



## Supply chain-related risk management

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### Summary

This paper will review some examples of supply chain-related risks, some theory related to supply chain risk management and conclude with management options from the perspective of a range of stakeholders in the supply chain. However, the start point has to be some understanding of risk and risk management. Two joint standards are used to enable this understanding and link up relevant research.

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### Introduction

The start point for this paper is a question: Why bother with risk management, especially risks to supply chains?

Research has shown that supply chain disruptions in companies listed on US stock exchanges suffered a reduction of about 10% in shareholder value (Hendricks & Singhal, 2003, 2005; Hendricks, Singhal, & Zhang, 2009). Furthermore, the evidence found that firms did not recover quickly from the negative effects of disruptions and the equity risk also increased significantly from the time of the disruption. These results are similar to those found by Knight & Pretty (2002, 2003). Knight & Pretty also demonstrated the beneficial effect on share price of assertive action by the Chief Executive compared with the negative effect of a more reserved style. Such research findings are surely good reasons for actively managing risks associated with supply chains.

Further issues arising are: *What do we mean by 'supply chain'?*, and *Are supply chains really networks?*

Peck (2006) suggested the following definition of supply chains:

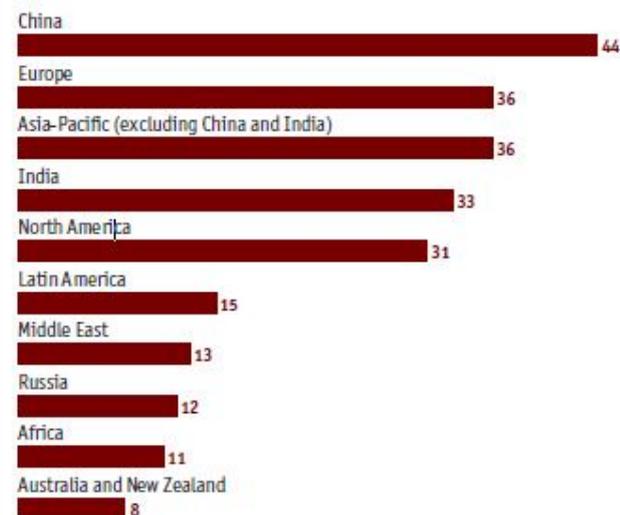
*... supply chains comprise flows of materials, goods and information (including money), which pass within and between organisations, linked by a range of tangible and intangible facilitators, including relationships processes, activities and integrated (information) systems.*

She went on to point out that supply chains may be “linked by physical transport and distribution networks, and national/international communications and transport infrastructures”.

In the past 20 years the western world has undergone a major shift from local, integrated manufacturing to an outsourced world with at least some suppliers offshore and, for major organisations, this trend is likely to continue with expected growth indicated in Figure 1.

If Australia and New Zealand are likely to contribute 8% of the expected growth we clearly need to give assurances that risks in our supply chains are well-managed.

**Figure 1. Regions expected to give greatest contributions to growth 2008-2018**



Source: Economist Intelligence Unit survey, 2008.



## What, then is risk?

Too few people stop to think what risk is or what it means to them personally or in business. That makes it hard to manage risk effectively.

Before looking at some theory and practice of risk and risk management here are some quotes.

*If you want a guarantee, buy a toaster.*

Clint Eastwood

*A ship is safe in harbor, but that's not what ships are for.*

William G.T. Shedd

Or, perhaps, in this context:

*Risk comes from not knowing what you're doing.*

Warren Buffett.

This paper uses the somewhat more serious definition in AS/NZS ISO 31000:2009 *Risk management – Principles and guidelines* (2009) where risk is:

*“the effect of uncertainty on objectives”.*

The definition is supported by five notes that tell us:

- an effect is a deviation from the expected – positive or negative
- objectives can have different aspects such as financial, health and safety, and environmental goals and can apply at different levels such as strategic, organisation-wide, project, product, and process
- risk is often characterised by reference to potential events, consequences, or a combination of these and how they can affect the achievement of objectives
- risk is often expressed in terms of a combination of the consequences of an event or a change in circumstances, and the associated likelihood of occurrence
- uncertainty is the state, even partial, of deficiency of information related to, understanding or knowledge of, an event, its consequence, or likelihood.

Notice that risk is about uncertainty. That is, all risk lies in the future. Once a risk has eventuated we are confronted by issues needing management. Some of those issues may, in turn, give rise to further risks and some risks may be found to give rise to cascades of knock-on consequences.

The standard also tells us that risk management is “the coordinated activities to direct and control an organisation with regard to risk”.

Using definitions from AS/NZS 5050 and AS/NZS ISO 31000 disruption-related risk is the “effect of uncertainty on objectives, arising from the possibility of disruptive events”. Drucker (1974, pp. 511-512) wrote:

*The main goal of a management science must be to enable business to take the right risk. Indeed, it must be to enable business to take greater risks – by providing knowledge and understanding of alternative risks and alternative expectations; by identifying the resources and efforts needed for desired results against expectations, thereby providing means for early correction of wrong or inadequate decisions.*

Some years later Crockford (2005) reviewed Drucker’s work and concluded:

*In short, all management is risk management.*

Thus, we should think of all managers as managers of the risks they are (or should be) accountable for. An organisation may employ specialist “risk managers” but their job is not to manage risks: it is to help the organisation direct, control and coordinate its activities in relation to risk.

The standard, AS/NZS ISO 31000, sets out guidance on establishing a risk management framework to enable cross-organisation coordination of risk management and a risk management process to enable consistent assessments and management of risks. Following the guidance in the standard does not “buy a toaster” (as per Eastwood) but it does enable a ship to leave the harbour (as per Shedd) knowing what it’s doing (as per Buffett).



## Examples of supply chain-related risks and disruptive events

A brief review of some risks and recent disruptive events follows.

A survey of US companies carried out by O’Keeffe (2004) showed that the following supply chain-related sources of risk were considered to be the most important.

- purchase price
- regulation and compliance
- contracts and other legal issues
- customer tastes, satisfaction and service
- process efficiencies
- product introduction and life-cycle
- projects
- information integrity, reliability and availability
- demand and supply planning
- inventory and obsolescence
- fraud
- human resource skills and qualifications
- corporate culture
- change management

We might now want to include natural hazards and other external events that can overwhelm an organisation. Such disruptive events that have occurred at some distance from New Zealand have included floods in Thailand in 2011 (Anon, 2011b; Birsal, 2011) and the volcanic eruption in Iceland in 2010 (Anon, 2011a).

Research by Peck (2006) also identified unintended effects of management decisions leading to shorter lead-times and outsourcing as sources of risk.

The Japan earthquake provided many examples of knock-on effects as small suppliers were damaged or destroyed so disrupting supplies to larger businesses who, in turn, were unable to fulfil orders in the USA, Europe and elsewhere (EIU, 2011). Those customers then were unable to supply to their customers, including New Zealand businesses. The earthquake has continued to have effects on the price of oil and gas due to shutdown of the damaged Fukushima Daiichi nuclear power station and other, undamaged nuclear power stations.

However, we need look no further than the sequences of Canterbury earthquakes 2010-now for examples of disrupted supply chains within the region and at a national level <sup>1</sup>. The Auckland volcanos also show how a relatively minor eruption could disrupt road, air and sea transport as well as production and consumption of manufactured and agricultural goods.

Single point damage to the transport infrastructure in New Zealand also can be disruptive. The last few years have seen several landslides blocking roads (Keith, 2011) and railway lines (Anon, 2010) adding to transport costs and time.

Damage to or loss of container due to storms <sup>2</sup> can disrupt supply chains (Wichmann, 2006) but containers can also be damaged or lost on inland waterways (Wichmann & Kratz, 2007).

Dependencies can have profound effects on a business. In March 2000, a lightning strike resulted in a fire in a Philips microchip plant in the USA. The fire caused little direct damage but almost the entire stock of microchips were contaminated by the smoke. Nokia responded rapidly to the event and grew its business by 3% while Ericsson, a major Philips customer, lost 3% of its business (approximately \$400 million) and eventually was forced out of the mobile phone business leaving Nokia dominant for the next decade (Brazeau, 2005; Starr, Newfrock, & Delurey, 2003).

The 2013 horse meat scandal in Europe (Anon, 2013a) resulted in a public outcry, resignations of politicians, litigation and criminal prosecutions. In a sequel, the veterinary drug phenylbutazone has been found in British corned beef resulting in a further outbreak of public concern (Anon, 2013c).

Occupational health and safety in supply chains has not been widely considered as a risk to others in the chain but regulatory agency interest has been growing (Benjamin & White, 2006; Walters & James, 2009; Winkler & Irwin, 2003) as it becomes apparent that some harm to people is caused indirectly (ie, other than by their employer). It also has the potential for influence by major manufacturers and retailers as a component of corporate social responsibility (Peace, 2009).

<sup>1</sup> The protracted loss of supply of Marmite, a favourite New Zealand spread for toast, was the cause of much breakfast-table grief.

<sup>2</sup> In his 2011 book, *Moby-Duck*, Donovan Hohn describes his research into the source of 28,800 bath toys lost at sea in 1992. The toys subsequently aided oceanographic research as well as adding to plastic pollution of the oceans and beaches.

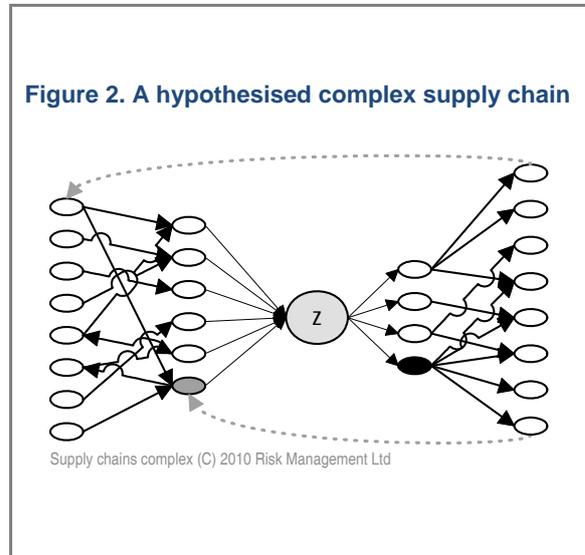
A related issue for New Zealand food exporters has been food miles, with some European food producers complaining about the carbon-cost of food exports to the European Union. Much work has now been done to counter such arguments (see, for example, Saunders, Barber, & Taylor, 2006).

A further related issue is the long-term cost of oil, its likely effect on the New Zealand economy generally (Donovan *et al.*, 2008) and exporters and importers more specifically. Recent reductions in the price of shale gas in the USA have affected investments in energy the USA and might affect investments in New Zealand and elsewhere.

As Figure 2 suggests, complex, even amorphous supply chains (Ritchie & Brindley, 2000) now seem the rule rather than the exception with suppliers becoming customers and customers supplying suppliers,

We often think of disruptive events as happening at a single point in time. However, changes spread over months or years can affect or disrupt supply chains. The European Environment Agency has published research showing the impact of shipping on air quality and climate change (Aardenne *et al.*, 2013) and the International Maritime Organization is reviewing how to reduce pollution from shipping (Anon, 2013b). The likely changes to shipping will add cost to supply chains and might have unexpected impacts on New Zealand shipping and trade.

Figure 2. A hypothesised complex supply chain



### What to do about supply chain-related risks?

Given the potential for supply chain-related risks to destroy shareholder value, deciding to manage such risks is surely plain common sense. However, the long-term solution is resilience (the “adaptive capacity of an organisation in a complex and changing environment” (SA/SNZ, 2010) rather than dependence on *Maginot Line*-type defences<sup>3</sup> and voluminous business continuity plans that are out of date before they are published or tested.

Achieving resilience starts with an understanding of the context of the organisation and business environment of the supply chain, including objectives and criteria. It then leads on to diagnosing organisation-wide risk and interdependencies (Starr *et al.*, 2003). Such diagnosis requires a risk assessment of the supply chain but this in turn requires an understanding of how supply chains can be conceptualised. Peck (2006) reviewed a range of research and argued supply chains can be considered at four levels:

- 1: value stream, product or process
- 2: asset and infrastructure dependencies of the goods and services at level 1 where the nodes are the assets or infrastructure
- 3: organisation and inter-organisation networks where supply chain organisations are the nodes
- 4: the context or business environment in which the supply chain operates.

Peck also discussed “extended enterprises” based on powerful organisations willing to share their knowledge and power. Tang (2006) also reviewed research on supply chain risk management and concluded it was possible to conceptualise four sources of risk along two axes see Figure 3 on the next page:

- supply and demand
- product management and information management.

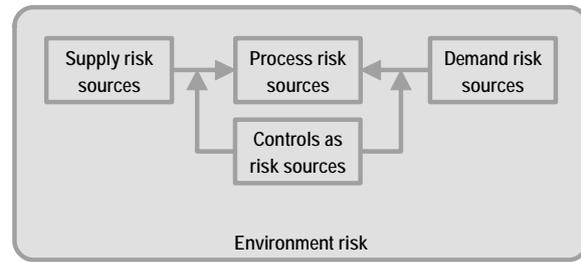
<sup>3</sup> A vast fortification built 1930-1940 that spread along the French/German border but became a military liability when the Germans attacked France in the spring of 1940 using blitzkrieg – a tactic that completely nullified the Maginot Line’s purpose.



**Figure 3. Four approaches to supply chain risk sources**



**Figure 4. Sources of risk in the supply chain**



Source: Tang (2006)

Depending on the supply chain analysis level and risk source being assessed, risk assessment techniques might include strengths/weaknesses/opportunities/threats (SWOT) or political, economic, social, technological, legal and environmental (PESTLE) analysis, flowcharting, horizon scanning, concept mapping and structured-what-if-then (SWIFT) analysis.

Flowcharting can help raise questions about supply chain visibility (ie, the ability to see from one end to the other) while SWIFT can raise questions about supply chain velocity (ie, the speed with which orders are fulfilled). Both give invaluable (and quick) insights into what might happen if a hypothesised event were to happen. Such techniques can be applied to risk sources including (Kleindorfer & Saad, 2005):

- operational contingencies
- natural hazards
- political instability.

Christopher, Peck, & Towill (2006) analysed generic demand and supply characteristics and developed Table 1 below. Using this model, the risk assessment should provide data on product replacement lead times and demand characteristics.

**Table 1. Demand/supply characteristics and pipeline types**

Replenishment characteristics	Long lead time	<b>Lean: plan and execute</b>	<b>Lean/agile: postponement</b>
	Short lead time	<b>Lean: continuous replenishment</b>	<b>Agile: quick response</b>
		Predictable demand	Unpredictable demand
Demand characteristics			

Using the results from a risk assessment of the whole supply chain an organisation can adapt its corporate strategy and operating model to manage risks in the supply chain. It needs little imagination to conclude a risk assessment is founded in a deep understanding of the context of the supply chain along with considerable communication and consultation with other organisations in the supply chain.

In an earlier paper Christopher & Peck (2005) provided a slightly different version of Tang’s model; theirs included controls and the environment – see Figure 4 above. The AS/NZS ISO 31000 and AS/NZS 5050 risk management process diagrams and descriptions include controls and the business environment in risk assessments as suggested by the Christopher & Peck model.

A survey carried out by O’Keeffe (2004) suggested that key controls for supply chain-related risks were:

- an integrated and supported supply chain supported by the strategic plan
- an organisation-wide sourcing process
- effective supplier and contract management.

Kleindorfer & Saad (2005) suggested 10 principles for effective supply chain risk management, including the following strategies:

- first, ensuring resilience in one’s own organisation



- diversification of locations, sourcing options, logistics and operational modes
- enhancing the robustness of the weakest link in the chain
- avoidance of extreme leanness and efficiency
- establishing back-up systems and contingency plans; testing of plans and work-around plans
- collaborative sharing of information with others in the supply chain (ie, building genuine, long-term partnerships)
- using information from risk assessments to help understand the potential for damage to the supply chain
- development of modular product and process designs to enable agility and flexibility.

However, some of the above carry trade-off costs, see Table 2 below.

**Table 2. Simple/compact vs complex/dispersed trade-off**

Simple and compact business	Complex and dispersed business
More vulnerable to disruption	Less vulnerable to disruption
Lower overheads	Greater overheads
Fewer transaction costs	More transaction costs
Greater potential for economies of scale	Less potential for economies of scale
Harder to customise	Easier to customise

Source: Armstrong & Alsop (2010)

Developing such tailored risk controls will lead to the ability to accept increased risk and supply chain complexity. An organisation will also need to develop business intelligence and risk monitoring systems to help further improve decision-making and responses to risk as it changes over time.

Resilience then becomes “a relative expression describing one outcome of the organisation’s risk management activity. It is not a process, system or framework or other single element of an organisation” (SA/SNZ, 2010). Further, resilience is not a permanent state; it requires organisational effort to maintain an adaptive capacity in a complex and changing environment. Without such effort, resilience is transient.

## The future?

What might the future hold? Ritchie & Brindley (2000) presaged some of the changes the internet and ecommerce would bring, including changes in relationships leading to more amorphous supply chains. More recently, an article in *The Economist* has discussed how supply chains (a western concept built for first-world economies) are making it easier for developing-world economies to compete with first-world companies and economies (Anon, 2012).

Much of the underlying language and structure for this paper is adapted from AS/NZS 5050 *Business continuity: management of disruption-related risks*. That standard is, in turn, based on AS/NZS ISO 31000:2009. *Risk management – Principles and guidelines*. Work is in hand on the joint standards committee, OB007, developing a handbook giving more detail to AS/NZS 5050.

Risk is the effect of uncertainty on objectives regardless of whether the objectives are supply chain-related or elsewhere in organisations. Managing risk in a structured manner using AS/NZS ISO 31000 and AS/NZS 5050 will help organisations achieve their objectives.

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## About Risk Management Ltd

Risk Management Ltd provides evidence-based risk management consultancy and training services to clients in New Zealand, Australia and Asia.

### Consultancy services

Our consultancy services include risk assessments, help with developing risk management frameworks and processes, independent opinions for insurers and acting as an expert witness.

Some of our consultancy work requires extensive reviews of research evidence and trends elsewhere in the world. Examples of such work are in the sidebar to the right.

### Training services

We offer two-day public courses including the following:

- establishing the risk management framework
- applying the risk management process
- managing disruption-related risk
- managing compliance and risk
- managing OHS-related risk
- managing environment-related risk
- managing project risk
- achieving risk management excellence.

Please visit [www.riskmgmt.co.nz](http://www.riskmgmt.co.nz) for the latest information about courses.

These courses are based on standards published by Standards New Zealand, including:

AS/NZS ISO 31000:2009 *Risk management – Principles and guidelines*

ISO 31010: 2009 *Risk Management - Risk Assessment Techniques*

AS/NZS 5050: 2010 *Business continuity: management of disruption-related risk*

We also apply the guidance in handbooks published by Standards New Zealand and Standards Australia.

Courses can be tailored for specific needs of an organisation. In some cases, courses are a combination of training and consultancy work. This can help an organisation to both understand risk management better and develop plans to improve the application of risk management.

All training notes are fully referenced to enable course participants to follow up on topics of interest.

### Expert witness services

Chris Peace has investigated events and reported to clients. He also has acted as an expert witness in court cases under a range of legislation.

#### Consultancy case studies

##### PSMS in the gas and electricity industries

In 2010 the Gas and Electricity Acts were amended to include requirements for audited public safety management systems (PSMS) if members of the public could be harmed by gas or electricity assets. A client asked us to identify what should be in a PSMS. We researched the background to occupational health and safety management systems (OHSMS) and PSMS. We found the research evidence on OHSMS was uncertain (ie, some work, some don't) and there was no mention for PSMS, let alone what they might include.

We also found such gas and electricity assets in New Zealand had a better safety record than elsewhere in the world. Recently, we have helped lobby for repeal of such needless legislation and application of regulatory impact statements to all proposed legislation.

##### Vulnerability survey

A client was trying to quickly gather information on vulnerabilities at more than 60 production and retail sites across Australasia. They asked us for conceptual ideas and we suggested an online survey to be completed by each site manager. We then developed the survey and they completed the project in-house.

##### Business continuity management

In early 2012 a large organisation with staff spread over three buildings on one campus asked for help with developing site-specific business continuity management. As part of the risk assessment we found the buildings might not meet current earthquake code requirements. While adaptations to business continuity management have proceeded, the client is now actively searching for alternative office accommodation.

##### Legal liability for pest control

A key pest control agency asked us to review their potential legal liabilities arising from pest control work. We researched the science background and the operational controls and concluded their exposure was very low.



## Joint standards committee work

Since 2007 Chris has been a member of the joint standards committee, OB007, that has oversight of risk management standards and handbooks published in Australia and New Zealand. He now represents the New Zealand Institute of Safety Management on that committee.

## Our resources

Our work is supported by a library containing more than 7,000 books, research and magazine journal articles, standards, reports and other documents. These are catalogued to make it easy to find documents relevant to a project. When used in a report, the documents are referenced so clients know where information came from and can follow up on sources of interest.

The company is a member of Standards New Zealand through a related business, Risk Management Associates Ltd, owned jointly with Business Continuity Planning Ltd.

We often collaborate with other organisations and colleagues to develop solutions for clients.

## Applied research

We are currently researching the effectiveness of risk assessments in relation to decision-making and corporate governance.

## Our website

Check our website [www.riskmgmt.co.nz](http://www.riskmgmt.co.nz) for articles, conferences and updated course information.

## How to contact us

For further advice or information drop us a line or call our number!

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### Risk assessment & business continuity

The insurer of a food manufacturer required the development of a business continuity plan. We carried out a risk assessment and suggested a simple plan based on mutual aid with other companies.

### Transport of LPG in NZ and other countries

We were asked to review current and emerging risks associated with land transport of bulk LPG.

Our research covered the period from the early 1980s (when LPG was first exploited in New Zealand) to 2010. It included a search of key databases and the 2009 Via Reggio, Italy disaster.

### Trends in enforcement

A regulatory agency asked us to help develop better policies and procedures for enforcement. We researched effective enforcement activities and trends in enforcement in the UK, USA, Europe and Australia.

This enabled us to develop a model based on (1) regulatory agency liaison with key organisations that could act as influencers and (2) more enforcement attention on areas of high non-compliance.

Such a model had the potential to be more cost-effective than traditional approaches to enforcement.

### Captive insurance companies in NZ

In 2008 proposed changes to the regulation of insurance companies threatened the continued viability of captive insurance companies. It also jeopardised future opportunities for the use of such risk finance vehicles.

We researched aspects of captive insurers in New Zealand and elsewhere and prepared a submission to the Reserve Bank of New Zealand.

### Insurable risk and insurance

A timber company found their insurance costs were becoming unsustainable and asked for suggestions for alternative risk controls. Our suggestions included improved fire protection and a change to the business model.