“Successful Entrepreneurship in a Changing Fabless Landscape”

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Semiconductors drive the Electronics food chain

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

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

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

Expanding Applications Driving Semiconductor Landscape

Higher volume projections for widespread connectivity, communications, ...

Drivers:
- Memory, μP
- Mobile Processors: Integrated SoC/SiP, Analog, RF, PM, ...

Unit Volume:
- 1x
- 10x
- >100x

Computers
- PC’s, Internet Mobile Computing

Computers Communications Consumer
- Mobile Wireless Voice, Data, Multimedia Social Media...

Mobile Life “The Internet of Everything”
- Connecting People, Places, Things
  - Mobile Health
  - Appliance Configuration/Control
  - Interact
  - Digital Home, ...

Prof. Tom Lee

“The Internet of Everything”

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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)

- Global connectivity
- Personal mobile
- Digital society Sustainable world

THINGS 50 billion
PEOPLE 5 billion
PLACES 1 billion

~100 years
~10 y ~5 y

Source: Ericsson

Ref: Joshipura, GSA Expo, September 26, 2010
More Moore

...Transistor complexities have doubled every 2 years

Moore’s Law
2x / 12mos…1965-70
2x / 18mos„1970-90’s
2x / 24mos…now

-13% / year

+43% / year

Transistors per Chip, M
Minimum Feature Size, um

Year

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,…


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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 dissipation
- 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!

Continued Moore Scaling is threatened …
…cost effectiveness is an issue

Cost Reduction has driven the Technology Roadmap

Relative Cost Per Gate (log scale)

Year Production

Source: ITRS

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

“More than Moore” activities
...positioned for continued industry growth

Source: ITRS

“More than Moore” examples - Innovative Packaging

Stacked Chips

Stacked Packages

Side-by-Side

3D Stacked IC’s

Source: IMEC


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IDM approach now practiced at fewer companies

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

Fabless model generates results
...*CAGR consistently better than semiconductor*

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

QCT Revenue Leads the Fabless Industry

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

<table>
<thead>
<tr>
<th>Rank</th>
<th>2009 Rank</th>
<th>Company</th>
<th>Headquarters</th>
<th>2007 ($M)</th>
<th>2008 ($M)</th>
<th>% Change</th>
<th>2009 ($M)</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Qualcomm</td>
<td>U.S.</td>
<td>5,619</td>
<td>6,477</td>
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<td>6,385</td>
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<td>4,190</td>
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<td>5</td>
<td>MediaTek</td>
<td>Taiwan</td>
<td>2,445</td>
<td>2,864</td>
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<td>3,500</td>
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<td>Nvidia</td>
<td>U.S.</td>
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<td>3,660</td>
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<td>3,135</td>
<td>-14%</td>
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<td>U.S.</td>
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<td>3,055</td>
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<td>2,700</td>
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<td>Xilinx</td>
<td>U.S.</td>
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<td>1,906</td>
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<td>1,675</td>
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<td>U.S.</td>
<td>1,779</td>
<td>1,795</td>
<td>1%</td>
<td>1,445</td>
<td>19%</td>
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<td>8%</td>
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<td>870</td>
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<td>Novatek</td>
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<td>-1%</td>
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<td>10</td>
<td>Himax</td>
<td>Taiwan</td>
<td>918</td>
<td>833</td>
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<td>685</td>
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<td>534</td>
<td>12%</td>
<td>615</td>
<td>15%</td>
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<td>Mstar</td>
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<td>605</td>
<td>33%</td>
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<td>12</td>
<td>CSR</td>
<td>Europe</td>
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<td>695</td>
<td>-18%</td>
<td>600</td>
<td>14%</td>
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<td>663</td>
<td>13%</td>
<td>530</td>
<td>20%</td>
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<td>18</td>
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<td>U.S.</td>
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<td>472</td>
<td>13%</td>
<td>530</td>
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<td>525</td>
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<td>495</td>
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<td>MegaChips</td>
<td>Japan</td>
<td>420</td>
<td>535</td>
<td>27%</td>
<td>480</td>
<td>10%</td>
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<td>20</td>
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<td>416</td>
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<td>440</td>
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<td>21</td>
<td>Zoran</td>
<td>U.S.</td>
<td>445</td>
<td>380</td>
<td>-15%</td>
<td>345</td>
<td>-9%</td>
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<td>22</td>
<td>22</td>
<td>SMSC</td>
<td>U.S.</td>
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<td>-6%</td>
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<td>Semtech</td>
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<td>270</td>
<td>5%</td>
<td>250</td>
<td>7%</td>
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<td>24</td>
<td>35</td>
<td>Ricontek</td>
<td>Taiwan</td>
<td>184</td>
<td>217</td>
<td>18%</td>
<td>244</td>
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<td>25</td>
<td>14</td>
<td>Conexant</td>
<td>U.S.</td>
<td>761</td>
<td>554</td>
<td>-27%</td>
<td>240</td>
<td>57%</td>
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</table>

Source: IC Insights' Strategic Reviews Database
# 2009 Top 20 Semiconductor Sales Leaders ($M)...forecast

<table>
<thead>
<tr>
<th>2008 Rank</th>
<th>2009 Rank</th>
<th>Company Name</th>
<th>2008 Revenue</th>
<th>2009 Revenue</th>
<th>Percent Change</th>
<th>Percent of Total</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Intel</td>
<td>$33,767</td>
<td>$32,095</td>
<td>-5.0%</td>
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<td>2</td>
<td>2</td>
<td>Samsung Electronics</td>
<td>$16,902</td>
<td>$17,123</td>
<td>1.3%</td>
<td>7.6%</td>
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<td>3</td>
<td>3</td>
<td>Toshiba</td>
<td>$11,081</td>
<td>$10,640</td>
<td>-4.0%</td>
<td>4.7%</td>
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<td>4</td>
<td>4</td>
<td>Texas Instruments</td>
<td>$11,068</td>
<td>$9,612</td>
<td>-13.2%</td>
<td>4.2%</td>
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<td>5</td>
<td>STMicroelectronics</td>
<td>$10,325</td>
<td>$8,400</td>
<td>-18.6%</td>
<td>3.7%</td>
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<td>6</td>
<td>8</td>
<td>Qualcomm</td>
<td>$6,477</td>
<td>$6,475</td>
<td>0.0%</td>
<td>2.9%</td>
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<tr>
<td>7</td>
<td>9</td>
<td>Hynix</td>
<td>$6,023</td>
<td>$5,940</td>
<td>-1.4%</td>
<td>2.6%</td>
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<tr>
<td>6</td>
<td>8</td>
<td>Renesas Technology</td>
<td>$7,017</td>
<td>$5,664</td>
<td>-19.3%</td>
<td>2.5%</td>
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<tr>
<td>12</td>
<td>9</td>
<td>Advanced Micro Devices</td>
<td>$5,455</td>
<td>$5,038</td>
<td>-7.6%</td>
<td>2.2%</td>
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<tr>
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<td>10</td>
<td>Sony</td>
<td>$6,950</td>
<td>$4,670</td>
<td>-32.8%</td>
<td>2.1%</td>
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<tr>
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<td>11</td>
<td>NEC Electronics</td>
<td>$5,826</td>
<td>$4,403</td>
<td>-24.4%</td>
<td>1.9%</td>
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<tr>
<td>10</td>
<td>12</td>
<td>Infineon Technologies</td>
<td>$5,954</td>
<td>$4,340</td>
<td>-27.1%</td>
<td>1.9%</td>
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<td>14</td>
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<td>Broadcom</td>
<td>$4,643</td>
<td>$4,198</td>
<td>-9.6%</td>
<td>1.9%</td>
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<td>Micron Technology</td>
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<td>1.8%</td>
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<td>24</td>
<td>15</td>
<td>MediaTek</td>
<td>$2,896</td>
<td>$3,524</td>
<td>21.7%</td>
<td>1.6%</td>
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<td>19</td>
<td>16</td>
<td>Elpida Memory</td>
<td>$3,599</td>
<td>$3,498</td>
<td>-2.8%</td>
<td>1.5%</td>
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<td>13</td>
<td>17</td>
<td>Freescale Semiconductor</td>
<td>$4,966</td>
<td>$3,344</td>
<td>-32.7%</td>
<td>1.5%</td>
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<td>15</td>
<td>18</td>
<td>Panasonic Corporation</td>
<td>$4,473</td>
<td>$3,230</td>
<td>-25.6%</td>
<td>1.5%</td>
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<tr>
<td>17</td>
<td>19</td>
<td>NXP</td>
<td>$4,055</td>
<td>$3,247</td>
<td>-19.9%</td>
<td>1.4%</td>
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<tr>
<td>18</td>
<td>20</td>
<td>Sharp Electronics</td>
<td>$3,607</td>
<td>$2,886</td>
<td>-20.0%</td>
<td>1.3%</td>
</tr>
</tbody>
</table>

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
Worldwide Growth of Fabless Companies

Number of Fabless Companies Worldwide by Year

Source: Global Semiconductor Alliance (formerly FSA)

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

The I.C. entrepreneurship creation


Assemble the right team!
Top reasons for failure of fabless start-ups

- 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

# Success elements – product positioning

## EXISTING
- **Standard, market, customer base**
  - **Super-Integration**
  - **Problem solutions**
  - **Evolutionary enhancements**
    - e.g. Cost reduction

## NEW
- **Standard, market, customer base**
  - **Emerging standard**
  - **New features/capabilities**
  - **New interfaces**
  - **“Revolutionary” enhancements**

### Will Impact Schedule, Technology Selection, Design Methodology,....

Lifecycle of a fabless IC company – activity highlights

Typical ASIC Development Cycle

System vs. IC Development Cycle

a. At the System company:

- Start Product Design
- Launch

b. At the Fabless IC company:

- Start Design
- Tapeout
- ES
- QS
- Prod HW/SW
- Launch

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”

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.

<table>
<thead>
<tr>
<th>Process Node Maturity</th>
<th>Mature</th>
<th>Mainstream</th>
<th>Leading Edge</th>
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<td></td>
<td>500</td>
<td>350</td>
<td>250</td>
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<td>180</td>
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<td>90</td>
</tr>
<tr>
<td></td>
<td>65</td>
<td>45</td>
<td></td>
</tr>
</tbody>
</table>

Success elements – supply chain selection

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

Success elements – cost management

- Unit cost optimization

- Development cost optimization

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

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