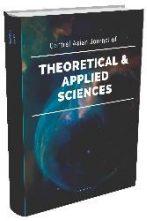

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Creating a Sustainable Supply Chain

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Abstract: *Currently, several effective methods are used to establish a sustainable supply chain. In this article, we have thoroughly analyzed the sustainable supply chain and proposed solutions to several of its shortcomings.*

Keywords: *Economy, environment, society, supply chain management, sustainability, greenhouse gases, transport-intensity, carbon footprint, reduce, re-use, re-cycle, just-in-time.*

Introduction

Perhaps one of the biggest issues to rise to prominence across every aspect of business and society in the opening years of the twenty-first century has been 'sustainability'. The growing concern with the environment, in particular the possibility of climate change through global warming, has led to a focus on how human and economic activity has the potential to adversely impact the long-term sustainability of the planet. The definition of sustainability that is most widely used originates from the United Nations Brundtland Commission which reported in 1987. Sustainability, the Commission suggested, was about meeting the needs of the present without compromising the ability of future generations to meet their own needs.

The triple bottom line

This definition can be further augmented by adopting the parallel idea of the 'triple bottom line'.2 The triple bottom line concept emphasizes the importance of examining the impact of business decisions on three key areas:

- Environment: For example, pollution; climate change; the depletion of scarce resources, etc.
- Economy: For example, the effect on people's livelihoods and financial security; the profitability of the business, etc.
- Society: For example, the reduction of poverty; the improvement of working and living conditions, etc.

These three elements – the 3Ps of People, Profit, and Planet – are inevitably intertwined and they serve to remind us that for a business to be truly sustainable, it must pay regard to the wider impact of the activities it undertakes if it seeks to remain viable and profitable.

In the context of supply chains, we can build on the triple bottom line philosophy to encompass the wider idea that sustainability is concerned with ensuring the long-term viability and continuity of the business as well as contributing to the future well-being of society. Indeed, it can be argued that these two goals are mutually supportive, i.e. supply chain strategies that benefit the wider environment are likely also to involve the business in less cost in the long-term as the result of a better use of resources. For example, one element in a 'green' supply chain might involve utilizing transport capacity more efficiently through better routing and scheduling. In so doing, not only is the environmental impact of transport reduced, but also the cost to the company.

Because the supply chain underpins the efficient and effective running of the business, it can provide a useful framework for exploring opportunities for improving sustainability. If we adopt the philosophy advocated in Chapter 9 that the supply chain 'begins on the drawing board', i.e. that product design decisions impact subsequent supply chain costs, it makes sense to look at sustainability across the entire product life cycle. In other words, we need to understand the impact on sustainability of everything we do from product design through to end-of-life disposal.

Greenhouse gases and the supply chain

Recent years have seen a considerable growth of awareness of the potential harm to the environment that can be caused by so-called 'greenhouse gases'. These gases include carbon dioxide, methane, and nitrous oxide and various fluorocarbons. Generically these emissions as they relate to an activity are often referred to as its 'carbon footprint'. As a result of increased economic activity around the world, the level of these greenhouse gases has risen significantly over the years. It is estimated that current levels are around 430 parts per million compared to 280 parts per million before the Industrial Revolution.

A view that is held by many commentators, although not all, is that this increase in greenhouse gas levels has been, and is, a major cause of climate change.

Several influential reports, e.g., that produced by Sir Nicholas Stern in the UK3 and the work of Al Gore in the USA4 have brought these issues to the attention of governments, industry and the wider public on a global scale. Even though it has proved difficult to get universal agreement on the best means for reducing greenhouse gas emissions, there is a widespread acknowledgment that action is required.

For supply chain managers this is a particular call to action because some of the major causes of greenhouse gases arise from industrial activities such as manufacturing, energy production and transportation. In the specific case of freight transport, for example, it is acknowledged that as a result of the globalization of supply chains we are now moving products greater distances than ever before with a consequent impact on the carbon footprint. The example of the laptop used by Thomas Friedman, the author of The World is Flat, is a case in point.5 He estimated that the approximately 400 different components in his Dell computer had traveled hundreds of thousands of miles from all their different sources and through the assembly and distribution process to reach him.

In recent years there has been a growing awareness amongst consumers of the issue of 'food miles' – in other words how far food travels from its origin to the point of final consumption – and what the impact of this might be on carbon emissions. The item highlighted below is indicative of this growing concern.

Whilst at the moment the environmental costs incurred as a result of commercial activity are not generally borne by the companies that cause them, this will almost certain change as a result of carbon taxes, emission trading schemes and regulatory change. Hence the need for supply chain managers to be thinking hard about alternative strategies.

Reducing the transport intensity of supply chains

As global economic growth continues, so too does international trade increase and hence transport. The continued upward trend in global sourcing has inevitably led to products traveling greater distances.

The result is an increase in what might be termed the transport intensity of the supply chain. Transport intensity can be measured in several ways, but at its simplest, it is a reflection of the miles or km traveled per unit of product shipped. As the transport of raw materials and finished goods globally is estimated to consume 15 million barrels of oil each day – almost one-fifth of the world's daily production6 – there is a correlation between transport intensity and a supply chain's carbon footprint. Not only is there an economic benefit to be gained by improving transport intensity but also a potential positive environmental impact – this is the concept of eco-efficiency7 which is rapidly becoming a major issue in global commerce.

What practical steps can organizations take to improve the transport intensity of their supply chains?

- Review product design and bill of materials

Product design can impact transport intensity through the physical characteristics of the product, its density, the choice of materials (including packaging materials), the ease of recycling and re-use, and end-of-life disposal.

- Review sourcing strategy

As we have previously noted, many sourcing decisions have led to a migration to low-cost country locations. This often has led to products being moved greater distances. Global sourcing decisions will increasingly need to factor the carbon footprint into the TCO.

- Review transport options

Different transport modes have different impacts on carbon and other emissions. The design of vehicles and vessels is also increasingly influenced by the need to improve fuel efficiency. There are also arguments for increasing the size of the vehicle or the vessel to achieve lower transport intensity per unit. For example, new generation container ships such as the Maersk lines 'Triple E' class of vessels.

- improve transport utilisation

Research has highlighted that often vehicle capacity is poorly utilized. It is suggested that empty running because of the lack of return loads means that up to a third of the trucks on the roads of Europe are running empty! More use of the shared distribution, better vehicle routing and scheduling, and better loading can also dramatically improve transport intensity.

- use postponement strategies

If standard, generic products can be shipped in bulk from their point of origin and then assembled, customized, or configured for local requirements nearer the point of use, there may be an opportunity to reduce overall transport intensity. A further incentive to reduce the transport intensity arises from the continued upward pressure on oil-based fuel costs which will only intensify as oil reserves become depleted.

Beyond the carbon footprint

Whilst there is an understandable concern that the supply chain's carbon footprint should be minimized, it must also be recognized that supply chain decisions have a wider impact on resources generally. Rather than limiting the focus of attention to reducing greenhouse gas emissions, it is important to recognize the effect of economic activity on the use of scarce resources across the value chain as a whole. Decisions

that are taken at every stage in a company's value chain can have significant implications for resource requirements and the wider environment.

Return

Because so many natural resources are being depleted at an increasing rate, businesses must understand these linkages. Some examples of the resource implications of supply chain decisions are described below

Design

We have previously argued that the supply chain 'starts on the drawing board', meaning that decisions that are taken regarding the design of the product can have a significant impact across the supply chain. This is particularly true when considering the supply chain's 'resource footprint'. More and more companies are actively seeking to reduce the amount of packaging material that is used for example, but there can be other, less obvious ways to improve resource sustainability. If those managers responsible for new product development are not aware of the resource implications of their design decisions, this may lead to the launch of products with a bigger than desirable resource footprint. For example, many high-tech products rely for their functionality on scarce materials such as the so-called 'rare earth metals' (e.g. dysprosium and neodymium) whose future availability may increasingly be limited.

Source

'Sustainable sourcing' is emerging as a fundamental element of best-practice procurement. One reason for this is that it is estimated that for a manufacturer somewhere between 40 percent and 60 percent of their total carbon footprint lies upstream of their operations, for retailers it can be as high as 80 percent.8 Depending on where and how those upstream materials and products are sourced and made, there can be major differences in resource consumption. For example, SAB Miller, one of the world's biggest beer producers, compared its 'water footprint' in two different countries – South Africa and the Czech Republic. It found that the water used in crop production accounted for the vast majority of the total water footprint, but the South African footprint was greater than the Czech footprint because of a greater reliance on irrigation and higher levels of evaporation required to grow the crops used in South Africa. It required 155 liters of water to produce a liter of beer in South Africa against 45 liters of water required to produce a liter of beer in the Czech Republic.

Make

Manufacturing processes impact the resource footprint primarily through their use of energy, their relative efficiency, and the creation and disposal of waste and toxic materials/effluents. In this age of outsourcing and offshore manufacturing, it may not always be apparent to the customer what impact manufacturing strategy decisions can have on supply chain sustainability. However, there are big differences in the energy efficiency of different factories and also in the waste they generate and how they dispose of it. Even the source of energy has sustainability implications. For example, a study conducted by the UK Carbon Trust10 looked at the different footprints created by a UK national daily newspaper when it used newsprint produced in Sweden compared to newsprint made in the UK. Because newsprint production is a highly energy-intensive manufacturing process, and as most electricity generated in Sweden is from renewable hydro sources – unlike in the UK where most electricity is generated from coal or gas – the most sustainable manufacturing source was Sweden, not the UK!

Delivery

Decisions on the mode of transport will affect the carbon footprint of a supply chain as will the extent to which transport capacity is efficiently used. However, the nature of the delivery network (i.e. the number,

location, and design of distribution centers, the use of hub and spoke arrangements, the extent of cross-docking, etc) can have a wider impact on supply chain sustainability.

Many companies have used network optimization models to help determine the shape of their distribution arrangements. However, these models tend to optimize on a narrow definition of cost rather than taking into account the wider resource footprint that is created by the network. A new generation of network optimization tools is now emerging which take account of the carbon footprint as well as the more conventional costs.

Return

'Reverse logistics' is the term usually used to describe the process of bringing products back, normally at the end-of-life, but also for recall and repair. In the past, little attention was paid to the challenge of reverse logistics, often resulting in extremely high costs being incurred. Now, partly driven by increasingly stringent regulations – particularly on product disposal and re-use/re-cycling requirements – the issue has moved much higher up the agenda.

Essentially the challenge today is to create 'closed-loop' supply chains that will enable a much higher level of re-use and re-cycling. Products must be designed with their end-of-life in mind, but also the logistics network employed must minimize the use of resources. Reverse logistics provides a major opportunity for companies to impact both their costs and their carbon footprint and should be viewed as an opportunity rather than a threat. Xerox is a good example of a company that actively seeks to design products and supply chain processes that enable a sustainable end-of-life recovery program to be achieved.

Reduce, re-use, re-cycle

The 3Rs of sustainable supply chain management – reduce, re-use, and re-cycle – are now starting to receive much more attention in most companies today. There is a growing realization that not only is a strategy focused on improving the environmental impact of economic activity good for all who live on this planet, but because such strategies consume fewer resources the overall profitability of the business should also improve.

Many companies are now actively seeking to create marketing strategies that emphasize the 'greenness' of their supply chains. Whilst the more cynical observers may dismiss these moves as opportunism – what some have dubbed 'greenwash' – there can be no question that customers and consumers in markets around the world are starting to demand that suppliers reduce their various footprints.

Strong evidence is emerging that consumers are increasingly basing their purchasing behavior on ethical and environmental criteria.

In some instances, major retailers such as Wal-Mart and Tesco are seeking to improve their supply chain footprints and are demanding action from their suppliers to improve their performance on the 3Rs, i.e. to demonstrate how they are reducing the use of materials such as packaging and how they are designing products that can be re-used or re-cycled. Both Wal-Mart and Tesco (and other retailers too) intend to provide information on the labels of the products they sell detailing the overall environmental impact of those items. To do this they are working closely with their suppliers to ensure that their supply chain arrangements are sustainable and that they continue to seek innovative ways to improve the end-to-end environmental footprint.

For example, Tesco recognized that glass bottles, because of their weight, add significantly to transport intensity and overall carbon emission. By working with suppliers to create lighter-weight wine bottles Tesco reduced its annual glass usage from one single supplier by 2,600 tonnes – a 15 percent saving.

Further savings were achieved by importing wines into the UK from Australia in bulk and then bottling them in lightweight glass in the UK.

Further pressure on businesses to reduce their environmental footprints is coming from government regulations, often in the form of emissions trading schemes or so-called 'cap and trade' legislation. For example, the European Union's Emissions Trading Scheme has been extended to cover a greater range of industries and is based on the principle that companies have a basic allowance for carbon emissions – if they go beyond that level they have to buy additional allowance from other companies who do not fully use their own. Similar schemes are currently contemplated by governments around the world and in time their impact is likely to be significant.

As, as we have noted, most of a typical business's total environmental footprint lies in its wider supply chain, particularly upstream of its operations, the need for supply chain managers to become more involved in managing this footprint becomes apparent. Unless upstream suppliers can reduce their footprint the additional costs that they will incur will inevitably end up in their COGS – and ultimately in the price of the products in the final marketplace.

The impact of congestion

One of the key issues when considering sustainable supply chain solutions is traffic congestion and related infrastructure issues. In probably the majority of countries, developed and developing, the creation of logistics infrastructure has not kept pace with the level of economic activity. This is true for all types of infrastructure including roads, ports, and railways. Gridlock on motorways, container vessels waiting to unload at ports, and bottlenecks on the railways are common occurrences in many countries and add to carbon emissions as well as adding costs to suppliers and customers alike.

There have been several causes of this problem including increased global trade, lack of investment in capacity, and the widespread adoption of JIT practices:

- increased global trade

With the growth in offshore manufacturing and the emergence of new markets, alongside the removal of trade barriers, the flow of products across borders has increased dramatically. At the same time, the size of many container vessels has increased significantly – the new generation of container ships can carry upwards of 18,000 TEUs (20-foot equivalent), which if laid end-to-end would stretch for over 100 kilometers or 60 miles! When unloaded each of these containers may need to be stacked on the dockside before being loaded out to trains or trucks, further adding to congestion. Furthermore, in recent years the increase in container security requirements has led to additional delays at both the points of origin and destination.

- lack of capacity

Paradoxically in some developed countries, environmental concerns have led to unwillingness to build more infrastructure such as new motorways or port extensions. Equally, there has been resistance in countries such as the UK to introduce bigger trucks which could reduce congestion, as fewer would be required. Equally, in developing countries the sheer scale of the investment required to meet the demand is daunting. India is a good case in point where, because of a lack of previous investment, there is an overwhelming shortage of capacity on the roads, railways, and at ports – particularly in the face of burgeoning demand.

- Just-in-time practices

As we have noted previously in this book, over the last 50 years there has been a significant uptake across all sectors and supply chains of the philosophy and practice of JIT. Essentially this has led to smaller but

more frequent movements of products and materials. Even though many of those who have adopted JIT have attempted to mitigate its effects through aggregation and consolidation there can be no doubt that it has contributed to an increase in shipments and movements. In the past, it could be argued that the saving in inventory holding costs more than covered the additional transport cost. However, now that concern with environmental issues has become much more prevalent, JIT in its crudest form will increasingly be questioned. The challenge for supply chain managers is to find a solution that enables the benefits of JIT to be gained without incurring potential environmental disadvantages.

Whilst congestion will probably continue to impact logistics management for many years to come, particularly as economic growth and development continue, there is likely to be some alleviation as a result of the application of what might be termed 'smart logistics' and 'intelligent transport'. The idea here is to combine the opportunities that exist for greater partnership and collaboration, both vertically and horizontally, in the supply chain with advanced-level ICT.

Smart logistics works by aggregating and combining individual shipments into consolidated loads for final delivery. 'Cross-docking' is an example of this idea whereby different suppliers ship complete truck loads to a distribution center, typically with each pallet bar-coded or RFID-tagged with product and destination details, for re-sorting and consolidation with other shipments to the same final destination. The same principle can be used by utilizing 'logistics platforms' on the edge of large cities or conurbations to reduce individual deliveries to congested locations.

When advanced IT solutions such as dynamic vehicle routing and scheduling and intelligent agent modeling are used alongside these collaborative strategies, many things become possible – particularly enabling the better management of constrained capacity against a backdrop of uncertain demand. The further development of 'autonomous' vehicles will also enable better utilization of existing transport infrastructure.

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