1 A Framework for Strategic Environmental Sourcing

SPRINGER PUBLISHING
TITLE: GREENING THE SUPPLY CHAIN
CHAPTER 1
Robert Sroufe
Duquesne University
Supply Chain Management Department
600 Forbes Avenue, Pittsburgh, PA 15238
Sroufer@duq.edu

As competition among businesses intensifies on a global scale, companies will continuously be looking for ways to reduce waste and its associated costs, maintain a flexible corporate strategy and improve their position in the marketplace. Managers are finding environmental practices being employed more widely as a result of changing business conditions that emphasise environmental and financial performance (Cordeiro and Sarkis 1997; Hart and Ahuja 1996). Consequently, meaningful and effective frameworks for change are increasingly important because of the cost of environmental options and the need to comply with regulatory pressures and address the concerns of consumer groups. Additionally, the adoption of voluntary environmental initiatives—such as the Business Principles for Sustainable Development of the International Chamber of Commerce, and international standards such as ISO 14001 from the International Organisation for Standardisation (ISO)—have impacted firms in recent years (Corbett and Kirsch 2001; GEMI 1997). These voluntary initiatives are causing many firms to emphasise environmental programmes that are both internal and external in scope. Basically, the stage has been set for the extension of environmental management to the supply chain and to associated environmental sourcing strategies. For the purpose of this chapter, sourcing as a function includes supply-base management, the controlling of total costs, the creation and exchange of long-term value and the creation of value partnerships with suppliers (Handfield and Nichols 1999).

Given the increased amount of attention recently to greening the supply chain (Beckman *et al*. 2001; Bowen *et al*. 2001; Carter and Ellram. 1998; Green *et al*. 1998; Min and Galle 1997; Narasimhan and Carter 1998; Seuring 2001; Walton *et al.* 1998), there still remains a lack of comprehensive frameworks and a dearth of information as to how the purchasing function can simultaneously integrate environmental initiatives into functional and strategic level decision-making processes.

Strategically, buyers should work with suppliers to explore the mutually beneficial results of solving environmental issues. Environmental issues represent an opportunity for purchasing to further influence supply chain management. For the purposes of this chapter, supply chain management involves the systematic, strategic co-ordination of the traditional business functions and the tactics used across these business functions within a particular company and across businesses within the supply chain, for the purpose of improving long-term performance of the individual companies and the supply chain (Mentzer *et al*. 2001). The greening of business processes can be a catalyst for finding ways to advance other areas of purchasing and supply management strategy. Environmental issues and imperatives can

spur new ways of thinking and acting on total quality principles and the concept of continuous improvement (Baker 1996).

A different and new image of environmental sourcing is emerging—one that is cost-driven (Seuring 2001) and strategy-driven, economically justified and integrated with the corporate and product and/or process decisions. If done correctly, purchasing is part of an environmentally conscious management philosophy, which can be defined as a system that integrates product and process design issues with the issues of manufacturing production planning and supply chain management (Handfield *et al*. 1997). Purchasing can help to identify, quantify, assess and manage the flow of environmental waste through the system with the goal of reducing waste and maximising resource efficiency. The role of purchasing is to assess the available sources of supply and provide supply strategy. One criterion of this strategy is to evaluate the suppliers' capabilities regarding cost, quality, lead times, flexibility and the environment. Additional supplier evaluation criteria include distribution, safety, incidents, health records and adherence to environmental regulations and/or involvement in voluntary environmental programmes.

Supply base sourcing strategies and practices have evolved from a typically non-competitive, overlooked element of strategy before the 1970s, to a synergistic and integral part of corporate competitive advantage today. Being part of a firm's competitive advantage means keeping one step ahead of the competition. For firms who are considered to be innovators and early adopters (Moore 1991) there are many challenges and hidden opportunities to recognising and integrating the critical function of purchasing and green supply chain management. For some time now, research has shown that suppliers are critical to the competitive success of firms (Monczka *et al*. 1993). The fact that future supplier performance is expected to improve continuously adds to the complexity of the environment and the importance of purchasing.

Borrowing from Dobler *et al*. (1990), I define strategic environmental sourcing as being concerned with the development of a firm's environmental plans for its long-term material, component or system requirements. This is in contrast to a firm's plans for foreseeable, near-term requirements. Strategic environmental sourcing helps management to focus attention on long-term competitiveness and profitability rather than on short-term, bottom-line considerations. Accepting this definition means understanding the importance of the trade-off of short-term environmental cost to obtain long-term performance goals and benefits. Strategic sourcing therefore involves an action plan designed to achieve and enhance the purchasing manager's specific long-term goals and objectives for his or her function. Strategic procurement has had, and is having, a growing impact on firms' competitive stances in the marketplace.

Given the growing importance of supply chain management and the additional environmental concerns that purchasing mangers are facing, the purpose of this chapter is to briefly review the history of sourcing strategy and to highlight the schools of thought that have helped shape the strategy and practices of the sourcing function. Additionally, the aim of this chapter is to posit frameworks to aid practitioners and academic researchers to gain a

better understanding of strategic environmental sourcing and supplier selection, by addressing the following questions:

- How has purchasing evolved to meet the needs of the environment?
- What is strategic environmental sourcing?
- How should suppliers be evaluated and selected?
- What metrics are available to assess suppliers?
- Where are the opportunities for future research?

The chapter is arranged into the following sections:

- Section 1.1: background
- Section 1.2: strategic planning
- Section 1.3: strategic environmental sourcing and framework
- Section 1.4: supplier development programs
- Section 1.5: a model of supplier selection for environmental sourcing
- Section 1.6: supplier assessment metrics
- Section 1.7: managerial implications, and directions for future research

The background section provides insight into the body of knowledge surrounding sourcing strategy, and is followed by subsequent sections that help to identify and highlight a framework for strategic sourcing. The following sections present an incremental model integrated into a new conceptual framework. This is followed by a discussion of the processes and steps involved in a strategic sourcing and supplier assessment model. Finally, there is a discussion of performance metrics and potential areas for new research in this growing field.

1.1 Background

Purchasing strategy first achieved a general level of recognition and interest in the mid-1970s (Farmer 1978; Rajagopal and Bernard 1993; Spekman 1981). Until that time, conventional corporate planning for a firm's long-range planning cycle began with the analysis of its products, markets and its competition—and then worked back through various operating and staff departments. Typically, purchasing or materials management departments were seldom included in this process until the long-term plans were agreed by other departments and translated into annual operating plans. This process worked satisfactorily as long as the materials were readily available at competitive prices. The importance of the purchasing function was taken more seriously when arguments were made that a function, which spends 50%–70% of a firm's revenue, should have more input concerning corporate strategy. Owing to the recessions of the 1970s, the scarcity of some resources, intensive worldwide competition and increasing international and external variables, a marked change in evolution of the purchasing function's involvement in strategy formation was necessary. Not only was the involvement of the purchasing function in strategy formation necessary, it was also

critical to the growth and development of the sourcing function and to supply chain management.

If recessions of the past were a catalyst in the recognition of the importance of the purchasing function and sourcing strategy, then perhaps the timing is now right to take sourcing strategy and supply chain management to the next level. The current recession and the exponential growth since the 1970s of US regulatory requirements—such as the Occupational Safety and Health Act, the Resource Conservation and Recovery Act, the Environmental Protection and Community Right to Know Act and the Clean Water Act—and other international legal requirements have put manufacturing firms in a precarious position. Add to this the release of voluntary environmental standards—such as ISO 14001, Green Lights, the 33/50 programme of the US Environmental Protection Agency (EPA), Green Seal and many companies are realising the importance of the supply chain and the need to manage hundreds or thousands of external processes in addition to internal processes (Montabon *et al*. 2000). Given the increased external pressures on firms, how do firms go about integrating environmental practices into supply chain management and strategic sourcing?

Over twenty years ago, Spekman and Hill (1980) found purchasing personnel, especially at higher levels, do not spend a sufficient amount of time and energy on such important strategic activities as external monitoring. Unfortunately, this is still true in some firms today. Unless high-level purchasing personnel concentrate to a greater degree on these external relationships they will not be able to have a positive impact on a firm's strategic planning process. The point is that being an effective purchasing manager of day-to-day activities is not enough. Strategic purchasing demands that managers become adept at: (1) monitoring the external environment, (2) forecasting and anticipating changes in relevant purchasing related factors and (3) communicating and sharing purchasing-related information with suppliers as well as with internal stakeholders.

Many firms find themselves facing a significant list of critical materials that may not be readily available at competitive prices. Consequently, it is necessary to identify those potentially critical materials early in the design and planning process—and to analyse each issue thoroughly enough to determine whether a serious problem exists. In many firms this situation has led to modification of the corporate long-range planning process. The process now brings together product-demand and material-supply considerations early in the design process.

If integrated successfully, strategic environmental sourcing provides firms with opportunities to design products that are more environmentally sound, to reduce waste, to lower costs and to reduce risk. The unique characteristics of strategic environmental sourcing are the focus on the impact that changes in external environmental issues have on a firm's future material needs and supplier policies. Spekman's generalised model of the strategic procurement planning process highlights the significance and interactive nature of this characteristic. The scope of the purchasing function can be characterised in three ways: by a clerical function, by commercial activity or by a strategic business function (van Weele 1984). In the past, purchasing was looked at as either a clerical arm of manufacturing and materials management or as a tactical function of marketing and manufacturing. Currently,

purchasing has become recognised as a cross-functional player in the process of strategy formation; top management recognises the importance of this function and the need for purchasing strategy to be linked to corporate strategy (Monczka *et al*. 1993). Additionally, environmental sourcing strategies are emerging; investing in the supply base through supplier development programmes is seen as an investment in the future, and purchasing managers need to think strategically and be aware of the environmental long-term opportunities found in supply chain management.

When making the transition from a clerical function to that of a strategic business function, purchasing managers will be given greater autonomy and responsibility for identifying external environmental issues and for aligning purchasing goals and firm-level goals. Sourcing strategies require the buying organisation to determine which suppliers are best positioned to provide long-term competitive advantage, what number of suppliers is most appropriate, when orders should be established with suppliers and for how long (Bowersox *et al.* 1985). The purchasing manager should understand and interpret the firm's strategic posture before deciding on the specific techniques to use in acquiring intermediate products from suppliers.

To date, the purchasing function has evolved to meet the strategic challenges of sourcing. Given this evolution, frameworks are still needed to take strategic planning to the next level and integrate strategic environmental sourcing processes.

1.2 Strategic planning

Although strategic planning is entrenched deeply in the minds of corporate managers and market planners, strategic environmental sourcing concepts need to be diffused throughout the organisation and especially throughout the purchasing function. Before strategic environmental sourcing can affect long-range decisions at the corporate level, purchasing managers must first understand, develop and implement strategic planning more effectively at the department level. The corporate planning process must incorporate more effective integrative and co-ordinating mechanisms among the various components of the strategic planning process. The end result must ultimately enhance corporate profitability.

In order to realise the opportunities of strategic environmental planning, communication barriers must be eliminated. In some organisations corporate planners tend not to communicate well with purchasing personnel. In other companies, the interaction between the two departments is missing because purchasing managers typically do not think strategically. Alternatively, purchasing managers may not be *allowed* to act strategically. Bales and Fearon (1993) found that chief executive officer (CEOs) and presidents do not see the purchasing function as adding much value to anything but the firm's bottom-line profits and its production and operations. Additionally, purchasing is typically not expected to take risks, innovate or assure external customer satisfaction. In developing a strategic approach to environmental sourcing, purchasing managers must themselves be strategically oriented.

Communication with all levels of management, and communication with the key environmental personnel within the firm, is important throughout the planning process.

It is important for the purchasing manager to recognise that the planning process is repetitious. This repetitive nature can be seen in the process of strategy development. This process is a hierarchy of strategies and plans, beginning at the corporate level, filtering down to the division level and finally to the department level. At the corporate level, the primary strategic concern is, 'What business, or businesses, should we be involved in?' At the division level, the strategy question is redefined as, 'How should we compete in a given business?' Finally, at the departmental or functional level, the strategic focus converges on integrating the various activities into the total corporate scheme and on designing strategic programmes that are aligned closely with current and anticipated environmental changes.

Environmental strategy formulation and implementation results from the synthesis of corporate and purchasing goals with the various external constraints on the entire system. The process of strategy formulation forces the purchasing manager to select from among a number of options and to focus on a more manageable array of alternative courses of action. Operationally, strategic development will be a progressive, stepped process. Successful attainment of lower-level strategies will be necessary before higher-level strategies can be enacted.

There are three levels to environmental strategy hierarchy and implementation. The lowest levels are performance-related strategies. These strategies focus primarily on managing purchasing resources, on reducing costs and on providing internal services. Mid-level hierarchies contain 'systems'-related strategies. These strategies involve issues relevant to vendor analysis, and other strategies that co-ordinate organisational sub-functions. At the highest level are the competition-related strategies. These strategies typically focus on the buyer's bargaining power, which generates purchasing leverage and, as a result, facilitates the improvement of the firm's competitive market position.

Strategy evaluation brings the planning process full circle and forces managers to confront the appropriateness of potential environmental alternatives. The objective is to understand both the process and the results of the strategic planning process. The following list of criteria is recommended for the procurement planning process:

- Internal consistency:
  - Are the procurement strategies mutually achievable?
  - Do they address corporate and/or divisional objectives?
  - Do they reinforce each other? Is there synergy
  - Do the strategies focus on crucial environmental procurement issues?
- External consistency:
  - Do the purchasing strategies exploit external opportunities?
  - Do they deal with external threats?
- Resource fit:
  - Can the strategies be carried out in light of resource constraints?

  - Is the timing consistent with the ability of the department and/or business to adapt to the change?
- Communication and implementation:
  - Are the strategies understood by key implementers?
  - Is there organisational commitment?

The dominant concern throughout the process is the focus on the effective allocation of corporate and purchasing resources to meet external constraints and opportunities.

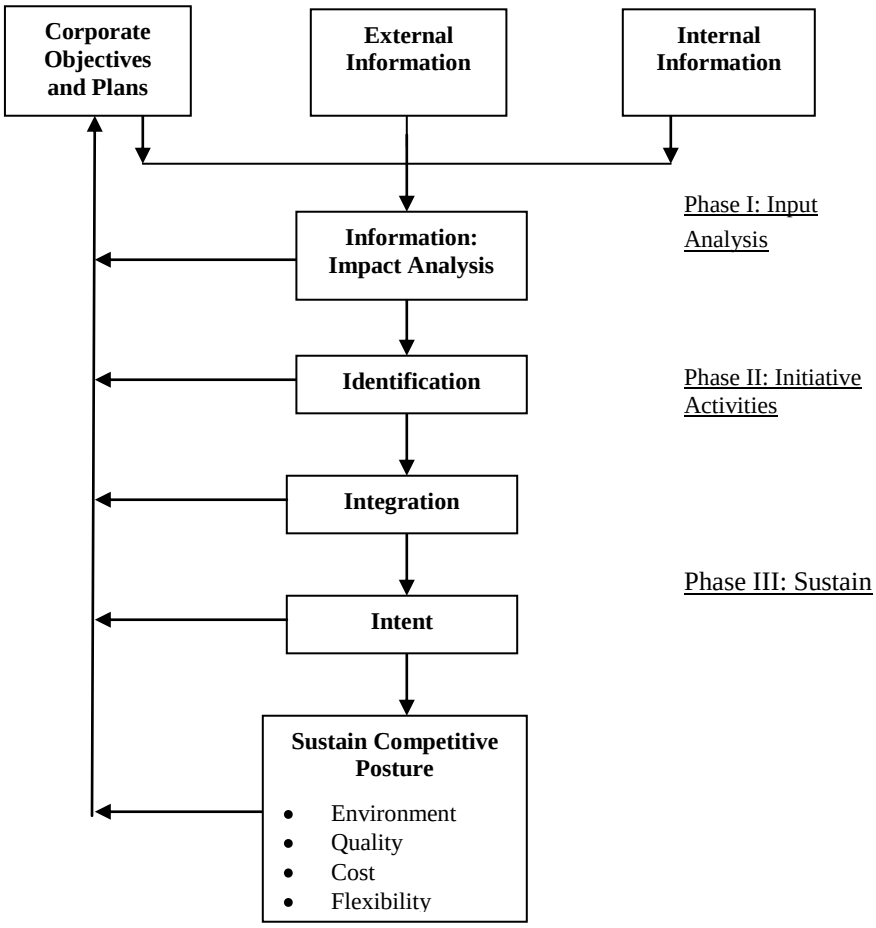
As noted by Farmer (1978: p. 12), 'supply strategies do not stand on their own'. The purpose of developing the strategy is to help give the buying firm a competitive advantage. Companies who ignore the opportunities of sourcing strategies forego this potential advantage. The task is to develop a purchasing strategy in conjunction with other corporate strategies and the company supply base.

1.3 Strategic Environmental Sourcing: A Model

Although Spekman's model of strategic procurement planning helps to develop a foundation for the planning process, a better understanding of strategic 'environmental' planning is needed. Working with the definition that strategic environmental sourcing is concerned with the development of a firm's plans for its long-term material, component or system requirements, Rajagopal and Bernard (1993) provide a conceptual framework for the development of a competitive environmental sourcing strategy. The incremental development of an environmental sourcing strategy model has several important implications (see Fig. 1.1). First, the increasing amount of complexity of the purchasing function has contributed to the need for a systematic way to design a strategy. Second, the framework can serve as a guideline to meet the unique requirements of organisations. Third, the framework provides guidelines to help identify environmental needs and thus enable a shift in strategy. The development of this procurement strategy is divided into three phases, involving information, identification, integration, and intent:

- Phase 1: input analysis, including information-gathering and appraisal
- Phase 2: initiation of activities, including identification and integration of processes
- Phase 3: sustaining a competitive edge, including communication and implementation of strategic intent by all parties involved

Figure 1.1: Conceptual Framework for Strategic Environmental Sourcing



Phase 1 focuses on the need to be continuously aware of the internal and external environments affecting the firm. Part of procurement's environmental operations should include the collection of information on suppliers, assessment, operational reviews, prioritisation and listing of opportunities and the dissemination of information (Peterson 1996). Information-gathering and processing is crucial to risk identification and is reflected in the ability of the decision-making unit to be proactive or reactive. Mintzberg (1994) suggests that firms with a planning office, or designated strategic planners, should involve such planners in the dissemination of data and in helping to motivate managers to think strategically. Purchasing is ideally positioned to help in this process by monitoring and gathering the required information about the supply base. In this first step of the model, purchasing personnel should concentrate efforts on: assembling a team and gaining organisational commitment and support for that team; identifying metrics; setting environmental goals; and establishing systems and processes (Peterson 1996). As with so many processes today, the need for an information system, or environmental management system (EMS), to accommodate data and performance metrics will be a critical vehicle to disseminate information accurately and in real time. In developing a purchasing information

system, the emphasis should be on supplying information that assists the purchasing function in making decisions that are in line with the firm's competitive strategy.

Phase 2 of the process involves the initiation of activities. Here, one finds feasibility analysis, consisting of identifying relevant information and then performing technical and economic evaluations of the data. The feasibility analysis will lead to the understanding and selection of environmental opportunities (Peterson 1996). During this phase it is important to identify relevant issues and then to integrate those issues into the purchasing plan. This includes the identification of:

- Objectives
- Materials, and the classification of those materials
- The supplier base, and the management of that supplier base
- The company's bargaining strength and the strength of critical suppliers
- A strategic decision-making hierarchy
- An organisational structure to facilitate strategy development
- The process elements in strategy development
- Behavioural elements in strategy development
- Available strategic tools

Purchasing strategies are the basis for supplier selection and development. Some of the most important factors required to formulate a company strategy involve the integration of data and information. Integration of suppliers and all functional areas has been a prominent theme in literature for some time now. The establishment of cross-functional relations with top management and environmental experts is essential. With this integration typically comes the need to formalise lines of communication and the protocols for interaction among the various functions. It is here that Mintzberg (1994) warns that caution should be used so as not to go over the formalisation edge. Rajagopal and Bernard (1993) suggest the need for some formalisation. Six modified steps have been identified as essential to the implementation and integration of a sourcing strategy within a firm. These are the integration of:

- Metrics, information and identified goals
- Objectives and policies in order to develop an environmental sourcing strategy for each supply market
- Internal functions in order to develop and implement environmental sourcing strategy
- Selected suppliers with the company in order to develop long-term strategic relationships and mutually beneficial advantages
- Logistics operations in order to execute environmental sourcing operations effectively
- Long-term strategic environmental sourcing plans with corporate planning activities and outputs

In phase 3, sustaining a competitive posture helps to ensure that firms will not become laggards. The assertion is that firms cannot become complacent, or satisfied with only meeting minimum environmental requirements. The goal is to develop a long-term plan to

achieve a sustainable, competitive advantage. To obtain this goal, purchasing managers will have to justify projects and obtain funding, install equipment and implementation procedures, and evaluate performance (Peterson 1996). Basically, there must be a strong strategic environmental sourcing *intent* involved in the allocation of resources, specification of individual objectives, and in the motivation and training of those involved. Garrambone (1995) noted that, 'One of the biggest challenges for purchasing will be how to turn an individual accustomed to transactional purchasing into a skilled strategic sourcing professional'. This transition of purchasers to strategic sourcing professionals will not be done overnight, or without continually reviewing and upgrading of the firm's procurement processes and management systems (Burt 1989).

With a model of strategic environmental sourcing developed, attention now turns to supply chain issues that impact strategic sourcing. Additional information is given to help operationalise the strategic environmental sourcing model through supplier integration, including co-operative relationships, and supplier quality assurance and assessment programmes.

1.3.1 Supplier Integration

Long-term strategic advantages can be developed by working with suppliers (Rajagopal and Bernard 1993). Supplier integration is the evolutionary process used to form long-term co-operative relationships with suppliers. Ideal suppliers assist their customers with co-operation to promote product development, life-cycle analysis, performance metric development, risk assessment and timely delivery.

A co-operative buyer–seller relationship uses a supply base that consists of one or a few preferred suppliers. This will maximise bargaining power and achieve economies of scale. This is the opposite of the open-market bargaining model and clerical perspective of purchasing that attempted to sustain a competitive environment by maintaining many suppliers. By managing the relationship with suppliers, a purchasing manager will be better able to contribute to a firm's strategic success (Landeros and Monczka 1989). The characteristics of a co-operative relationship include:

- A supply pool of preferred environmental customers
- An alliance incorporating a credible commitment between buyers and sellers
- Joint activities aimed at environmental problem-solving
- An exchange of environmental information between firms
- Joint adjustments to marketplace conditions

A credible commitment to a long-term relationship is maintained because there is a concentrated joint effort to improve quality and productivity and to reduce waste and overall costs. Disputes are resolved in such relationships by working jointly on the problem instead of taking hard positions in which the outcome may depend only on power. Also, in order to develop a mutual response to changes in the marketplace, the buying and selling firms use joint problem-solving efforts. Last, there is a greater amount of data-sharing in a co-operative relationship. The goal of a successful supply chain is to trade off information for inventory

whenever possible, holding inventory in the locations, quantity and form that is optimal for the entire supply chain.

1.3.2 Supplier Quality Assurance and Assessment Programmes

The importance of quality cannot be overlooked. Although it has taken the quality movement decades to become installed in US business, management has awakened to the knowledge that quality has replaced price as the key to increased market share and higher profit margins (Garvin 1983). Instead of trying to inspect quality into a product, managers have learned to design and purchase quality into the product (Burt 1989). Quality and total quality environmental management (TQEM) begin with the accurate description of the item being obtained. This requires co-ordination with the marketing and engineering functions in order to establish the item specification, environmental attributes, quality, quantity and timing.

The selection of a source for an item is the next step. The supplier must have the capability to provide the item and services the buyer requires. This often requires a co-operative relationship and a close look at the supplier's operations to determine whether it can ensure the necessary level of quality. Supplier development is a process that encompasses these activities. Monitoring of the supplier's process control data may be necessary to maintain ongoing adherence to environmental quality standards. Performance summary data will help in this effort and should be aligned with the objectives of the assessment. It is through the assessment that a better understanding of the supplier's processes comes about. It is also here that supplier development programmes can target potential problem areas in the supplier and work with that supplier to move toward a mutually beneficial long-term relationship.

1.4 Supplier Development Programmes

The development of suppliers is important to maintaining a purchasing strategy. In order to compete effectively in global markets, a company must have a competent supply base. Suppliers must be able to produce high-quality parts and materials at an acceptable cost and deliver these on a timely basis. A supplier development programme can link purchasing strategy with a firm's corporate competitive strategy. With the increasing introduction of new technology, just-in-time (JIT) practices and the global scale of the marketplace, a supplier development programme can turn into a competitive advantage. Without a competent supplier network, a firm's ability to compete effectively can be hampered significantly.

The basic objective of the purchasing function is to secure competent supplier sources that will provide an uninterrupted flow of required materials at a reasonable cost. A supplier development programme can be defined as any systematic organisational effort to create and maintain a network of competent suppliers. At a micro level this involves seeking out new suppliers for new 'greener' products and materials. At a macro level, a supplier development programme includes activities that help suppliers continually improve quality, reduce waste and bring about a better understanding of the long-term mutual benefits to both parties.

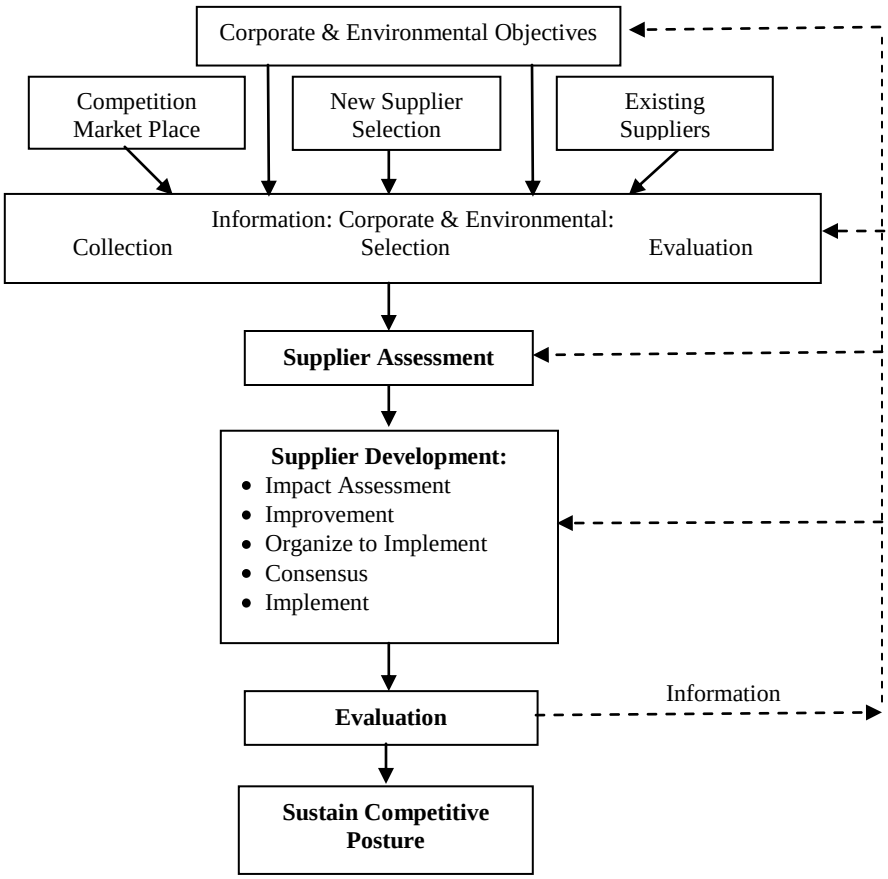
Today, supplier development programmes are viewed as a complex organisational activity requiring formal and active involvement from a number of functional areas.

Although each organisation tends to approach supplier development decisions differently, Hahn *et al*. (1990) have developed a generalised conceptual model depicting the organisational decision process. Key steps on the process involve programme initiation, programme organisation, supplier evaluation, consensus development plans and, finally, implementation and evaluation of the development programme.

1.5 A Model of Supplier Selection for Strategic Environmental Sourcing

There is a need for procedures to help understand the concept of a firm's environmental fitness. Figure 1.2 shows a new framework for purchasers to use when assessing suppliers and making decisions involving supply chain management. The basis for this model is a collection of information from Hahn *et al*. (1990), Rajagopal and Bernard (1993) and Peterson (1996). Whereas Hahn *et al*. and Rajagopal and Bernard supply a good framework for strategy and supplier development decisions, Peterson outlines the building of an environmental programme for purchasing, but with no real framework or detailed supplier assessment. Figure 1.2 is an attempt to pull together critical elements from each of the above models. This new model highlights the importance of having strategic environmental and corporate goals to focus the purchasing organisation, as well as the long-term benefits obtained from the selection of suppliers.

Figure 1.2: Framework for Selecting and Developing an Environmental Supplier



By breaking this model down into its components purchasers are able to understand the strategic interrelationship between competition and suppliers. To begin, support from top management is key to any type of program. The need for an environmental programme is recognised through management's desire to improve the firm's competitive position or in response to specific threats to the firm. In some cases, top management will initiate the programme directly. In other cases, ad hoc groups already working on supplier issues initiate the need for a programme. The recognition of the need for a programme is then transformed into a set of corporate and environmental objectives. These objectives should be broad-based and flexible.

By using the framework of corporate and environmental goals, performance measures for issues such as quality improvement, cost reduction and waste reduction will be created during an information-gathering phase (Peterson 1996). The process of collecting information will also include the evaluation and selection of relevant data. Environmental decision-support systems (Frysinger 2001) or environmental management systems (EMSs) become critical elements in the process of evaluating and assessing supply-base data.

Input sources for this data and information will come not only from the external marketplace and competition but also from existing suppliers and any new suppliers being considered, resulting in a supplier assessment programme. This evaluation typically will involve the measurement of efficiency, quality, cost reduction and on-time delivery and will include specific measurements regarding the environmental practices of the supplier, such as ISO certification (e.g. within the ISO 14000 series), involvement in pollution-prevention and waste-reduction programmes, hazardous waste management, and the meeting of environmental performance measures. Thus, more information will be available to make the supplier-selection decision. If a supplier does not perform well on the assessment but is still included in the supply base, the option to implement a supplier development programme can be used.

When the buying firm is not satisfied with the performance of a supplier, it may initiate selected supplier development activities with that supplier. To get to this step, typically, the supplier assessment has triggered the need for improvements to some aspect of the supplier's performance. The supplier evaluation is an integral part of the supplier development programme. The results serve as a guide to those areas of the supplier's performance that need the most improvement, or the least amount of attention.

The formulation of a supplier development team will need to be developed to analyse the impact assessment and set forth objectives for the programme. The organisation of this type of programme falls on cross-functional teams among U.S. automotive manufacturers such as Ford and General Motors, on permanent supplier development departments for Japanese automotive manufacturers and on a permanent department utilising several ad hoc teams among some Korean firms (Hahn *et al*. 1990). The development team can next be organised by the material to be purchased or by the supplier to be developed.

The next step is to identify areas for improvement in corporate and environmental performance. The purpose of this phase is to find the specific causes of the problem. Supplier performance problems can be classified in terms of required supplier capabilities—technical, manufacturing, quality, delivery, financial or managerial. This classification helps to narrow the area(s) to be investigated. At this point in the process, the supplier's managers should be invited to participate in the analysis; the objective is to obtain a consensus diagnosis involving both the supplier and the buyer. It is very important that early involvement of the supplier in the analysis is critical for successful programme implementation (Hahn *et al*. 1990).

Once the causes of the problem have been identified, an implementation team with the appropriate expertise must be organised. This group then designs the plan and time-schedule for the programme. During this phase the team must determine the degree of emphasis on each developmental area. There should be a consensus between the buyer and the supplier at this point. Through working with the supplier the development plan is implemented.

The final stage of the suppler development programme is the evaluation of the results. The consensus development plans, developed by both the buyer and the seller, have been implemented. When the implementation is complete, the results should be evaluated for developmental objectives as well as for specific environmental, technical, quality, cost and delivery capability objectives. It is recommended that if the programme works properly over the short term, participating suppliers should qualify for long-term 'certified', or 'preferred' status. Suppliers who do not achieve this status should be eliminated from the supplier base (Hahn *et al*. 1990).

Supplier development programmes are only as good as the metrics by which the suppliers are assessed. But what metrics can firms use to assess their supply base? Capturing attributes of supplier performance is necessary to measure, monitor and manage sourcing and supply chain performance. In the following section, environmental metrics are suggested for use in the strategic environmental sourcing model, supplier assessment and supplier development.

1.6 Supplier Assessment Metrics

The growing importance of both internal and external environmental reporting places even more emphasis on understanding and using new performance metrics. The experiences of the author and previous research projects are now used to highlight performance metrics and look at how managers perceive some environmental metrics. In Handfield, et al. (2002) a review of the literature identified a large number of potential environmental performance indicators (EPIs). For the sake of this chapter, a sample of EPIs from the same study is presented in Table 1.1, the method of data collection briefly reviewed, and then EPIs are discussed in relation to the proposed supplier selection model in Figure 1.2. An assessment of EPIs in the previous study included identifying a number of Fortune 500 companies considering integrating environmental decisions into the supplier selection and supply chain management processes, including Daimler-Chrysler, Baxter, AT&T, General Motors and others. A number of managers at these companies were interviewed by telephone and, in some cases, actual supplier evaluation manuals were obtained from the companies. These

companies maintained active databases on a number of performance indicators for their major suppliers, yet were struggling with the development of a systematic method of integrating EPIs into the supplier evaluation and selection decision. One of the biggest problems encountered by purchasers at these companies involved how many metrics to maintain, and which metrics are the most important. For the purposes of this chapter, the metrics used by a firm should help to measure the extent to which a supplier has integrated environmental management systems that positively impact environmental and operational performance. When done effectively, these management systems include management support, communication, measurement, monitoring, and reporting for internal and external stakeholders. When working with new environmental performance measurement, many purchasing managers can be unsure as to what performance metrics reflect actual supplier performance. To help overcome this potential problem a Delphi group (expert panel) was used to assess important environmental information for supplier assessment.

Table 1.1: Examples of Environmental Performance Indicators

Biodegradable / compostable (%)
Commitment to periodical environmental auditing
Contains no ozone depleting substances
Emissions and Waste (per unit of product)
Energy efficiency label
Environmentally-responsible packaging
Global application of environmental standards
Hazardous air emissions
Hazardous waste
Involvement in Superfund site
International Organization of Standards (ISO) 14000 certification
Landfill – tons of waste per year
Longer shelf life than industry standard
Number of hours of training on environment per employee
On Environmental Protection Agency (EPA) 17 hazardous chemicals list
Ozone depleting Chemicals
Participation in voluntary EPA programs
Pre/post consumer recyclable content (%)
Public disclosure of environmental record
Received any EPA/(RCRA non-compliance fines
Resources and Energy (per unit of product)
Second tier supplier environmental evaluation
Secondary market for waste generated
Solid waste
Take-back or reverse logistics program
Third party certification (eco labeling)
Total energy used
Toxic pollution
Use of less hazardous alternative (% of weight/volume)
Volatile Organic Compound (VOC) content (%)

1.6.1 The Expert Panel

The objective of most Delphi applications is the reliable and creative exploration of ideas or the production of suitable information for decision making. In order to develop a framework of the many different types of environmental criteria shown in Table 1.1, a group of supply chain managers was assembled to conduct a Delphi group study. Managers were chosen because they were known as experts in the field of environmental management and had primary responsibility for waste reduction and materials management within their organisations. A primary task of the group was to assess the overall rankings of the criteria individually, then integrate the perspectives to create a single collective framework in which to make sense of the results (for a detailed discussion of applying the Delphi method to operations issues, see Malhotra *et al*. 1994).

For many firms getting started in the assessment of a supplier's environmental performance, new metrics will be necessary. For managers, the list of EPIs in Table 1.1 can be a good starting point. For performance indices to be useful, they should be easy to obtain, and assess. Difficulties of performance measurement and assessment include how to introduce and integrate new performance metrics, and how to collect data regarding the metric. Purchasing managers, for some time now, have been predicting an increased use of supplier's external reports. To this end, corporate environmental reports are becoming more useful to supplier assessments. The Delphi group expressed concern as to how environmentally conscious a supplier should be. The more relevant aspect of the supplier's environmental performance is that the organisation is improving and working toward waste minimization within its own plant and also working with its suppliers to do the same. The "greenness" of a supplier may only become clear when data is available to compare one supplier to the rest of the supply base.

One task for the Delphi group included going over the list of EPIs to indicate if a metric was relevant, easily assessed and important to their corporate environmental strategy. All indicators were deemed relevant, but that data for some indicators would be more difficult to obtain. For the purpose of this chapter, the most important indicators are discussed in relation to the proposed supplier assessment framework. The 10 most important indicators are shown in Table 1.2.

Table 1.2: Top Indicators of supplier Environmental Performance

Top Ten Most Important

1. Public disclosure of environmental records: such as corporate environmental reports, and Toxic Release Inventory data
2. Second tier supplier environmental evaluation: evaluation of suppliers beyond the first tier (direct contact) firms
3. Hazardous waste management: process in place to document and manage hazardous materials and waste
4. Toxic pollution

management: process in place to document and manage toxic pollution

5. On EPA 17 Hazardous Material List: does the firm use any of the chemicals on the Environmental Protection Agencies Hazardous Materials list?
6. ISO 14000 certified: have third party certification of Environmental Management Systems
7. Reverse logistics program: a system is in place for the recovery of products or packaging from the consumer, or supply chain members
8. Environmentally friendly product packaging: use of recycled materials for packaging, or waste minimization of packaging materials
9. Ozone Depleting Substances: substances that when used contribute to the degradation of ozone
10. Hazardous air emissions management: process in place to document and manage air emissions

The performance indicators chosen as the most important by the expert panel help to demonstrate the need for purchasing personnel to understand long term environmental impacts and to not focus only on short term costs. Managers want to emphasize corporate environmental reports, second tier supplier assessment, and documented processes for managing hazardous waste, pollution, environmental management systems, and reverse logistics. As would be expected, there is a relatively large amount of focus on hazardous materials and risk management related to the important EPIs. The difficulty comes in collecting this new environmental information when firms may have little understanding of the internal processes of their suppliers. This is where purchasing personnel need to work with existing suppliers and new suppliers to identify and collect new data. If suppliers produce external reports, especially corporate environmental reports, information in these reports can more easily be used in supplier assessment processes. The evaluation, selection, and development of suppliers will come only after a systematic process is in place to evaluate all relevant performance metrics. Here again there is a need for organizations to pay attention to their own internal communication, monitoring, and reporting to make sure an environmental management system is in place to help facilitate the selection and development of suppliers. It is also important for this same environmental management system to have visibility outside of the purchasing function to help with corporate alignment of strategic and environmental objectives. Those firms considered leaders in environmental management have systems that demonstrate the internal benefits of waste reduction, and important environmental metrics. This same information is then used to help assess, and improve suppliers. The information collected for these systems is continuously updated,

accurate, easy to access, and reviewed at multiple levels of management so that decisions regarding suppliers are made with the best available data.

For practitioners and researchers, the information and models put forth in this chapter give only a limited focus on purchasing regarding the complexity of environmental metrics, and the issues involving environmental assessment of suppliers. The information in Table 1.1 helps to set the groundwork for what metrics practitioners can include in supplier assessment and in the internal auditing of their own facilities and processes. It is hoped that the information from the Delphi study discussed here will help academic researchers to operationalise the concept of strategic environmental sourcing and to highlight the need to obtain this type of environmental performance information. In the next section I review the questions motivating this chapter, further managerial implications and opportunities for future research.

1.7 Managerial Implications and Directions for Future Research

With increased attention given to managing the supply chain in environmentally conscious ways there is a need for systematic development and validation of strategic models and frameworks for operationalising strategic environmental sourcing and environmental supply chain management. The development of frameworks or models is only the first step in theory development. Two models are posited in this chapter to provide guidelines and potential environmental metrics to practitioners struggling with environmental sourcing issues.

Motivations for this chapter can be found in the search for answers to several questions concerning sourcing, strategy and the integration of environment management into sourcing processes. To start, has purchasing evolved to meet the needs of the environment? It appears the stage has been set for the strategic involvement of the purchasing function in supply chain management. Purchasing is no longer a clerical function. Instead, purchasing managers and personnel have the opportunity to leverage their positions within firms to impact material acquisition and supply chain management processes through strategic long-term planning.

An additional motivation for the information presented in this chapter was a call for a better understanding of strategic environmental sourcing. Strategic environmental sourcing is concerned with the long-term material, component or systems requirements of a firm. This definition has been placed within the context of strategic procurement planning and supported with a framework for selecting and developing environmental suppliers. While the strategic environmental sourcing framework calls for collecting and using information to make long-term decisions regarding supply strategy, having a strategy is not enough. Key to any successful sourcing strategy is the need to integrate suppliers and important metrics into processes management.

Information and frameworks posited in this chapter deal with how firms should evaluate and select suppliers. In order to integrate strategic environmental sourcing into the long-term planning processes of a firm, supply base considerations need to be addressed. Supplier

assessment, development and integration are important mechanisms for developing and adjusting the strategic environmental sourcing plan. Guidelines and environmental management systems that aid in the assessment and selection of suppliers who understand environmental goals are critical to the success of any strategy. Working closely with suppliers to meet environmental goals and sharing information and will help ensure a firm's supply base is a strong resource contributing to a sustainable competitive position in the marketplace.

In reviewing the literature and existing schools of thought, opportunities for future research abound. Opportunities not only take the form of frameworks for supplier decision-making when dealing with strategic environmental issues but also are evident in the measurement and assessment of suppliers.

Suggested future research involves the following questions:

- At what level of strategy formulation is it best to have environmental information?
- What are the cross-functional impacts of environmental metrics?
- What 'industry-specific' metrics are involved in the role of purchasing in supplier assessment of environmental corporate practices and products?
- How can we identification and collection of the major variables and measurement standards to test supplier development programme effectiveness.
- What are the major performance metrics that result in a better understanding of the effective role of procurement in the design process?
- What are the major factors prohibiting the integration of environmental issues into strategic planning decisions?

There are tremendous opportunities for research in strategic environmental sourcing and supply chain management. Future research should address how firms go about strategy formation, determine the short-term and long-term impacts on the firm's environmental and operational performance, look at scale and construct development and investigate barriers to environmental practices.

References

Baker, R.J. (1996) 'Let's Think Green', *Purchasing Today* (July 1996): 48.

Bales, W., and H. Fearon (1993) CEOs'/Presidents' Perceptions and Expectations of the Purchasing Function (Tempe, AZ: Center for Advanced Purchasing Studies).

Beckman, S., J. Bercovitz and C. Rosen (2001) 'Environmentally Sound Supply Chain Management', in C.N. Madu (ed.), *The Handbook of Environmentally Conscious Manufacturing*, Kluwer Academic Publishers: 317-39.

Bowen, F.E, P.D. Cousins, R.C. Lamming and A.C. Faruk (2001) 'The Role of Supply Chain Management Capabilities in Green Supply', *Production and Operations Management* 10.2: 174-90.

Bowersox, J.D., P.L. Carter, and M.R. Monczka (1985) 'Materials and Logistics Management', *International Journal of Physical Distribution and Logistics Management* 15.5: 27-35.

Burt, N.D. (1989) 'Managing Product Quality through Strategic Purchasing', *Sloan Management Review* (Spring 1989): 39-47.

Carter, C., L. Ellram (1998) 'Environmental Purchasing', *International Journal of Purchasing and Materials Management* 34.4: 28-39.

Clean Water Act (1977), Washington, DC: US Government Printing Office.

Corbett, C., and D. Kirsch (2001). 'International Diffusion of ISO 14000 Certification', *Production and Operations Management* 1.3: 327-42.

Cordeiro, J.J., and J. Sarkis (1997) 'Environmental Proactivism and Firm Performance: Evidence from Security Analyst Earnings Forecasts', *Business Strategy and the Environment* 6: 104-14.

Dobler, D.W., D.N. Burt and L. Lee Jr (1990) *Purchasing and Materials Management* (New York: McGraw-Hill).

Emergency Planning and Community Right-to-Know Act (1986), Washington, DC: US Government Printing Office.
Farmer, D.H. (1978) 'Developing Purchasing Strategies', *Journal of Purchasing and Materials Management* (Autumn 1978): 6-11.
Frysinger, S.P. (2001) 'Environmental Decision Support Systems: A Tool for Environmentally Conscious Management'in C.N. Madu (ed.), *The Handbook of Environmentally Conscious Manufacturing*, , Kluwer Academic Publishers: .317-39.
Garrambone, L.J. (1995) 'Sourcing Strategy', *American Management Association* (Member Spotlight May 1995): 62.
Garvin, D. (1983) 'Quality on the Line', *Harvard Business Review* (September–October 1983): 64-75.
GEMI (Global Environmental Management Initiative) (1997) *ISO 14000:Measuring Environmental Performance,* (March 1997: Washington, DC: GEMI).
Green, K., B. Morton and S. New (1998) 'Green Purchasing and Supply Policies: Do they Improve Companies' Environmental Performance?', *Supply Chain Management* 3.2: 89.
Hahn, C.K., C.D. Watts and K.Y. Kim (1990) 'The Supplier Development Programme: A Conceptual Model', *Journal of Purchasing Management*, Spring: 2-7.
Handfield, R., and E. Nichols (1999) *Introduction to Supply Chain Management* (Upper Saddle River, NJ: Prentice-Hall).
Handfield, R., S. Walton, L. Seegers and S. Menlyk (1997) 'Green Value Chain Practices in the Furniture Industry', *Journal of Operations Management* 15.4: 293-315.
Handfield, R., S. Walton, R. Sroufe and S. Menlyk (2002) 'Applying Environmental Criteria to Supplier Assessment: A Study of the Application of the Analytical Hierarchy Process', *European Journal of Operations Management* 141: 70-87
Hart, S.L., and G. Ahuja (1996) 'Does it Pay to be Green? An Empirical Examination of the Relationship Between Emission Reduction and Firm Performance', *Business Strategy and the Environment* 5: 30-37.
Landeros, R., and R.M. Monczka (1989) 'Co-operative Buyer/Seller Relationships and a Firm's Competitive Posture', *Journal of Purchasing and Materials Management* (Autumn 1989): 9-17.
Malhotra, M., D. Steele and V. Grover (1994) 'Important Strategic and Tactical Manufacturing Issues in the 1990s', *Decision Sciences* 25.2: 189-214.
Mentzer, J., W. DeWitt, J. Keebler, S. Min, N. Nix, C. Smith and Z. Zacharia (2001) 'Defining Supply Chain Management', *Journal of Business Logistics* 22.2: 1-26.
Min, H., and W.P. Galle (1997) 'Green Purchasing Strategies: Trends and Implications', *International Journal of Purchasing and Materials Management* 33.3: 10-17.
Mintzberg, H. (1994) 'The Rise and Fall of Strategic Planning', *Harvard Business Review* (January–February 1994): 107-14.
Monczka, M.R., J.R. Trent and J.T. Callahan (1993) 'Supply Base Strategies to Maximise Supplier Performance', *International Journal of Physical Distribution and Logistics Management* 23.4: 42-54.
Montabon, F., S. Melnyk, R. Sroufe and R. Calantone (2000) 'ISO 14000: Assessing its Perceived Impact on Corporate Performance', *Journal of Supply Chain Management* 6.2: 4-16.
Moore, A.G. (1991) *Crossing the Chasm: Marketing and Selling Technology Products to Mainstream Customers* (New York: Harper Business).
Narasimhan, R., and J. Carter (1998) *Environmental Supply Chain Management* (Tempe, AZ: Centre for Advanced Purchasing Studies).
Occupational Safety and Health Act (1970), (Washington, DC: US Government Printing Office.
Peterson, J. (1996) 'Stop It and Shrink It', *Purchasing Today* (July 1996): 28-31.
Rajagopal, S., and K.N. Bernard (1993) 'Strategic Procurement and Competitive Advantage', *International Journal of Purchasing and Materials Management* (Autumn 1993): 13-20.
Resource Conservation and Recovery Act (1976), Washington, DC: US Government Printing Office.
Seuring, S. (2001) 'A Framework for Green Supply Chain Costing', in J. Sarkis (ed.), *Greener Manufacturing and Operations: From Design to Delivery and Back* (Sheffield, UK: Greenleaf Publishing): 150-60.
Spekman, R.E. (1981) 'A Strategic Approach to Procurement Planning', *Journal of Purchasing and Materials Management* (Winter 1981): 2-8.
Spekman, R.E. and R.P. Hill (1980) 'Strategy for Effective Procurement in the 1980s', *Journal of Purchasing and Materials Management* (Winter 1980): 2-7.
van Weele, A.J. (1984) 'Purchasing Performance Measurements and Evaluation', *Journal of Purchasing and Materials Management*, Autumn: 20, 3, 16-23.
Walton, S., R. Handfield, and S. Melnyk (1998) 'The Green Supply Chain: Integrating Suppliers into Environmental Processes', *International Journal of Purchasing and Materials Management* (Spring 1998): 2-10.