Supply Chain Trends and Consequences

- The trend towards reducing costs: has resulted in the globalization of supply chains, making supply chains more vulnerable and complex.

  - The trend towards outsourcing non-core business activities: has resulted in loss of control when it is most needed.

  - The trend towards just-in-time and lean practices: has resulted in efficiency rather than effectiveness.

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Examples of Supply Chain Failures

There are many vivid examples of supplier failures, due to natural disasters, and associated supply chain disruptions.

• A classic example is the Royal Philips Electronics cell phone chip manufacturing plant fire, due to a lightning strike on March 17, 2000, and subsequent water and smoke damage, which adversely affected Ericsson, which, unlike Nokia, did not have a backup, and suffered a second quarter operating loss in 2000 of $200 million in its mobile phone division.

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- Boeing, facing challenges with its 787 Dreamliner supply chain design and numerous delays, ended up having to buy two suppliers for $2.4 billion because the units were underperforming in the chain.
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Which Suppliers Matter the Most?

Figure: The Multitiered Supply Chain Network Topology
Risk is often defined as

\[ RISK = f(\text{Probability, Consequences}). \]

Hence, risk is the combination of the probability of an event and its consequences/impacts.
Risk in the context of supply chains may be associated with the production/procurement processes, the transportation/shipment of the goods, and/or the demand markets.
Supply Chain Risk Management

Such supply chain risks are directly reflected in firms’ financial performances, and priced in the financial market. For example, it has been estimated that the average stock price reaction to supply-demand mismatch announcements was approximately -6.8%. In addition, supply chain disruptions can cause firms’ equity risks to increase by 13.50% on average after the disruption announcements.

Supply chain risk management is the intersection of supply chain management and risk management.
Some Research Articles on Risk Modeling and Supply Chains


See the Virtual Center for Supernetwork website; http://supernet.isenbg.umass.edu for other articles.
Figure: The Basic Constructs of Supply Chain Risk Management

Categorization of Risk

There have been different ways proposed of categorizing risk:

• High-Impact Low-Likelihood (sometimes called Black Swan events)— Low-Impact High-Likelihood
• Environment-Organization-Network
URL is http://www.youtube.com/watch?v=Zqo4MidIK28

Click on underlined text:

Mr. Patrick Dixon, futurist, on High-Impact events
The Risk Matrix

Supply Chain Risk Management

Figure: Risk Sources in Supply Chains

Supply Chain Risk Management – Environmental Risk Sources

**Environmental risk sources** consist of any uncertainties arising from the supply chain and environmental interactions.

These may be the result of accidents (such as fires, explosions, etc.), man-made (terrorist attacks), or natural disasters (earthquakes, tsunamis, and other extreme weather events).
Organizational risk sources lie within the scope of the boundaries of the supply chain parties and include labor issues such as strikes, production uncertainties (quality and machine failures) to IT-based uncertainties.
Network-related risk sources arise from interactions between the organizations involved in the supply chain.
Supply Chain Risk Management – Network-Related Risk Sources

• Lack of Ownership

Lack of ownership risk sources is due from the blurring of boundaries between suying and supplycing companies in the chain. With outsourcing, there may be confused lines of responsibility.

• Chaos

There may be chaos effects in a supply chain due to mistrust, overreaction, and distorted informaion.

• Inertia

Such risks are due to a lack of responsiveness to changing environmental conditions and market signals. Flexibility may be sacrificed, especially in global supply chains, where they may be an emphasis on cost reduction.
Supply Chain Risk Management – Adverse Risk Consequences

Risk may have adverse consequences that can be measured ex post through performance indicators. 

Ex ante they are captured in the variances of the indicator components. 

Three of the most important adverse consequences are:

1. Financial consequences
2. Health and safety negative impacts
3. Reputation damage.
### Supply Chain Risk Management – Drivers of Risk

<table>
<thead>
<tr>
<th>Category of Risk</th>
<th>Drivers of Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disruptions</strong></td>
<td>- Natural disaster  &lt;br&gt; - Labor dispute  &lt;br&gt; - Supplier bankruptcy  &lt;br&gt; - War and terrorism  &lt;br&gt; - Dependency on a single source of supply as well as the capacity and responsiveness of alternative suppliers</td>
</tr>
<tr>
<td><strong>Delays</strong></td>
<td>- High capacity utilization at supply source  &lt;br&gt; - Inflexibility of supply source  &lt;br&gt; - Poor quality or yield at supply source  &lt;br&gt; - Excessive handling due to border crossings or to change in transportation modes</td>
</tr>
<tr>
<td><strong>Systems</strong></td>
<td>- Information infrastructure breakdown  &lt;br&gt; - System integration or extensive systems networking  &lt;br&gt; - E-commerce</td>
</tr>
<tr>
<td><strong>Forecast</strong></td>
<td>- Inaccurate forecasts due to long lead times, seasonality, product variety, short life cycles, small customer base  &lt;br&gt; - “Bullwhip effect” or information distortion due to sales promotions, incentives, lack of supply-chain visibility and exaggeration of demand in times of product shortage</td>
</tr>
</tbody>
</table>
### Supply Chain Risk Management – Drivers of Risk

<table>
<thead>
<tr>
<th>Category of Risk</th>
<th>Drivers of Risk</th>
</tr>
</thead>
</table>
| Intellectual Property | - Vertical integration of supply chain  
- Global outsourcing and markets |
| Procurement | - Exchange rate risk  
- Percentage of a key component or raw material procured from a single source  
- Industrywide capacity utilization  
- Long-term versus short-term contracts |
| Receivables | - Number of customers  
- Financial strength of customers |
| Inventory | - Rate of product obsolescence  
- Inventory holding cost  
- Product value  
- Demand and supply uncertainty |
| Capacity | - Cost of capacity  
- Capacity flexibility |

# Supply Chain Risk Management – Mitigation Strategies

<table>
<thead>
<tr>
<th>Mitigation Strategy</th>
<th>Disruptions</th>
<th>Delays</th>
<th>Forecast Risk</th>
<th>Procurement Risk</th>
<th>Receivables Risk</th>
<th>Capacity Risk</th>
<th>Inventory Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add capacity</td>
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<td>Add inventory</td>
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<tr>
<td>Have redundant suppliers</td>
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<tr>
<td>Increase responsiveness</td>
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<tr>
<td>Increase flexibility</td>
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<tr>
<td>Aggregate or pool demand</td>
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<tr>
<td>Increase capability</td>
<td></td>
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<tr>
<td>Have more customer accounts</td>
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</tbody>
</table>

According to Juttner, Peck, and Christopher (2003) risk mitigation strategies are:

- **Avoidance**
  - Dropping specific products / geographical markets, etc.

- **Control**
  - Vertical integration, increased stockpiling, maintaining excess capacity in production, storage, etc., and composing contractual obligations on suppliers

- **Cooperation**
  - Joint efforts to improve SC visibility, the sharing of risk-related information, and preparation of SC continuity plans

- **Flexibility**
  - Postponement, multiple sourcing, localized sourcing
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Companies can explore their risk through the investigation of various possible scenarios to stress test the supply chains. They can then prioritize and work on mitigating the risks.
## Supply Chain Risk Management – Stress Testing the Supply Chain

<table>
<thead>
<tr>
<th></th>
<th>Supplier-Related</th>
<th>Internal</th>
<th>Customer-Related</th>
</tr>
</thead>
</table>
| **Disruptions**          | • Supplier of a key part shuts down plant for a month or at a key part of the production cycle  
                          | • Supplier capacity drops by 20% overnight                                        | • Key plant shuts down unexpectedly for one month                              | • Demand goes up by 20% ... for all products  
                          |                                                                                 | • Capacity at a key plant drops by 20% overnight                                  | ... for a key product  
                          |                                                                                 |                                                                         | ... across the board  
                          |                                                                                 |                                                                         | • Demand goes down by 20% under conditions above |
| **Delays**               | • Purchase orders of key parts or raw materials delayed by month                  | • Distribution or production orders delayed by a month                    | • Customer orders delayed by a month                                             |
| **Systems**              | • Supplier's order-entry system goes down for a week                             | • Key customer's procurement system inside your company goes down for a week  
                          |                                                                                 | • Company's inventory/accounts system goes down for a week                     | • Order entry system not working for a week  
                          |                                                                                 |                                                                         | • Key customer's procurement system inside your company goes down for a week  
                          |                                                                                 |                                                                         | • Credit card information stolen from hacked e-commerce system |
| **Information Processing** | • Supplier rations supplies by 20%  
                          | • Supplier increases minimum order size by 20% then 100%                           | • To take advantage of volume discounts, company begins to order in quantities twice as large as usual, but half as frequently, which impacts supplier's ability to forecast | • Key customer begins to order in batches that are twice as large as usual but less frequent (the impact of forecasting) |
| **Intellectual Property** | • Key supplier redesigns parts and creates own product                            | • To take advantage of volume discounts, company begins to order in quantities twice as large as usual, but half as frequently, which impacts supplier's ability to forecast | • Key customer begins to order in batches that are twice as large as usual but less frequent (the impact of forecasting) |
| **Procurement**          | • Supplier delays in processing returns by twice as long  
                          | • Supplier forced to increase price of key components by 20%  
                          | • Unforeseen cash squeeze requires month-long delays in paying key suppliers   | • Unforeseen cash squeeze requires month-long delays in paying key suppliers   |
## Supply Chain Risk Management – Tailored Strategies

<table>
<thead>
<tr>
<th>Mitigation Approach</th>
<th>Tailored Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Increase Capacity</strong></td>
<td>- Focus on low-cost, decentralized capacity for predictable demand.</td>
</tr>
<tr>
<td></td>
<td>- Build centralized capacity for unpredictable demand. Increase decentralization as cost of capacity drops.</td>
</tr>
<tr>
<td><strong>Acquire Redundant Suppliers</strong></td>
<td>- Favor more redundant supply for high-volume products, less redundancy for low-volume products.</td>
</tr>
<tr>
<td></td>
<td>- Centralize redundancy for low-volume products in a few flexible suppliers.</td>
</tr>
<tr>
<td><strong>Increase Responsiveness</strong></td>
<td>- Favor cost over responsiveness for commodity products.</td>
</tr>
<tr>
<td></td>
<td>- Favor responsiveness over cost for short lifecycle products.</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
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<th>Tailored Strategies</th>
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<tbody>
<tr>
<td>Increase Inventory</td>
<td>- Decentralize inventory of predictable, lower-value products.</td>
</tr>
<tr>
<td></td>
<td>- Centralize inventory of less predictable, higher-value products.</td>
</tr>
<tr>
<td>Increase Flexibility</td>
<td>- Favor cost over flexibility for predictable, high-volume products.</td>
</tr>
<tr>
<td></td>
<td>- Favor flexibility for low-volume unpredictable products.</td>
</tr>
<tr>
<td></td>
<td>- Centralize flexibility in a few locations if it is expensive.</td>
</tr>
<tr>
<td>Pool or Aggregate Demand</td>
<td>- Increase aggregation as unpredictability grows.</td>
</tr>
<tr>
<td>Increase Capability</td>
<td>- Prefer capability over cost for high-value, high-risk products.</td>
</tr>
<tr>
<td></td>
<td>- Favor cost over capability for low-value commodity products.</td>
</tr>
<tr>
<td></td>
<td>- Centralize high capability in flexible source if possible.</td>
</tr>
</tbody>
</table>

More on Risk Reduction

URL is http://www.youtube.com/watch?v=QlZ6TyUaYpw

Click on underlined text:
Professor Wilding of Cranfield University
Which Supply Chain Risk Management Strategies Are Relevant to Humanitarian Operations?
<table>
<thead>
<tr>
<th>Risk sources</th>
<th>Business logistics</th>
<th>Humanitarian relief operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental</td>
<td>Natural disasters create complex operating conditions</td>
<td></td>
</tr>
<tr>
<td>Organisational</td>
<td>Natural disasters affect labour, communication, and transportation</td>
<td></td>
</tr>
<tr>
<td>Supply-chain related</td>
<td>Interaction between many different humanitarian organisations</td>
<td></td>
</tr>
<tr>
<td>Risk consequences</td>
<td>Financial consequences</td>
<td>Risk of losing lives</td>
</tr>
<tr>
<td>Risk drivers</td>
<td>Focus on efficiency rather than effectiveness</td>
<td>More attention to efficiency and accountability</td>
</tr>
<tr>
<td>Globalisation of supply chains</td>
<td>Globalisation of humanitarian supply chains</td>
<td></td>
</tr>
<tr>
<td>Focussed factories and centralised distribution</td>
<td>Centralisation of most distribution</td>
<td></td>
</tr>
<tr>
<td>Trend of outsourcing</td>
<td>Outsourcing of transportation</td>
<td></td>
</tr>
<tr>
<td>Reduction of supplier base</td>
<td>Not mentioned in literature</td>
<td></td>
</tr>
<tr>
<td>Strategies</td>
<td>Avoidance</td>
<td>Avoidance of suppliers due to risk</td>
</tr>
<tr>
<td>Control</td>
<td>• Prepositioning inventory</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Excess capacity in storage, handling and/or transport</td>
<td></td>
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<td></td>
<td>• Contracts with suppliers</td>
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<tr>
<td></td>
<td>• Warning tools</td>
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<tr>
<td>Cooperation</td>
<td>• Collaboration of key players in the humanitarian operations</td>
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<tr>
<td>Flexibility</td>
<td>• Postponement</td>
<td></td>
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<tr>
<td></td>
<td>• Multiple sourcing</td>
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</tr>
<tr>
<td></td>
<td>• Localised sourcing</td>
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⇒ D. Li and A. Nagurney, 2014. Supply Chain Performance Assessment and Supplier and Component Importance Identification in a General Competitive Multitiered Supply Chain Network Model, Isenberg School of Management, UMass Amherst.
