

Environmental Supply Chain Pressure – is the supply chain really the pressure it is perceived to be?

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Introduction

Over the last two decades, business attitudes towards environmental management have undergone a substantial change, and the environment is no longer perceived as an inexhaustible resource to be exploited at will. Up until about seven years ago, many businesses were mostly concerned with ensuring compliance with environmental legislation, with an emphasis on protecting human health. They focussed largely on activities relating to site management and their reputation for good environmental practice in the local community. There was little interest in the actual or potential environmental impact of companies forming part of their supply chains.

The more proactive approach towards environmental management now apparent especially in large companies, reveals that many have moved on from managing their own operations effectively, to begin to address environmental management issues in their supply chain. The environment is no longer an add-on function, but an integral part of business operations, often viewed as central to a corporate mission, and thus integrated into all strategic levels (*Roy & Vezina, 2001*). Some companies have moved on even further, and are starting to integrate social and ethical issues into their operations, although this is applicable mainly to a minority of often blue chip organisations. It is an interesting observation that some companies that are starting to manage the social and ethical aspects of their supply chains, notably in the food and clothing sectors, have been less concerned with the environmental impacts of their products or processes. Conversely, those companies that have been more successful in managing the environmental elements of their supply chains, are now facing difficulties in integrating the social and ethical impacts successfully.

There are a number of wide ranging motivations for the growth in interest of environmental, and now social and ethical, supply chain management. Schot and Fischer in the early 1990s (1993:1) identified factors such as increasing commercial pressures, loss of credibility, increasing stringent government regulation and increasing awareness of investors as important reasons why businesses were starting to look at their environmental aspects. Today, risk is becoming an increasingly important factor, and this, together with corporate image, community awareness, regulatory compliance, liability and negligence, employee health and safety, customer relations and economic motivations are stated as important (Kleindorfer and Snir, 2001).

Legislation has always been a key motivator for addressing environmental management issues and the current development of producer responsibility legislation, for example in the European Union, is of particular significance as it makes companies responsible for managing their whole product life cycles in a more sustainable way. The European Waste Electrical and Electronic Equipment Directive, (WEEE) and End of Life Vehicles Directive, (ELV) are driving companies to take a more collaborative approach with other businesses and organisations in the supply chain to ensure that products can be disassembled and reused, recycled or disposed of safely at the end of their life.

The issue of risk management in the supply chain is linked to the emergence of rapid globalisation. Interruption in material supplies due to environmental incidents can result in a domino effect through the supply chain, and can cause expensive stoppages or reductions in production. Thus, companies cannot afford to take risks with their supply chains. As international competition is growing ever more fierce, companies competing in a world wide market are facing a constant pressure to improve the quality of goods whilst reducing costs in order to remain viable. As many markets are saturated, businesses are having to look at additional ways of adding value to products and of gaining a

competitive edge. This has led to business looking at core business functions to improve efficiency and add value wherever possible, and as the potential of the supply chain has been realised it has begun to take a more central role in achieving these objectives. Companies can no longer act as singular entities as businesses within supply chains are inextricably linked. One of the most significant paradigm shifts of modern business management is that individual businesses no longer compete as solely autonomous entities, but rather as supply chains. (*Lambert and Cooper, 2000*).

Risk also relates to reputation management. Businesses operating on a global scale cannot afford to take risks with their reputation. A company's reputation is based not only on its ability to deliver high quality products on time, but is also about its responsibilities to its many stakeholders, including the public. Businesses that lose their reputation of being a global "good neighbour" also risk losing their sales. It is these companies, operating on a global scale, that are leading the way in environmental supply chain management (ESCM) and are starting to use the supply chain as a motivator for environmental performance improvement for their suppliers.

The factors identified and discussed above would seem to imply that the influence of large companies in managing the environmental performance of their supply chains is both well developed, and environmentally effective. Indeed, there are a number of studies (Green et. al., 1998) and well documented programmes that show the influence that businesses and other organisations, have had on the environmental performance suppliers. These studies and programmes tend however, to focus on the methodologies used and outputs achieved, rather than evaluating the process of supplier engagement and the challenges and difficulties faced by individual companies, business support agencies and government bodies in getting suppliers to participate in environmental supply chain management programmes and activities. While there are undoubted benefits from the environmental supply chain programmes that do exist, it is very difficult to assess the pressure and influence of the supply chain if no monitoring or understanding of the underlying context of the process of engagement is carried out.

The picture of ESCM that is currently emerging tends to show the positive benefits that can be obtained by participating in environmental supply chain management programmes. What is not shown or discussed to any great degree are the difficulties involved in the process of engagement i.e. the effort involved in gaining supplier participation, and the investigation of the associated continuing barriers to success that are caused by the interacting complexities of motivational factors. Without ongoing and greater evaluation of these additional elements of the ESCM process, it would appear almost impossible to make an assessment of the real influence of the supply chain in exerting pressure to achieve environmental performance improvements in supplier companies. While individual businesses instigating ESCM programmes may make internal judgements on the financial and environmental efficacy of developing ESCM programmes foreseeable, it is rare that full or extensive evaluations of driving factors and elements are made available to interested parties.

The model below (Figure 1) attempts to summarise these ideas using the analogy of an iceberg i.e. most of the iceberg is hidden in the same way that most of the details of the process of engagement and the elements contributing towards pressure are hidden from the view of those observing the outcomes. The model attempts to highlight the importance of these hidden aspects, and reveals the need to understand the full process of engagement if a proper evaluation or assessment of the true influence of the supply chain in achieving environmental performance improvements in supplier companies is to be carried out.

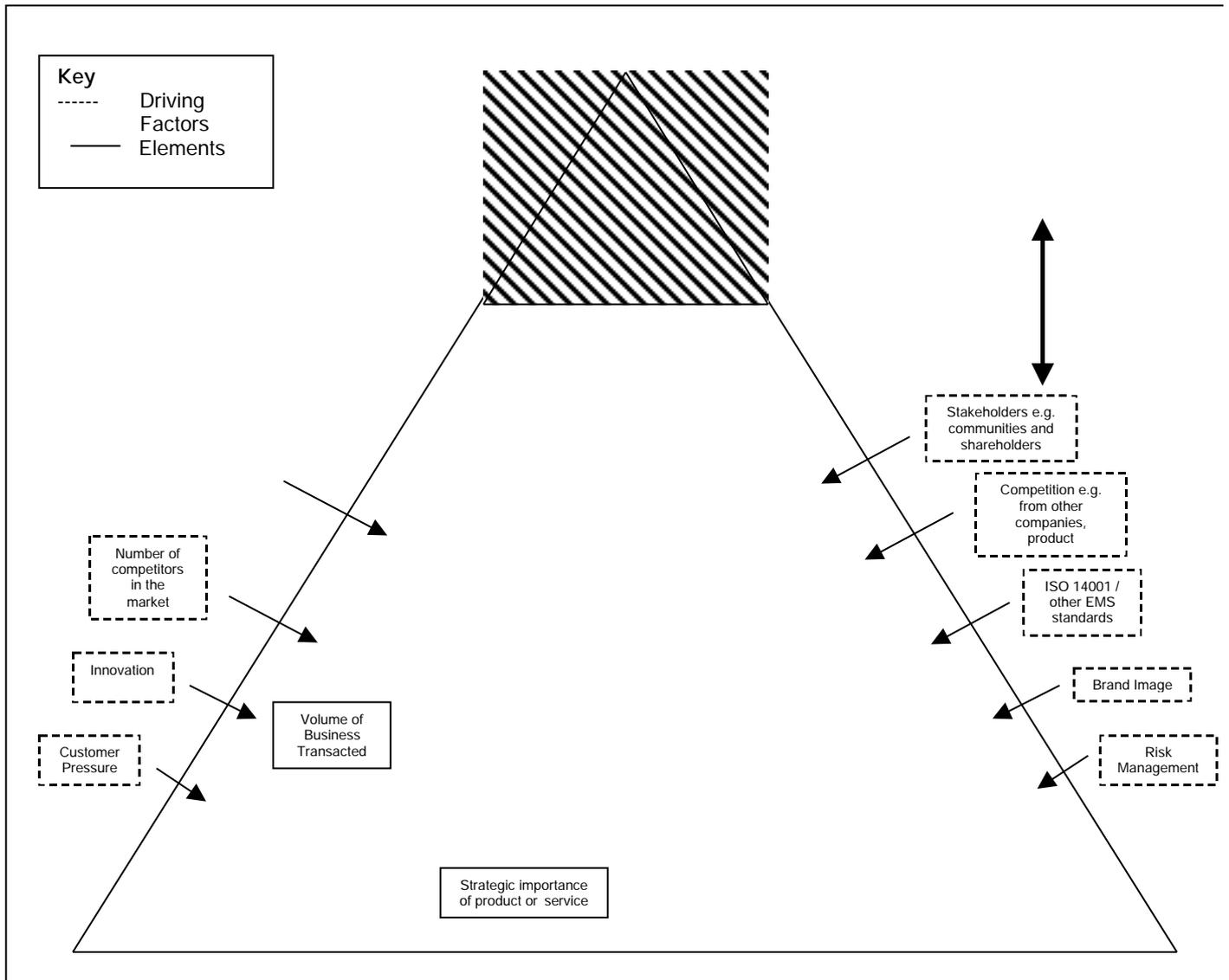


Figure 1: Model to show visible and hidden driving factors and elements of ESCM programmes

The model shows driving factors, which are largely external, and hidden elements, that are largely governed by the decisions made by the firm, and their combined influence on supply chain pressure. The degree to which elements are hidden will also vary between companies as shown by the potential for the top of the iceberg to become more or less visible, shown by the variability bar. The interrelationships between the factors and elements will vary across individual companies. For example, one company may find that the legislative factor is the most important in stimulating them to initiate an ESCM programme or in encouraging it, as a supplier, to join the programme set up by a customer company. Alternatively, a supplier could find itself being targeted by a customer as it fell within the criteria for supplier inclusion identified by the customer's ESCM programme, for example, the size of the supplier may be relevant here. It is therefore important to understand in each individual case what the interacting drivers and factors are, and how these interactions may generate pressure, and how they can determine the programme outcomes. An apparently successful programme involving a small number of suppliers may have required an inordinate amount of time and effort to achieve the outcomes demonstrated and a real danger is that companies without sufficient resources and lacking awareness of the hidden elements may be encourage to develop an ESCM programme, only to struggle and maybe fail. The open presentation and discussion of the hidden elements would enable more informed decisions to be made about plans to work with their suppliers and ultimately

lead to ESCM practice being taken forward in a more efficient and effective manner. In order for pressure to diffuse along the supply chain with minimal tension the whole picture needs to be available.

This paper aims to try and begin to establish the true nature of environmental supply chain pressure. It starts by defining the supply chain and environmental supply chain management methodologies that may be involved and the factors that motivate companies to start ESCM programmes. The paper discusses more fully the need to have a thorough evaluation and measurement of the hidden elements and influencing factors that will interact to increase or decrease the level of pressure customer companies will have to exert on their suppliers to engage them in an ESCM programme. Following on, the paper then provides an analysis of the availability of information on the hidden elements identified above by carrying out a brief review of some of the major ESCM programmes that are currently in place. The influence of supply chain pressure is then discussed using an analysis of research studies and the findings they present. It goes on to use research carried out by the authors in Wales and the UK to reveal the reality of the process of engagement and to bring to the foreground some of the negative perceptions held by suppliers when facing pressures to become involved in such projects. Environmental supply chain pressure is assumed to be an effective mechanism for improving environmental performance but as the paper shows, supply chains are very complex and there are a number of factors that can influence both customer and supplier actions. While past and current ESCM programmes and surveys can provide highly useful ideas and approaches for companies to achieve environmental management objectives, both internally and with their suppliers, there is a danger that without a clearer understanding of the difficulties involved in engaging suppliers to participate, and the true nature of the influence of customers of their supply chains, companies with fewer resources, especially small and medium sized enterprises (SMEs), may be encouraged to develop their own programmes only to struggle to engage suppliers in any meaningful way, and ultimately fail.

Environmental supply chain management

Supply Chain Management

There is a wealth of literature and research on supply chains and supply chain management. Traditionally, the supply chain has been defined as an integrated manufacturing process wherein raw materials are converted into final products, then delivered to customers (via distribution, retail or both), (Beamon, 1999). However all businesses will have a supply chain to a greater or lesser extent regardless of the sector in which they operate. A more extended definition of the supply chain includes all those organisations whose goods or services are needed to produce, sell or supply the company's product or service. It also includes all those companies and organisations that receive, contract or buy the goods and services. In reality, the term supply chain itself is misleading as it is not a linear chain of businesses with one-to-one, business-to-business relationships, but may instead be a complex network of relationships between businesses. Today, supply chains may be formal or informal networks of alliance, may take the form of supply loops, be dynamic, act strategically to adapt to changing situations, and be altogether highly complex entities that provide many challenges for management. Businesses are no longer working and competing individually in supply chains but are entering a phase where inter-network competition is becoming more important. Whole supply chains are now competing against one another instead of, for example, brands. (*Lambert & Cooper, 2000*).

Although there have been obvious changes in the structure of supply chains as discussed above, the perception of the individual company as to their extent of influence through a supply chain is very variable. Some companies view the supply chain purely in terms of the procurement function, where the supply chain consists of those companies from whom they procure goods or services. Others have a broader view and include both customers and suppliers as part of their supply chain and may

include primary and secondary suppliers. The structural location of a company within a supply chain and the perceptions that individual companies hold that may determine their willingness to, or interest in, becoming involved in supply chain management programmes, either as the instigator or as participant. Where a company is unaware of its position within the whole chain, it will not have an integrated or strategic understanding of the implications of supply chain management and the external conditions that may affect it and thus may be less inclined to participate in supply chain management programmes.

Supply chain management (SCM) is the term used to describe the management of the multiple relationships across the supply chain. Initially, the focus of SCM was on the logistics function but there are also material and information flows to take into account. Indeed, Lambert and Cooper (2000) state that SCM offers the opportunity to capture the synergy of intra- and inter-company integration and management and in that sense, SCM deals with *total* business process excellence and represents a way of managing the business and relationships with other members of the supply chain.

It is clear that pressure is exerted throughout the supply chain due to the competitive nature of business and those within the supply chain will be competing with one another in terms of cost, quality, delivery time, reliability, reputation and flexibility. Competition has become especially fierce with the move towards supplier rationalisation and lean manufacturing. It is frequently the customer that sets requirements and suppliers have to compete and meet them as best they can. As identified previously, a supplier's perception of its location and importance within a supply chain may determine the extent to which the pressure is realised. When customer companies develop supply chain management programmes, they can ensure their requirements are met, and participating suppliers can be assisted to meet those requirements while at the same time, hopefully achieving benefits themselves. Supply chain management programmes that have focused on quality i.e. reduction of product reject percentages between customer and supplier have demonstrated that such benefits exist (Johns, 2000).

The focus of SCM has until relatively recently focused on issues of quality, cost and reliability of supply. In the last few years of the twentieth century, environmental concerns have started to become SCM issues, and it is to these that the paper now turns.

Environmental Supply Chain Management

With the development of globalisation, the potential for greater spatial impact from individual companies is becoming greater. Large companies are more visible, and frequently the focus of stakeholders and have started to look to their suppliers in order to help ensure environmental credibility and protect corporate image. Environmental supply chain management (ESCM) has developed partly as a response to these external conditions.

There are a number of terms that are used to describe environmental supply chain management. Environmental Supply Chain Management (ESCM) itself is one such term, but others include supply chain environmental management (SCEM) and sustainability supply chain management (SSCM – this encompasses some elements of the environment within sustainability). Such a plethora of terms itself provokes confusion and the similarities between programme and the potential for their integration can fail to be realised. For the purposes of this paper, Environmental Supply Chain Management will be used. ESCM has been described as referring to the *“variety of approaches through which companies work with their suppliers to improve the environmental performance of the products or manufacturing processes of the supplier, customer or both”* (NEETF, 2001:5). This is a good general definition although, as with traditional approaches towards supply chain management, it focuses on manufacturing and although this industry type is likely to have the most visible impact, there are others in the supply chain who will have environmental impacts. Therefore, perhaps a more accurate definition of environmental supply chain management is as follows:

'the set of supply chain policies held, actions taken, and relationships formed in response to concerns related to the natural environment with regard to the design, acquisition, production, distribution, use, reuse, and disposal of the firm's goods and services' (Zsidisin and Siferd, 2001, cited in Hagelaar and Van Der Vorst, 2001)

Therefore, ESCM dictates that companies work to address environmental issues in their supply chain, taking into account all the associated environmental effects of each stage, including the immediate and eventual environmental effects of all products and processes (Beamon, 2001).

The ways in which companies develop programmes to manage environmental issues in their supply chain are varied. Hill (1997) suggests that environmental supply chain management and the exertion of pressure is mainly concerned with two constituent elements: customers, who purchase the products of a firm; and suppliers, the firms which sell the raw materials and semi-manufactured inputs which go into another firm's production processes and products. Customers are in more of a position to exert pressure on their suppliers than vice versa due to the balance of power in customer – supplier relationships and suppliers are always in the position where they are trying to sell to customers. Hoek, (1999) found that initially, the focus of improving environmental performance through the supply chain was focussed largely on the logistics function, especially in relation to reverse logistics, and did not attempt to address other business practices within the supply chain. However, again this is only one approach and it can be useful to summarise environmental supply chain management methodologies in a staged model as shown in Figure 2. Obviously, the degree of involvement that a programme expects of both customer and supplier companies may do much to determine the degree to which the programme is initially greeted by the suppliers, and the eventual success of that programme. The degree of involvement required of suppliers and the resources demanded of them may be inversely proportional to the number of suppliers taking part in a programme. There are a wide range of factors that will further affect the process of engagement or act as barriers to success and many of these are related to the methodologies of the programmes themselves. These factors are discussed in greater detail below.

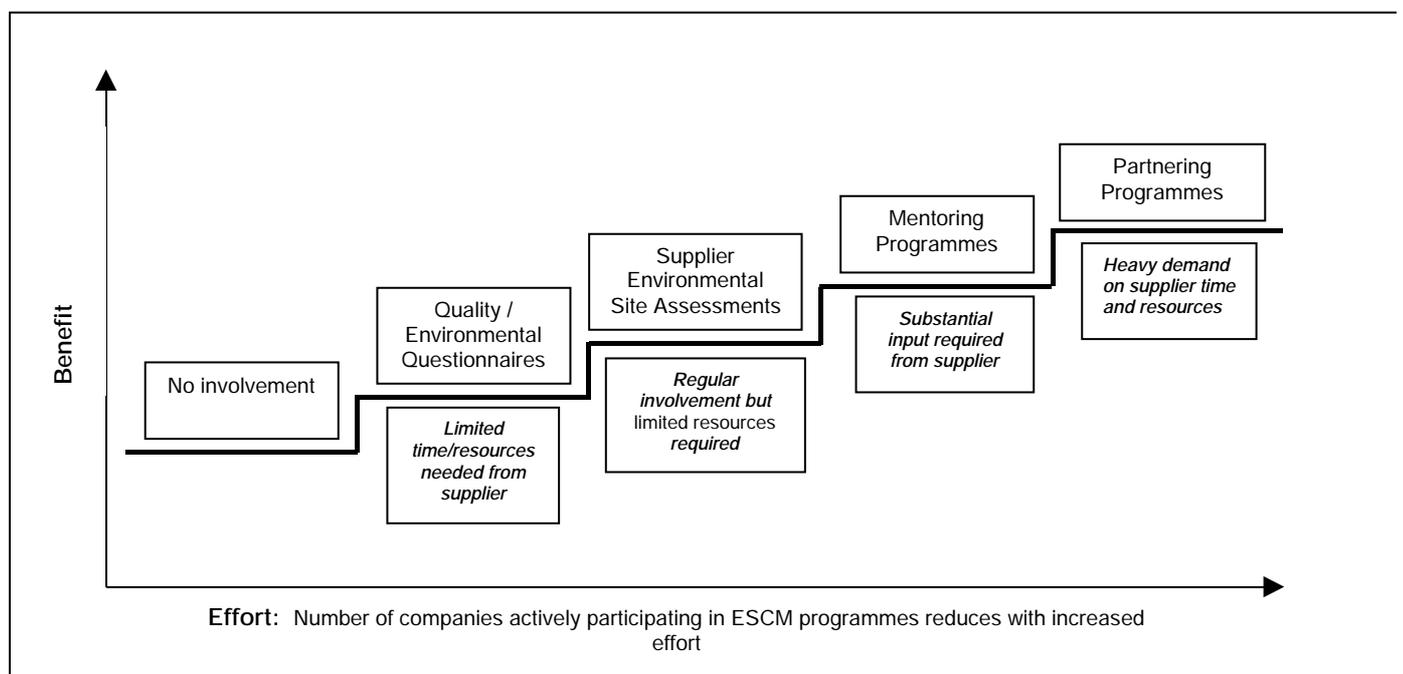


Figure 2 Model of stages of ESCM and degree of supplier involvement

Motivating Factors for the Development of ESCM by Customer Companies

The environment gets built into supply chains in response to a number of factors. The National Environmental Education and Training Foundation (NEETF) in the US found a number of motivating factors (see Table 1 below). These motivating factors are both internal and external and are primarily concerned with risk management, regulatory stance, enhanced brand image, international purchasing restrictions and customer pressure. Other secondary motivations were identified as cost reductions linked to pollution prevention, increased innovation and enhanced quality.

PRIMARY MOTIVATIONS	
Internal	External
Risk Management <ul style="list-style-type: none"> • Supply interruption • Long-term risk to human health and the environment • Competitive disadvantage 	Enhanced brand image <ul style="list-style-type: none"> • Corporate culture of forecasting trends and moving proactively • Potential for harm to public image due to environmental concerns
Regulatory stance <ul style="list-style-type: none"> • Desire to go beyond compliance • Suppliers knowingly or unwittingly provide materials containing problematic substances • Supplier non-compliance poses production risk 	International purchasing restrictions <ul style="list-style-type: none"> • Eco-labelling and product takeback gaining momentum • May drive the creation of systems for collection • Frequently focused on high-profile brands
	Customer pressure <ul style="list-style-type: none"> • Often appears in conjunction with a threat to brand image • Frequently focussed on high-profile brands
SECONDARY MOTIVATIONS	
Cost reduction as suppliers apply pollution prevention	Increased innovation <ul style="list-style-type: none"> • Can result from supplier participation in new product development
Enhanced quality	

Table 1 Motivations for Undertaking Supply Chain Environmental Management (from NEETF, 2001: 6)

Table 1 summarises in a useful way the range of motivating factors and the complex nature of many of these factors and reflects the discussion made previously in relation to the model (Figure 1). Not all of these will be discussed within this paper, but there are some key drivers that need to be considered more fully. Environmental regulation is perhaps still the key driver for the implementation of ESCM programmes. In Europe, environmental regulation is moving more towards the producer responsibility approach, and companies will have to be aware of and responsible for the whole lifecycle of their products. The automotive and electronics industry are already experiencing this with the ELV and WEEE Directives, which place an obligation on companies to develop products that can be disassembled and preferably be reused or recycled at the end of the product life. This legislation forces companies to work with others in the supply chain on product development and environmental issues and will act to consolidate supply chains further. Whereas previous environmental legislation may have had little or no direct impact on a company, either in its capacity as a customer or supplier, this new legislative approach and other integrated forms of environmental legislation in Europe, and elsewhere, means that few companies will be able to avoid becoming involved to some degree.

Another key reason for embarking on ESCM programmes has been identified as risk. Major reputation related risks can occur during the manufacture and distribution processes of supplying goods and services, and the action of one supplier can reflect on others in the supply chain. Businesses competing in the global market are no longer competing on an individual basis and actions of individual businesses in the supply chain can reflect badly on others. The authors have personal experience of this in Wales, when a large company was identified in the regional press for its association with a supplier that had experienced a major environmental incident. In this case, the large company was directly motivated to participate in one of the ESCM projects managed by the authors and described further below. The effective management of risk reduces the likelihood of incidents happening, protects corporate image and helps to ensure the stability of business and reliability of supplies. With the trend towards outsourcing, many companies now out source goods and services that originally took place on site. This has led to certain elements of control, for example, pollution

control no longer being under the direct management of the customer company. This has implications for the customer company as they have little control over what happens on outsource company sites, and in order to protect their own image, environmental supply chain management offers a means by which a certain degree of control can be regained.

Many large companies have recognised the benefits of being global leaders in environmental management and exceeding regulatory requirements. It is well recognised that environmental management within a company can lead to cost reductions through waste and energy minimisation and more efficient material management. ESCM can lead to further efficiency savings as these resources can be managed between supplier and customer company and can therefore achieve mutual advantage for those involved. Working with others in the supply chain can also stimulate innovation, perhaps leading to quality improvements and resulting in competitive advantage and market differentiation. The changes in environmental legislation as described above, requiring innovation in product design to achieve eco-efficiency, are excellent gateway through which customers and suppliers can work together to achieve innovation.

There is a general perception that international environmental management system standards such as ISO 14001 can be a motivating factor for customer companies to develop ESCM programmes (US-AEP, 2000). They have also been identified as a useful tool to exert pressure on suppliers, for example the Ford Motor Company has set a target for all manufacturing sites shipping products to Ford to be certified to ISO 14001 by 2003. As of January 2002, there were 36,001 certifications world wide to ISO 14001 – the number is growing every year even though it is a voluntary standard. Japan has the greatest number of certifications, with 8,169, followed by Germany with 3,380 and the UK with 2,500. (Figures taken from ISO World). By gaining certification, companies can demonstrate their environmental responsibility and can achieve continuous improvement partly through involving suppliers in environmental improvement activities. However, research into how important ISO14001 and other EMS approaches are in generating ESCM pressure, carried out by the United States – Asia Environmental Partnership (US-AEP), indicates that many companies regard internal environmental management systems as being just as effective as ISO14001, if not more so. While a generally held perception of the importance of ISO14001 in driving environmental improvement through the supply chain appears to exist within some academic, business support and business circles, the reality is much less convincing, and the picture is influenced by many sectoral and locational factors.

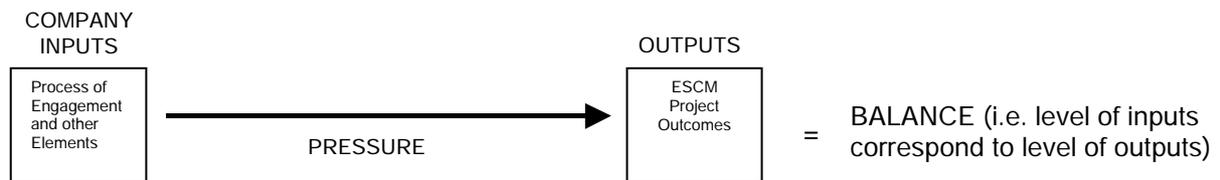
One of the main omissions from Table 1 is the importance of the ESCM programme as a hidden or covert mechanism practised by customer companies to achieve supply base rationalisation. This motivating factor is not broadly advertised as ostensibly customer companies are acting to achieve environmental improvement in their supply chain. The reality is that they wish to shrink the number of suppliers that they use for any particular material or component whilst having a tighter control on the quality and cost of supplier items. Here the depth and nature of inter company relationships will obviously be a key factor in determining whether suppliers are retained following involvement in such an ESCM programme, and whether the remaining suppliers are then invited to participate in mutually beneficial ECSM programmes.

Current ESCM programmes and the process of engagement

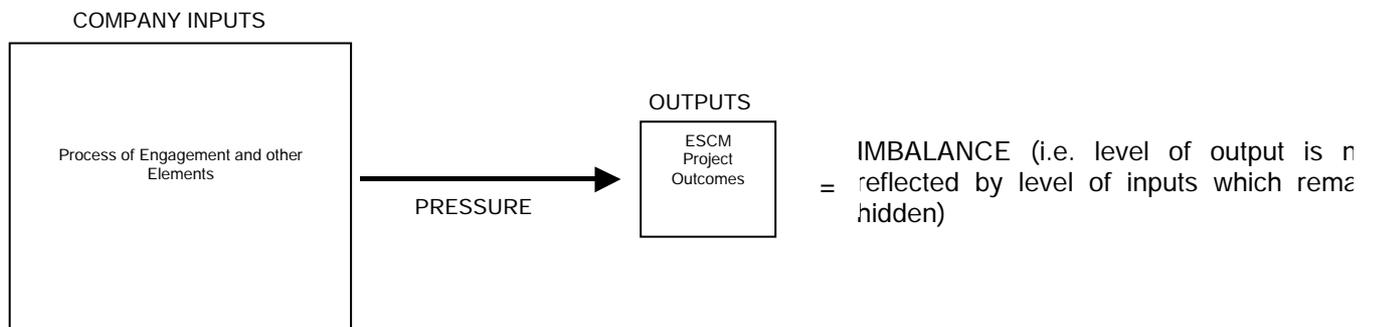
There are a large number of ESCM programmes currently in operation or recently concluded in the UK, Europe and elsewhere. A number of individual companies, mostly large corporations have given details about their ESCM programmes and there are a number of cases where academic and business authors have discussed the positive influence of the supply chain in achieving environmental performance improvement of suppliers. However, the main focus seems to be on the drivers for ESCM and the practical implementation of programmes, often based on case study examples and the effectiveness of supply chain pressure is a topic that is tackled far less frequently. One of the means

by which it would be possible to evaluate the degree of pressure being exerted through the supply chain would be to have complete knowledge of the actual process of engagement that had taken place to achieve the outcomes that are demonstrated by that programme as discussed earlier in Figure 1.

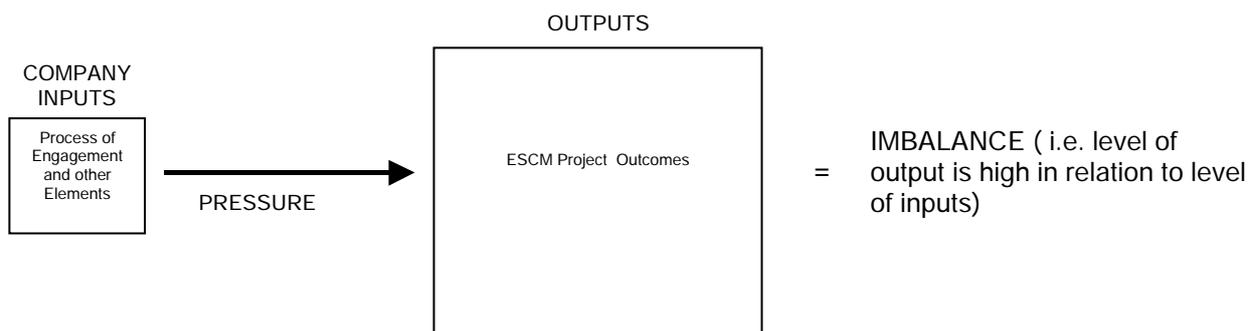
This can be visualised as a simple input-output balance model in which the costs of engagement can be measured against the output benefits. The diagrams below illustrate the importance of the hidden elements identified in the model in Figure 1. While this does not directly measure the degree of pressure exerted on a supplier, it does provide a measure of the commitment of the customer company to achieving ESCM programme outcomes, perhaps sometimes at a disproportionate cost?



What may occur, however, is;

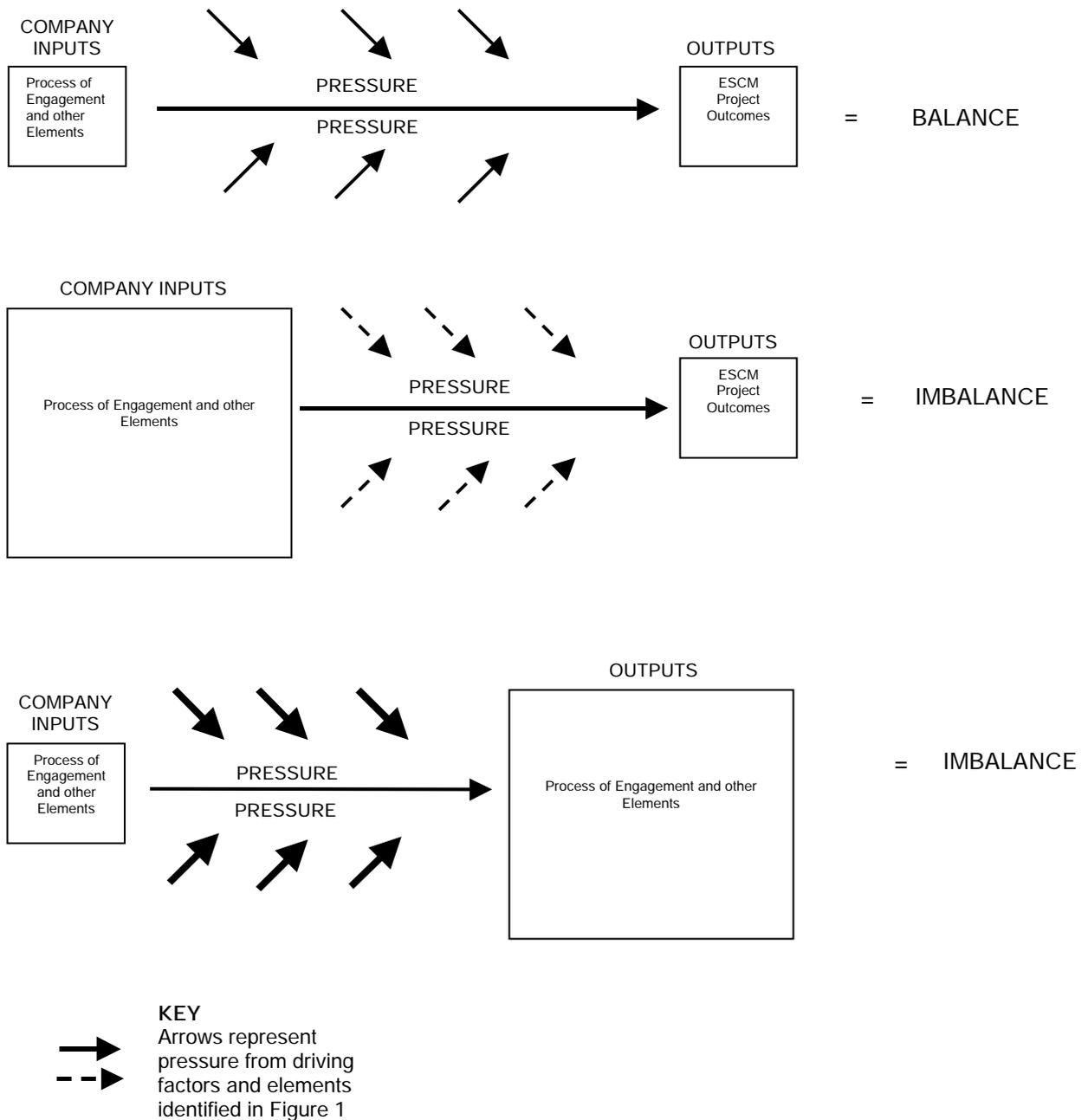


or, more rarely;



As stated above, this model does not directly measure the pressure exerted, but provides a simplified picture of the degree of effort required to achieve programme outcomes, and, if measured, would enable companies to begin to understand the reality of the process of engagement. The model would need a means of measurement of the inputs together with a measurement of the outputs (based on evaluation of their benefits and non-benefits). This would allow a true measure of the balance between inputs and outputs, so that companies instigating an ESCM programme would know the

challenges facing them in gaining supplier participation, and could adjust the degree of pressure they exert accordingly. To understand how the pressure exerted by a company on its suppliers during this process may be influenced, and thus how the level of outputs may be affected, it is necessary to build into the model a measurement of the external factors as previously identified (see Figure 1 and other references) that could have a bearing on whether a supplier would choose to participate in an ESCM programme. Examples may include the influence of new legislation where a supplier may feel that an ESCM programme would offer sufficient assistance and support to help them achieve compliance. The ELV and WEEE Directives of the EU are currently having such an effect on automotive and electronics suppliers in the UK. Another example may be where stakeholder risk management encourages a supplier to seek unity with its customers in addressing site management or planning related issues. The chemical and waste management industries are sectors in which such relationships are likely to develop.



The model offered only begins to address the issue of the problem of measurement and the importance of the context in which internal element and external factors exist. ESCM is a 'new science', and while there remain arguments for innovation in the way programmes are carried out, and the methodologies that are developed, the point would appear to have arrived when a greater methodological rigour could be applied. Greater clarity, transparency and access to the whole process of ESCM would enable a greater number of businesses to make more informed decisions about the benefits and drawbacks of engaging in the ESCM process. The next section provides a brief review of a selection of current ESCM programmes to highlight the issue of hidden knowledge, and to question the true success of outcomes identified by programme instigators.

ESCM and the question of hidden knowledge

Current ESCM programmes are reported on in a variety of ways. They are often the basis of press releases, corporate information on the Web, the subject of case study reports (geared for a business audience), and are focused mainly on the methodologies employed and the outcomes. There are studies which do highlight the problems and difficulties involved in the development of ESCM programmes, but they rarely go beyond the common challenges faced by companies in the operationalisation of the programme, and do not consider the issue of the process of engagement or the measurability of inputs and outputs in any meaningful way. It is understandable that companies carrying out ESCM programmes wish to promote the benefits and successes of what they are doing, but as discussed in the previous section, without a true understanding of the process it may be difficult for ESCM programmes to diffuse along supply chain links.

Table 2 below provides a brief summary of a selection of current ESCM programmes and the data available through accessible channels. This is the data that is publicly available, and which business would use to help them decide whether they should develop an ESCM programme of their own. The table shows that the information available is variable in nature. This appears partly to be because many of the companies that are involved in ESCM programmes have an ongoing programme of ESCM mechanisms in place and do not have programmes with objectives and targets set up. Suppliers are just subject to terms and conditions and requirements that are set in order to become suppliers or to continue being suppliers. For example, BT Group, Xerox and Hewlett Packard have standards and requirements for suppliers and in some cases offer support in order to achieve them. However, there appears to be no information available that says how many suppliers actually abide by these standards and requirements, or to what degree, or whether in reality environmental performance is used as a factor in supplier decisions. Likewise, are certain aspects of the standards non negotiable such as banned and restricted substances (for example Hewlett Packard), but others dependent on factors such as strength of relationship or brand? Companies such as Jaguar and Ford have very defined targets and specific ESCM programmes in place and so there is more information available regarding number involved. However, this is still limited and there is no information readily available on the percentage of suppliers involved from the whole supply base, refusing involvement and resistant to involvement, the cost of the programme per supplier involved and the time needed to engage suppliers. These are just a few of the largely hidden factors and elements where there is little information or, however there are additional ones, see Figure 1.

Table 2: Summary of a selection of current ESCM programmes

ESCM Programme Instigator	Date of Programme	Programme Content / Aims	Number of Suppliers involved	Outcome	% of suppliers involved from whole supply base	% Supplier Refusing involvement	% of suppliers resistant to involvement	Cost of programme per supplier involved (£ per supplier)	Time needed to engage suppliers / per supplier (hours per supplier)
BT Group	Introduced 1992, mandatory 1998 & revised environmental supplier strategy launched 1999	<ul style="list-style-type: none"> GS13 – Environmental impact standard Investors in Excellence awards. 	All suppliers are asked to identify the environmental impacts most relevant to the product or service they supply to BT	Ongoing "over the past few years, we have influenced the environmental performance of many of our suppliers by means of GS13"	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear
Ford Motor Company	Programmes of have been in place since the early 1980's (e.g. restricted substances) and are ongoing.	<p>Several strategies to work with suppliers as partners in reducing environmental This includes:</p> <ul style="list-style-type: none"> ISO 14001 Awareness Training Requiring suppliers to have at least 1 manufacturing site certified to SO 14001 by the end of 2001 All manufacturing sites shipping products to Ford by 1 July 2003. Mentoring 	Affects about 5,000 of Ford's production and non production suppliers with manufacturing facilities	Ongoing Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear
Ikea	Set as a priority for 2000 - 2003	<ul style="list-style-type: none"> Introduced a set of social and environmental principles that must be met by suppliers – specify minimum requirements Developed 4SEA – 4 point Supplier Environmental Assurance 	Approximately 2,150	Ongoing Hidden knowledge / Not readily available / Unclear	All	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear
Jaguar	a. & b 1997 –1999 c. 1999-2001 d. 2002	<p>a Started work with suppliers b Phase 1: SMEs embarked on a 10 stage programme to install EMSs</p> <p>c Phase 2 d. Phase 3</p> <ul style="list-style-type: none"> Told 605 1st tier suppliers to achieve ISO 14001 by end of 2001 Want all 1st tier suppliers accredited to ISO 14001 by 2003 	<p>a. unclear b. 50 c. 15 d. 605 1st tier suppliers to achieve ISO 14001 by end of 2001. Aims to have 800+ manufacturing sites certified by 2003</p>	<ul style="list-style-type: none"> Have helped 11 small suppliers achieved ISO 14001 <p>Ongoing</p>	Hidden knowledge / Not readily available / Unclear	By the end of 2001, 32% 1 st tier suppliers achieved certification	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear
Xerox	Started 1998	<ul style="list-style-type: none"> Supplier EH&S Requirements consistent with internal targets for reducing environmental impacts Suppliers are asked to meet five specific requirements in order to do business Xerox suppliers are expected to develop an environmental management system conforming to the ISO 14001 standard. Integrated into supplier assessment programme & form the basis for competitive comparisons between suppliers 	Hidden knowledge / Not readily available / Unclear	Ongoing Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear	Hidden knowledge / Not readily available / Unclear
Hewlett Packard		<p>At minimum], suppliers are asked to:</p> <ul style="list-style-type: none"> Comply with the law and HP's General 	Hidden knowledge / Not readily available /	Ongoing	Hidden knowledge /	Hidden knowledge /	Hidden knowledge /	Hidden knowledge /	Hidden knowledge /

Evaluating ESCM pressure – a review of research

There have been a number of research studies carried out in the UK and elsewhere designed to identify, at least in part, the importance of the supply chain in engaging suppliers in environmental improvement programmes. The following discussion highlights some of the more salient points that have arisen from this research.

Hill (1997) carried out one of the most important research surveys in terms of identifying environmental supply chain pressure in 1991. Since this time, there has been little direct research focusing on the assessment of the pressure exerted between customers and suppliers. Hill's survey was based on 1500 cross-sectoral manufacturing firms in Yorkshire and Humberside gaining responses from 301 companies. 75% of the firms surveyed identified pressure being exerted through the supply chain as a stimulus for environmental change, preceded only by environmental legislation (88%) and local authorities (77%), who have a role in the enforcement of legislation. Hill found that larger, corporately owned, longer established or finished goods manufacturers in the chemicals and printing sectors were more likely to respond. Smaller, more recently established, family owned or single plant companies in the clothing and metal goods sectors were least likely to respond.

Hill concludes that most of the pressure that had been exerted has been by large firms and MNCs and has been concerned with reducing exposure to liability and costs, however this has been limited as economic factors are still the main emphasis. He argues that "industrial customer pressure has the potential to be highly significant...(but) ... that customer do not see the necessity for this kind of pressure unless it is forced by legislation" (ibid.). These conclusions are, however, based on the responses of companies in 1991, and there has been a substantial change in attitudes towards the management of the environment throughout the business community, supported by a wide range of increasingly demanding and innovative pieces of legislation that require much closer co-operation between companies in the supply chain.

A focus study completed by the Centre for Advanced Purchasing Studies (*Carter & Narasimhan, 1998*) on ESCM provides further emphasis on the weakness of the supply chain in effecting change. The study was based on 14 in depth case studies on businesses already implementing some form of ESCM. It recognised that ESCM is an emerging field and the aim of the study was to examine environmental issues that were relevant to the supply chain, together with the identification of leading edge practices and methodologies and the development of a framework for ESCM strategies and projected trends. The conclusion of the study was that the use of environmental programmes in supplier selection and quality assurance has minimal importance and the focus, even in the most proactive, was largely on adhering to, and avoiding violations of legislation.

Some more recent research has come to rather more positive conclusions, perhaps reflecting the changes that appear to be taking place in business at the current time in regard to ESCM. Business for Social Responsibility (BSR) in the US, for example, have carried out research and published a report on '*Suppliers Perspectives on Greening the Supply Chain*' (BSR,2001). This looks at strategies for supply chain environmental management and gives insights from the perspective of the suppliers. For this research, 25 leading suppliers, spanning the automotive, electronics, business services and forest products sectors were investigated. They were typically supplying large companies that have begun to address environmental issues and look at greening their supply chain.

It was discovered that nearly all of the 25 companies interviewed had received some sort of requests regarding environmental issues from their customers, and that some of these requests have lead to changes in the suppliers' environmental performance. Different sectors made different demands, with companies supplying the electronics and automotive sectors having received the most requests. Most customers communicated their environmental expectations and requests through questionnaires and lists of restricted substances, but there were examples of a small but growing number of more collaborative processes for addressing environmental issues across the supply chain. However, suppliers were vocal in their complaints that environmental expectations were not being integrated into purchasing decisions, with price still being the major overriding factor. Of the 25 companies interviewed, 20 of them had initiatives to address environmental concerns with their products or services and of these, seven were as a direct result of meeting the

environmental requirements of their customers. This was mainly concerned with the elimination of restricted substances. A further conclusion of the report was that "customer companies' environmental programmes involving Tier 1 suppliers have begun to translate into action further up the supply chain, but this is only just beginning to take place" (ibid). The research team also found that rather than environmental requests flowing one way i.e. up the supply chain, they are in fact flowing both ways and a number of the suppliers interviewed said that customers had been involved in assisting them to meet their (the suppliers') own environmental objectives.

The same study also raised the issue of pressure exerted by ISO14001 and other environmental management systems. ISO14001 is often quoted by businesses, academics and governments to be significant as a pressure forcing suppliers to become involved in ESCM programmes. Much of this perception is generated from rather poorly researched or loosely focused anecdotal evidence, although an increasing number of researchers are attempting to establish the importance of the EMS standard in this area. The BSR report provides some of this evidence as a large proportion of the companies involved in the study said that they had received 'requests' to implement ISO14001. At the time of the research, 6 of the 25 companies interviewed had obtained certification to the ISO 14001 standard as a direct result of such 'requests'. However, as the study did not provide full information on the number of companies in each sector, it would be difficult from the report produced to make a comment about the proportional strength of pressure across the different sectors involved.

Young and Kielkiewicz-Young (2001) present an overview of current practices in managing sustainability (social, ethical and environmental) issues in supply networks, based on interviews and desk top research into 8 economic sectors in Europe and North America. (Full research report: *Supply Chain Strategy and Evaluation, First Report*, carried out by Charter et.al., 2001)

Although this is based on sustainability management, there were interesting findings with regard to the environment. The reason for the relative focus on environmental issues, was found to be due to the presence of internal and external factors focusing on the environment including business to business pressure. It was found that large organisations can have a significant influence over smaller companies in the supply chain, but significantly, the authors identified that the ability for customer companies to dictate requirements is ultimately dependent on a range of market factors. Such factors include, as identified in Figure 1 above (as elements and driving factors), the volume of business transacted, the number of competitors in the market and the strategic importance of the product or service. It was also found that SCM is most developed in those sectors that are subject to the greatest drivers, such as legislation, and this is apparent in the electronics, automotive and chemicals sectors. This piece of very recent research heralds at least the beginning of an interest in addressing the issue of pressure measurement.

There are a wide number of additional reports carried out on ESCM by organisations such as the US National Environmental Education and Training Foundation report on supplier environmental management¹ report, but they fails to address the measurement of pressure exerted through the supply chain and as such have not been further discussed in this paper

In the last few years, published research into ESCM has increased greatly. Most of the current information on ESCM appears to be business led, with a focus on how ESCM methodologies, mainly using the case study to illustrate the benefits of the approach. Apart from the research carried out by Hill (1997), there appears to be very little research that looks at which companies are not involved in ESCM programmes, which have refused to become involved and why they may change their minds if external drivers stimulate them to do so. Thus, most of the published materials focuses on those companies already involved in ESCM. This suggests that the understanding of the true influence of the supply chain may be skewed as it is based on those companies

¹ The report, *Going Green Upstream: The Promise of Supplier Environmental Management*. The research for this report consisted of background research, 40 interviews of SCEM experts and carried out 10 in depth interviews for case study material and appears to represent one of the most detailed studies carried out so far. The information gathered was qualitative. It is sectoral and highlights the differences in ESCM between different industries and the complexity of relationships within those industries. The report is largely geared up for businesses to make use of and so develop their own ESCM programme. and does not address the effectiveness of pressure exerted. The NEETF report notes that ESCM 'does not yet have a robust collection of case studies or research that demonstrates the economic benefits' of ESCM programmes. The information that does exist is very context specific'

generally enjoying success from their involvement and does not reveal the hidden knowledge discussed above. It has also focussed on the manufacturing sector, however, this is the sector that has the most visible environmental impact and so is appropriate in the early development of ESCM.

Perceptions of reality – case studies from research in Wales and the rest of the UK

The authors have been involved in a number of ESCM related research projects in the last four years². The research carried out provides a further insight into the pressure exerted through the supply chain to effect environmental improvements in supplier companies.

From 1999 to the end of 2001, the Supplier Environmental Assessment (SENA) Project was carried out in south Wales. The main aim of the SENVA project was to work with customer and supplier companies to improve environmental performance in the supply chain. The project involved carrying out environmental assessments of supplier companies on behalf of customer companies. These reports and ongoing advice to both supplier and customer companies was provided without cost. The customer companies were determined initially by identifying those industrial sectors important to the Welsh economy. Once the industrial sectors were identified, existing databases of large companies and organisations were used to pick a representative sample of each sector to contact. The process of engagement and the difficulties encountered (i.e. relating to the hidden elements of the project) are discussed below. The project finally achieved the participation of 12 customer companies and 1 customer company complex, and 100 supplier companies (63 of which had environmental assessments carried out). The customer companies are identified in Table 3.

Customer	Description	No. of Suppliers Assessed
Company 1	A Welsh government agency	19
Company 2	A large chemical company	1
Company 3	A medium sized electronics company	1
Company 4	A medium sized electronics company	6
Company 5	A large educational establishment	4
Company 6	A large chemicals company	2
Company 7	A large chemicals company	4
Company 8	A heavy engineering SME	3
Company 9	A large chemicals manufacturing company	4
Company 10	A large heavy engineering company	4
Company 11	A medium textile company	2
Company 12	A medium engineering/metals company	1
Complex 1	A group of chemical companies working together	12

Table 3: Customer Companies participating in the SENVA Project

The customer companies involved in the project chose to participate, and the reasons for their participation provide some clues as to the reasons they decided to exert pressure on their suppliers. Table 3 summarises these reasons:

Customer	Reasons for Participation in the Project
A Welsh government agency	Legislation – environmental protection and compliance
A large chemical company	Chemical company supplier management programme ISO14001
A medium sized electronics company	ISO14001
A medium sized electronics company	ISO14001
A large educational establishment	As part of environmental policy
A large chemicals company	ISO14001
A large chemicals company	ISO14001
A heavy engineering SME	ISO14001 Stakeholder risk management
A large chemicals manufacturing company	A defensive move to regain lost reputation and to ensure environmental risk security in the supply chain
A large heavy engineering company	ISO14001 Ongoing supplier management programme
A medium textile company	ISO14001
A medium engineering/metals company	Interest following an environmental review of the company
A group of chemical companies working together	ISO14001 Ongoing improvement to methodology of supplier management programme

² The research has been carried out by the authors mainly involved in projects funded by the European Union European Regional Development Fund (ERDF), and through ESRC funding for the new ESRC centre for Business Relationships, Accountability, Sustainability and Society (BRASS) of which the authors are both members.

Table 4 : Summary of Reasons for Participation in the SENVA Project

It is clear from the table that one of the main reasons for participation was the driver of ISO14001. Many of these businesses either already had certification to the standard or were progressing towards it, and had been advised by the third party auditor (certification body) that they needed to address the supply chain issue. While this was the main reason, it is interesting to note that some companies were building on supplier management programmes already developed, for quality or health and safety reasons for example, whilst one or two were using the project because they had experienced incidents that had damaged their reputation locally and wanted to ensure that such problems would not reoccur. While these figures are interesting, and do indeed reveal some of the reasons for participation as a customer in the project, the hidden knowledge relating to the inputs of the project engagement process reveal a picture much less positive about environmental supply chain pressure. Of 466 companies contacted³ by telephone (of which 393 were large companies and 73 were SMEs), 70 agreed to a visit to discuss the project further and the final 12 participating businesses (there were 5 companies in the chemical complex so 17 companies or organisations were involved in total). This means that only 2.58% of the companies contacted agreed to participate, even following repeated telephone and mail contacts and lengthy face to face discussions. The reasons given by these companies for their lack of interest were varied. A large number stated that they were not interested in environmental issues or environmental management, but of those who were, common responses centred on the fact that it would be one or two years before the company started to implement ISO14001. Until that time they were reluctant to contact suppliers as those suppliers might question the validity of pressure if the customer company had not improved its own environmental management. They were also reluctant as they perceived participation to involve a drain on resources in terms of time and indirect costs, even though they were assured that they would have to play a minimal initial role in the engagement of suppliers. Some companies could not see that any benefits would accrue from such involvement. They did not appear to place importance on the fact that efficiency savings relating to materials and product management could occur, that they could ensure risk management of environmental incidents on supplier sites and thus reduce the risk to reputation or more importantly reduce the potential interruption to supply. They had a short term view and lacked the capacity to plan strategically for the future.

Once the customer companies had decided to participate they provided either a complete supplier database or a selected number of suppliers to the project team to enable the process of engagement to begin. These suppliers were contacted initially by letter and then by telephone to explain why their customers had decided to join the project, why they wanted their suppliers to participate and what benefits should be available to the supplier, as well as to the customer, if they agreed to become involved. While some of the databases used were extremely large with hundreds of suppliers and included suppliers that operated outside the research teams spatial limit (under the funding mechanism), and produced therefore a proportionately low number of suppliers agreeing to participate, even when supplier lists were selective and focused on a small number, the response was sometimes surprisingly low. Three examples serve to identify some of the reasons why suppliers chose to refuse participation. The medium sized electronics company provided a supplier list of 49 companies. Of these only 6 (12.24 %) agreed to participate following much persuasion and repeated contacts. During the contact process and also when the visits were made to participating suppliers, a large number of very negative comments were made about the customer company especially in its inability to pay suppliers on time, and this fact alone was sufficient to make suppliers very resistant. The second example, that of the chemical complex was even more surprising. The research team were given a selection of 20 suppliers. These suppliers worked extremely closely with the complex, had long relationships with them, often worked on the sites of the complex, and were already involved in supplier management programmes relating to health, safety and quality. Of the 20 contacted, 12 (60%) agreed to take part, when the customer had assumed that 100% would be easily achieved. Despite the powerful nature of the companies making up the complex, all of whom were internationally important and who were large employers in the local area, there were still suppliers who were apparently willing to risk non-participation. In this particular case, the suppliers who did not take part did

³ Of the companies contacted there were wide range of sectors involved. The authors are well aware that this sector breakdown makes up part of the hidden element of the process of engagement, but do not wish to pursue this aspect in this particular paper as it will inform future papers. Having said that, a large number of the companies were from chemical, automotive, electronics, food and heavy engineering, and it is clear from Table 3 that those companies that did participate were heavily biased towards chemicals, heavy engineering and electronics

not directly refuse, but followed a process of continued resistance, for example, cancelling appointments, asking for more time to prepare materials and so on. The final example involved the most powerful customer. This locally important company of international stature, employing thousands of people in South Wales, asked the team to gain the involvement of only 5 potentially high risk suppliers. These companies had again had a long relationship with the customer, worked on its sites and were dependent on the customer for the main proportion of their income. Four suppliers agreed immediately to participation (80%), but despite the customer's reputation for dealing swiftly with suppliers who did not meet their requirements, the fifth supplier refused outright. It stated that it had no environmental problems and that it was perfectly capable of managing its own operations "without interference from its customers". These examples provide a brief, but telling, insight into the hidden knowledge that lies behind ESCM programmes. It is clear, even from this very brief discussion, that the notion of the iceberg accurately reflects the true situation, and that the management of the process of engagement needs to be fully understood, measured and evaluated.

However, identifying the need for measurement and actually carrying out such measurements are two very different things. It is fraught with difficulties. A lot of the information is anecdotal, there are a huge range of methodologies used and costs are calculated in different ways leaving little chance for data equivalence. In terms of measuring the pressure created by external factors, again the difficulty is in finding a way to calculate the importance of each factor for each company, in order to make meaningful comparisons. While it may be possible to measure each factor in different ways, for example, using a scale of one to ten to identify strength of pressure according to the opinions of company managers, it is harder to compare these factor pressures with each other.

There were some interesting points made by many of the companies visited under the project, and under other research projects concerned with ESCM carried by the authors over the same period of time. Comments offered in response to the question of how strong pressure is through the supply chain generally revealed that little pressure seems to exist. Many companies stated that they have received no pressure from customers previous to the contact made by the authors, or have received one or two telephone or fax enquiries in the past few years. This pattern is not true of some sectors, and not unexpectedly, suppliers to the automotive, chemical and electronics sectors have reported greater levels of pressure from customers, the latter two sectors clearly in response to ELV and WEEE. There also appeared to be a low level of awareness amongst suppliers about the reasons that pressure was being exerted. For example, while many of the customers joining the SENVA project identified ISO14001 as a driver for pressure, very few of their participating suppliers realised that this was why the customer was exerting pressure, were not aware of ISO14001 at all or thought it was a quality or health and safety related standard. Often, suppliers could not see the reasoning behind any kind of ESCM programme, and were on the whole very negative about the whole ESCM process stating that they thought it was a "cost-down exercise on the part of the customer", that customers were doing it to make themselves look good and "didn't really mean to assist the [supplier] in achieving environmental improvements. Also, that they had been through all of this process with the quality management system and they knew it was a waste of time meeting customer requirements because they still chose suppliers on cost grounds, and they were suspicious of customers implying that their suppliers were not able to manage their own companies.

The SENVA project has yet to be fully analysed and many of the points made above will be more fully explored and applied to the model of hidden knowledge in the future. However, it is clear from even this brief and initial analysis that the interactions between customers and suppliers are extremely complex, that neither side fully understand what elements and driving factors exist and have little comprehension of the necessity of development tools to measure the outputs of such programmes.

Research Survey

The research team have recently begun to receive some results from a UK wide survey launched in 2002 partly designed to assess the level of involvement companies have with their suppliers to effect supplier environmental improvements and to investigate the drivers encouraging companies to instigate ESCM programmes. The survey was sent to over 800⁴ companies and organisations. To date some 40 responses

⁴ The 800 companies comprised the whole of the FT500 list for 2000 and the whole of the Wales Top 300 list for the same year

have been received and these have been subjected to analysis for the purposes of this paper. Companies were asked about their priorities for sourcing suppliers. The most important priorities were quality of supplies, cost and delivery time. Environmental performance of the supplier was ranked 13th overall (out of 16 priorities identified, see Table 5).

The companies were also asked to indicate the drivers or elements motivating them to engage in ESCM programmes, and here cost savings, increased profitability and business reputation were the top reasons, followed by environmental legislation. Pressure from others in the supply chain, or concerns about environmental management generally were much less important and ISO14001 was ranked as the least important factor.

Rank	Factor
1	Quality of products
2	Cost
3	Delivery time
4	Technical specification / reliability
5	Product availability
6	Legislative compliance
7	High degree of trust
8	Flexibility
9	Business reputation
10	Support in product design / development
11	Ethical principles
12	Potential for partnership with your company
13	Environmental performance
14	Sustainability performance
15	Length of contract
16	Proximity

Table 5: Factors important to companies when sourcing suppliers

The survey also asked companies to identify their levels of involvement with suppliers using a range of ESCM programmes (as discussed in Figure 2 above). It was apparent that most companies have yet to move beyond the basic supplier questionnaire with 54% using this approach, whilst far fewer companies were engaged in more interactive relationship based programmes such as environmental partnering (14.29%). Companies were asked to give reasons for the lack of pressure they were exerting on suppliers even when they themselves had developed proactive environmental management programmes for their own companies. Once again, cost was the main reason given and companies were also unsure about the benefits of ESCM and identified potentially high levels of resource allocation as barriers to involvement. This provides further justification for the case made by the authors throughout this paper for a clearer understanding of the hidden elements involved in ESCM and the need to have a means of measuring the costs and benefits of ESCM.

Conclusions

ESCM is not going to go away. In the last two or three years, environmental supply chain management seems to have risen on the agenda of at least the largest companies and organisations, however the picture is very fragmented and the reasons for it very complex. Research to date has focused on manufacturing firms however it is not just these firms which have an impact on the environment. Current ESCM literature, whether programme reports from companies, government commentaries or academic research outputs, does little to address the issue of hidden knowledge. This is due to the nature and current position of ESCM, as programmes are business led, information often based on case studies designed to illustrate methodology and therefore designed to provide practical support for other companies wishing to instigate ESCM programmes. We do not know the complete picture. The numbers of businesses and organisations that do not participate in ESCM, refuse or avoid participation, the lack of involvement by certain industrial sectors or companies of different sizes has never been revealed comprehensively. It is this lack of knowledge that raises the greatest concern as the spread of ESCM approaches may be restricted and its true potential may not be realised.

As changes in the concept and structure of supply chains occur, they may also provide either positive or negative impacts on the ease with which ESCM programmes can be introduced, or on the importance

companies place on the management of the environment as a supply chain issue. The Internet and other communications technologies, for example, may cause unforeseen negative impacts. Electronic procurement and arms-length electronic business-to-business supplier exchanges can reduce the importance of the supply chain relationship and make it difficult for suppliers to compete on any parameter other than price. Another current trend is the move towards greater outsourcing and the development of global supply bases, which make it more important – but more difficult – for customers to understand the environmental impacts across their supply chain as their mechanisms of control are diluted by distance.

Conversely, while there remains a continued focus on cost reduction as a key parameter in making supply chain decisions, there is evidence that some companies are beginning to assess *total costs* rather than price. These companies may be willing to pay higher up front costs for an environmentally preferable commodity if the company will save money overall through decreased compliance or waste disposal costs as a result (BSR 2001). The notion of power in the supply chain is important for ESCM. Power is frequently linked with size of a company however, this is not necessarily the case. A key type of power can be associated with a firm's ability to innovate and become a source of new ideas for its trading "partner(s)" (Green et al., 1998). In this case, those suppliers lucky enough to be involved with a well structured and clearly focused ESCM programme may receive substantial benefits. However, power may be used in a very negative way from the viewpoint of the supplier, if customers use the supply chain to rationalise suppliers, or to force cost down on them following the implementation of an ESCM programme. Evidence for this rationalisation approach exists, and may be instrumental in causing some suppliers to be wary of agreeing to participate in ESCM programmes. Customers may disagree with this perception, and argue that brand reputation needs to be preserved and enhanced, this objective being one of the highest priorities of the firm. From the customer perspective, rationalisation and the removal of high environmental risk suppliers may be one of the most efficient, if most ruthless, ways of achieving this objective.

In addition to the impacts created by structural changes in supply chains, external factors may have significant impacts on the degree to which ESCM is used as a management tool, or the level of success that may be obtained from its use. The most advanced organisations are those in sectors that are exposed to the strongest legislative and market drivers, but where external drivers are lacking or are weak, companies are not nearly as advanced. Pressure so far only seems to be applied by the larger companies with smaller ones still concerned about getting their own operations in order

Environmental supply chain management offers the opportunity to those willing to be involved more collaborative and stronger relationships with customer and suppliers. With globalisation, the marketplace is becoming ever more competitive and cost margins are being reduced all the time. By working with others there is the opportunity to improve efficiency and reduce risk – a win-win situation. Environmental supply chain management should be viewed as an opportunity to strengthen relationships, and improve reputation and efficiency, something that many large companies seem to have grasped and acted upon. What needs to take place now is much more research into the whole process of ESCM. Hidden knowledge must become public knowledge. Methodologies must be developed to enable measurement of all the elements and factors involved in ESCM so true costs and benefits can be judged. Motivations for participation by customers, and by suppliers, must be more fully investigated and related to the patterns of hidden knowledge and the measurement of factors and elements. If a more open and comprehensive approach to the dissemination of knowledge about ESCM could be developed, the value of the concept would be more readily understood. This would allow businesses and other organisations to more clearly identify the potential pitfalls of the ESCM approach, and encourage the diffusion of ESCM practice through the increasingly complex structure of the supply chain.

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Additional Web Sites

Hewlett Packard: <http://www.hp.com/hpinfo/community/environment/operations/supplychain.htm>

Ford Motor Company: <http://www.ford.com>

Ikea: <http://www.ikea.com>

Jaguar: <http://www.jaguar.com>

Xerox corporation: <http://www.xerox.com>

British Telecom: <http://www.groupbt.com>