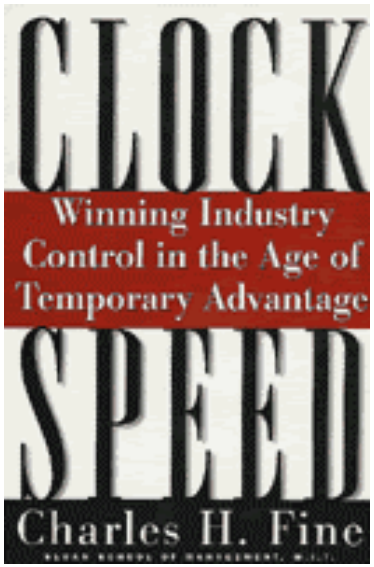
Strategic Supply Chain Design

Excerpts from

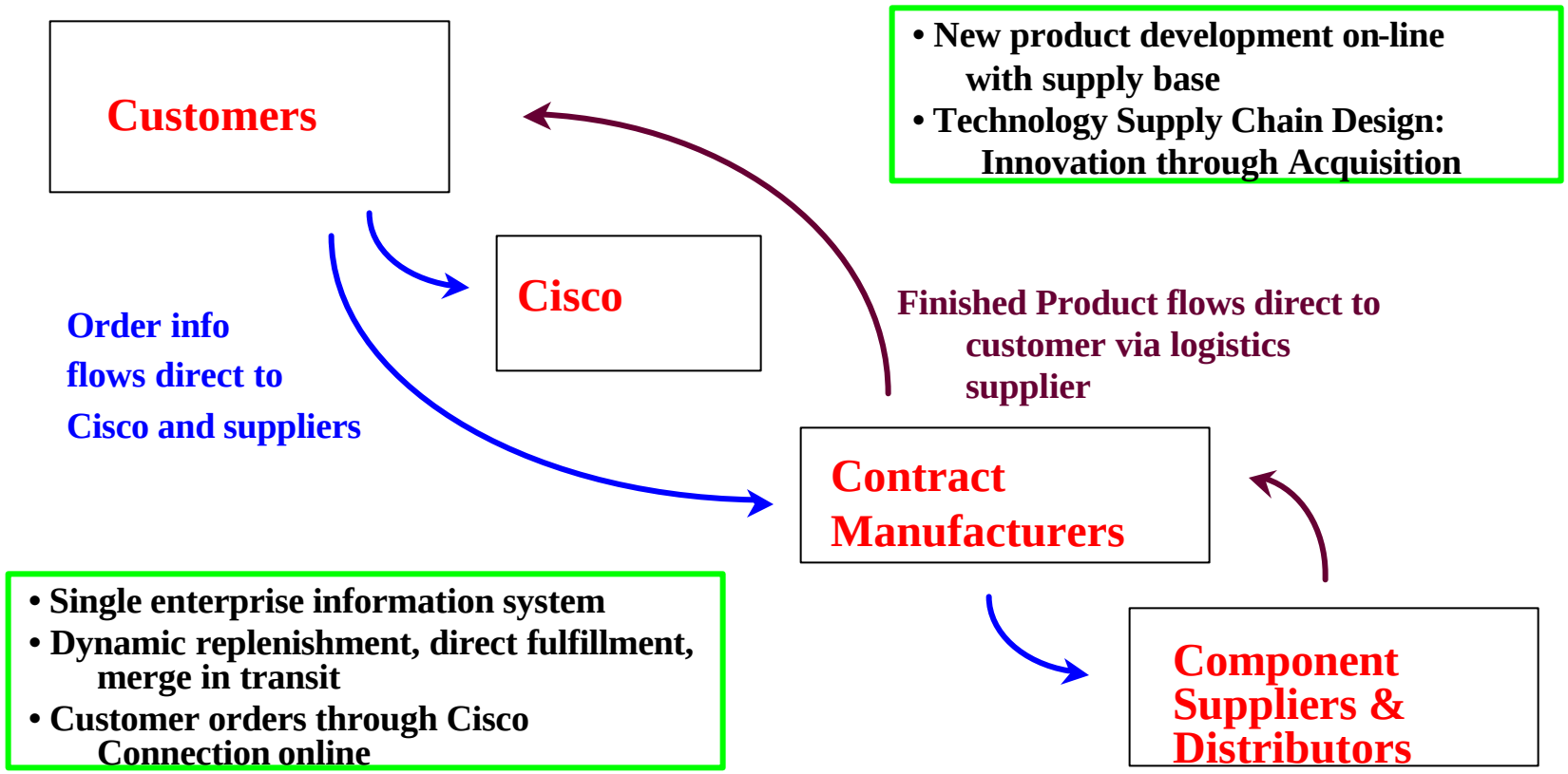


Professor Charles Fine
Massachusetts Institute of Technology
Sloan School of Management
Cambridge, Massachusetts 02142

May 2001

charley@mit.edu
http://www.clockspeed.com
Tel: 1-617-253-3632, Fax: 1-617-258-7579

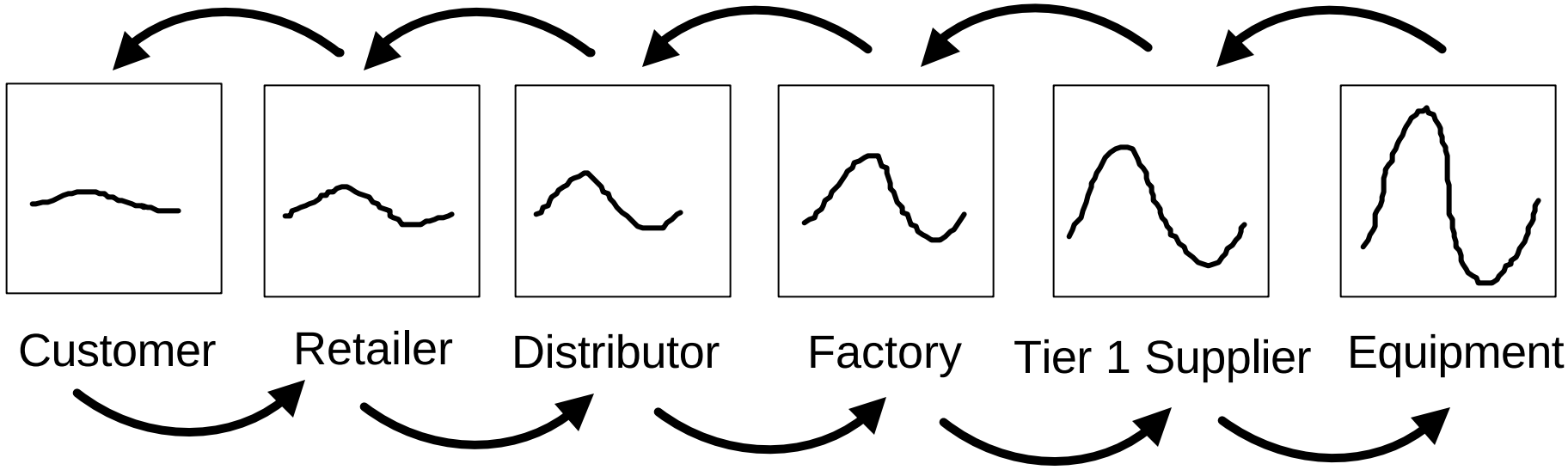
Cisco's End-to-End Integration for its Fulfillment Value Chain



Cisco's Strategy for Technology Value Chain Design

1. Integrate technology around the router to be a communications network provider.
2. Leverage acquired technology with
   - sales muscle and reach
   - end-to-end IT
   - outsourced manufacturing
   - market growth
3. Leverage venture capital to supply R&D

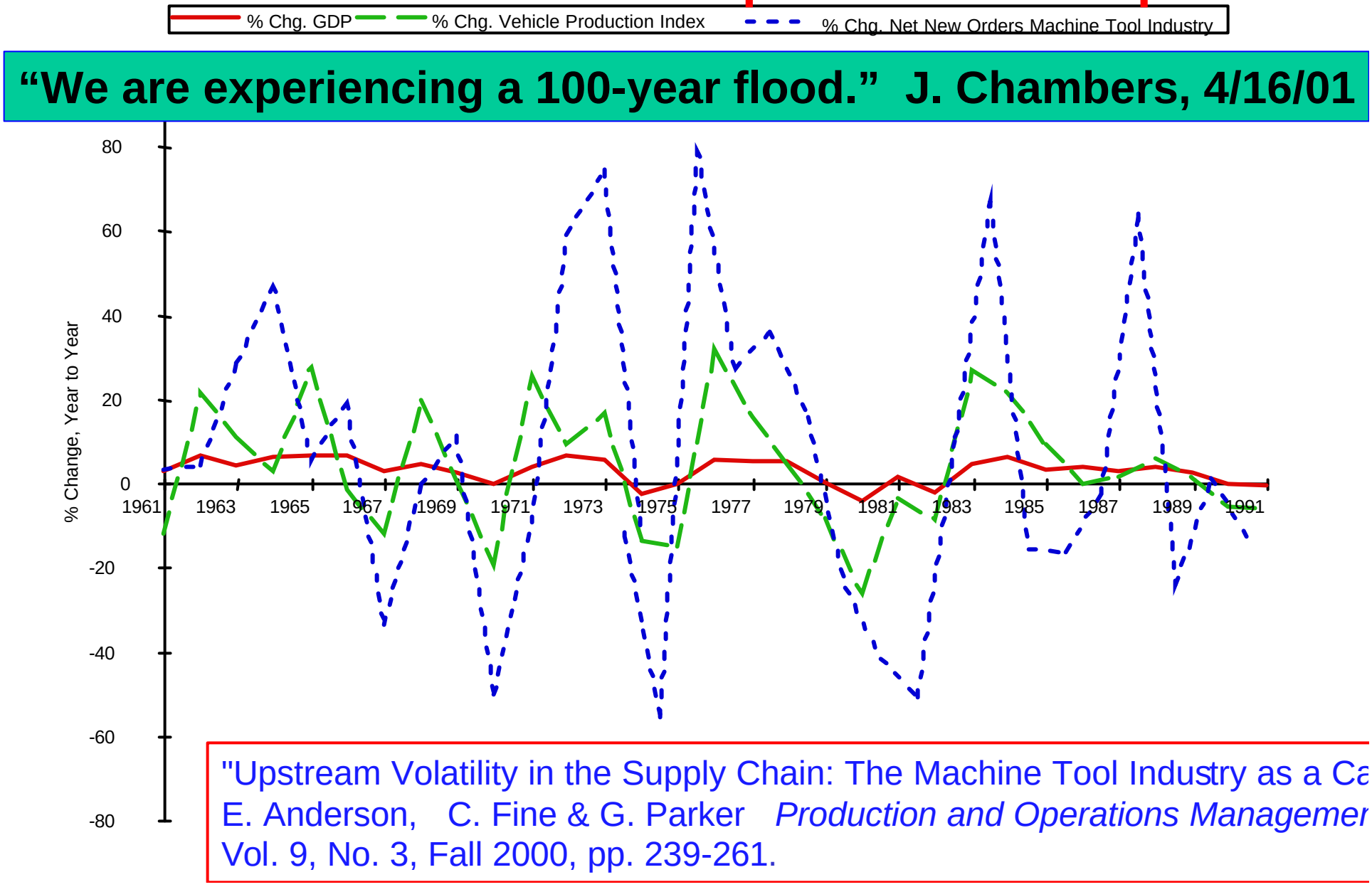
Volatility Amplification in the Supply Chain:
"The Bullwhip Effect"



Information lags
Delivery lags
Over- and underordering
Misperceptions of feedback
Lumpiness in ordering
Chain accumulations

SOLUTIONS:
Countercyclical Markets
Countercyclical Technologies
Collaborative channel mgmt.
(Cincinnati Milacron & Boeing)

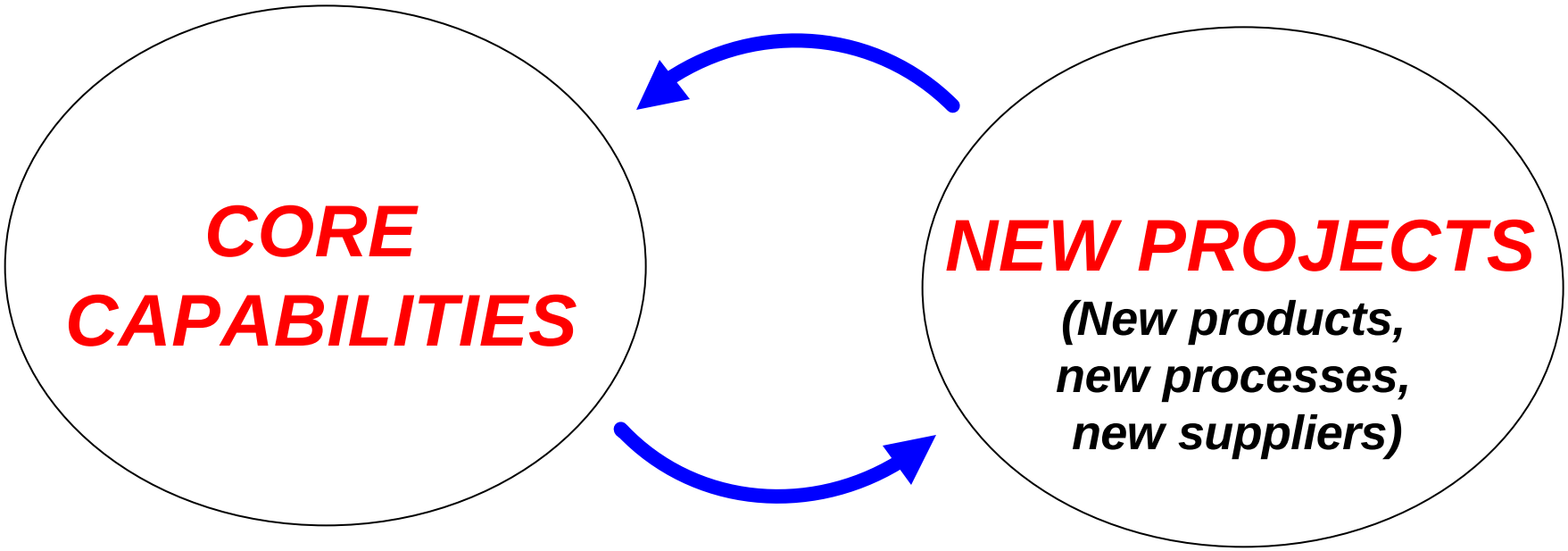
Supply Chain Volatility Amplification: Machine Tools at the tip of the Bullwhip



"Upstream Volatility in the Supply Chain: The Machine Tool Industry as a Ca
E. Anderson, C. Fine & G. Parker *Production and Operations Managemer*
Vol. 9, No. 3, Fall 2000, pp. 239-261.

Clockspeed drives *Business Strategy Cadence*

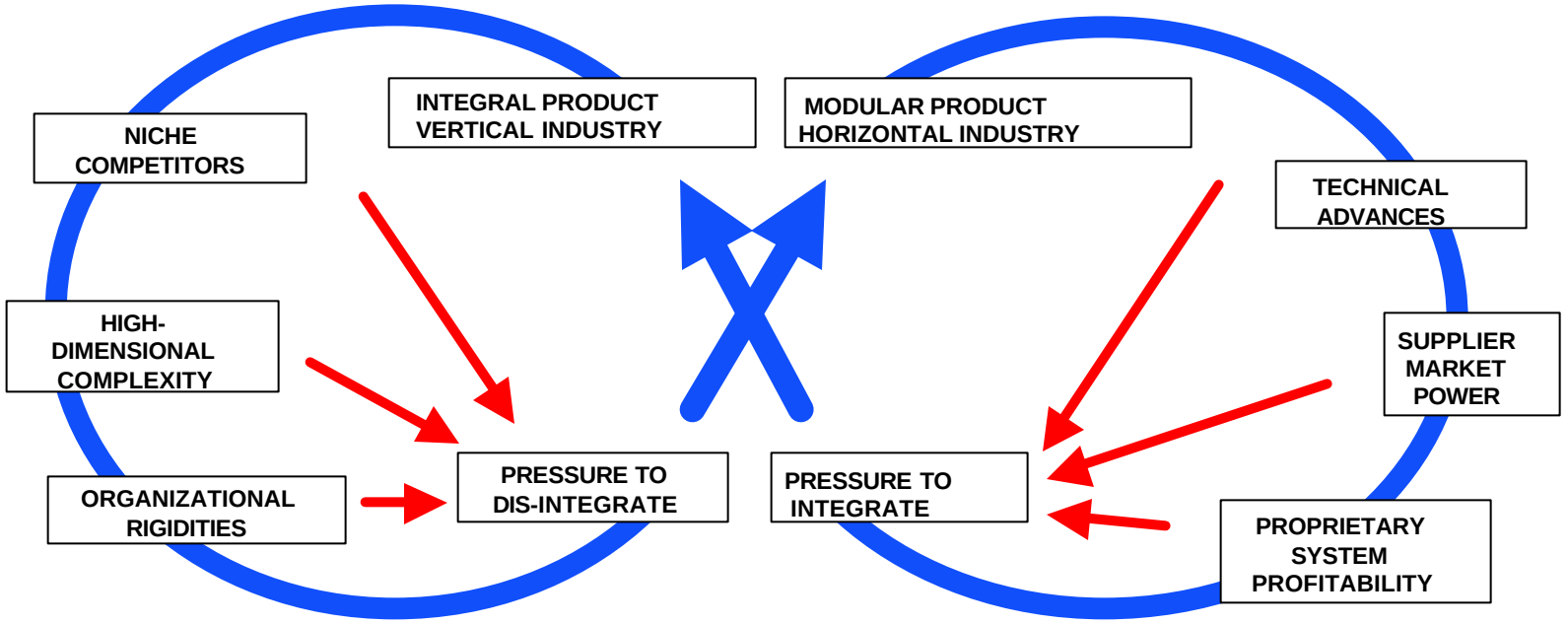
Dynamics between New Projects and Core Capability Development: PROJECTS MUST MAKE MONEY AND BUILD CAPABILITIES



Leonard-Barton, *Wellsprings of Knowledge*

THE DYNAMICS OF PRODUCT ARCHITECTURE AND VALUE CHAIN STRUCTURE:

THE DOUBLE HELIX

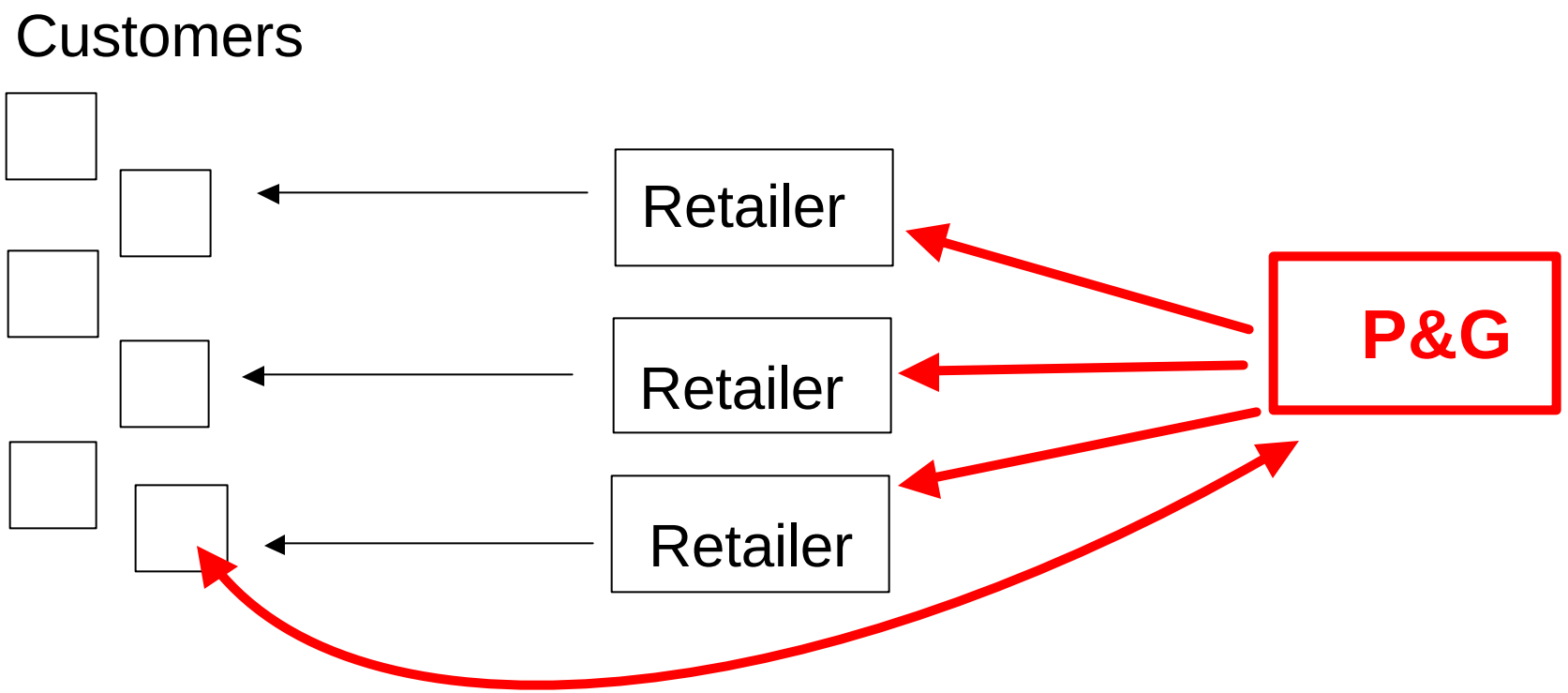


Fine & Whitney, “Is the Make/Buy Decision Process a Core Competence?”

Controlling the Chain Through Distribution:

The End of *P&G Inside* ?

- *Controlling the Channel Through Closeness to Customers:*
- *consumer research, pricing, promotion, product development*

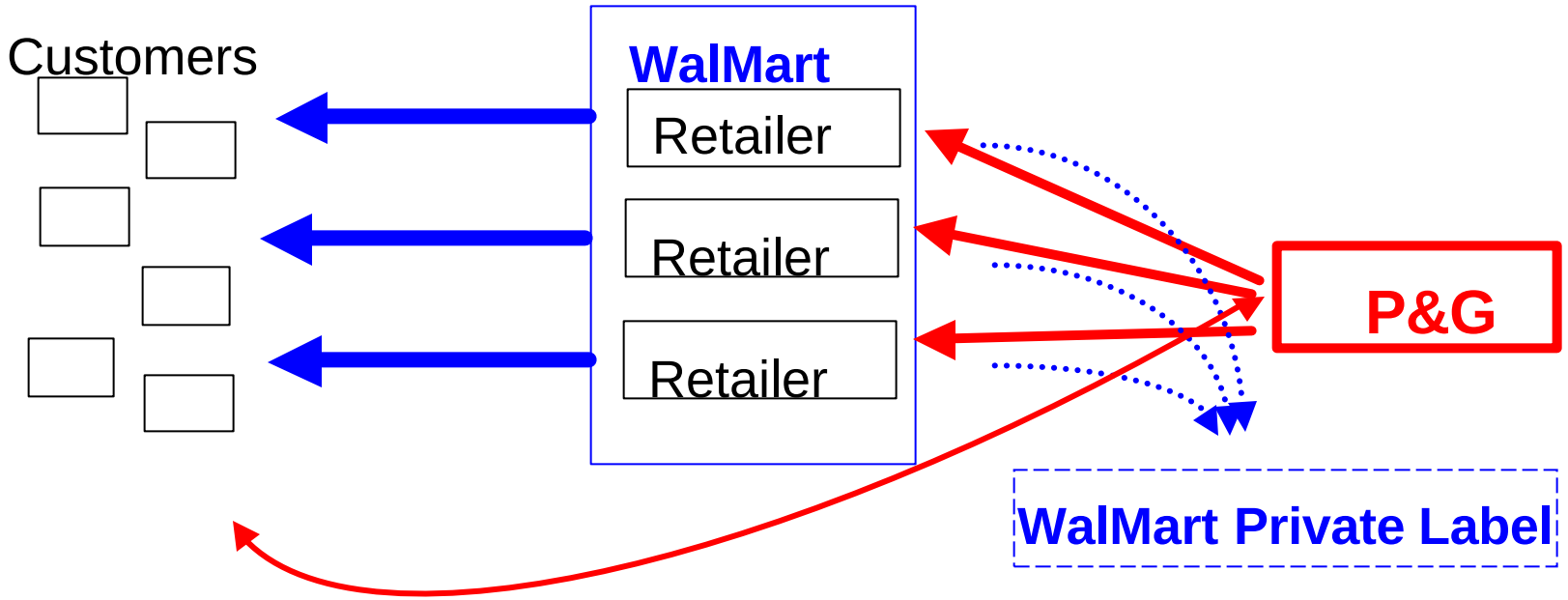


Controlling the Chain Through Distribution:

Beware of *Walmart Outside*

Controlling the Channel Through Closeness to Customers:

Chain Proximity



ALL COMPETITIVE ADVANTAGE IS TEMPORARY

Autos:

Ford **in 1920,** ***GM*** **in 1955,** ***Toyota*** **in 1990**

Computing:

IBM **in 1970,** ***DEC*** **in 1980,** ***Wintel*** **in 1990**

World Dominion:

Greece **in 500 BC,** ***Rome*** **in 100AD,** ***G.B.*** **in 1800**

Sports:

Bruins **in 1971,** ***Celtics*** **in 1986,** ***Yankees*** **no end**

The faster the clockspeed, the shorter the reign

VALUE CHAIN ARCHITECTURE

Integral value-chain architecture
features close proximity among its elements
- Proximity metrics: Geographic, Organizational
Cultural, Electronic
- Example: Toyota city
- Example: Ma Bell (AT&T in New Jersey)
- Example: IBM mainframes & Hudson River Valley

Modular value-chain architecture features multiple,
interchangeable supplier and standard interfaces
- Example: Garment industry
- Example: PC industry
- Example: General Motors' global sourcing
- Example: Telephones and telephone service

DESIGNING ARCHITECTURES FOR PRODUCTS & VALUE CHAINS: THE NEED FOR ALIGNMENT

VALUE CHAIN ARCHITECTURE

(Geog., Organ., Cultural, Elec.)

PRODUCT ARCHITECTURE	INTEGRAL	MODULAR
INTEGRAL	Jet engines Microprocessors Mercedes vehicles	Polaroid Nortel
MODULAR	Automotive Supplier Parks	Personal Computers Bicycles Chrysler Vehicles Cisco

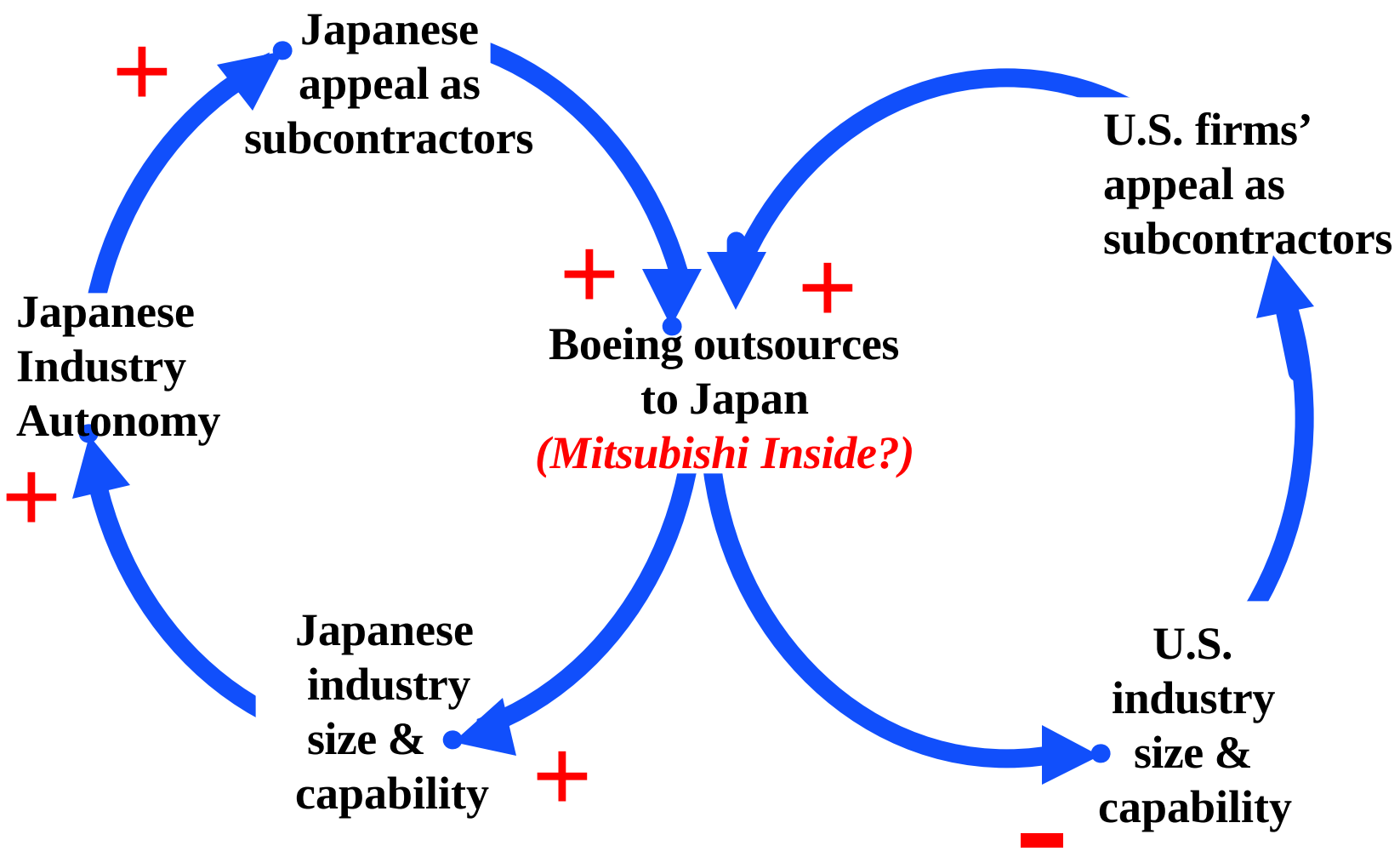
DESIGNING ARCHITECTURES FOR PRODUCTS & VALUE CHAINS: MODULARITY VS. OPENNESS

ARCHITECTURAL STRUCTURE \ ARCHITECTURAL PROPRIETARINESS	CLOSED	OPEN
INTEGRAL	Pentium Chip Mercedes Vehicles SAP ERP	Linux
MODULAR	IBM Mainframes Microsoft *Windows* Chrysler Vehicles	Palm Pilot software & accessories Phones & service Web-based ERP

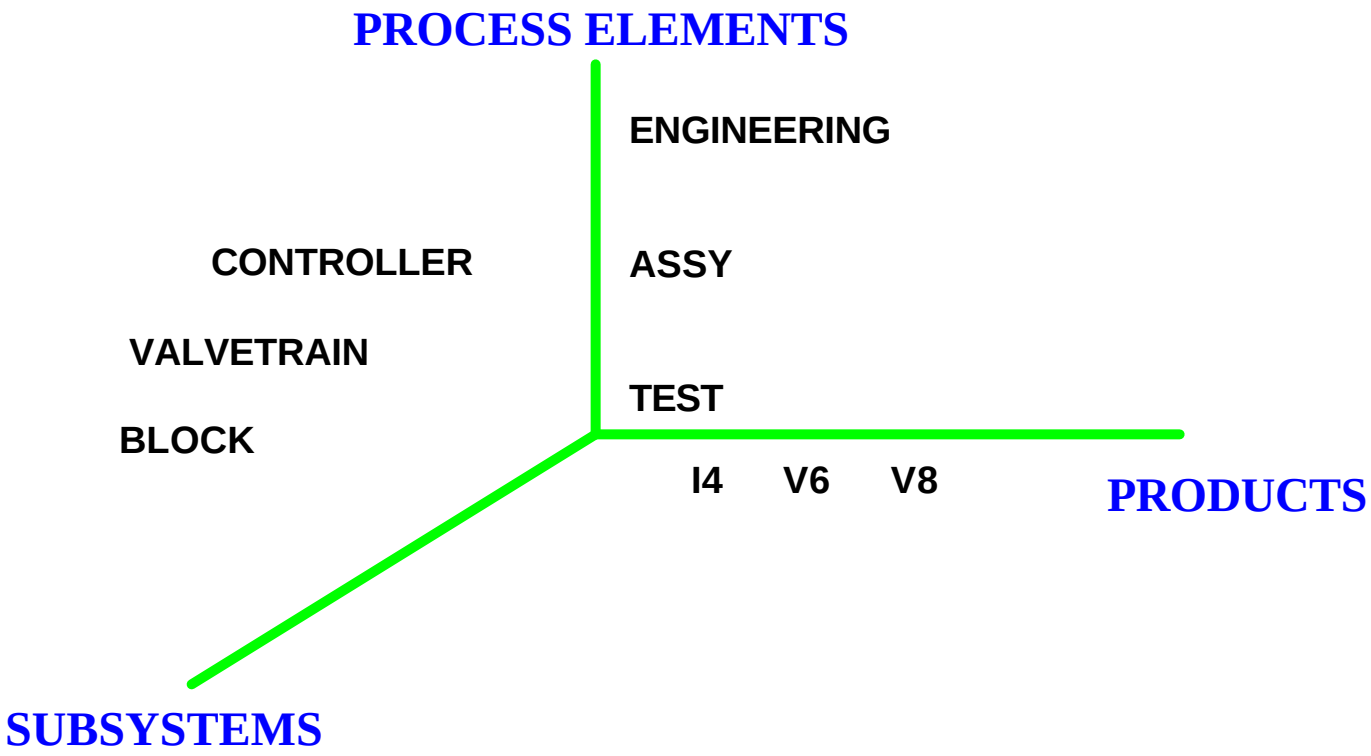
INFORMATION ARCHITECTURE MUST REFLECT BUSINESS MODEL

Technology Dynamics in the Aircraft Industry:

LEARNING FROM THE DINOSAURS



SOURCEABLE ELEMENTS

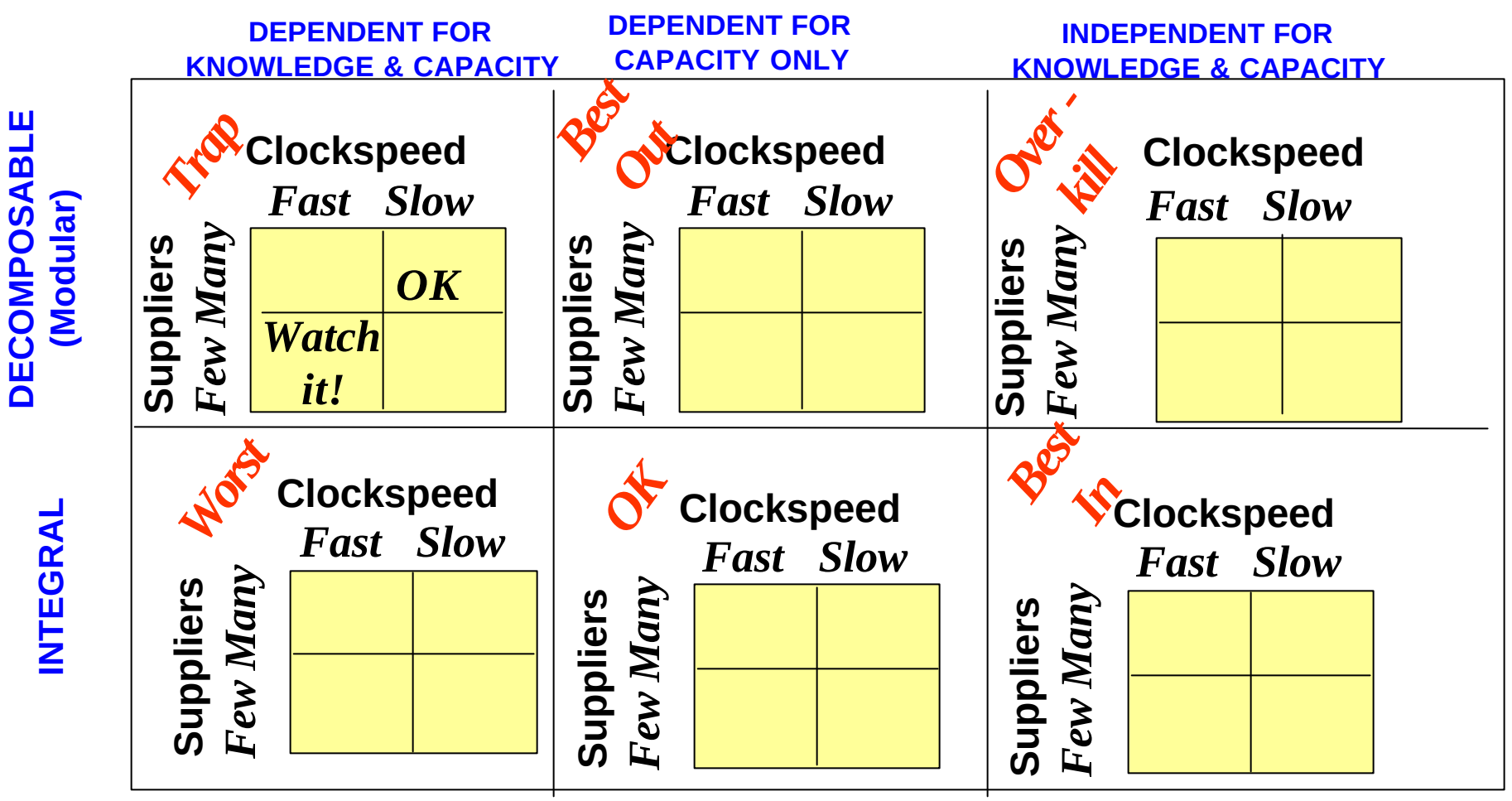


Strategic Make/Buy Decisions: Assess Critical Knowledge & Product Architecture

ITEM IS INTEGRAL ITEM IS MODULAR	DEPENDENT FOR KNOWLEDGE & CAPACITY	INDEPENDENT FOR KNOWLEDGE & DEPENDENT FOR CAPACITY	INDEPENDENT FOR KNOWLEDGE & CAPACITY
	A POTENTIAL OUTSOURCING TRAP	BEST OUTSOURCING OPPORTUNITY	OVERKILL IN VERTICAL INTEGRATION
	WORST OUTSOURCING SITUATION	CAN LIVE WITH OUTSOURCING	BEST INSOURCING SITUATION

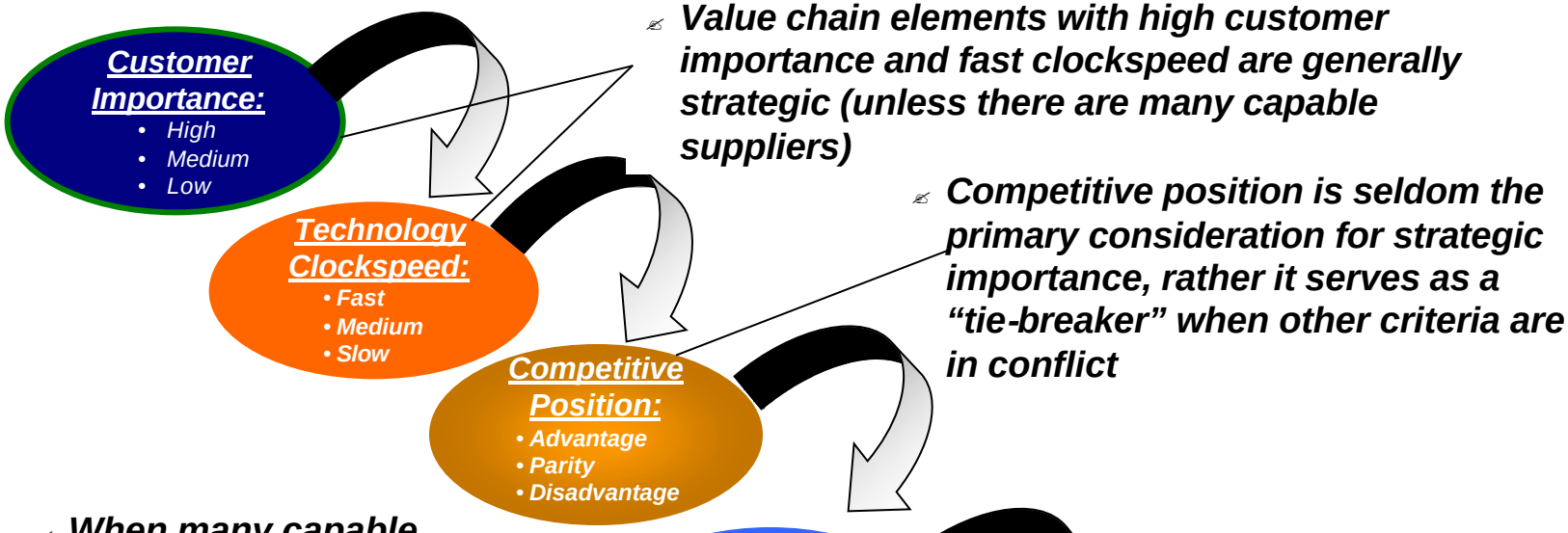
Adapted from Fine & Whitney, "Is the Make/Buy Decision Process a Core Competence?"

Strategic Make / Buy Decisions: Also consider Clockspeed & Supply Base Capability



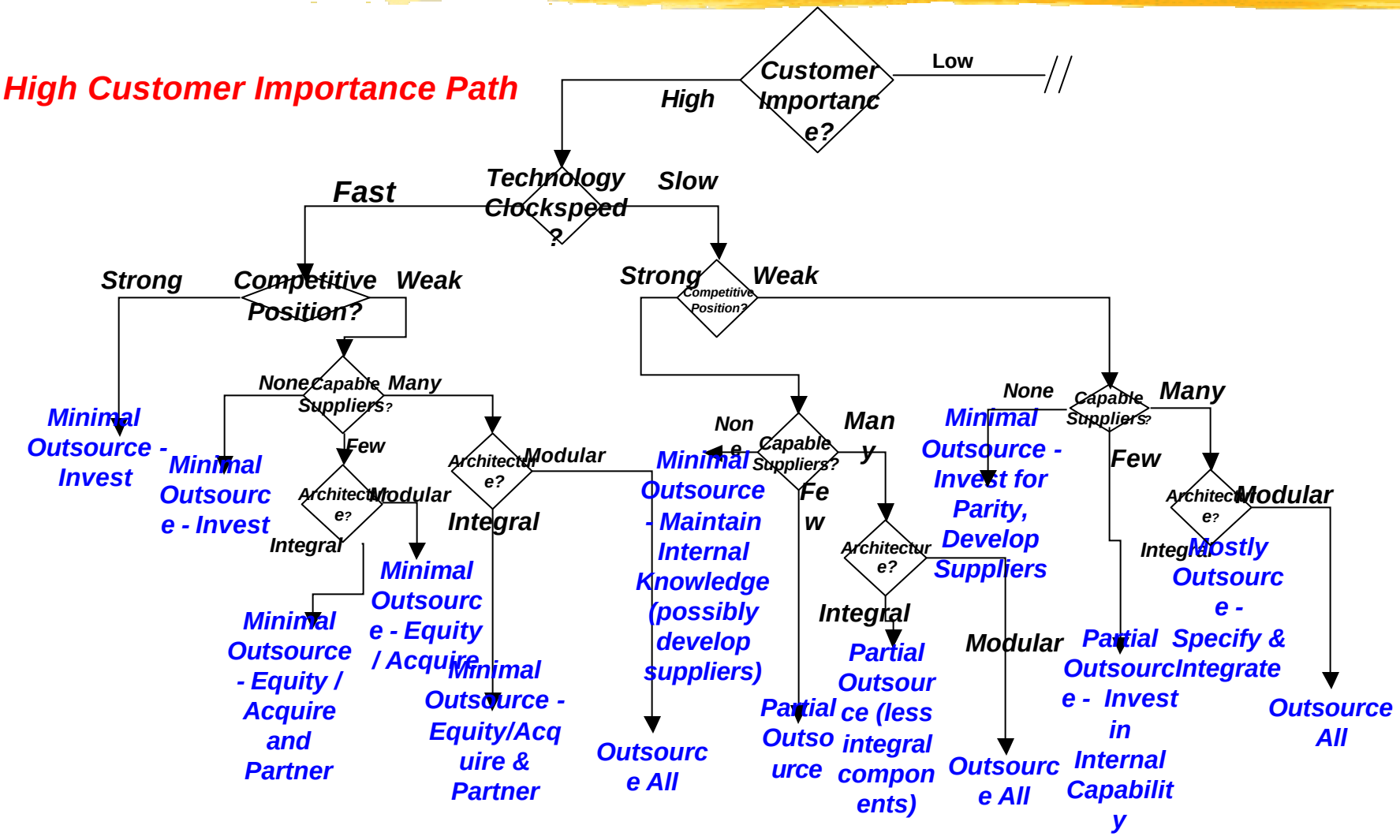
Adapted from C. Fine, *Clockspeed*, Chap. 9

Qualitative analysis of strategic importance uses five key criteria

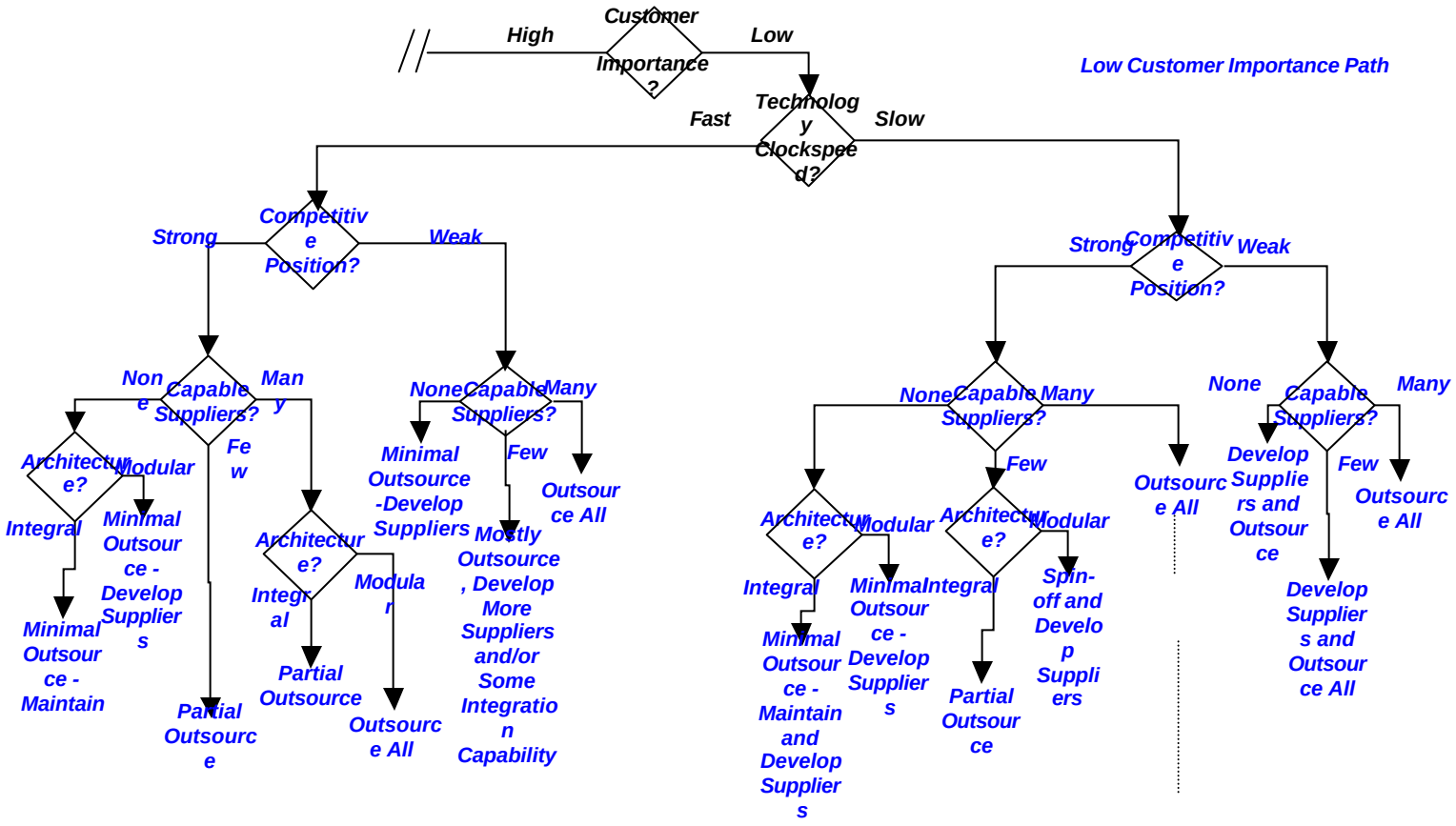


- *Value chain elements with high customer importance and fast clockspeed are generally strategic (unless there are many capable suppliers)*
- *Competitive position is seldom the primary consideration for strategic importance, rather it serves as a "tie-breaker" when other criteria are in conflict*
- *When many capable suppliers exist, knowledge may be considered commodity and development should be outsourced*
- *Architecture is considered a constraint for the sourcing decision model, controls the level of engineering that must be kept in house for integration purposes*

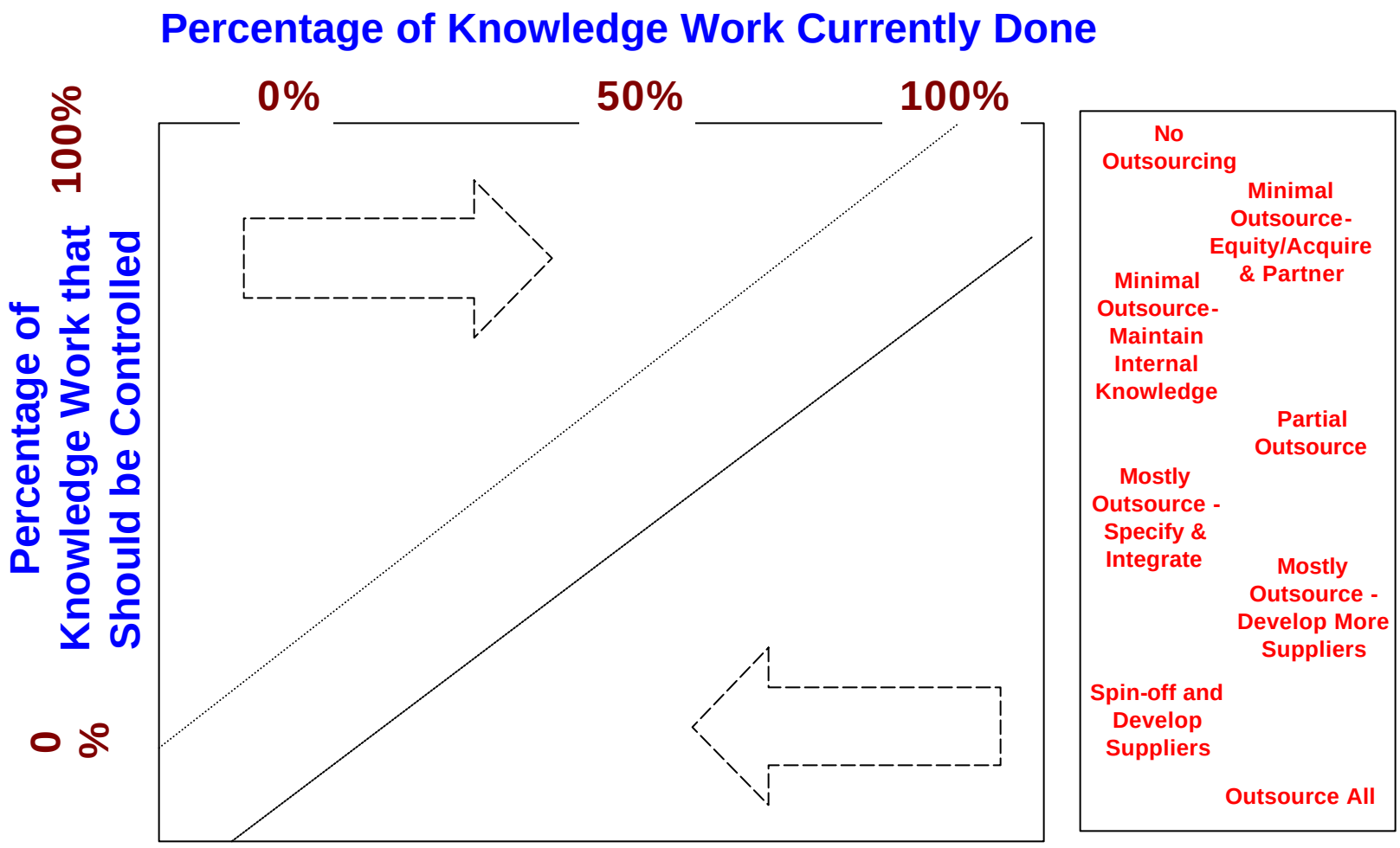
Sourcing Strategy Decision Tree - High Customer Importance Path



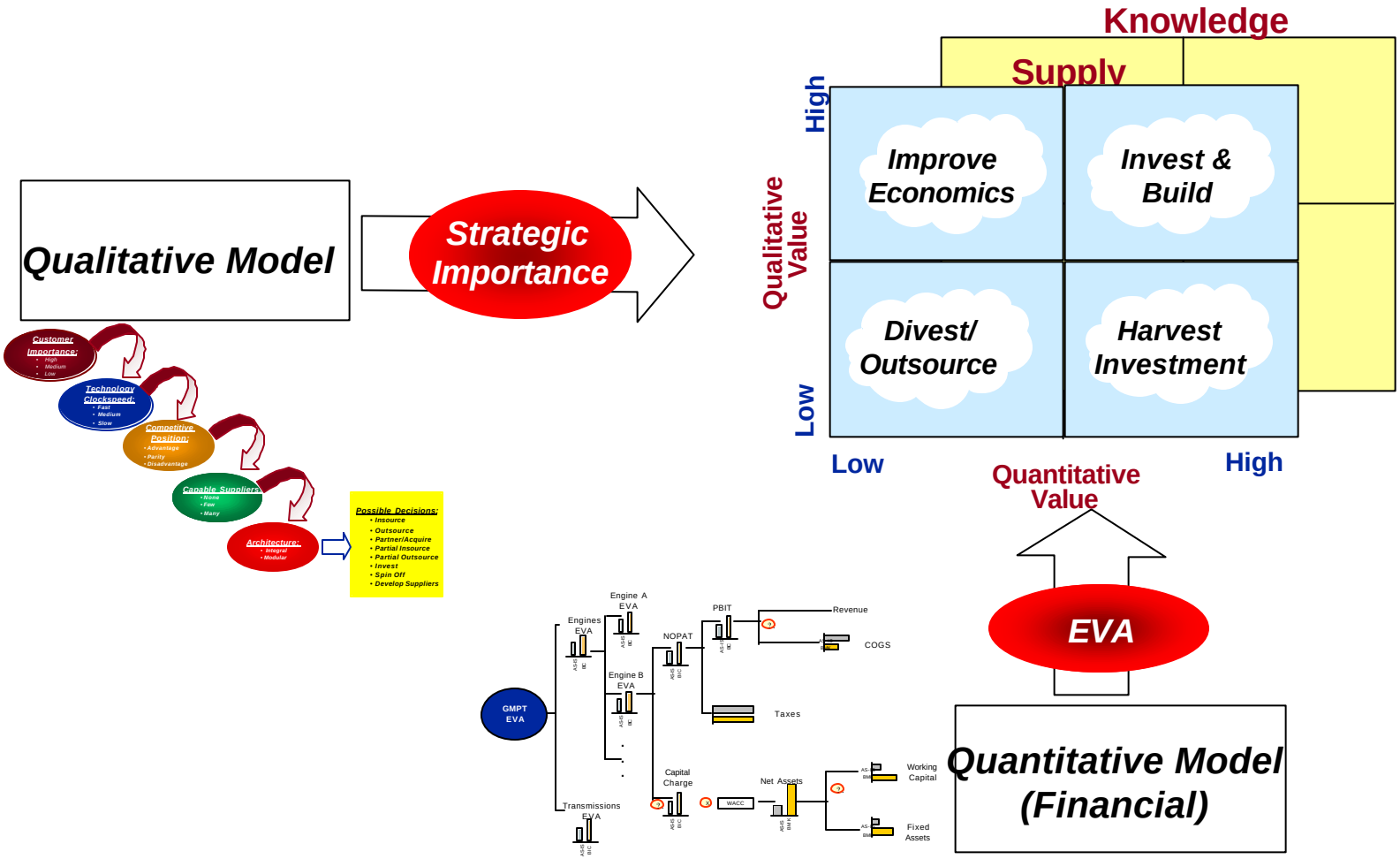
Sourcing Strategy Decision Tree - Low Customer Importance Path



Actual knowledge work compared to outcome of Decision Framework



Every decision requires qualitative and quantitative analysis to reach a conclusion



Value Chain Mapping

Organizational Value Chain

Chrysler	**Eaton**	**casting supplier**	**clay supplier**

Technology Value Chain

engines	**valve lifters**	**casting manufacturing process**	**clay chemistry**

Capability Chain

Supply Chain Management	**Quality assurance**	**NVH engineering**	**R&D**

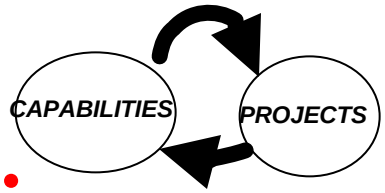
Underlying Assumption: You have to draw the maps before you can assess their dynamics.

VALUE CHAIN DESIGN IS *THE ULTIMATE* CORE COMPETENCY

Since all advantages are temporary,
the only lasting competency is to continuously build and assemble capabilities chains.

KEY SUB-COMPETENCIES:

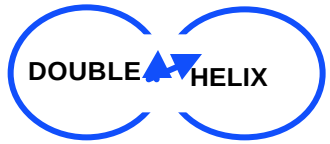
1. **Forecasting the dynamic evolution of market power and market opportunities**
2. **Anticipating Windows of Opportunity**
3. **3-D Concurrent Engineering: Product, Process, Value Chain**

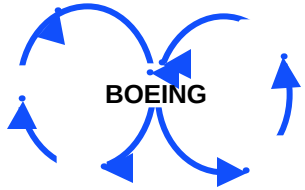


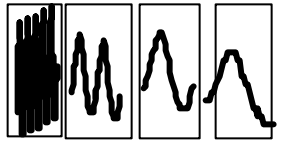
Fortune Favors the Prepared Firm

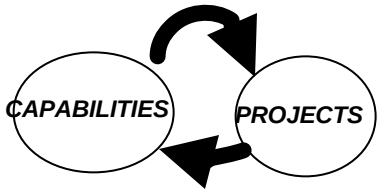
PROCESS FOR VALUE CHAIN DESIGN

1. Benchmark the Fruit Flies
2. Map your Supply Chain
   - -Organizational Value Chain
   - -Technology Value Chain
   - -Competence Chain
3. Dynamic Chain Analysis
   at each node of each chain map
4. Identify Windows of Opportunity
5. Exploit Competency Development Dynamics
   with 3-D Concurrent Engineering









Strategic Supply Chain Design

1. Fruit Flies & Temporary Advantage

2. Value Chain Design & 3-DCE

3. eBusiness Phenomena:
   Business Model Innovation

4. Telecom Value Chains:
   A fruit fly example

Internet Era Phenomena:

eCompetition in Business Model Innovation

Benchmarking the eFlies

E-tailing:

Attack:

Amazon, Webvan **Market disruption in hopes of making a place**

Defend:

Walmart.com, Ford.com **Defense can require costly SC revamping**

B2B:

E2E integration:

Cisco, Dell **Integration pays off with modular products**

Marketplace Creation:

Freemarkets **Reverse auctions reduce short term costs**

Covisint **Common standards reduced supplier investment cost**

Free & Open Digital Content:

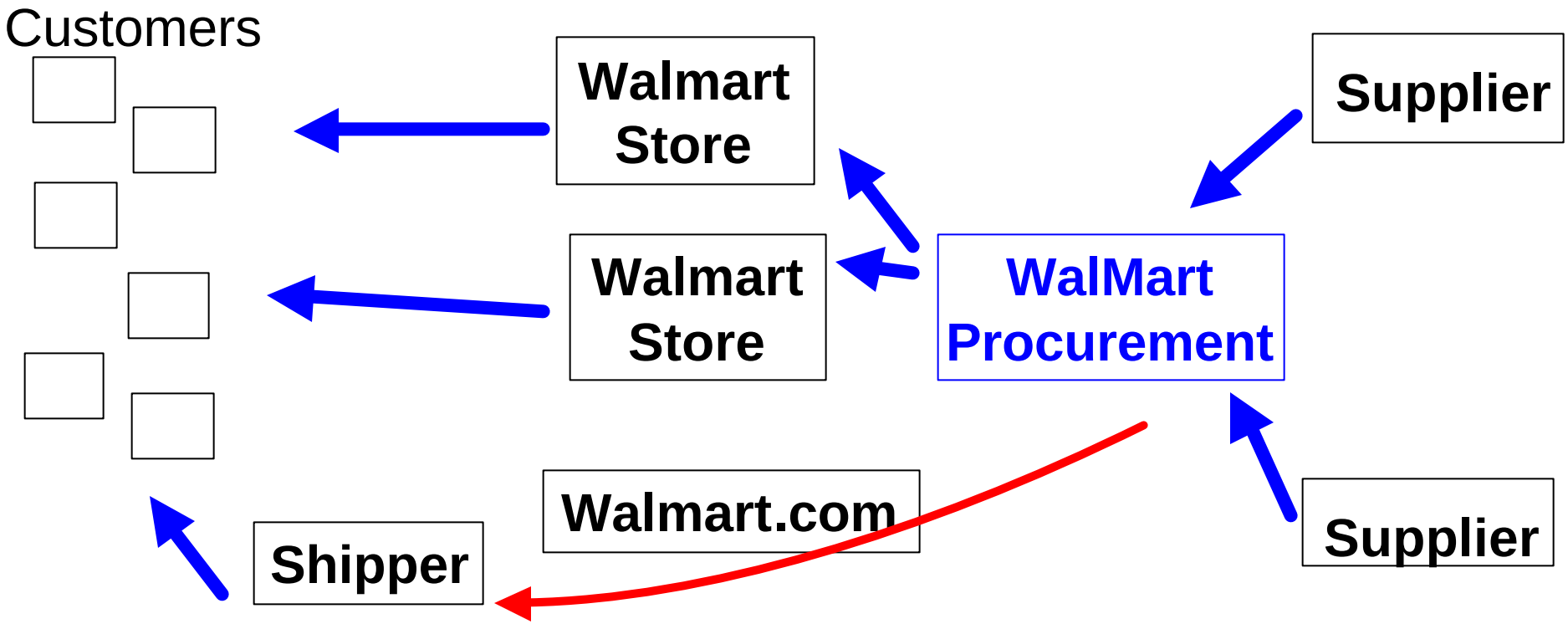
Peer-toPeer Sharing/Theft:

Napster **Industry-shaking disruptions require value chain SWAT team**

DOT.COM COMPETITION: FOCUS ON THE SUPPLY CHAIN

CASE#1:

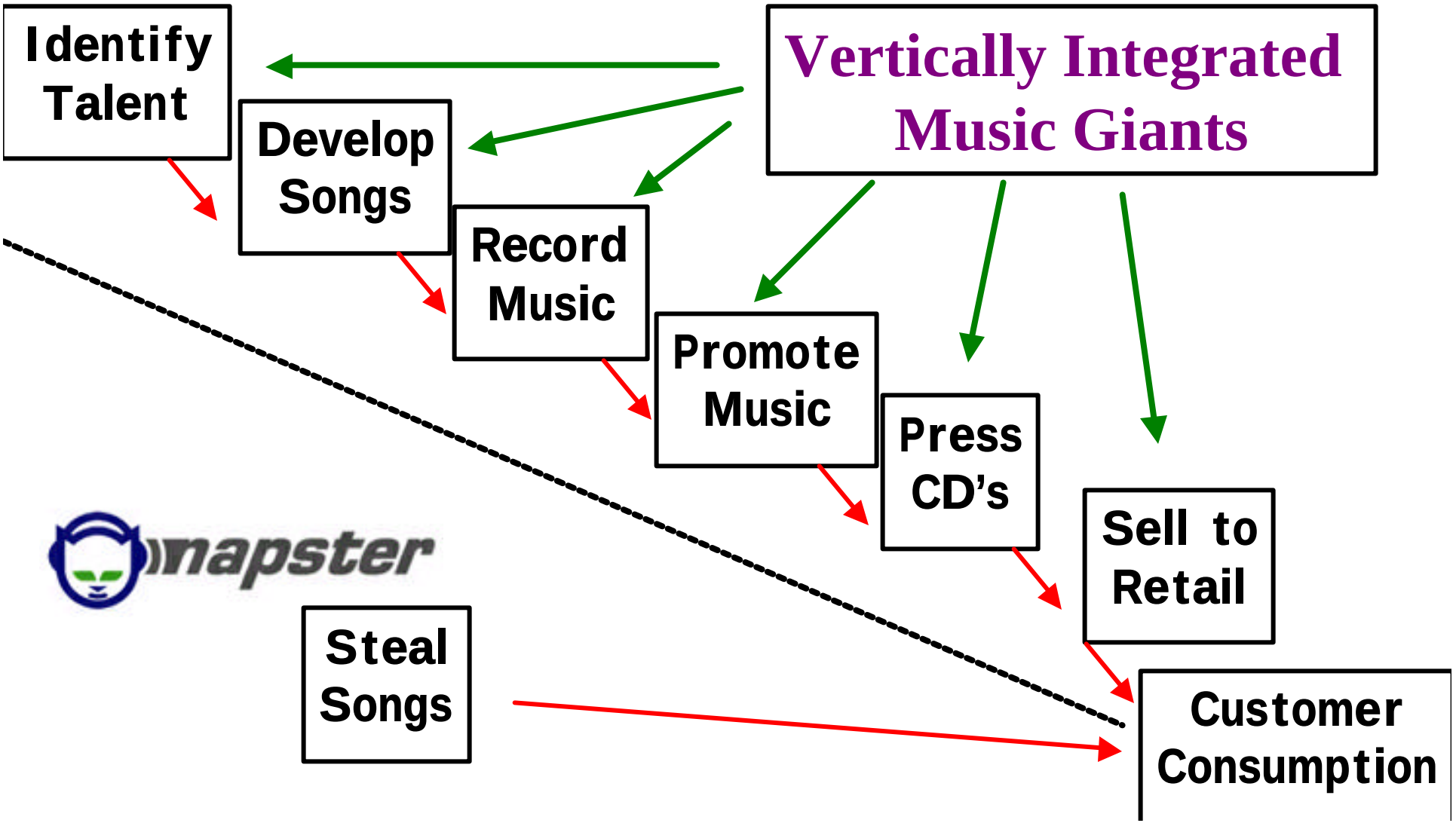
WALMART.COM GOT NO TRACTION



DOT.COM COMPETITION: FOCUS ON THE SUPPLY CHAIN

Napster's New Supply Chain Strategy

(go to the end and steal everything!)



Strategic Supply Chain Design

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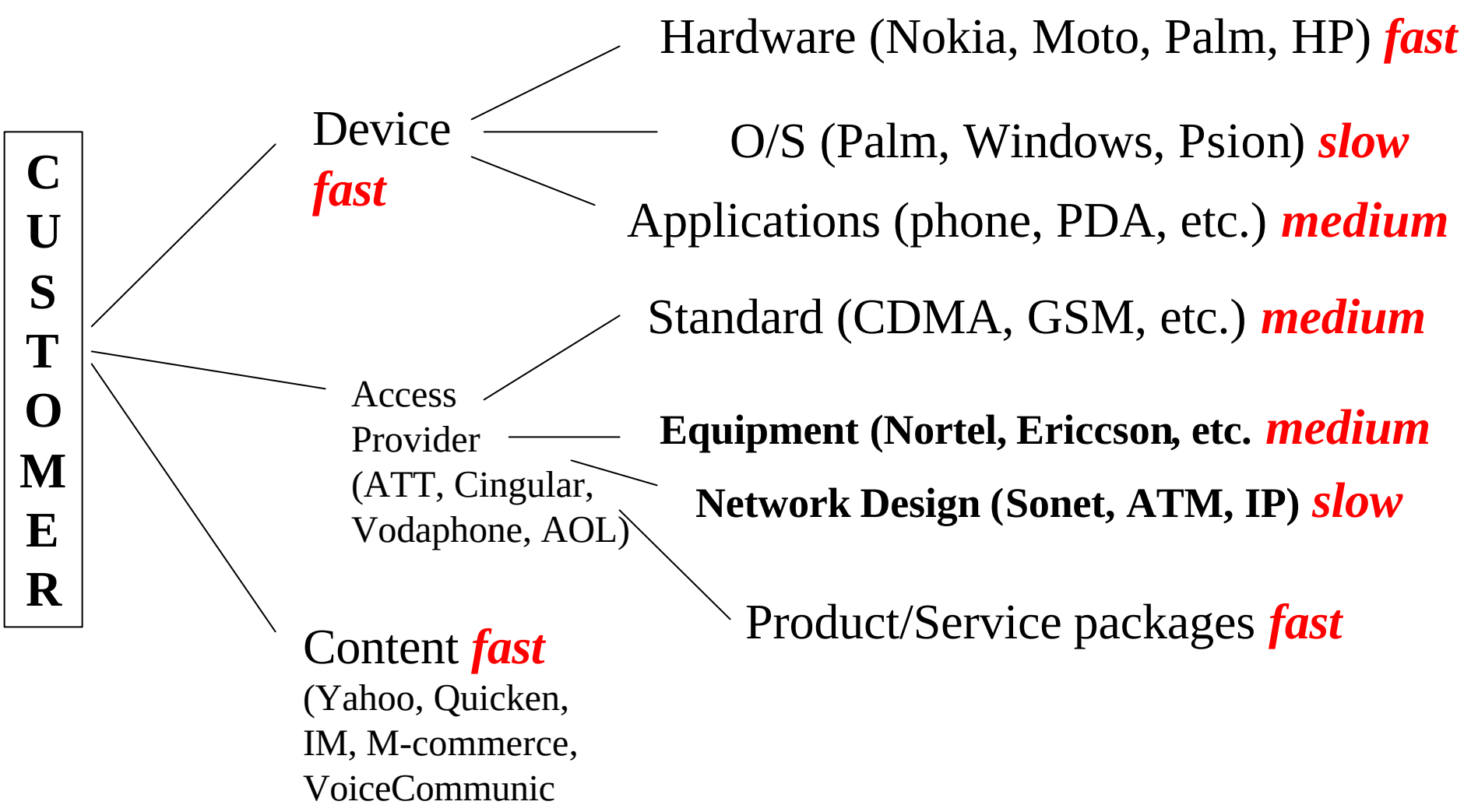
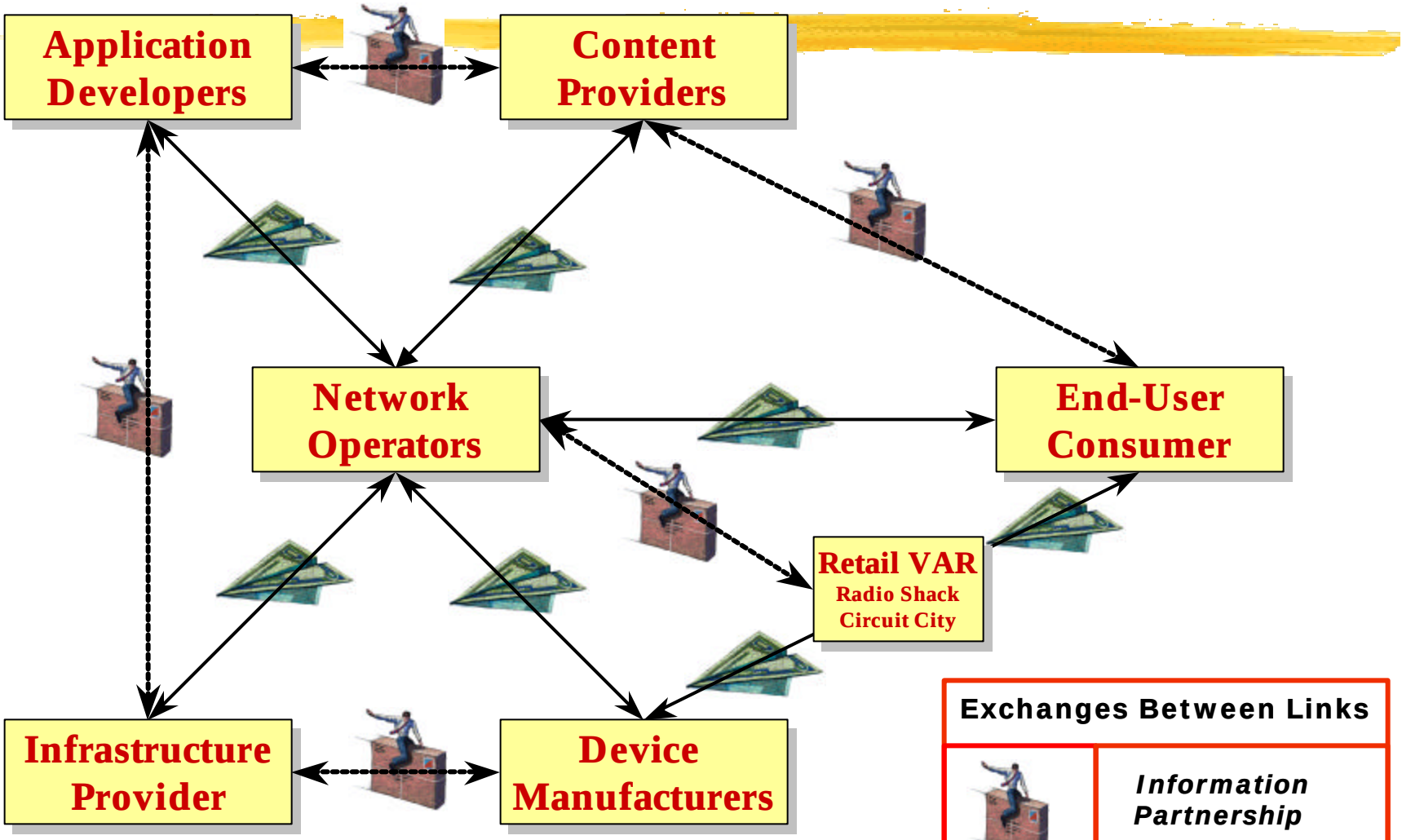
Wireless Value Chain
& clockspeeds



Wireless Marketplace

Value of Exchanges Between Supply Chain Links



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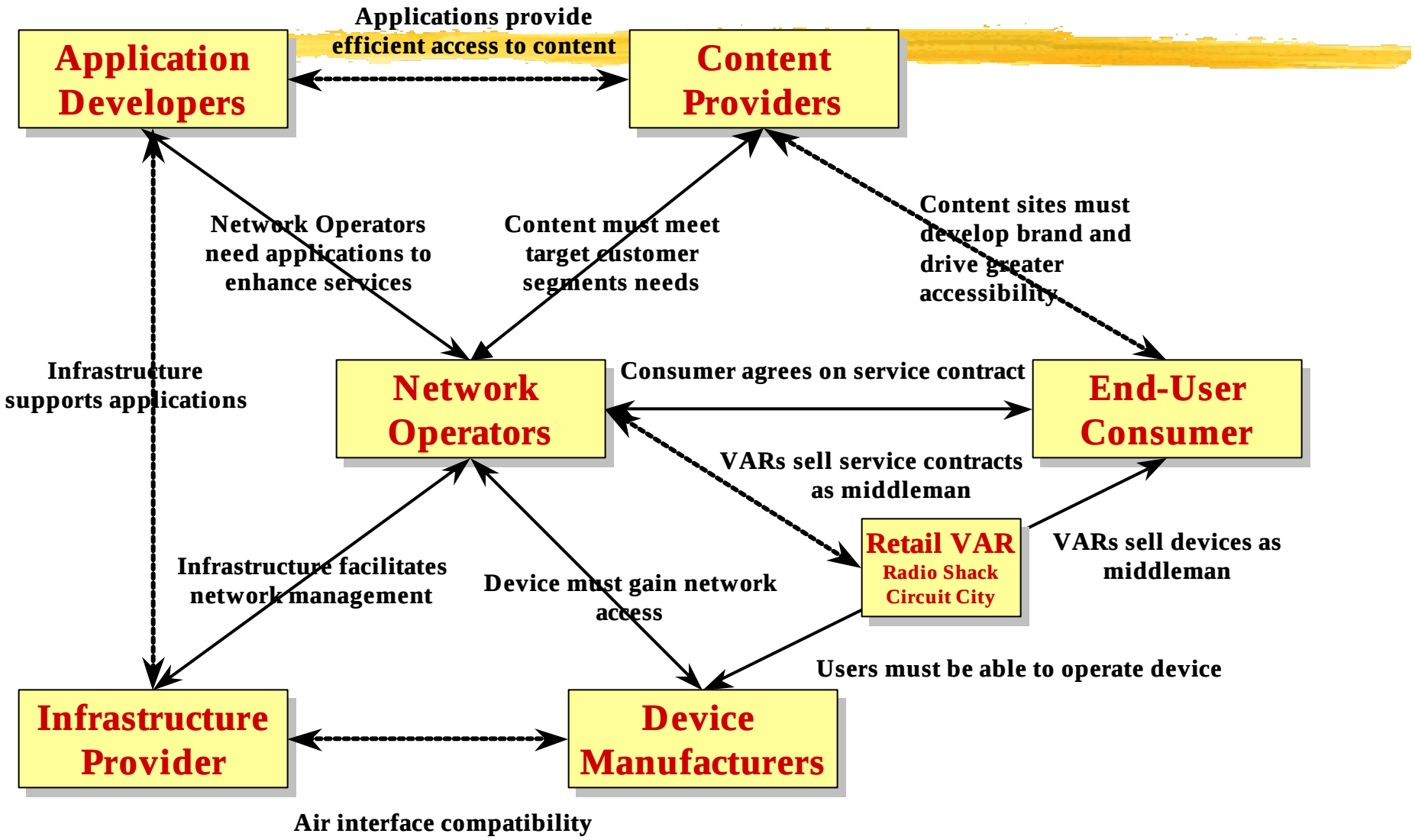
Wireless Marketplace

Links Are Consummated on Exchanges



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Wireless Marketplace

Wireless Industry Structure: 5 Forces

Market Entry
- *Proprietary learning curve*
- *Economies of scale*
- *Capital requirements*
- *Brand identity*
- *Switching costs*
- *Expected retaliation*
- *Proprietary products*

Supplier Power
- *Supplier concentration*
- *Importance of volume to supplier*
- *Differentiation of inputs*
- *Switching costs of firms*
- *Threat of forward integration*

Firm Rivalry
- *Industry concentration ratio*
- *Fixed costs/Value added*
- *Industry growth*
- *Intermittent overcapacity*
- *Product differences*
- *Switching costs*
- *Brand identity*

Buyer Power
- *Bargaining leverage*
- *Buyer volume*
- *Buyer information*
- *Brand identity*
- *Price sensitivity*
- *Product differentiation*
- *Substitutes available*

Substitutes
- *Switching costs of adopters*
- *Buyer propensity to substitute*
- *Relative price performance of substitutes*

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MIT & Siemens

Wireless Marketplace

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Industry Structure: 5 Force Analysis

Market Entry	Entry
Network Operator	Hard
Infrastructure Provider	Difficult
Device Manufacturer	Difficult
Application Provider	Easy
Content Provider	Easy

Competition	Rivalry
Network Operator	Intense
Infrastructure Provider	Intense
Device Manufacturer	Intense
Application Provider	Weak
Content Provider	Strong

Substitutes	Number
Voice/Data Network	Many
Network Components	Few
Cell Phones	Many
Applications&Content	Few

Supplier Power	Power
Network Operator	moderate
Infrastructure Provider	low
Device Manufacturer	low
Application Provider	low
Content Provider	moderate

Buyer Power	Power
Network Operator	Strong
Infrastructure Provider	moderate
Device Manufacturer	Strong
Application Provider	moderate
Content Provider	moderate

- Network Operator
- Device Manufacturer
- Content Provider
- Content Enabler
- Infrastructure Provider
- Application Provider

Many

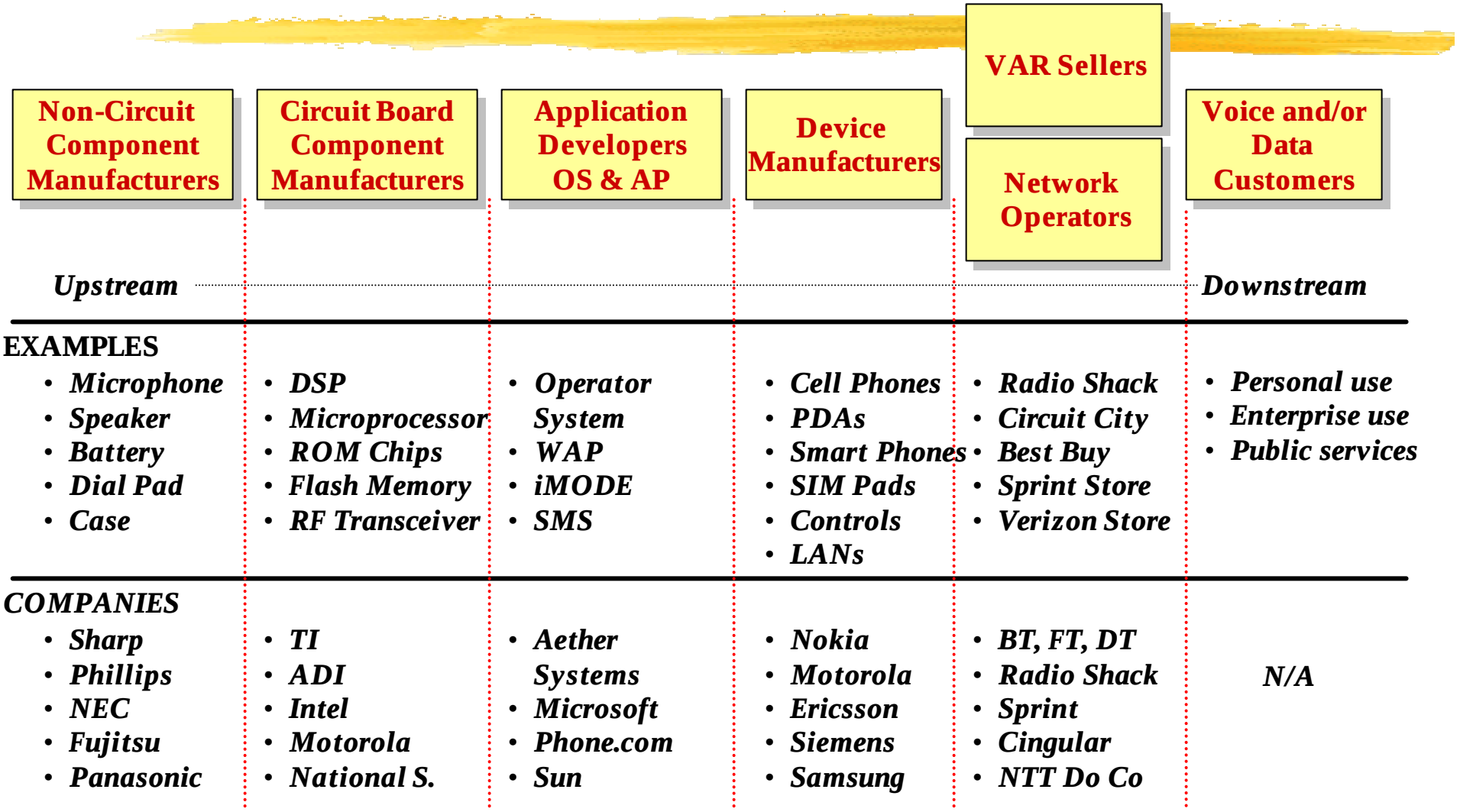
Few

Unattractive

Attractive

Wireless Marketplace

Wireless Device Supply Chain (Horizontal/Modular?)



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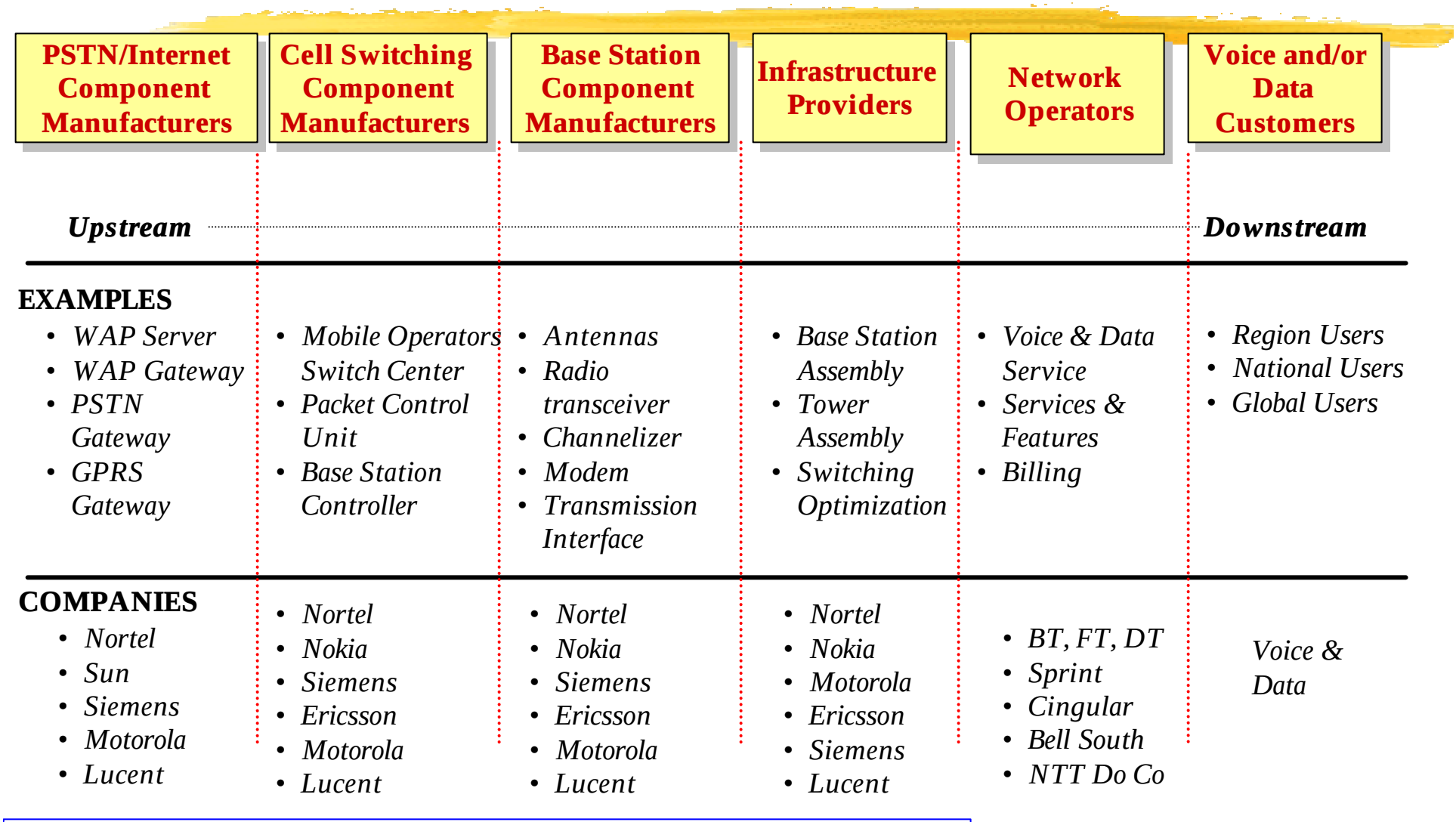
Wireless Network Supply Chain (Vertical / Integral?)



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Wireless Marketplace

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Wireless Devices Becoming Horizontal & Modular

US -Motorola-Devices

Abroad Ericsson/Nokia/NTT Devices

-Massive adoption of handsets capacity strained as outsourcing coordination becomes apparent
-International demand & competition
-Consumer Expectations Increase
-Avg. # of Components 550 to 900

Device	Manufacturers
Cell Phone	Nokia, Motorola, Siemens, Ericsson, Samsong
PDA	Handspring, Palm, Compaq, Casio, Sony
SIM Pads	Sony, Siemens, Nokia
Smart Phones	Kyocera, Ericsson

1980-85

1985-1990

Phone Becomes Easy to Carry

2005E-2010E

Software Radio Emerges

1999-2001

1997-1999

2G Digital Phone Shift to Messaging and Data

2001-2002E

Outsourcing Devices
-Flextronics & EMS

1996-97

-US 1996 Telecom Act
-DSP & Flash Chips accelerate as PC Sales slow

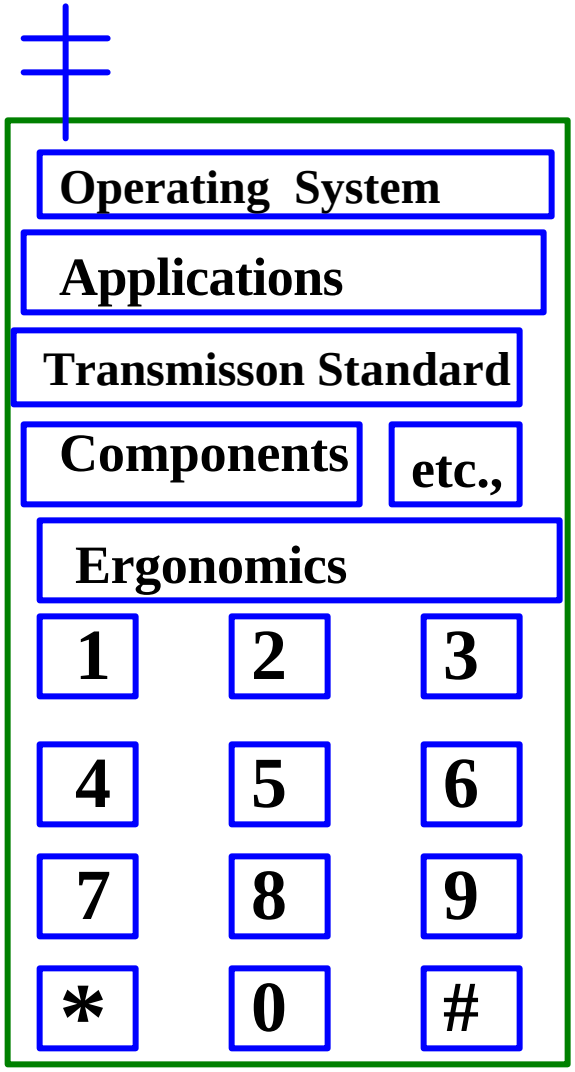
2003E

-Qualcomm liciences Chip Sets for Phone
-Motorola & Others follow

Complexity of phone increases
Avg. # of Components 200 to 550

WIRELESS VALUE CHAIN: MINI CASE EXAMPLE

Wireless Handsets comprise numerous subsystems



Wireless handsets tend to exhibit integral architectures and rapid obsolescence, but require a large number of design decisions.

This results in slow and costly development processes.

Increased modularity with standardized subsystems might speed dramatically the rates of innovation.

Wireless Marketplace

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Wireless Infrastructure Still Vertical & Integral

US -Motorola, Nortel

Abroad Ericsson,Nokia,Siemens

-Network costs focus attention on Spectral Efficiency and Network Optimization
-Pressure from Consumer for data services and from device manufacturers to provide faster data rates

1980-90

AMPRS AT&T & Baby Bells
BT, FT, Vodaphone, NTT

1990-1995
-US 1996 Telecom Act

-American Tower, ArrayComm

2001-2005E

2007E-2010E
Convergence of Wireline to Wireless IP & 3G

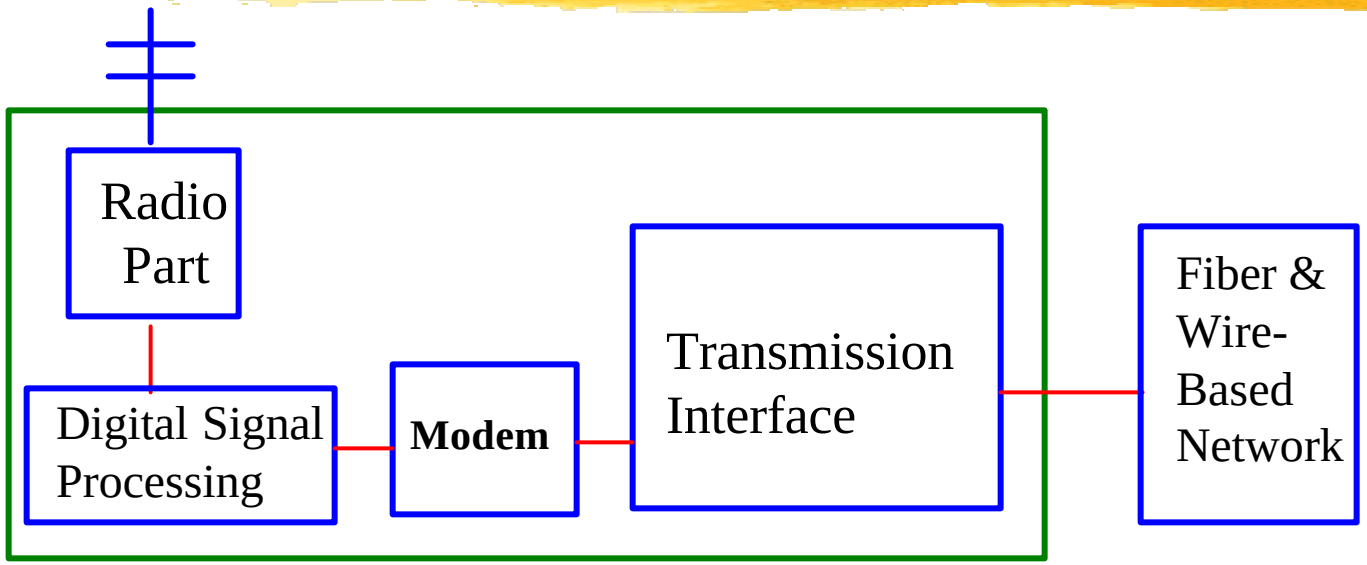
1995-2001
-US 1996 Telecom Act
-Spectrum Auctions $$$$$
-Vender Financing

2006E

-2.5-3 G Costs, ROI cycle shrinks
-IP Standardizing PSTN/Packet Interface
-Demand for data service increases complexity

WIRELESS VALUE CHAIN: MINI CASE EXAMPLE

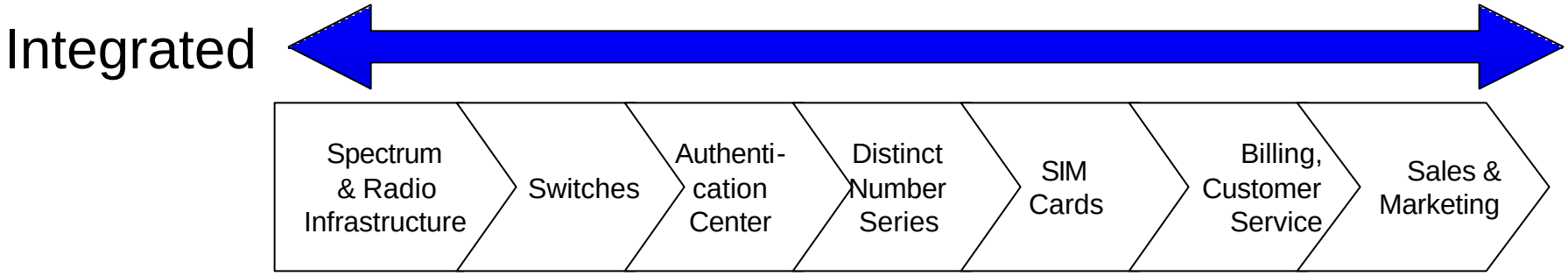
Wireless Base Stations (WSB'S) comprise 4 key subsystems:



WSB architectures are
-integral & proprietary
Suppliers include: Nortel, Moto, Ericsson, Siemens, Nokia
Disruptive Modem advances (e.g., MUD) can double Base Station Capacity

Modular WSB's might
(1) Stimulate new WSB entrants (ala Dell)
(2) Stimulate standard subsystem suppliers
(3) lower prices to the network operators
(4) Speed base station performance imp.
(5) Increase demand for basestations due to improved price-performance ratios.

Value Chain of Mobile Virtual Network Operator (MVNO)



MVNO:

- Does not have Spectrum & Radio Infrastructure
- Needs a host network
- Has at least Billing, Customer Service, Sales and Marketing

Eelco de Jong, MIT

MVNO Example 1: Virgin Mobile

Eelco de Jong, MIT

-Launched in Nov. 1999 in UK,
wants to become a global player,
leveraging its worldwide brand

-Host network: One 2 One (Deutsche Telekom)
Virgin purchases wholesale minutes from One 2 One

-Virgin does not require customers to buy a new handset - only a Virgin SIM card (for US$ 20).
Little handset subsidization. Simple pricing structure

-Extensive content offering, targeting the mass-market

-Low ARPU, but also low customer acquisition costs

MVNO Example 2: Financial Times & Carphone Warehouse

Announced in March 2001,
joint venture between FT, Carphone and BT Cellnet

Targeting business consumers, who will receive
a WAP-enabled FT-branded phone

- Financial Times will provide content
- The retailer Carphone will provide billing, customer service, leveraging existing services in this area
- Cellnet will provide the host network

"Killer Technologies" of the Information Age: Semiconductors, Magnetic Memory, Optoelectronics

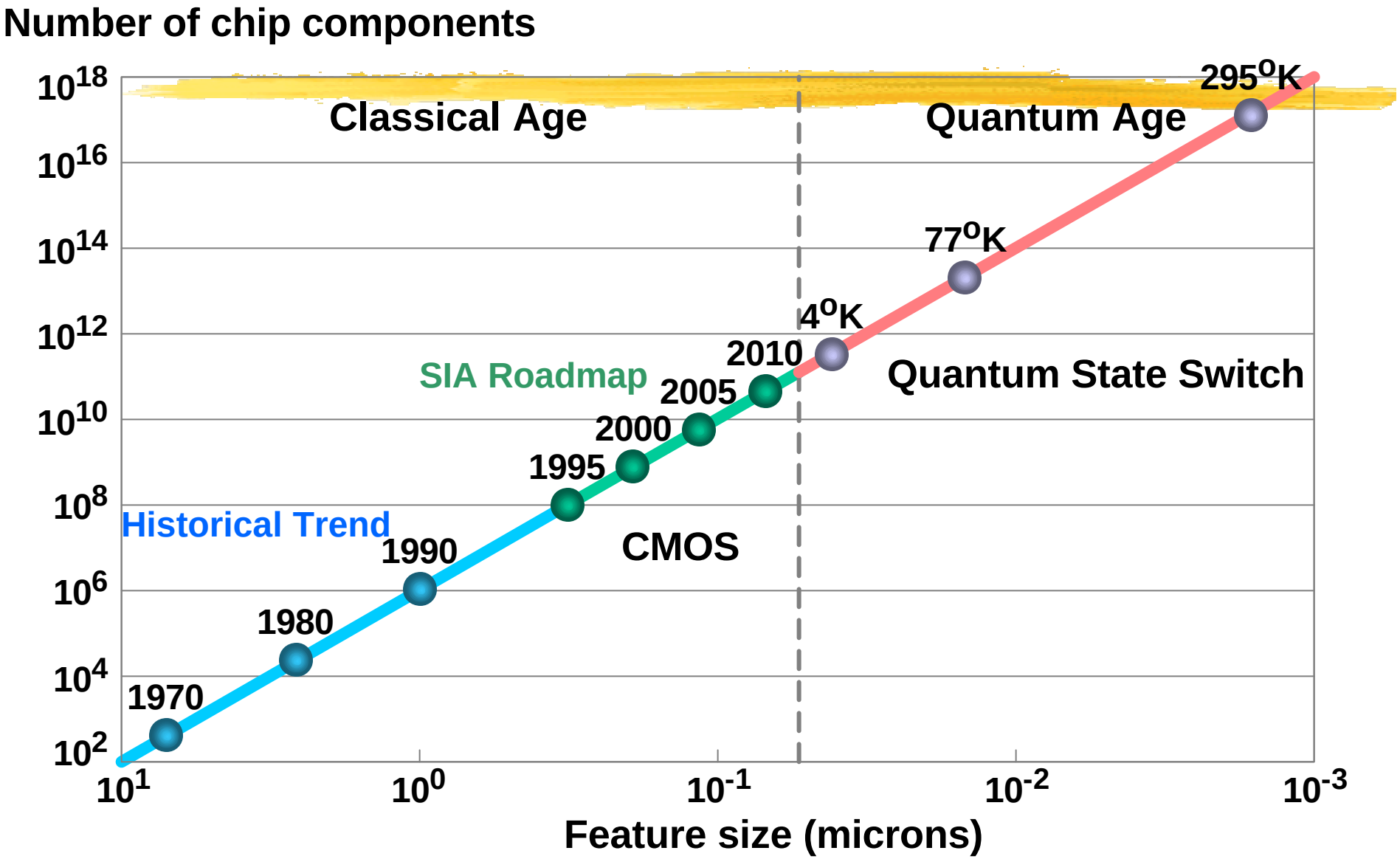
"We define a ***'killer technology'*** as one that delivers enhanced systems performance of a factor of at least a hundred-fold per decade."

C.H.Fine & L.K. Kimerling, "Biography of a Killer Technology: Optoelectronics Drives Industrial Growth with the Speed of Light," published in 1997 by the Optoelectronics Industry Develoment Association, 2010 Mass Ave, NW, Suite 200, Wash. DC 20036-1023.

Killer Question:

Will ***Integrated Optics*** evolve linearly like Semiconductors with Moore's Law or like Disk Drives with repeated industry disruptions?

Roadmap for Electronic Devices



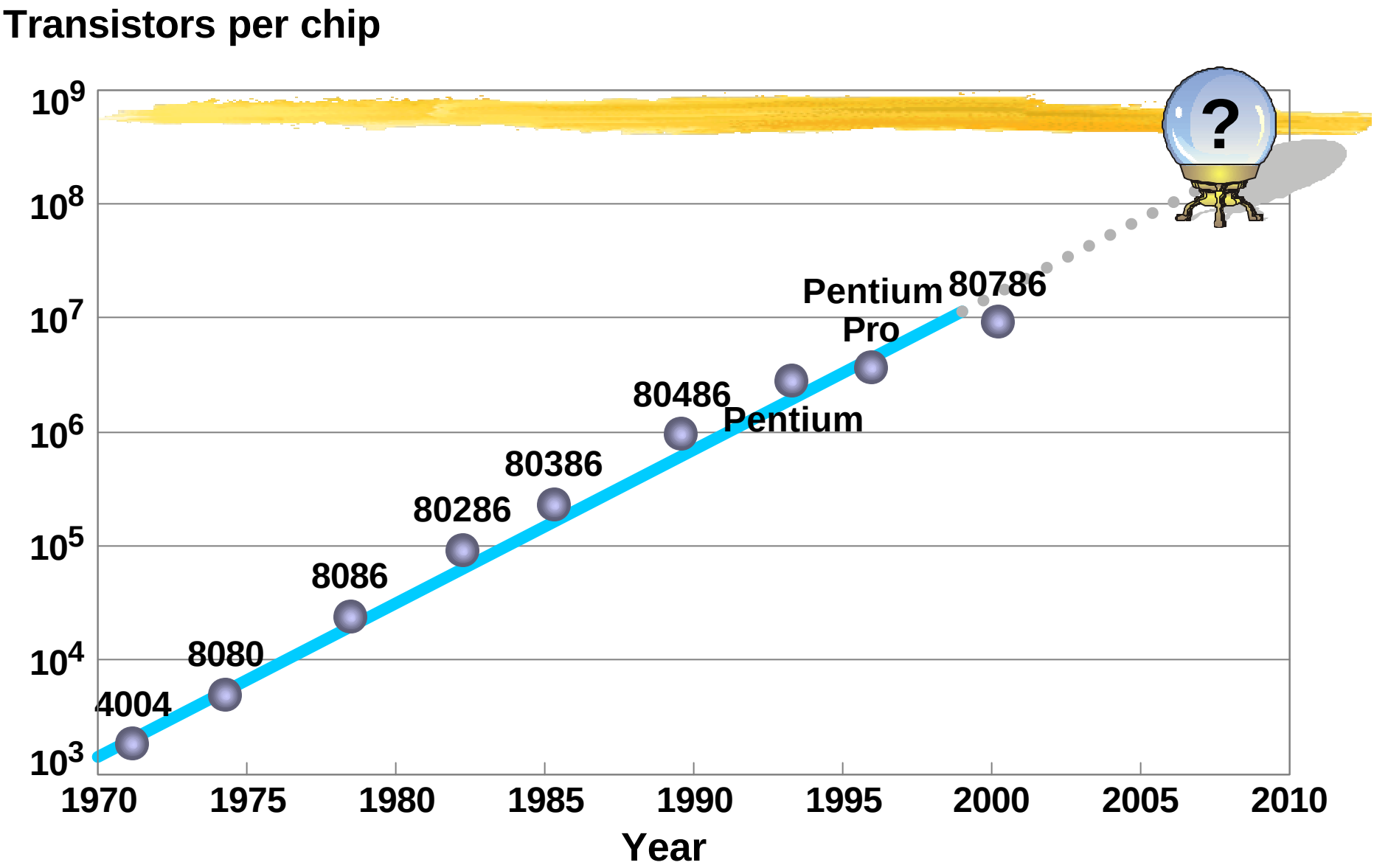
Horst D. Simon

LAWRENCE BERKELEY NATIONAL LABORATORY

International Technology Roadmap for Semiconductors '99

Year	2005	2008	2011	2014
Technology (nm)	100	70	50	35
DRAM chip area (mm^2)	526	603	691	792
DRAM capacity (Gb)	8		64	
MPU chip area (mm^2)	622	713	817	937
MPU transistors ($x10^9$)	0.9	2.5	7.0	20.0
MPU Clock Rate (GHz)	3.5	6.0	10.0	13.5

Moore's Law



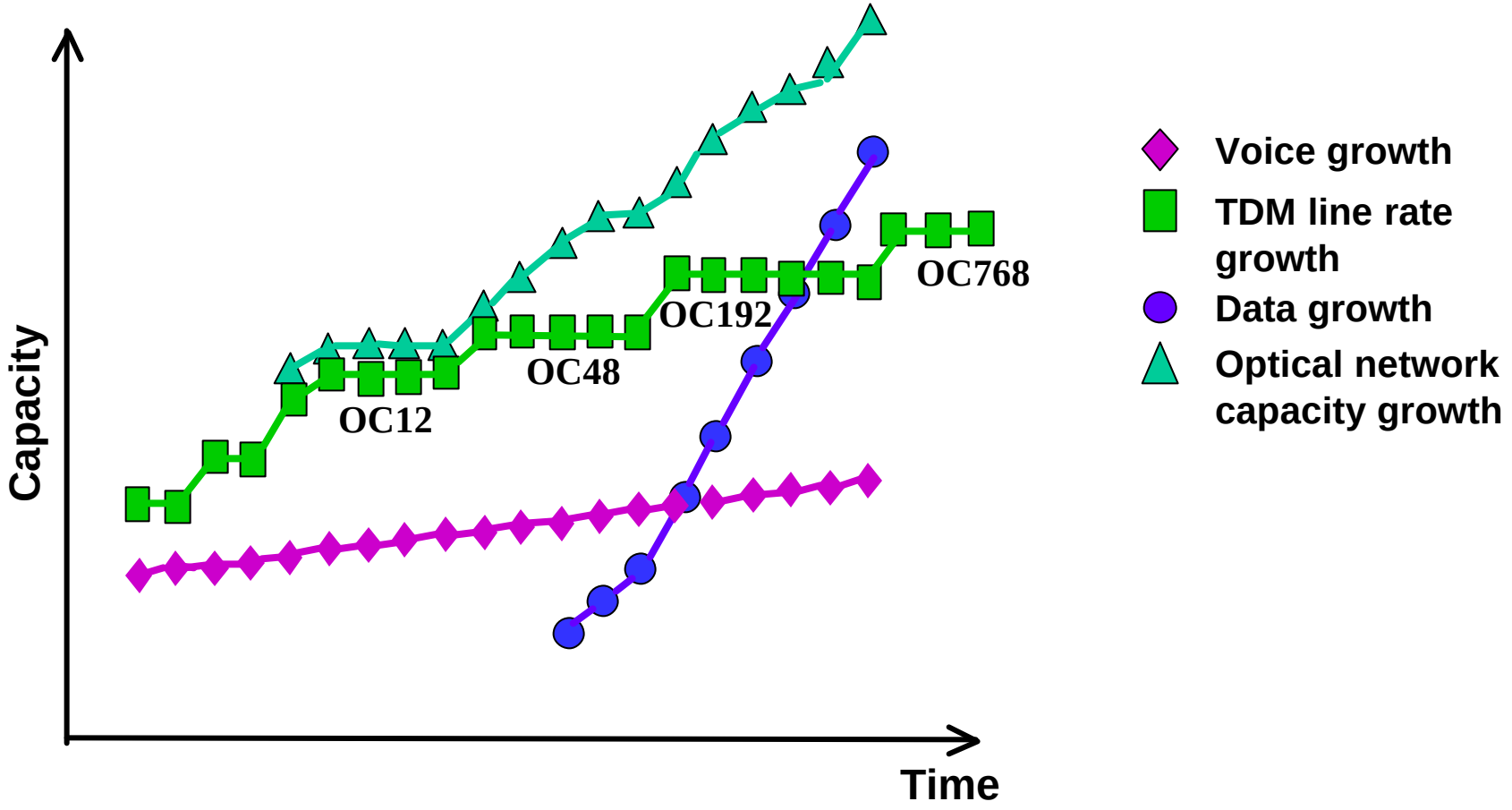
Source: Joel Birnbaum, HP, Lecture at APS Centennial, Atlanta, 1999

Disk Drive Development 1978-1991

Disk Drive Generation	Dominant Producer	Dominant Usage	Approx cost per Megabyte
14”	IBM	mainframe	$750
8”	Quantum	Mini-computer	$100
5.25”	Seagate	Desktop PC	$30
3.5”	Conner	Portable PC	$7
2.5”	Conner	Notebook PC	$2

From 1991-98, Disk Drive storage density increased by 60%/year while semiconductor density grew ~50%/year. Disk Drive cost per megabyte in 1997 was ~ $ .10

Optical Networking is Keeping Up!



Optical Technology Evolution: Navigating the Generations with an Immature Technology

	1	2	3	4	5
Timeline	Now	Starting	Starting	3-5 years	5-15 years
Stage	Discrete Components	Hybrid Integration	Low-level monolithic integration	Medium Monolithic integration	High-level monolithic integration
Examples	MUX/ DEMUX	TX/RX module OADM	TX/RX module OADM	OADM, Transponder Switch Matrix	Transponder
Core Techno-logies	FBGs, Thin-film, fused fiber, mirrors	Silicon Bench, Ceramic substrates	Silica Silicon InP	InP, ??	InP, ??
How many Functions?	1	2-5	2-5	5-10	10-XXX
Industry Structure	Integrated	Integrated/ Horizontal	Integrated /Horizontal	DOUBLE HELIX	DOUBLE HELIX

Dr. Yanming Liu, MIT & Corning

OPTICAL VALUE CHAIN:
MINI CASE EXAMPLE

NORTEL NETWORKS plays at at least three levels of the Optical Network Telecom value chain:

1. **Network design & installation**
2. **Modules (OC-192 network elements)**
3. **Components (lasers, amplifiers)**

QUIZ: Should Nortel sell their components business?

Hint: How likely are the scenarios of:

- **An *Intel Inside* effect in components?**
- **Networks become sufficiently modular as to be assembled by the customer?**

All Conclusions are *Temporary*

Clockspeeds are increasing almost everywhere

eCommerce is a clockspeed driver

Value chain design is a key competency

Study of eFlies can help with crafting strategy