# Mitigating Supply Chain Risk Through Improved Confidence

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**Key words : supply chain risk, confidence, visibility, control**

**Abstract**
Today's marketplace is characterised by turbulence and uncertainty. Market turbulence has tended to increase for a number of reasons. Demand in almost every industrial sector seems to be more volatile than was the case in the past. Product and technology life-cycles have shortened significantly and competitive product introductions make life-cycle demand difficult to predict.

At the same time the vulnerability of supply chains to disturbance or disruption has increased. It is not only the effect of external events such as wars, strikes or terrorist attacks, but also the impact of changes in business strategy. Many companies have experienced a change in their supply chain risk profile as a result of changes in their business models, for example the adoption of 'lean' practices, the move to outsourcing and a general tendency to reduce the size of the supplier base.

This paper suggests that one key element in any strategy designed to mitigate supply chain risk is improved 'end-to-end' visibility. It is argued that supply chain 'confidence' will increase in proportion to the quality of supply chain information.

Managing supply chains in today's competitive world is increasingly challenging. The greater the uncertainties in supply and demand, globalisation of the market, shorter and shorter product and technology life cycles, and the increased use of manufacturing, distribution and logistics partners resulting in complex international supply network relationships, have led to higher exposure to risks in the supply chain (Christopher et.al., 2002).

Supply chain risks come in many different forms (Harland & Brenchley, 2001). First, the *financial risks* can be huge. Inventory costs due to obsolescence, markdowns and stock-outs, can be significant. Personal computers devalue by more than one percent per week. In the USA retail markdowns constitute about 20% of total retail volumes. Mismanaged supply chains, leading to excessive or mismatched inventory, are thus liable to huge financial risks. Financial risks can also present themselves through the risk of reworking stock and penalties for non-delivery of goods.

The complexity and uncertainty within a supply chain can also increase the *"chaos" risks* within the supply chain. These chaos effects result from over-

reactions, unnecessary interventions, second guessing, mistrust, and distorted information throughout a supply chain (Childerhouse, et.al, 2003). The well-known "bullwhip" effect (Lee, et.al., 1997), which describes increasing fluctuations of order patterns from downstream to upstream supply chains, is an example of such chaos. Deming called this "nervousness." This increased nervousness will of course lead to higher costs and inefficiencies through over-ordering and 'squirreling' of inventory.

In addition, there are many unexpected and unpredictable disruptions that add to the risks of a supply chain. The closure of the US air space after the terrorist event of September 11, 2001; the longshoremen strike in California in 2002, and the outbreak of SARS in 2003, are examples of events that paralysed supply chain flows. The impacts of such disruptions can be catastrophic.

The existence of nervousness and chaos in a supply chain also means that it is difficult to make optimal decisions at each stage in the supply chain. The risks of making the wrong or ineffective decisions, or *decision risks*, become the inevitable consequence. Thus, for example, it will not be possible to design optimal production schedules if there is uncertainty as to when materials or components will be available.

Ultimately, the supply chain is exposed to *market risks*, i.e., missing the market opportunities that may exist. A supply chain cannot be responsive to changing market trends and customer preferences if the right market signals cannot be recognised. For example, a supply chain cannot support a new product launch if it is unable to change production or supplies to meet demand. Finally, market opportunities can be missed when customer orders with short lead times cannot be met.

A supply chain with high risk exposure cannot be efficient. A manager running a supply chain with these risks lacks confidence in the supply chain. Table I shows some of the many ways in which supply chain confidence can be impacted.

**Table 1 : Lack of Supply Chain Confidence**

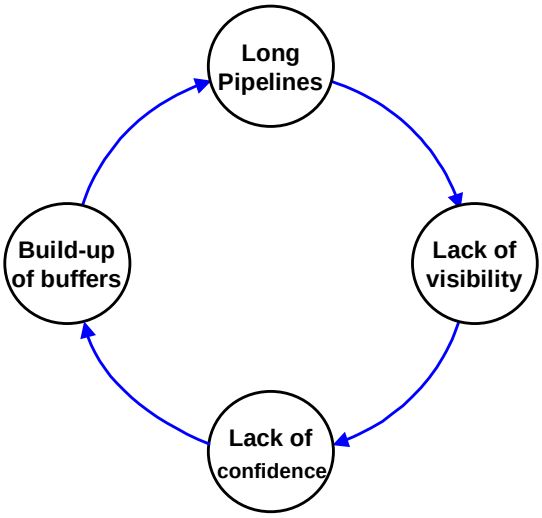
| **No confidence in:** |
|---|
| • Order cycle time<br>• Order current status<br>• Demand forecasts given<br>• Suppliers' capability to deliver<br>• Manufacturing capacity<br>• Quality of the products<br>• Transportation reliability<br>• Services delivered |

**The Risk Spiral**

Where do these supply chain risks come from? There are evidently tangible risks in the supply chain which lead to its poor performance (Wilding, 1998), for example, high levels of process variation, but what are not recognised in the same way are the intangible elements, for example, the attitudes and perceptions of the users and members of the supply chain. The intangible lack of confidence in a supply chain leads to actions and interventions by supply chain managers throughout the supply chain, which collectively, could increase the risk exposure. A classic example of this is the potential reaction from the customer-facing end of a business. For example, if a sales team believes that order cycle and order fulfilment times are not reliable, they will devise their own means of addressing this. They may order stock so as to have supplies to support their key customers and put in phantom (i.e. their own private buffer stock) orders to secure supply, all causing inefficiencies. Figure 1 depicts the risk spiral as a self-perpetuating descent into chaos. Because there is no visibility of upstream and downstream flows and stocks, confidence declines and decisions are taken to buffer the interfaces in the supply chain with inventory to cope with uncertainty. These inventory buffers then serve to further obscure supply chain visibility because the end-to-end pipeline is now longer as a result of the build up of inventory.

These effects are reinforced by the actions taken by workers to ignore the formal system and create an operative informal system

**Figure 1 : The risk spiral**




Without supply chain confidence, entities within the supply chain are liable to chaos and decision risks and the acceleration and expansion of the above spiral. Sales people start over-ordering since they do not have timely visibility of the correct demand signals, or they know from experience that supplies may be late or insufficient to fill the complete orders. Production plans are based on inflated production lead times due to similar lack of visibility and control. "Safety lead times" are commonly used in standard MRPs, since production planners do not want to be blamed for production delays. The lack of means to expedite or flexibility in manufacturing also means that any yield shortfalls or production downtimes have to be made up by additional production, and as a result, lead times are stretched out in production plans.

This risk spiral exists everywhere, and the only way to break the spiral is to find ways to increase confidence in the supply chain. To do so, we need to understand the elements of the supply chain that can reduce the lack of confidence – visibility and control.

### Visibility

Confidence in a supply chain is weakened when end-to-end pipeline time, i.e., the time it takes for material to flow from one end of supply chain to the other, is long. The increased globalisation of supply chains and the prevalent use of subcontract manufacturing and offshore sourcing can contribute to the length of time it takes to complete all the needed steps in the process. Associated with pipeline length is the lack of visibility within the pipeline. Hence, it is often the case that one member of a supply chain has no detailed knowledge of what goes on in other parts of the chain – e.g. finished goods inventory, material inventory, work-in-process, pipeline inventory,

actual demands and forecasts, production plans, capacity, yields, and order status.

The key to improved supply chain visibility is shared information among supply chain members. Traditionally companies have tended to subscribe to the view that 'information is power' and to interpret the phrase as meaning power is diminished if that information is shared. In fact in supply chains the reverse is true. If information between supply chain members is shared, its power increases significantly. This is because shared information reduces uncertainty and thus reduces the need for safety stock. As a result, the system becomes more responsive and, ultimately, could become demand driven rather than forecast driven. Mason-Jones and Towill (1997 and 1998) have demonstrated that 'information-enriched' supply chains perform significantly better than those that do not have access to information beyond their corporate boundaries.

**Control**

In addition to visibility, supply chain confidence requires the ability to take control of supply chain operations. Paradoxically, most supply chains do not have a great deal of control once the order is released. Hence, even if a supply chain manager has visibility of some part of the pipeline, he/she often could not make changes in a short time. For example, even if information is obtained on demand changes or on yield shortfalls, the supply chain manager may be helpless, since the suppliers may not be flexible enough to respond to late changes, or there are no expediting options available, or the production line is inflexible and production schedule changes are not feasible, etc. Semiconductor manufacturers are often faced with this problem of lack of control. In this industry, the long lead times required by foundries are such that, even if the manufacturer is made aware of sudden market demand changes, it takes a long time to respond so that the market opportunities are then missed.

Recently there has been much interest in the 'Six Sigma' methodology as a way of reducing variability in processes (for example, George 2002). Six sigma tools such as control charts and Failure Modes and Effects Analysis (FMEA) can be very helpful in identifying the opportunities for reducing process variability in supply chains. However, these tools and methodologies are primarily of benefit within the business for the control of repetitive activities. In looking to improve control across the wider supply chain a more collaborative approach to control is required. The newly emerging field of Supply Chain Event Management (Stiles, 2002) holds some promise here. The idea behind Event Management is that partners in a supply chain collaborate to identify the critical nodes and links through which material flows across the network. At these nodes and links, control limits are agreed within which fluctuations in levels of activities are

acceptable e.g. shipments from an off-shore manufacturing source. If for whatever reason the level of activity goes outside the control limit, then an alert is automatically generated to enable corrective action to be taken.

**The impact of loss of confidence**

Without visibility and control, it is common that the supply chain is plagued with buffer inventories. Buffering is another means employed by supply chain managers to hedge against the uncertainties and risks in the supply chain. Excessive inventory of course leads to higher financial risks. Another means by which supply chain managers hedge against supply chain uncertainties and risks is through investing in excessive capacity. The well-known episode of 1995-6 in the semiconductor industry is such a lesson. The conditions of 1995 were chaotic, with many IC orders left unfilled, lead times were excessive, and supplier unreliabilities were at an all-time high. Worried that demand would continue to outstrip supply, semiconductor manufacturers were concerned to find ways to assure supply. The problems faced by fab-less semiconductor manufacturers were even more acute. Without clear demand and supply visibility throughout the supply chain, and the feeling of not having control of their own fabrication capabilities resulted in many fab-less semiconductor manufacturers finding ways to invest in capacity – some purchased wafer capacities with foundries, some co-invested in new fabrication lines with their foundry partners, and some toyed with ideas like capacity options in the same way that options work in the financial market. When the 1996 market did not turn out to be as rosy, many of these manufacturers incurred significant financial losses.

Without confidence, logistics providers also have to build slack into their operations. Quoted transportation lead times may have built-in safety times, and extra shipping capacities may need to be purchased. Lacking visibility of shipment and requirement schedules, unnecessary expedite shipments may be taken, or the wrong mode of transportation is used.

The lack of confidence also makes it difficult to be responsive to customers, to react to changes in market conditions, and to be competitive in providing customer service. Lead times quoted to customers tend to be longer, since added protection is needed when the sales representative does not have confidence in the supply chain. Similarly, contracts may be constructed in ways that do not give much flexibility to customers, and special requests by customers are turned down. The supply chain is no longer competitive. The supply chain is thus liable to market risks. This is exactly the situation that Adaptec, a semiconductor manufacturer, was faced with in 1997. The inability to quote precise order lead times to their customers, and the failure to meet the lead times reliably resulted in loss of market share.

Of equal concern is the risk to the business of a sudden downturn in demand whilst inventory levels are high through excessive buffering.

Probably one of the biggest and most costly examples of what can happen when supply chains are heavily buffered at the same time that demand declines, was provided by Cisco in 2001 when they announced an inventory write-off of US$2 billion as a result of a dramatic fall-off in orders for their network infrastructure products. Because demand for those products had previously been rising at a meteoric rate and supply of components was often constrained, all levels in their supply network had been buffering through placing additional orders.

With excessive buffer inventory and capacity throughout a supply chain, as well as long pipelines from end to end, the information pertaining to the status and problems within the supply chain is also less available meaning that prompt actions to respond to irregularities or unexpected events are less feasible. Thus, there is even less confidence in the supply chain operation, and the vicious cycle of the risk spiral repeats itself – lack of supply chain confidence creates excessive supply chain risks, which in turns breeds actions by supply chain members that could further erode the confidence of the supply chain. Table II gives some examples of how low confidence creates risk in the supply chain.

**Table II : Lack of confidence and supply chain risk**

| Business Area | Lack of confidence outcomes |
|---|---|
| Sales | • Over order to hold buffer stocks for key customers<br>• Over quote on delivery times to customers – may lose the order |
| Customer service | • Cannot give accurate information on availability<br>• May order buffer stock to assist customers |
| Operations | • Can derive no patterns of sales due to lack of confidence in other areas – forecasting becomes inaccurate and the trend continues<br>• Likely to over-produce or have excess capacity to compensate for lack of confidence in other areas |
| Marketing | • Delays in new product launches due to uncertainty of supply<br>• Markdowns or big discounts when left with excess inventory at end of season or at the end of product life cycle |
| Raw material supplier | • Does not have accurate forecast and has suffered from previous emergency requirements, starts to hold more stock and passes the cost onto their customer<br>• Quote long lead times to hedge against risks |

**Breaking the Spiral and Restoring Supply Chain Confidence**

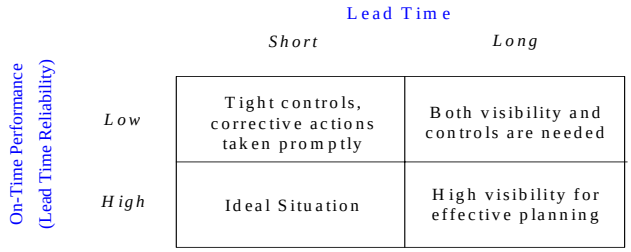
Supply chain confidence reflects the perception of performance reliability at each step in the chain. In other words how much faith do the various players in a supply chain have in the ability of those 'upstream' and 'downstream' of themselves to do what they say they're going to do.

The higher the confidence the greater will be the willingness to reduce safety stock for example. Equally once confidence is gained there is likely to be a greater willingness to move further in terms of substituting information for inventory.

To restore supply chain confidence and break the risk spiral, we must address the two basic elements of supply chain confidence: visibility and control.

Total end-to-end visibility will enable supply chains to be transparent, and the right information would be available to the right member of the supply chain at the right time. Enabling adequate control levers to be accessible to the partners will also allow prompt actions to be taken when information reveals such needs. Both visibility and control are critical for restoring supply chain confidence, although in some cases, one may take priority over the other. For example, in Figure 2 below, we show how visibility and control are needed in situations with differing lead times and on time performance.

**Figure 2 : Relative importance of visibility & control**




Here are a few key levers to break the risk spiral:

***Information Accuracy, Visibility and Accessibility***

Throughout the supply chain, key operational metrics and status reports such as inventory, demand, forecasts, production and shipment plans, work in progress, yields, capacities, backlogs, etc., should be accessible easily by key members of the supply chain. Such information should be accurate and timely, rendering it useful for all parties for planning and re-planning purposes. Thus, it is important that the key indicators are tightly managed and that any updates are made as timely as possible. The accuracy of the data should be a source of confidence to the parties using the data.

***Alerts for Out of Control Conditions***

Any time when deviations from the plan have occurred, then the appropriate parties in the supply chain have to be alerted. Here, intelligent controls are needed to determine if the deviations are normal, random events, or if they represented some systematic or unexpected changes that warrant attention. The parallel to statistical process control can be drawn here. A process control chart should be sensitive enough to detect out of control conditions, but not overly

sensitive so as to cause the system to be overly nervous, with a lot of unnecessary changes and corrections.

***Responsive Corrective Actions***
We should provide members of the supply chain with contingency plans and the tools to make corrective actions when out of control conditions have been detected. For example, if the shipment schedules have deviated from plan due to traffic conditions, then there should be clearly defined contingency plans for the logistics carrier to take appropriate actions, e.g., expedite shipments may be used, alternative supply source may be tapped, or product offerings to the customers may have to be changed.

Supply chain leaders like Benetton have invested in gaining the confidence of the supply chain through visibility and controls. Benetton's extensive EDI network linking its design centre with the network of outsourced manufacturers, sales agents, retail outlets, transportation carriers and logistics centres allow the supply chain to become transparent. Its investments in flexible manufacturing lines with its famous postponement concepts in manufacturing, cycle time reduction, and its state-of-the art distribution centre also enable it to respond to demand signals promptly, by being able to change production schedules and distribute the right products to the right markets to meet the highly seasonal demands of apparel products. The company has also invested in computer-aided design tools which are linked to computer-aided manufacturing tools, concurrent design processes, and cross-functional design teams so as to reduce the new product development cycle. This enables the company to introduce new products in the middle of a season in response to the fashion trends of the season.

As indicated earlier, the lack of supply chain confidence and the exposure to excessive market risks had hurt the market share of Adaptec, a semiconductor manufacturer. It was not until 1997 when the company invested in internet technologies to gain visibility of its supply chain operations throughout the complete supply chain, consisting of Adaptec in Milpitas, California, TSMC in Taiwan, ASAT in Hong Kong, and Seiko in Japan, that the company began to regain some of the confidence in its supply chain performance. Working with logistics providers and design teams at the multiple companies that span the Adaptec supply chain, Adaptec was able to put in place control levers to respond to out of control conditions promptly, those improving its supply chain drastically. The result was that the total cycle time was reduced by 50%, inventory dropped by 30%, customer satisfaction significantly improved, and ultimately, improving ROA and profitability.

**Synchronising the supply chain**
Once information can flow across the supply chain, then we are only a short step away from a dramatic reduction in total system inventory whilst

simultaneously improving responsiveness to demand. The ability to match supply more closely with demand we call *agility* and the key to agility is speed (Christopher & Towill, 2002). If flows through the pipeline can be accelerated then it stands to reason that volatile unpredictable demand can be met more precisely. Even better, there is less inventory in the pipeline because it is shorter – in effect we have substituted information for inventory.

However, agility is not a single company concept. Rather it implies synchronisation from one end of the pipeline to the other. In other words all the players in the supply chain are marching in step, to the same drum beat as it were.

Synchronous supply requires transparency of demand and pipeline inventory in as close to real time as possible. It also requires a willingness on the part of all the members of the supply chain to work to a single supply chain plan. Even a short while ago such an idea would have seemed fanciful. However, two things have changed the landscape of supply chain management in the last few years. The first of these is the availability of the technology and the software to enable the capture and sharing of information across a supply chain – increasingly using extranets. The second, even more fundamental change, is the increasing willingness of members of the supply chain to put aside the traditional arms-length relationship with each other and in its place move towards a closer, partnership-type arrangements.

Evidence of these information-based collaborative supply chains is emerging in industries as diverse as automobiles, grocery retailing and apparel manufacturing. One leading UK retailer Sainsbury has developed an extranet to enable suppliers such as Nestle to access point of sale data. Nestle are now better positioned to re-supply Sainsbury and in turn can share that data with their materials and packaging suppliers. The effect is staggering, the whole supply chain is now demand-driven rather than forecast driven.

In high fashion, traditionally, companies in the apparel industry have had pipelines up to twelve months long with all the risk that that implied. The Spanish company Zara can move from design to in-store availability in a matter of weeks as a result of closely connected, highly synchronised arrangements with internal and out-sourced suppliers. For companies like Zara, these supply chains are increasingly global and yet, through transparency of information, they can still maintain a high degree of agility and confidence.

**Conclusion**

While supply chain risks tend to paralyse most supply chains, the case is not hopeless. Successful companies are the ones that break the risk spiral by restoring supply chain confidence throughout the chain. The benefits are much more than cost reduction, but also, as we argued earlier, the reduction

of market risks leads to increase in sales and market share, penetration to new markets, and speedy new product introduction.

Clearly not all supply chain risk is created through a lack of confidence amongst supply chain members. However, our contention is that improvements in confidence, as we have defined it, can have a significant effect on mitigating supply chain risk.

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