Metrology's Value

in the semiconductor industry

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Metrology
is a modern engineer's eyes

- Sees and measures at nanometer scale dimensions
- Without measurement it is impossible to adjust complex processes
- The result: computers and chips become capable of solving ever more complex problems
  - More cost effectively
  - While using less power

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Metrology is Enabling

- Metrology:
  - Empowers engineers with the information needed to make transistors smaller
  - while systematically eliminating
    - The causes of yield losses
    - Performance sapping variability at the transistor level
- At the semiconductor and electronics levels
  - Metrology creates demand using Moore's Law to lower the cost of chips and computers
  - The macroeconomic result is greater productivity, lower inflation, and job creation

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The Power of Inspection & Metrology

300 mm wafer

10 nm

Scatter 100 coins

Find in 1 hour

Optical Inspection

Samples all ~17 trillion pixels in this area and finds the coins in about an hour

Source: KLA-Tencor

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Value is created *through these mechanisms:*

- Koomey's Law
- Moore's Law
- Dennard's scaling rules

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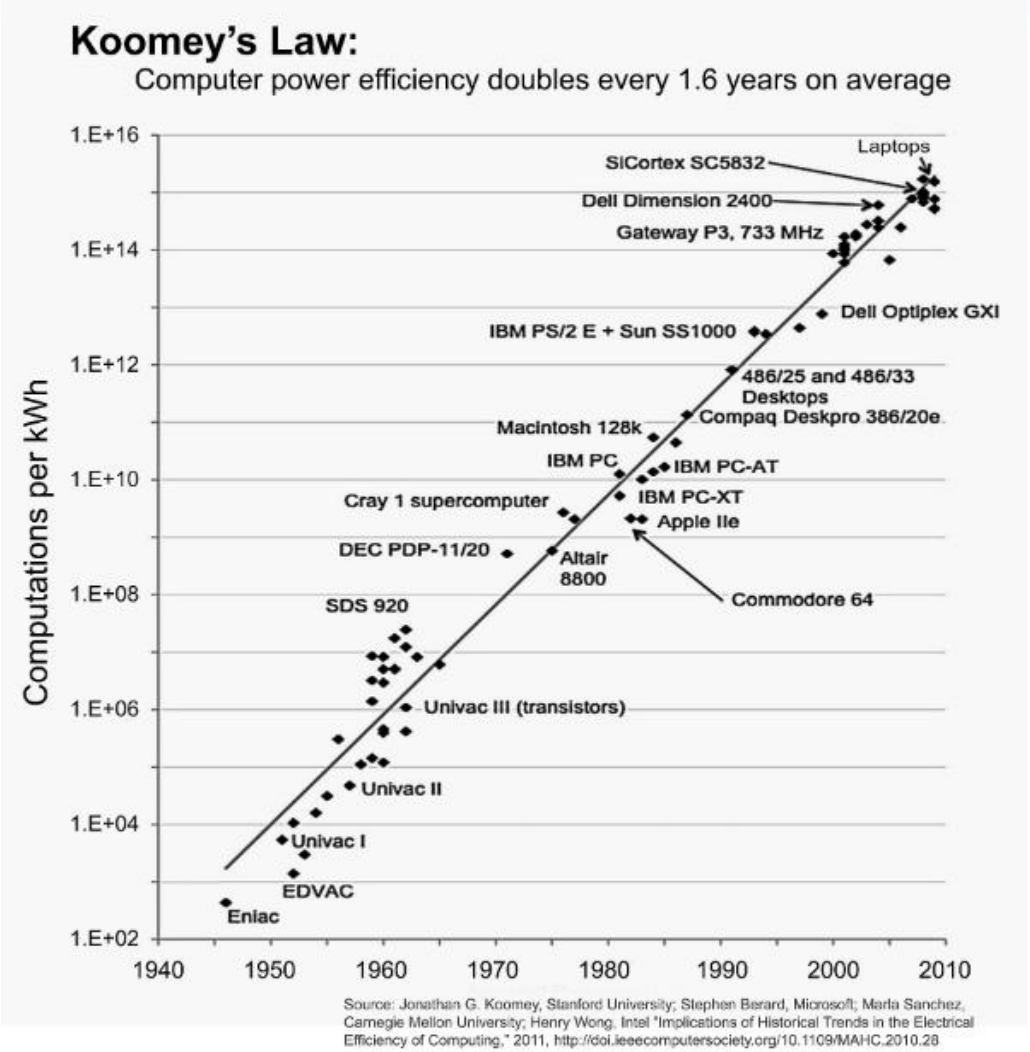
Koomey's Law

- Computer power efficiency grows at a 54% CAGR
- Thus power-per-computation is declining at a 35% annual rate



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Moore's Law

Component density **doubles** every two years

due to

geometry shrinks

for roughly the

same areal cost

Gordon Moore - 1975

Gordon Moore in 1975 Source: Intel

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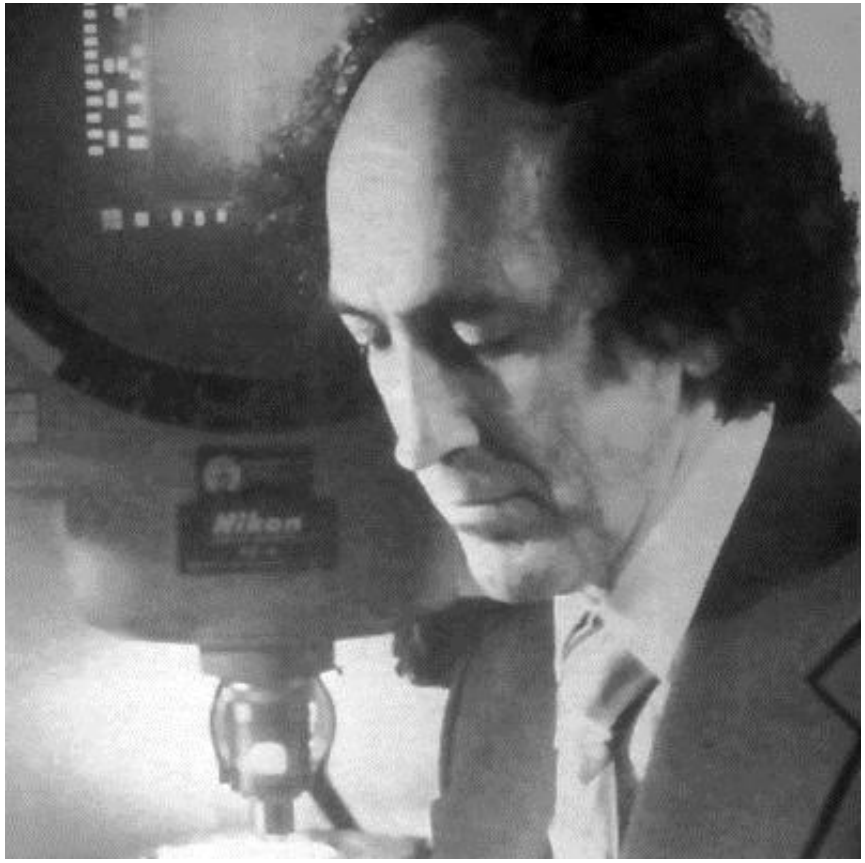
Dennard's scaling rules

Transistor **shrinks** result in

proportional power and/or

performance **gains**.

Robert Dennard - 1974



Robert Dennard Source: IBM

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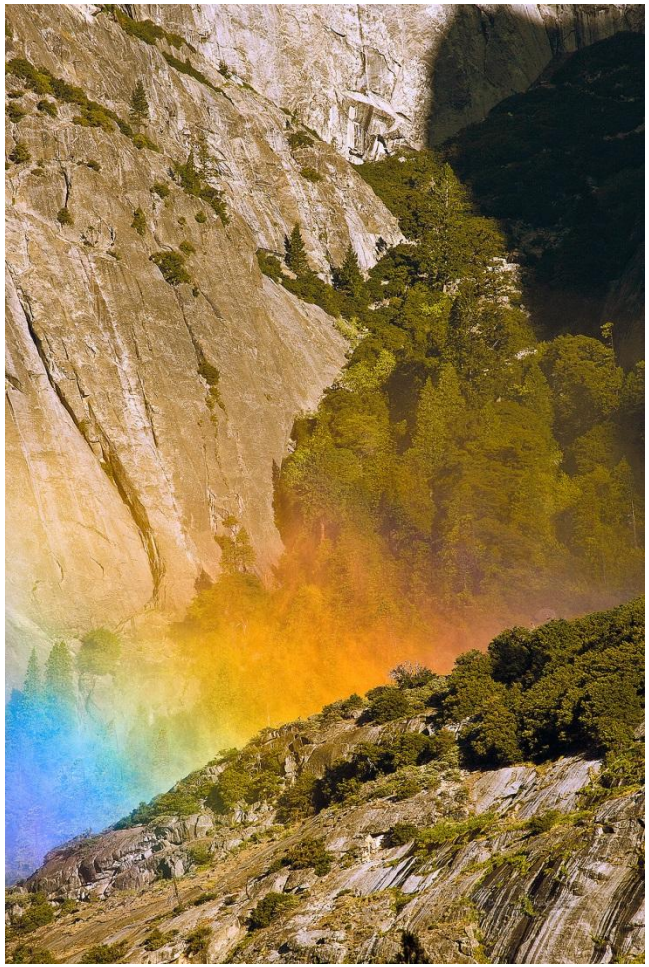
The Value of Metrology

is delivered in many forms

- Return on Investment
- Increased Revenues
- Faster Time to Money
- Greater Profits
- Loss Prevention
- Business Continuity
  - Brand value



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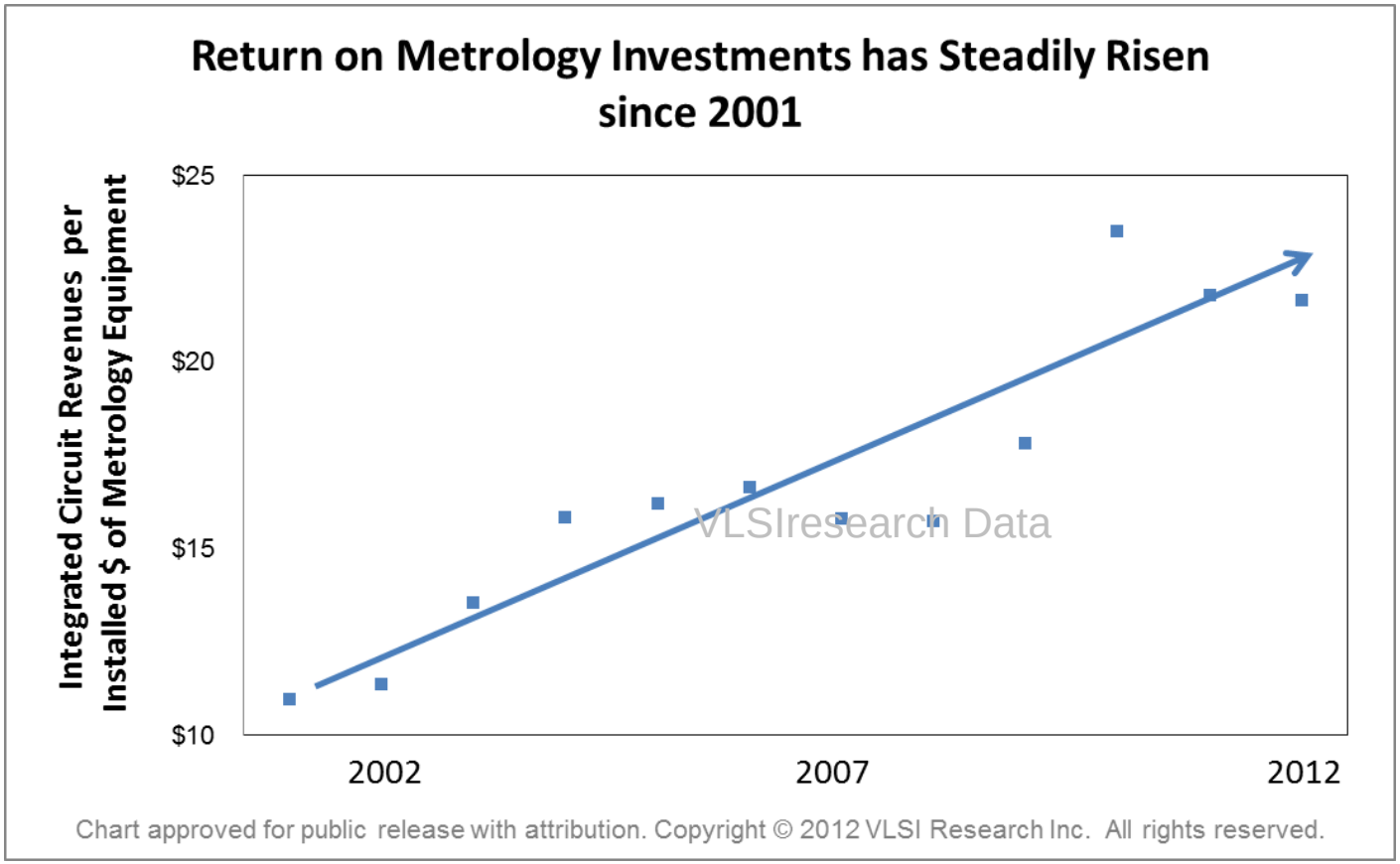
Metrology ROI

Steady increase for last 10 years



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Chip Makers' Return

- In 2002:
  - Each dollar spent on metrology generated
    - $11 in IC sales
- In 2012:
  - Each dollar spent on metrology generated
    - $22 in IC sales

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Value of Yield

Yield → **Profit** → **Industry Share Holder Value**

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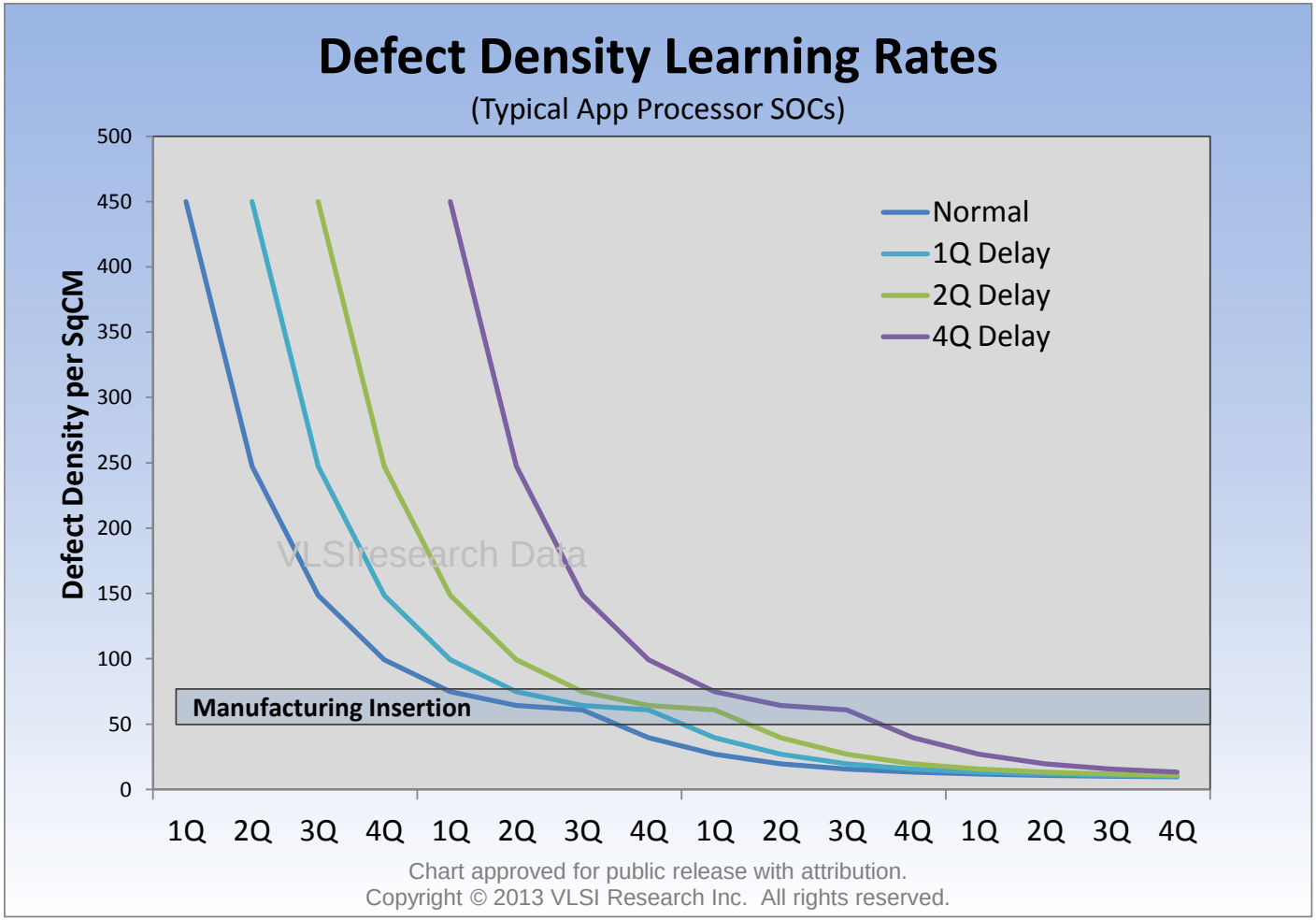
Faster Time to Money



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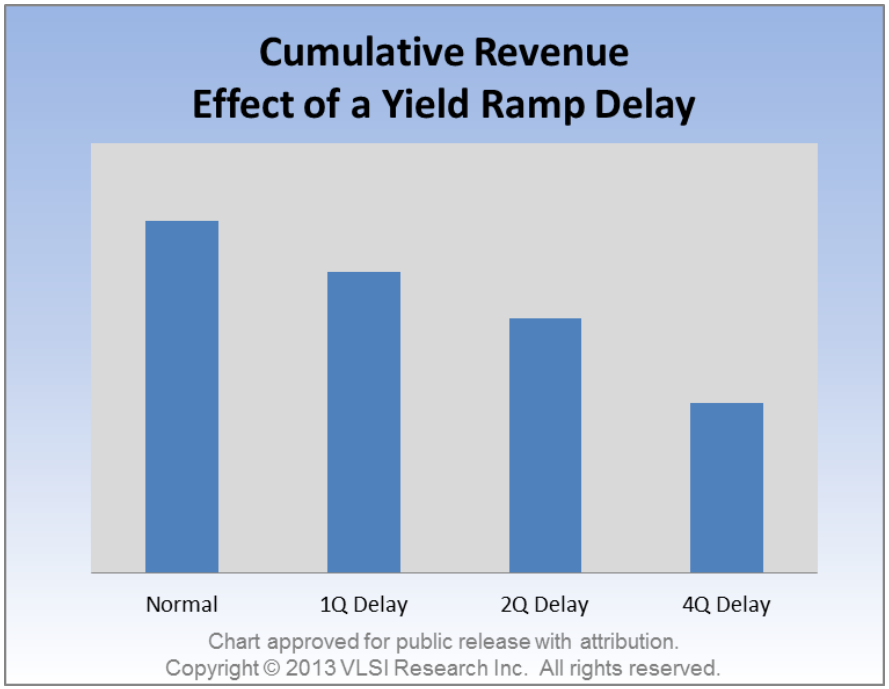
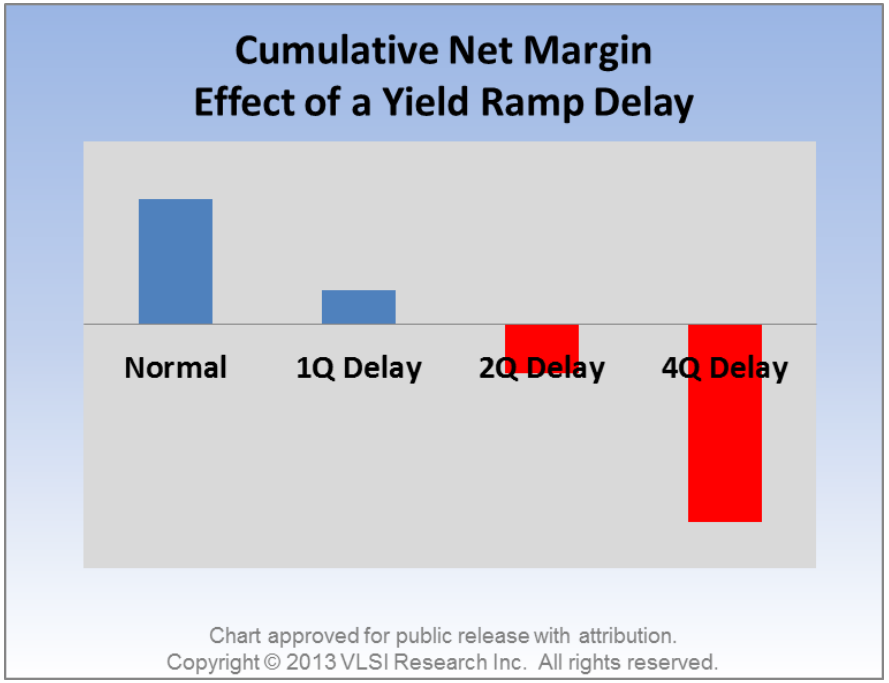
Delay in Yield Ramp Denies Profits

Preventing investment in R&D and future nodes





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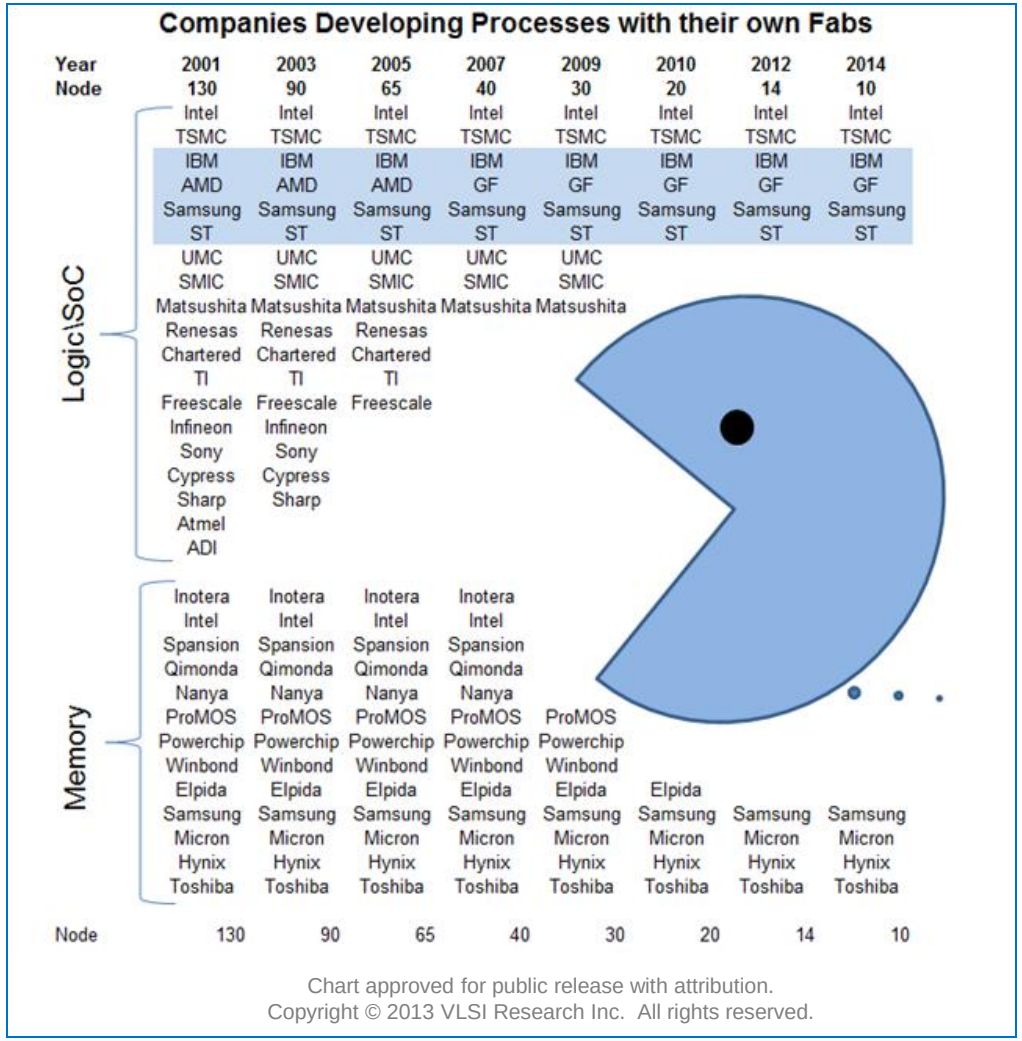
Cost of Delay

Over the life cycle of the node

- One quarter delay costs $3B
- Two quarters $6B
- And full year $11B
- Time to money has also been driving the manufacturing consolidation



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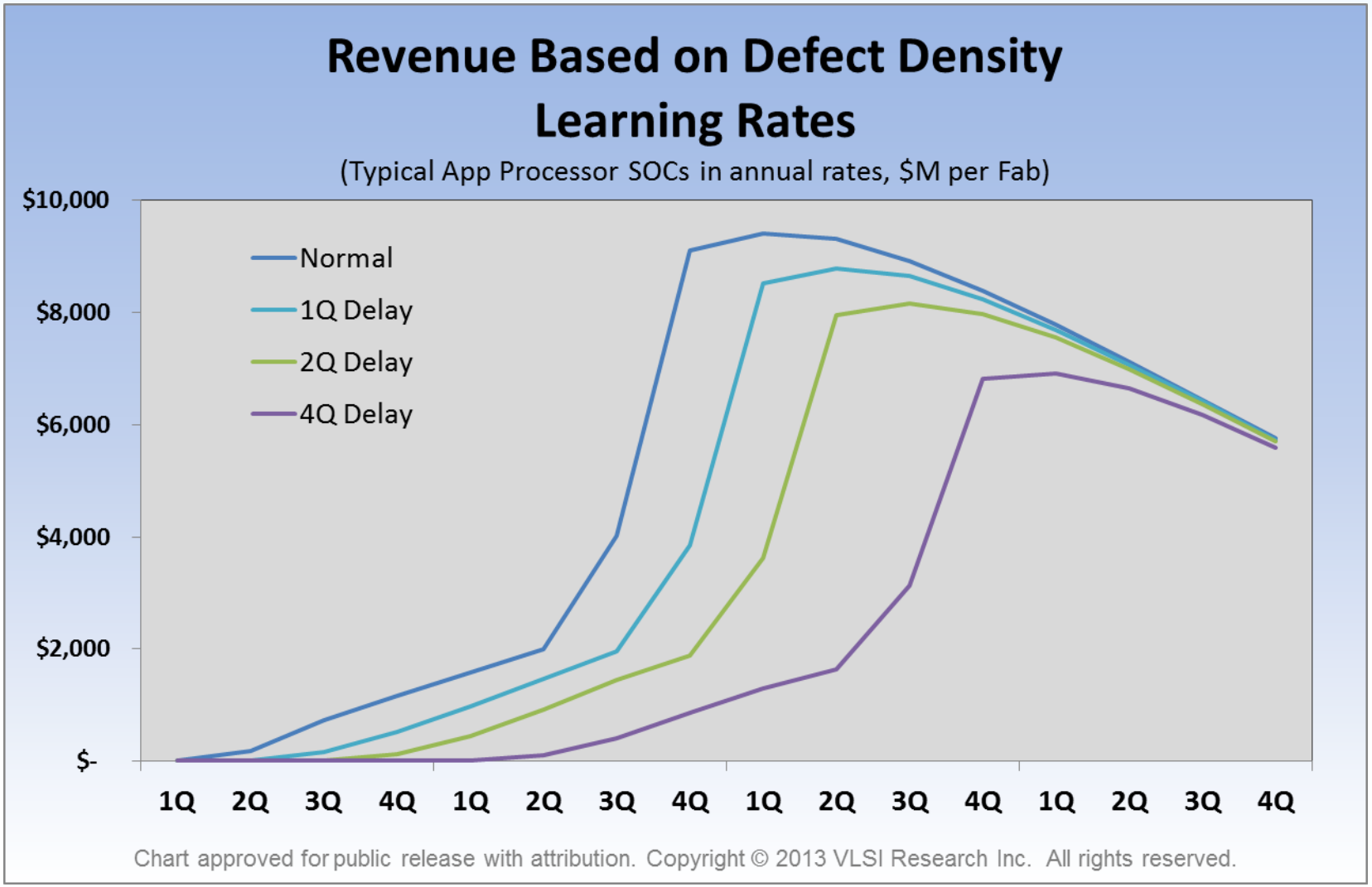
Increased Revenues



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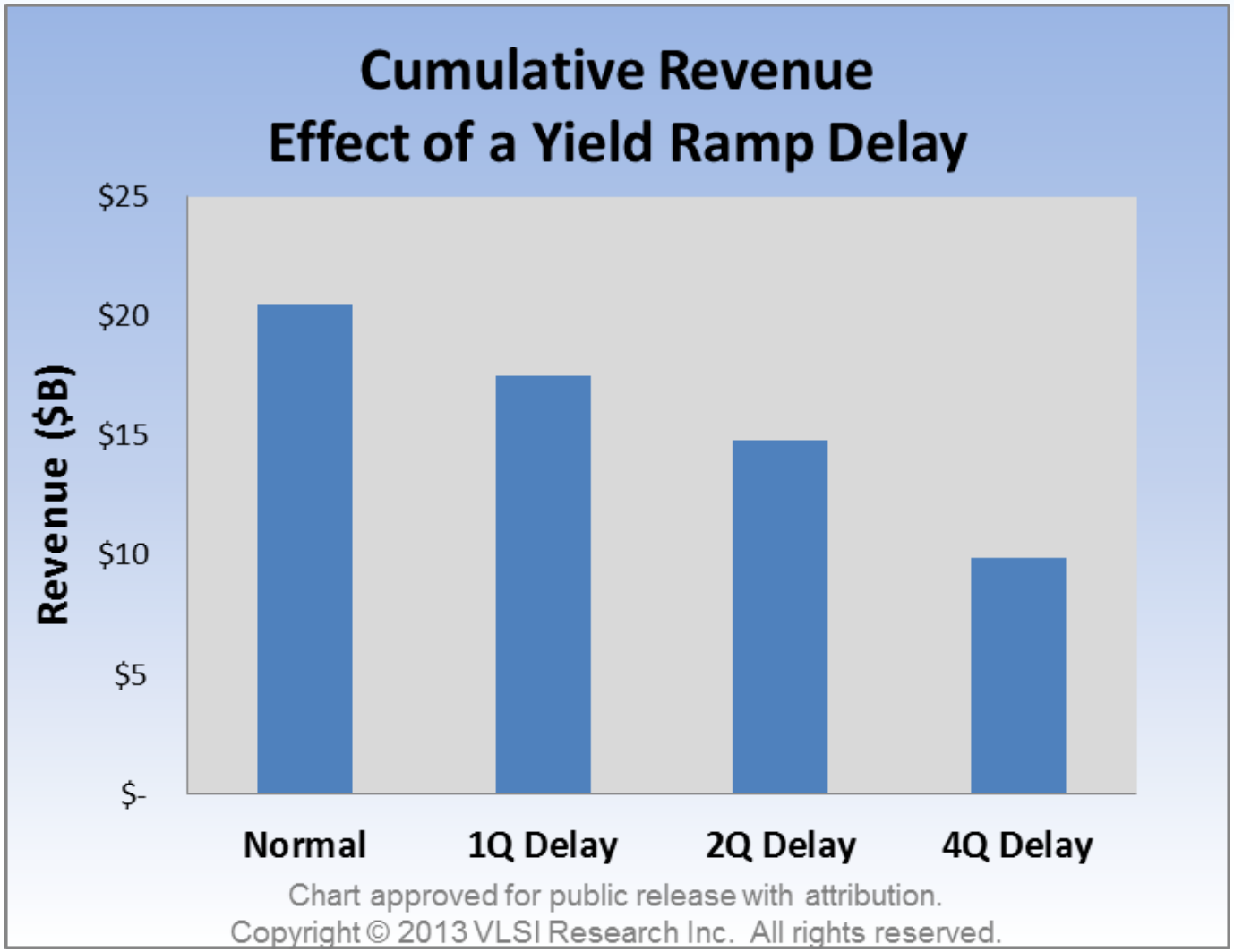
1 Quarter Delay is Worth Half a Fab



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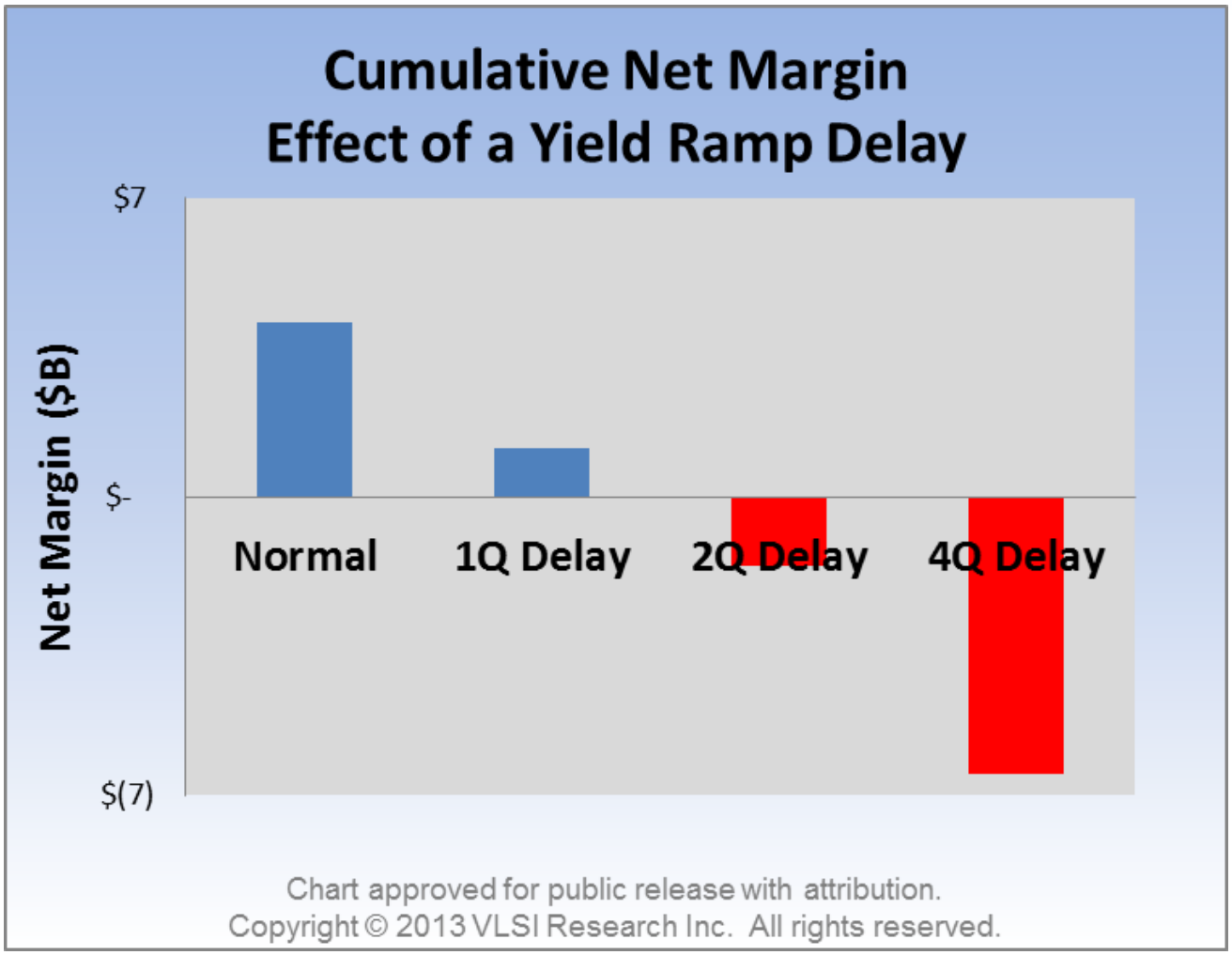
Faster Learning = Greater Profits



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Value of Yield Improvement

Shareholders are the greatest beneficiaries

- For a 1% yield improvement from a $1B metrology investment
  - The result is 4000% return for shareholders

Or opposite….

- When metrology budgets are reduced by $1B costing 1% in yield
  - Risking yield loss resulting -3000% shareholder return though profitability reduction
- Metrology becomes the best insurance available

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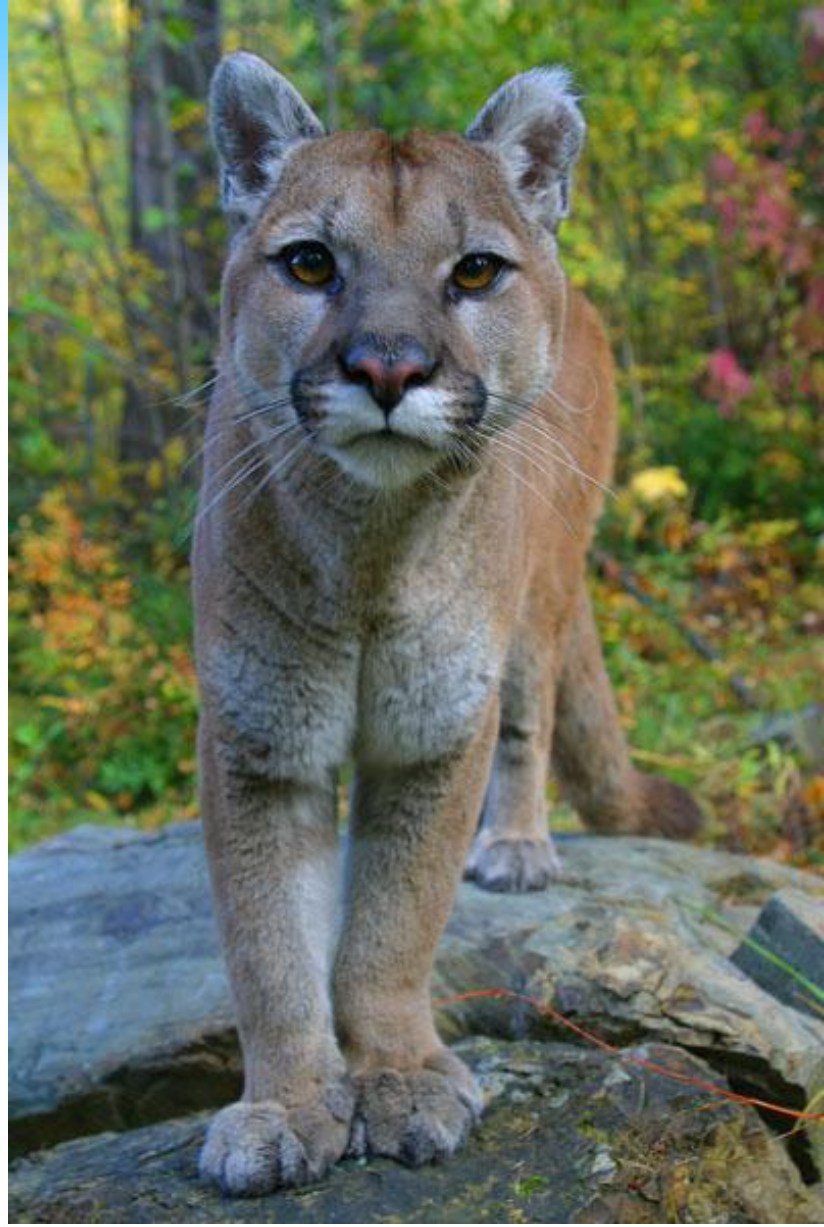

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- Education site on semiconductors
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- Where Technology = Opportunity
- A virtual science & engineering conference
- Ads reach 200K visitors per month
  - 15-20mins & 35 page views / visit, >1 visit / week
  - High signature authority and income viewership
  - High Yield on Targets for your business

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