Supply Chain Research in the Age of eBusiness

2000 NSF Design and Manufacturing Research Conference

Morris A. Cohen

Matsushita Professor of Manufacturing & Logistics

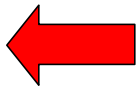
Fishman-Davidson Center for Service & Operations Management

Wharton School

University of Pennsylvania

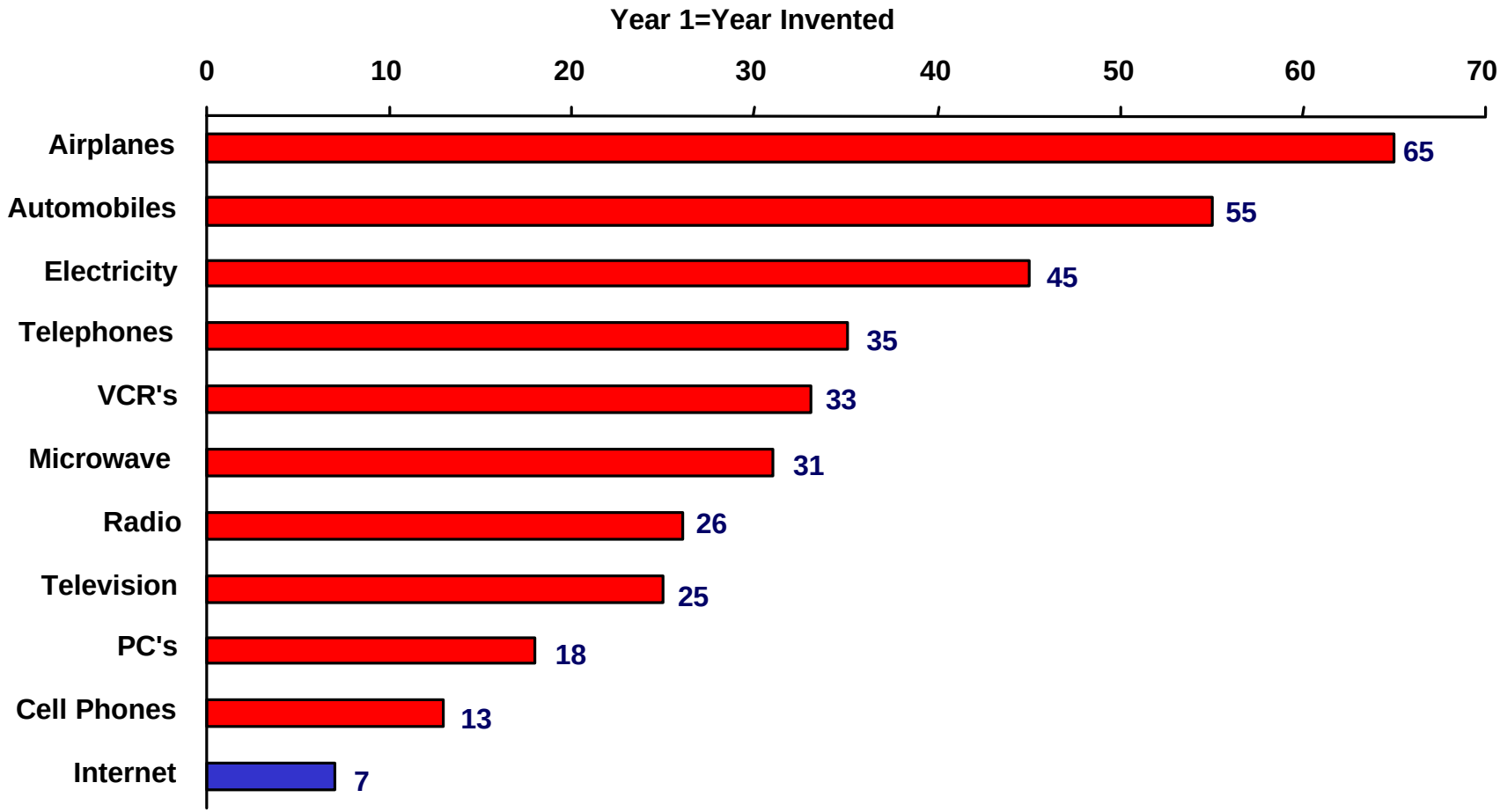
January 4, 2000

Agenda

- Recent Trends in eCommerce 
- Lessons from the PC Industry
- Supply Chain Considerations
- 3 Dimensional Design Framework
- Research Issues

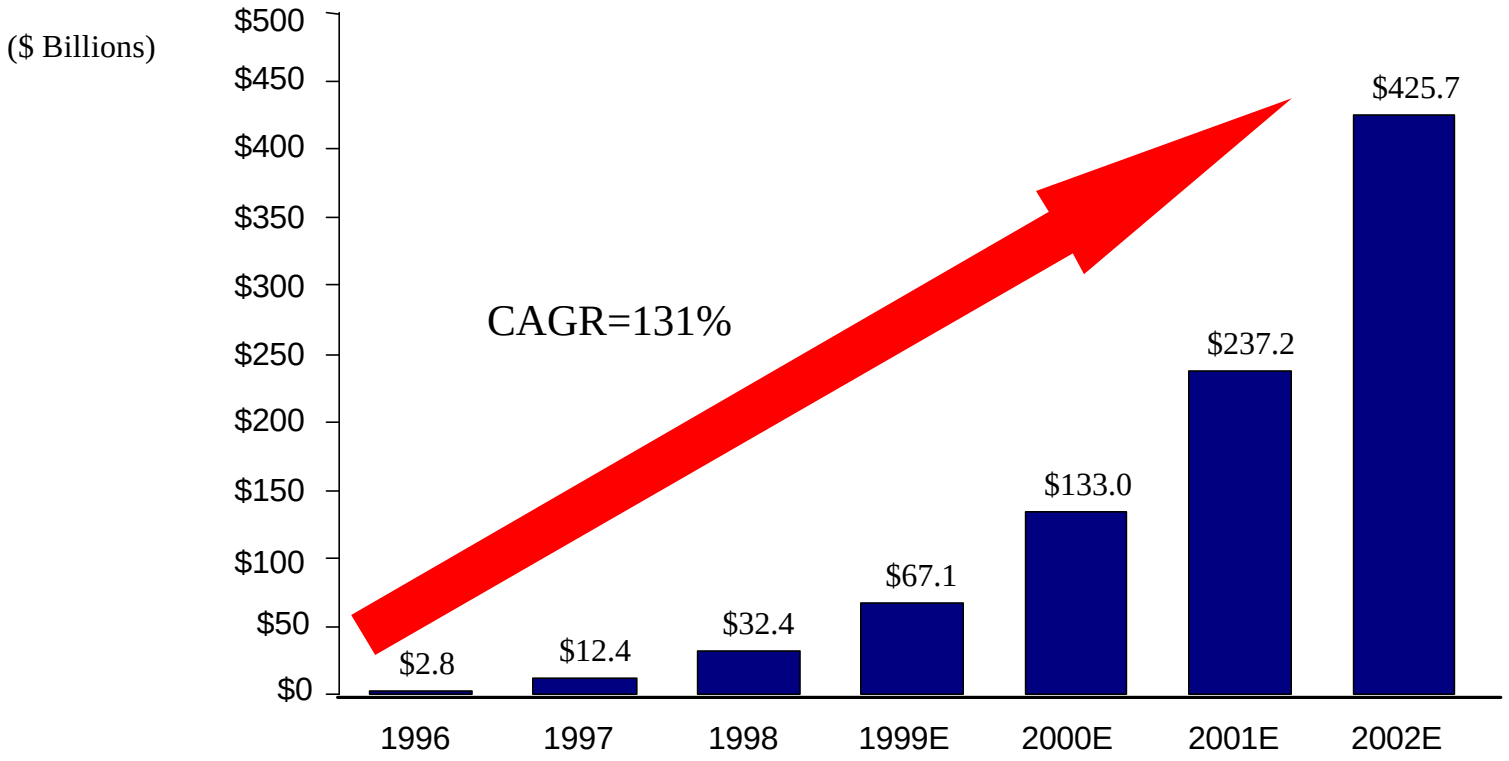
Mass Adoption at Record Rates

Years to Achieve 25% Population Penetration in U.S.



Source: Forbes, 1998/ Internet Capital Group

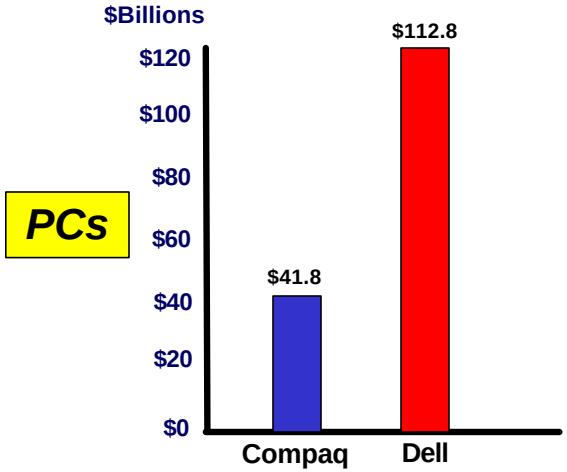
Online Commerce is Exploding

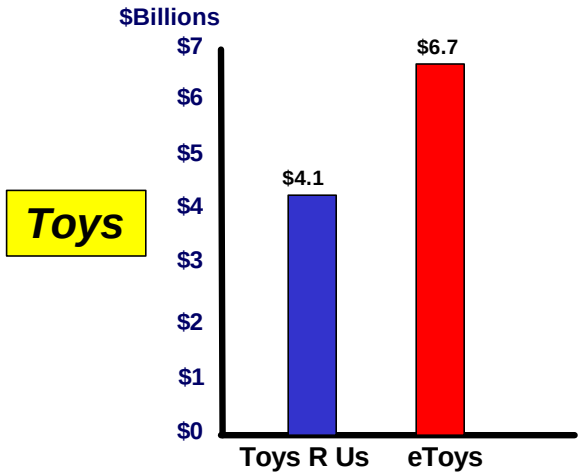


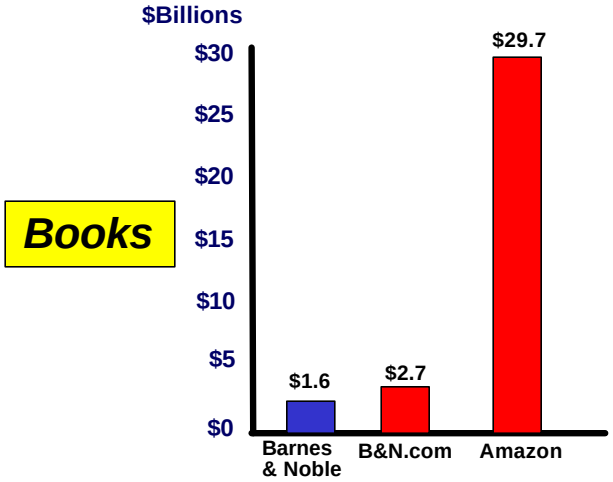
Source: Forrester Research/ Internet Capital Group

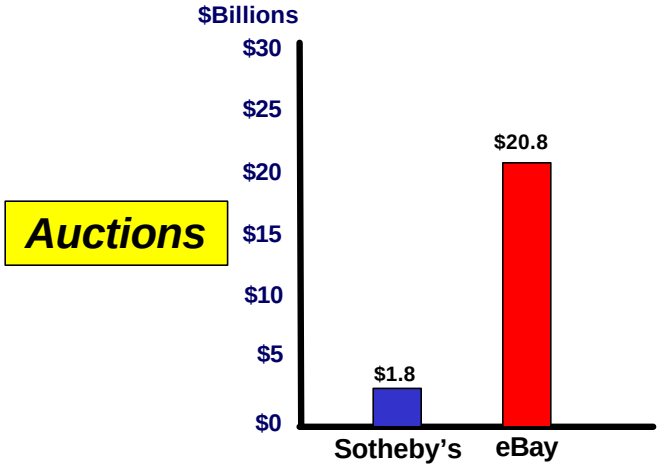
The Capital Markets Reward E-Commerce

Comparative Equity Market Capitalization





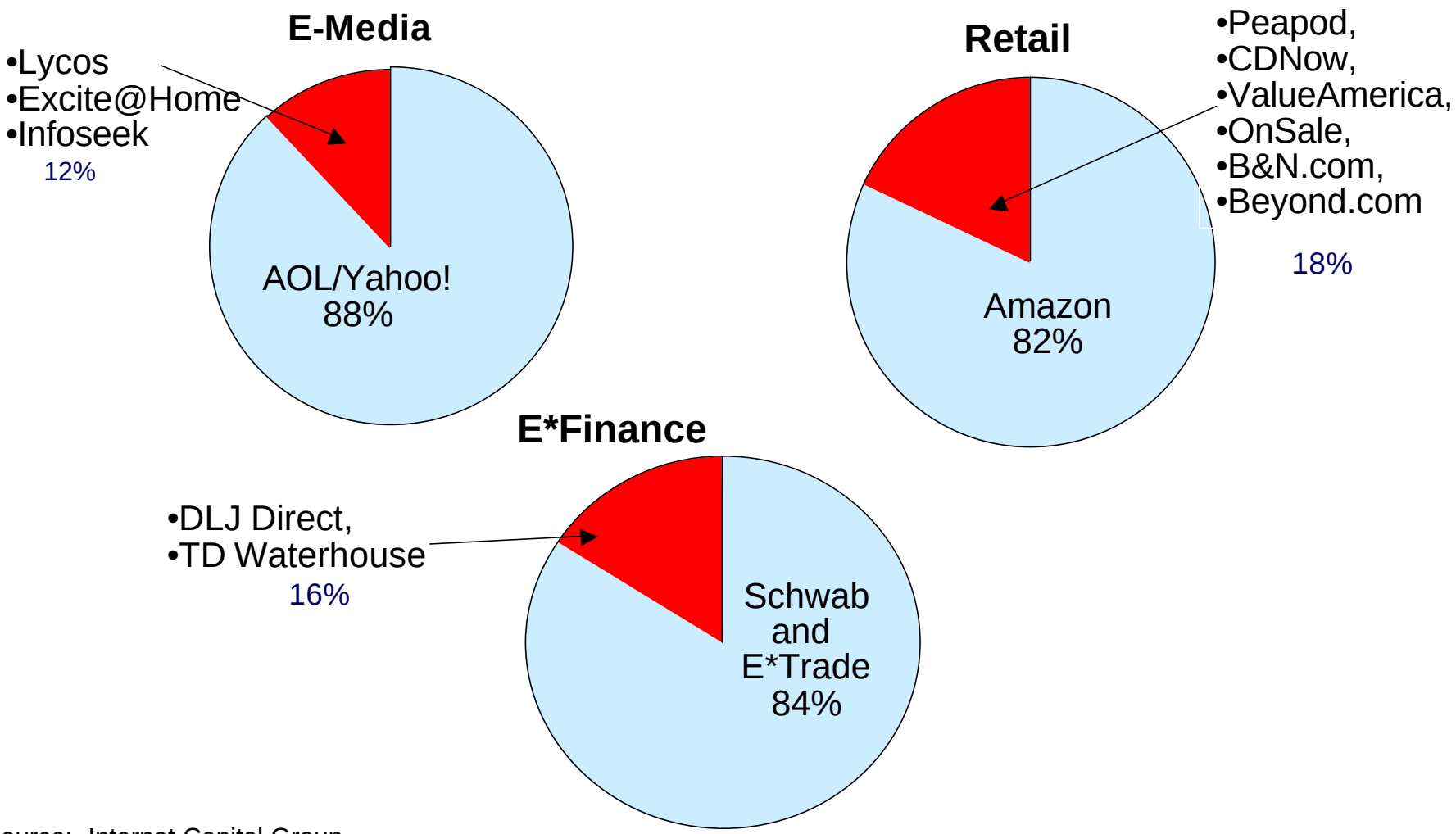




Note: Market Capitalization as of 12/2/99
Source: Internet Capital Group

“Winner Takes Most Markets”

Comparative Equity Market Capitalization



Source: Internet Capital Group

Analyst Discovers Order in the Chaos Of Huge Valuations for Internet Stocks

HEARD ON THE STREET

By GREG IP
Staff Reporter of THE WALL STREET JOURNAL

Internet stocks, the conventional wisdom goes, are a chaotic mishmash defying any rules of valuation.

But one unconventional analyst thinks he has found proof of precisely the opposite: that Internet stocks adhere to a mathematical valuation system so rigid, it resembles patterns found in nature. That pattern suggests there may be fewer ultimate winners in the Internet arena than some investors expect.

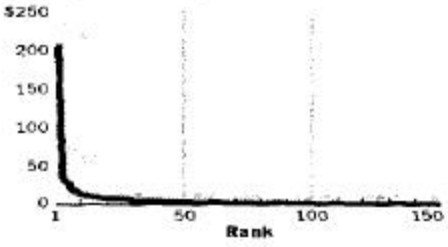
The analyst, Michael Mauboussin, the chief investment strategist at Credit Suisse First Boston, found this pattern, not by comparing Internet stocks to more ordinary benchmarks such as earnings, but by looking at the valuation of Internet stocks relative to one another. Among Internet stocks, he says, "there is literally a mathematical relationship between the ranking of the stock and its capitalization."

Most conventional analysis finds the sector's enormous valuation irrational. Mr. Mauboussin doesn't try to justify the high prices investors are willing to pay for Internet stocks as a group. Instead, he is intrigued by how so much of the stock-market value of Internet concerns is clustered into just a handful of companies. Indeed, just 1% of 400 companies in the sector account for 40% of its $900 billion value in the stock market.

A Method to the Internet Madness?

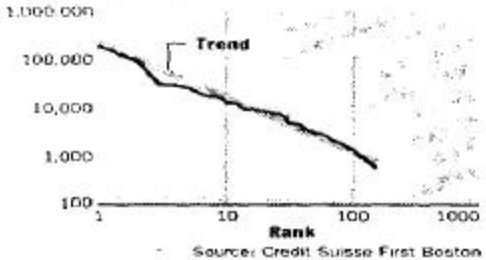
Internet Stock Values Appear Jumbled...

Internet stock values in billions, and rank on normal scale



But May Adhere to a Hidden Order

Internet stock values and rank on logarithmic scale



Source: Credit Suisse First Boston

Mr. Mauboussin uses some mathematical wizardry to find the pattern. Simply scattering the companies' value and ranking (relative to one another) on an ordinary chart results in a hockey-stick-like pattern: a couple of companies in the multiple billions of dollars, and everything else clustered close to zero.

Using some slightly different but relatively simple math, he found that each company's value bears a predictable relationship to the others'. He couldn't find a pattern like this in any other sector.

"I don't know why it works for this sector, but it suggests a couple of things," Mr. Mauboussin says. "One, there is a little method to the madness of how the market values these things. More important, these are winner-take-all or winner-take-most markets."

The pattern emerges when the companies' values are plotted along with their market-capitalization rank on a logarithmic chart. On such a chart, each inch equals a similar percentage change. For example, the distance between 100 and 1,000 is the same as that between 1,000 to 10,000, because both moves represent a 900% increase. Mr. Mauboussin says this is characteristic of a "power law," normally found only in measuring natural or social

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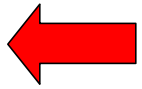
- Lessons from the PC Industry 
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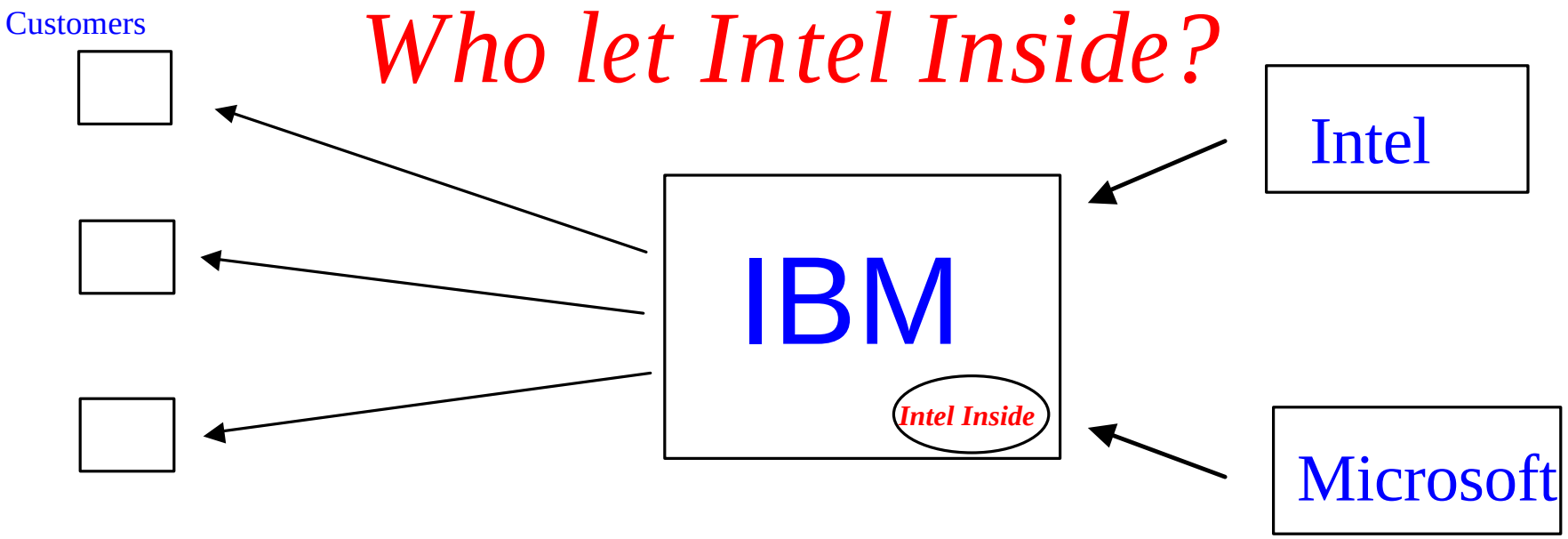
Power Diffusion up the Supply Chain: The Leverage of 3-D Concurrent Engineering

1981: IBM designs a product, a process, & a supply chai



The Outcome:

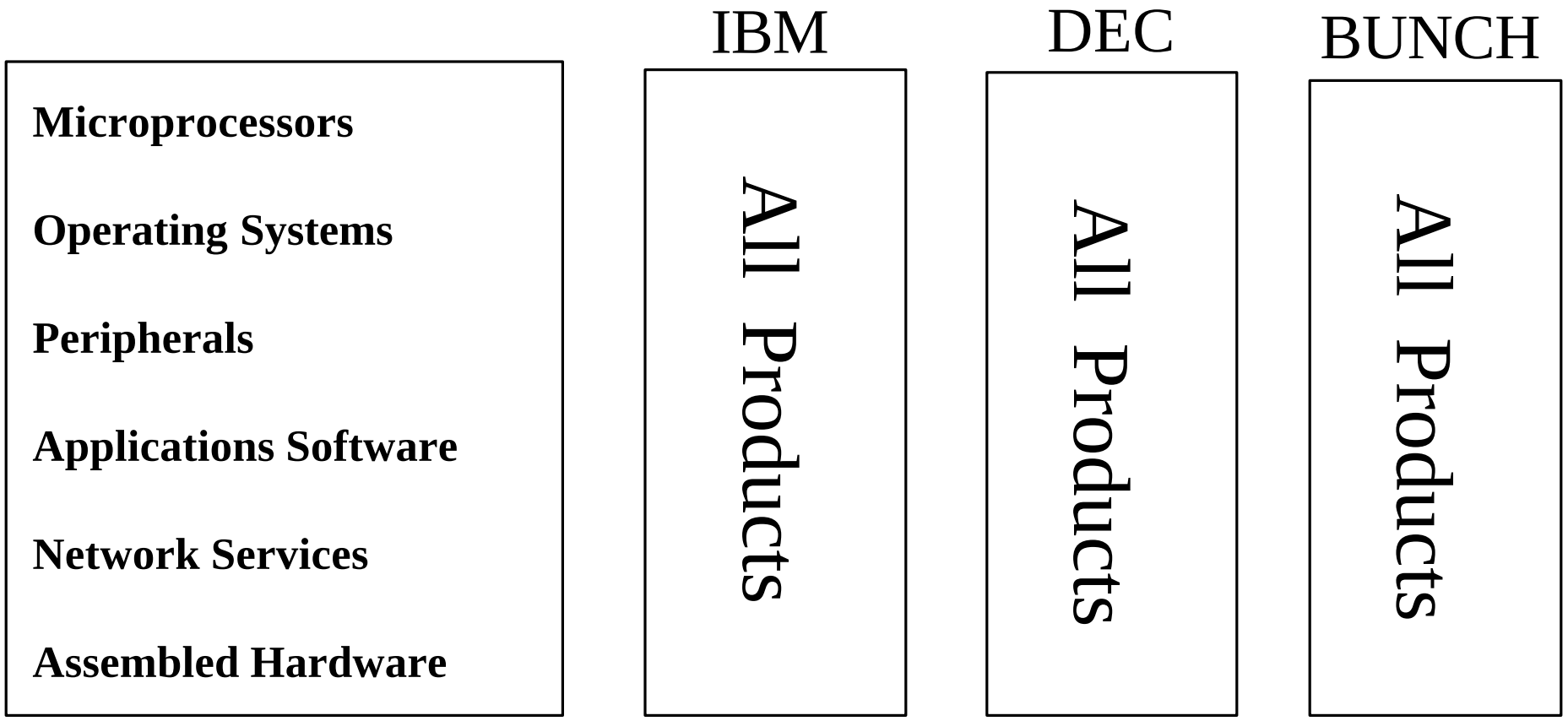
A phenomenally successful product design

A disastrous supply chain design (for IBM)

Vertical Industry Structure

with *Integral* Product Architecture

Computer Industry Example, 1975-85

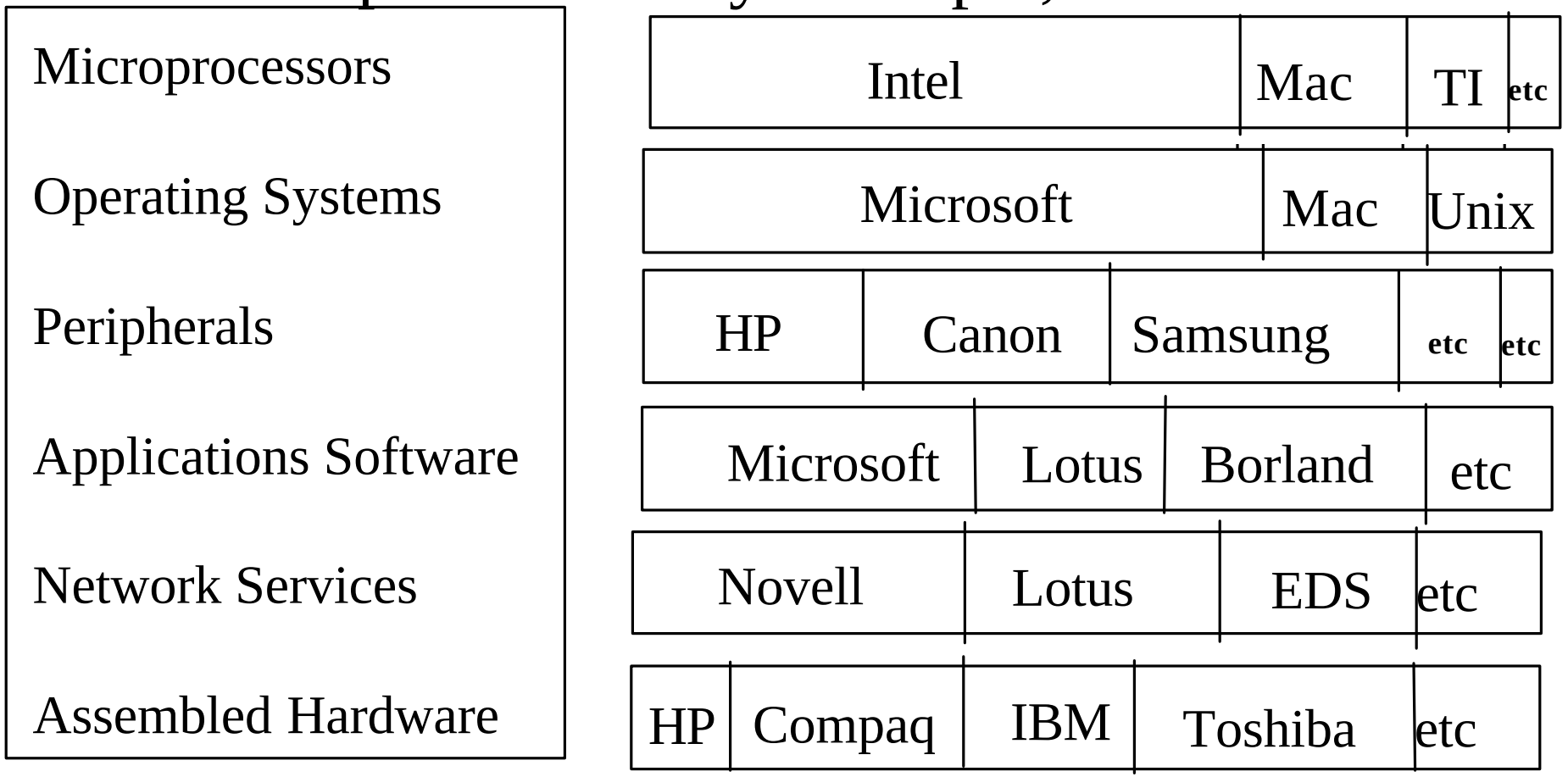


(A. Grove, Intel; and Farrell, Hunter & Saloner, Stanford)

Horizontal Industry Structure

with *Modular* Product Architecture

Computer Industry Example, 1985-95

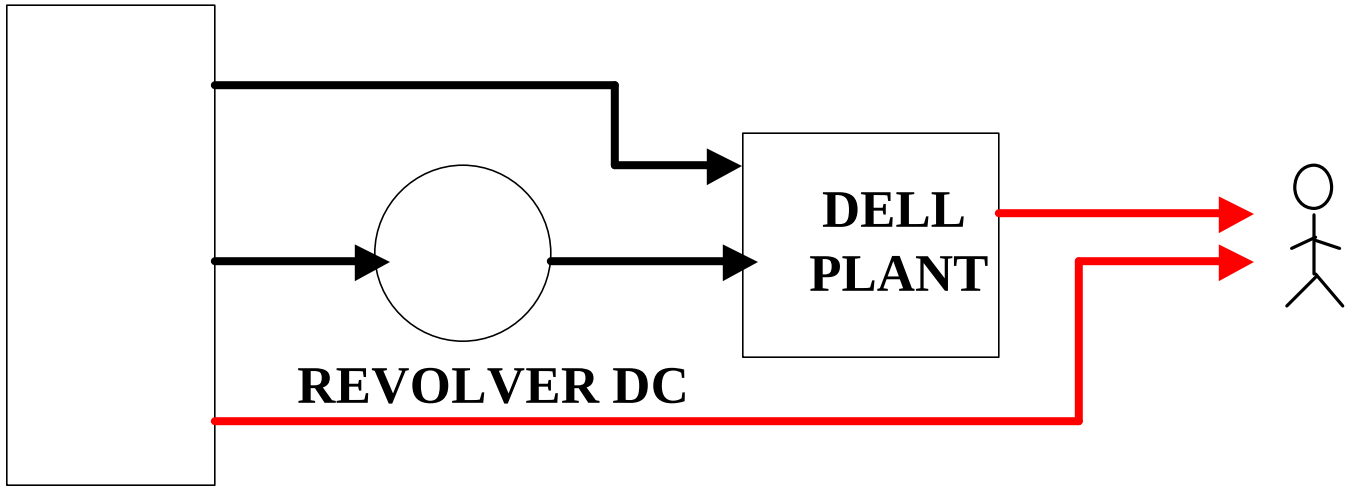


(A. Grove, Intel; and Farrell, Hunter & Saloner, Stanford)

The Dell Direct Model

(1990s)

- All computers built to order (direct channel)
- < 7 days of inventory (corporate)
- Higher profit margin (reduce obsolesence risk)
- 190% Return on Assets



Dell Online

- 1999 Internet Sales: $14 Million/Day
- 30% higher margin and reduced costs for Internet generated sales (1 vs 5 calls)
- Direct sales model limited due to cost (time) of providing information via sales rep & incentive system for sales rep
- Enhanced role of sales rep for relational business via Premier Pages

Lessons Learned from PC Industry

- Product architecture change coincident with supply chain redesign & industry re-structuring
- Direct business model enabled by these changes
- Internet channel has increased customer value
  - convenient/personalized/customized service
    $\Rightarrow$ market segmentation
    (e.g. Dell's Premier Page, Amazon.com)
  - provides new services
    (e.g access to technical support database, FAQs, Amazon's customer book reviews)
  - reduces costs
    (e.g inventory obsolescence, receivables, transaction, information content)

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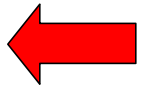
- Supply Chain Considerations 
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Supply Chain Structure and Coordination

- A supply chain is a network of value adding cells (each cell fulfills demand by transforming inputs into outputs)
  - *Supply Chain Coordination* incorporates the information links and decisions that determine the flow of materials and services in order to match supply with demand throughout the supply chain
  - *Supply Chain Structure* determines the location, capacity, connectivity and mission of the cells in the supply chain network

MATCHING SUPPLY WITH DEMAND IN THE WORLD OF eCOMMERCE

INFORMATION:

- accurate, real-time, rich
- based on all supply chain transactions (retail to raw material)
- visible throughout supply chain
- unlimited connectivity
- search & price discovery cost reduced

MATERIAL FLOW:

- direct, just-in-time shipments ("Pull")
- zero switching cost for suppliers
- new channels (market makers)

PRODUCT:

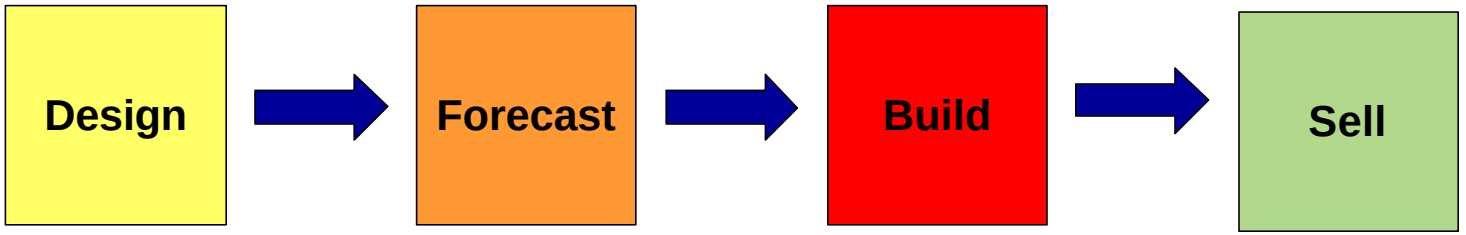
- customized relationship products with high information content
- reduced economies of scale in production
- unbundling of products/services

DECISIONS:

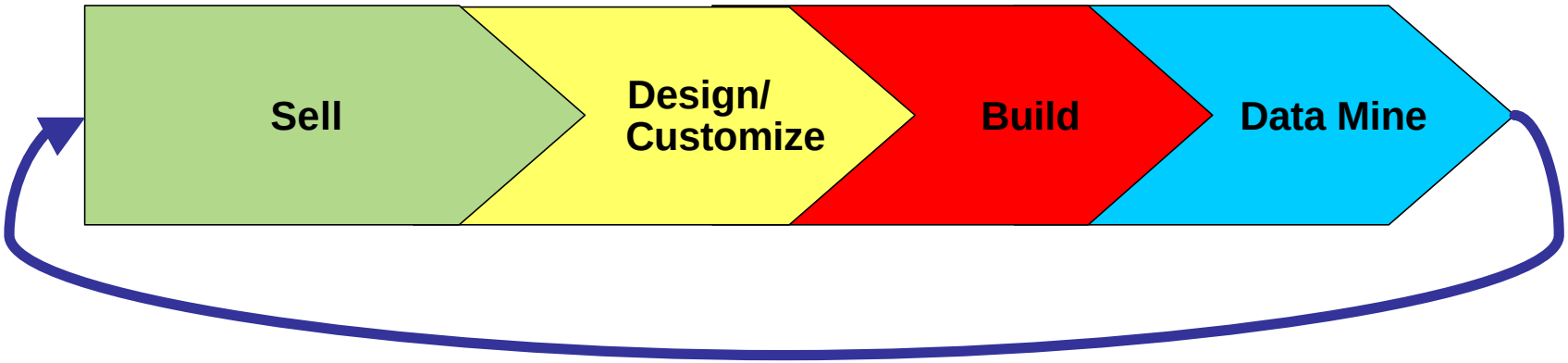
- real-time reaction to contingencies
- coordinated responses across communities
- globally optimal solutions

The Traditional Business Model Will Be Turned Upside Down

Traditional Approach: "The Product is King"
Best product to largest customer base

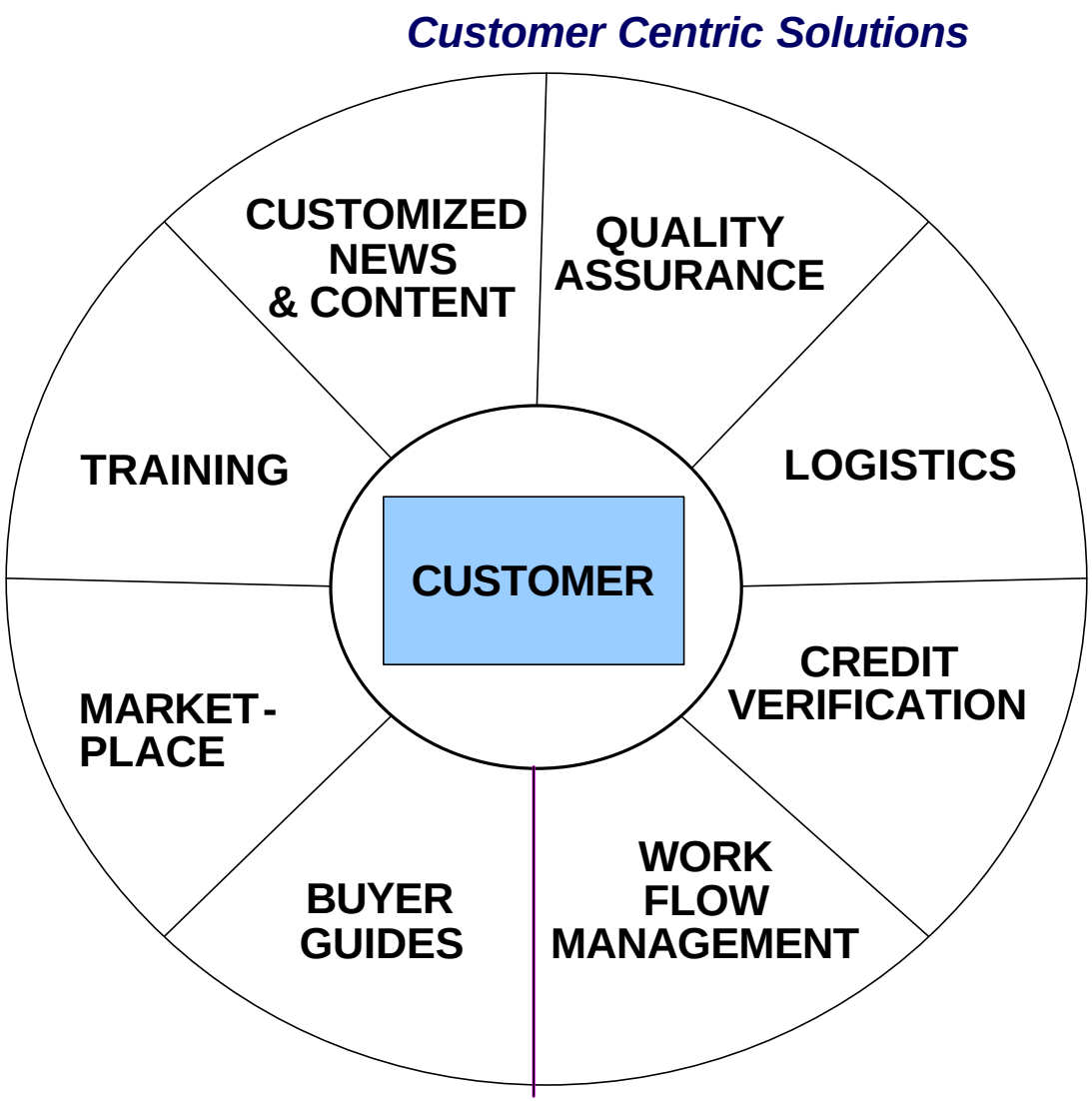


Internet Approach: "The Customer is King"
Right product to each customer



Source: Internet Capital Group

Market Power Shifting to Customer

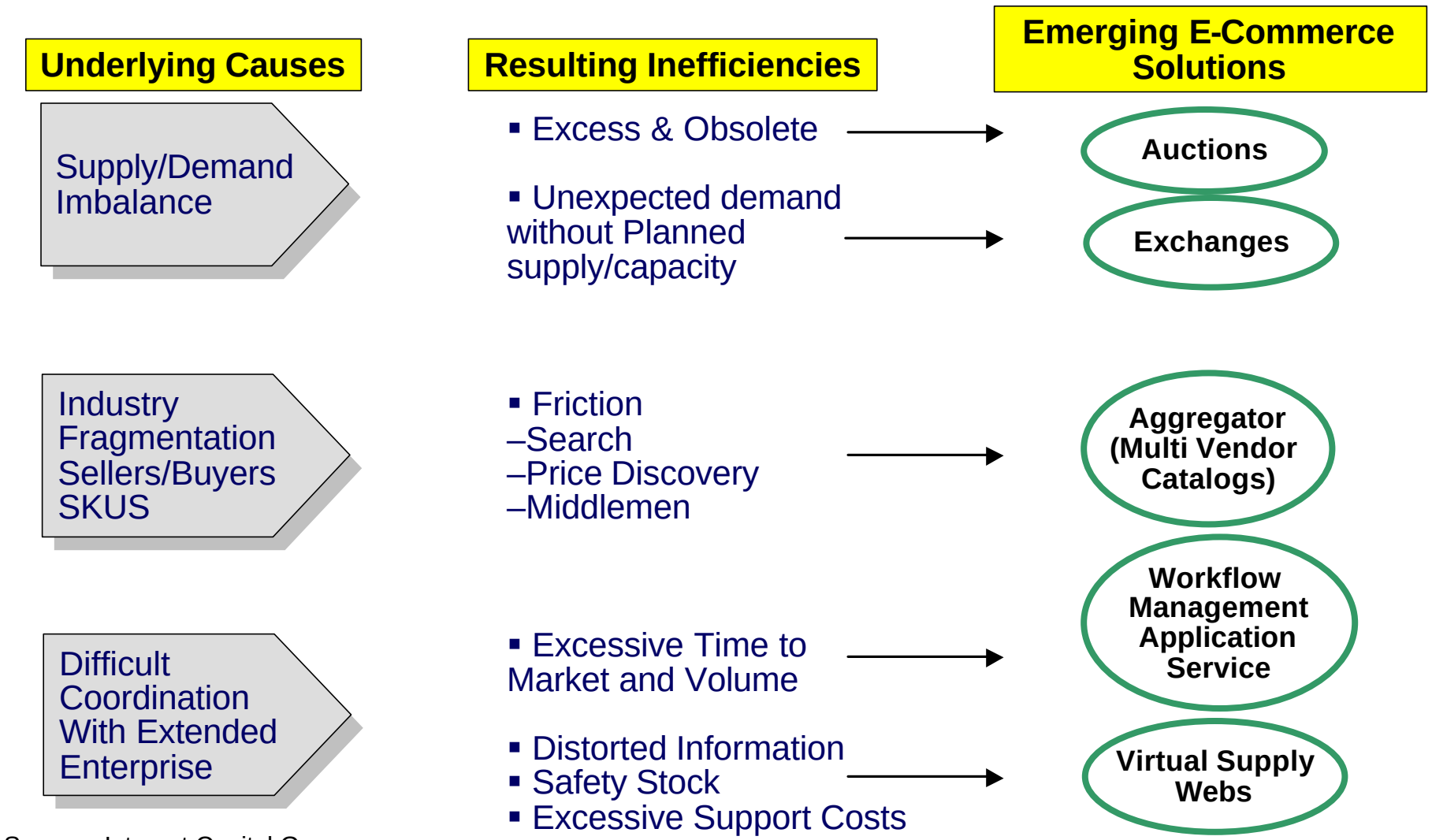


- **Business models and services will "consolidate" around customers**
- **Customers will have full information (no asymmetry)**
- **Customers will have unprecedented choices, visibility & ability to communicate their needs**

Customized products with enhanced service expectations at low cost

- **Suppliers absorb risk & cost (VMI, consignment, etc.)**
- **Best-in-class companies will thrive**
- **Marginal players will die**

eCommerce Coordination



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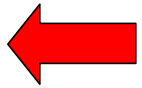
- 3 Dimensional Design Framework 
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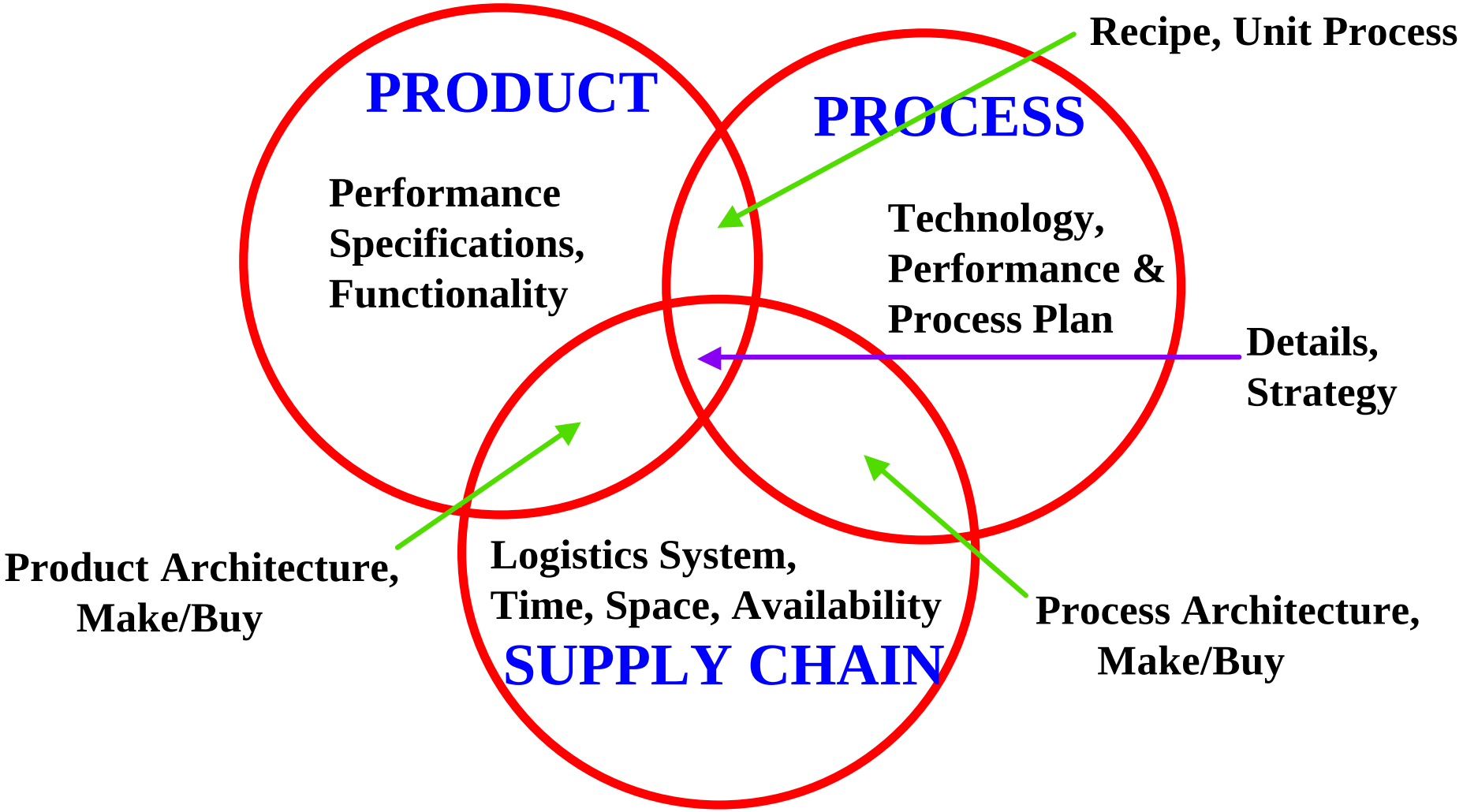
3-D CONCURRENT ENGINEERING



From Design to Architecture

Design

1) Set detailed performance (function) specifications
2) Select discrete (unit) elements

- Product = part
- Process = machine
- Supply Chain = facility

Architecture

1) Map between functions & elements
2) Linkage among the elements - (How combined and organized)

- Product = Integral / Modular
- Process = Dedicated / Flexible
- Supply Chain = Integral / Modular

KEY CONCEPT FOR 3-D CE PRODUCT, PROCESS, AND SUPPLY CHAIN ARCHITECTURES

Integral architectures **feature close coupling among the elements**

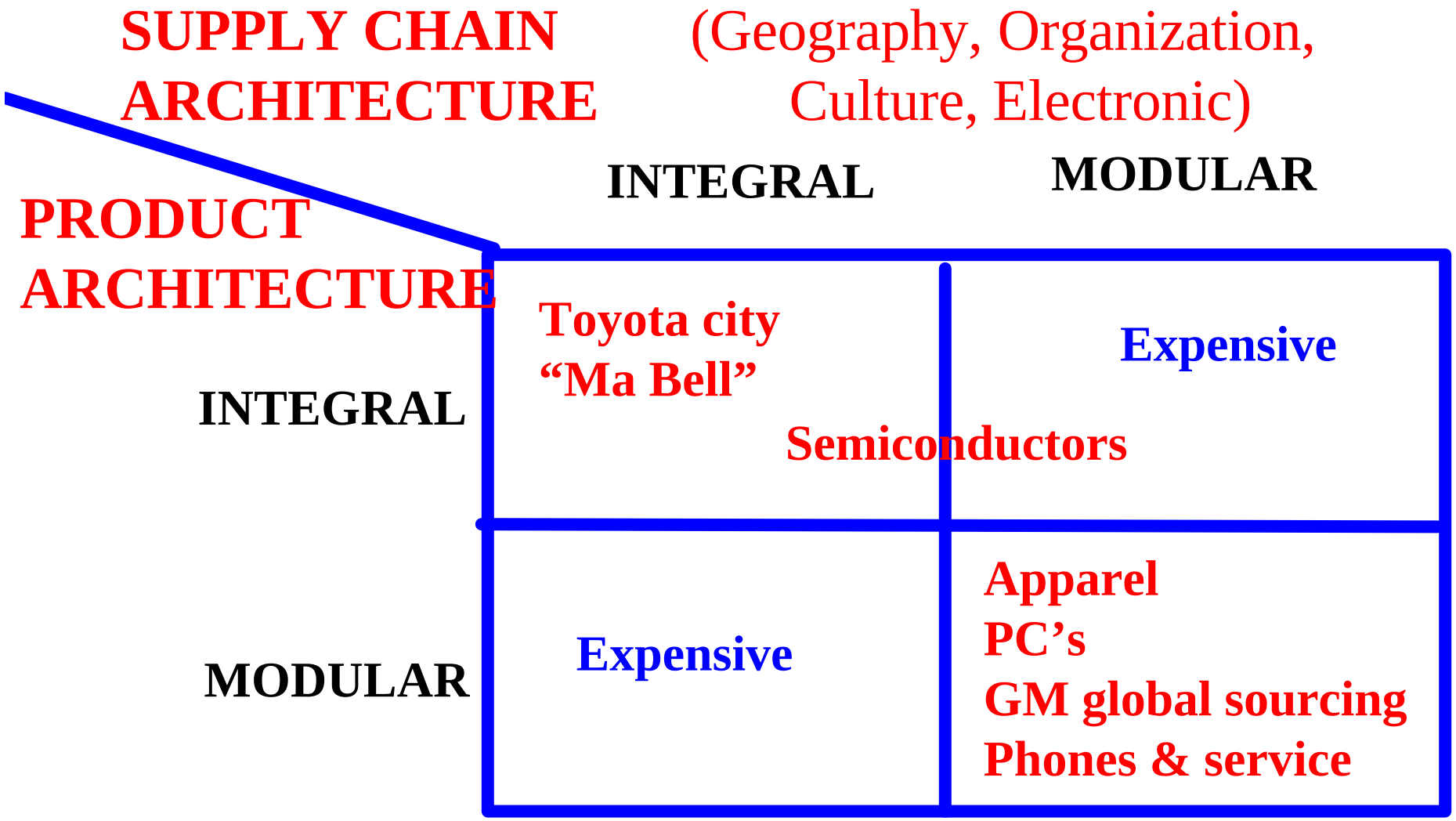
- **Elements perform many functions**
- **Elements are in close proximity (close spatial relationship)**
- **Elements tightly synchronized**

Modular architectures **feature separation among the elements**

- **Elements are interchangeable**
- **Elements are individually upgradeable**
- **Element interfaces are standardized**
- **System failures can be localized**

CONCURRENT ARCHITECTURE DESIGN FOR PRODUCT AND SUPPLY CHAIN

(Hypothesis: "On Diagonal is statically optimal")



Clockspeed Impact

Hypothesis 2: As industry clockspeed increases, product designs become more modular

Hypothesis 3: As industry clockspeed increases, processes become more flexible

Hypothesis 4: As industry clockspeed increases, supply chains become more integral

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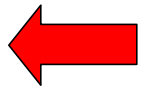

eSupply Chain Research Questions

- Will industry supply chains convergence to a generic design across firms, within an industry, and across industries
  Or, will it adopt rapid re-structuring?
  - to provide tailored performance to specific market segments in response to competitive opportunities
- What key industry attributes drive structure?
  - "clockspeed" of product and process technologies
  - cost structure
  - intensity of competition
  - architectures of products and supply chains
- How do product attributes drive adoption of eCommerce?
  - Commodities (high volume, low cost, standard design, low relationships) vs. High Relationship products
- What is the value of brands (reputation)?
- How should Incentives & Contracts be structured?
- What will be the impact of new market mechanisms?