Strategic Sourcing and Supply Chain Design
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1. Fruit Flies & Temporary Advantage
2. Supply Chain Design & 3-DCE
3. eBusiness Phenomena: Business Model Innovation
4. Technology Roadmapping: A telecom example
Business System Design in a **Fast-Clockspeed World:**

*Study the Industry Fruitflies*

### Evolution in the Natural World:

<table>
<thead>
<tr>
<th>FRUITFLIES</th>
<th>evolve faster than</th>
<th>MAMMALS</th>
<th>evolve faster than</th>
<th>REPTILES</th>
</tr>
</thead>
</table>

### Evolution in the Industrial World:

<table>
<thead>
<tr>
<th>INFOTAINMENT</th>
<th>is faster than</th>
<th>MICROCHIPS</th>
<th>evolve faster than</th>
<th>AUTOS</th>
<th>evolve faster than</th>
<th>AIRCRAFT</th>
<th>evolve faster than</th>
<th>MINERAL EXTRACTION</th>
</tr>
</thead>
</table>

### The Key Tool:

*Cross-SPECIES Benchmarking of Dynamic Forces*
Cisco’s End-to-End Integration for its Fulfillment Supply Chain

- Customers
- Cisco
- Contract Manufacturers
- Component Suppliers & Distributors

- New product development on-line with supply base
- Technology Supply Chain Design: Innovation through Acquisition
- Single enterprise information system
- Dynamic replenishment, direct fulfillment, merge in transit
- Customer orders through Cisco Connection online
- Finished Product flows direct to customer via logistics supplier

Order info flows direct to Cisco and suppliers

Basic Design Principle: Arm’s length Relationship with Fulfillment Chain Partners
Cisco's Strategy for Technology Supply 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

Basic Design Principle: Acquisition Relationship with Technology Chain Partners
Volatility Amplification in the Supply Chain: “The Bullwhip Effect”

Customer  Retailer  Distributor  Factory  Tier 1 Supplier  Equipment

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

“We are experiencing a 100-year flood.” J. Chambers, 4/16/01

LESSONS FROM A FRUIT FLY:  
*CISCO SYSTEMS*

1. KNOW YOUR LOCATION IN THE VALUE CHAIN  
2. UNDERSTAND THE DYNAMICS OF VALUE CHAIN FLUCTUATIONS  
3. THINK CAREFULLY ABOUT THE ROLE OF VERTICAL COLLABORATIVE RELATIONSHIPS
INDUSTRY CLOCKSPED IS A COMPOSITE:
OF PRODUCT, PROCESS, AND ORGANIZATIONAL
CLOCKSPEDS

Mobile Phone INDUSTRY CLOCKSPED

THE Mobile Phone product technology

THE Mobile Phone PRODUCTION PROCESS process technology

THE Mobile Phone MANUFACTURING COMPANY organization
Mobile Phone System CLOCKSPED is a mix of Transmission Standards, Software and Handsets

**ISSUE:** THE FIRMS THAT ARE FORCED TO RUN AT THE FASTEST CLOCKSPED ARE THE MOST LIKELY TO STAY AHEAD OF THE GAME.
Clockspeed drives Business Strategy Cadence

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

See Leonard-Barton, D. Wellsprings of Knowledge
The Strategic Leverage of Supply Chain Design:

*Who let Intel Inside?*

1980: IBM designs a product, a process, & supply chain

![Diagram showing supply chain relationships between IBM, Intel, Microsoft, and customers.]

The Outcome:
A phenomenally successful product design
A disastrous value chain design (for IBM)
LESSONS FROM A FRUIT FLY:
THE PERSONAL COMPUTER

1. BEWARE OF INTEL INSIDE
   (Regardless of your industry)

2. MAKE/BUY IS NOT ABOUT WHETHER IT IS
   TWO CENTS CHEAPER OR TWO DAYS FASTER
   TO OUTSOURCE VS. INSOURCE

3. SUPPLY CHAIN DESIGN CAN DETERMINE
   THE FATE OF COMPANIES AND INDUSTRIES,
   AND OF PROFIT AND POWER

4. THE LOCUS OF VALUE CHAIN CONTROL
   CAN SHIFT IN UNPREDICTABLE WAYS
**Vertical Industry Structure**

*with Integral Product Architecture*

**Computer Industry Structure, 1975-85**

<table>
<thead>
<tr>
<th>Microprocessors</th>
<th>Operating Systems</th>
<th>Peripherals</th>
<th>Applications Software</th>
<th>Network Services</th>
<th>Assembled Hardware</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IBM</strong></td>
<td><strong>All Products</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DEC</strong></td>
<td><strong>All Products</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BUNCH</strong></td>
<td><strong>All Products</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(See A. Grove, Intel; and Farrell, Hunter & Saloner, Stanford)
Horizontal Industry Structure with *Modular* Product Architecture

Computer Industry Structure, *1985-95*

<table>
<thead>
<tr>
<th>Microprocessors</th>
<th>Intel</th>
<th>Moto</th>
<th>AMD</th>
<th>etc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Systems</td>
<td>Microsoft</td>
<td>Mac</td>
<td>Unix</td>
<td></td>
</tr>
<tr>
<td>Peripherals</td>
<td>HP</td>
<td>Epson</td>
<td>Seagate</td>
<td>etc</td>
</tr>
<tr>
<td>Applications Software</td>
<td>Microsoft</td>
<td>Lotus</td>
<td>Novell</td>
<td>etc</td>
</tr>
<tr>
<td>Network Services</td>
<td>AOL/Netscape</td>
<td>Microsoft</td>
<td>EDS</td>
<td>etc</td>
</tr>
<tr>
<td>Assembled Hardware</td>
<td>HP</td>
<td>Compaq</td>
<td>IBM</td>
<td>Dell</td>
</tr>
</tbody>
</table>
THE DYNAMICS OF PRODUCT ARCHITECTURE
AND VALUE CHAIN STRUCTURE:
THE DOUBLE HELIX

See Fine & Whitney, “Is the Make/Buy Decision Process a Core Competence?”
THE DOUBLE HELIX
IN OTHER INDUSTRIES

• **TELECOMMUNICATIONS**--
  – “MA BELL” was **Vertical /Integral**
  – BABY BELLS & LONG LINES & CELLULAR are Horizontal/Modular
  – Today’s Verizon is going back to **Vertical /Integral**

• **AUTOMOTIVE**--
  – Detroit in the 1890’s was Horizontal/Modular
  – Ford & GM in the mid 1900’s were **Vertical /Integral**
  – Today’s Auto Industry is going back to Horizontal/Modular

• **TELEVISION**--
  – RCA was **Vertical /Integral**
  – 1970’S THROUGH 1990’S were Horizontal/Modular
  – Today’s media giants are going back to **Vertical /Integral**

• **BICYCLES**--
  – Safety Bikes to 1890’s boom to Schwinn to *Shimano Inside*
Controlling the Chain Through Distribution: The End of *P&G Inside*?

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

Customers

![Diagram showing relationships between customers and retailers, leading to P&G]
Controlling the Chain Through Distribution:

Beware of Walmart Outside

Controlling the Channel Through Closeness to Customers: Chain Proximity

Vertical Growth on the Double Helix
Volatility Amplification in “The Bullwhip Effect” and Clockspeed Amplification in “The Speedup Effect”

Inventories & Orders fluctuate more as you look upstream, tough on suppliers, but

Clockspeeds accelerate as you head downstream, closer to the final customer
Media Supply Chains: An Industry at *Lightspeed*

**Customers**

- Customers

**The box**

- Wired Phone
- Wireless phone

**The Pipe**

- (Access, Metro, Backbone)
  - Land-based Telco:
    - copper POTS
    - fiber
    - DSL
  - Cable Networks

**The Content**

- Video/Audio:
  - Movies & Art & News & Sports
- News/articles/books (newspapers & magazines)
- Communication:
  - voice & video & email

**Retail Outlets**

- Borders:
- Blockbuster
- Seven-Eleven

- Delivery (e.g., FedEx)

**Television**

**PC/laptop**

**PDA**

**VCR**

**Pager**

**Wireless**

- broadcast TV
- CDMA, TDMA, GSM
- satellite/microwave
ALL COMPETITIVE ADVANTAGE IS TEMPORARY

**Autos:**

**Computing:**

**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*
Strategic Business System Design
And Technology Roadmapping

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4. Telecom Value Chains: A fruit fly example
SUPPLY CHAIN DESIGN:
Three Components

1. Insourcing/OutSourcing
   *(The Make/Buy or Vertical Integration Decision)*

2. Partner Selection
   *(Choice of suppliers and partners for the chain)*

3. The Contractual Relationship
   *(Arm’s length, joint venture, long-term contract, strategic alliance, equity participation, etc.)*
IMPLEMENTATION OF BUSINESS SYSTEM DESIGN: EMBED IT IN 3-D CONCURRENT ENGINEERING
ARCHITECTURES IN 3-D
INTEGRALITY VS. MODULARITY

Integral product architectures feature close coupling among the elements
- Elements perform many functions
- Elements are in close spacial proximity
- Elements are tightly synchronized
- Ex: jet engine, airplane wing, microprocessor

Modular product architectures feature separation among the elements
- Elements are interchangeable
- Elements are individually upgradeable
- Element interfaces are standardized
- System failures can be localized
- Ex: stereo system, desktop PC, bicycle
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 & SUPPLY CHAINS: THE NEED FOR ALIGNMENT

SUPPLY CHAIN ARCHITECTURE
(Geog., Organ., Cultural, Elec.)

PRODUCT ARCHITECTURE

INTEGRAL MODULAR

INTEGRAL
Jet engines
Microprocessors
Mercedes vehicles

MODULAR
Polaroid
Nortel, Lucent

INTEGRAL
Automotive
Supplier Parks

MODULAR
Personal Computers
Bicycles
Chrysler Vehicles
Cisco
In/Outsourcing: Sowing the Seeds of Competence Development to develop dependence for knowledge or dependence for capacity

**Dependence**
- Amount of Work Outsourced
- Knowledge +/or supply

**Supplier Capability**

**Amount of Supplier Learning**

**Independence**
- Amount of Work Done In-house
- Knowledge +/or supply

**Internal Capability**

**Amount of Internal Learning**
Technology Dynamics in the Aircraft Industry: LEARNING FROM THE DINOSAURS

Japanese industry size & capability

+ Japanese appeal as subcontractors

Boeing outsources to Japan (Mitsubishi Inside?)

+ +

U.S. firms’ appeal as subcontractors

+ +

U.S. industry size & capability

+ +

Japanese Industry Autonomy

+
SOURCEABLE ELEMENTS

PROCESS ELEMENTS

ENGINEERING

ASSY

TEST

I4  V6  V8

PRODUCTS

SUBSYSTEMS

BLOCK

VALVETRAIN

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

<table>
<thead>
<tr>
<th>DEPENDENT FOR KNOWLEDGE &amp; CAPACITY</th>
<th>INDEPENDENT FOR KNOWLEDGE &amp; DEPENDENT FOR CAPACITY</th>
<th>INDEPENDENT FOR KNOWLEDGE &amp; CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A POTENTIAL OUTSOURCING TRAP</strong></td>
<td><strong>BEST OUTSOURCING OPPORTUNITY</strong></td>
<td><strong>OVERKILL IN VERTICAL INTEGRATION</strong></td>
</tr>
<tr>
<td><strong>WORST OUTSOURCING SITUATION</strong></td>
<td><strong>CAN LIVE WITH OUTSOURCING</strong></td>
<td><strong>BEST INSOURCING SITUATION</strong></td>
</tr>
</tbody>
</table>

Adapted from Fine & Whitney, “Is the Make/Buy Decision Process a Core Competence?”
Strategic Make/Buy Decisions:
Also consider Clockspeed & Supply Base Capability

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Clockspeed</th>
<th>Suppliers</th>
<th>Clockspeed</th>
<th>Suppliers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Few</td>
<td>Fast</td>
<td>Many</td>
<td>Fast</td>
<td>Few</td>
</tr>
<tr>
<td>Slow</td>
<td>OK</td>
<td>Slow</td>
<td>OK</td>
<td>Slow</td>
</tr>
<tr>
<td>Watch it!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adapted from C. Fine, *Clockspeed*, Chap. 9
Strategic Sourcing Assessment requires evaluation of five key criteria

- **Customer Importance:**
  - High
  - Medium
  - Low

- **Technology Clockspeed:**
  - Fast
  - Medium
  - Slow

- **Competitive Position:**
  - Advantage
  - Parity
  - Disadvantage

- **Capable Suppliers:**
  - None
  - Few
  - Many

- **Architecture:**
  - Integral
  - Modular

- **High customer importance and fast clockspeed means more strategic**

- **Competitive position is critical for assessing value of outsourcing**

- **Supply Base Capability must be present for successful outsourcing**

- **Degree of modularity affects significantly the ease of outsourcing**

Model Developed by PRTM, Inc., GM Powertrain & Clockspeed, Inc.
Every decision requires qualitative and quantitative analysis to reach a conclusion.

Model Developed by PRTM, Inc., GM Powertrain & Clockspeed, Inc.
Value Chain Mapping

Organizational Supply Chain

Chrysler  Eaton  casting supplier  clay supplier

Technology Supply 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.
SUPPLY 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 SUPPLY CHAIN DESIGN

1. Benchmark the Fruit Flies
2. Map your Supply Chain
   - Organizational Supply Chain
   - Technology Supply 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
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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-to-Peer 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**

Alternate Solution: Partner with UPS or FedEx
DOT.COM COMPETITION: FOCUS ON THE SUPPLY CHAIN
Napster’s New Supply Chain Strategy
(go to the end and steal everything!)

Vertically Integrated Music Giants

Identify Talent

Develop Songs

Record Music

Promote Music

Press CD’s

Sell to Retail

Alternate Solution: partner with your competitor

Customer Consumption
Strategic Business System Design
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Moore’s Law

Transistors per chip

See: Joel Birnbaum, HP, Lecture at APS Centennial, Atlanta, 1999
# Disk Drive Development 1978-1991

<table>
<thead>
<tr>
<th>Disk Drive Generation</th>
<th>Dominant Producer</th>
<th>Dominant Usage</th>
<th>Approx cost per Megabyte</th>
</tr>
</thead>
<tbody>
<tr>
<td>14”</td>
<td>IBM</td>
<td>mainframe</td>
<td>$750</td>
</tr>
<tr>
<td>8”</td>
<td>Quantum</td>
<td>Mini-computer</td>
<td>$100</td>
</tr>
<tr>
<td>5.25”</td>
<td>Seagate</td>
<td>Desktop PC</td>
<td>$30</td>
</tr>
<tr>
<td>3.5”</td>
<td>Conner</td>
<td>Portable PC</td>
<td>$7</td>
</tr>
<tr>
<td>2.5”</td>
<td>Conner</td>
<td>Notebook PC</td>
<td>$2</td>
</tr>
</tbody>
</table>

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 ~ $0.10
“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.”


**Killer Question:**
Will *Integrated Optics* evolve linearly like Semiconductors with Moore’s Law or like Disk Drives with repeated industry disruptions?
All Conclusions are *Temporary*

Clockspeeds are increasing almost everywhere

Supply Chain Relationships must anticipate Industry and Value Chain Dynamics

Proactive Relationships Design is a key organizational competency

Supply Chain Relationships must be designed concurrently with the products and systems they will deliver

Study of Fruit Flies can help with crafting strategy