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Understanding Supply Chain Resilience

Making Operational Sense of a Key Supply Chain Capability



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Topics to be covered

- Clarify the concept of supply chain resilience.
- Identify the two major components of resilience
 - Resistance
 - Recovery
- Identify the four different resilience strategies.
- Map investments to resilience stages.

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Resilience – An Overview

- Focus – supply chain disruptions
- Widely encountered within the relevant literature.
- Yet, not well defined
 - Used within the fields of ecology, psychology, systems thinking, disaster management, supply chain management.
 - Research has identified over 20 different definitions of resilience.

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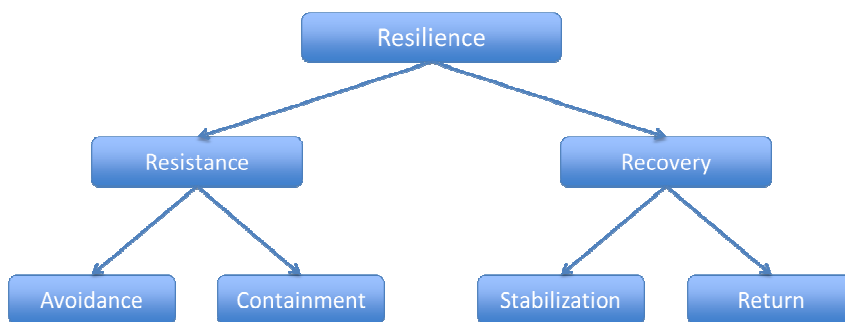
Resilience Defined

- The ability of a system to both resist disruptions and recover operational capability after disruptions occur.
- Consists of two major stages:
 - Resistance
 - Recovery
- Resistance – Avoidance + Containment

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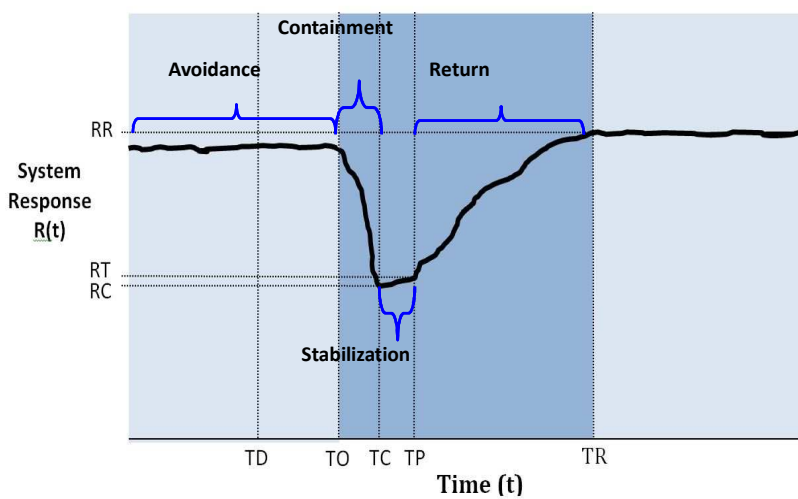
Resilience – Conceptual Framework



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Time Series Display of Supply Chain Resilience Factors



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Description of time Series Inflection Points

Event	Type	Full Name	Operational Definition
TD	T	Time of Disturbance	Specific time period in which the triggering event is initiated.
TO	T	Time of Onset	The time period in which the system being studied feels the impact of the triggering event.
TC	T	Time of Climax	Time period in which the system reaches its climax.
RC	R	Response at Climax	The system response at the climax.
TP	T	Turning Point	The time period in which the system begins to recover from the disturbance.
RT	R	Response at Turning Point	The system response at the turning point; the response at which the system transitions from being impacted by the disturbance to recovering from the disturbance.
TR	T	Time of Recovery	The time period in which the system returns to steady-state.
RR	R	Response at Recovery	The system response level at the recovery period (may differ from the pre-disturbance response level).



Resistance and Recovery Matrix

Resistance capacity	High	Resistant but Sluggish	Hardy
	Low	Fragile	Vulnerable but Responsive
		Low	High

Recovery capacity



Resilience, Risk and Uncertainty

- Most of the research has dealt with risk.
- Cannot overlook the role of uncertainty (Knight, 1921).
- Risk
 - Can determine in advance the distributions of:
 - Impact
 - Probability of occurrence.
- Uncertainty
 - Cannot determine one or both of these distributions.



Investing in Supply Chain Resilience

Investment Strategies	Investment Strategies Summarized	Examples of Investments
Discovery	Investing in the ability of the firm to identify potential problems in the supply chain as close to the event occurrence as possible.	<ul style="list-style-type: none"> • Information technology/information sharing • Early warning by supply chain partners • Forecasting • Demand sensing • Monitoring of performance in the supply chain
Information	Investments in improving the quantity, speed, and quality of information flowing within the supply chain.	<ul style="list-style-type: none"> • Improved information technology • Effective communication • Information visibility
Supply Chain Design	Designing and implementing supply chains that can be configured and reconfigured quickly in response to changes within the supply chain.	<ul style="list-style-type: none"> • Supplier base management (strategies for better managing suppliers at the major, minor, and scouting levels) (Melnyk, Griffin, Cooper, Macdonald & Phillips, 2010). • Supplier base configuration • Supplier base reconfiguration
Buffers	The creation of excess cushions in the form of inventory, capacity or lead times.	<ul style="list-style-type: none"> • Human resources – capacity • Human resources – capability/experience • Inventory • Operating flexibility • Excess operating capacity • Redundancy • Excess/safety lead time
Operating Flexibility	The ability of the system to change either flows or product specifications in response to supply chain problems.	<ul style="list-style-type: none"> • Transportation alternatives • Variable bills of material
Security	Ability to protect the system from supply chain shocks.	<ul style="list-style-type: none"> • Firewalls • Quarantine • Strengthened physical systems
Preparedness	Designing contingency plans for dealing with possible supply chain shocks and in carrying out drills	<ul style="list-style-type: none"> • Planning for contingencies • Training/rehearsing • Risk assessment



Hypothesized Investment Impact

<i>Strategies</i>	<i>Investments</i>	<i>Avoidance</i>	<i>Containment</i>	<i>Stabilization</i>	<i>Return</i>
Indirect Investment					
	Anticipated impact	+	++	++	++
Direct Investments					
Discovery		+	++	+	0
Information		++	++	++	++
Supply Chain Design		++	+	+	++
Buffers		+	++	++	++
Operating Flexibility		+	++	++	++
Security		++	++	+	0
Preparedness		++	++	++	++



Concluding Comments

- Have developed a methodology for analyzing the time series signature of a disruption.
- Now need to develop a theoretical framework for understanding resilience.
- Have identified potential investments and their impact on resilience.
- Keep posted for future research!!!



Questions



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Survey



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