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***“Resilient Supply Chains in an uncertain environment”***

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**Supply chain resilience: The possible application of triple bottom line costing to supply chain risk management**

**Introduction**

Within the context of the supply chain industry, the long term value of an organization equates to the fiscal metrics used in the classical definition of enterprise modified by the sustainability (or capacity to endure) of the activity.

Logistics practitioners and academics design logistics solutions with varying degrees of resilience and robustness in response to both internal and external forces. Supply chain disruption events test the resultant operations. A 2010 survey recorded 45% of the respondents as experiencing supply chain disruption within the past year and of these more than 50% incurred a loss of over US\$1m (Banerjai et al, 2012). The industry is also experiencing more Black Swan incidents (Taleb, 2008) i.e. events that are a surprise to us and have a major impact on life, organizational value and sustainability.

The focus of this paper is on sustainability, how it should be gauged and how might supply chain resilience and triple bottom line costing (TBLC) influence the valuing of the organization. The underpinning research is based on previous work by the authors; it applies the principles proposed by Průša and Savage (2007) to the findings from a three round Delphic study (Gibson et al, 2011). The output of this has been examined in the light of other relevant literature to draw conclusions on the practical importance of supply chain resilience and the potential role of triple bottom line costing.

## **Definitions**

Supply chain resilience: The ability of a system to return to its original state or move to a new, more desirable state after being disturbed (Christopher & Peck, 2004)

Supply chain risk appetite: The amount and type of risk that an organization is prepared to seek, accept or tolerate (Howard, 2009).

Supply chain risk tolerance: The maximum risk that can be taken before financial distress (Howard, 2009).

## **Literature Review**

Waters (2011) ably encapsulates research into risk within supply chain operations as:

'If you collect any group of managers and ask them to discuss risk in the supply chain, they rarely agree about the meaning of either 'risk' or the 'supply chain'.

He goes on to describe eight physical features of a resilient supply chain as well as five relationship-based features, which include collaboration, confidence in partners, visibility and process management.

Altay and Ramirez (2010) hold that different disasters affect different levels of the supply chain and mitigation strategies need not be disaster specific, the best ones being composite disaster impact measures. Peck (2010) asserts that culturally determined perceptions of risk may vary greatly from one country to another and therefore impact risk perception differently throughout global supply chains. Reviewing the World Economic Forum supply chain and transport risk survey, Wright and Datskorska (2012) and put forward five recommendations including the use of collaboration and visibility to enable effective international, management and governance processes across supply chains. Inadvertently, these visible and collaborative ways of working also propagate the conditions for the high adverse impact of Black Swan events (Marchese, 2012).

Ritchie and Brindley (2007) describe how risk and supply chain performance are interconnected and supply chain management (SCM) should evaluate the risk of changing structures and relationships prior to introducing any change into the chain.

Narusimham and Talluria (2009) present an operational focus and suggest organizations should become more flexible and agile to respond to supply chain risk through better internal integration as well as external integration and flexibility. Christopher (2010) defines the '4r's' supported by (SCM) in a modern world including reliability and responsiveness which both rely on supply chains being sufficiently agile to cope with unanticipated events. The IBM (2010) survey recorded risk as the second highest issue in supply chain after visibility. But, whilst 69% of respondents formally monitored risk, only 31% manage performance and risk together. John et al (2012) surveyed over a 1,000 supply chain

practitioners in July 2012 and found at least eight out of ten organizations had been hit by supply and demand side disruption over the previous two years.

Sodhi et al (2012) report three gaps pertinent to future research in this field, firstly there is no clear consensus in the definition of SCRM, secondly there is a lack of commensurate research on responding to supply chain risk incidents and finally there is a shortage of empirical research in the area of SCRM. From the perspective Value Chain Risk Management, Carter et al (2012) identify two risk dimensions, firstly the probability of an event occurring and secondly its impact upon value chain performance. Operationally this means the organization has the choices of: avoiding the risk, accepting the risk, shifting the risk to another party or mitigating the risk and Boer (2012) defines success through mitigation as being on time, in full and compliant. This supports the supposition that the value of an organization is the sum of its enterprise value and the sustainability (or compliance) of its activity.

Wilding (2011) describes a model for building resilience into the supply chain and this is illustrated in figure one. Simchi Levi (2010) reports that a \$10 increase in the price of a barrel of crude oil could produce a 7.9% increase per mile in EU transportation rates. This is reason enough for using a risk exposure index and measuring both the time taken to recover from supply chain disruption

as well as the financial impact. Peck (2010) suggests a management system based on level one challenges at the local level through to level four challenges at the macro level, all of which may need a degree of redundancy or slack in order to assure resilience.

### **Description of Challenge**

The academic world of supply chain risk management and TBLC often debate an optimum state of organizational capability. In the commercial environment, organizations approach these topics based on their awareness, organizational maturity and their capacity for change. A number of permutations may develop across market sectors and within organizations that balance the demands of market based enterprise value with long term sustainability.

At the heart of this research is the simple question: how can organizations know if they have adopted the optimal balance of these factors to drive sustainability and long term growth?

This does assume that there is a common understanding of the term sustainability, which is

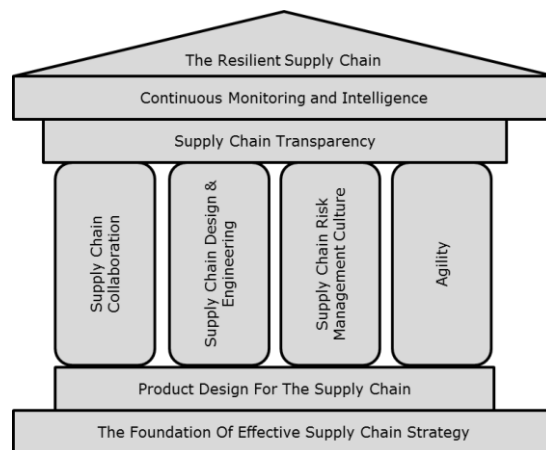


Figure 1 Resilient Supply Chain Model, Wilding (2011)

not the case. There are many perceptions, many of which are too narrow. A key feature of genuine sustainability is that it has both commercial and environmental components (Jenkins et al, 2012). Further, that in successful models, these will complement one another and not compete.

### **Research Work**

To assess the importance of risk in developing a supply chain strategy, a three round Delphi survey was conducted with a panel of constituents numbering 1,002 at the outset (Gibson et al, 2011). The final group of respondents had over 2,190 years of experience, two thirds occupied senior supply chain roles and represented a broad mix of own account and outsourced operators along with consultants to the industry. The results were compiled using a web based survey platform, which reduced the administrative burden in managing 12,000 pieces of data from 381 respondents. Pragmatically, consensus was based on majority answers to closed style multiple choice questions

The anonymous Delphi exercise took place during 2010 and 2011 and included questions on the following topics:

- Does your organisation have a supply chain strategy?
- Is there an up to date operations manual in situ?
- Do you measure the cost of your supply chain and how frequently?
- Do you conduct value chain analysis?
- Who will fund the collaboration required in the future supply chain?
- What does a good supply chain feel like?

The assessment of the possible influence of TBLC was based on a review of previous work and publications by the authors and others.

### **Results and Analysis**

**Risk & strategic management** - The panel were asked if they had a strategy or plan for the organization, over what period of time this extended and whether there was a current operations manual which could define the supply chain activity. To make the questions more relevant for the groups of respondents, the survey platform split the question sets for operators, logistics service providers and consultants. Key headings included;

#### 1. Strategy and functional specification

The majority of operators felt their strategic plans ran longer than the service providers perceived. Consultants generally felt customer's plans were built on even shorter timescales. Put simply, operators felt they plan over a longer period than their service providers perceive and the consultants felt they planned over an even shorter period.

A large proportion (but still a minority) of customers of logistics service do not have written functional specifications for any part of their supply chain. Further, operators are likely to have an operations manual but it may not be relevant and may be out of date.

## 2. Cost, value chain and defining success

Measuring costs is most likely to happen periodically or weekly, but a large proportion of respondents reported measuring costs only annually. Most respondents had not used value chain analysis to affect improvements in their supply chains, where used it was mainly in transport and stock holding. Benchmarking was not seen as a route to defining or confirming a successful supply chain, it appears that the industry was unwilling to share its learning's to improve standards and performance. This indicates that benchmarking is not used as part of continuous improvement initiatives.

When asked what a good supply chain "felt like", the following six areas were significant:

- Calmness / Quiet: When the contract is not making any 'noise' then everything is "OK"
- Contract renewal: If the contract is renewed then this must be evidence of success
- Industry sector: Apparently success criteria differs by industry sector
- Key Performance Indicators: Achieving these measures of internal performance deliver success.
- Satisfaction; If the customer is satisfied then that must mean success
- Customer Driven: The customer should drive success by setting targets they will be happy with.

The quality of 'calmness' appeared to be a common factor in operations that are deemed to be good as well as feel good. This probably suggests that both operators and service providers are 'composed' in their relationship which comes from feelings of trust and both parties accepting a mutual dependency. There were some significant other outlying comments on this topic and the answer-set remained divergent.

## 3. Collaboration, risk and the future supply chain

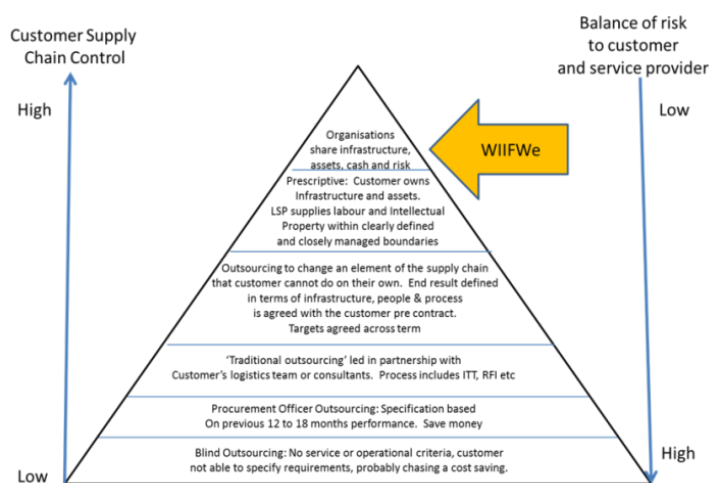


Figure 2 Outsourcing solutions vs control and risk

Generally, collaboration is felt to be self-funding between all parties engaged in the activity. But, comments were varied and suggested whilst good partnerships would bring strength to the supply chain, self-funding is often a myth

because there needs to be investment first in order to achieve the necessary improvements to reduce costs.

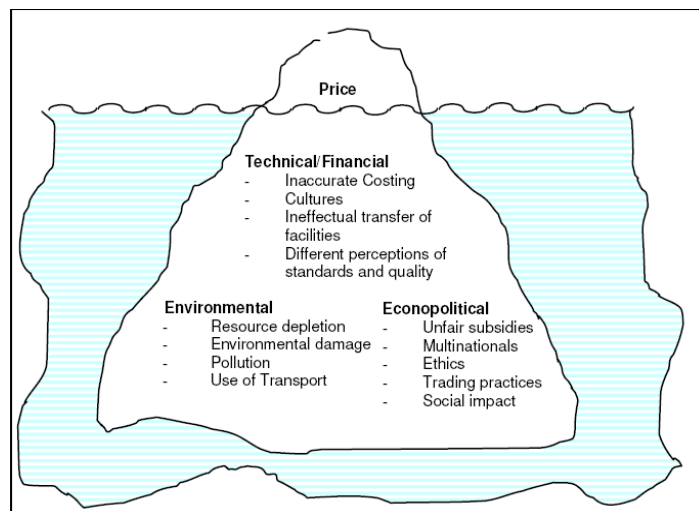
Customers of service providers felt they will fund collaboration through their own efficiencies or these efficiencies will be supported by all parties to the activity.

The academic world of logistics outsourcing defines several iterations and stratifications of logistics and supply chain outsourcing solutions. There are many service offerings and the nature of the industry allows for bespoke service offerings with an eagerness to avoid a one size fits all solution. Commentators are prescriptive in their responsibilities for customers of service providers to control and specify their businesses successfully and the ongoing role they have in managing the outsourced relationship. It is not clear what degree of risk each service offering entails for the customer and the service provider.

This risk based approach is illustrated in figure two which describes a pyramid of outsourcing solutions balancing them with the degree of control and risk inherent to the parties involved.

### **Triple bottom line costing -**

Griffiths and Savage (2007) discuss the downsides of globalization and conclude that whilst extended global supply chains offer great benefits in terms of extended markets, enhanced supplier bases, new products, etc. there are also losers, often from less developed countries. Importantly they also note that extended supply chains increase the adverse impact on the



**Figure 3 Price and hidden costs iceberg. Bailey et al (1998)**

environment as well as risks to supply chain performance and escalating costs due to technical problems and over-reaching on the part of global sourcers. Menna et al (2007) propose a method of attempting to assess the impact on supply chains based on cost, risk, time and the environment, whilst Průša & Savage (2007) combine the two concepts and suggest that such costings should recognize the "price and hidden costs" iceberg effect where many environmental, econopolitical and technical / financial costs that tend to be hidden – see figure three. They conclude that, before proposing further extension of supply chains, sources and marketers should use TBLC to take account of people, the planet as well as profit to ensure that sustainable in the future, rather than simply carrying out a conventional profit and loss calculation.

This may seem like an idealistic approach, but close examination of many of the principles used to improve the “greenness” of a supply chain also make good economic sense. For example, the use of vehicles with high fuel economy and practicing variable time based routing and scheduling will both lead to reduced fuels costs and environmental improvements (Maden et al, 2008). Further, the steps taken to reduce the environmental impact of supply chains (e.g. limiting the number of nodes in a chain or sourcing locally to reduce carbon emissions) will help to reduce risk and improve both their robustness and resilience, for example: their ability to recover from an unexpected, disruptive event.

## Discussion

Against a background of an era of disruption and uncertainty (Christopher, 2010), formal risk management in the supply chain is at an immature state in its development. The pillars of the Wilding (2011) resilience house are collaboration, design, management culture and agility. The responses from the Delphi survey demonstrate there is little consistency in these areas and it may be viewed as a poorly informed area amongst supply chain operators, with many questioning the value of investing their time on the subject.

In terms of strategy and functional specification the results suggest the constituent parties in the supply chain are not joined on strategic activity and have differing points of view dependent upon their position in the supply chain. This may compromise collaboration, agility and supply chain design. Supply chain risk management is often further hampered by not having current operations manuals which describe the current operation.

The responses to the question of cost, value chain and defining success indicate the industry is not comfortable with benchmarking and has a varied view of what good looks like with no views expressed about resilience. This hampers collaboration and agility as the organization is not clear of its supply chain capability. The uncertainty is surprising because Competitive Benchmarking has been proposed as a vital component of service level definition and improvement for 20 years (Christopher, 1992). For the issue of collaboration, central to supply chain resilience (Lambert et al. 1996), respondents were reasonably positive and there was a willingness amongst operators to fund these initiatives.



**Figure 4 Good and bad behaviours for managing risk**

To have a positive approach to supply chain resilience, the organization must have a current strategy with a clearly defined set of objectives (which include risk management) balanced with competing priorities within the business. Supply chain familiarity will be evident with current operational manuals, highly visible costs and cost drivers working with clear service level management policies at the supply chain interfaces. Looking from the outside or 'the balcony view' the organization will be seen to be exhibiting a high degree of control on its supply chain and partners as well as a willingness and openness to engage in a collaborative style.

Supporting colleagues with relevant training in Supply Chain Risk Management is critical and this may be a challenge in this arena at the present time as the traditional industry bodies struggle to catch up with a concept referenced by Christopher and Peck as far back as 2004. Combining and analysing the findings of the papers on the impact, costs and risks of global sourcing with that of Gibson's work on supply chain risk and resilience (2011) suggest that efforts to reduce environmental damage and avoid adversely affecting people's way of life can also help take much of the risk out of extended supply chains. Therefore, applying the principles of triple bottom line costing to operational and business decisions will not only enhance the life of the planet, but also reduce the risk components in individual supply chains. This in turn can enhance both the commercial and environmental sustainability of the companies concerned, thus improving their value.

### **Conclusion**

Building the resilient supply chain becomes an important strategic goal, clearly stated it aligns design and management culture through collaborative and agile working practices and the transparency of a well-controlled and monitored supply chain yields an enhanced organizational approach to risk. It is reasoned that supply chain costs will flatten as disruption costs reduce and organizational agility allows for different approaches and solutions to emerging issues.

By integrating risk into operations and business decisions we can be more responsive and agile to optimizing performance within the supply chain and mitigate the impact from events in the world around us. The value contribution is strengthened with greater sustainability in addition to the traditional measures of enterprise value so the value of the whole organization increases.

Bearing this in mind combined with the sustainability principles mentioned above, this paper proposes that making triple bottom line costing a part of the decision making process, particularly when considering extending or outsourcing a supply chain will enhance the value of the company, allow us to enjoy the benefits of living in a global village whilst enabling us to worry less about the legacy we leave for our descendants.



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