International Crisis Hits the Supply Chain: The Japan Disaster

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James B Rice, Jr.
Deputy Director, MIT Center for Transportation and Logistics (CTL)
Cambridge, MA

jrice@mit.edu
W 617.258.8584

Agenda

• Foundation on Supply chain risk management → resilience

• Review of earthquake/tsunami disaster impact

• Learnings and suggestions going forward
**Foundation of SC Risk Management Resilience**

- Supply chains today – global, complex, vulnerable
- High Consequence-Low Probability disruptions have quantifiable business impact
  - They are frequent enough that they are not low probability
- Enterprise vulnerability: strategic, financial, operational, hazard
- Disruption Profile
- Vulnerability Map for a single company
- SC Resilience Principles: assess vulnerabilities and mitigate, reduce probabilities, then focus on failure mode prep
  - FMIs – supply, transp, personnel, financial, internal ops, comms
- Fail smartly – flexibility and redundancy
- Many pathways to flexibility

**Enterprise Vulnerability**

- Financial Risk:
  - Interest Rate Fluctuations
  - Tax Law Changes
  - Credit Default
  - Loss of IP
- Strategic Risk:
  - Ethics Violation
  - Technology Decisions
  - Mkt Share Battles
  - Labor Relations
- Hazard Risk:
  - Cargo Losses
  - Earthquake
  - Wildfire
  - Product Liability
  - Facility Loss
- Operations Risk:
  - Theft
  - Key Supplier Loss
  - Utility Failure
  - Denial of Service Attack
- Ref: Dr. Debra Elkins, General Motors
The Disruption Profile

Vulnerability Map (for a single company)

SC Resilience Principles

- **Business Continuity Planning (BCP)**
  - Design to ‘fail smartly’ – the system WILL fail; plan to fail so that the damage is not crippling
  - “Options” thinking and planning

- **Failure Mode Analysis**
  - Focus on recovery from Failure Mode, not risk type/source

- **Design for Supply Network Resilience**
  - Ability of system to sustain and recreate itself after disruption
  - Achieve through Flexibility and Redundancy

- **Flexibility**
  - Responding through actions that entail prior investments in infrastructure and capabilities

- **Redundancy**
  - Responding through actions that entail prior investments in capital and capacity that may not be used

Supply Chain Failure Modes/Core Capacities

All disruptions result in one or more of these capacity losses for a period of time:

- Capacity to acquire materials (supply)
- Capacity to ship/transport
- Capacity to communicate
- Capacity to convert (internal operations)
- Availability of human resources (personnel)
- Financial flows (e.g. demand)
Many Pathways to Flexibility

- Flexibility through interchangeability
  - Standard facilities (Intel, GM)
  - Standard parts (Dell, Lucent SCN, Southwest Airlines)
  - Standard processes (Helix, UPS)
- Flexibility through postponement (Benetton, H-P)
- Flexibility through supply (Jabil, Lucent, Toyota)
- Flexibility through distribution (Caterpillar, Dell)
- Flexibility through flexible culture
  - Awareness of risks, tradeoffs
  - Early warning systems (Nokia)
  - Educate for awareness
  - Train for response (Intel)
  - Distributed decision-making (P&G, UPS)
  - Open and unconstrained communication (Dell)


Considering the Japan quake and tsunami...

- Do these principles still hold?
- What is new?
- What can we learn from the Japan case?
Considering the Japan quake and tsunami...

- Do these principles still hold?
  - Yes!

- What is new?
  - Awareness of supplier hub vulnerabilities
  - Dependence on niche suppliers in distant tiers
  - Triple disruption – quake, tsunami, nuclear plant failure but ONE OUTCOME – loss of capacity
    - Multiple disruptions are not new – Katrina and levee break
  - Scope is the same (global), scale of impact is greater
  - This really wasn’t different than any other disruption aside from the number of companies affected

- What can we learn from the Japan case?

First lets recap – What happened?
What happened: company response?

- Emergency Response Centers (ERC) activated & Business Continuity Plans (BCP) exercised
  - “Broken field running”
  - GM – 100s join response tm, 80 visit suppliers in Japan
  - Industry groups collaborate: SCRLC
  - Daily adjustments depending on facility, supply, utility avail
  - Moving operations outside of affected area
  - Resupply from non-traditional sources
  - Allocating inventory to high-margin products until resupply
  - Working with suppliers: resources & collaboration to restart
- Those without ERCs and BCP searching for back-up
  - Searching after a disruption is not the best time to be setting up back-up options

What happened: business impacts?

- **Primary impacts** – local ops damaged, personnel lost, comms lost
  - Automotive finished vehicles & parts (esp. engine air flow sensors & engines): Honda, Toyota, Nissan, Mazda
  - High tech: semiconductors, technology (e.g. LCD, silicon wafers, rechargeable batteries, DRAM, NAND, digital cameras): Sony, Hitachi, Shin-Etsu, SUMCO, Toshiba, Nikon, Fujitsu
  - Pharmaceuticals (insulin, penicillin): Novo Nordisk, GSK, Roche

- **Secondary impacts** – downstream customers suffered loss of supply from primary impacts causing shutdowns
  - Retailers and downstream customers working off inventories, slowdowns
  - Factories in Japan shuttered to conserve power
  - Unreliable utilities (power, water) continue to impact operations

- **Discovery of critical dependence**
  - Niche suppliers in lower tiers (Hitachi engine airflow sensors, Renesas drive train microprocessors, Mitsubishi Gas BT resin)
Business Impacts: Capacity Losses

<table>
<thead>
<tr>
<th>Company</th>
<th>Product</th>
<th>Initial Impact Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>iPad 2</td>
<td>Key component suppliers shutdown (NAND flash memory, touch screens, iPad batteries)….</td>
</tr>
<tr>
<td>GM</td>
<td>Autos</td>
<td>US plant closed because lack of supply of engine airflow sensors</td>
</tr>
<tr>
<td>Hitachi</td>
<td>Airflow sensor</td>
<td>Plant damaged; makes 60% of global supply of airflow sensors</td>
</tr>
<tr>
<td>Honda</td>
<td>Autos, parts</td>
<td>Dependend on 10 suppliers in radiation zone; Closed component &amp; assembly plants; expect to lose 16,500 units; lost contact with 44 of 113 suppliers ….</td>
</tr>
<tr>
<td>Mazda</td>
<td>Autos, parts</td>
<td>Plants closed; some to be closed until April</td>
</tr>
<tr>
<td>Nikon</td>
<td>SLR cameras</td>
<td>Plant closed; only plant making SLR cameras</td>
</tr>
<tr>
<td>Nissan</td>
<td>Autos, engines</td>
<td>Facility closed; lack water, electricity &amp; gas to operate. May send engines from Tennessee plant to Japan.</td>
</tr>
<tr>
<td>Renesas</td>
<td>Drive train microcontroller</td>
<td>Facility closed; lost 40% capacity …. Expects to return to 100% capacity by October, restart in June, using 3P foundries TSMC</td>
</tr>
<tr>
<td>Shin-Etsu Chemical</td>
<td>Silicon wafers</td>
<td>World's largest maker of silicon wafers disrupted; 57% of world's wafers come from Japan</td>
</tr>
<tr>
<td>Toyota</td>
<td>Autos</td>
<td>Shutdowns across all TMC plants. Original est loss of 140,000 units; 50-70% capacity by June, 300 part shortages…. Now expect 100% by Nov &amp; 90% in Japan in June (up from 70% 2 wks ago). Lost 900,000 units thru May.</td>
</tr>
</tbody>
</table>

Tier 3 & 4 suppliers put Apple (& others) at risk

<table>
<thead>
<tr>
<th>Company</th>
<th>Apple</th>
<th>FoxConn (Hon Hai)</th>
<th>ASE or SPIL</th>
<th>Kinsus or Unimicron</th>
<th>Electrotechno (Mitsubishi Gas Chemical sub)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>iPad 2</td>
<td>Assemble product</td>
<td>Chips (TSMC) to substrate, to PCB</td>
<td>Use BT to make IC substrate</td>
<td>Manufacture bismaleimide triazine BT resin</td>
</tr>
<tr>
<td>Location</td>
<td>Retail</td>
<td>China</td>
<td>Taiwan</td>
<td>Taiwan</td>
<td>Fukushima, Japan</td>
</tr>
</tbody>
</table>

- Electrotechno in Fukushima produces ~50% of global BT resin supply
- Kureha in Iwaki makes 70% of global supply of PVDF
Hitachi airflow sensor in Mazda D23

$2 sensor in $90 airflow unit

Tier 1-2-3 suppliers put GM (& others) at risk

<table>
<thead>
<tr>
<th>Company</th>
<th>GM</th>
<th>GM Engine Plant</th>
<th>Hitachi Automotive Syst</th>
<th>Hitachi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>Trucks &amp; Cars</td>
<td>Engines</td>
<td>Mass airflow sensor units</td>
<td>Sensor</td>
</tr>
<tr>
<td>Location</td>
<td>Shreveport LA</td>
<td>Buffalo, NY</td>
<td>Sawa/Ibaraki, Japan</td>
<td>Japan</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Company</th>
<th>Auto OEMS</th>
<th>Various</th>
<th>Renesas Electronics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>Trucks &amp; Cars</td>
<td>Drive train</td>
<td>Microcontroller chip</td>
</tr>
<tr>
<td>Location</td>
<td>Global assembly</td>
<td>Various</td>
<td>Naka/Ibaraki, Japan</td>
</tr>
</tbody>
</table>

- Hitachi airflow sensors affecting Nissan, PSA, Ford, VW, Renault, GM. Hitachi makes 60% of global supply of airflow sensors
- Renesas is world's largest maker of microcontrollers, 30% share
Some current thinking

- Outages due to electricity shortages expected
- Many local companies expect impact on earnings thru 3-4Q
- Toyota shifting ratio of overseas vehicle assembly
- Criticism of geo supply concentration, JIT
- Got lucky: 1Q is slow period & chip mfrs build inventory, had 80+ DOI (9 days more than 1Q 2010), added 2-4 wk buffer
- Moody’s – Japan earthquake and tsunami have little impact on companies outside Japan
- Two other more vulnerable geos
  - Pearl River Delta in China – conc electr systems & parts mfrs
  - Taiwan – semiconductors
- Suggestion – portfolio SC, risk is spread across geos, technologies, suppliers

What will happen?

- Still some unanticipated disruptions in the coming weeks/months in downstream supply chains
  - Not limited to automotive & high tech industries
- Japan is not the world’s leading supplier
  - Japan is 8th largest supplier... Imagine if this occurred in China?
- Expect some costs to increase (electricity)
- Growth opportunities
  - For those firms that fill the void left by lost capacity
- Resilience and risk management will matter to many
  - But only for a little while; only a subset will take action
  - Will your company act now to prepare for the next disruption?
- Wisdom of JIT & Lean practices are being challenged
  - But the advantages are so high and downsides can be mitigated
- Soft earnings & growth will be blamed on Japan, true or not
What should companies do?

- Seize the moment: get senior exec support for risk mgt action
- Develop back-up plans
  - ‘Business continuity plans’ (BCP) focused on restoring lost capacities
  - Failure mode focus (the limited set of core capacities)
- Identify full supply chain network (Tier 1, 2, 3, etc.) & risks
  - Who are my suppliers?
  - Assess geographical risk (Are my suppliers all located in the same geo?)
  - Assess organizational risk (Are we sole sourced?)
  - Assess embedded risk (Are my various suppliers all dependent on a common material source?)
- What are the probabilities & consequences of loss
  - Reduce probability of disruption through preventative measures
  - Reduce consequences through mitigation measures: resilience
  - Choose balanced mix of redundancy & flexibility
- More aggressively manage risk (SCRLC ref)

Supply Chain Risk Leadership Council

What: A council of leading experts representing a broad spectrum of interests that are exposed to diverse types of supply chain risks. Together, SCRLC discusses, brainstorms, and develops a core set of principles and practices to foster advancement in effective management of supply chain risk.

Current Members:
- **Industry:** Cisco, Boeing, GE, Coca Cola, John Deere, FedEx, LMI, Zurich Insurance, Procter & Gamble, Medtronic, Genentech, Applied Materials, Jabil Circuits, Rolls Royce, Foxconn, Merck
- **Government/Think Tank:** TSA, RAND, USAF, ASIS
- **Academia:** University of Michigan, MIT, Stanford
Best Practices Guide

The SCRLC will publish a "Supply Chain Risk Management (SCRM) Best Practices Guide" later in June 2011

- Available online at www.scrlc.com
- A detailed “how to” guide for the SCRM practitioner or novice
- Feedback welcomed; please share with others

Considering the Japan quake and tsunami...

- Do these principles still hold?
  - Yes!

- What is new?
  - Awareness of supplier hub vulnerabilities
  - But this really wasn’t different than any other disruption

- What can we learn from the Japan case?
  - Companies proven to be more resilient than expected
  - Assess geo or industry structural vulnerabilities
  - Reduce probability, exposure to those vulnerabilities
  - Failure mode preparation
References & Thank you

- SC Resilience Publications
  - Mechanical Engineering Magazine “Beyond the Breaking Point” article, June 2011
  - Text your email & name to 516.627.7062 for copy
  - Sloan Management Review “A Supply Chain View of the Resilient Enterprise” article
  - Other references
  - [http://ctl.mit.edu/research/supply_chain_resilience_publications](http://ctl.mit.edu/research/supply_chain_resilience_publications)

- THANK YOU
  - Jim Rice – [jrice@mit.edu](mailto:jrice@mit.edu), 617.258.858, 516.627.7062