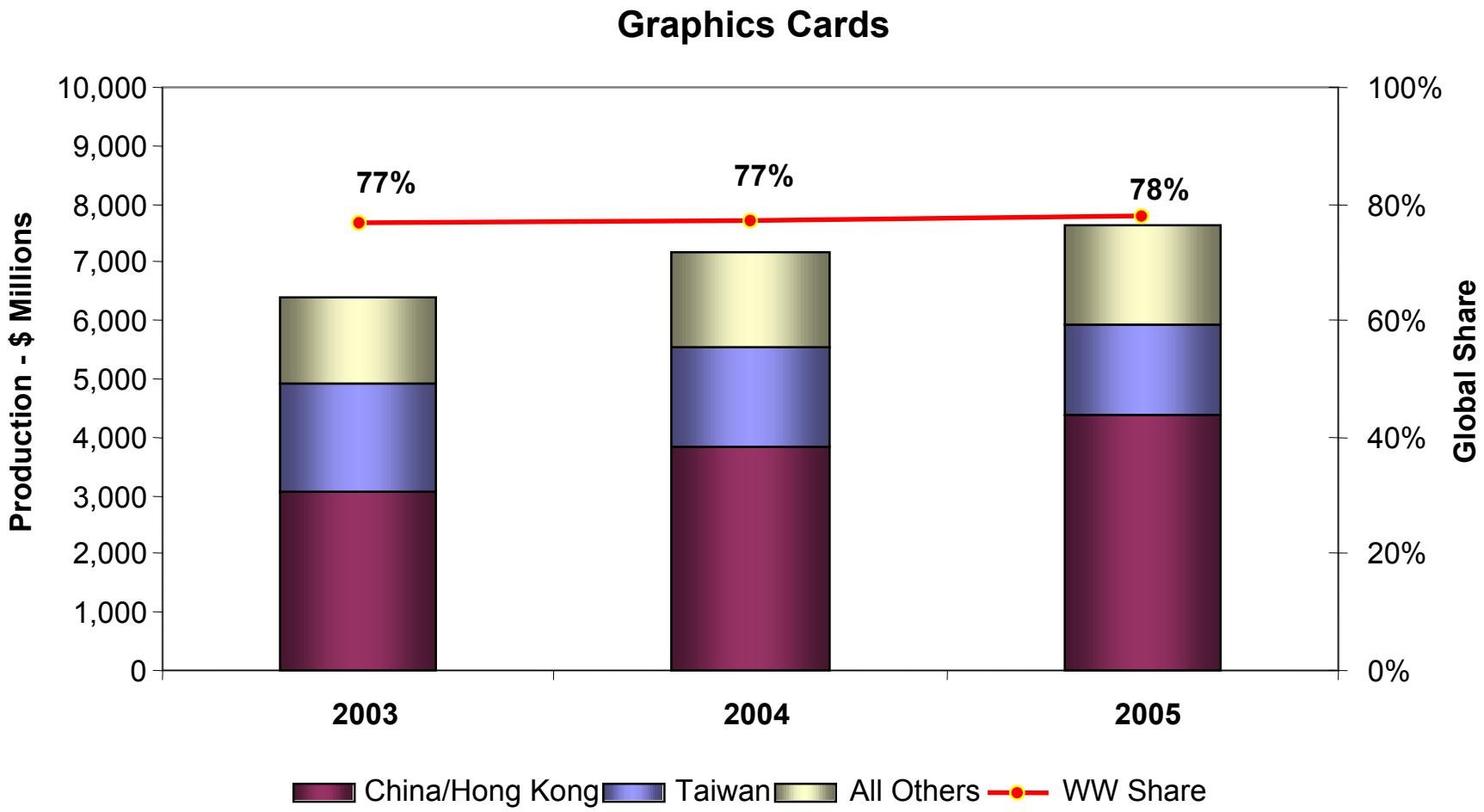
** Note: Adjusted for Inflation* *Source: Taiwan Ministry of Economic Affairs, 2002*

# China & Taiwan Dominate Motherboard Production



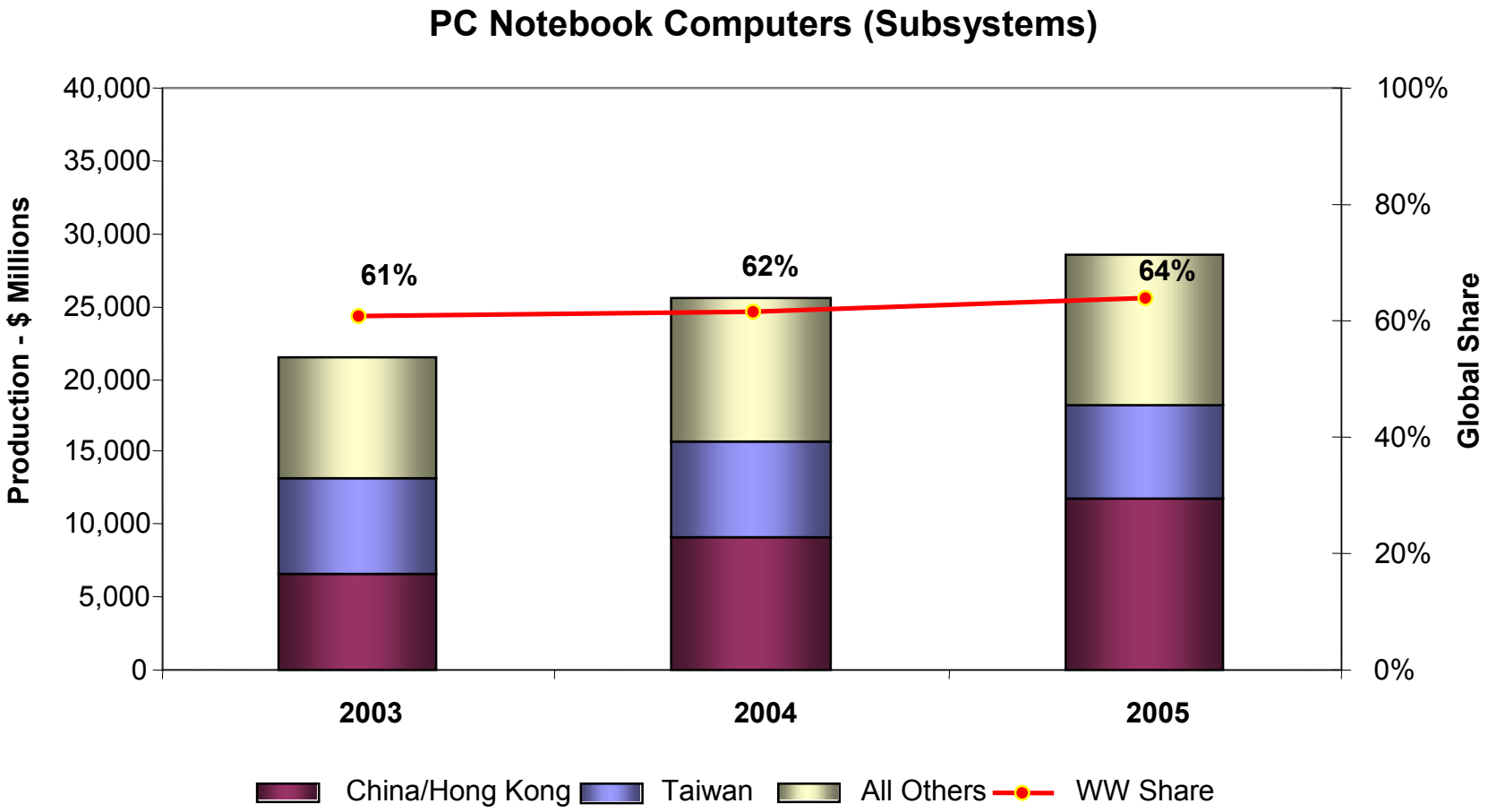

*Source: Gartner/Dataquest, 2004*

# China/Taiwan Dominate the Graphics Card Industry



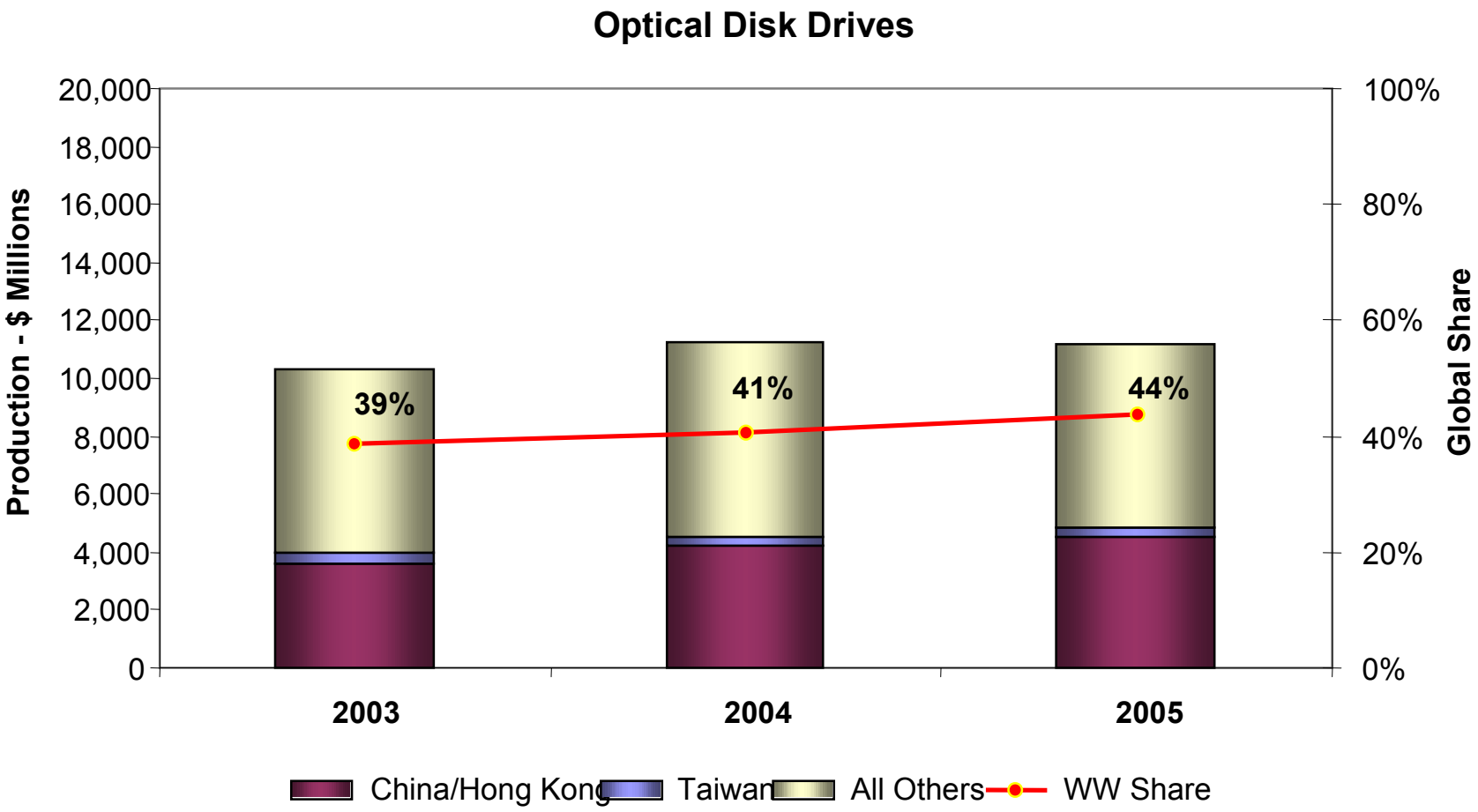

*Source: Gartner/Dataquest, 2004*

# China/Taiwan Leading in Notebook Production



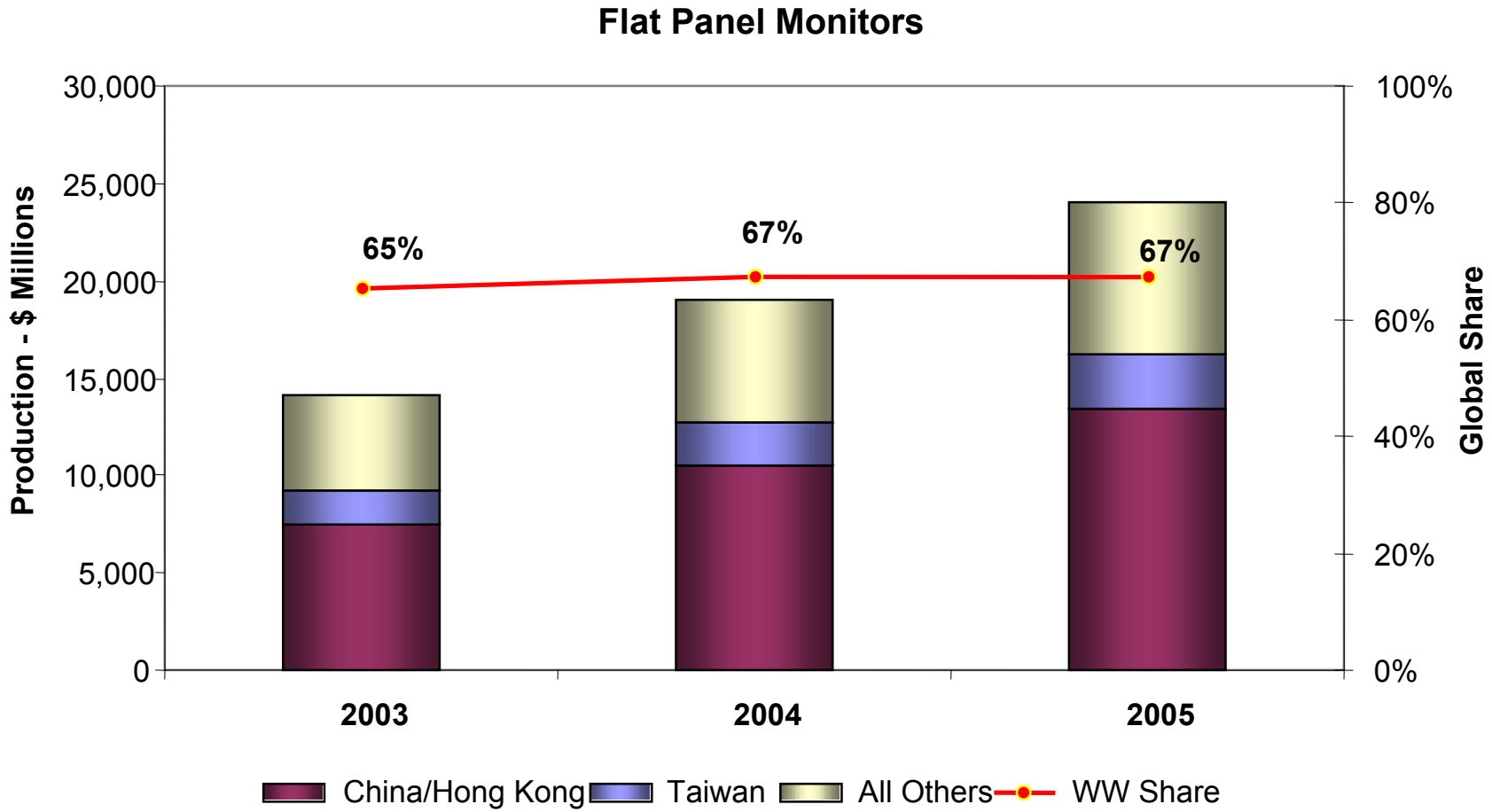

*Source: Gartner/Dataquest, 2004*

# China Leading the Optical Disk Drive Industry



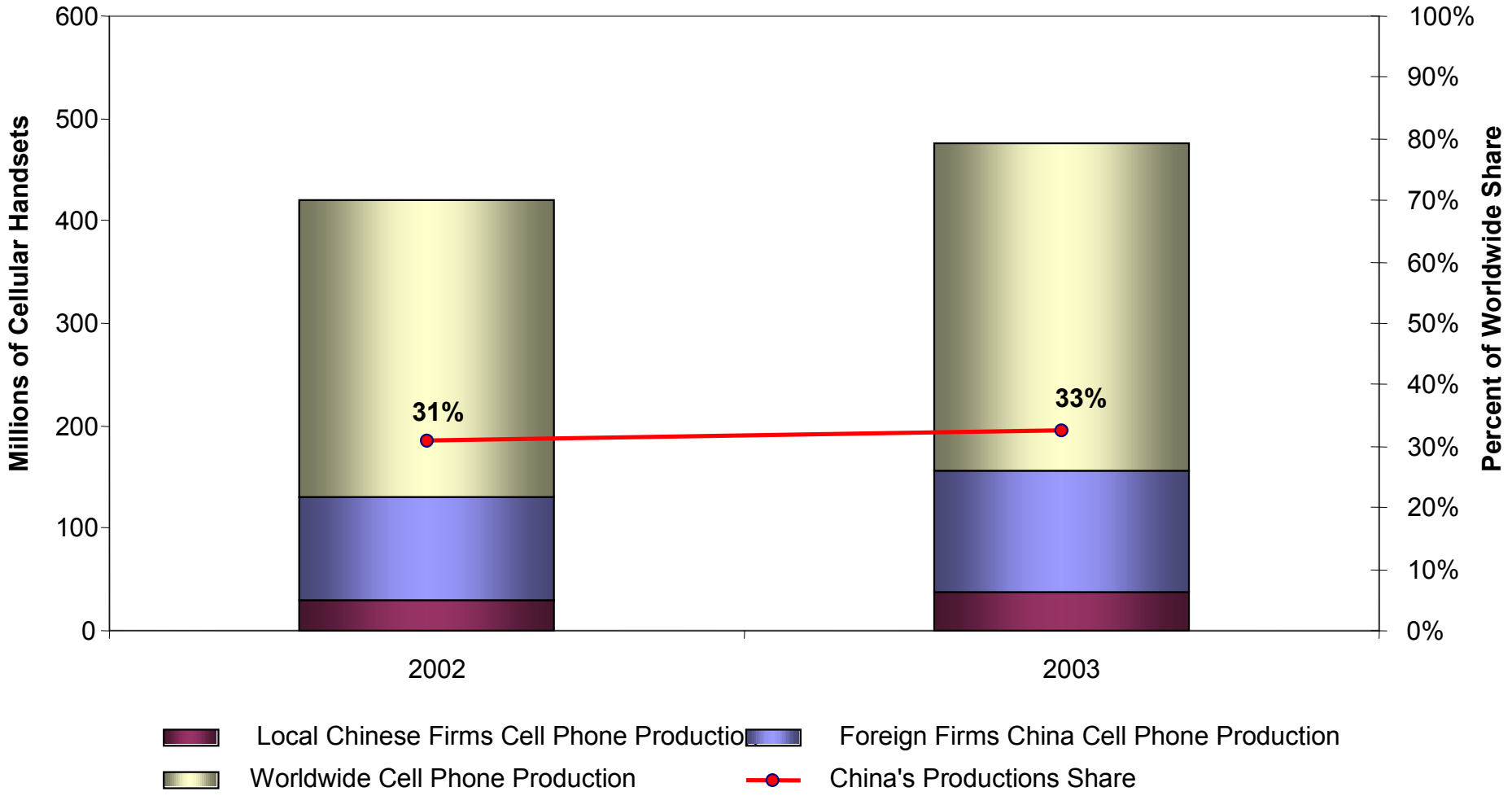

*Source: Gartner/Dataquest, 2004*

# China/Taiwan Dominate Flat Panel Monitors



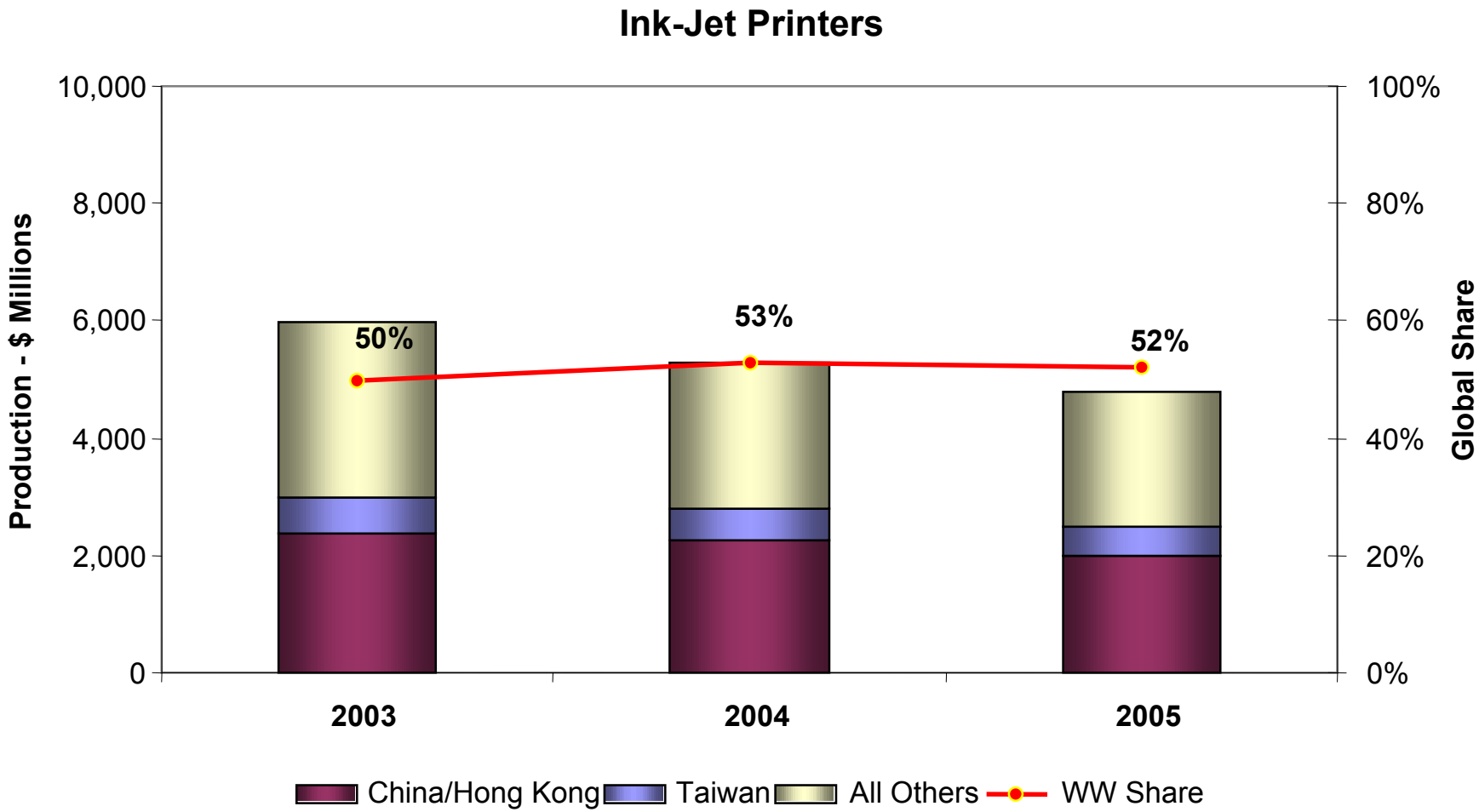

*Source: Gartner/Dataquest, 2004*

# China's Cellular Phone Production



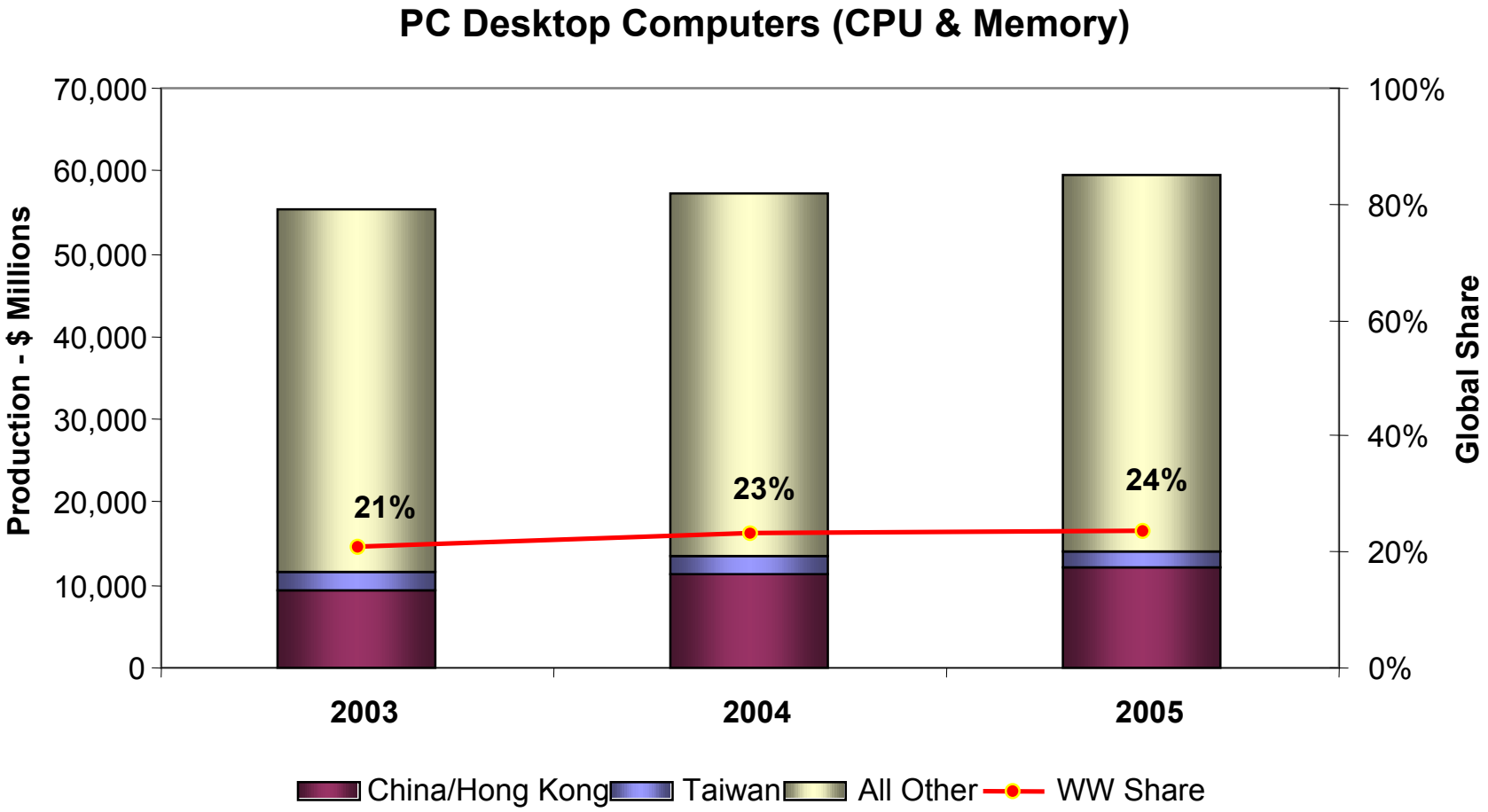

*Source: IC Insights Emerging Markets 2004*

# China/Taiwan Lead in Ink-Jet Printers



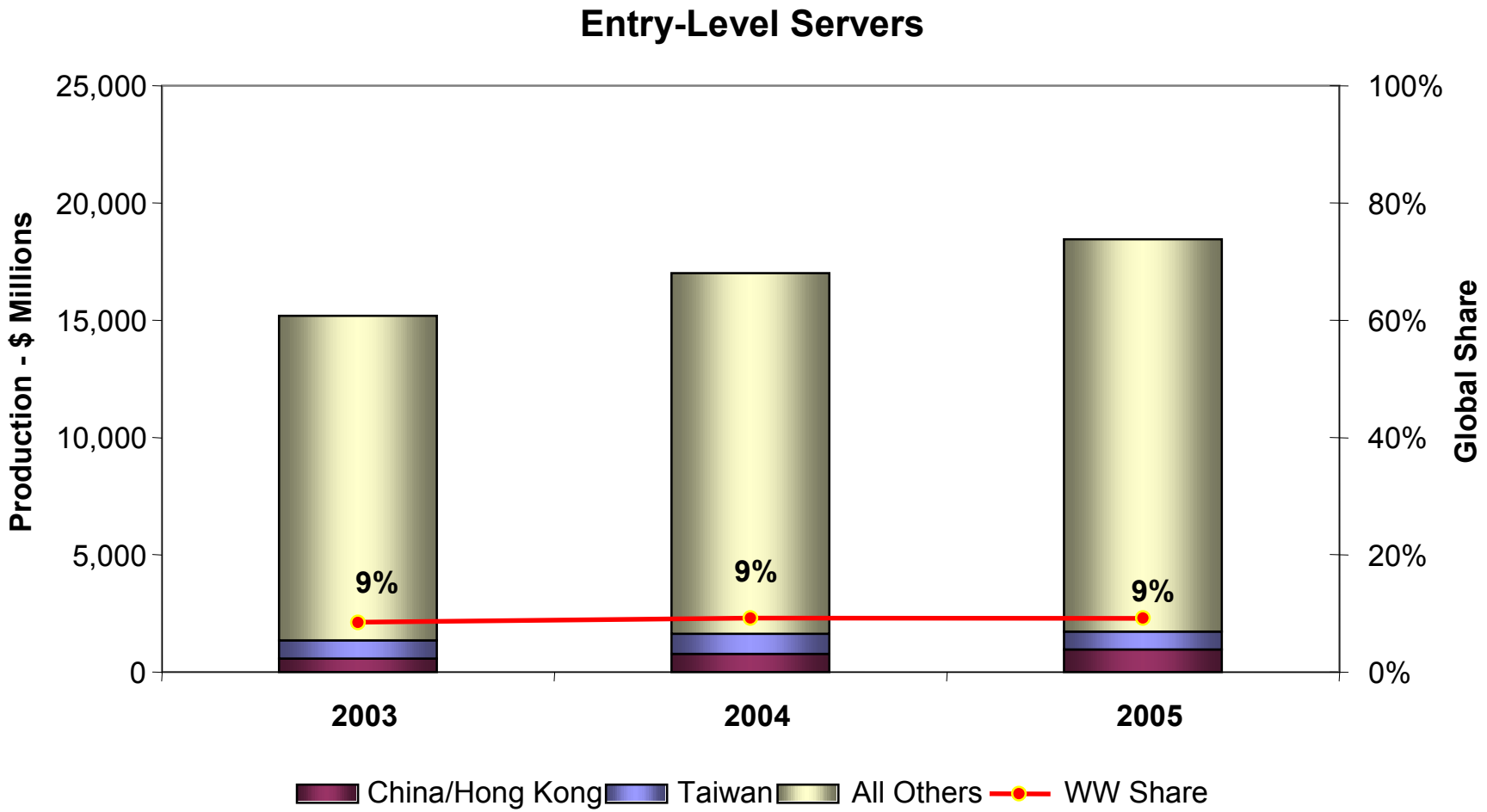

*Source: Gartner/Dataquest, 2004*

# China/Taiwan Only a Quarter of the PC Desktop Systems Market



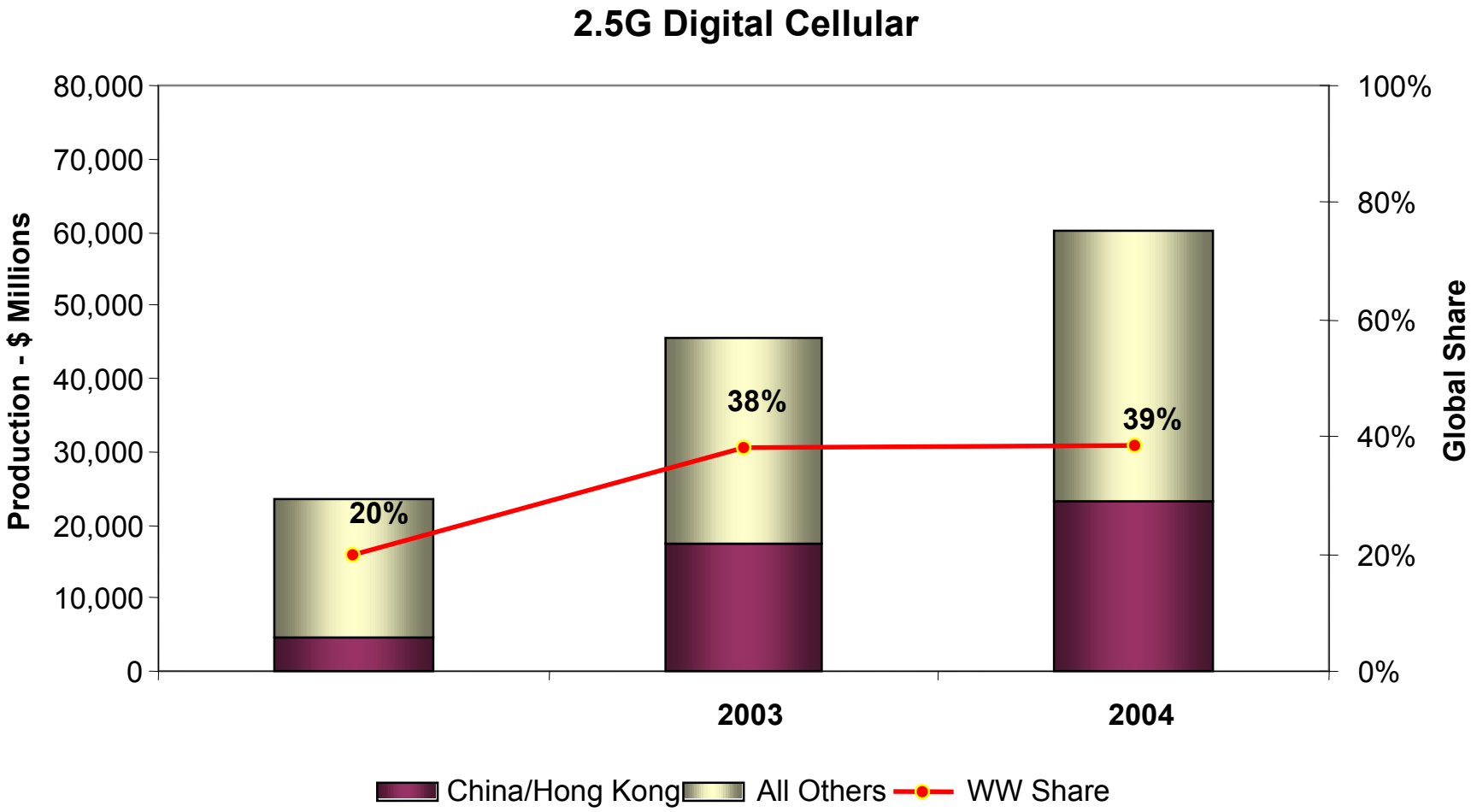

*Source: Gartner/Dataquest, 2004*

# China/Taiwan Lag in Entry-Level Servers




*Source: Gartner/Dataquest, 2004*

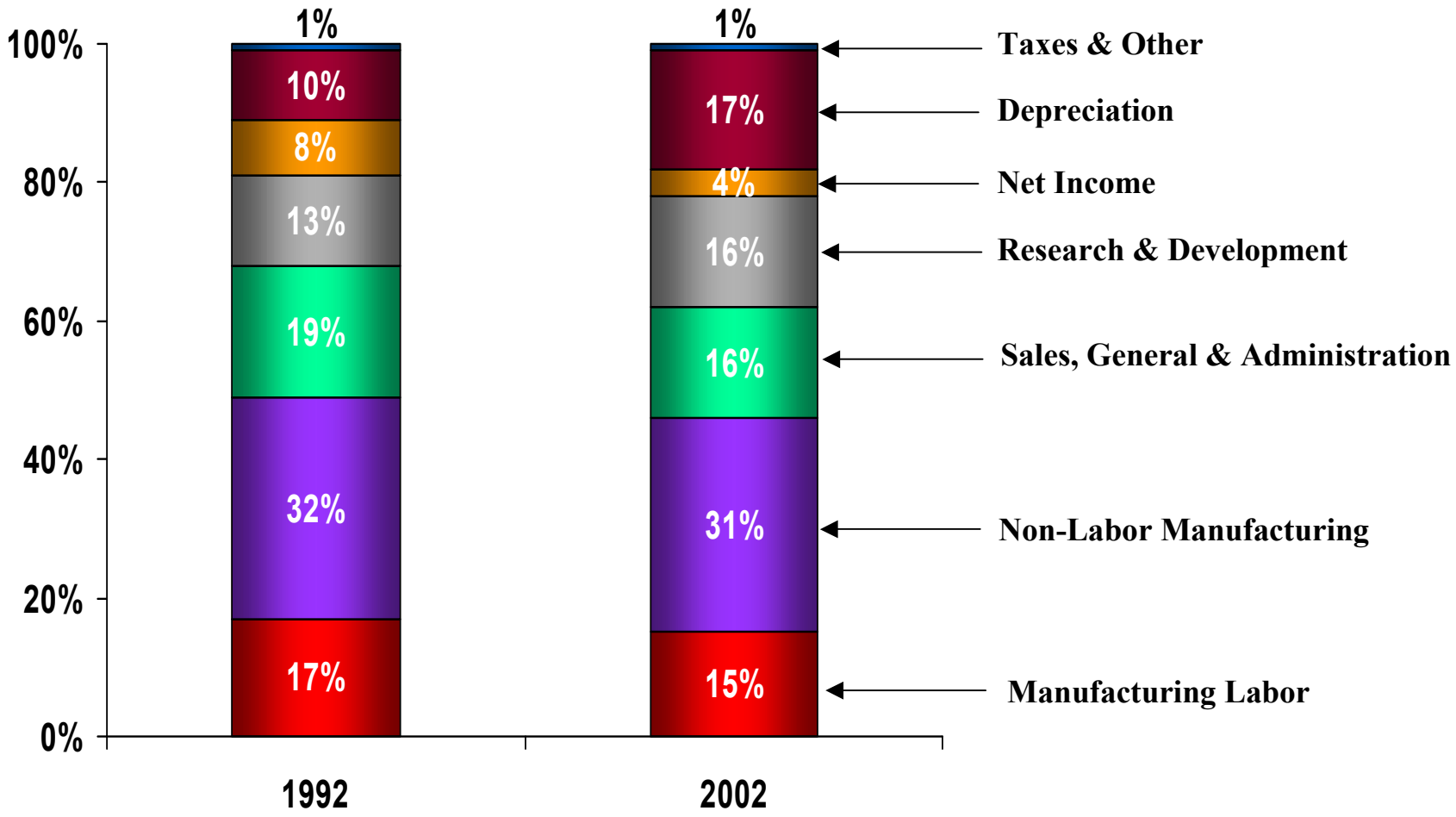
# China Growing in 2.5G Digital Cellular
## (Taiwan not Available)




*Source: Gartner/Dataquest, 2004*

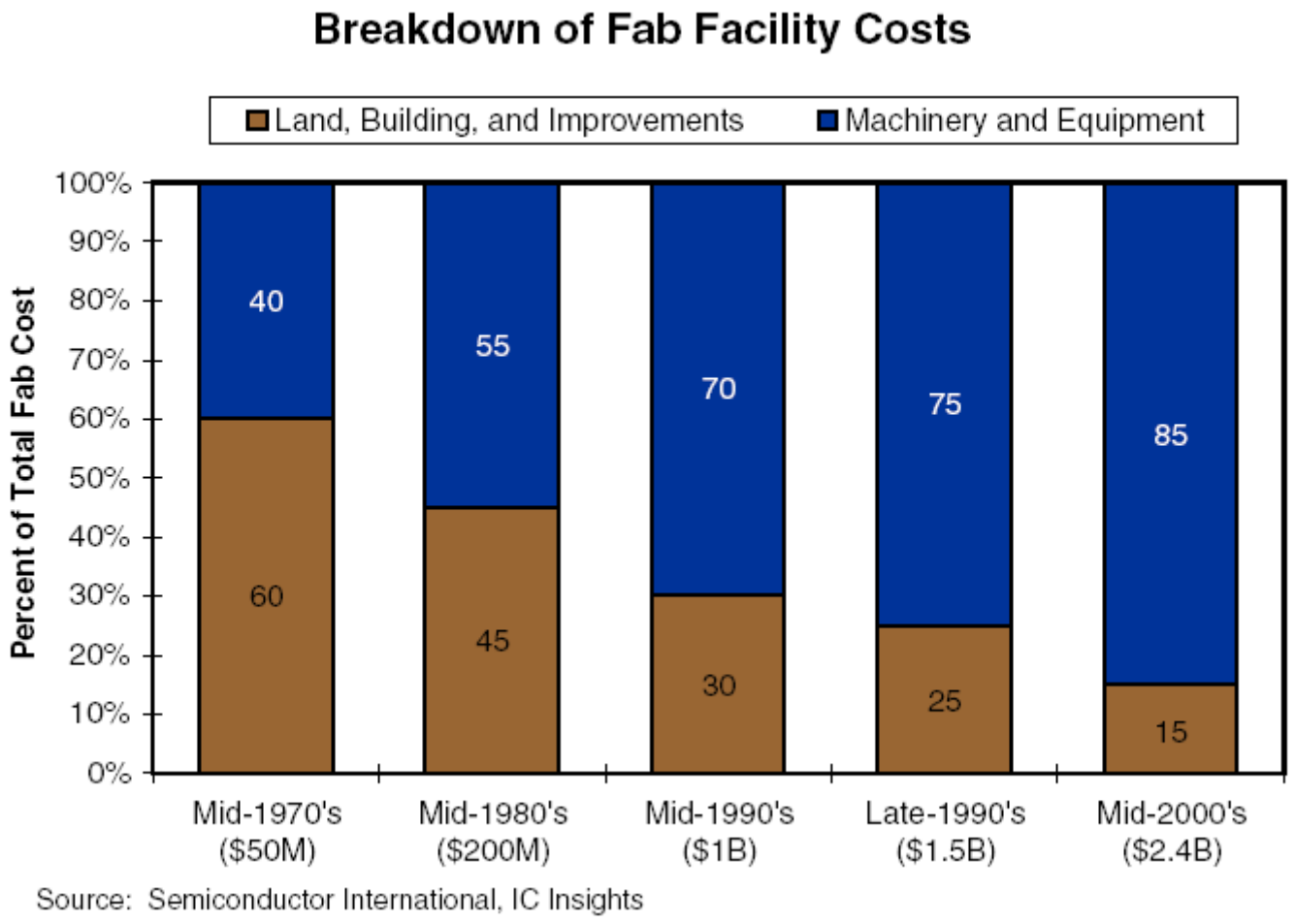
# Manufacturing Labor Not Driving US Semiconductor Cost

**Cost Structure of US-Based Merchant Producers – 1992 vs. 2002**




*Source: Semiconductor Industry Association, 2003 Databook*

# Machinery and Equipment Drive Fab Cost




Source: Semiconductor International, IC Insights

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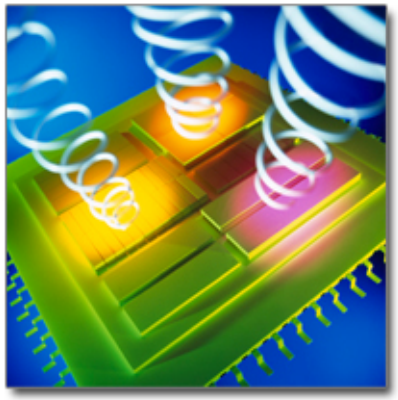
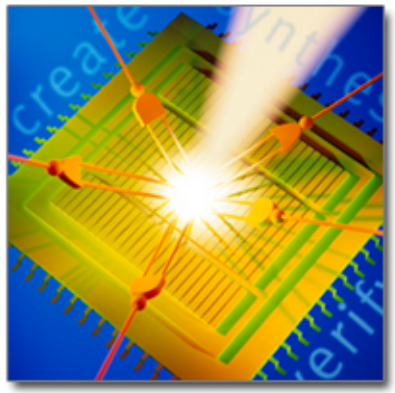
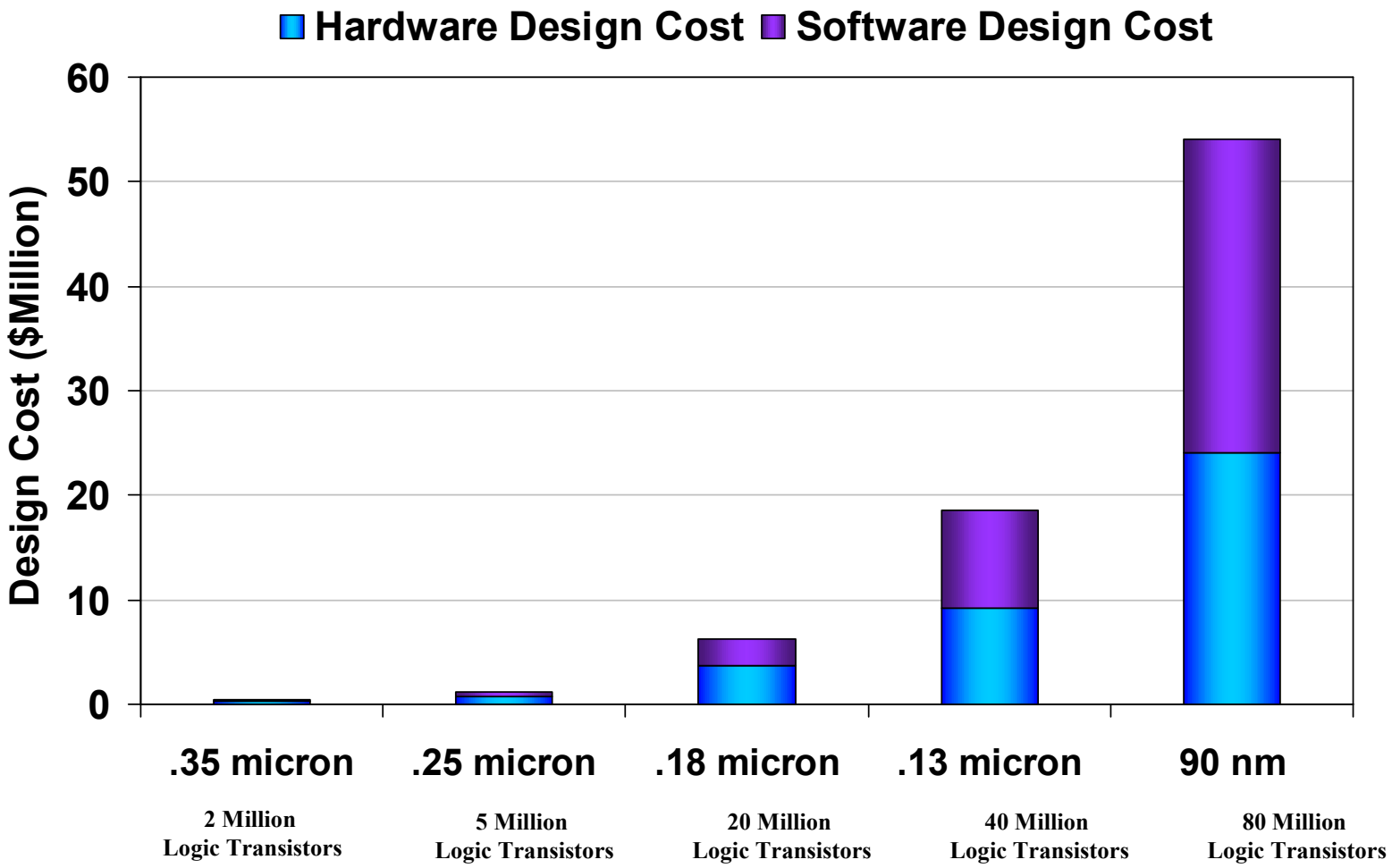


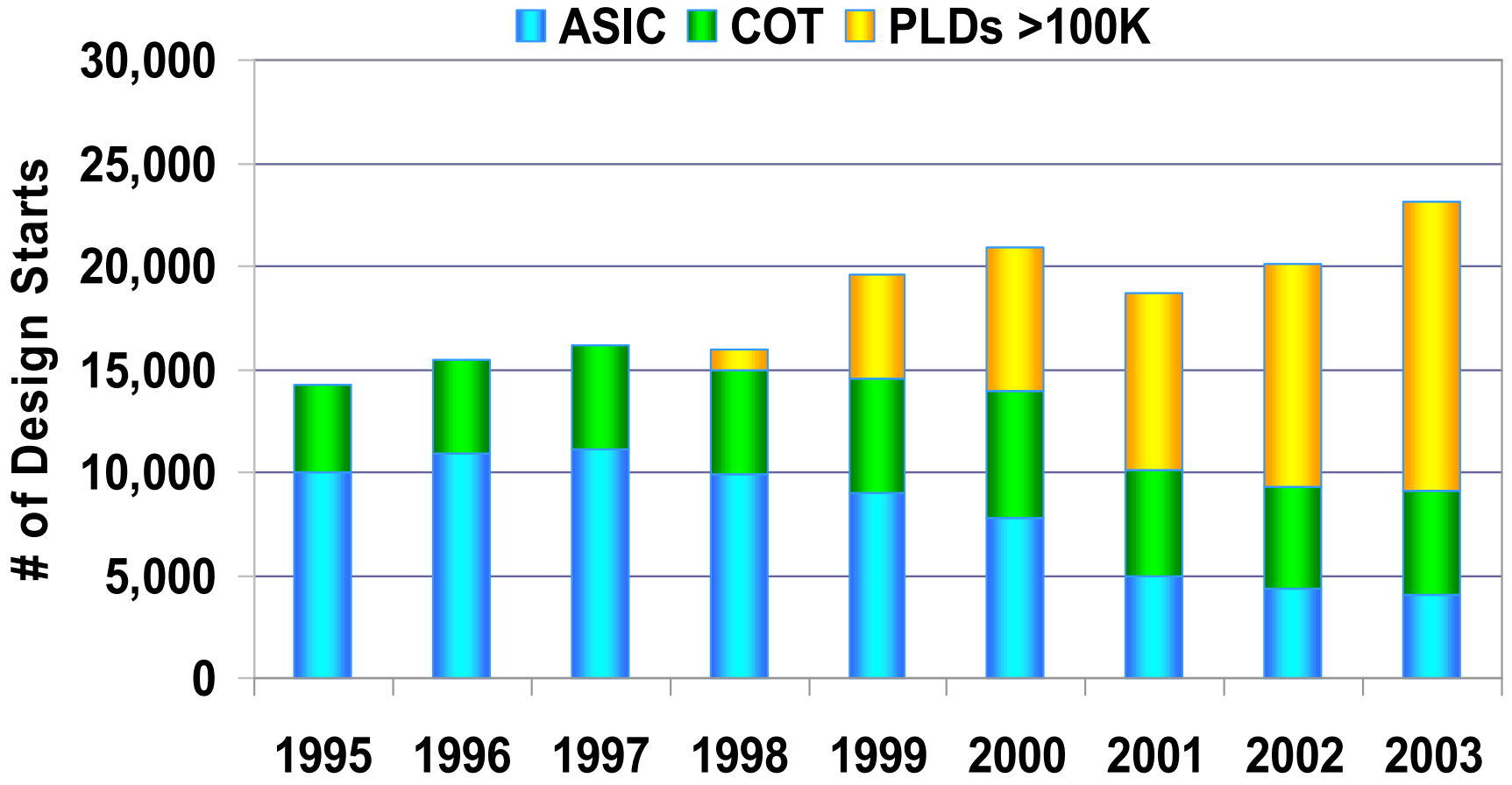


# Cost of Design is Becoming a Major Portion of Total Semiconductor Cost



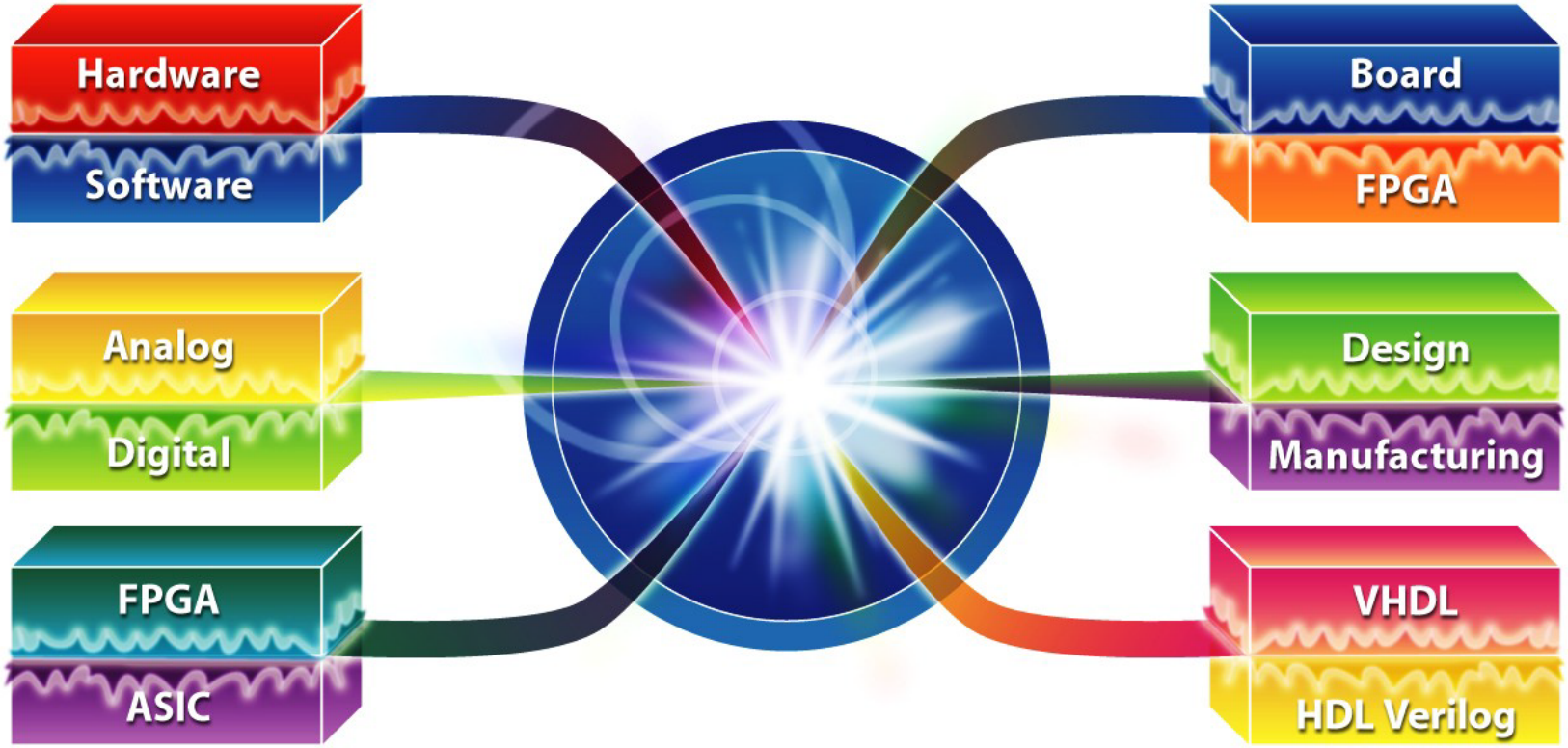

*Source: IBS, Analysis of the Relationship Between EDA Expenditures and Competitive Positioning of IC Vendors*

# Design Flexibility and Cost are Driving Design Starts to Field Programmable Logic




*Source: Dataquest, ASIC/SOC: "Rebuilding After the Storm", 11/19/02*

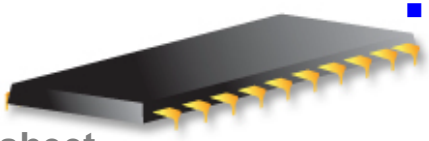
# SoC Design Requires Integration of Disparate Parts



# Semiconductor Support of Original Design Manufacturers

## Then

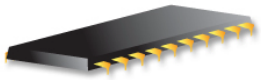
- Pricing
- Production Commitment



- Datasheet
- Application Notes

## Now

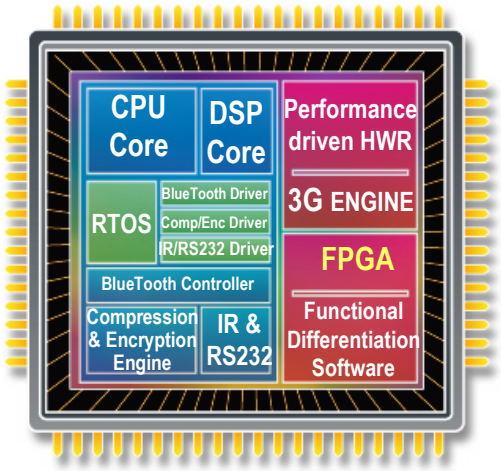
- Application Engineers
- Firmware Modification
- Embedded RTOS



- Application Software
- Reference Designs
- Customization

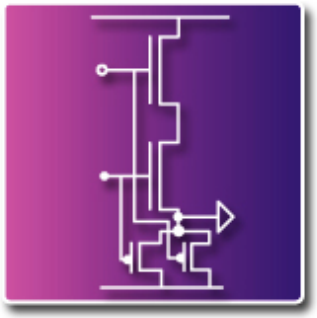
# Cost-Effective Custom IC Design Requires Raising the Level of Abstraction

**IP Blocks & Buses**



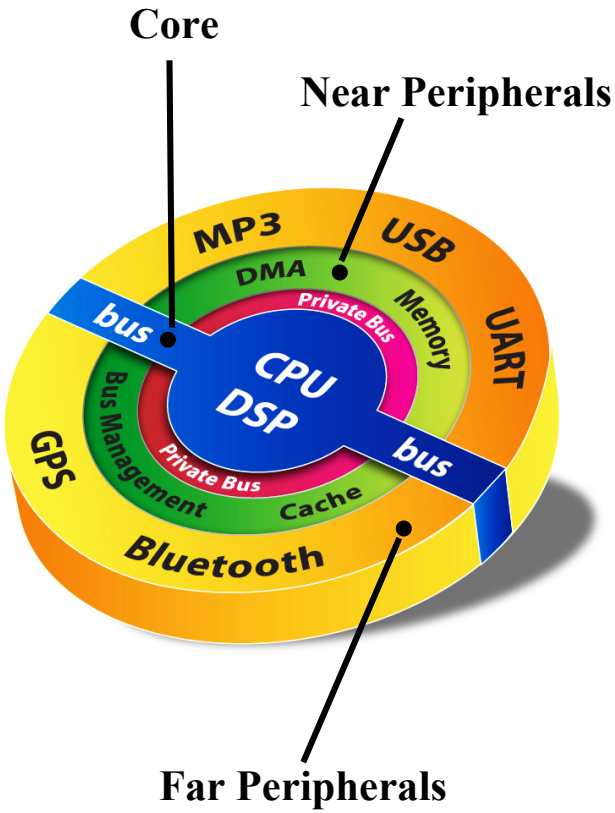

**RTL**


**Gate**



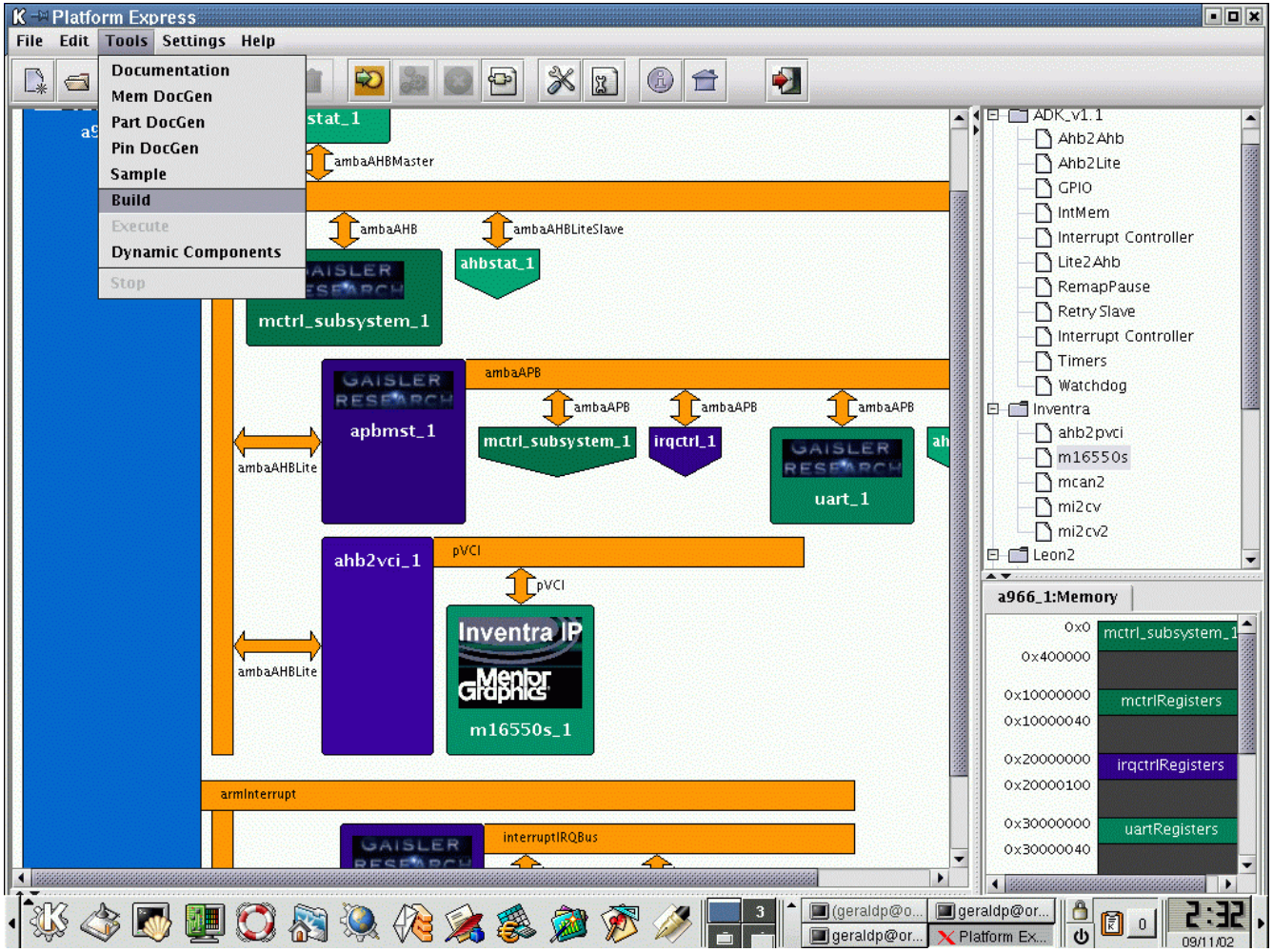
**Transistor**

# Platforms Enable Simplified SoC Design



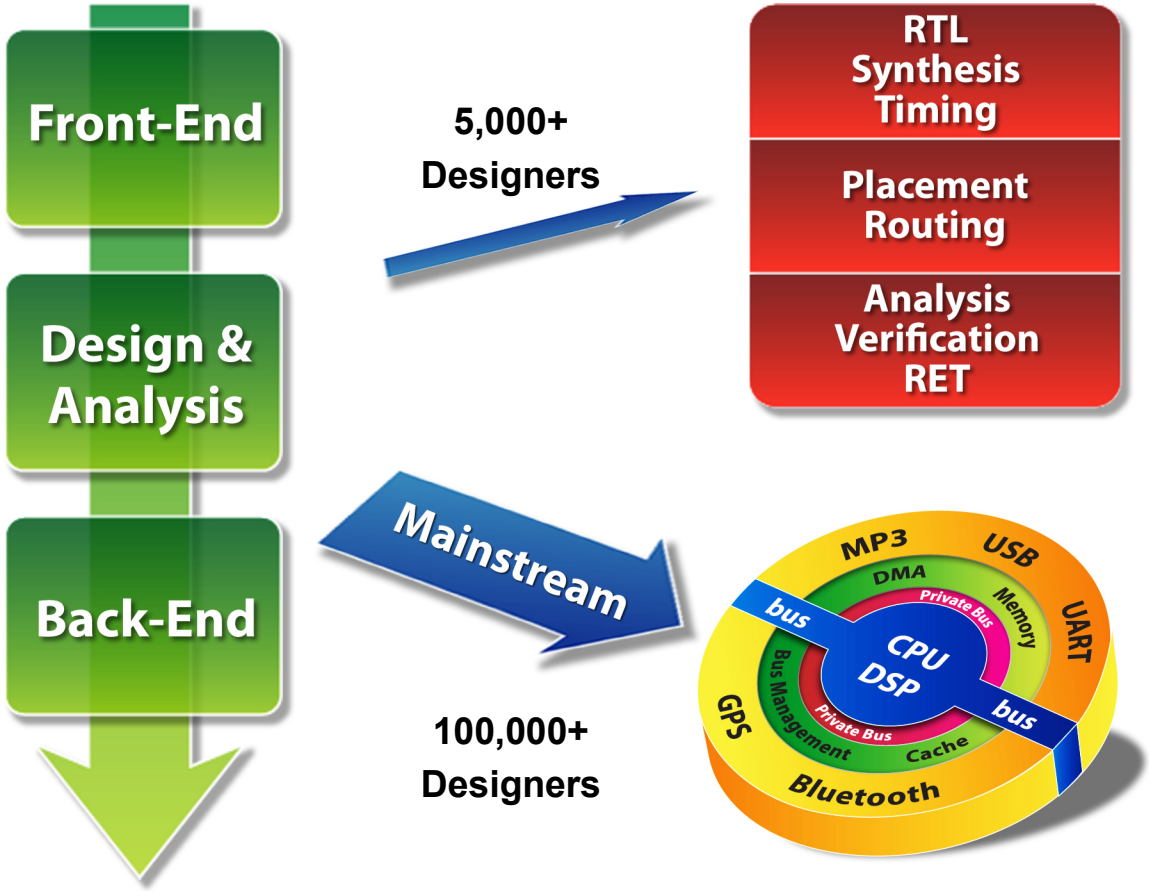

- Customer demands
  - Fast turn-around time
  - Easy access to pre-qualified building blocks
  - Web enabled
- Design technology
  - Core platforms
  - 'Big' IP
  - Emerging SoC bus standards
  - Embedded software
  - HW/SW co-verification

# And Automation of IP Selection & Integration

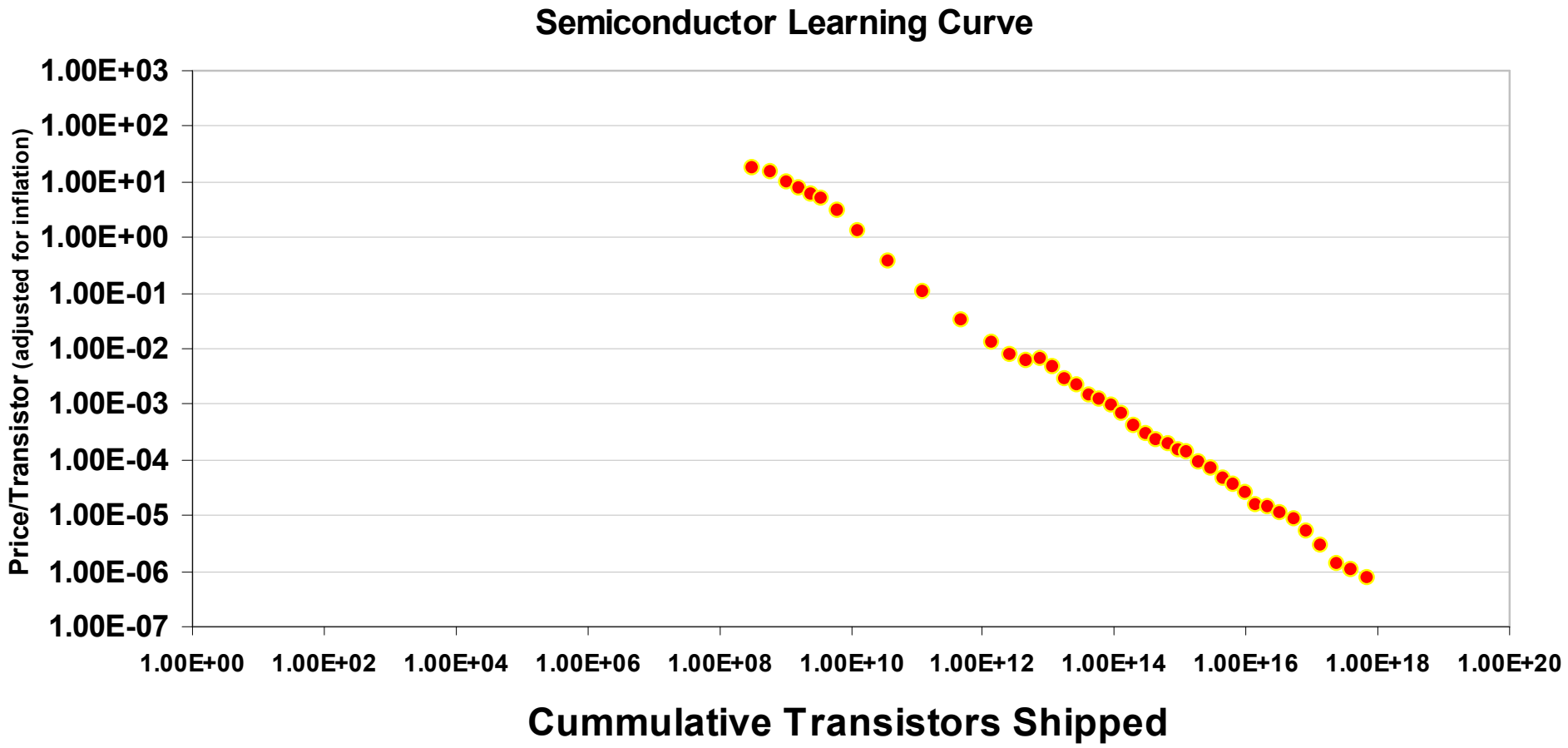


# Shift in System/SoC Design Empowers Growing Number of Engineers

## IP & Platform Creation



# System Cost Reduction Makes New Applications Possible




*Source: Mentor Graphics, SIA, Woodrow Federal Reserve Bank*

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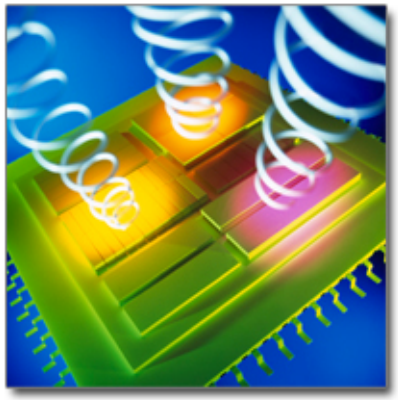

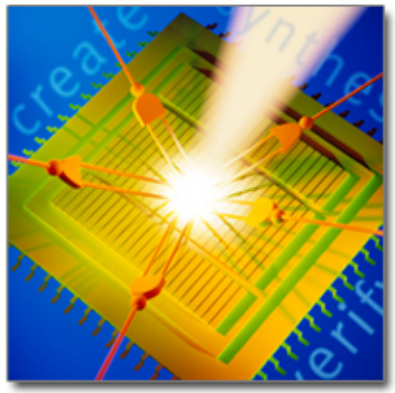

# Increasing the Number of Innovators Increases Innovation

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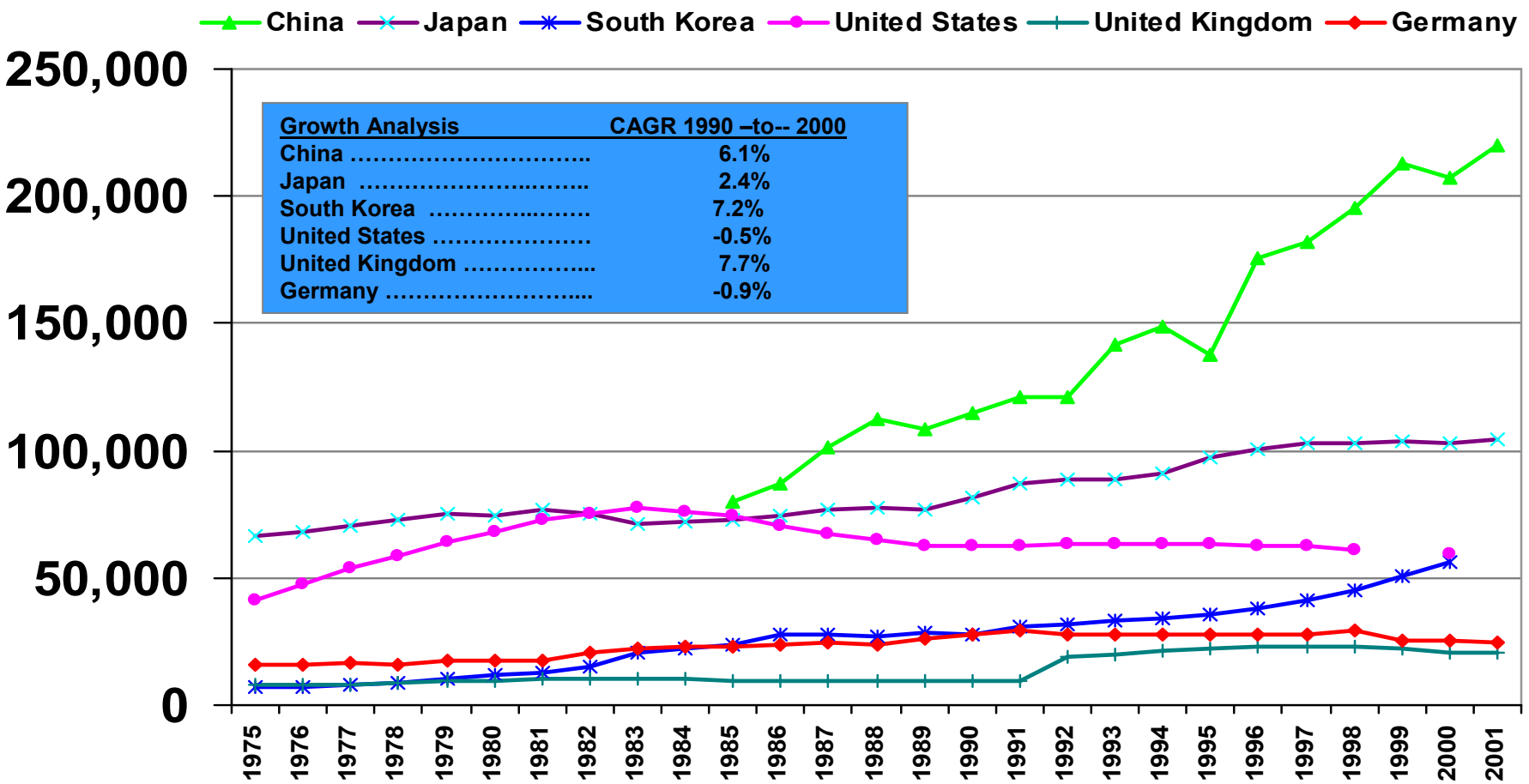
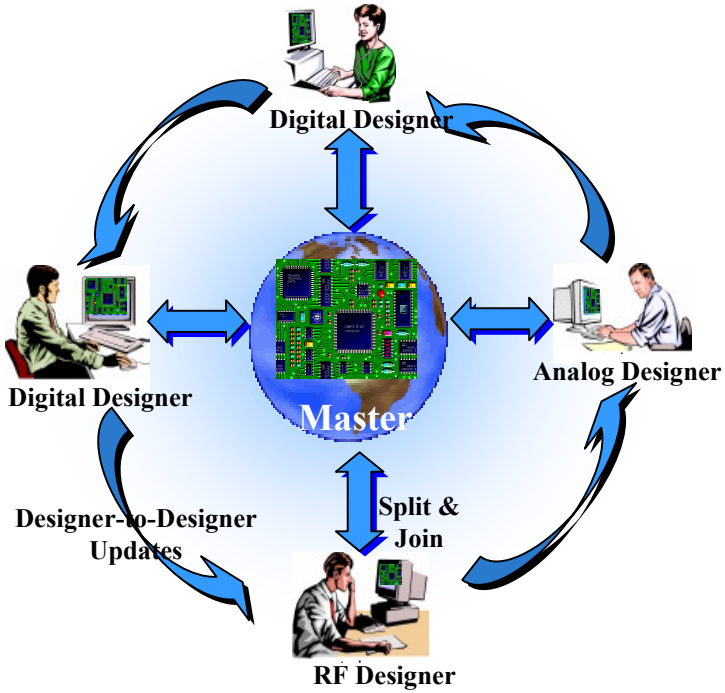
# Geographic Distribution of Electronics Innovators is Changing

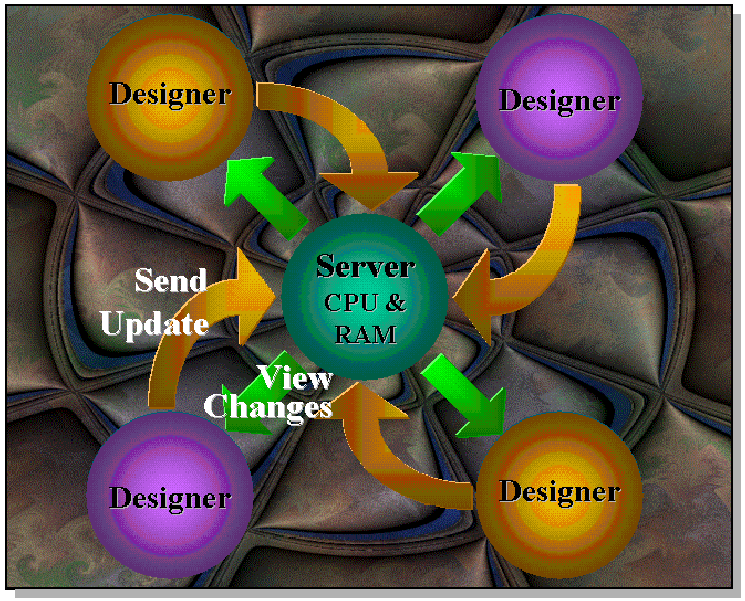



*Source: National Science Foundation, Science & Engineering Indicators - 2004*

# Design Work Will Be Done Concurrently At Many Locations



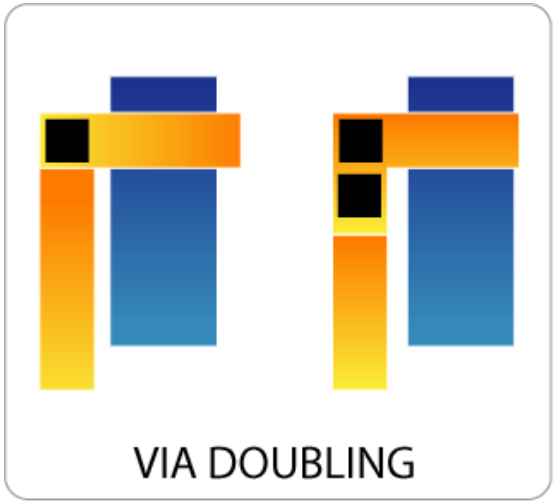

- Divide design into sections
- Layout sections in parallel
- Share progress with other designers
- Merge sections back into master design



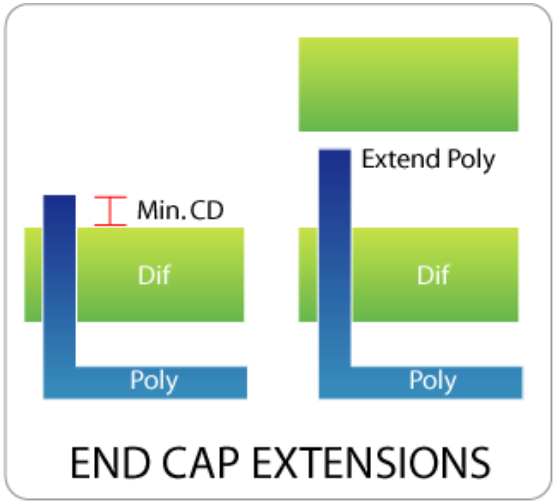

- Simultaneous design on a common database
- Dynamic update of designer's views
- Heterogeneous design tool environment

# Manufacturing Yield Improvement Requires "Design for Manufacturing"

- **DRC Rules**
  - Checks design compliance with process rules
- **DFM Rules**
  - Define the optimal layout for highest yield
  - Must be implemented in an RET-aware environment

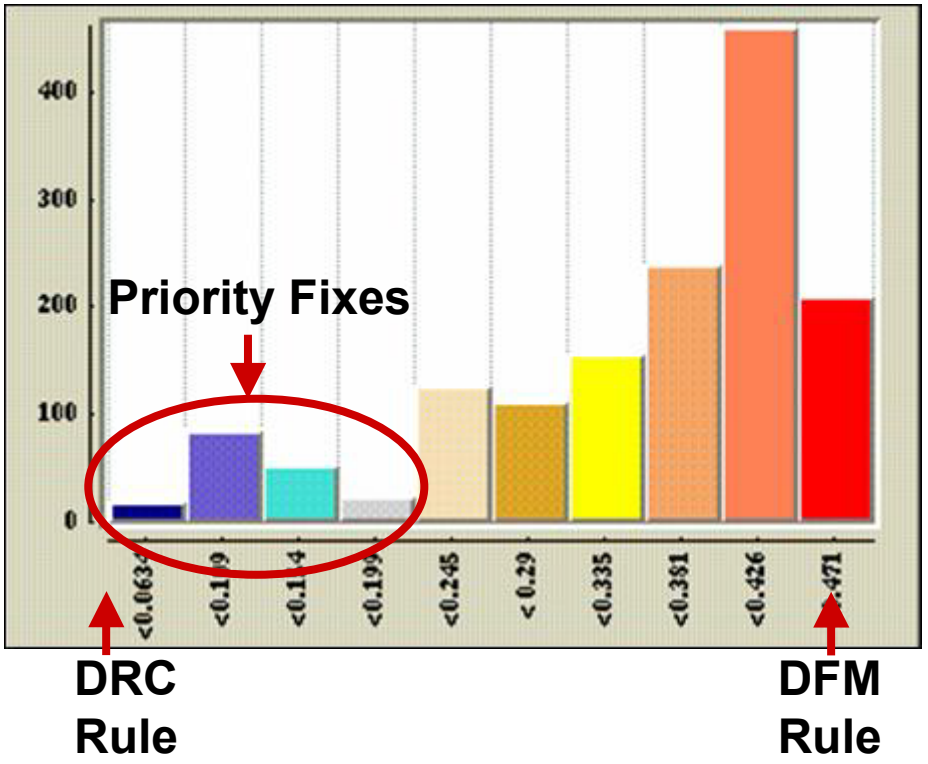






# Design Guidelines vs. Design Rules

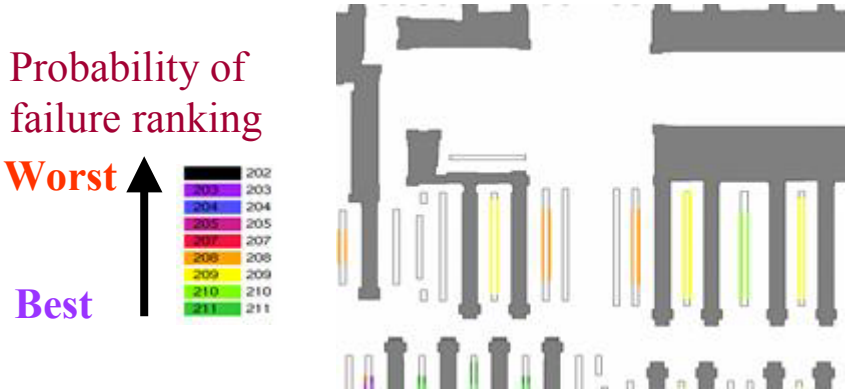
- Designers need to know which design features most affect manufacturing yield



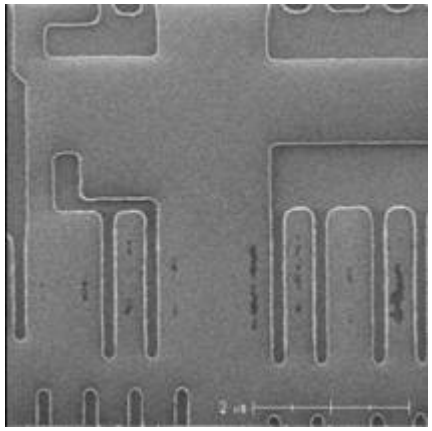
# Designers Need to Know Effects of Manufacturing Variability

**Process Models**

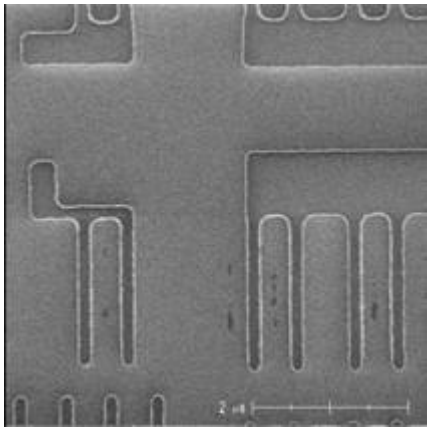

**Identify weak post-RET regions**



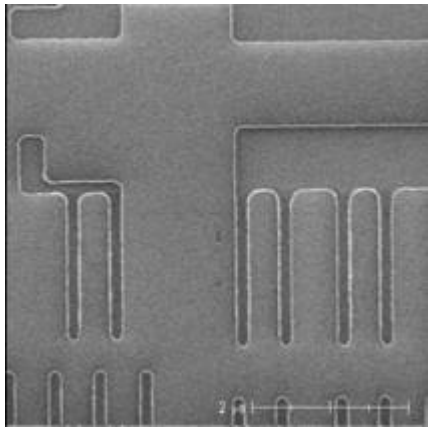

Probability to failure report



**12% Underdose**



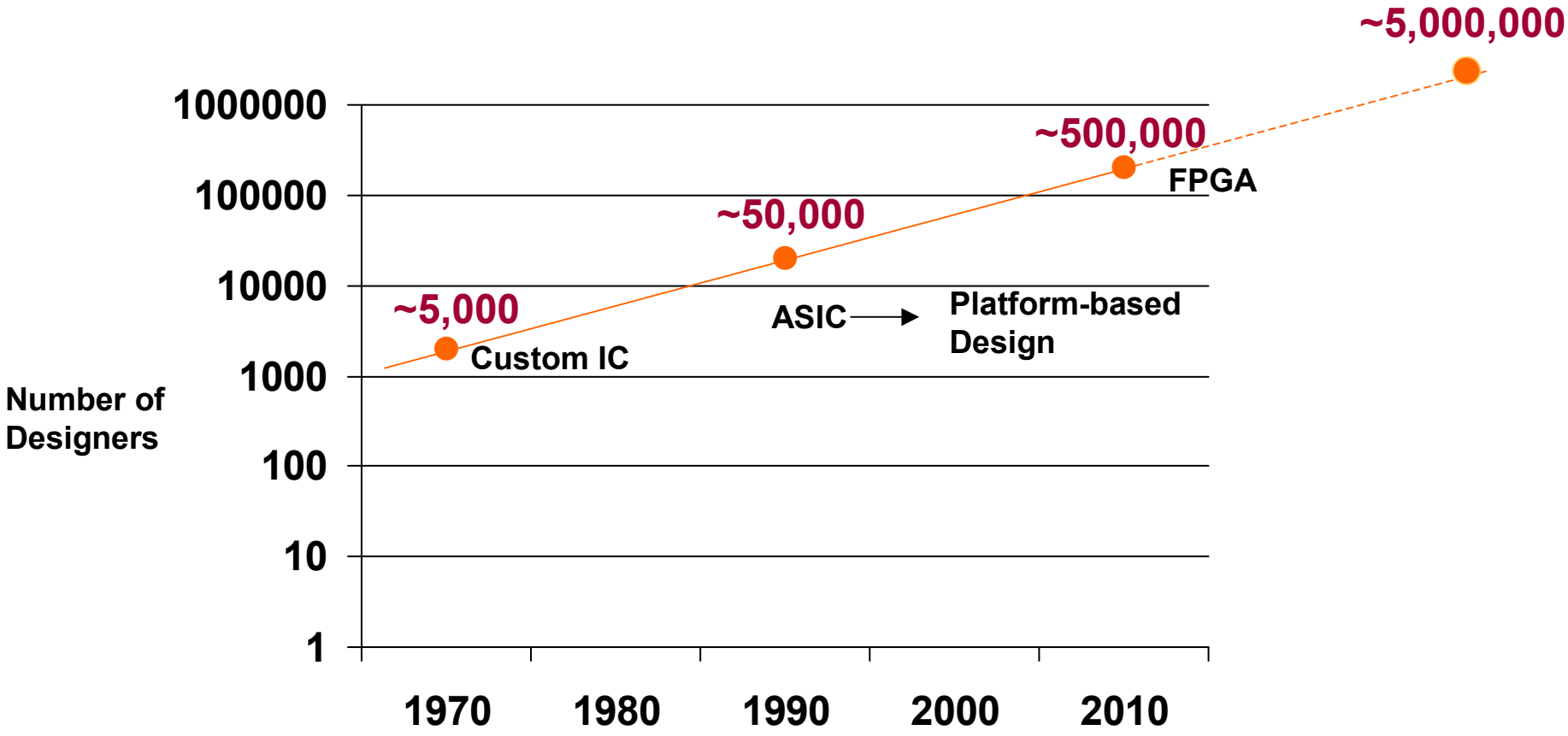
**8% Underdose**



**4% Underdose**

**Silicon Validation**

# Next Wave of Growth in Number of Designers



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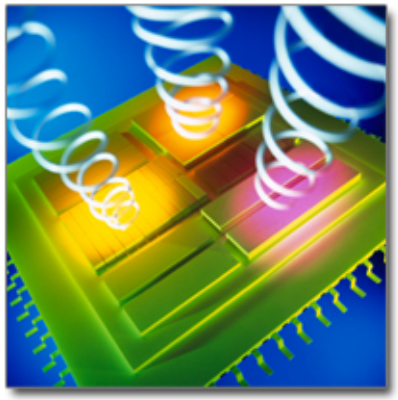
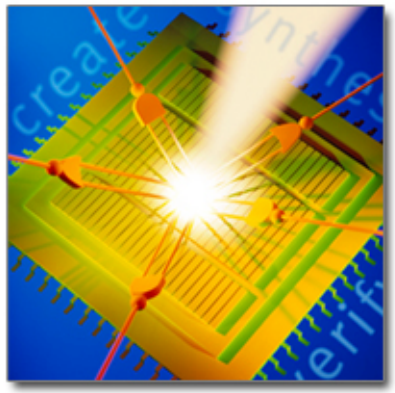
- Increasing the pool of innovators
- **From litigation to cross-licensing**





# The Most Rapid Period of Innovation in History 1947 - 1987

- AT & T provides open licensing of transistor patents.
- Patent-holders not favored in litigation – No Federal Circuit dedicated to patent appeals
- Broad cross-licensing for relatively low fees

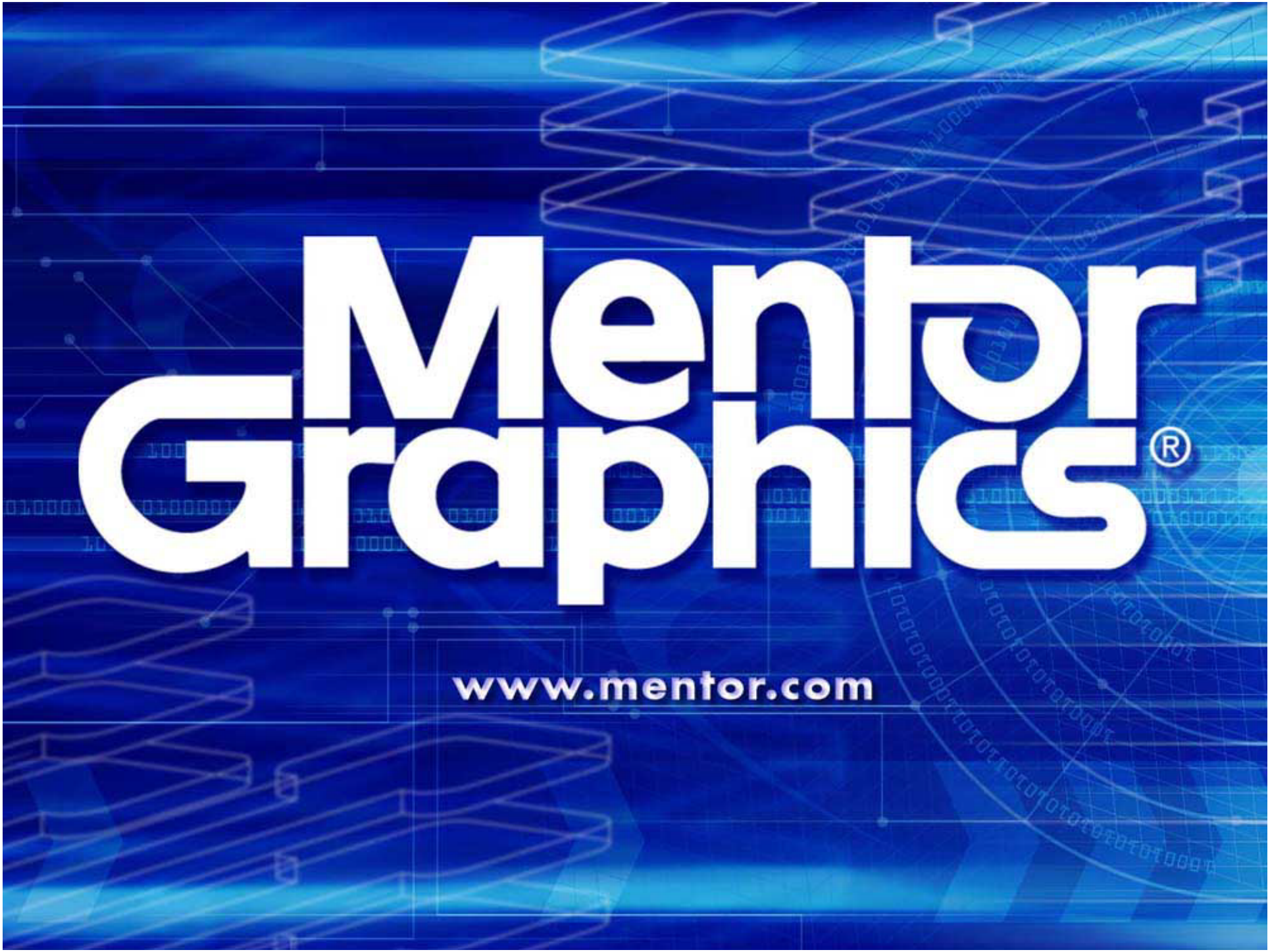
# Litigation Slows Innovation and Inhibits Market Growth

- ITC used for fast track to block import of products violating U.S. patents
- Extreme cost of litigation favors the wealthy
- Use of patents to prevent innovative competition
- Licensing companies buying up patents and demanding fees or threatening litigation

# Business Innovation Occurs Everywhere


## IKEA

- $17.6B sales 2004
- 200+ stores worldwide
- 400 million store visitors annually
- 84,000 employees in 44 countries
- Ingvar Kamprad the #1 or #2 wealthiest person in the world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