# *"Successful Entrepreneurship in a Changing Fabless Landscape"*

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October 7, 2010 Denver, CO.

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*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.

TCX TECHNOLOGY CONNEXIONS

# Semiconductors drive the Electronics food chain

*...but the industry is at a cross-road*
*atomistic levels*
*business considerations dominate*

**Connectivity**
**Social Media**
**Teenagers**

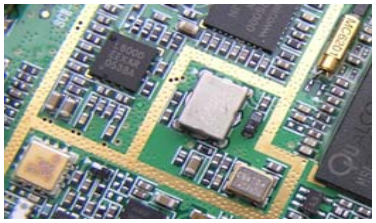
*Macro Trends:*

Market demand continues to drive:
**Chip Complexity↑, Performance↑, Cost↓ and Power↓**

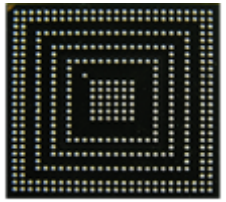
It was that "Real men must have fabs"
- but now…
**…over 1300 Fabless companies**
**…contribute over 20% of WW Semiconductor Revenue**
**…strong Eco-system available**

Product

Board



Package



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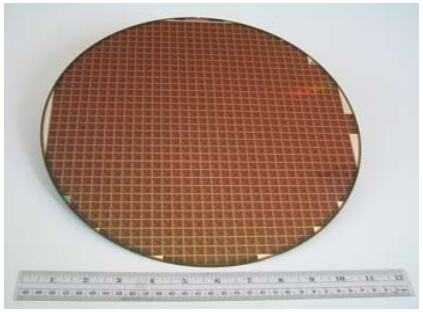
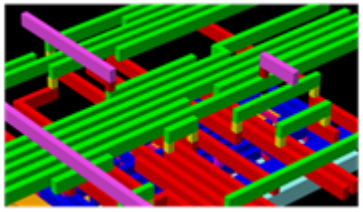
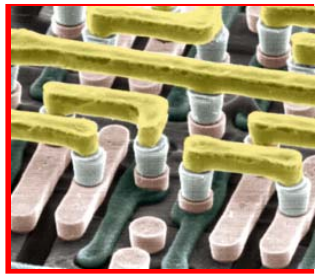
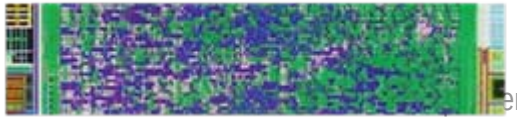


Design







*Reference:* …entation", McGraw Hill, 2008.

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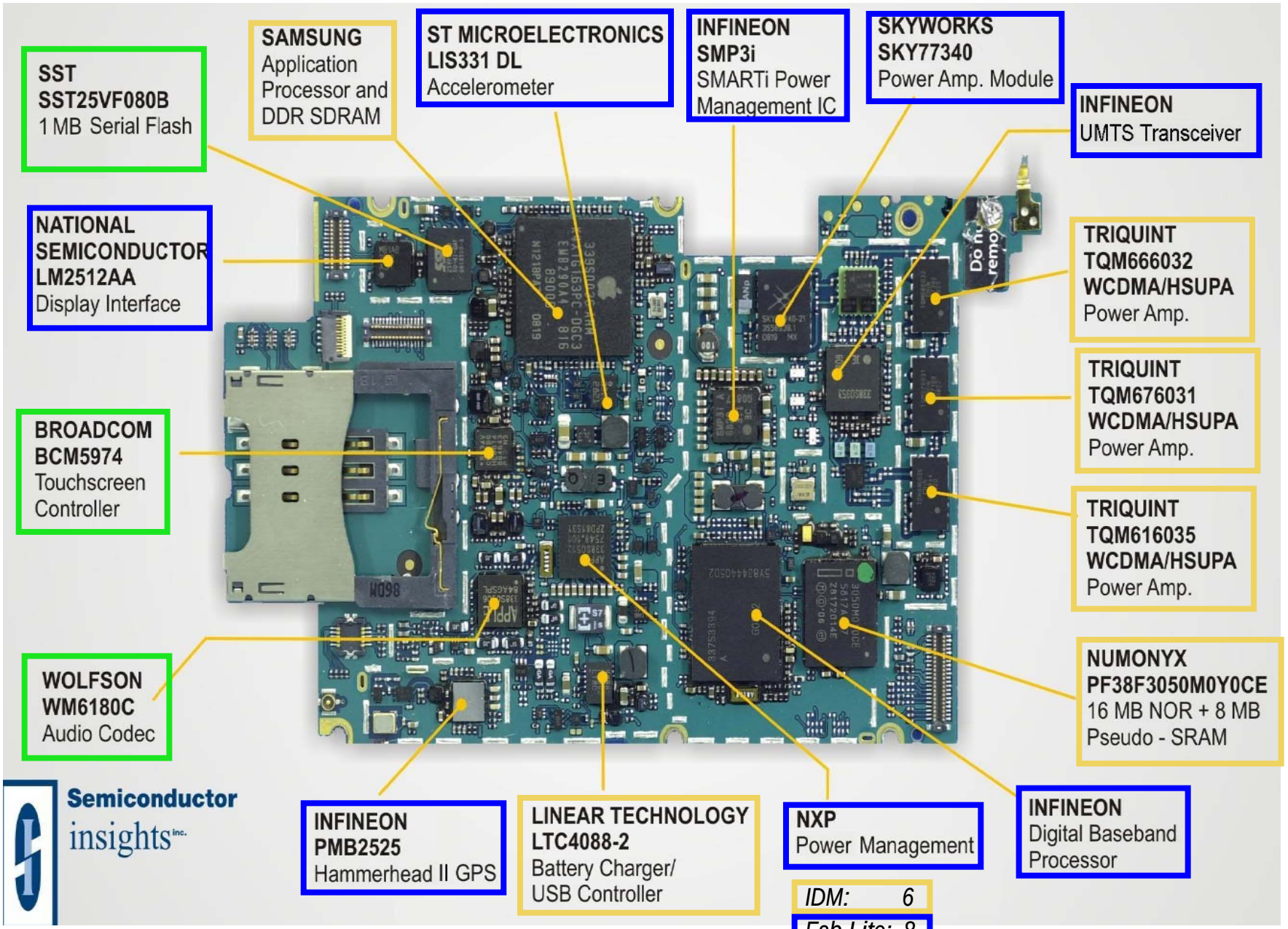


*IDM: 6*

*Fab-Lite: 8*

*Fabless: 3*

*Reference: R Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008*

EETimes.com - Under the Hood - Update: Apple iPhone 3G exposed



TCX TECHNOLOGY CONNEXIONS

- **What you will learn today**
  - Semiconductor industry trends and fabless entrepreneurial perspectives
- **What we will NOT do today**
  - Design new circuits
  - Invent new process technology
- **My background**
  - Over 36 years in semiconductor industry – Motorola, Unisys, Cadence, TCX
    - Over half in fabless companies
    - Outsourced technology and products for ~30 years
    - Consulting services for ~20 emerging and established companies over ~10 years
  - VP, and President-elect of IEEE Solid-State Circuits Society
    - JSSC continues to be the #1 in downloads
    - SSCS sponsors/manages 4 major conferences, and technically co-sponsors many others

# Successful Entrepreneurship in a changing Fabless Landscape

- Semiconductor Landscape changes
  - Macro Trends
  - Product and Business drivers
- Entrepreneurship success elements
  - Lifecycle and development schedule
  - Product positioning
  - Technology selection
  - Cost management
  - Supply chain management

*Reference:* R.Kumar, “Fabless Semiconductor Implementation”, McGraw Hill, 2008.

TCX TECHNOLOGY CONNEXIONS

# Expanding Applications Driving Semiconductor Landscape

*…Higher volume projections for widespread connectivity, communications,…*

**Computers**

**PC's, Internet**
**Mobile Computing**

**Computers**
**Communications**
**Consumer**

**Mobile Wireless**
**Voice, Data, Multimedia**
**Social Media,..**

**Mobile Life**
**"The Internet of Everything"**
*…Prof. Tom Lee*

**Connecting People,**
**Places, Things**
Mobile Health
Appliance Configuration/Control
Interact
Digital Home, …

| Drivers: | **Memory, µP** | **Mobile Processors** Integrated SoC/SiP, Analog, RF, PM, … | **Remote Processors** Integrated Modules, Sensors, Energy Scavenging |
|---|---|---|---|
| Unit Volume: | **1**x | **10**x | **>100**x |

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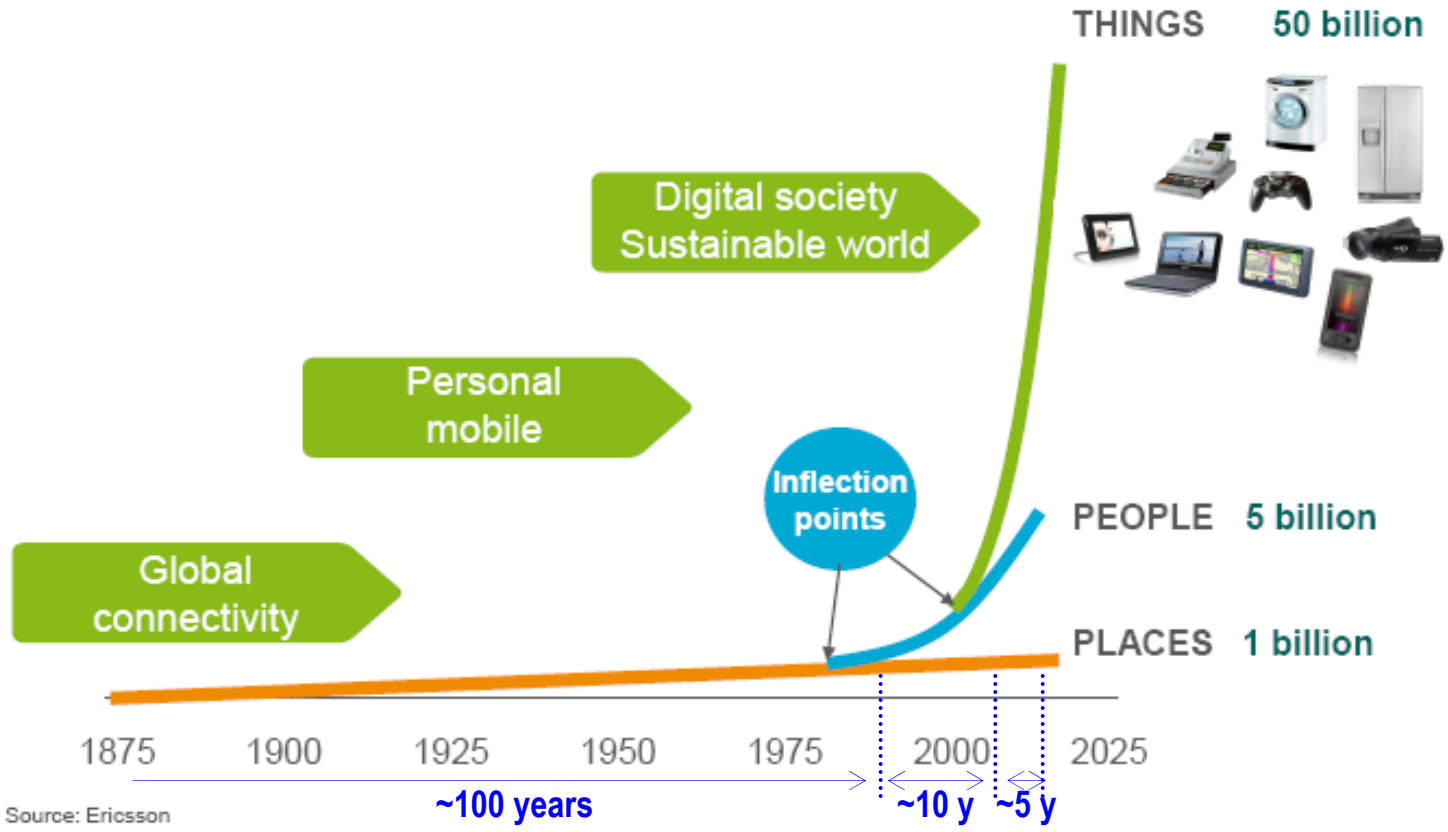
# Ericsson's view of industry trends / inflection points

1

**2020**
**Three challenges**

- 50B devices (10X scale)
- 1000X Traffic
- Convergence (Mobility+Internet)




Ref: Joshipura, GSA Expo, September 26, 2010

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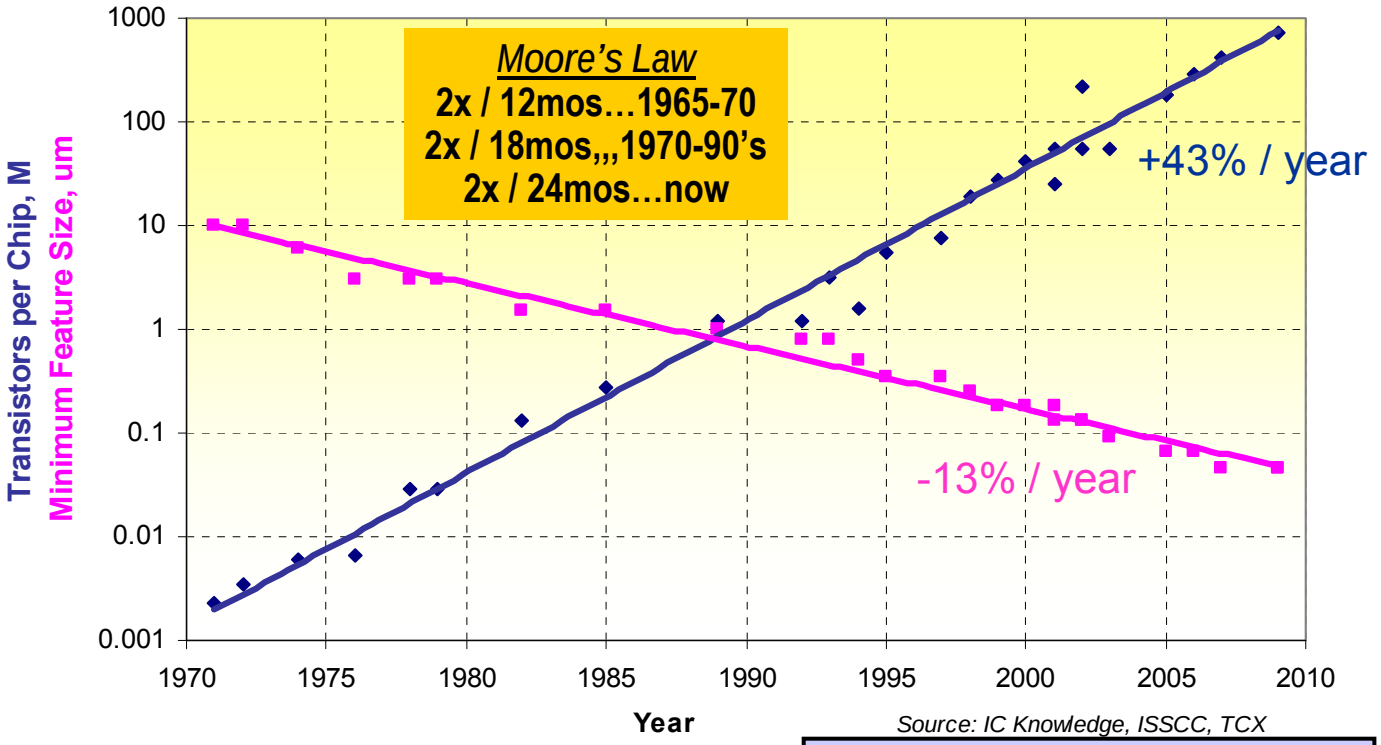
# More Moore

*…Transistor complexities have doubled every 2 years*

MF | µP | PC | iNet | Cellular




*Source: IC Knowledge, ISSCC, TCX*

Fabless Co.'s

Semiconductor Co's – Fairchild, T.I., Motorola, National, Intel, Toshiba, …

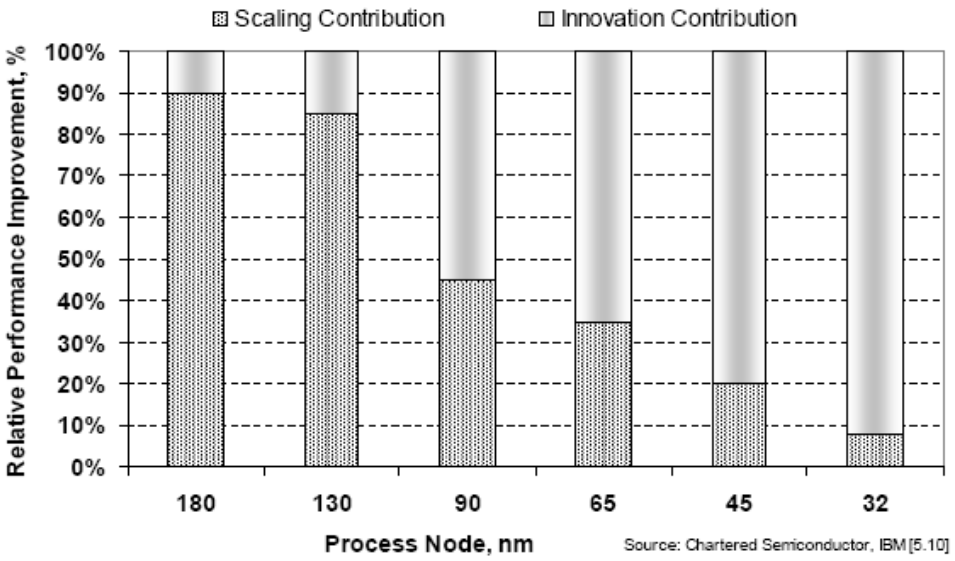
System Co.'s – IBM, Hitachi, Sony, Philips, Unisys,…

*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.

TCX TECHNOLOGY CONNEXIONS

# Technology and Business Challenges

- Process Technology Challenges
  - Lithography
  - New Materials and Processes
    - Strained Si, Lo K, Hi-K MG,..
  - New Device Structures
    - FinFETs,..
  - …
- Design and Co-design Challenges
  - Managing leakage and Power dissi
  - DFM
  - …
- Business Challenges
  - Large investment – capital, process cost, design cost…
  - Few players – users, fabs,…

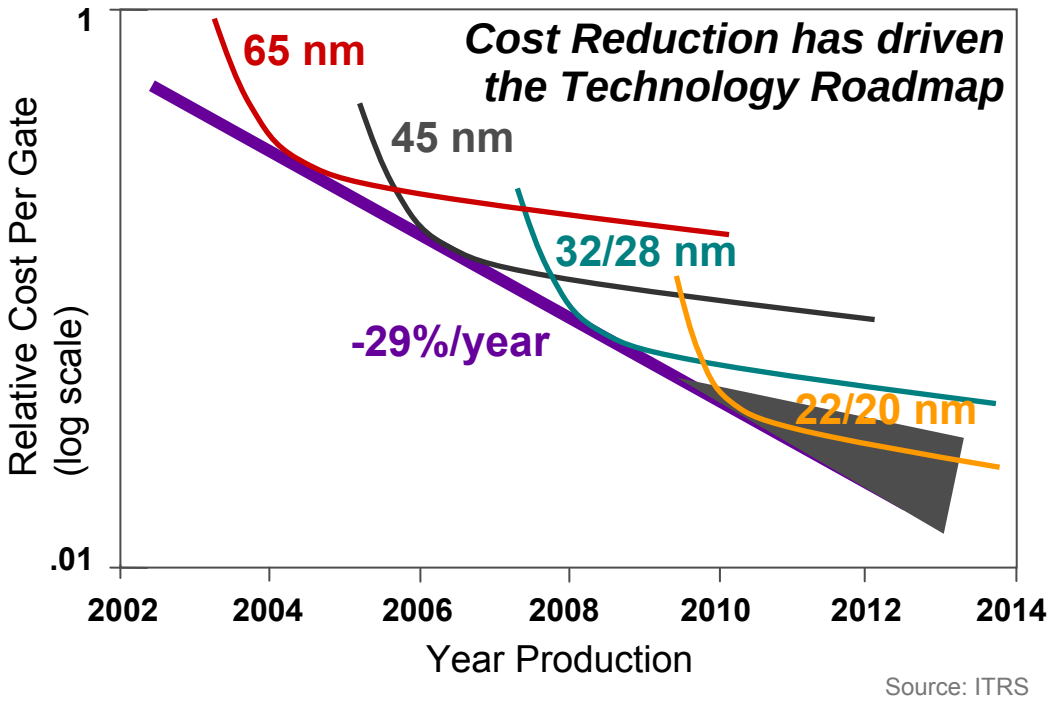



**Continued Scaling will be dominated by solutions to Business challenges …expect Technical solutions to be available when needed!**

*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.

# Continued Moore Scaling is threatened …

## …**cost effectiveness** is an issue




Source: ITRS

**Litho, Optimized Process solutions & DD reduction are a must for continued scaling economics**

*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.

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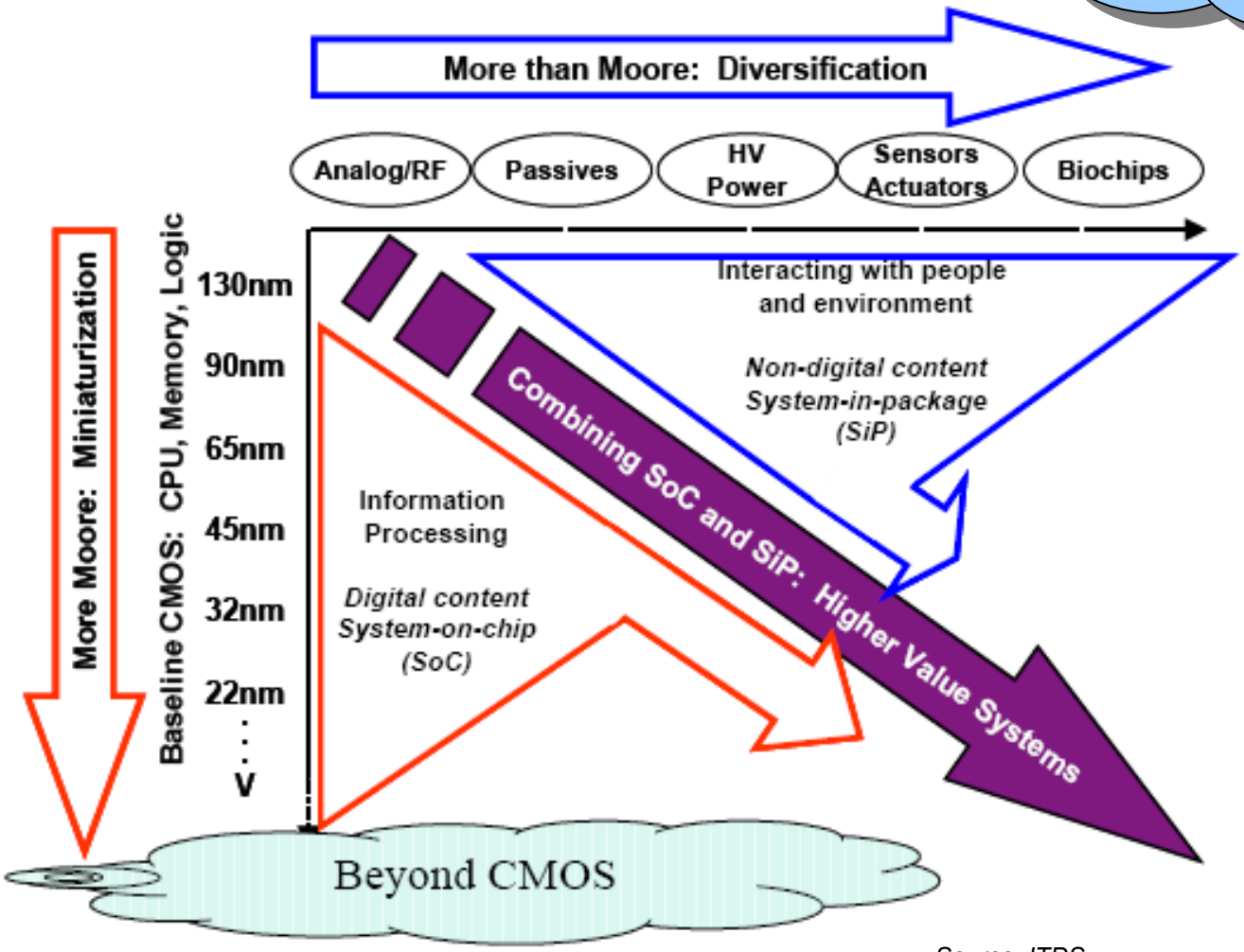
# "More than Moore" activities

*….positioned for continued industry growth*

Innovation & entrepreneurial opportunities




*Source: ITRS*

*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.

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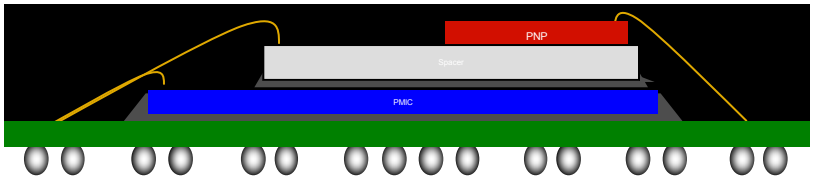
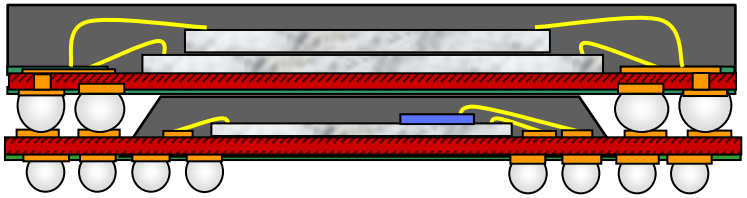
# “More than Moore” examples - Innovative Packaging

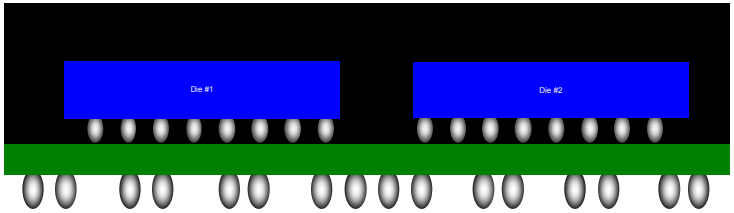
## Stacked Chips



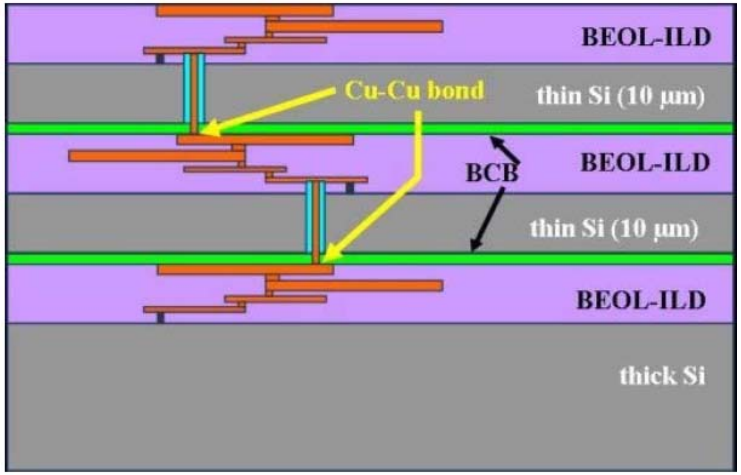

## Stacked Packages



## Side-by-Side




## 3D Stacked IC’s

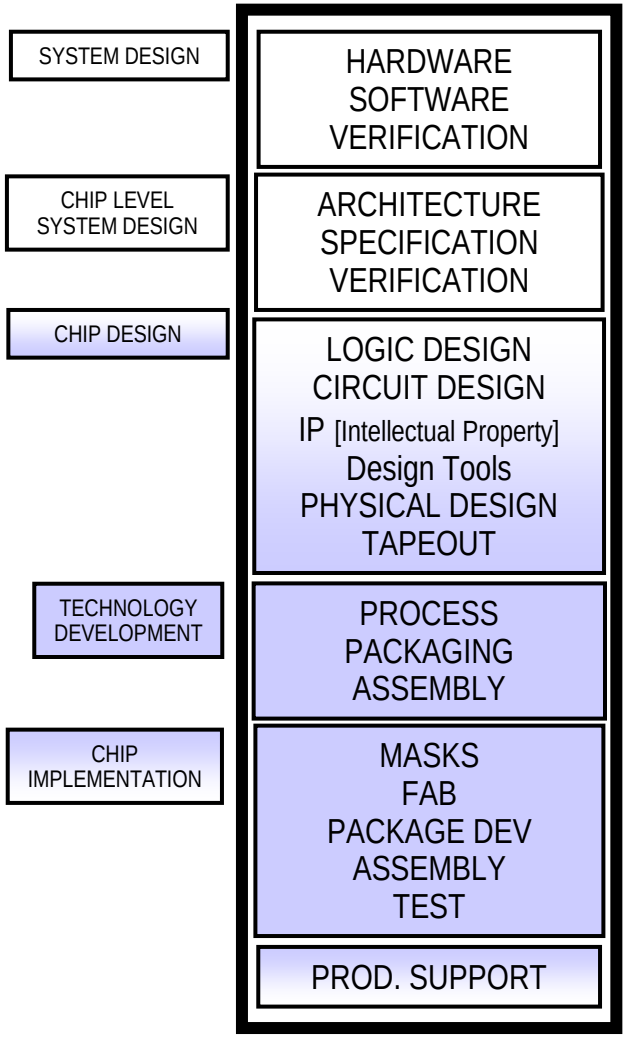


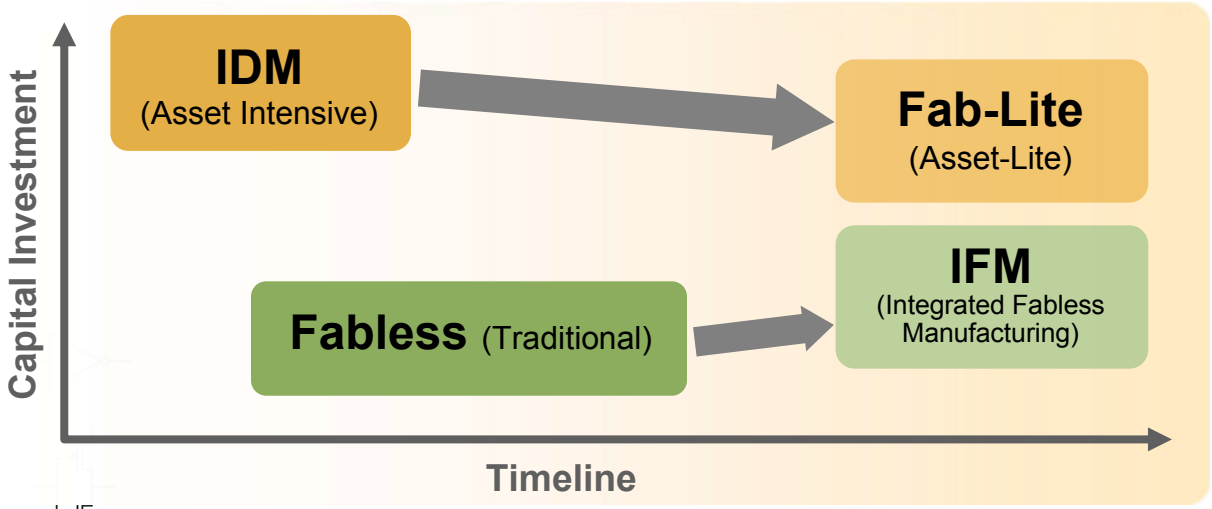

*Source: IMEC*

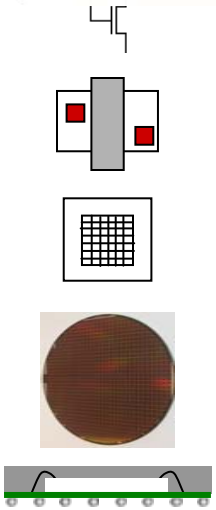
*Reference:* R.Kumar, “Fabless Semiconductor Implementation”, McGraw Hill, 2008.

# IDM approach now practiced at fewer companies

*….has given way to increased outsourcing, and a fabless supply chain*



Outsourced activities

*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.

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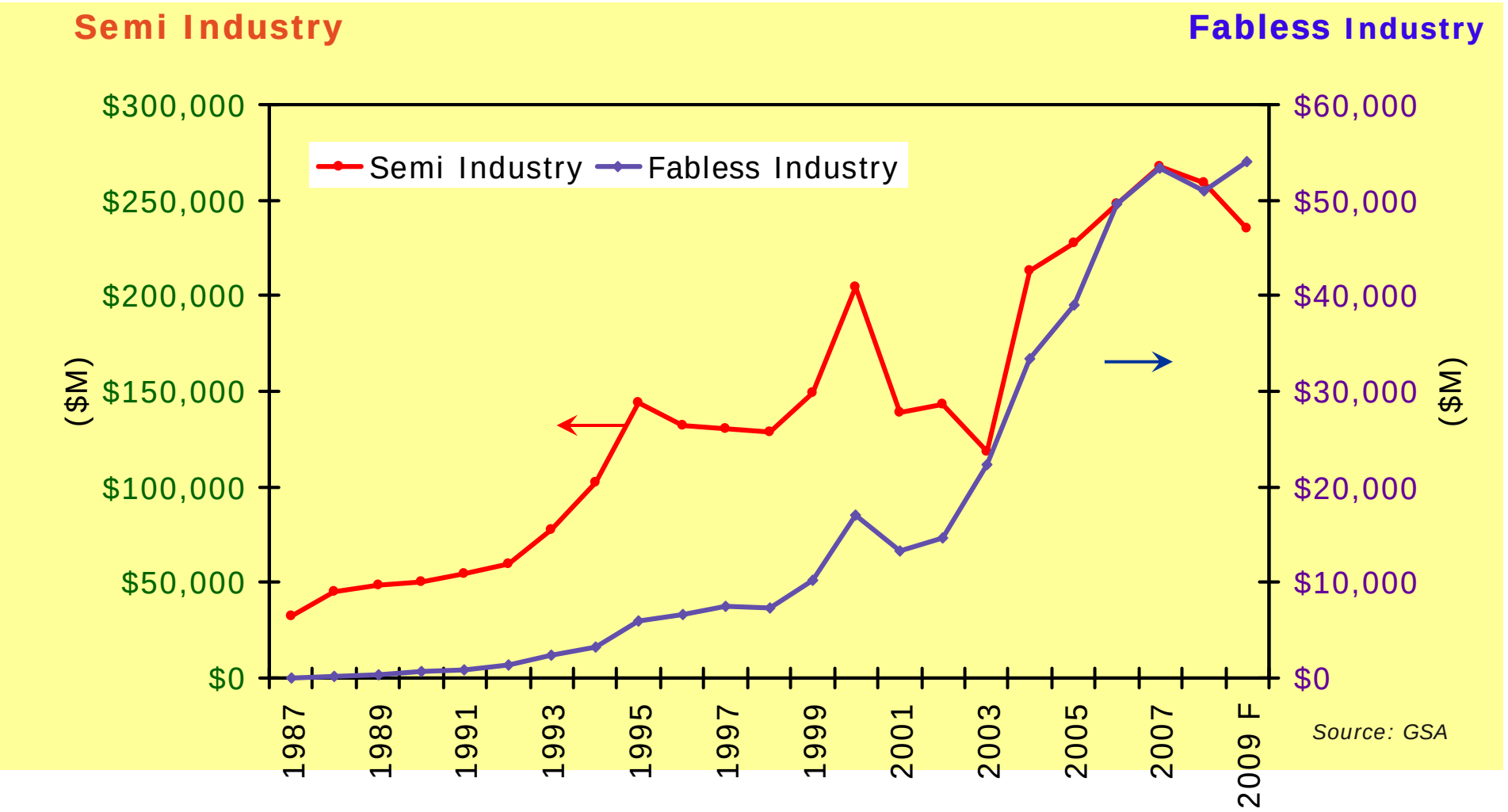
# Fabless model generates results

*...CAGR consistently better than semiconductor*




*Over the last 20 years,* Fabless CAGR = 28% while Semiconductor CAGR = 8%

*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.

TCX TECHNOLOGY CONNEXIONS

# QCT Revenue Leads the Fabless Industry

## …use of an Integrated Fabless Model ("IFM") has been key

### 2009 Top 25 Fabless IC Suppliers

| 2009 Rank | 2008 Rank | 2007 Rank | Company | Headquarters | 2007 ($M) | 2008 ($M) | % Change | 2009 ($M) | % Change |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | Qualcomm | U.S. | 5,619 | 6,477 | 15% | 6,585 | 2% |
| 2 | — | — | AMD | U.S. | 0 | 0 | N/A | 5,252 | N/A |
| 3 | 2 | 3 | Broadcom | U.S. | 3,754 | 4,449 | 19% | 4,190 | -6% |
| 4 | 5 | 5 | MediaTek | Taiwan | 2,445 | 2,864 | 17% | 3,500 | 22% |
| 5 | 3 | 2 | Nvidia | U.S. | 3,979 | 3,660 | -8% | 3,135 | -14% |
| 6 | 4 | 4 | Marvell | U.S. | 2,830 | 3,055 | 8% | 2,700 | -12% |
| 7 | 6 | 6 | Xilinx | U.S. | 1,810 | 1,906 | 5% | 1,675 | -12% |
| 8 | 7 | 7 | LSI Corp. | U.S. | 1,779 | 1,795 | 1% | 1,445 | -19% |
| 9 | 8 | 8 | Altera | U.S. | 1,264 | 1,367 | 8% | 1,165 | -15% |
| 10 | 9 | 12 | Avago | U.S. | 820 | 905 | 10% | 870 | -4% |
| 11 | 11 | 9 | Novatek | Taiwan | 1,099 | 829 | -25% | 819 | -1% |
| 12 | 10 | 10 | Himax | Taiwan | 918 | 833 | -9% | 685 | -18% |
| 13 | 16 | 15 | Realtek | Taiwan | 478 | 534 | 12% | 615 | 15% |
| 14 | 19 | 23 | Mstar | Taiwan | 378 | 454 | 20% | 605 | 33% |
| 15 | 12 | 11 | CSR | Europe | 849 | 695 | -18% | 600 | -14% |
| 16 | 13 | 14 | QLogic | U.S. | 585 | 663 | 13% | 530 | -20% |
| 17 | 18 | 21 | Atheros | U.S. | 417 | 472 | 13% | 530 | 12% |
| 18 | 17 | 16 | PMC-Sierra | U.S. | 449 | 525 | 17% | 495 | -6% |
| 19 | 15 | 20 | MegaChips | Japan | 420 | 535 | 27% | 480 | -10% |
| 20 | 20 | 27 | Silicon Labs | U.S. | 338 | 416 | 23% | 440 | 6% |
| 21 | 21 | 19 | Zoran | U.S. | 445 | 380 | -15% | 345 | -9% |
| 22 | 22 | 24 | SMSC | U.S. | 374 | 352 | -6% | 280 | -20% |
| 23 | 25 | 33 | Semtech | U.S. | 257 | 270 | 5% | 250 | -7% |
| 24 | 35 | 45 | Ricktek | Taiwan | 184 | 217 | 18% | 244 | 12% |
| 25 | 14 | 13 | Conexant | U.S. | 761 | 554 | -27% | 240 | -57% |

Source: IC Insights' *Strategic Reviews Database*

Source: IC Insights, 20100119

# 2009 Top 20 Semiconductor Sales Leaders ($M)…forecast

Preliminary WW Ranking of the Top 20 Suppliers of Semiconductors in 2009

(Ranking by Revenue in Millions of U.S. Dollars)

| 2008 Rank | 2009 Rank | Company Name | 2008 Revenue | 2009 Revenue | Percent Change | Percent of Total |
|---|---|---|---|---|---|---|
| 1 | 1 | Intel | $33,767 | $32,095 | -5.0% | 14.2% |
| 2 | 2 | Samsung Electronics | $16,902 | $17,123 | 1.3% | 7.6% |
| 3 | 3 | Toshiba | $11,081 | $10,640 | -4.0% | 4.7% |
| 4 | 4 | Texas Instruments | $11,068 | $9,612 | -13.2% | 4.2% |
| 5 | 5 | STMicroelectronics | $10,325 | $8,400 | -18.6% | 3.7% |
| 8 | 6 | Qualcomm | $6,477 | $6,475 | 0.0% | 2.9% |
| 9 | 7 | Hynix | $6,023 | $5,940 | -1.4% | 2.6% |
| 6 | 8 | Renesas Technology | $7,017 | $5,664 | -19.3% | 2.5% |
| 12 | 9 | Advanced Micro Devices | $5,455 | $5,038 | -7.6% | 2.2% |
| 7 | 10 | Sony | $6,950 | $4,670 | -32.8% | 2.1% |
| 11 | 11 | NEC Electronics | $5,826 | $4,403 | -24.4% | 1.9% |
| 10 | 12 | Infineon Technologies | $5,954 | $4,340 | -27.1% | 1.9% |
| 14 | 13 | Broadcom | $4,643 | $4,198 | -9.6% | 1.9% |
| 16 | 14 | Micron Technology | $4,435 | $3,995 | -9.9% | 1.8% |
| 24 | 15 | MediaTek | $2,896 | $3,524 | 21.7% | 1.6% |
| 19 | 16 | Elpida Memory | $3,599 | $3,498 | -2.8% | 1.5% |
| 13 | 17 | Freescale Semiconductor | $4,966 | $3,344 | -32.7% | 1.5% |
| 15 | 18 | Panasonic Corporation | $4,473 | $3,330 | -25.6% | 1.5% |
| 17 | 19 | NXP | $4,055 | $3,247 | -19.9% | 1.4% |
| 18 | 20 | Sharp Electronics | $3,607 | $2,886 | -20.0% | 1.3% |
| | | Top 20 Companies | $159,519 | $142,422 | -10.7% | 62.8% |
| | | All Others | $99,389 | $84,313 | -15.2% | 37.2% |
| | | Total Semiconductor | $258,908 | $226,735 | -12.4% | 100.0% |

Source: iSuppli Nov. 2009

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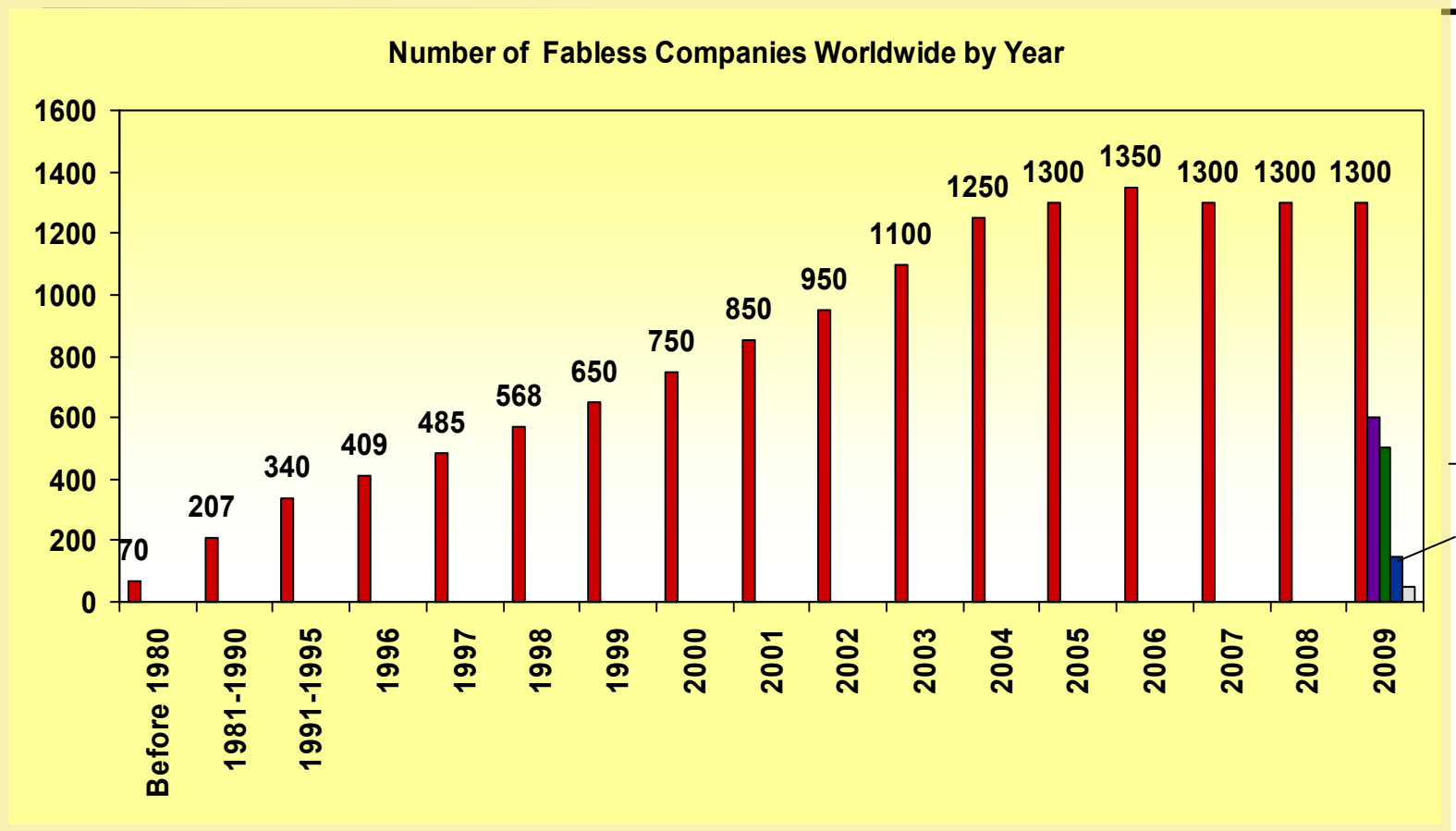
# Worldwide Growth of Fabless Companies



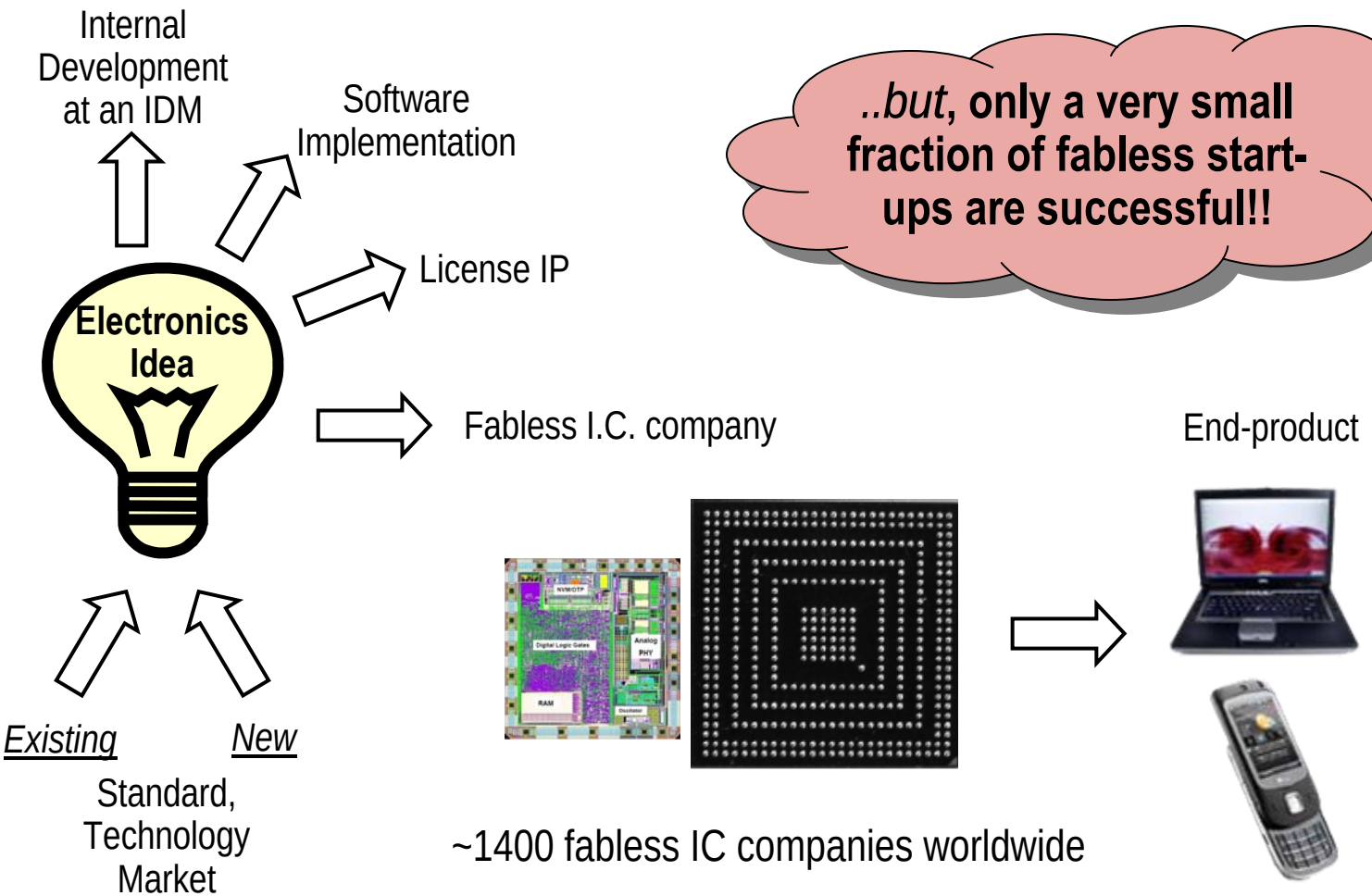

*Source: Global Semiconductor Alliance (formerly FSA)*

***Fabless Industry pioneered by innovators with ideas, but without wafer fabs***

*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.

TCX TECHNOLOGY CONNEXIONS

# The I.C. entrepreneurship creation




*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.

# Top reasons for failure of fabless start-ups

**Create your product as a *"must-have"* for the customer**
Product Positioning
Differentiation

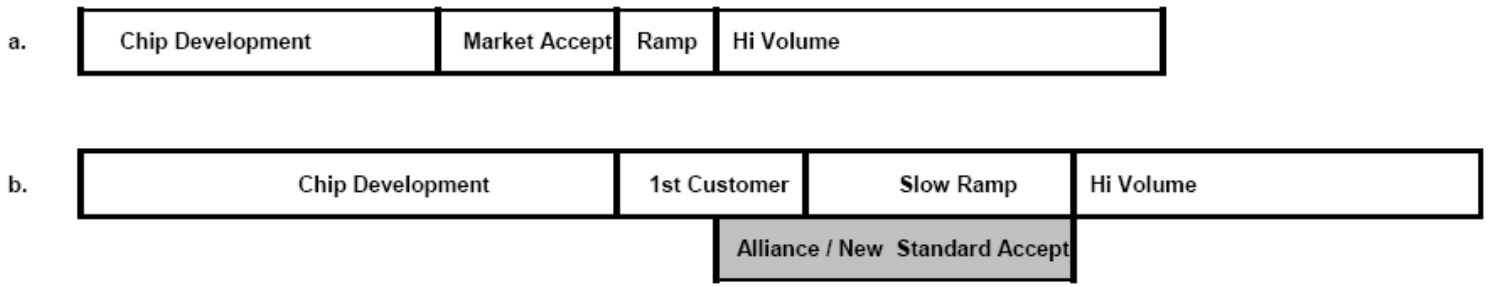
- **No customer engagement** until it's too late
- Not understanding and meeting **customer expectations**
- Overly **aggressive product specifications**
- The **"kitchen-sink syndrome"**
- Poor management of the **Supply Chain**

**A systematic approach to**
***planning and execution***

*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.

# Success elements – product positioning

| EXISTING<br>Standard, market, customer base | NEW<br>Standard, market, customer base |
|---|---|
| ▪Super-Integration<br>▪Problem solutions<br>▪Evolutionary enhancements<br>– e.g. Cost reduction | ▪Emerging standard<br>▪New features/capabilities<br>▪New interfaces<br>▪"Revolutionary" enhancements |




**Will Impact Schedule, Technology Selection, Design Methodology,….**

*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.

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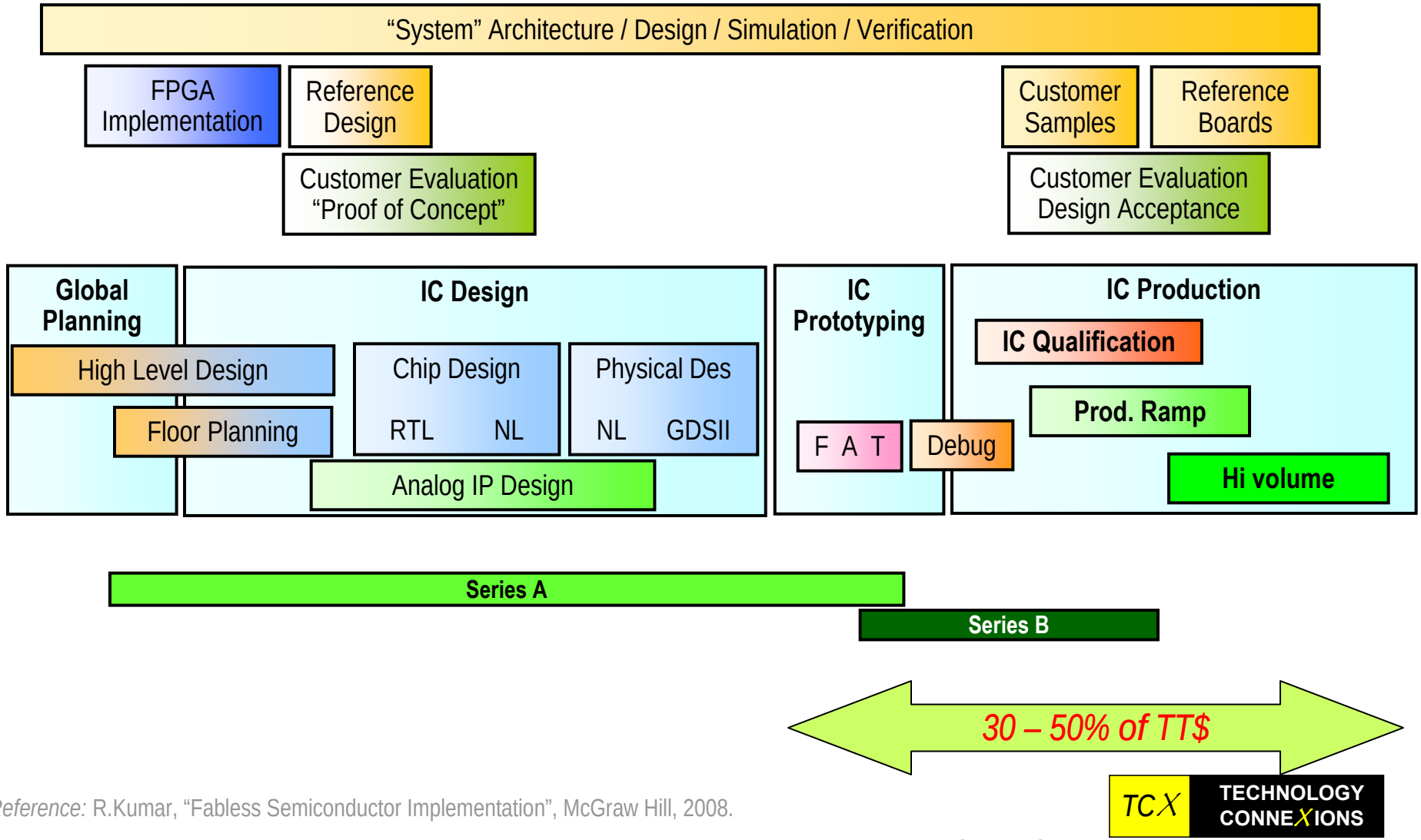
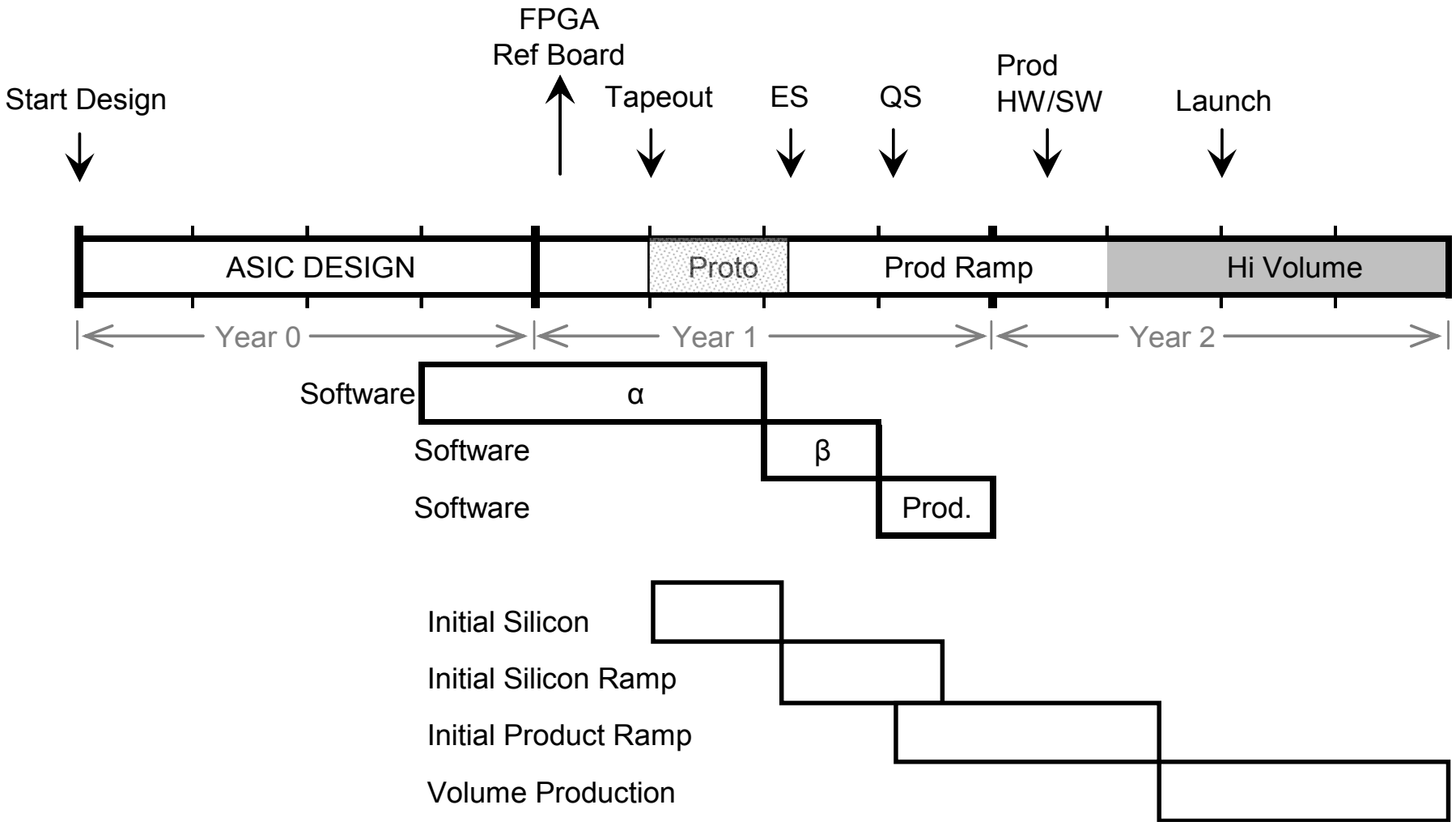
# Lifecycle of a fabless IC company – activity highlites




*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.

# Typical ASIC Development Cycle




*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.

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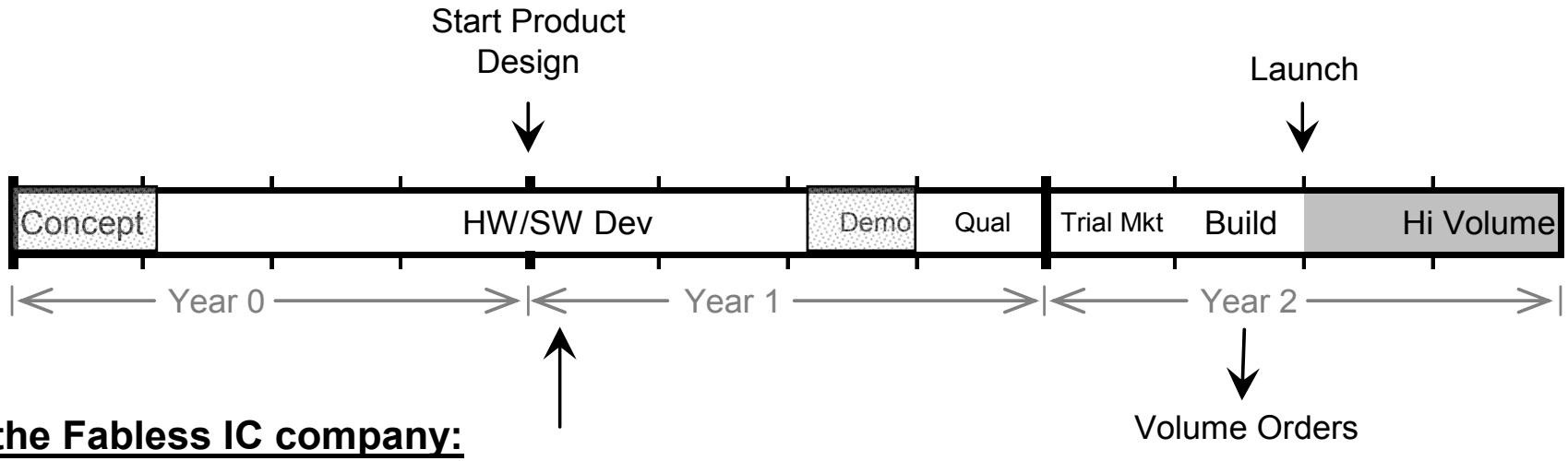
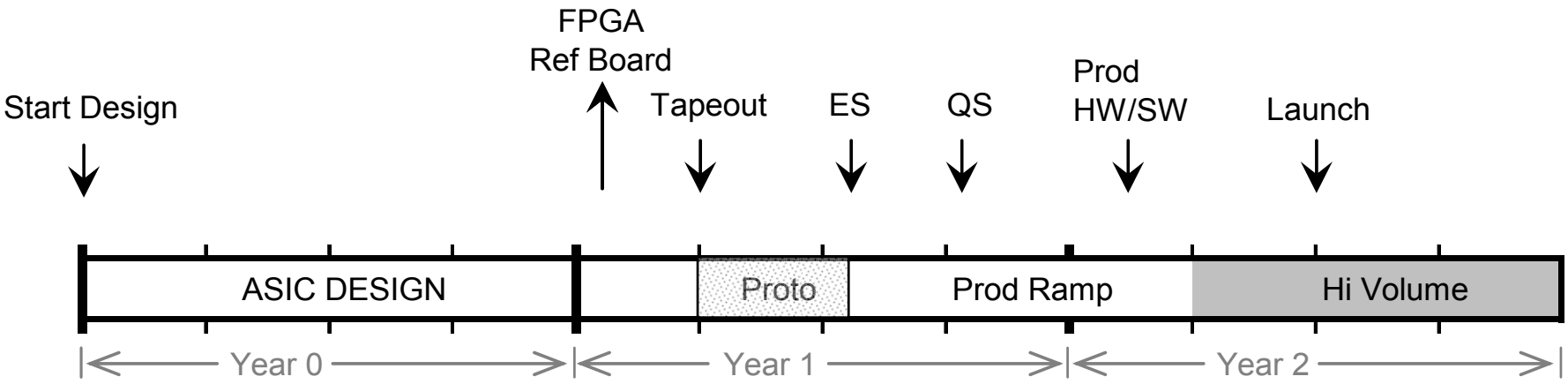
# System vs. IC Development Cycle

**a. At the System company:**




**b. At the Fabless IC company:**



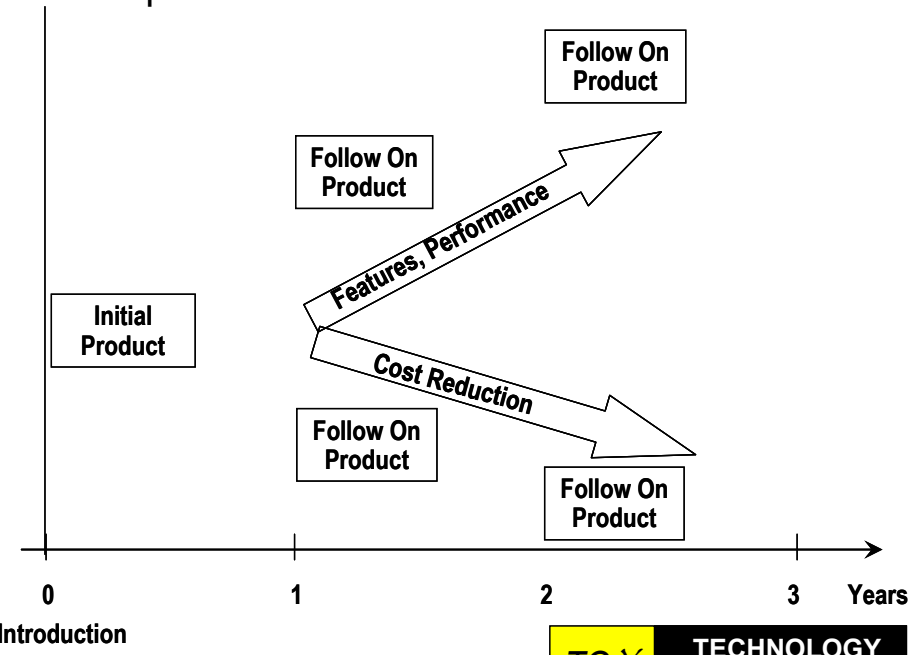

*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.

TCX TECHNOLOGY CONNEXIONS

# Success elements – product definition

- Judicious selection of features and specifications
- What are your product's **differentiating features**?
  - **If process technology only**.....go back to the 'drawing board'!!
- **Overly aggressive specifications** (timing, gate density,....)
- Show a Product Roadmap
  - **Establish credibility** by delivering the first samples
    - on schedule
    - may not have all the 'bells and whistles'

Avoid the "kitchen sink syndrome"

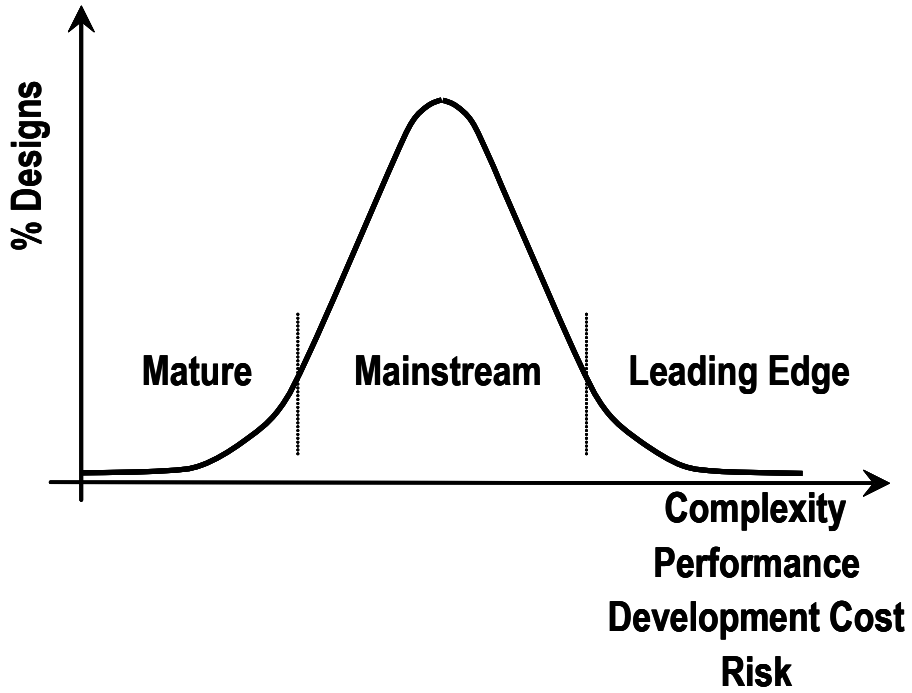


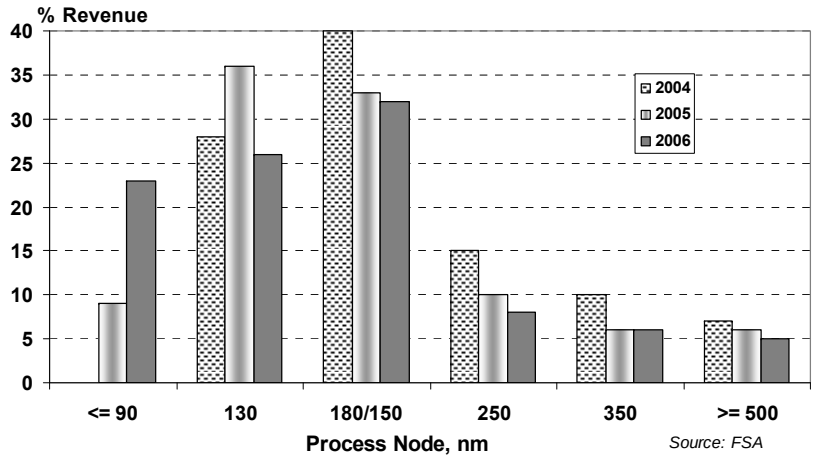

*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.

TCX TECHNOLOGY CONNEXIONS

# Success elements – technology selection

- Avoid using the newest technology (process, design, packaging, …)
  - If that is the only way you can meet the specifications…..
- Use the *newest* technology you can **afford**, and the *oldest* technology that lets you **meet the specifications**




| Process Node Maturity | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Mature | | | Mainstream | | | Leading Edge | | |
| 500 | 350 | 250 | 180 | 130 | 90 | 65 | 45 | nm |

*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.

TCX TECHNOLOGY CONNEXIONS

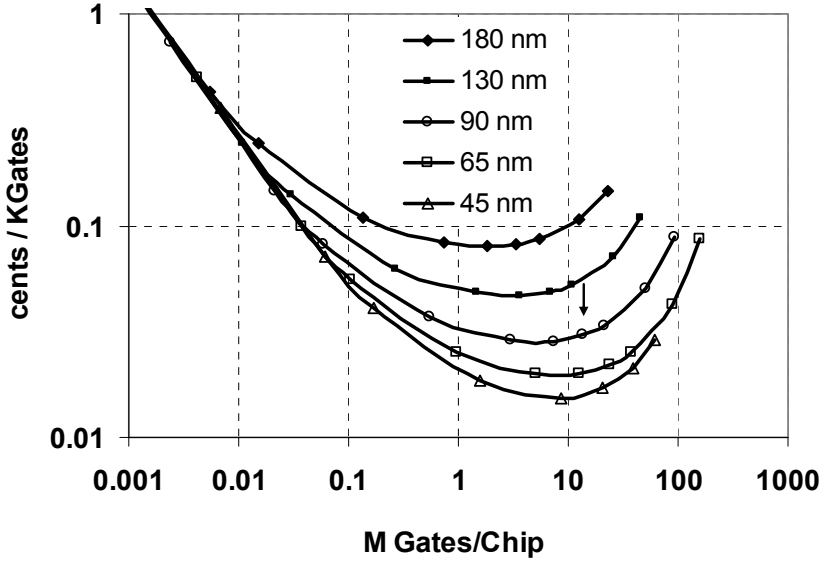
# Success elements – supply chain selection

- Technical due diligence
- Business due diligence
  - Will they accept your business?
  - Confidentiality documents
  - Quotes
  - Firm up the commitments

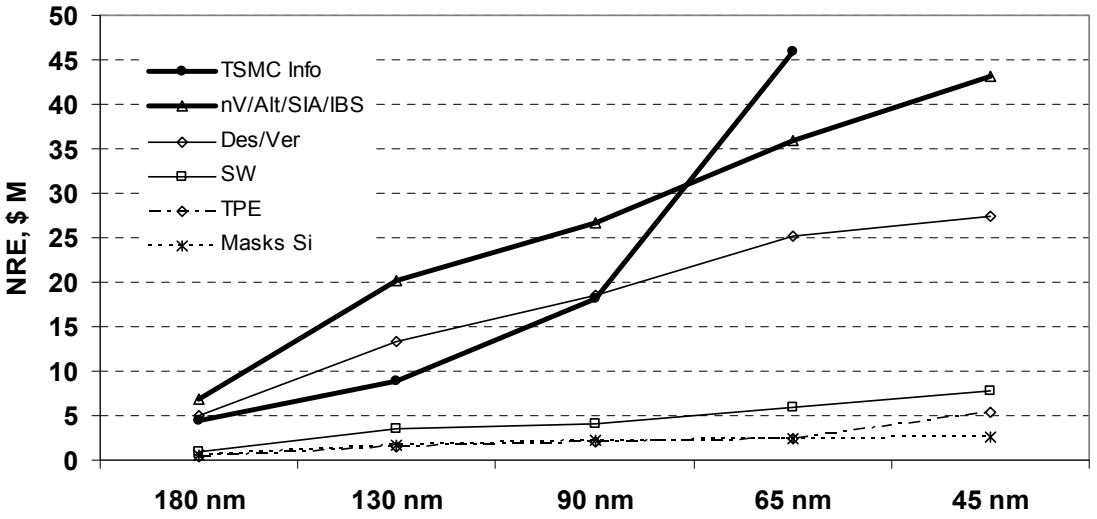
*Reference:* R.Kumar, “Fabless Semiconductor Implementation”, McGraw Hill, 2008.

# Success elements – cost management

- Unit cost optimization




- Development cost optimization




*Reference:* R.Kumar



TCX TECHNOLOGY CONNEXIONS

# Success elements – other considerations

- Sourcing methodology – FPGA, ASIC, COT,..
- Operations best practices – legal, financial, production control, customer support,…
- Quality and reliability – Quality Manual, build in quality from the start,…
- Schedule development and management
- Program management
  - Internal development
  - Management of the distributed supply chain

*Reference:* R.Kumar, “Fabless Semiconductor Implementation”, McGraw Hill, 2008.

TCX TECHNOLOGY CONNEXIONS

# Summary and key take-aways

- Semiconductor industry continues to be the hub of the electronics revolution
  - As long as there are innovators, and…
  - Teenagers and other users…
  - This will continue to be an exciting and challenging industry
- Successful new product implementation can be a very rewarding experience
  - It's not for the faint hearted! **Complex, but can be done!**
- For entrepreneurs…

**Best Technical idea ≠ Success**

**Create customer "must-have" through Product Differentiation**

**PLANNING**
**EXECUTION EXECUTION EXECUTION**

*Reference:* R.Kumar, "Fabless Semiconductor Implementation", McGraw Hill, 2008.