How Supply Chains Can Deal with Uncertainty and Risk

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Agenda
• Introduction

• How Supply Chains Can Deal with Uncertainty
  • Uncertainty from a changing world
  • Dealing with Uncertainty (concepts)
  • Dealing with Uncertainty (examples)

SCREAM
Access xlsx file at
http://ctl.mit.edu/jim
Uncertainty from a changing world

Supply Chains Today ➔ Uncertainty and Vulnerability

- Global sources of supply & customer destinations
  - Increasing distances ➔ longer lead times
  - Many transborder imports & exports
  - Added security constrains flow, raises costs (C-TPAT, AEO)
- Product dynamics:
  - Fast NPI, product proliferation, increasing variety (margin*), shorter life cycle
  - How many variations of toothpaste are there on the shelf?
- Complexity! More parties in the supply chain
  - More outsourcing
  - More dependence on others in supply network
- Lean supply chains
  - Reduced inventories ➔ Fragile supply chains
- Result ➔ uncertainty and high vulnerability
  - Our vulnerability is a function of the supply network
  - Ex. Pan Am over Lockerbie; Williams Pipeline
How do you predict the demand for new products?

"Why would you want to buy an Apple Watch? I'm still trying to figure that out."**

Announced 3-2-11, for sale 3-11-11, 5 week delay by 3-15-11...then the tsunami impact hit

"It would have been nice if I'd made sure the product tasted good."**

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Cases of NPI Sales Forecasting Optimism

Before their time.....

It was never their time.....

Adapted from Y. Sheffi, Jan '12 MIT Executive Education Program
A Few Cases of Sunset Sales Forecasting Surprise

Despite their initial death….they’re back

A Ten-Year Look at High Consequence-Low Probability Disruptions

- Toyota Brake Plant Fire
- GM Labor Strike
- Firestone-Ford Tire Recall
- Philips Plant Fire
- Sept. 11 Terrorist Attacks
- West Coast Ports Lockout
- Iraqi War
- Blackouts US - EU
- Katrina
- Global Financial Crisis
- UPS Labor Strike
- Quebec Ice Storm
- Taiwan Earthquake
- FMD in UK
- Scandals: Enron, Andersen, Worldcom
- GM-Ok. tornado
- London Madrid Attacks
- SARS
- Nor’Easter
- Tornadoes, Pirates, Wash. storms, bridge collapse

Ref: Adapted from Dr. Debra Elkins, General Motors
Some Recent Disruptions...

- Avian Bird Flu Outbreak (US), April 2015
- GE Appliance Whse Fire, April 2015
- Typhoon Halong, SE Asia, Aug 2014 ($10B revenue & 41 week impact)
- Severe flooding, NY USA, 2014 ($4B revenue & 38 week impact)
- Typhoon Rammsun, SE Asia, July 2014, ($1.5B rev & 38 week impact)
- Gas explosions, Kaoshing, Taiwan, 2014 ($900M rev & 26 week impact)
- Hazmat spill, Arizona US, 2014 ($900M revenue & 10 week impact)

How did these affect your supply chain?


High Impact of Supply Chain Failures

- Japan Earthquake/Tsunami/Nuclear Meltdown 2011: $Bs+
- Phillips Fire 2000– Nokia vs Ericsson, Ericsson loses $400m
- West Coast Lockout 2002, $~20B economic loss
- Boeing 787 Outsourced SC 2007-8, 2-yr delay, $2B charges
- Mattel Product Quality Recall, 2007, 50% stock price drop
- Hershey Halloween Miss (IT), 1999, $150M loss, -30% stock
- Nike IT system failure, $100M revenue drop, -20% stock
- P&G Folgers (Hurricane Katrina)
- GM (tornado at Oklahoma City)
- Land Rover/UPF Thompson frame supplier bankruptcy
- Toyota (Aisin) brake plant fire 1997
- Toyota defective gas pedals, $1.2B settlement and equity/share loss
Effect of Supply Chain Problems

Figure 3: Change in control-adjusted operating performance of sample firms during the year before the announcement of glitches using the most-matched control sample.

Adapted from Y. Sheffi, June '10 MIT Executive Education Program

Complexity.....
How complicated is it to make a bedsheet? (or other products...)

Source: Hendricks & Singhal, “Association Between Supply Chain Glitches and Operating Performance”
Suppliers to the 2010 Chevrolet Corvette

Complexity!

Partners Across The Globe Are Bringing The 787 Together

Ref.: http://3.bp.blogspot.com/-WGcAEdvDQx4/UHbqZTQVpXI/AAAAAAAAArw/dK8CnoNSLyM/s1600/104664-Boeing_787_DreamLiner.gif
Dealing with Uncertainty (concepts)

Some Observations about Forecasting or “we often depend on forecasts and are disappointed”

- The only function of economic forecasting is to make astrology look respectable” – John Kenneth Galbraith


- “Prediction is very difficult, especially if it’s about the future.” – Nils Bohr, Nobel laureate in Physics

- “If you have to forecast, forecast often.” – Edgar R. Fiedler in The Three Rs of Economic Forecasting-Irrational, Irrelevant and Irreverent, June 1977.

- “An economist is an expert who will know tomorrow why the things he predicted yesterday didn’t happen today.” – Evan Esar

Forecasting reality

• A point forecast is always wrong – high or low
• How to make the forecast more accurate?
  – A range forecast can be right and encompass the actual demand
  – Forecasts for near-horizons can be more accurate (there is less uncertainty)
  – Collaborate with upstream and downstream partners, sharing promotion/demand/supply plans
  – Learn from past patterns – but don’t be slave to them if the conditions vary
  – Share risks with partners
  – Scenario planning for multiple options

• But there is always uncertainty about the outcome until occurs

• Consider other actions that can help address uncertainty
  – Supply chain design
  – Managing uncertainty

Supply Chain Design Key Success Factors

• Design the supply chain as a System
  – Dell, Zara, Caterpillar, P&G, Walmart, Flextronics, Cisco

• Develop a portfolio of supply chains
  – Fast, responsive – low volume, high cost, near point of demand
  – Slow, efficient – high volume, low cost operation

• Right supply chain for product

• Design for Flexibility & Robustness

Ref.: HBR “What is the right supply chain for your product?” Marshall Fisher, March 1997
Design for Flexibility and Robustness

- **Flexibility**: prior investments in capabilities & options
  - Workforce trained to perform multiple tasks
  - Products designed to be easily reconfigured based on material and supplier selection
  - Production assets designed to be reconfigured to accommodate variability in demand
  - Provides benefit dealing with daily variations

- **Robustness/Redundancy**: prior investments in assets
  - Inventory maintained throughout the supply chain, at suppliers, internally, finished goods inventory
  - Additional production capacity maintained beyond needs to serve known customer needs
  - Only provides benefit when assets are used

Supply Chain Risk Management

http://ctl.mit.edu
Supply Chain Risk Leadership Council

An industry council comprised of world class supply chain firms working together to develop and share supply chain risk management standards and best practices

www.scrlc.com

Risk Management Framework & ISO 31000

ISO 31000:2009
RISK MANAGEMENT – PRINCIPLES AND GUIDELINES

1. Vulnerability assessment
2. Ongoing Monitoring & Measurement
3. Crisis Management & Emergency Response
4. Mitigation planning & implementation (resilience)
Vulnerability Maps: probability and consequence

Key risk factors
- Probability
- Consequences

4. Mitigation Planning & Implementation

- Identify options for reducing probabilities & consequences
  - Identify company risk profile
  - Choose right mix of each for the business
  - Prevention or Response? How much of each?

- Reduce Probability → Security and Prevention

- Reduce Consequences → Response and Resilience
Reduce Vulnerability to Disruption

1. Reduce probability of disruption: increase security, prevention

2. Reduce consequences of disruption: increase resilience

Ref. – Sheffi, Rice & SC Response Project

Supply Chain Resilience

- Supply Chain Resilience:
  - In material science, resilience is the physical property of a material that can return to its original shape or position after a deformation that does not exceed its elastic limit.
  - In today’s business environment, resilience is widely used to characterize an organization’s ability to react to an unexpected disruption, such as one caused by a terrorist attack or natural disaster, and restore normal operations.
  - It’s the ability to recreate supply chain capabilities, to ‘bounce back’ from variations and disruptions

- Examples of supply chain resilience?

**SC Resilience Principles**

- Failure Mode Analysis – predictable outcomes
  - Plan for recovery from failure modes, not on risk source
  - Design to ‘fail smartly’ – plan to fail with limited impact
  - ‘Options’ thinking and planning

- Business Continuity Planning (BCP) for outcomes
  - Identify action plans to maintain & recreate business operations after disruption
    - Focus on responding to Failure Modes – outcomes
    - Prepare organization to response and recover
    - Choose mix of flexibility & redundancy
  - Design supply chain network for resilience
    - From upstream suppliers, internal operations and downstream to customer, plan for backup


**Supply Chain Failure Modes**

All disruptions result in a loss of one or more of these capacities:

- Capacity to acquire materials (supply)
- Capacity to ship/transport
- Capacity to communicate
- Capacity to convert (internal operations)
- Human resources (personnel)
- Financial flows
Known Risks – Enterprise Vulnerability

- Financial Risk
  - Interest Rate Fluctuations
  - Tax Law Changes
  - Economic Recession

- Hazard Risk
  - Cargo Losses
  - Earthquake
  - Wildfire
  - Epidemic

- Operations Risk
  - Product Liability
  - Facility Loss
  - Theft

- Strategic Risk
  - Loss of IP
  - New Competition
  - Negative Media

- Interchangeability
- Postponement
- Supply
- Distribution
- Flexibility culture

Many Paths to Flexibility Through...

Sources: "SC Response Project Interim Report" by J. Rice, F. Caniato, Aug 8, 2003; Draft of SC Response Book project, Oct 2004, later pub as "The Resilient Enterprise by Y. Sheffi"
Many Paths to Flexibility

• Interchangeability
  • Use standardized facilities
    • Intel ‘Copy Exact’ – same orientation to the sun....
  • Use standard parts
    • Common parts and platforms used at tech companies (Dell, Lucent),
      Lucent reduced platforms from 85 → 5
    • Single interface used by Southwest for pilots
  • Use standard processes
    • Helix Technologies reduced production process into many small steps that
      can be taught and performed quickly
    • Standard processes enable rapid response to disasters (UPS)

• Postponement
  • Delay customization of product
    • Benetton make greige sweaters, batch colors the final product
    • H-P makes std printer & tailors for EU markets once demand surfaces
    • Sherwin-Williams paint mixed at store for custom color

Many Paths to Flexibility (continued)

• Supply
  • Contract with suppliers for different response rates (Jabil, Lucent)
  • Favorable relationship supports supplier collaboration in response to disaster
    (Toyota – Aisin fire)

• Distribution
  • Use distribution system to provide broad access to parts across entire network
    (Caterpillar)
  • Use make-to-order and direct distribution system to enable tailoring product
    sales to materials on hand (Dell)

• Flexibility culture
  • Make employees aware of risks & tradeoffs in decisions
  • Install early warning systems (Nokia)
  • Educate for awareness & train for response (Intel)
  • Distribute decision-making, open communications
A few examples of flexibility....

- Auto part supplier: Fire burned facilities, data
  - *Standard production process, suppliers* provide ‘lost’ info
- Cantor Fitzgerald: Lost traders, customer info
  - Recaptured 50% of trades using CRM for info
- Intel
  - *Interchangeable plants* via “Copy Exact!”, Earthquakes BCP
- UPS
  - *Standardized processes* enable work force flexibility
- Lucent Technologies
  - *Interchangeable parts, standard models, concurrent SC*
- Reebok
  - *Postpone* customization of NFL jerseys
- Helix Technology
  - Simplified production so supplier produces in emergency
- Jabil Circuits
  - Builds flexibility into standard contracts, 100% in 4 weeks

A few examples of robustness....

- Morgan Stanley
  - *Redundant IT system, restarted 9-12-01*
  - Redundancy added after ‘93 attack on World Trade Center
- USPS: Anthrax
  - *Used excess capacity* to shift processing to other sites
- Boston Scientific
  - *Financial analysis indicated cash flow crunch*
  - Set up *redundant production facility, staff* – ready & waiting
- US Government & J&J
  - *Maintain stock* of medical supplies, rolling inventory
Managing Uncertainty

**Uncertainty Reduction**
- Risk Pooling
  - Aggregation
  - Platform strategy, product modularization
  - Standardization
  - Inventory centralization
- Time compression
  - Cycle time reduction
  - Postponement
- Information Management:
  - Focus groups, expert opinions IT tools (ERP, cloud, SaaS)
  - CPFR, VMI
  - Demand shaping
  - POS data

**Risk Management**
- Buffering
  - Inventory, capacity, time
- Capacity Segmentation
  - 80/20 rule,
  - ABC classification, customer profiles
- Diversify supply sources
- Flexible capacity
- Service level management
- Supply Contracts
- Outsourcing


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**Adding Resilience to a Supply Chain**

How would you add resilience to this supply chain?
Adding Resilience to a Supply Chain

Options include…..
- Redesign entire SC for resilience (streamline)
- Adding back up supplier
- Adding additional inventory
- Add additional facility
- Choices on response time
- Buying options for additional capacity in your network…..

Break