Strategic Supply Chain Design

Massachusetts Institute of Technology
Sloan School of Management
Strategic Supply Chain Design

0. Introduction
1. Fruit Flies & Supply Chain Evolution
2. Supply Chain Design & 3-DCE
3. Customer Service and Service Supply Chains
4. Value Chain Roadmapping & Strategy Making
3-D Concurrent Engineering &
the imperative of concurrency

Product
- Detailed Design
  - Spec
  - Materials
  - Functions
- Product Architecture
- Modular/Integral Life Cycles

Process
- Unit Processes
- Technology Equipment
- Production System
  - Objectives
  - Systems
  - People
  - Capacity

Supply Chain
- Supply Chain Architecture
- Sourcing
- Selection
- Relationship
- Technology
  - Supply Chain
- Logistics & Coord System
- Information
- Inventory
- Integration

Fulfillment Architecture Technology
## SC Principles to Understand

### Decision Scope

<table>
<thead>
<tr>
<th>Tactical</th>
<th>Strategic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fulfillment Supply Chain</td>
<td>Technology Supply Chain</td>
</tr>
</tbody>
</table>

| Costs, Cycle Times, Inventories | Collaborative Prod Devel |
| Bullwhip | Clockspeed |
| Revenue Management | Double Helix |
| IT System Design | Supply Chain Architecture |
| Order Fulfill. Process | Value Migration |
| Logistics System Design | 3-DCE |
| Supply-Demand balance | |
| Relationship Design | |
| Flexibility | |
## Components of Supply Chain Business Processes

### System Design/Capabilities

<table>
<thead>
<tr>
<th>Product</th>
<th>Fulfillment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>Architecture</td>
</tr>
<tr>
<td>Supply Chain</td>
<td>Technology</td>
</tr>
</tbody>
</table>

### External Influences
- clockspeeds (product, process)
- risks (design, supply, demand)

### Solution Implementation
- postponement
- quick response
- lean production
- common parts/platforms

### Operational Objectives/Customer Requirements
- cost
- quality
- speed (flexibility, responsiveness)
- improvement (learning/knowledge)
INTRODUCTIONS

Who are you?
What can you offer?
What do you want to learn?
Strategic Supply Chain Design

1. Fruit Flies & Supply Chain Evolution
2. Supply Chain Design & 3-DCE
3. Customer Service and Service Supply Chains
4. Value Chain Roadmapping & Strategy Making
Supply Chain Design in a Fast-Clockspeed World: Study the Industry Fruitflies

*Evolution in the natural world:*

FRUITFLIES evolve faster than MAMMALS
MAMMALS evolve faster than REPTILES

**THE KEY TOOL:**

Cross-SPECIES Benchmarking of Dynamic Forces

*Evolution in the industrial world:*

INFOTAINMENT is faster than MICROCHIPS is faster than AUTOS evolve faster than AIRCRAFT evolve faster than MINERAL EXTRACTION

**THE KEY TOOL:**

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

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"

- 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
4. INFORMATION AND LOGISTICS SPEED DO NOT REPEAL BUSINESS CYCLES OR THE BULLWHIP.

Bonus Question:
How does clockspeed impact volatility?
INDUSTRY CLOCKSPEED IS A COMPOSITE: OF PRODUCT, PROCESS, AND ORGANIZATIONAL CLOCKSPEEDS

Mobile Phone INDUSTRY CLOCKSPEED

THE Mobile Phone product technology

THE Mobile Phone production 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.
Automobile CLOCKSPED IS A MIX OF ENGINE, BODY & ELECTRONICS

ISSUE: MOST AUTO FIRMS OPERATE AT ENGINE OR BODY CLOCKSPEDS; IN THE FUTURE THEY WILL NEED TO RUN AT ELECTRONICS CLOCKSPED.
Clockspeed drives Business Strategy Cadence

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

CORE CAPABILITIES

NEW PROJECTS
(New products, new processes, new suppliers)

See Leonard-Barton, D. Wellsprings of Knowledge
Projects Serve Three Masters: Capabilities, Customers, & Corporate Profit

- **CORE CAPABILITIES**
- **PROJECT DESIGN** (New products, new processes, new suppliers)
- **CUSTOMER VALUE PROPOSITION**
- **CORPORATE VALUE PROPOSITION**
The Strategic Leverage of Value Chain Design: **Who let Intel Inside?**

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

The Outcome:
A phenomenonally 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 TO OUTSOURCE

3. VALUE 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
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 VERSUS INSOURCE.*

3. DEVELOPMENT PARTNERSHIP 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

- IBM
  - All Products
- DEC
  - All Products
- BUNCH
  - All Products

Microprocessors
Operating Systems
Peripherals
Applications Software
Network Services
Assembled Hardware

(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

Retailer

Retailer

Retailer

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
Clockspeeds accelerate as you head downstream, closer to the final customer;

Clockspeed = f(technology push, customer pull, system complexity)
Media Supply Chains: An Industry at *Lightspeed*

**Customers**
- Wired Phone
- Wireless Phone
- PC/laptop
- PDA
- Television
- VCR
- Pager

**The box**
- Wired Phone
- Wireless Phone
- PC/laptop
- PDA
- Television
- VCR
- Pager

**The Pipe**
(Access, Metro, Backbone)
- Land-based Telco:
  - copper POTS
  - fiber
  - DSL
- Cable Networks
- Wireless:
  - broadcast TV
  - CDMA, TDMA, GSM
  - satellite/microwave

**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)**

**Banking**

**Education**

**Shopping**

**Internet, *et al***
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*
Exercise 1: Value Chain Analysis

Consider these five industries:
- Food
- Defense aircraft
- Automobiles
- Handheld electronic organizers/communicators
- Music

At each table, pick two of these industries:
What are the key elements in the value chain?
Who has power in the chain?
What are the key dynamic processes influencing chain power?
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VALUE 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 VALUE CHAIN DESIGN: EMBED IT IN 3-D CONCURRENT ENGINEERING
Projects Serve Three Masters: Capabilities, Customers, & Corporate Profit

- **Core Capabilities**
- **Project Design** (New products, new processes, new suppliers)
- **Customer Value Proposition**
- **Corporate Value Proposition**
IMPLEMENTATION OF *PROJECT DESIGN*: FRAME IT AS 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
ALIGNING ARCHITECTURES: BUSINESS SYSTEMS & TECHNOLOGICAL SYSTEMS

BUSINESS SYSTEM/SUPPLY CHAIN ARCHITECTURE (Geog., Organ., Cultural, Elec.)

INTEGRAL ↔ MODULAR

<table>
<thead>
<tr>
<th>INTEGRAL</th>
<th>MODULAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microprocessors</td>
<td>Lucent Nortel</td>
</tr>
<tr>
<td>Mercedes &amp; BMW</td>
<td>Polaroid</td>
</tr>
<tr>
<td>vehicles</td>
<td></td>
</tr>
<tr>
<td>MSFT Windows</td>
<td>Chrysler</td>
</tr>
<tr>
<td></td>
<td>vehicles</td>
</tr>
<tr>
<td>Digital Rights/</td>
<td>Cisco</td>
</tr>
<tr>
<td>Music Distribution</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dell PC’S Bicycles</td>
</tr>
</tbody>
</table>
Dell Supply Chain

Continuity of Supply

Global \ Regional Procurement

Demand/ Supply Management

Demand Management

Build to customer specifications

Sales

Supplier

Supplier

SLC

Dell

Customer

Materials ordering cycle
10-180+ days

Customer fulfillment
2-5 days

Modular Product Architecture enables Modular Supply Chain
Demand-Supply Chain Management
@ Dell

- **Demand Management:**
- **Forecast = Buy = Sell**
- **Buy to Plan, but Build to Order**

- **Inventory Velocity is a wonderful thing ...**
  - Customers have immediate access to the latest technology.
  - Suppliers get their products to market quickly
  - Quality is improved with fewer touches.
  - Cash is generated through negative cash cycle.
  - Model efficiencies drive Market Share gain.
Can “Dell Direct” Work for Autos?

- Appealing to OEM’s on Many Dimensions
  - Satisfy customer need for Speed
  - Reduce Supply Line Inventories
  - Reduce mismatches and discounting
  - Direct OEM-Customer Relationships (& Data!)
  - Information Transparency

Adapted from Prof. J.P. MacDuffie, IMVP & The Wharton School
BUT,
A Car is not a Computer!!

- **Personal Computer**
  - ~50 components
  - 8-10 key parts
  - 40 key suppliers
  - 24 hour burn-in
  - 100 design
  - variations
  - Modular
  - Architecture

- **Car**
  - ~ 4000 components
  - 100 key subsystems
  - 300 key suppliers
  - 12 month validation
  - 1,000,000 variations
  - Integral Architecture

Adapted from Prof. J.P. MacDuffie, IMVP & The Wharton School
### Designing Architectures for Products & Value Chains: Modularity vs. Openness

**Architectural Proprietaryness**

**Closed**
- Pentium Chip
- Mercedes Vehicles
- SAP ERP

**Modular**
- IBM Mainframes
- Microsoft Windows
- Chrysler Vehicles

**Open**
- Linux
- Palm Pilot software & accessories
- Phones & service
- Web-based ERP

**Information Architecture Must Reflect Business Model**
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 Autonomy

Japanese appeal as subcontractors

Boeing outsources to Japan (*Mitsubishi Inside?*)

U.S. firms’ appeal as subcontractors

Japanese industry size & capability

U.S. industry size & capability

+ +

46
SOURCEABLE ELEMENTS
Strategic Make/Buy Decisions: Assess Critical Knowledge & Product Architecture

<table>
<thead>
<tr>
<th>Item is Integral</th>
<th>Item is Modular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent for Knowledge &amp; Capacity</td>
<td>Independent for Knowledge &amp; Dependent for Capacity</td>
</tr>
<tr>
<td>Dependent for Knowledge &amp; Capacity</td>
<td>Independent for Knowledge &amp; Capacity</td>
</tr>
<tr>
<td>A Potential Outsourcing Trap</td>
<td>Best Outsourcing Opportunity</td>
</tr>
<tr>
<td>Worst Outsourcing Situation</td>
<td>CAN Live with Outsourcing</td>
</tr>
<tr>
<td>OVERKILL in Vertical Integration</td>
<td>BEST Insourcing Situation</td>
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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>
<th>Clockspeed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Few</td>
<td>Fast</td>
<td>Many</td>
<td>Fast</td>
<td>Few</td>
<td>Slow</td>
</tr>
<tr>
<td>Slow</td>
<td></td>
<td></td>
<td>Slow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Dependent for Knowledge & Capacity**

- **Trap**
  - Fast: OK
  - Slow: Watch it!

- **Best**
  - Fast: OK
  - Slow: OK

- **Worst**
  - Fast: OK
  - Slow: OK

**Dependent for Capacity Only**

- **Overkill**
  - Fast: OK
  - Slow: OK

**Independent for Knowledge & Capacity**

- **Best In**
  - Fast: OK
  - Slow: OK

- ** Worst**
  - Fast: OK
  - Slow: OK

Adapted from C. Fine, *Clockspeed*, Chap. 9
Qualitative analysis of strategic importance uses 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

- 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

Model developed by GM Powertrain, PRTM, & Clockspeed, Inc.
Every decision requires qualitative and quantitative analysis to reach a conclusion.
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.
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
STRATEGY IN 3-D: CASE EXAMPLES

Boeing: Static 3-D in airplane Projects
  Dynamic, Strategic Value Chain,
  unintegrated w/ Product & Process

Intel: Modular Product vs. Process
  Integral Process and Value Chain

Chrysler: Modular Product & Value Chain
  (weak on process?)

Toyota: Integral 3-D in Nagoya
  (weak on global 3-D?)
Exercise 2: Value Chain Analysis

Consider these five industries:
- Food
- Defense aircraft
- Automobiles
- Handheld electronic organizers/communicators
- Music

At each table, pick two of these industries:
What are the key dependency relationships in the value chain?
What is driving the clockspeed in the chain?
What are the opportunities for outsourcing to contract manufacturers
What are the windows of opportunity in the chain?
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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
SERVICES VS. MANUFACTURING

WHAT'S THE DIFFERENCE?
Some Characteristics of Services

- **Intangibility** - explicit and implicit intangibles
  - “We manufacture perfume; we sell hope.”

- **Perishability** - an hour of non-production is an hour lost
  - Airplane w/o spare part costs > $10K/hr

- **Heterogeneity** - inherent variability of personal needs and personal service
  - Each doctor’s bedside care is unique

- **Simultaneity** - services are simultaneously produced and consumed
  - A poor attitude by the server cannot be recalled
Services vs. Manufacturing

**Dell Product Features**
- μP & modem speed
- CD ROM speed
- MB DRAM & HD
- screen size
- order-to-deliv time
- features range
- fulfillment accuracy

**Airline Product Features**
- check-in time
- reservations help
- meals
- price
- flight frequency
- mileage awards
- route coverage
- baggage handling
- customer coddling
## ON-LINE and IN-STORE GROCERY SERVICES

<table>
<thead>
<tr>
<th><strong>TESCO</strong></th>
<th><strong>STOP &amp; SHOP/AHOLD</strong></th>
<th><strong>WEBVAN</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tesco on-line</td>
<td>Peapod</td>
<td>Last-mile provider</td>
</tr>
<tr>
<td>• 24/7 operations</td>
<td>• 24/7 web; 16 hours/day</td>
<td>• 24/7 web</td>
</tr>
<tr>
<td>• Low capital cost</td>
<td>• Low capital cost</td>
<td>• Dedicated network</td>
</tr>
<tr>
<td>• Pick off the floor;</td>
<td>• Pick off dedicated section</td>
<td>• High capital cost</td>
</tr>
<tr>
<td>- “steals” floor stock</td>
<td>• Limited menu</td>
<td>• Utilization sensitive</td>
</tr>
<tr>
<td>- adds floor congestion</td>
<td>• Peapod dedicated team</td>
<td>• No startup slack</td>
</tr>
<tr>
<td>• Weak inventory control</td>
<td>• $200K/wk peapod-B/E</td>
<td>• Unrealistic promises</td>
</tr>
<tr>
<td>• Messy; 1.3% waste</td>
<td>• $1M/wk store floor</td>
<td>- to customers</td>
</tr>
<tr>
<td>• High Monday out-of-stock</td>
<td>• Spotlessly clean</td>
<td>- to investors</td>
</tr>
</tbody>
</table>
Challenges of Service Interface: Grocery Stores vs. Webvan

- **Intangibility** - customer expectations vs. perceptions
  - Grocery Stores: quality, selection, *ENVIRONMENT*
  - Webvan: quality, selection, *DELIVERY*
- **Perishability** - use it or lose it
  - Grocery Stores: fresh foods (produce, meats, baked goods)
  - Webvan: fresh foods & *TRUCK CAPACITY*
- **Heterogeneity** - inherent variability of service & customer
  - Grocery: checkout people, counter people, customer needs
  - Webvan: *DELIVERY PERSON*
- **Simultaneity** - services simultaneously produced & consumed
  - Grocery: presentation in the store
  - Webvan: *DELIVERY TO THE HOME*
On-line vs. In-store Groceries

**Webvan Features**
- selection
- price
- quality/freshness
- shop any hour
- never leave home
- choose delivery time
- save your time
- same day delivery
- fulfillment accuracy
- no lugging required

**Grocery Store Features**
- selection
- price
- quality/freshness
- shopping environment

Who has the advantage on each dimension?
DOT.COM COMPETITION: FOCUS ON THE SUPPLY CHAIN
Napster’s New Supply Chain Strategy
(go to the end and steal everything!)

Identify Talent → Develop Songs → Record Music → Promote Music → Press CD’s → Sell to Retail

Vertically Integrated Music Giants

Napster

Stolen Songs

Alternate Solution: partner with your competitor

Customer Consumption
Exercise 3: Service Supply Chains

Consider these five industries:
- Food
- Defense aircraft
- Automobiles
- Handheld electronic organizers/communicators
- Music

At each table, pick two of these industries:
What are the key service elements in the value chain?
What are the challenges of managing these services?
Strategic Supply Chain Design

1. Fruit Flies & Supply Chain Evolution
2. Supply Chain Design & 3-DCE
3. Customer Service and Service Supply Chains
4. Value Chain Roadmapping in Communications
   (Architectures and Roadmaps for Communications and Media)
One View (the consumer’s) of the Communications Value Chain

Form (Size, Weight, Ergonomics)

O/S (Windows, Linux, Palm)

HW system (OEM, ODM, CEM)

Bundled Apps (phone, MP3, IM, etc.)

Network (CDMA, WiFi, Sonet, IP, Cable)

Equipment (Lucent, Ericsson, Cisco)

Channel (KaZaA, AOL/TW, MTV)

Artist (Madonna, NBA, Spielberg, SAP, Self)

Openness (EFF, RIAA/DMCA, TCPA)

Appliance
(Phone, Camera, Laptop, PDA, TV, Missile, MP3 Player)

Access
(Wireless, POTS, ISP, Satellite, Cable, HotSpot)

Content & Applications
(Music, Movies, Email, VoIP, Shopping, ERP, SCM, CRM, Banking, IM, Surveillance, Photos, Games)
# Another View of the Communications Value Chain

<table>
<thead>
<tr>
<th>MATERIALS &amp; PROCESS EQUIP</th>
<th>COMPONENTS</th>
<th>EQUIPMENT MAKERS</th>
<th>NETWORK OWNERS</th>
<th>SERVICE PROVIDERS</th>
<th>CONTENT &amp; APPLICS</th>
<th>APPLIANCES</th>
<th>END USERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Silicon</td>
<td>• Lasers</td>
<td>• Routers</td>
<td>• Wireless</td>
<td>• Long dist.</td>
<td>• Music</td>
<td>• Computers</td>
<td>• Business</td>
</tr>
<tr>
<td>• Gaas</td>
<td>• Amplifiers</td>
<td>• Switches</td>
<td>• Backbone</td>
<td>• Local</td>
<td>• Movies</td>
<td>• Phones</td>
<td>• Consumer</td>
</tr>
<tr>
<td>• InP</td>
<td>• Transceiver</td>
<td>• Hubs</td>
<td>• Metro</td>
<td>• Cellular</td>
<td>• Email</td>
<td>• Media Players</td>
<td>• Gov’t</td>
</tr>
<tr>
<td>• Polymers</td>
<td>• Filters</td>
<td>• Base Stations</td>
<td>• Access</td>
<td>• ISP</td>
<td>• VoIP</td>
<td>• Cameras</td>
<td>• Military</td>
</tr>
<tr>
<td>• Steppers</td>
<td>• Processors</td>
<td>• Satellites</td>
<td>• Substations</td>
<td>• Broadcast</td>
<td>• POTS</td>
<td>• ERP</td>
<td>• Education</td>
</tr>
<tr>
<td>• Etchers</td>
<td>• Memories</td>
<td>• Satellites</td>
<td>• Hot Spots</td>
<td>• Shopping</td>
<td>• Shopping</td>
<td>• SCM, CRM</td>
<td>• Medical</td>
</tr>
<tr>
<td>• MEMS</td>
<td>• Fiber</td>
<td>• Servers</td>
<td>• Cable TV</td>
<td>• ERP</td>
<td>• Surveillance</td>
<td>• Cameras</td>
<td>• Education</td>
</tr>
<tr>
<td>• Insertion</td>
<td>• ASICs</td>
<td>• Software</td>
<td>• Satellite TV</td>
<td>• MVNO’s</td>
<td>• Surveillance</td>
<td>• PDA’s</td>
<td>• Medical</td>
</tr>
<tr>
<td>• Etc..</td>
<td>• MEMS</td>
<td>• O/S</td>
<td>• Broadcast Spectrum</td>
<td>• eBusiness</td>
<td>• Surveillance</td>
<td>• Weapons</td>
<td>• Etc..</td>
</tr>
<tr>
<td></td>
<td>• DSP’s</td>
<td>• Etc..</td>
<td>• Communic Spectrum</td>
<td>• Etc..</td>
<td>• Etc..</td>
<td>• Etc..</td>
<td>• Etc..</td>
</tr>
</tbody>
</table>

- Computers
- Business
- Phones
- Etc.
- Consumer
- Media Players
- Etc.
- Gov’t
- Cameras
- Etc.
- Military
- PDA’s
- Etc.
- Education
- Weapons
- Etc.
- Medical
- Surveillance
- Etc.
Roadmapping Communications: What are the Premises?

Communications Value Chain is in ill health (ROADKILL MAPPING?)

Vertical disintegration is the dominant structure. Silo execs tend to focus on their own narrow slices. Most industry consortia are within-silo.

Silos in the value chain are interdependent (integrality).

Absence of leadership and coordination across an interdependent value chain creates uncertainty, risk, and reluctance to invest.

HOW TO ACHIEVE COORDINATION IN THE ABSENCE OF VERTICAL INTEGRATION?

SOME VALUE CHAIN COORDINATION COULD SPEED GROWTH.
Roadmapping Communications: What are the Premises?

Technology dynamics, Industry dynamics, and Regulatory dynamics are interdependent.

Technology and industry roadmapping are typically done by different people.

SIA roadmaps provided productive coordination in semiconductors, but focused only on technology & a narrow slice of the value chain. Industry growth was assumed. --> Not a good model for Communications.

Productive roadmapping must encompass multiple links of the value chain, a multidisciplinary team, and the co-evolution of technology, industry, and regulatory policy.
“If you come to a fork in the Road[map], Take it.”
--Yogi Berra

Internet explosion
Wireless Explosion
Connectivity Explosion
File Sharing Explosion

INFORMATION WANTS TO BE SHARED
==> Difficult content business models

INFORMATION SHARERS GO TO JAIL
==> Poverty of The Commons
“If you come to a fork in the Road[map], Take it.”
--Yogi Berra

Internet explosion
Wireless Explosion
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File Sharing Explosion

INFORMATION WANTS TO BE SHARED
==> Difficult content business models

INFORMATION SHARERS GO TO JAIL
==> Poverty of The Commons

Is there a third way? (Quantum Roadmap)
**Proposed MIT Communications Roadmap Consortium**

- **MPC, MTL**
- **RLE**
- **LCS**
- **ITC**
- **eBusiness, Oxygen, Media Lab**

## CROSS-INDUSTRY CHALLENGES

### Digital Rights

“To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries;” U.S. Constitution, Article 1, Section 8, Clause 8

### Access Architecture

- **Materials & Process Equip**
- **Components**
- **Equipment Makers**
- **Network Owners**
- **Service Providers**
- **Content & Appliances**
- **End Users**

- **Silicon**
- **Gaas**
- **InP**
- **Polymers**
- **Steppers**
- **Etchers**
- **MEMS**
- **Insertion**
- **Etc..**

- **Lasers**
- **Amplifiers**
- **Transceiver**
- **Filters**
- **Processors**
- **Memories**
- **Fiber**
- **ASICS**
- **MEMS**
- **DSP’s**
- **Etc..**

- **Routers**
- **Switches**
- **Hubs**
- **Base Stations**
- **Satellites**
- **Servers**
- **Software**
- **O/S**
- **Etc..**

- **Wireless**
- **Backbone**
- **Metro**
- **Access**
- **Substations**
- **Satellites**
- **Broadcast Spectrum**
- **Communic Spectrum**
- **Etc..**

- **Long distance**
- **Local Phone**
- **Cellular**
- **ISP**
- **Broadcast**
- **Hot Spots**
- **Cable TV**
- **Satellite TV**
- **VPN’s**
- **MVNO’s**
- **Etc..**

- **Music**
- **Movies**
- **Email**
- **VoIP**
- **POTS**
- **Shopping**
- **ERP**
- **SCM, CRM**
- **Surveillance**
- **eBusiness**
- **Etc..**

- **Computers**
- **Phones**
- **Media Players**
- **Cameras**
- **PDA’s**
- **Weapons**
- **Etc..**

- **Business**
- **Consumer**
- **Gov’t**
- **Military**
- **Education**
- **Medical**
- **Etc..**

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**Prof. C. Fine, MIT**
Dynamic Analysis to Support Industry & Technology Roadmapping

- Corporate Strategy Dynamics
- Customer Preference Dynamics
- Technology Dynamics
- Regulatory Policy Dynamics
- Industry Structure Dynamics
- Capital Market Dynamics
- Business Cycle Dynamics
MIT Communications Roadmap Consortium

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Access Architecture

C. Fine, MIT
Roadmap Components: Dynamic Analyses

1. Business cycle dynamics (e.g., the bullwhip effect)
2. Industry structure dynamics (e.g., double helix in *Clockspeed*)
3. Corporate strategy dynamics (e.g., dynamic matching of customer needs with corporate opportunities)
4. Customer Preference Dynamics
5. Technology dynamics (e.g., the Semiconductor Industry Assoc. roadmap built around Moore's law)
6. Regulatory Policy Dynamics (Cross-National, Cross Sector)
7. Capital Markets Dynamics
Business Cycle Dynamics
“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)
Industry Structure Dynamics

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

- **CORE CAPABILITIES**
- **PROJECT DESIGN** (New products, new processes, new suppliers)
- **CUSTOMER VALUE PROPOSITION**
### Corporate Strategy Dynamics

**BUSINESS SYSTEM/SUPPLY CHAIN ARCHITECTURE**

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

<table>
<thead>
<tr>
<th>INTEGRAL</th>
<th>MODULAR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INTEGRAL</strong></td>
<td><strong>MODULAR</strong></td>
</tr>
<tr>
<td>Microprocessors &amp; BMW vehicles</td>
<td>Lucent Nortel</td>
</tr>
<tr>
<td>MSFT Windows</td>
<td>Chrysler vehicles</td>
</tr>
<tr>
<td>Digital Rights/ Music Distribution</td>
<td></td>
</tr>
</tbody>
</table>
Customer Preference Dynamics
(adapted from Sadek Esener, UCSD and Tom O’Brien, DuPont “Macro-Trends” process)

1. Population
   - Aging, Growth
2. Awareness
   - of Environment/Energy costs, Personal Health
   - of consumption possibilities & disparities
3. Globalization
   - of commerce, culture, knowledge, disease, terrorism
4. Clusters
   - urbanization
   - wealth
   - affinity/ethnic groups
5. Technology
   - cheap computation, pervasive connectivity
   - technology at the molecular (nano) level
     (life sciences, electronics, polymers)
Regulatory Policy Dynamics: Some Components

1. Players:
   United States: FCC, Congress, Consumers, Corporations, Interest Groups

2. Environments:
   Wireless in Europe, NTT DoCoMo, Broadband in Sweden & Korea
   India vs. China Development
   US: Access, Digital Rights

3. Standards:
   e.g., wCDMA vs CDMA2000
Technology Dynamics: Moore’s Law predictions are linear & deterministic

Source: Joel Birnbaum, HP, Lecture at APS Centennial, Atlanta, 1999
Technology Dynamics: Disk Drive Development is non-linear & non-deterministic

<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 ~ $ .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 Questions:
1. Will Integrated Optics evolve linearly like Semiconductors with Moore’s Law or like Disk Drives with repeated industry disruptions?
2. How do we distinguish between the types?
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?
Wireless Base Stations (WSB'S) comprise 4 key subsystems:

Radio Part

Digital Signal Processing

Modem

Transmission Interface

Fiber & Wire-Based Network

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 base stations due to improved price-performance ratios.
Supply Chain Design is the Ultimate Core Competency: Competency of passing judgement on all other competencies

Benchmark the Fruit Flies
• Beware of *Intel Inside*
• SC control point unstable (comp, assem, distrib)
• SC structures oscillate
  -- int/int or mod/mod
• The Bullwhip lives
• Dependence/Independence has positive feedback
• Projects feed capabilities & vice-versa
• eBusiness accelerates Clockspeeds
• All Advantage is Temporary
• Align Architectures in Pdt, Proc, & SC
• Tech & Comp drive clockspeeds
All Conclusions are *Temporary*

Clockspeeds are increasing almost everywhere

Many technologies and industries exhibit fast clockspeed & high volatility

Value chain design and service system key competencies

Study of Fruit Flies can help with crafting strategy
8:00 pm, Friday 17 March 2000: Lightning Strikes an ASIC semiconductor plant of Philips in Albuquerque, New Mexico, USA
8:10 pm: Fire is extinguished. Plant will be down for months.

LESSON: RESPONSE SPEED
Mother Nature strikes
The Cell Phone Supply Chain

NOKIA

Shipment discrepancies noticed within 3 days.
Philips is pushed hard.
New supply sources.
New chip design.
Global capacity grab.

ERICSSON

Problem undiscovered for weeks.
Slow chain of command.
Slow response.
Capacity already taken.
$400M revenue loss.
Exits phone manufacture.

LESSON: RESPONSE SPEED