

Lecture 10- Supply Chain Risk Management (SCRM)



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Risk Assessment				
Severity	Disaster	High	Medium	Minimal
Probability	Critical	Critical	High	Medium
Regularly	Critical	High	Medium	Medium
Probable	Critical	High	Medium	Medium
Occasional	Critical	High	Medium	Low
Rarely	High	Medium	Medium	



Supply Chain Risk

Covid 19 Effects

- Considerable 'chaos' exists in our supply chains through the effects of Covid 19
 - Supply Chain Disruptions
 - Supply Chain uncertainty
 - Shortage of freight containers
 - Increased shipping cost
 - Longer lead times
 - De-globalization
 - Reshoring
 - Shorten of Value Chains
 - Localize production

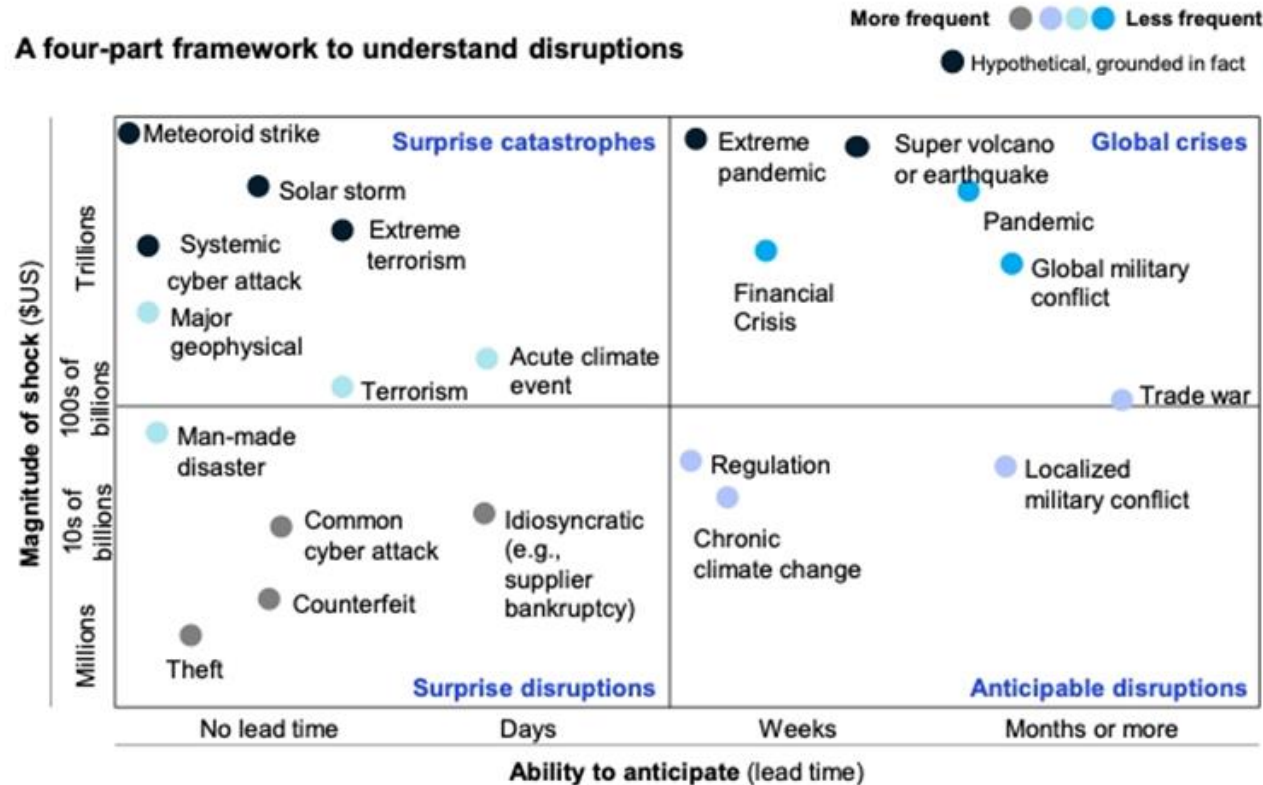
Russia-Ukraine War

- Sanctions
- Increase Oil prices → Gas → Transportation Cost
- Food Shortages → Inflation
- Rare Earth Material Shortages → Chip Shortage

Predicting Supply Chain Shocks

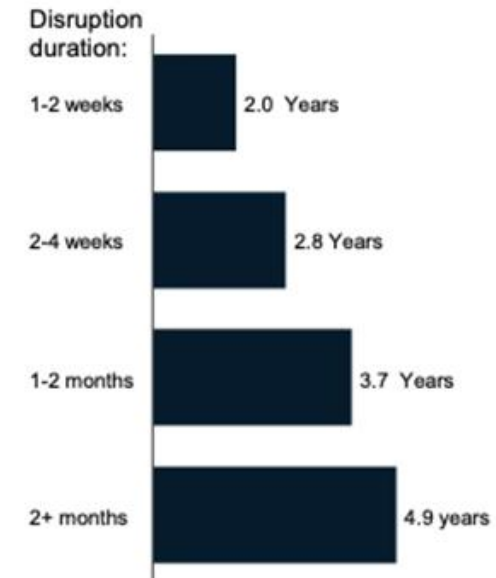
Supply chain shocks are often impossible to predict, but happen with regularity

A four-part framework to understand disruptions



Expected frequency of a disruption (in years) by duration

Based on expert interviews, n=35



Supply Chain Vulnerability

- Exposure to serious disturbance
 - From risks:
 - within the supply chain
 - as well as risks external to the supply chain
- (Cranfield School of Management 2002)

Vulnerability of supply chains to disturbance or disruption has increased

- Due to:
 - The globalisation of supply chains
 - The adoption of 'lean' practices,
 - The move to outsourcing
 - Tendency to reduce the size of the supplier base
 - Focused factories and centralised distribution

Risk Identification

Sources of Risk

1. *Supply risk*

How vulnerable is the business to disruptions in supply? Risk may be higher due to global sourcing, reliance on key suppliers, poor supply management, etc.

2. *Demand risk*

How volatile is demand? Does the 'bullwhip' effect cause demand amplification? Are there parallel interactions where the demand for another product affects the demand for ours?

3. *Process risk*

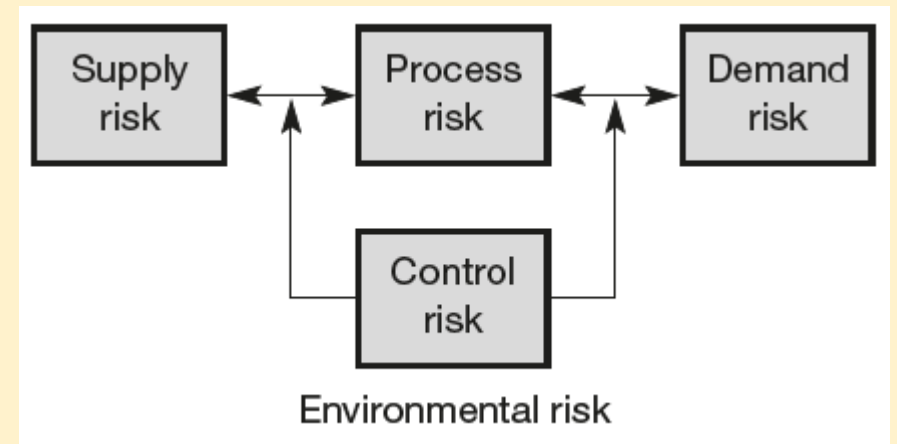
How resilient are our processes? Do we understand the sources of variability in those processes, e.g. manufacturing? Where are the bottlenecks? How much additional capacity is available if required?

4. *Control risk*

How likely are disturbances and distortions to be caused by our own internal control systems? Do we have 'early warning systems' in place to alert us to problems? How timely is the data we use?

5. *Environmental risk*

Where across the supply chain as a whole are we vulnerable to external forces? Whilst the type and timings of extreme external events may not be forecastable, their impact needs to be assessed.



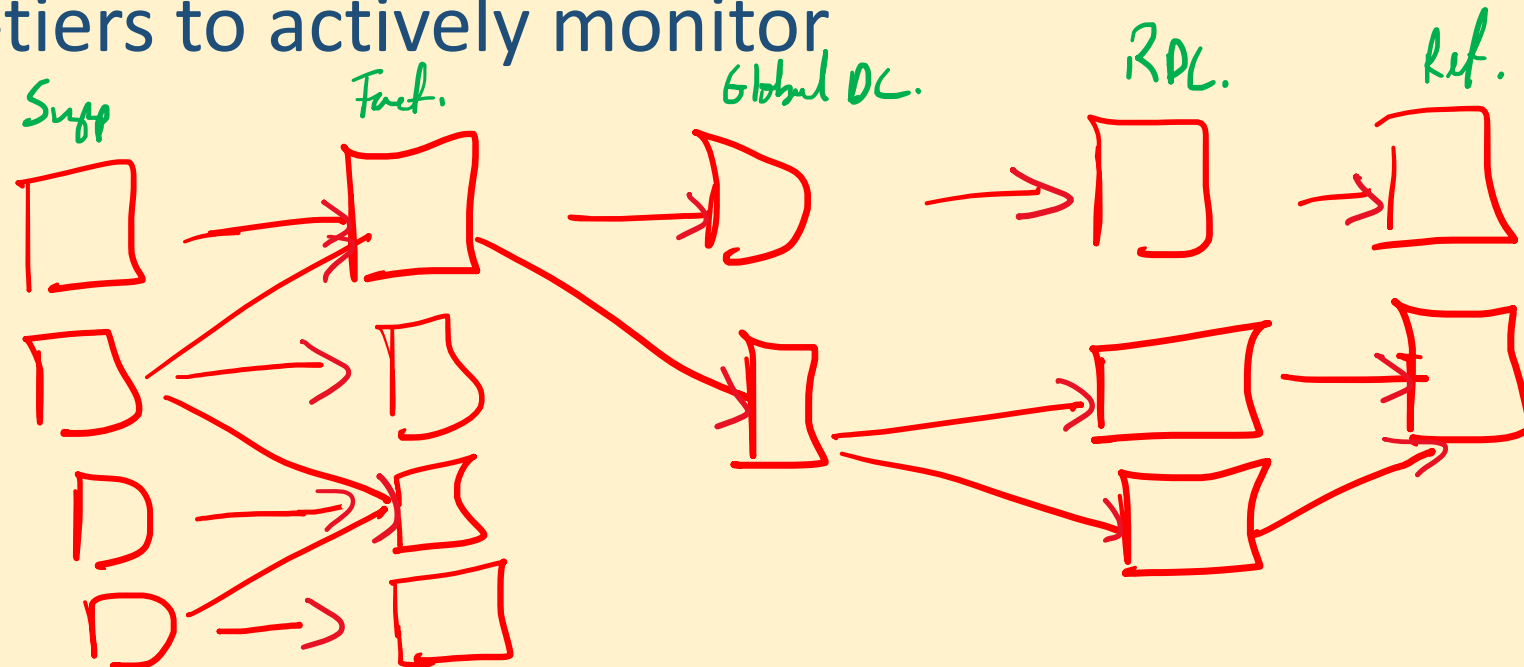
Supply Chain Risks to Be Considered During Network Design

Category	Risk Drivers
Disruptions	Natural disaster, war, terrorism Labor disputes Supplier bankruptcy
Delays	High capacity utilization at supply source Inflexibility of supply source Poor quality or yield at supply source
Systems risk	Information infrastructure breakdown System integration or extent of systems being networked
Forecast risk	Inaccurate forecasts due to long lead times, seasonality, product variety, short life cycles, small customer base Information distortion
Intellectual property risk	Vertical integration of supply chain Global outsourcing and markets
Procurement risk	Exchange-rate risk Price of inputs Fraction purchased from a single source Industry-wide capacity utilization
Receivables risk	Number of customers Financial strength of customers
Inventory risk	Rate of product obsolescence Inventory holding cost Product value Demand and supply uncertainty
Capacity risk	Cost of capacity Capacity flexibility

Source: Adapted from "Managing Risk to Avoid Supply Chain Breakdown." Sunil Chopra and Manmohan S. Sodhi, *Sloan Management Review* (Fall 2004): 53–61.

Risk Identification

- Establish risk profiles for all elements of your supply chain
- Active monitoring to keep these profiles up to date
- Determine which segments of your supply chain and how many sub-tiers to actively monitor



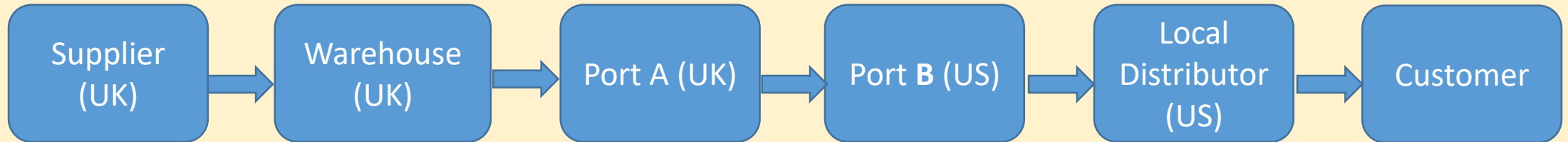
Understanding the supply chain risk profile

- The purpose of the risk profile is to establish:
 - **Where the greatest vulnerabilities lie?**
- Seek out the **'critical paths' through the network** where management attention should be especially focused
- Undertake an audit of the **main sources of risk** across the network

Critical paths are likely to have a number of characteristics

- **Long lead-time**, e.g. the time taken to replenish components from order to delivery.
- A **single source of supply** with no short-term alternative.
- **Dependence on specific infrastructure**, e.g. ports, transport modes or information systems.
- A high degree of **concentration amongst suppliers** and customers.
- **Bottlenecks or 'pinch points'** through which material or product must flow.

Supply Chain Risk Profile: One Path in the Supply Network



Source	Destinations	Logistics	Delivery time	Risk
Supplier	Warehouse	Train	4days	Unreliable train service
Warehose	Port	Lorry	1day	Lorry breaking down
Port A	Port B	Ship	15 weeks	Bad weather
Port B	Local distribution	Lorry	5 days	Traffic
Local distribut ion	Customer	Van	1day	Customer Not at home

Risk Assessment

Calculate Size of Risk

- What the probability of disruption is?
- What is the impact of the disruption?

$$\text{Supply chain risk} = \text{Probability of disruption} \times \text{Impact}$$

(Christopher, 2016)

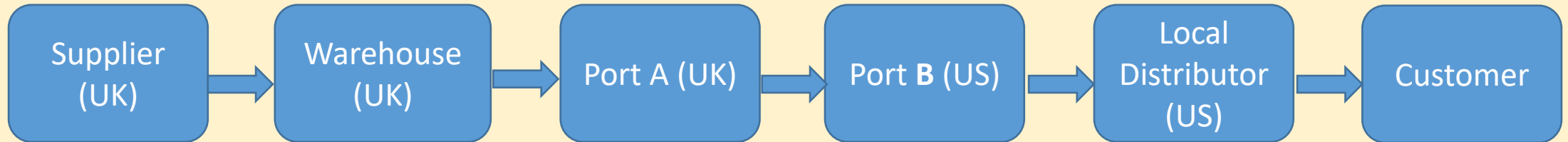
- A risk profile can be quantified by assigning score such as:
 - (1) for low, (2) for medium and (3) for highOR
 - 1 (low) to 10 (high)

Supply Chain Risk Profile- Simple

Risk name	Owner	Probability points	Consequence points	Total severity points
IT system fails	IT	Low: 1	High: 3	$(1 \times 3) = 3$
Key supplier strike	Buyers	Medium: 2	High: 3	$(2 \times 3) = 6$
Hail damage	Facilities	Low: 1	Low: 1	$(1 \times 1) = 1$
Obsolete inventory	Production	High: 3	High: 3	$(3 \times 3) = 9$
Unrealistic key customer demands	Sales	Low: 1	Medium: 2	$(1 \times 2) = 2$

APICS (2015)

Supply Chain Risk Profile: One Path in the Supply Network

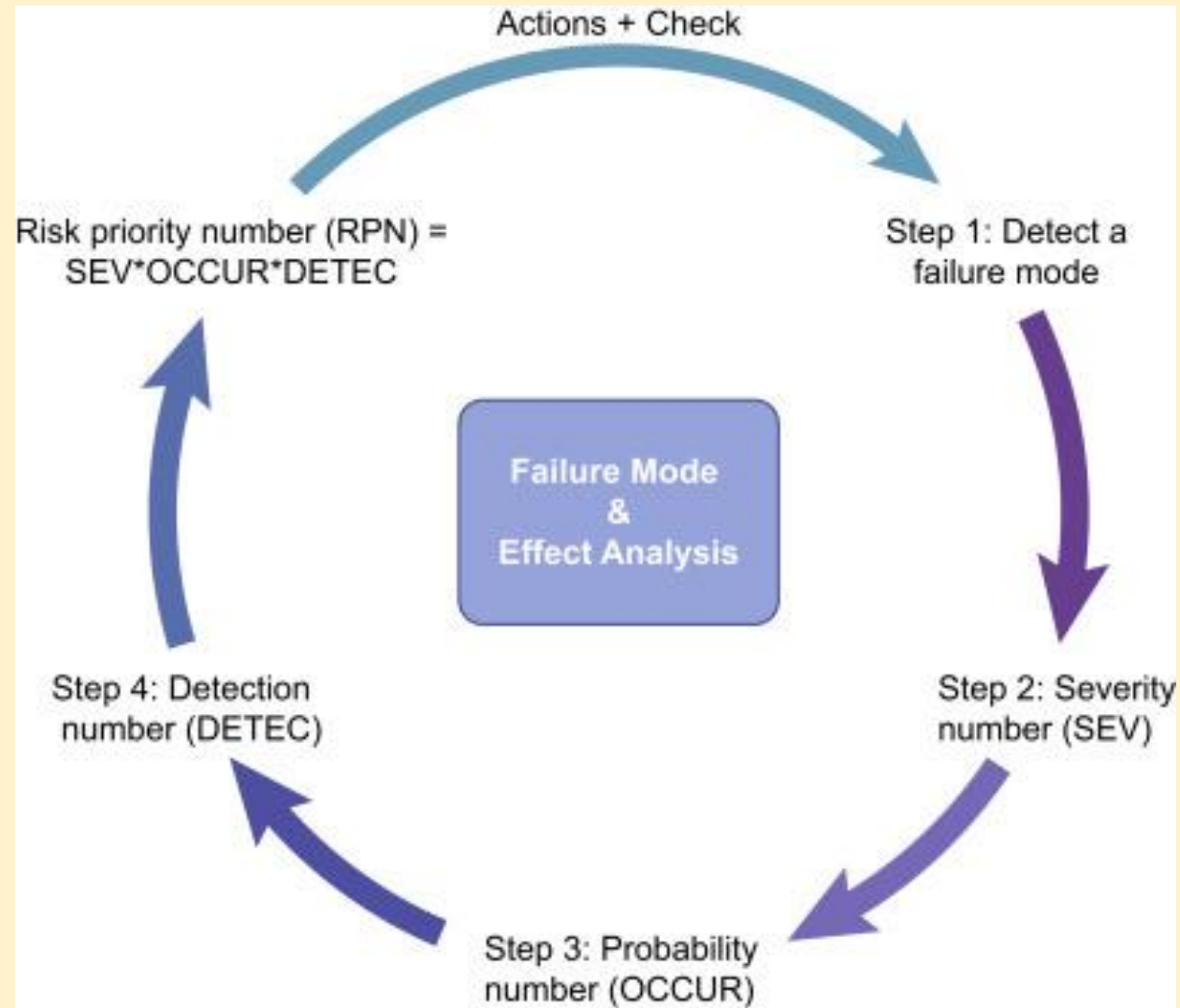


Source	Destinations	Logistics	Delivery time	Risk	Probability (1 low 10 high)	Impact (1 low 10 high)	Size of risk
Supplier	Warehouse	Train	4days	Unreliable train service	3	2	6
Warehouse	Port	Lorry	1day	Lorry breaking down	1	8	8
Port A	Port B	Ship	15 weeks	Bad weather	3	6	18
Port B	Local distribution	Lorry	5 days	Traffic	3	3	9
Local distribution	Customer	Van	1day	Customer Not at home	5	5	25

Failure Mode Effect Analysis (FMEA)

- Used to Identifying where the priority should be placed
- So as to reduce the risk of failure
- Ask:
 - What could go wrong?
 - What effect would this failure have?
 - What are the key causes of this failure?

FMEA Process



FMEA- Scoring

- Assess any possible failure opportunity against the following criteria:
 - **SEVERITY**- What is the severity of the effect of failure?
 - **OCCURENCE**- How likely is this failure to occur?
 - **DETECTION**- How likely is the failure to be detected?
- Calculate Risk Priority Number (RPN)

$$RPN = severity \times occurrence \times detection$$

Risk analysis scoring system

S = Severity

1. No direct effect on operating service level
2. Minor deterioration in operating service level
3. Definite reduction in operating service
4. Serious deterioration in operating service level
5. Operating service level approaches zero

O = Likelihood of occurrence

1. Probability of once in many years
2. Probability of once in many operating months
3. Probability of once in some operating weeks
4. Probability of weekly occurrence
5. Probability of daily occurrence

D = Likelihood of detection

1. Detectability is very high
2. Considerable warning of failure before occurrence
3. Some warning of failure before occurrence
4. Little warning of failure before occurrence
5. Detectability is effectively zero

(Christopher, 2016)

Risk Mitigation

Risk Mitigation

- Organizations will need to develop appropriate programmes to mitigate and manage SC risk
- The goal is to:
 - develop operational resilience
 - foster the ability to recover quickly
 - plot alternative courses to work around the disruption

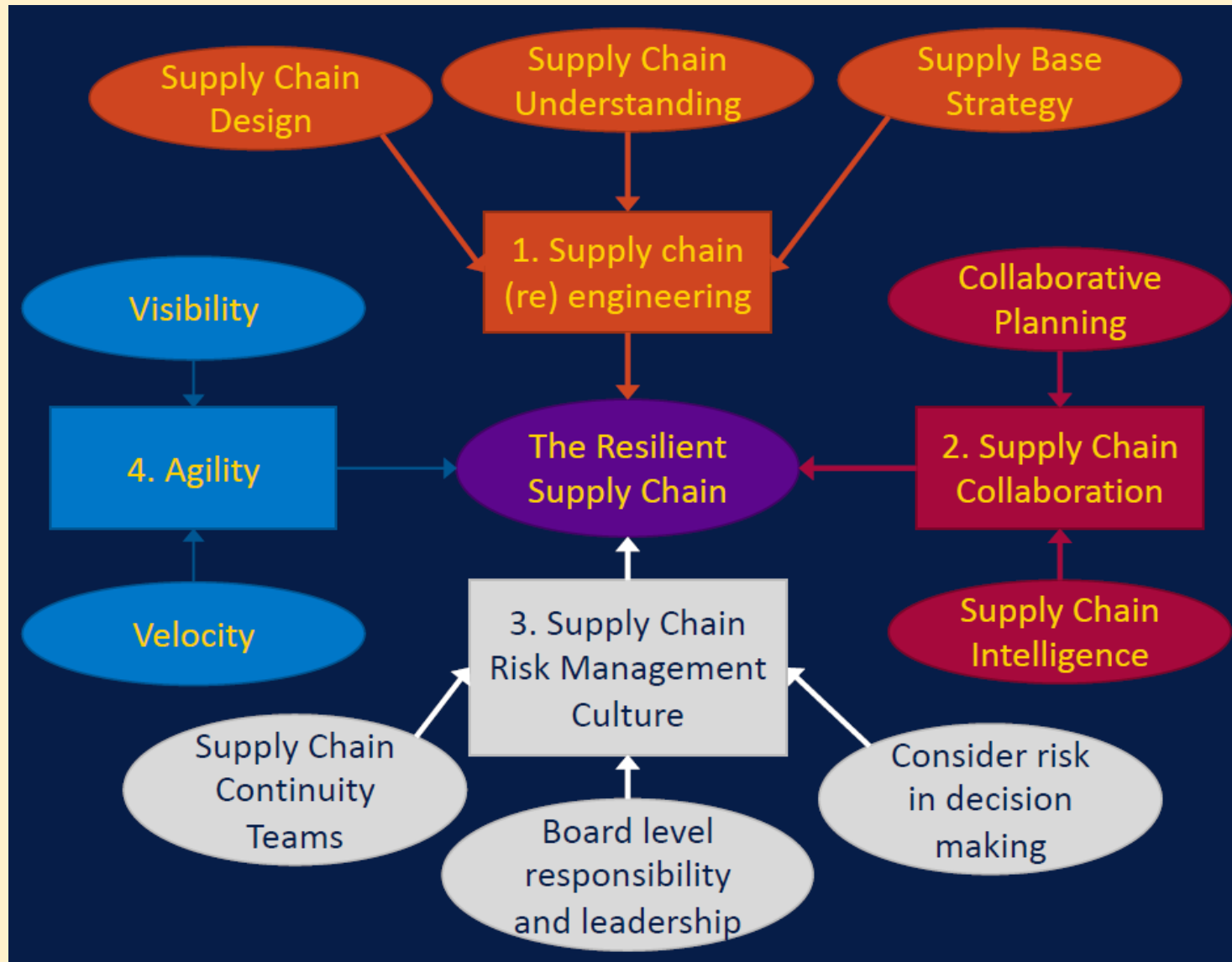
Mitigation Strategies

- End to End supply chain **visibility**- establish a supply chain **'control tower'**
- Work with suppliers and customers- **Synchronize**
- **Contingency plans** for actions to be taken in the event of failure
 - Adding capacity
 - Holding inventory
- **Re-engineering** of the supply chain

Achieving Supply Chain Resilience

- The ability of a system to return to its original or desired state after being disturbed
- Two key components:
 1. **Resistance** refers to the robustness of the supply chain which enables it to avoid the shocks
 2. **Recovery** relates to the ability of the supply chain to get back on its feet quickly

Key Factors for Building Resilience



(Christopher, 2016)

Tailored Risk Mitigation Strategies During Network Design

Risk Mitigation Strategy	Tailored Strategies
Increase capacity	Focus on low-cost, decentralized capacity for predictable demand. Build centralized capacity for unpredictable demand. Increase decentralization as cost of capacity drops.
Get redundant suppliers	More redundant supply for high-volume products, less redundancy for low-volume products. Centralize redundancy for low-volume products in a few flexible suppliers.
Increase responsiveness	Favor cost over responsiveness for commodity products. Favor responsiveness over cost for short-life cycle products.
Increase inventory	Decentralize inventory of predictable, lower value products. Centralize inventory of less predictable, higher value products.
Increase flexibility	Favor cost over flexibility for predictable, high-volume products. Favor flexibility for unpredictable, low-volume products. Centralize flexibility in a few locations if it is expensive.
Pool or aggregate demand	Increase aggregation as unpredictability grows.
Increase source capability	Prefer capability over cost for high-value, high-risk products. Favor cost over capability for low-value commodity products. Centralize high capability in flexible source if possible.

Source: Adapted from “Managing Risk to Avoid Supply Chain Breakdown.” Sunil Chopra and Manmohan S. Sodhi, *Sloan Management Review* (Fall 2004): 53–61.

Summary- Managing Supply Chain Risk



(Christopher, 2016)