



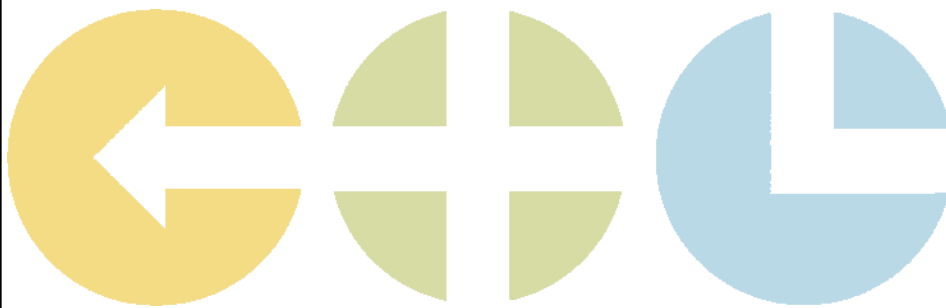
MIT Center for Transportation & Logistics

Supply Chain Risk Management – Resilience

Supply Chains Driving Strategic Advantage

January 18, 2017

Cambridge, MA



Agenda

- Managing Uncertainty.... → Dealing with Disruptions
- Disruptions → Managing Risks
- Managing Risk → Resilience and Prevention
- Key Resilience Success Factors
- Adding Resilience to Supply Chains....



The “Bullwhip Effect” & Managing Uncertainty

STRUCTURAL PROBLEMS:

- Information lags
- Delivery lags
- Independent forecasting
- Order batching
- Price fluctuations
- Inconsistent incentives
- Gaming allocations
- Promotions/discounting

➔

SOLUTION STRATEGIES:

- Reduce Uncertainty
- Reduce Variability
- Reduce Lead time
- Improve Channel Mgt
- Align policies, incentives, KPIs

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Managing Uncertainty and the “Bullwhip Effect”

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- Information lags
- Delivery lags
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SOLUTION STRATEGIES:

- Range forecasting
- Solicit early insight on demand (test batches)
- Contract for flexibility
- Contract to share risk
- Aggregation & risk pooling on products and parts
- Concurrent processes
- Postponement, delay customization
- Collaboration, align policies
- Design SC for flexibility & redundancy

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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
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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



Ref.: "Supply Chain Principle # 2; Topic: Uncertainty" MIT Supply Chain 2020 Working Paper, M. Singh July 24, 2006



But daily variation is different than disruption

- Avian Bird Flu Outbreak (US), April 2015
- GE Appliance Whse Fire, April 2015
- West Coast US Port Congestion & Labor Action, 2014-2015
- 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)
- Building Collapse, Rana Plaza Bangladesh, 2013
- Thai Floods 2013
- Hurricane Sandy 2012
- Europe Financial Crisis 2012
- Thai Floods 2011
- Japan Quake/Tsunami 2011
- Haiti Earthquake 2010
- Gulf Oil Spill 2010
- Iceland Volcano 2010
- Russian Wildfires 2010
- Global Financial Crisis 2008+
- Beijing Olympics Summer 2008

How did these affect your supply chain?



Ref: Source material from "The Japan Disaster: Rebuilding Supply Chains" webinar for Journal of Commerce, by B. Artzen and J. Rice, March 24, 2011; and Resilinc Event Watch Annual Report 2014, March 2015 available at <https://www.resilinc.com/products/eventwatch-2014-annual-report/>



High Impact of Supply Chain Failures

- Japan Earthquake/Tsunami/Nuclear Meltdown 2011: \$Bs+
- Philips 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
- And many others.....LA/LB port disruption/congestion 2014-2015, Hurricane Rita, London-Madrid-Bombay terrorist attacks, labor actions/strikes, SARS, H1NI, HiN5, Somali pirates....



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Effect of Supply Chain Problems

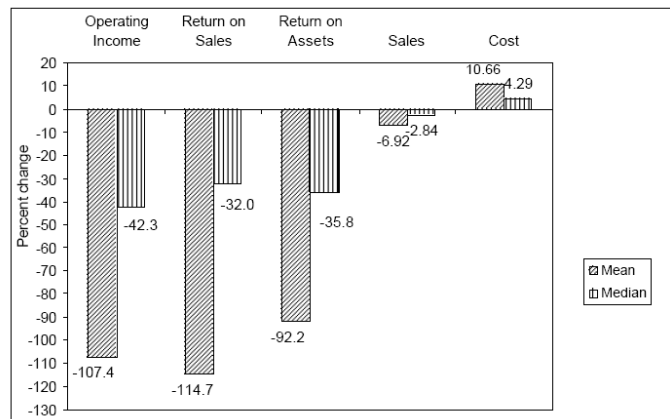
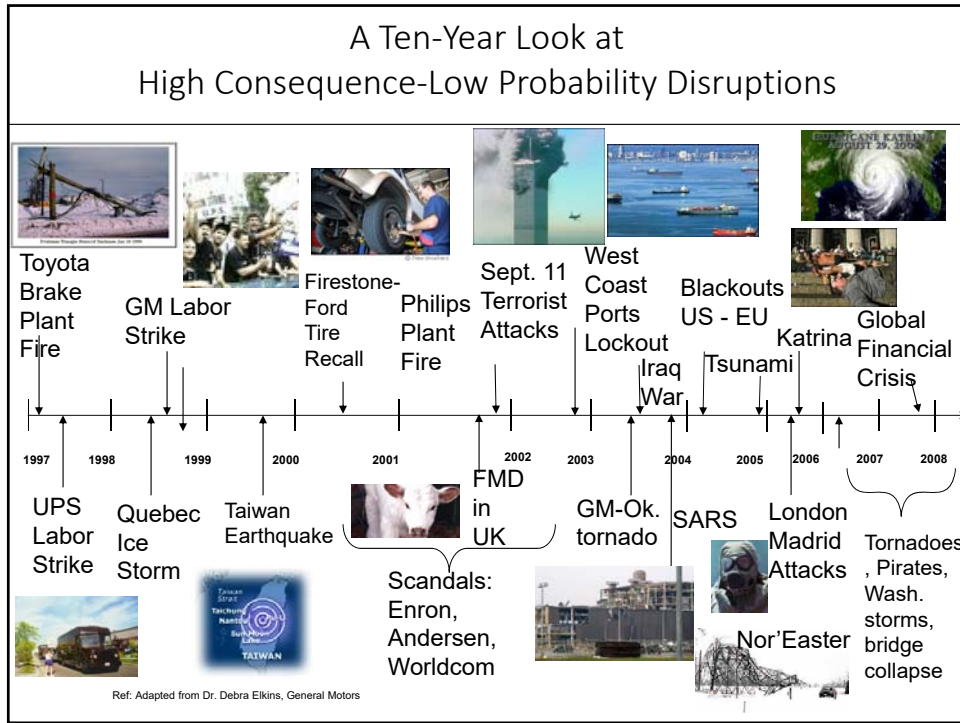


Figure 3: Change in control-adjusted operating performance of sample firms during the year before the announcement of glitches using the most-matched control sample.

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

Source: Hendricks & Singhal, "Association Between Supply Chain Glitches and Operating Performance"



Supply Chain Risk Management

MIT

Supply Chain Risk Leadership Council (SCRLC)

SCRLC
SUPPLY CHAIN RISK LEADERSHIP COUNCIL

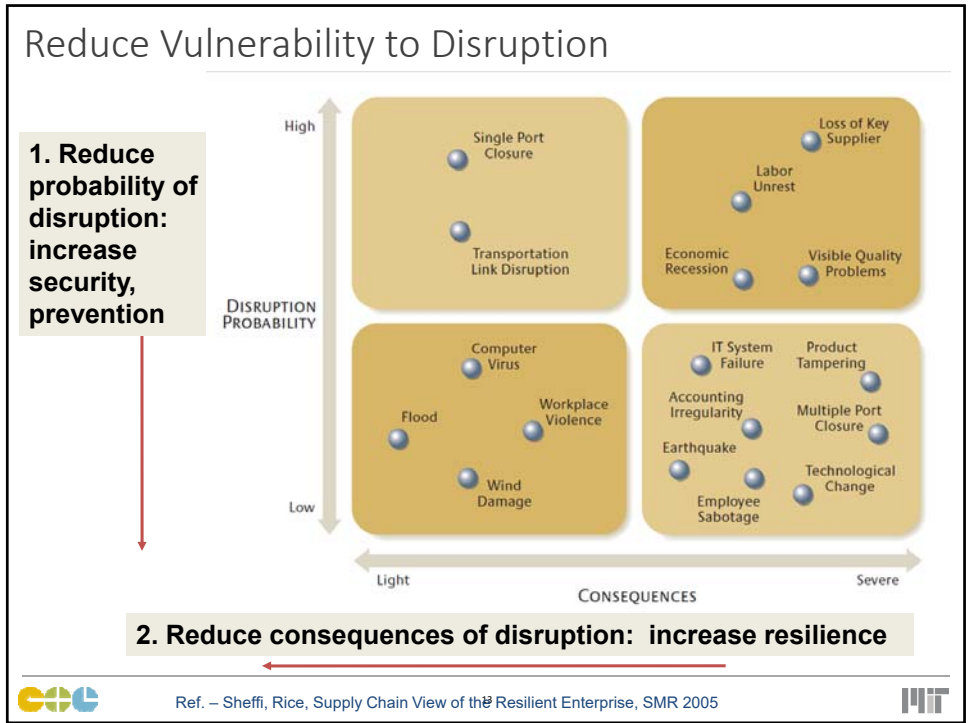
An industry council comprised of world class supply chain firms working together to develop and share supply chain risk management standards and best practices

www.scrlic.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)



- ### Actions
- 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

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.
- Today, resilience is widely used to characterize an organization's ability to react to a disruption (e.g. one caused by a natural disaster) and restore normal operations.
- It's the ability to recreate supply chain capabilities, to 'bounce back' from variations and disruptions*
- "We define resilience as 'the ability of a system to return to its original state or move to a new, more desirable state after being disturbed'."
- How has your supply chain been resilient? Or not?



*Source: "Building a Secure and Resilient Supply Network" by J. Rice, F. Caniato, SCMR Sept-Oct 2003

** Source: Christopher, Peck, at https://dspace.lib.cranfield.ac.uk/bitstream/1828/2666/3/Building_the_resilient_supply_chain-2003.pdf



Design for Flexibility and Redundancy

- 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
- 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



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Key Success Factors

- Failure Mode Analysis (Outcomes) – fail smartly



Sources: "SC Response Project Interim Report" by J. Rice, F. Caniato, Aug 8, 2003; Draft of SC Response Book project, Oct. 2004



Supply Chain Failure Modes / Outcomes

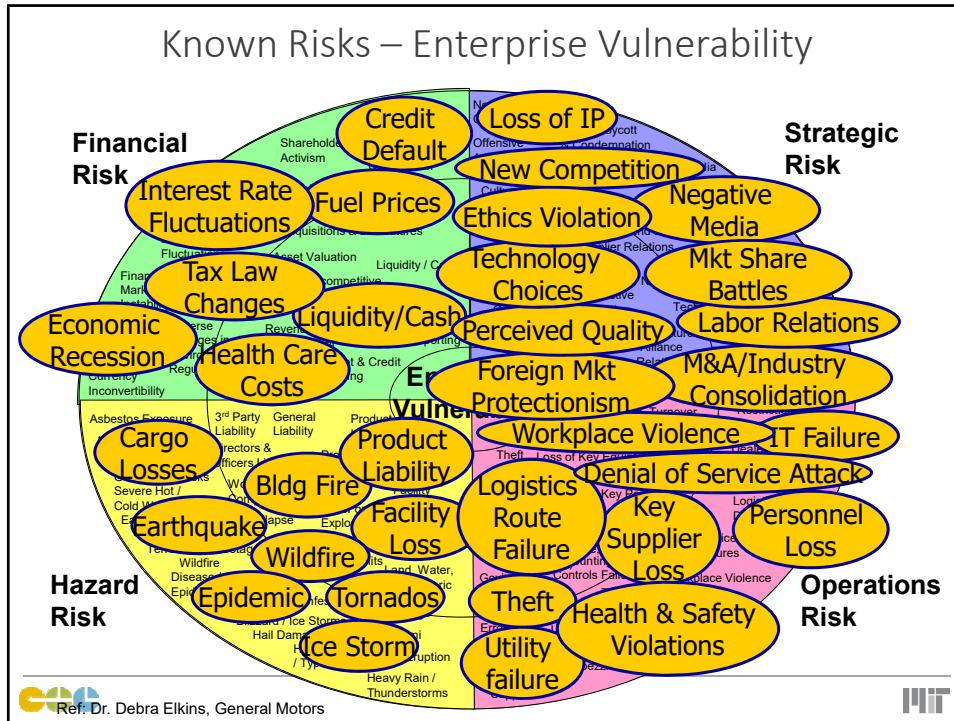
All disruptions result in a loss of one or more of these capacities:

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



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Key Success Factors

- Failure Mode Analysis (Outcomes) – fail smartly
- Business Continuity Planning – system design, plan to reconstitute
- Response planning – develop response playbooks, CERT teams
- Risk assessment – Impact analysis, maturity assessment
- Many paths to flexibility
- Making the resilience investment: Quantifying Resilience
 - Cost to mitigate, cost to recover, value-at-risk, effectiveness of recovery options, probability of disruption



Sources: "SC Response Project Interim Report" by J. Rice, F. Caniato, Aug 8, 2003; Draft of SC Response Book project, Oct. 2004



Many Paths to Flexibility

- Interchangeability
 - Use standardized facilities, parts, processes
 - Intel, Lucent/Alcatel, Southwest, Helix, UPS
- Postponement
 - Delay customization of product
 - Benetton, H-P, Sherwin-Williams
- Supply
 - Structure contract & relationships with suppliers for response
 - Jabil, Lucent, Toyota
- Distribution
 - Use distribution system for downstream options
 - Caterpillar, Dell
- Flexibility culture
 - Educate for risk awareness, tradeoffs, train for response
 - Nokia, Intel



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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



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A few examples of using redundancy....

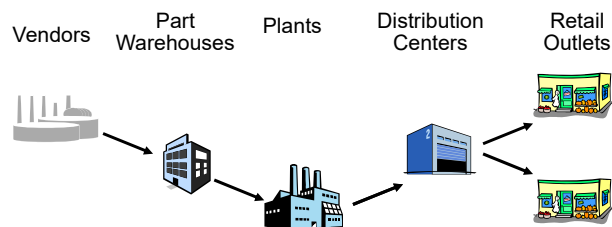
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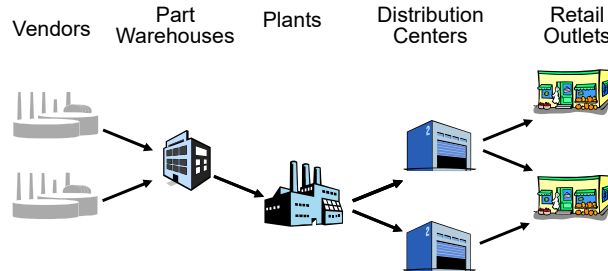


Adding Resilience to a Supply Chain



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

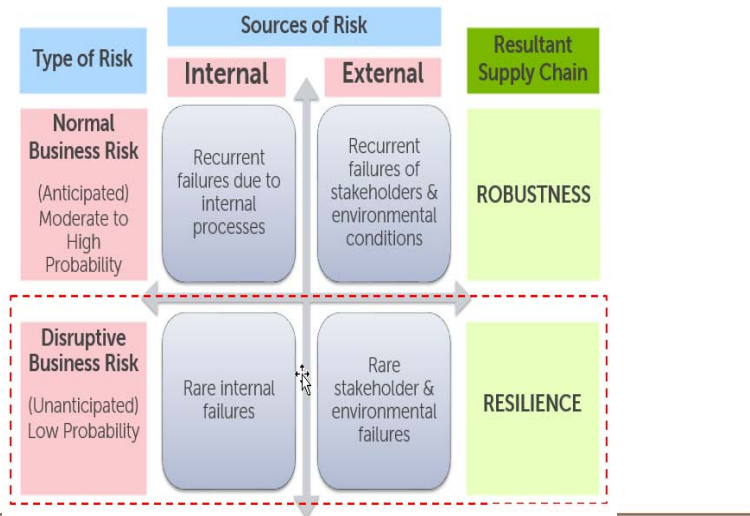
- What do you consider resilience?
- What examples of resilience do you have in your company?
- How does your company pursue resilience?
 - Organization?
 - Skills?
 - Initiatives & measures?
 - BCP? Risk Management?



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Assessing Resilience



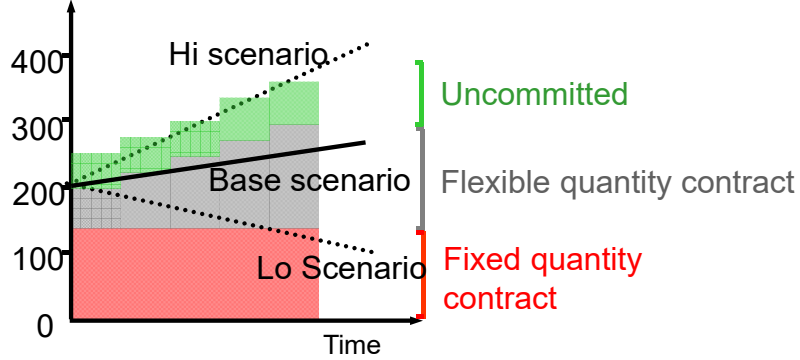
Ref.: Jaspas Siu and Santosh Stephen, 2015




Flexibility through Contracting




Demand forecast (units/mo)



- Develop flexible contracts
 - Jabil Electronics: +25% w/i one week; +100% in four weeks
- Multi-sourcing
 - HP – multiple plants for various stages



Adapted from Y. Sheffi, Jan '12 MIT Executive Education Program



Robustness & Resilience in a System



“We define supply chain robustness as the ability of a supply chain to resist or avoid change.” *

“We have taken ‘robust’ to mean ‘strong or sturdy in physique or construction’. Here the emphasis is on physical strength. A robust process may be desirable, but does not itself equate to a resilient supply chain. We define resilience as ‘the ability of a system to return to its original state or move to a new, more desirable state after being disturbed’. In practice the two terms (robustness and resilience) are used interchangeably, but in the context of supply chains they can acquire quite different connotations.”**

This is CONFUSING!

*Source: Wieland, A. from <https://scmresearch.org/2015/03/02/a-theory-of-robust-supply-chains/> on Nov 15, 2106; referring to Durach, C., Wieland, A., & Machuca, J. (2015). Antecedents and Dimensions of Supply Chain Robustness: A Systematic Literature Review. *International Journal of Physical Distribution & Logistics Management*, 45 (1/2), 118-137 DOI: [10.1108/IJPDLM-05-2013-0133](https://doi.org/10.1108/IJPDLM-05-2013-0133)

** Source: From Christopher, Peck, at https://dspace.lib.cranfield.ac.uk/bitstream/1826/2666/3/Building_the_resilient_supply_chain-2003.pdf

SC designed as a system

- Success of the model not dependent on one feature
- Alignment and coordinated elements
- Examples:
 - Dell ('90s): Make-to-order, sell direct, low inventory, targeted customer, online service, postponed parts purchase, corporate sales (educated customer), demand shaping → low cost, responsive supply chain offering tailored products
 - Zara: nearly vertically-integrated, integrated POS-design-mfg, centralized operations, high automation, near-market → low cost, fast response (new designs in 2 weeks to shelf), medium quality high fashion product
 - Lucent (pre-Alcatel): Outsourced mfg, consolidated CMs (14→3) and platforms (85→5), pre-order collaboration/commitment with suppliers, CFO in SC provides margin management, 1700 carriers to 1 LLP → responsive and profitable SC credited by CEO with company turnaround
 - Others: Cisco, P&G, Caterpillar...



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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 standard printer & tailors for EU markets once demand surfaces



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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)
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 - Distribute decision-making, open communications



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Managing Uncertainty

Uncertainty Reduction

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- Information Management:
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Risk Management

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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 & Redundancy

What is the Right Supply Chain for Your Product?

Matching Supply Chains with Products

	Functional Products	Innovative Products
Efficient Supply Chain	match	mismatch
Responsive Supply Chain	mismatch	match



Ref.: HBR "What is the right supply chain for your product?" Marshall Fisher, March 1997



Key Success Factors

- Develop response playbooks
- Impact analysis
 - On customers, facilities, products
- Create, train Corporate Emergency Response Teams (CERT)
 - Representatives from each function: Sales, marketing, logistics/supply chain, security, safety, legal, finance
 - Identify the roles for each function → practice
- Create protocols for communication
 - Methods, tools, frequency, responsibilities
 - Response roles identified and practiced
 - Public relations critical
- Beware of psychology of risk
 - Human brain bypasses cortex when dealing with risk, triggers emotional – not rational – response!

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