

Supply Chain Analytics

Lecture 7: Designing a robust supply chain network

Lecturer: Davranova Dilorom

- Supply chain risk and vulnerability
- The impact of global sourcing
- Supply chain risk management
- Agility holds the key to resilience
- Creating the resilient supply chain

- Widespread adoption of 'lean' practices
- The move to off-shore manufacturing and sourcing
- Out-sourcing and reduction in the supplier base
- Global consolidation of suppliers
- Centralised production and distribution

All of which combine to make supply chains vulnerable to disruption

Supply chain risk (i)

“The entire Japanese vehicle industry ground to a halt following an earthquake that stopped production of piston rings for engines provided by Riken, the industry leader in the domestic market.

Toyota, in particular, was forced to stop operations at all 12 of its domestic plants.”

Financial Times, 24 July 2007

Supply chain risk (ii)

“A fire at a key Philips semiconductor factory in 2000 caused a worldwide shortage of the radio frequency chips used by both Nokia and Ericsson. Nokia immediately lined up another source and redesigned other chips so they could be produced elsewhere. However, Ericsson responded more slowly and lost an estimated \$400 million in mobile phone handsets.”

MIT Sloan Management Review

Summer 2006

Supply chain risk (iii)

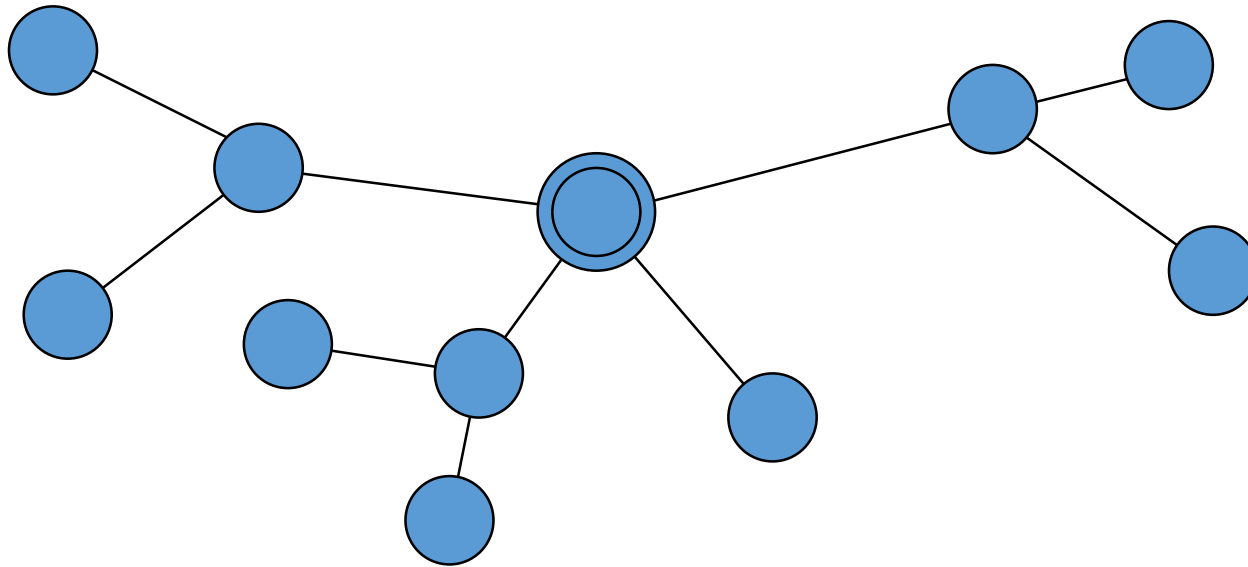
“Yesterday it emerged that ice-cream supplies may run short because Unilever’s only UK factory, based in flood-stricken Gloucester, has been closed for the past ten days.

The company usually manufactures five million ice-creams and lollipops a day at the plant. It has stocks in freezers but it could be days before normal production resumes. Industry insiders predict that there will now be an ice-cream war as rival brands attempt to exploit Unilever’s predicament and gain market share.”

The Times, 31 July 2007

- The biggest risk to business continuity may lie outside the company in the wider supply chain
- The complexity and inter-connectedness of modern supply chains increases their vulnerability to disruption
- Environmental risks are outside our control, but systemic risk is created through our own decisions

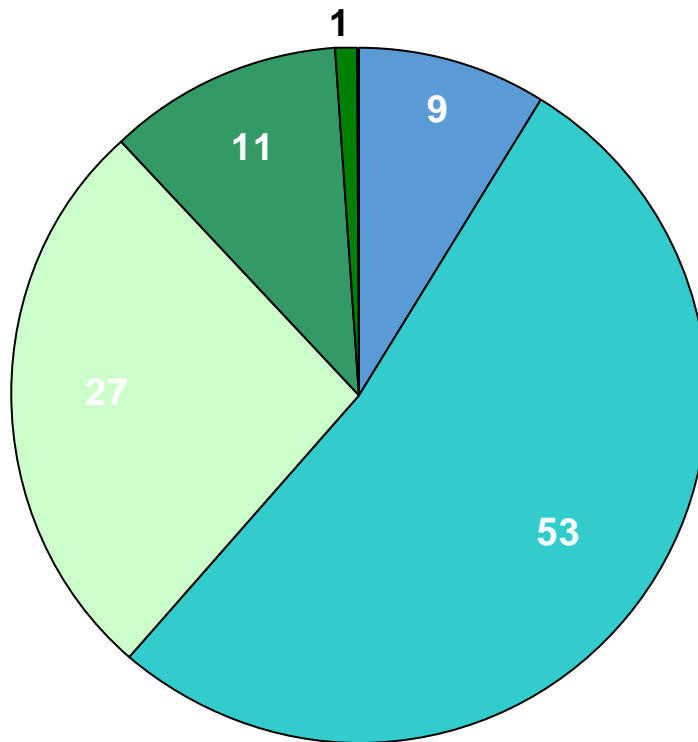
- Supply chains comprise nodes and links



- Nodes – organisational risk
- Links – network risk

“The identification and management of risks within the supply chain and risks external to it through a coordinated approach amongst supply chain members to reduce supply chain vulnerability as a whole”.

“Avoiding the loss of customer confidence and the erosion of shareholder value resulting from supply chain disruption.”



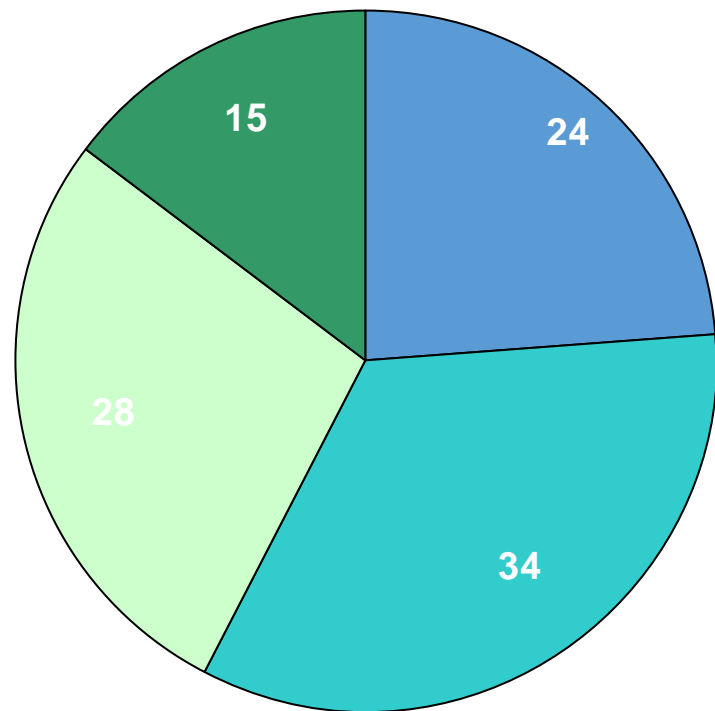
Somewhat Capable

% of respondents¹
(n=3,079)

- Extremely Capable
- Somewhat Capable
- Slightly Capable
- Not Very Capable
- Not at all Capable

¹ All data weighted by GDP of constituent countries; figures do not sum to 100%, because of rounding; excludes respondents who answered “don’t know.”

How does your organisation assess the risks to its supply chain?



On a wing and a prayer

% of respondents¹
(n=2,924)

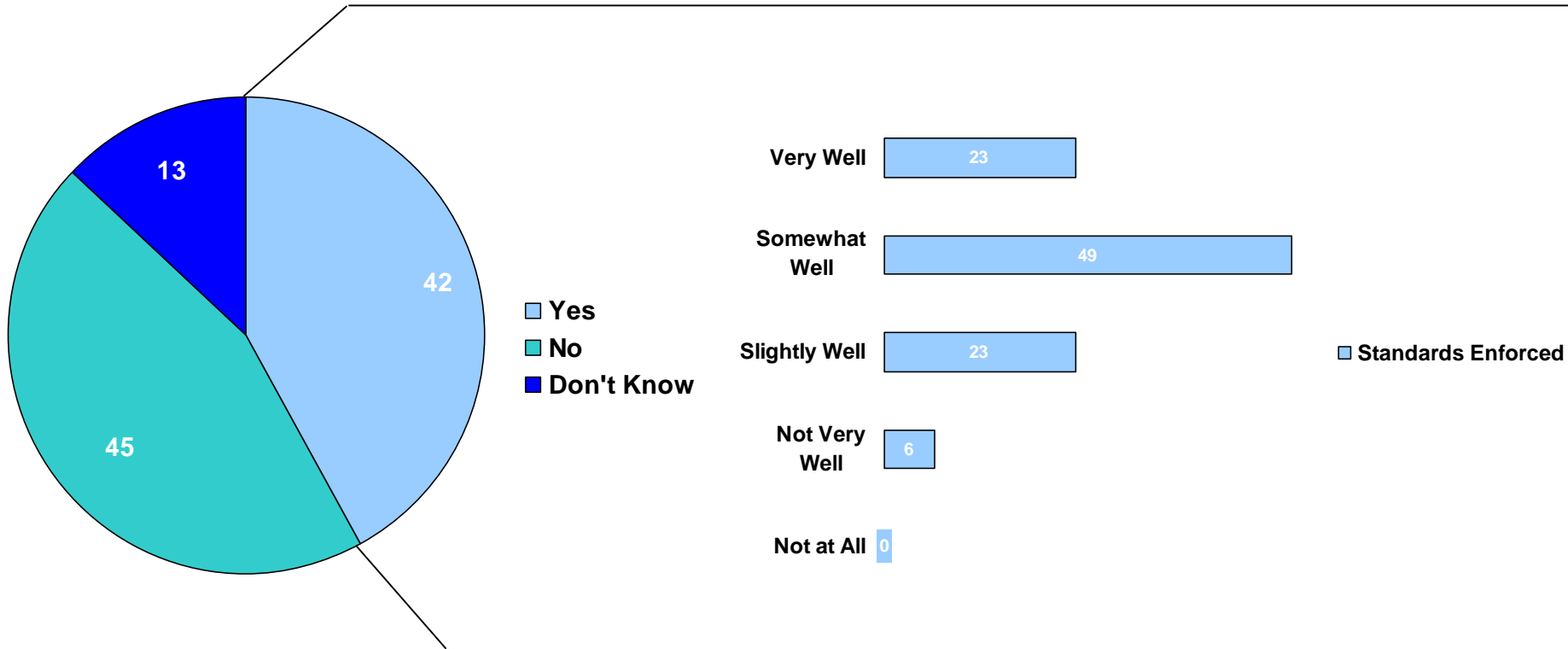
- There is no Formal Assessment
- Qualitatively/Intuitively
- With rough Quantative Estimates
- With Detailed Models of Cash Flow at Risk

¹ All data weighted by GDP of constituent countries; figures do not sum to 100%, because of rounding; excludes respondents who answered "don't know."

% of respondents¹
(n=3,172)

How strictly enforced are those standards and practices?

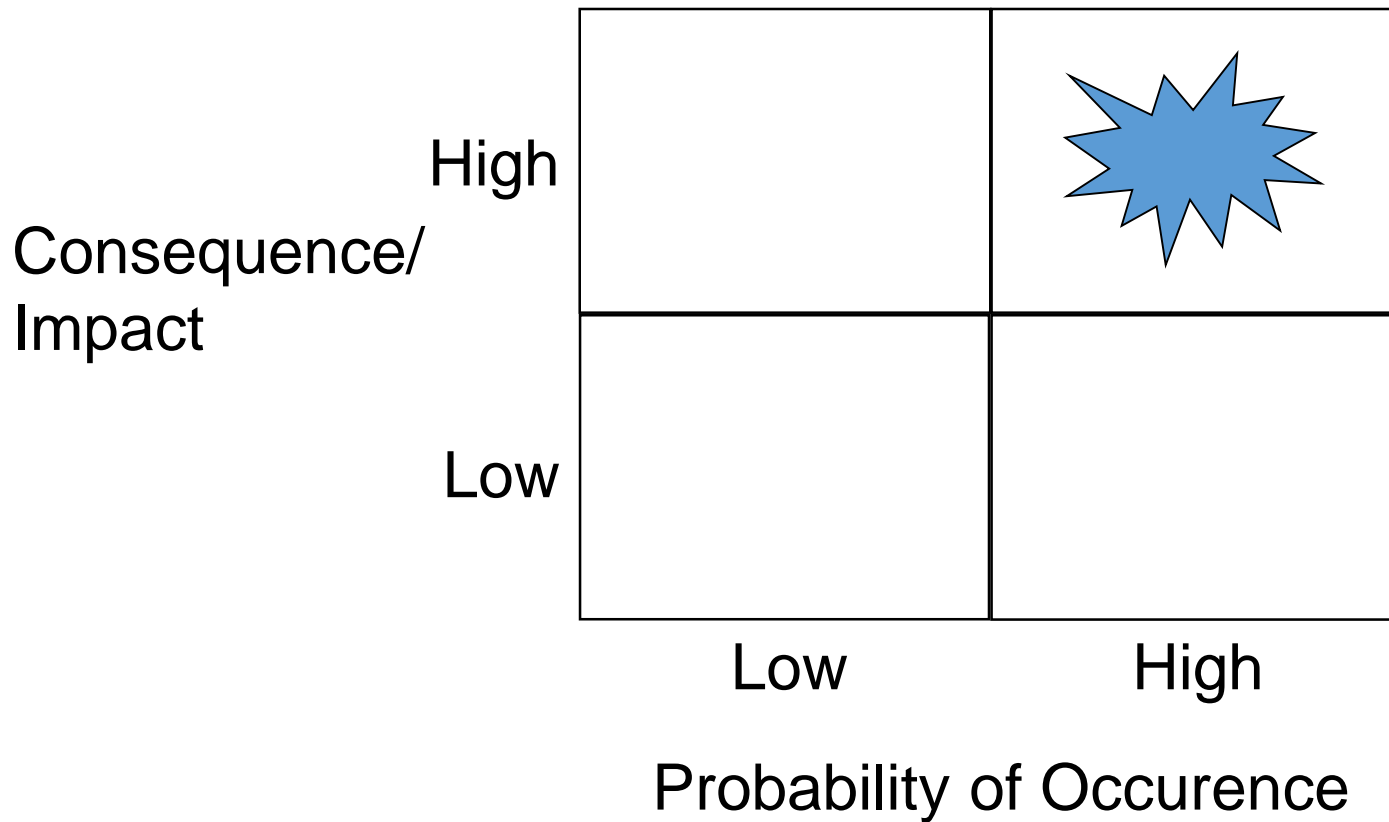
(n=1,301)²



¹ All data weighted by GDP of constituent countries;

² Figures do not sum to 100%, because of rounding; excludes respondents who answered "don't know."

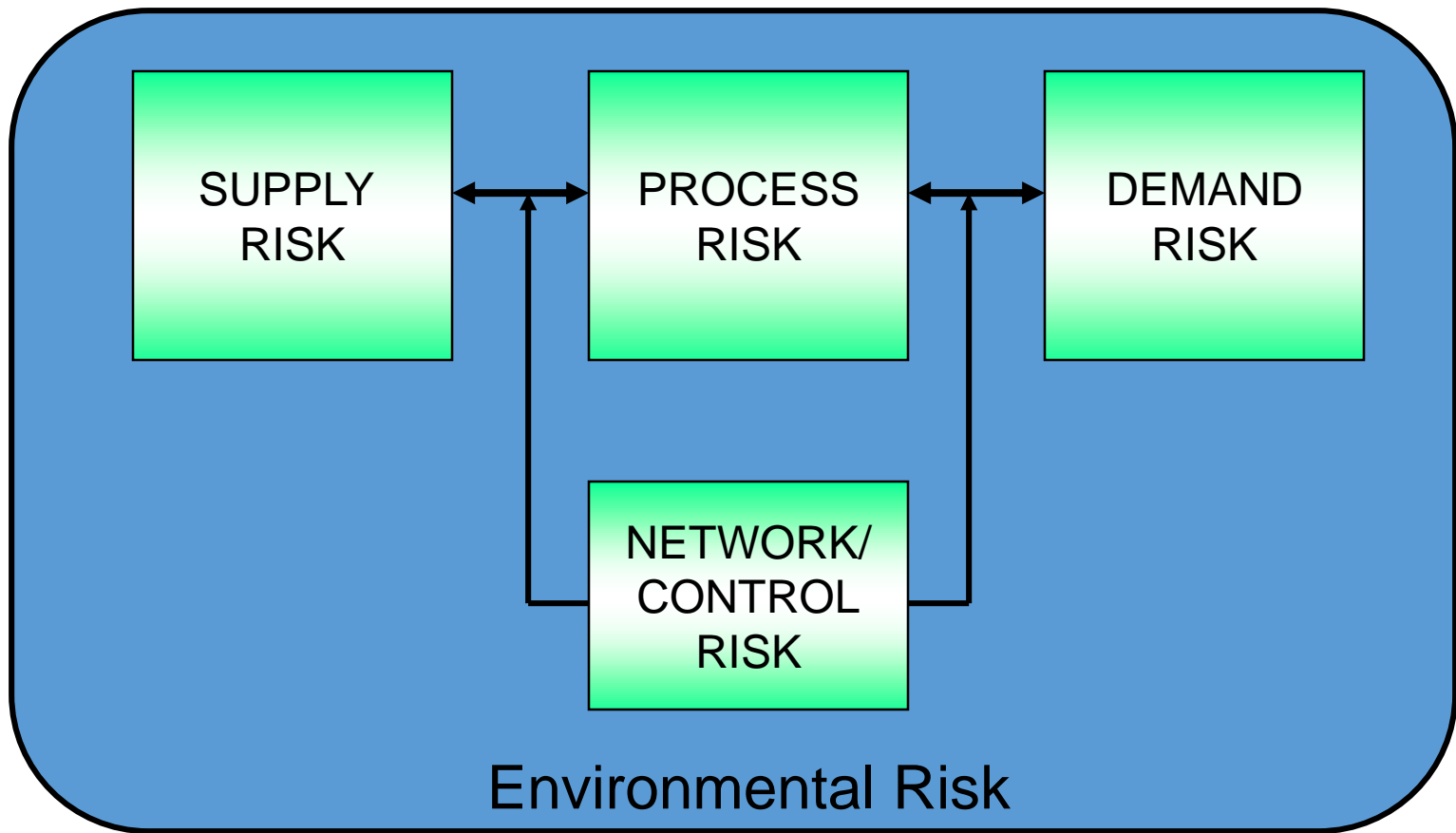
Risk = probability of occurrence x consequences



- Where can we reduce the probability?
- How can we reduce the consequence?

The five sources of risk

- Supply risk
- Demand risk
- Process risk
- Control risk
- Environmental risk



Demand Risk

- Loss of major accounts
- Volatility of demand
- Concentration of customer base
- Short life cycles
- Innovative competitors

Supply Risk

- Dependency on key suppliers
- Consolidation in supply markets
- Quality and management issues arising from off-shore sourcing
- Potential disruption at 2nd tier level
- Length and variability of replenishment lead-times

Process Risk

- Manufacturing yield variability
- Lengthy set-up times and inflexible processes
- Equipment reliability
- Limited capacity/bottlenecks
- Outsourcing key business processes

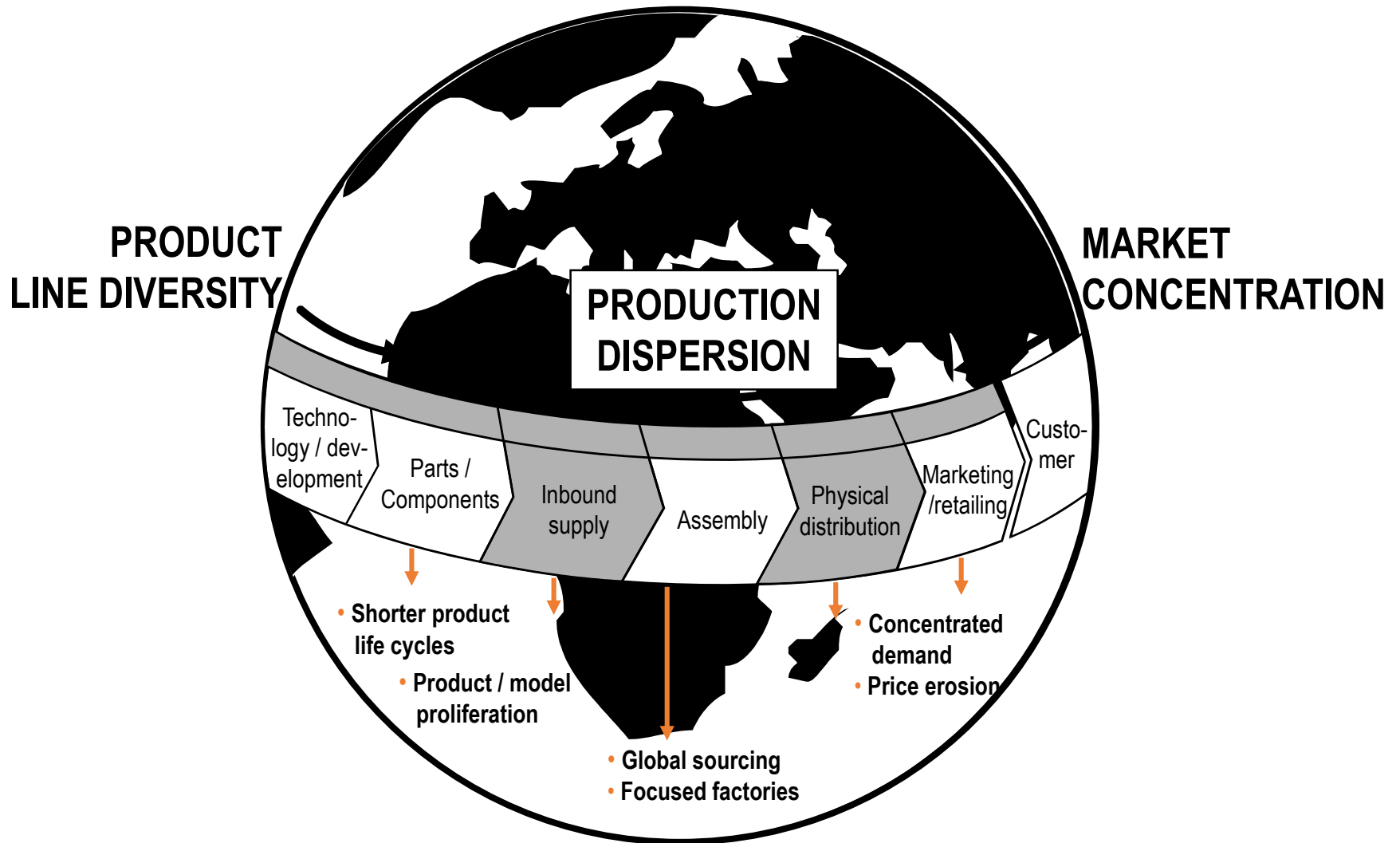
Network/Control Risk

- Asymmetric power relationships
- Poor visibility along the pipeline
- Inappropriate rules that distort demand
- Lack of collaborative planning and forecasts
- Bullwhip effects due to multiple echelons

Environment Risk

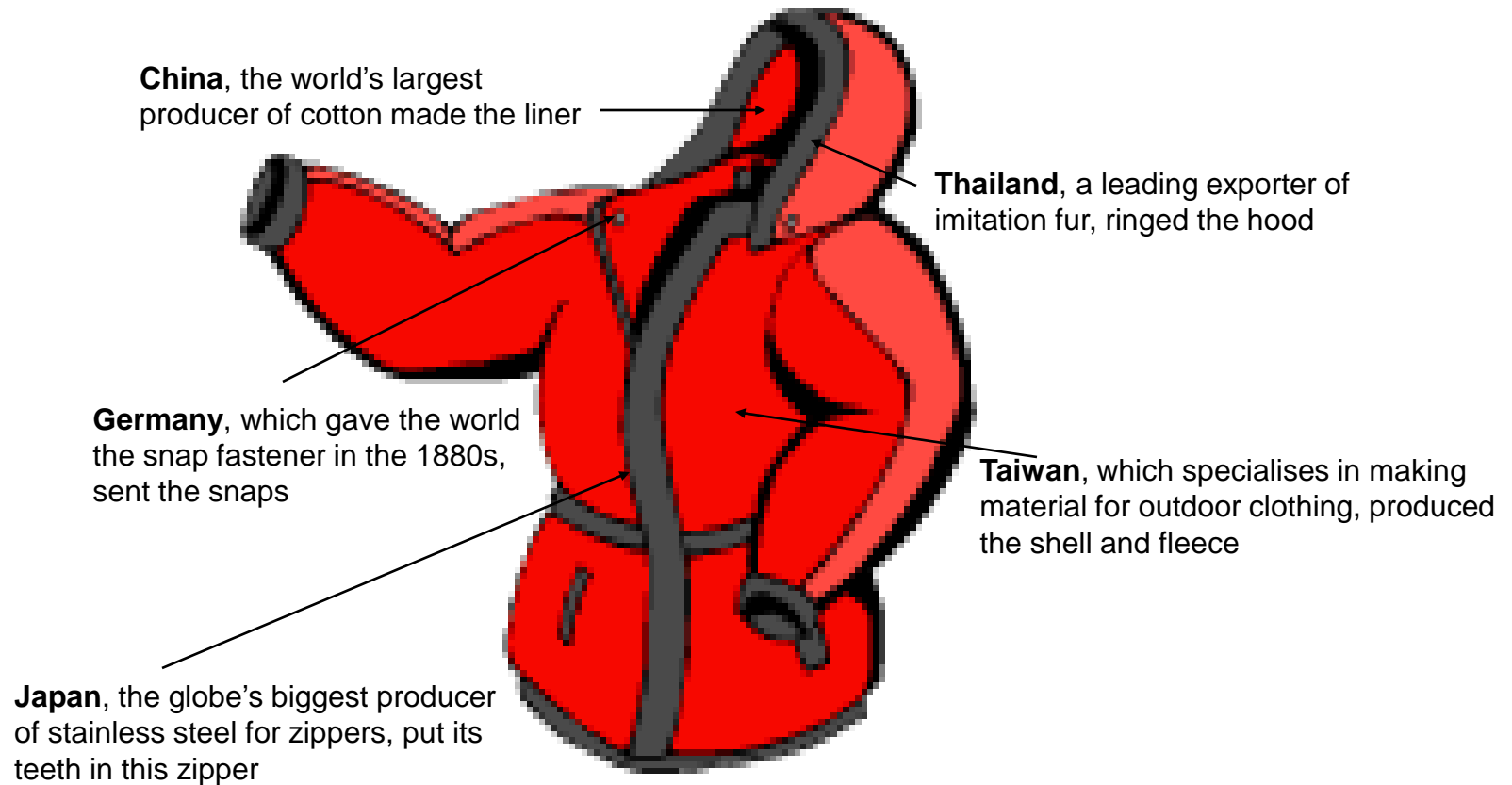
- Natural disasters
- Terrorism and war
- Regulatory changes
- Tax, duties and quotas
- Strikes

The challenge of global logistics



- Body shells from USA
- Motors from Brazil
- Drive Shafts from Italy
- Assembled in Taiwan
- Sold around the world

To make this jacket for the UK market, Hong Kong garment producer Li & Fung ordered materials from factories in five Countries and had them delivered to Thailand, where the jacket was stitched together. Using a network of web-sites, Li & Fung stays in touch with its worldwide suppliers and can compress the time it takes to get items into stores.



Continued trends to off-shore sourcing and focused factories bring reduced costs to purchase/manufacture but

..... have the potential to increase total supply chain costs and to reduce agility.

Not just the purchase price, but

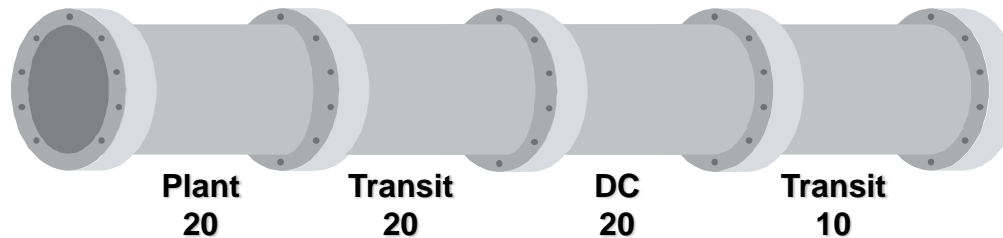
- Increased transport costs
- Increased inventory financing costs
- Increased uncertainty of supply
- Longer lead-times
- Less visibility and increased likelihood of “bullwhip” effect
- Loss of control in quality
- Longer development cycles for new products
- Increased exposure to security risks

..... etc

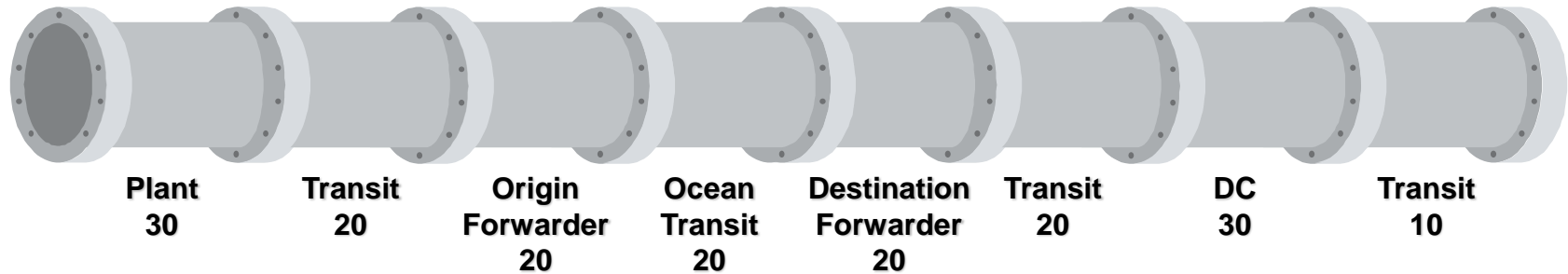
- Due to the length and increased uncertainty of global product pipelines, both planned and unplanned inventories may be higher than optimal

Illustrative inventory comparison: domestic vs. global product pipelines each with customer demand of 10 per week

Domestic Pipeline = 70 units inventory



Global Pipeline = 170 units inventory



- Map the supply chain
- Identify the critical paths
- Utilise cause and effect analysis (TQM tools)
- Implement supply chain event management
- Adopt agile practices
- Formalise supply chain risk management

Critical paths are characterised by:-

- long lead-times
- no short-term alternative source of supply
- bottlenecks
- high levels of identifiable risk (i.e. supply, demand, process, control and environmental risk)

e.g.

- pareto analysis
- asking 'why?' five times
- fishbone charts
- failure mode and effects analysis

80% of disruptions will share 20% of the causes

1. Q. Why did the machine stop?
A. There was an overload and the fuse blew.

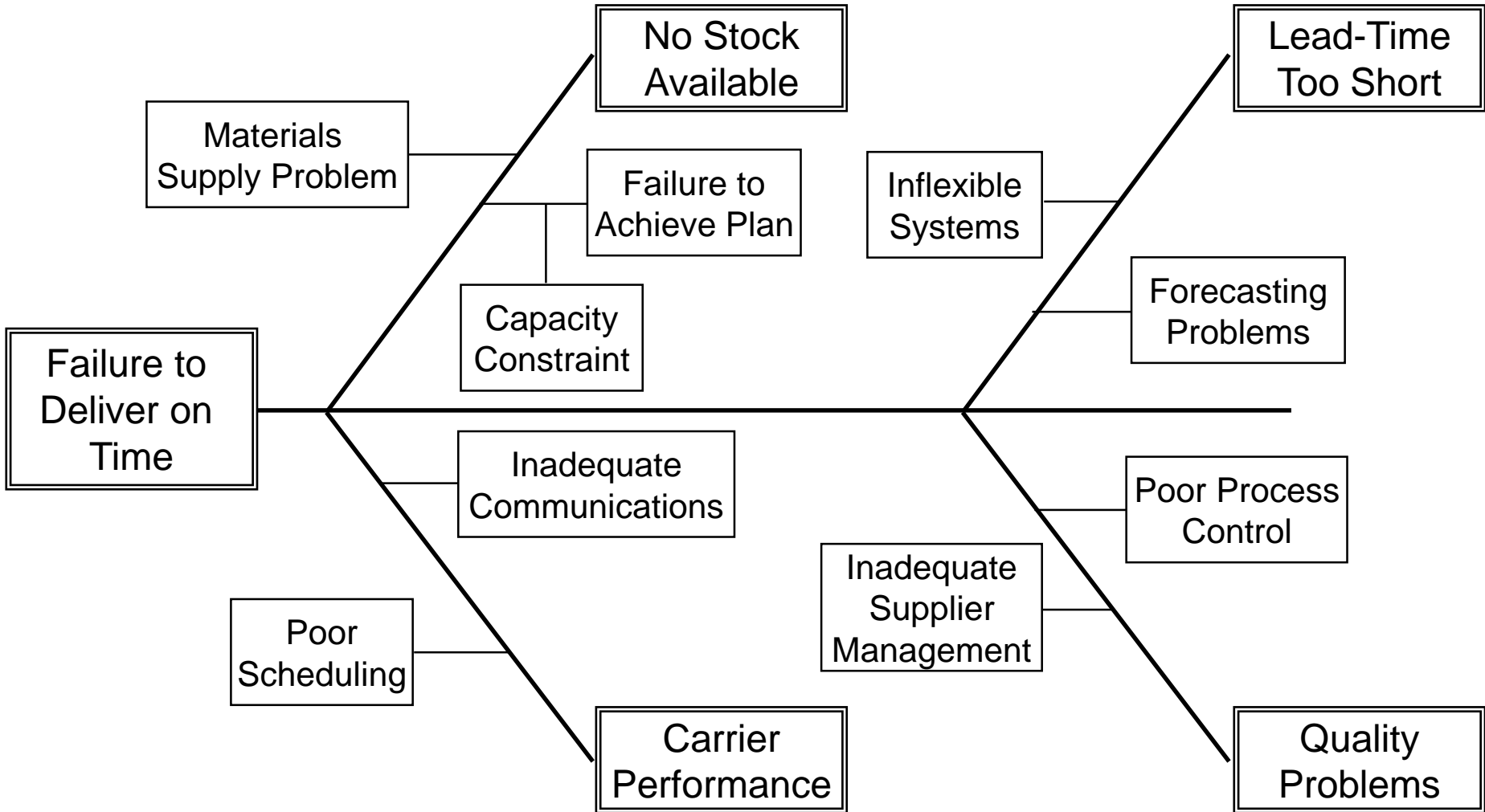
2. Q. Why was there an overload?
A. The bearing was not sufficiently lubricated.

3. Q. Why was it not sufficiently lubricated?
A. The lubrication pump was not pumping sufficiently.

4. Q. Why was it not pumping sufficiently?
A. The shaft of the pump was worn and rattling.

5. Q. Why was the shaft worn?
A. There was no strainer and metal scrap got in.

Repeating why five times like this can help uncover the root problem and correct it. If this procedure were not carried through, one might simply replace the fuse or the pump shaft. In that case the problem would reoccur in a few months.



- Asks three questions:
 - What could go wrong?
 - What effect would this failure have?
 - What are the key causes of this failure?
- Provides an assessment of risk for each possible failure:
 - S = severity of effect
 - O = likelihood of occurrence
 - D = likelihood of detection

S = Severity	<ol style="list-style-type: none"> 1. no direct effect on operating service level 2. minor deterioration in operating service level 3. definite reduction in operating service level 4. serious deterioration in operating service level 5. operating service level approaches zero
O = Likelihood of occurrence	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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

Agile supply chains are designed to respond rapidly to unpredictable change. They are based upon a number of principles:-

- Very close connection to final marketplace
- Visibility of real demand
- High levels of synchronicity upstream and downstream
- Organisational focus on processes rather than functions
- Advanced level of collaborative planning with supply chain partners
- Continuous search for time compression opportunities

What Does it Take to Become More Agile? Zara and M&S's Approach

- Changed structure of network to working directly with more raw material suppliers that have the capability to produce the garments, hence considerably reducing manufacturing time and the risk of miss-communicating design briefs
- Advance technical improvements in raw material supply base and garment manufacturers in QR to meet market demands
- Direct sourcing means that companies have become more agile because the procurement process is much quicker and cost effective
- Sourcing a mixture of suppliers with various skills & with close proximity to market for QR and to enable late configuration of products
- Manage SC risk by avoiding a narrow supply base & enables them to switch product to avoid supply chain disruption caused by political or economic events, or natural disasters

Zara & M&S: Design-Led Supply Chains

- Both **fashion retailers** have integrated design into their supply chains in recognition that this mitigates risk and enhances supply chain agility
 - Starting design procurement process as close to each selling season
 - Avoid costs of storing finished products
 - Make last minute changes (late customisation) as receive trend information & utilise sales information from the current season – hence reducing time-to-market
 - Design-led procurement prevents the build up inventory & enables companies to be more responsive
 - Designers are linked to the buying process and in control of design decisions
- By aligning design with the supply chain in this way, the companies have reduced their exposure to supply chain failure & ensured that suppliers are able to produce exactly what they require

Achieving Agility in The SC Through Design



- There are a number of critical principles underpinning design-led supply chains
 - The Supply chain 'begins on the drawing board'
 - Design is the start of the supply chain, not the end
 - Design must be integrative rather than functional orientation (silo)
 - Supplier integrated approach - (share product knowledge)
 - Multi-functional teams
 - Postponement & Planning
 - De-Coupling
 - Flexible

Design management is a holistic process which is not only concerned with the aesthetics of the product but rather the impact this product will have on the entire supply chain

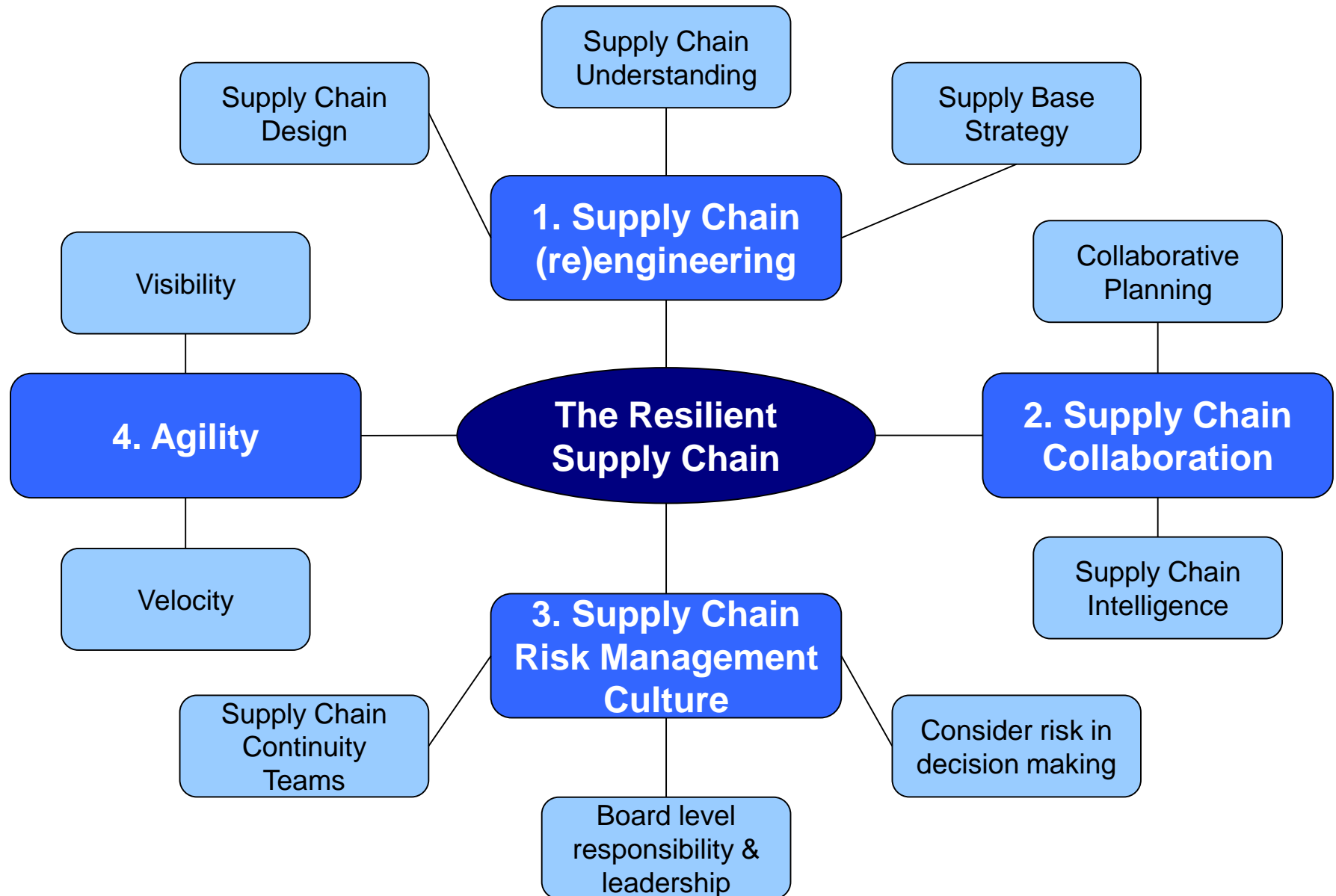
- Supply chain visibility to enable potentially disruptive events to be identified as they happen – or even before they happen.
- Work as a supply chain community to define the business rules and exceptions that need to be monitored.
- Use shared information across the extended supply chain in as close to real time as possible to create supply chain intelligence.

- A robust process can be defined as “a process able to deal with reasonable variability”
- A resilient supply chain can be defined as “a supply chain with the ability to recover quickly from unexpected events impacting supply chain performance”

A robust process can deal with reasonable variability in input whilst maintaining good control over output variability. It has some resilience but is it capable of recovery from an event that causes exceptionally high levels of variability in input or output requirement?

Robust	Resilient
'Lean thinking' central to supply chain management	Risk mitigation central to supply chain management
Lean 	Agile
Strong 	Elastic
Internal <i>quality</i> control	Internal and external <i>risk management</i>
Responsive to reasonable variation in input	Capable of responding to sudden and significant variation in input
Low inventory levels throughout	Built in spare capacity and buffers at critical nodes
Supply chain Velocity	Supply chain Velocity & Acceleration
A culture of quality awareness (i.e. Six Sigma)	A culture of risk and quality awareness
Processes are stable and under control	
Non-value adding activities and processes removed	

Creating a Resilient Supply Chain: Strategic Approaches



*“It is not the strongest of the species that survive
nor the most intelligent, but the one most
responsive to change”.*

Charles Darwin

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