A Glimpse of the Status-quo of Supply Chain and Logistics Management

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Agenda

The Basics of SC&LM
Current Popular Topics
My Research Projects
- Risk Management
- Resilient Supply Chains
- Reverse Supply Chains
- RFID

Backup Supply Contracts to build flexibility and contingency
Overview

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Logistics Management
of Supply Chain and
A Glimpse of the Status-quo
Supply-chaining is a method of collaborating horizontally—among suppliers, retailers, and customers—to create value. Supply-chaining is both enabled by the flattening of the world and a hugely important flattener itself.

An Interesting Comparison

1844 - idea of coordinated logistics management
Jules Dupuit, a French engineer

1961 - first textbook
Physical Distribution: Problems of the Firm, by Smykay et al.

1962 - formation of the Council of Logistics Management (CLM)

1969 - supply chain management was established
Supply chain management courses dedicated to supply chain management first appeared in the literature

1996 - Supply Chain Council was established

1999 - first textbook
Introduction to Supply Chain Management, by Handfield and Nicholas

Important Flattener Isself

1. Basics of SC&LM

1. Basics of SC&LM
Business Logistics in a Firm

The Immediate Supply Chain for an Individual Firm
Supply Chain Stages

Supply Chain Flows

Suppliers → Manufacturer → Distributor → Retailer → Customer

- Capacity, promotion plans, delivery schedules
- Raw materials, intermediate products, finished goods
- Credits, consignment, payment terms, invoice
- Sales, orders, inventory, quality, production plans
- Returns, repairs, servicing, recycling, disposal
- Payments, consignment

Information

Material

Finance

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## The Eight Key Supply Chain Business Processes

| 1 | Customer Relationship Mgt |
| 2 | Customer Service |
| 3 | Demand Mgt |
| 4 | Order Fulfillment |
| 5 | Manufacturing Flow and Distribution Plan |
| 6 | Supplier Relationship Mgt |
| 7 | Product Development & Commercialization |
| 8 | Returns Mgt |

### Business Processes

**Customer Relationship Mgt**: Identify key customer segments, tailoring product & service agreements to meet their needs, measuring customer profitability, and building loyal customers.

**Customer Service**: Providing information to customers such as product availability, shipping dates, order status, and managing product & service agreements.

**Demand Mgt**: Balancing customer demand with the firm's output capacity; forecasting demand and coordinating with production, purchasing, and distribution.

**Order Fulfillment**: Meeting customer requirements by synchronizing the firm's marketing, production, and distribution.

**Supplier Relationship Mgt**: Managing supplier issues, establishing agreements with suppliers, developing close working relationships and flexibility to satisfy demand.

**Manufacturing Flow and Distribution Plan**: Determining manufacturing process requirements to enable the right mix of flexibility and velocity to satisfy demand.

**Product Development & Commercialization**: Developing new products frequently and getting them to market effectively; integrating suppliers & customers into the process to reduce time to market.

**Returns Mgt**: Managing returned products, reusing parts of the process to reduce time to market.

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Supply Chain Issues

Converting Objectives

Supply Chain Challenge 1:

1. Purchasing
   - Large quantities
   - Little variation in mix
   - Flexible delivery time
   - Stable volume requirements

2. Manufacturing
   - Long run production
   - High quality
   - High productivity
   - Long run production

3. Warehousing
   - Low inventory
   - Reduced transportation costs
   - Quick replenishment capability

4. Customers
   - Low prices
   - Enormous variety of products
   - High in stock
   - Short order lead time

Integration

Supply Chain Umbrella

Supply Chain Issues
Uncertainty is hard to deal with.

Supply Chain Challenge 2:
Matching supply and demand is difficult.

Supply Chain Challenge 3:
System Dynamics

The variability increases as we proceed upstream in the supply chain. This phenomenon is referred to as the bullwhip effect. Distortions in demand information can and do occur as we move further away from the end users along the supply chain. Demand is not the only source of uncertainty:

- Component availability
- Natural disasters
- Transportation times
- Yields
- Lead times

Inventory and back-order levels typically fluctuate widely. Forecasting doesn’t solve the problem.

The variability increases as we proceed upstream in the supply chain. This phenomenon is referred to as the bullwhip effect.
Supply Chain Challenge 4: Increased Globalization

<table>
<thead>
<tr>
<th>Perspective</th>
<th>1. Customer perception of supply chain value</th>
<th>2. Customer order response time</th>
<th>3. No. of customers contact points in the supply chain</th>
<th>4. No. of substitute technologies demanded by customers</th>
<th>5. Replenishment cycle time</th>
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<tbody>
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<td>Learning and Growth</td>
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<tr>
<td>Financial Perspective</td>
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<tr>
<td>Internal Business Process</td>
<td>1. Value-added time + total time in supply chain</td>
<td>2. No. of choices per order cycle time</td>
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<td></td>
<td></td>
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<tr>
<td>Customer Perspective</td>
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**Balanced Scorecard: Measuring Supply Chains**

1. Time between product finalization and customer delivery
2. No. of shared data sets / total data sets
3. No. of substitute technologies demanded by customers

**Key Challenges**

- Increased Globalization
- Added Complexities and Uncertainties
- Substantial Geographic Distances
- Substantially increased exchange rates and other macroeconomic uncertainties
- Added forecasting difficulties and inaccuracies
- Inadequate infrastructure
- Lack of local process equipment and technologies
- Supply availability and supplier quality
- Worker skill

**Improved Import-Export Process**

- Explosive dimensions of product variety in global markets
- Inadequacies in transportation & telecommunication infrastructure
- Lack of local process equipment and technologies
- Supply availability and supplier quality
- Worker skill

**Other Challenges**

- Financial Perspective
- Learning and Growth
- Internal Business Process
- Customer Perspective
2. Current Hot Topics in SCM

- Risk Management
- Resilient Supply Chains
- Reverse Supply Chains
- RFID

**Supply Chain Performance Measurement: SCOR Model**

<table>
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<th>Metrics</th>
<th>Perspectives</th>
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<tr>
<td><strong>Turns</strong></td>
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<tr>
<td>Days Net Asset Turns</td>
<td></td>
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<tr>
<td>Days Cash-to-cash Cycle Time</td>
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<tr>
<td>Days Total Inventory Days of Supply</td>
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<tr>
<td>Days Warranty cost as percentage of revenue</td>
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<tr>
<td>Dollar Value Added per Employee</td>
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<tr>
<td>Percentage Supply chain management cost</td>
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<tr>
<td>Days Update Production Flexibility</td>
<td></td>
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<tr>
<td>Days Supply chain response time</td>
<td></td>
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<tr>
<td>Percentage Perfect order fulfillment</td>
<td></td>
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<tr>
<td>Percentage Fill rate</td>
<td></td>
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<tr>
<td>Days Order fulfillment lead time</td>
<td></td>
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<tr>
<td>Percentage On-time delivery</td>
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<tr>
<td>Percentage On-time delivery</td>
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<tr>
<td>Days Order fulfillment</td>
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**Assets/Utilization**

- Days Cash-to-cash cycle time
- Days Total inventory days of supply
RFID is a means of automatic identification and data capture. It allows objects to communicate information about themselves automatically with no human intervention. RFID is ranked as the top 3 technologies in 2004 along with biometrics and nano robotics.

Listed as the top 3 technologies in 2004 are:
- People (access management, mass transit ticketing, passport, etc.)
- Objects (supply chain management, anti-counterfeiting, etc.)
- Technology to identify themselves automatically with no human intervention.

A similar technology, the IFF transponder, was invented in 1939. Mario Cadullo's US Patent in 1973 was the first true ancestor of modern RFID. A demo of today's reflected power RFID tags was done at the Los Alamos Scientific Lab in 1973. An early work exploring RFID is the landmark 1948 paper by Harry Stockman. The first patent to be associated with the abbreviation RFID was granted to Charles Walton in 1983.
RFID Components

How RFID Systems Work

- RFID tag gets into reading device's electromagnetic field
- IC in return transmits the data stored in the tag which can be re-written or deactivated
- Reader also passes the information to the host system
- IC in return can be connected into the Internet or company's ERP system
- Host system can be connected into the Internet or company's ERP system

Passive RFID Read/Write

-Tag
-IC
-Antenna

Active

-Tag
-IC
-Antenna

No internal power source

-IC (integrated circuit) provides the memory and stores data

Antenna – harvests power & communicates with the reader

Indy/inlet – IC and antenna assembled together for insertion

RFID tag – an inlet converted in a way that it can be applied to an object
Current Uses

- Passports
- Transport payments
- Automotive
- Product tracking
- Animal identification
- RFID in inventory systems
- Human implants
- RFID in libraries

Impact of RFID on SCM

- RFID as a key enabler for improved SCM
- The use of RFID ranges from asset tracking to cashless payment to homeland security
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- This emerging technology for identifying and tracking objects which holds many promises for closing the time-lag gaps in information transfer for improving supply chain operation productivity.

- RFID in inventory systems
- Reduce inventories $117-$293 billion
- Increase sales $83-$166 billion

- Connecting, collaborating and synchronizing with the extended supply chain
- RFID as a key enabler for improved SCM
- The use of RFID ranges from asset tracking to cashless payment to homeland security
- This emerging technology for identifying and tracking objects which holds many promises for closing the time-lag gaps in information transfer for improving supply chain operation productivity.
Tag Costs by Applications

A study reported in 2005 shows that the application of RFID for high-volume and low-margin goods will probably arise only when the tag cost falls to 5 cents from its present level of about 20 cents.


The RFID Market
Research: RFID Economics

- In cost-benefit analysis, the following factors and trade-offs must be considered (2005):
  - Active versus passive RFID
  - Modulation schemes
  - Level coding versus transition coding
  - Governmental regulations
  - Power and bandwidth
  - Minimizing or maximizing tag information
  - Overall cost and its components (tag, reader, software, etc.)
  - Security

- Controversy
  - Human implantation
  - Religious opinion

- Privacy

- Reliability

- Data transfer and compatibility

- Environment

- Surface to which the tag is attached


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Research: RFID Implementation

- Security
- Privacy
- Controversy
- Human implantation
- Religious opinion
- Data transfer and compatibility
- Reliability
- Environment
- Surface to which the tag is attached
(2) Reverse Supply Chain

Open-loop Supply Chain

The Closed-loop Supply Chain

Total value estimated at $100B per year in the US!!
Processes in Reverse Supply Chains

1. Product acquisition: obtaining the used product from the user.
2. Reverse acquisition: collecting the used products.
3. Reverse logistics: transporting the products to a facility for a secondary market.
5. Production: remanufacturing or refurbishing to original specifications.

Additional processes: inspecting, sorting, and disposition; assessing the condition of the product; returning used products; and making decisions for reuse.


Research Stream: Remanufacturable Products

- Previous research on remanufacturing and competition.
- Remanufacturing is a production strategy whose goal is to recover the residual value of used products by reusing components that are still functioning well.

Literature on Remanufacturing

- Focus is on finding cost-effective operating policy or system design.
- Issues include disassembly, reverse logistics network design, inventory control, MRP, scheduling, and shop floor control.
- Price, demand rate, and remanufacturability are assumed to be exogenous, and consumers do not differentiate between new and remanufactured products.

New Research Questions

- Is producing a remanufacturing product profitable?
- What if consumers are heterogeneous in their willingness to pay and they value the remanufactured products less than new ones?
- Does the opportunity to reach low-end consumers outweigh the high cost of producing a remanufacturable product?
- What are the key drivers determining the profitability of offering a product portfolio?
- What are the key drivers determining the profitability of offering a remanufacturing product portfolio?
Research Stream 2: Reverse Supply

Reverse SC design is a tradeoff between speed and cost efficiency. The Centralized Model is efficient in supply chains. The Marginal Value of Time (MVT) influences the decision on how to handle returned products.

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Postponement vs. Preponement

Postponement, or delayed product differentiation, has been used as an effective strategy for dealing with the cost of variety in forward supply chains. In the reverse supply chain, there are significant time advantages to early, rather than late, process.

Responsive Supply Chains: the Decentralized Model

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Other Decision Drivers

Return rates vary widely by product category, by season

Return rates of different product categories and the cost of processing returns:

- Returns may cost as much as three to four times the cost of outbound shipments.

- The issue of how to extract value from the returns stream is largely ignored.

- Return rates tend to be considerably higher in North America due to differences in customer satisfaction and retailer return policies.

- Return percentages are typically higher for Internet and catalogue sales, from 5-9% for hard goods to up to 35% for high fashion apparel and across global markets.

Implications from Research

Companies with high return rates and considerable recoverable value should seriously consider redesign their return networks from a focus on centralization to a focus on decentralization and responsiveness (speed, flexibility, design).

Other Important Issues

- Treat returns as perishable assets
- Elevate the priority of the returns process: close the loop on the supply chain
- Make time the essential performance metric
- Reduce false returns
- Coordination: manufacturer and retailer collaborate to achieve speed at lower cost
- Use time value to design the right supply chain
- Use technology to achieve speed at lower cost
- The efficient-responsive tradeoff

Implementation

Resilient Supply Chains

- What: the ability to bounce back from disruptions
- Disruptions to normal activities
- Gaps between supply and demand

Two Categories of Risks

- Resilience
- Resilient Supply Chains

(3) Resilient Supply Chains

Two categories of risks

- Gaps between supply and demand
- Disruptions to normal activities
- Resilience

Recovering flexibility creates completeness
Creating redundancy costs

How?

Research

- Use technology to achieve speed at lower cost
- Use time value to design the right supply chain
- Make time the essential performance metric
- Elevate the priority of the returns process: close the loop on the supply chain
- Treat returns as perishable assets

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Building the Resilience

- The 5 Facets of Flexibility
  - Supply and procurement
    - single versus multiple sourcing
  - Conversion:
    - using standard processes
    - having multiple locations with built-in interoperability
  - Distribution and customer facing activities:
    - Customer vulnerability – fair allocation
    - Postponement
    - An opportunity to deepen the relationship with customers
  - Control systems: to detect and to foster speedy corrective actions
  - Right culture
    - Distribute decision-making powers efficiently
    - Empower front-line employees to take initiatives

(4) Risk Management

![Risk Management Diagram]

- Supply Risk
- Link Risk
- Operations/Process Risk
- Demand Risk
- Inbound Logistics
- Outbound Logistics
- Reverse Logistics
Uncertainty vs. Risk vs. Disruption

- **Uncertainty**: A mismatch between information processing needs and information processing requirements.
- **Risk**: Uncertainty and loss/damage.
- **Disruption**: A special case of loss/damage, often arising from natural disasters, strikes, acts of purposeful agents, including terrorists, and economic disruptions.

Risk/Disruption Factor

- Probability of occurrence
- Magnitude of impact
- Extent of recovery
- Detection lead time
- Detection difficulty
- Detection lead time
- Extent of supply chain configuration
- Magnitude of recovery
- Investment required to return to pre-occurrence levels
- Effect of investment required to being aware of the occurrence
- Lag time between occurrence and risk or an actual issue
- Ability to perceive a potential risk or an actual issue
- Extent of supply chain and well-being of the organization
- Severity of effect on financial well-being of the organization
- Probability of occurrence (likelihood)

A Disruption Profile

- How to avoid or mitigate disruptions effectively?
- Chain’s susceptibility to disruptions?
- What are the characteristics that increase a supply chain’s susceptibility to disruptions?
- Why are some supply chains more exposed to disruptions than others?
- Why do some supply chains have more disruptions than others in the same industry?
- Why do some supply chains have more disruptions than others in the same market?
- What are the available methodologies?
  - Supply Chain (Which?)
  - Company
  - Plant
  - Line
  - Machine
- Level of Analysis?

How to Study Disruptions?

- Outcomes of disruptions: Performance Impact
- Characteristics of disruption: Frequency and Scale
- Time when disruption occurs:
- Types of disruption: Predictable vs. Unpredictable
- Location of disruption: Source, make and deliver
- Combination
- Causes of disruptions: Human, System, or
- Sources of causes: Intemal vs External

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- Level of Analysis?
Challenges

- Costs versus benefits. Some firms may express concerns regarding the requisite costs associated with these robust strategies.
- Strategic fit. Even though these robust strategies enhance a firm’s capability to manage supply and demand better, they may not fit the firm’s overall business competitiveness.
- Proactive execution. A robust strategy is useless unless a firm can execute the strategy in a proactive manner.

Risk Mitigation Strategies

3. My Research on SCRM

New

- The power of substitutability in product line and management
- Contingency for supply chain disruption
- Backup supply contracts to provide flexibility and supply disruptions
- Single versus dual sourcing in the presence of
- Using standby suppliers to cope with supplier risks

Previous

- Optimal supply base in the presence of risks
- Using stochastic financial returns
- With deterministic financial terms

Overview

- The power of substitutability in product line and management
- Contingency for supply chain disruption
- Backup supply contracts to provide flexibility and supply disruptions
- Single versus dual sourcing in the presence of
- Using standby suppliers to cope with supplier risks
- Optimal supply base in the presence of risks

- Using stochastic financial returns
- With deterministic financial terms

Approaches (Accenture)

Supply Chain Risk-Mitigation

Mature

- Supply base
- Diversified
- Geographically dispersed
- Internationally distributed
- Establishing an

Developing

- Increased inventory levels
- Struggles with hedging
- Forward strategies
- Sourcing
- Contingent suppliers and providers
- Logistics providers
- Management program

Motivation: Observations from Industrial Practices

Nokia versus Ericsson

As a result of the 2000 fire that shut down the Philips Semiconductor plant, Nokia lost all of its supply from the plant, but it was able to transiently increase production at one of its other suppliers. In contrast, Ericsson has been "weeding out backup suppliers for many parts", and consequently "did not have a Plan B" and suffered a 4% decline in revenues (and lost over $100 million) while Chiquita increased revenues by 4% in the fourth quarter of 1998 (Curtis-Brown, 2003). Ericsson, however, was able to rely on temporary production at some of its other suppliers while Chiquita, on the other hand, suffered a 4% decrease in revenues.

Motivation: Observations from Industrial Practices

Flexible Supply Base

- Increase supply flexibility
- Improves capability to manage supply under normal circumstances
- Enables a firm to shift production among suppliers promptly after a major disruption
- To build such a supply base, many firms enter different supply contracts; however, existing supply contracts are all focused on the coordination and collaboration between downstream supply chain partners, that is, retailers/wholesalers (buyers) and manufacturers (suppliers). Existing contracts are all focused on the coordination and supply contracts; however, existing contracts are all focused on the coordination and collaboration between downstream supply chain partners, that is, retailers/wholesalers (buyers) and manufacturers (suppliers).
Combining strategic options selectively

| Immediate purchase | Portfolio |
| Spot market |
| Prepay for the option to purchase | Strategic |
| Prepay commitment made in advance |
| Long-term |
| Discounted wholesale price | Non-strategic |
| Buyer agrees to pay some agreed-upon price for any unnot |
| Purchase by the distributor |
| Buyer agrees to pay some agreed-upon price for any unnot |
| Inventory, for meeting urgent sales |
| Full refund for a limited number of unsold goods |
| Quantity-flexibility |
| Price |
| Revenue-sharing |
| Buy-back |

**Characteristics**

**Category**
Research Questions/Objectives

Impacts of environmental factors: A number of environmental factors will be taken into consideration. In particular, we plan to explore more sophisticated modeling frameworks to describe the disruption profile and buyer's demand profile, and seek to examine their impacts on the contract design.

Existing contracts for disruption management: How can these contracts be adapted and modeled for mitigating disruption risks?

New forms of backup supply contracts: We are interested in designing new forms of contracts by integrating the concepts and elements of best practices, such as vendor-managed inventory strategies, make-to-order, and product substitution, and strategic inventory/stock tactics.

Contract design framework and implementation guidelines: To provide a unified framework for designing backup supply contracts to help companies create flexibility and contingency in mitigating disruption risks and to provide guidelines for implementing each contract form given the firm's environmental conditions.