SUSTAINABILITY AND ITS IMPACT ON THE SELECTION OF A REVERSE LOGISTICS STRATEGY

There can be a synergistic effect between a reverse logistics strategy and the implementation of sustainability. Companies are becoming increasingly aware that the choices made concerning how they handle products and processes can directly impact the environment (Day, 1998). With the development and advancement of reverse logistics concepts and practice, there are several different business strategies an enterprise can pursue. However, recently the sustainable practices including waste reduction, recycling, reuse and waste diversion are being pursued by more companies as they are finding inefficiencies in their processes. “Many companies are pursuing sustainability because they are finding business value in it” (McMullen, 2001).

Evaluating the various strategies, especially in terms of sustainability is a challenge. This paper creates a model to assist in the decision making process and utilizes the Analytic Network Process.

Keywords: Reverse Logistics, Sustainability, ANP

INTRODUCTION

The issue of sustainability has steadily been gaining importance in the business world. Sustainability or sustainable development is defined as economic activity that meets the needs of the present generation without compromising the ability of future generations to meet their needs. Sustainability has become a strategic imperative for all businesses in the 21st century and has become a fundamental market force affecting long-term financial viability and success (Preston, 2001). Sustainability is based upon three components: economic, social, and environmental (BMS, 2002). Companies are
becoming increasingly aware that choices made about products and processes can have profound environmental impacts (Day, 1998). When addressing strategic issues the decision maker is overwhelmed with a plethora of stakeholder views such as environmental agencies and a social conscious towards workers, consumers, and communities, as well as ensuring a reasonable return on investment and long term enterprise viability. The evaluation of these EM decisions in such an environment requires analysis on multiple dimensions, including economic, societal and political impacts. When analyzing multiple dimensions there is interaction and often conflicting goals that makes the integration of the dimensions difficult. There are also organizational barriers to environmental change such as attitudes from staff and top management as well as industry barriers such as technical availability and knowledge, information, and regulatory constraints (Epstein, 1997). The interaction and often-conflicting nature of these impacts makes these decisions difficult, as does the need to integrate the needs and desires of multiple constituencies and stakeholders. These impacts are further complicated in that impacts extend beyond any single enterprise where the entire supply chain must be considered.

Management tools exist in practice and literature to support environmental decisions. Among these are environmental management initiatives, environmental indicators, life-cycle assessment, and the ISO 14000 certification framework. However, these tools, both in isolation and taken together as a set, have shortcomings. Among those listed in literature include the lack of criteria addressing all dimensions of environmental impact, lack of integration of criteria (especially integrating qualitative and quantitative criteria), difficulty in considering and integrating stakeholder requirements, and scarcity
of guidance in choosing which tools to use (Veleva, 2000, Baumann, 1999). Review of
the literature also indicates that the use of operations research decision-making tools is
uncommon in this area.

In this paper a conceptual model is developed to aid in the environmental systems
decision making process. The model utilizes the Analytic Network Process (ANP) as a
framework for selecting a reverse logistics strategy with a focus on environmental
management (Saaty, 1998) ANP allows both quantitative and qualitative criteria to be
entered into the model and offers an overall solution for the model. The paper includes a
discussion of sustainable development, reverse logistics, and a conceptual model for
selecting an appropriate strategy.

Literature review

SUSTAINABLE DEVELOPMENT

Traditional production companies are beginning to understand and pursue a
corporate goal of sustainable development. While the term sustainable development is
somewhat ambiguous and nebulous to production companies the overall definition has
not changed in 15 years since it was first defined by the World Commission on
Environment and Development. (WCED) The Brundtland Report defined it as "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (WCED 1987: p. 43). Sustainability is based upon three components: economic, social and environmental. Economic aspects of sustainability include, but are not limited to, financial performance, employee compensation, and community contributions. Examples of social aspects are public policymaking, fair labor standards, and equal treatment of all employees. Environmental
aspects include impacts on the air, water, land, natural resources, and human health. (BMS, 2002) At its broadest definition, sustainable development refers to managing the development of communities, nations, regions, and indeed the entire planet in such a way as to ensure efficient resource use, creation of efficient infrastructures, protection and enhancement quality of life, and the creation of new businesses to strengthen economies. It concerns itself with the creation of healthy communities that can sustain this quality of life for this and future generations. Sustainability is often seen as a community or institutional response to threats against human and planetary survival. Sustainable development provides a framework under which communities can use resources efficiently, create efficient infrastructures, protect and enhance quality of life, and create new businesses to strengthen economies.

Most work in sustainable development has been at the national and community level, with less work found that addresses the measurement and management at the company level (Veleva and Ellenbecker 2000). The Lowell Center for Sustainable Production defines sustainable production as “the creation of goods and services using processes and systems that are: non-polluting, conserving of energy and natural resources, economically viable, safe and healthful for workers, communities and consumers, and social and creatively rewarding for all working people.” (LCSP 1998). This is the definition used in this paper to look at reverse logistics strategies.

Regulation and business sustainable development has a relationship that exists (both self-imposed and mandatory). Based on several case studies it was found that if incentives in the marketplace are given, companies will innovate to greener processes (Sharfman, 2000). However, recently the sustainable practices including waste reduction,
recycling, reuse and waste diversion are being pursued by more companies as they are finding inefficiencies in their processes. “Many companies are pursuing sustainability because they are finding business value in it” (McMullen, 2001). Hewlett Packard is an example of a company integrating environmental sustainability into its fundamental business strategy (Preston, 2001). Obviously some of the integration is due to regulations; however some is self-imposed.

A major issue in sustainable development is how to operationalize its concepts and tenants. To executives, adopting and implementing sustainable development requires identifying how their company fits in the larger ecological and economic environment and identifying the actions required for its survival. Epstein and Wisner address this issue by using the balanced scorecard method to identify key performance factors that link a department’s work to the company’s strategic objectives in the area of sustainability. (Epstein and Wisner, 2001). A company’s reverse logistics strategy can be designed to support sustainability.

REVERSE LOGISTICS

As the concept of sustainable development has been gaining momentum, so has the concept of reverse logistics. Companies use to tolerate returns; however today they are looking at reverse logistics as a new frontier which includes the handling and disposition of returned products and the use of related materials and information (Meyer, 1999). Dowlatshahi even proposes a theory of reverse logistics (Dowlatshahi, 2000). The definition of reverse logistics can be viewed holistically to include the “process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods, and related information from the point of
consumption to the point of origin for the purpose of recapturing or creating value or proper disposal”. (Rogers and Tibben-Lembke, 2001). Becoming proficient at handling returned goods not only improve relationships along the supply chain, the reduced costs improve profits and higher recovery rates are reached as efficiency is improved. (Stock, et. al. 2002). Reverse logistics is increasingly becoming an area of organizational competitive advantage, making the pursuit of this function a strategic decision.

Traditionally, when organizations consider the reverse logistics function, many are concerned with providing services to customers who for some reason need to return a product back to them. The reasons can be broad ranged, including warranty requirements, defective products or even shipment of the wrong products to the customer. When these events occur, either the organization or the customer needs to be responsible for shipping the product back to its source or a location that can service the product. Thus a reverse logistics chain that includes pickup, packing, transportation, inspection, repair, storage, sorting, repair or processing, tracking, disposal and destruction requirements, needs to be available for adequate service requirements. The availability of each of these services will be heavily dependent on the product life cycle, product design, industry, and design of the reverse logistics network.

The increased importance of considering environmental issues in the product life cycle is one factor that has helped to drive the development and change the definition of reverse logistics. Reverse logistics suppliers play a role in helping organizations close the loop for products offered by those organizations. Traditionally, reverse logistics is an activity within organizations delegated to the customer service function, where customers with warranted or defective products would return them to their supplier. But, more
recently, an environmental corporate management dimension with a focus towards remanufacturing, recycling, and reclamation have added vigor to this area of study and practice. Environmental regulations such as the European Union legislation which requires the recycling of one used tire for every new tire being sold by manufacturers operating in Europe are forcing companies to address reverse logistics.

The growth of E-commerce has also precipitated the need to be aware of the reverse logistics function. Customer returns average 6% across all retailers and 50% among internet sales (Managing Logistics, 2002). With the increasing growth of business-to-business and business-to-consumer avenues the traditional supply chain has been expanded. Along with the forward supply chain, the organization must consider the impact of reverse logistics. A company must be aware of how it manages, processes, transports, and stores returned goods. According to the Reverse Logistics Executive Council, United States firms spend more than an estimated $35 billion annually for handling, transportation, and processing of returned products (Meyer, 1999). This estimate does not include disposition management, administration time, and the cost of converting unproductive returns into productive assets. In the E-commerce arena, reverse logistics is a critical issue as buyers need to be assured of the validity of the return. The cost of processing returns for Web merchandise last year was $2.5 billion, or twice the value of the merchandise itself. (Richardson, 2001).

This level of financial outlay and additional pressures from evolving environmental and electronic commerce practice points to strategic implications of reverse logistics decisions. The strategic nature of reverse logistics reflects sustainable production in the three primary categories of economic, political, and environmental.
Rogers and Tibben-Lembke (2001) examined the practices of reverse logistics and focused on the economic and supply chain issues relating to reverse logistics. Few analytical models exist which assist in reverse logistics strategic decisions. Some models focusing on designing for disassembly and logistics network design using mathematical programming approaches have been proposed (Fleischmann et al., 1997; Fleischmann et al., 2000). Reverse-logistics strategy for end-of-life product take-back models were also developed to allow the user to determine the optimal amount to spend on buy-back and the optimal unit cost of reverse logistics. (Klausner and Hendrickson, 2000). Advances in analytical modeling from an operational decision making perspective seem to be more advanced than strategic decision making analytical models. To help fill this void, this paper proposes one strategic model that links with virtual characteristics in the selection of third-party logistics providers.

Five Components of Reverse Supply Chain

Guide and Wassenhove suggest five key components to the reverse supply chain: (Guide and Wassenhove, 2002)

Product Acquisition: Retrieving the used product

Reverse Logistics: Process of transporting goods to facilities to be inspected and sorted.

Inspection and Disposition: Products are tested, sorted and graded.

Reconditioning: Extract and recondition components for reuse or complete remanufacture.

Distribution and Sales: Determine the market or create one.

Determining the appropriate strategy to handle each of these components in the reverse supply chain in terms of supporting sustainable development needs to be considered.

Functions of Reverse Logistics

In terms of reverse logistics strategies, the enterprise basically has two predominant choices: they can either handle it themselves or they can contract with a
third-party reverse logistics specialist. Whether the company decides to keep the process in house or partner there are several issues to consider when mapping a strategy. The various functions can be combined in various ways to develop a competitive strategy.

1. THIRD-PARTY PROVIDER

In a survey of 311 logistics managers 35% believed company policies would prevent them from installing an effective reverse logistics management system. Another 34% said their companies lacked the proper systems for effectively managing reverse logistics (Meyer, 1999). The Spiegel Group, who receives nearly 6 million returns a year, has selected a third party provider (Newgistics), to handle their reverse logistics strategy. The customer is provided a return label whenever they purchase goods and the goods are sent to an aggregate center managed by Newgistics. Newgistics notifies the Spiegel Group how many truckloads of returns they will be delivering and when, so the appropriate staff is made available (Trebilcock, 2002). Newgistics' innovative ReturnValet system consolidates the returns process and saves the retailer 10-25%.

ReturnValet uses Newgistics’ software and database, local network mail centers and US Freightway or R.R Donnelley Logistics provides the warehousing, distribution, and local hauling services. Some of their major customers include Lillian Vernon, Newport News, Eddie Bauer, and Spiegel. (Newgistics, 2002).

Third parties such as FastAsset will use various channels to liquidate surplus and returned CPUs, memory chips, video cards, hard drives, CD-ROMs, and peripherals from the manufacturers. They will then return a portion (usually 70% to 90%) of the price they get for those items to the manufacturer.
2. RECYCLE
   Having a specific organized location for returns to be placed may be difficult to
   accomplish if the volume does not justify the investment. Examples include sending
   metal back to a foundry or cartons back to a paper plant. Recycling does reduce the need
   for raw materials and disposal space, but it involves the use of energy, transportation, and
   processing resources (Ferrer, 2000).

3. REMANUFACTURE
   Several factors drive the decision to remanufacture and legislation is a
   predominant factor when concerns are made pertaining to environmental or safety issues.
   The concept of rebuilding a product to extend its useful life is not new; however, a
   growing number of firms are finding strategic reasons to engage in remanufacturing. The
   final decision must satisfy an economic rationale, even if prompted by legislation (Ferrer,
   2000).

   Real creativity is required when it comes to finding the most profitable market for
   returned goods. An example of creativity includes a manufacturer of engines and pumps,
   who determined it was better to sell parts not quite up to their precise specifications, but
   still acceptable for use in other applications. Previously the parts were sold for scrap, now
   they are sold at a fair market price. (Guide, et.al, 2002)

4. RECOVERY
   Recovery involves removing parts and components for reuse, with the rest of the product
   being dismantled for recycling. It requires the use of logistics, disassembly, and sorting
   skills (Ferrer, 2000).
5. AUCTION WEBSITES

Returned merchandise usually has a different market. This market may consist of resellers, scrap merchants, and charities. Auction websites such as eBay.com and FastAsset.com generate high recovery rates for returned goods, especially when the goods are posted in small batches. (Stock et. al, 2002). Online auctions conducted properly can attain higher prices and have access to large buying audiences, as well as low initial investment costs. The difficulty can be in classifying the items value, condition, and category so it can be found by potential buyers.

ELEMENTS OF THE DECISION MODEL

The basic ANP model for selecting a reverse logistics strategy is shown in Figure 1. There are four basic elements in the model: Stakeholders, Organizational Performance Criteria, Dimensions of Sustainability, and Reverse Logistics Functions. These elements are discussed as follows.

Stakeholders: This element refers to those groups of people or individuals who are affected by the implementation of an environmental management system and/or have input or influence into the decision process. Major individual stakeholder groups include Owners and Management, Customers, Employees, External Agencies (including Government and Non-Governmental agencies), and Society/Community (which would include the local and global communities a company operates in and the views of society at large).

Organizational Performance Criteria may consist of both strategic and operational metrics. Certainly, traditional operational and strategic metrics commonly used for
evaluation of suppliers are valid. Included here are the basic metrics such as time, quality, cost, and flexibility.

*Dimensions of Sustainability:* To facilitate analysis, the metrics for evaluating an environmental system were organized into a set of categories labeled the *Dimensions of Sustainability.* These dimensions are created in order to facilitate differing views and therefore differing levels of importance placed on the various aspects of sustainability. For example, Societal stakeholders (Society/Community) would be expected to put more weight on environmental metrics such as groundwater pollution than on an economic metric such as the payback period for the company. Below are listed some metrics that might comprise the given dimension of sustainability.

**Economic** This category addresses the financial criteria used for strategy selection along with selected market related criteria. These would be most important to the Owners/Management stakeholders. When decisions are made about sustainability the business case for environmental investments is more complex than simply analyzing dollars saved versus dollars spent. Many of the benefits from these investments are not quantifiable, indeed they are priceless, such as the value of preserving biodiversity, conserving natural resources, and protecting people’s health and safety (BMS, 2003; Epstein and Wisner, 2001). Recycling revenues is a metric to consider.

**Social** The social category includes those effects related to a company’s interaction with external entities such as government, communities, etc. These are obviously important to the external stakeholders of Society/Community and External Agencies. These metrics would tend to be the most qualitative in nature. Specific examples obtained from literature include improved corporate image, better customer and supplier relations, and
better cooperation and relationships with regulators and administrative bodies. How product recalls are handled as well as warranty claims could also be considered here.

**Environmental** The sustainability dimension of environment specifically addresses elements related to improved environmental performance. Example metrics include improved environmental performance, assured legal compliance, increased energy and material efficiencies, reduced pollution, impact on natural environment and conformance to ISO 14001 and other standards. This category remains the most problematic in that many of these metrics influence other metrics (e.g. increased material efficiency leads to lower cost, reduced pollution leads to improved image, etc.) This is important to all stakeholders and is one which external stakeholders play an increasing role. For example, institutional investors are realizing that companies who are pursuing a path in environmental excellence characteristics such as environmental-efficiency and environmental sustainability are driving financial performance of corporations (Kiernan, 2001). Specific to reverse logistics could include number of truck miles, packaging volume, percent of materials recycled and disposal costs.

*Reverse Logistics Process Functions* included in the decision model are: *collection, packing, storage, sorting, transitional processing, and delivery*.

These practices may not only be environmentally sound, but also provide opportunities for financially sound organizational operations. This is evident in companies like Xerox, with its remanufacturing of copier machines (Oakley, 1993), and Compaq with its reuse, remanufacturing, and reclamation of computer parts and equipment (Sarkis, 1998).
THE ANP DECISION MODEL

The decision model, using the Analytic Network Process (ANP) is capable of taking into consideration multiple dimensions of information into the analysis, a powerful and necessary characteristic for any strategic decision.

The ANP technique is a general form of the Analytic Hierarchy Process (AHP) (Saaty, 1980, 1996). The network structure of ANP is defined graphically with two-way arrows (or arcs), which represent interdependencies among clusters or groupings, or if within the same level of factors, a looped arc. The directions of the arcs signify dependence. Arcs emanate from a “controlling” attribute to other attributes that may influence it. The relative importance or strength of the impacts on a given element is measured on a ratio scale. The ANP approach is capable of handling interdependence among elements by obtaining the composite weights through the development of a ‘supermatrix’. Saaty (1996) explains the supermatrix concept as a parallel to the Markov chain process. The supermatrix will be developed as data is collected for the model.

Overall, there are five major steps in the ANP process:

1. Develop a decision network hierarchy showing the relationships among decision factors.

2. Elicit pairwise comparisons among the factors influencing the decision.

3. Calculate relative-importance-weight vectors of the factors.

4. Form a supermatrix (i.e., a two-dimensional matrix composed from the relative-importance-weight vectors) and normalize this supermatrix, so that the numbers in every column sum to one.

5. Calculate converged ("stable") weights from the normalized supermatrix.
RECOMMENDATIONS FOR FUTURE RESEARCH

This paper is primarily conceptual at this time and focuses on the literature review and support necessary to build the ANP model. The obvious next step is to actually test the model in industry. Plans are being made to complete this phase of the research. The author has had experience using this model in other research. (Meade and Presely, 2001). The purpose of the model is to aid the decision maker in making a proper selection of a reverse logistics strategy that would support sustainable production. The model is actually quite flexible in naming the number and types of alternatives, as well as various measures of sustainability. Based on past experiences the model should be a beneficial tool.

The ANP process of eliciting information and showing the various relationships requires that management be familiar with the issue and to think of the problem in broader terms. The actual process of going through the decision will help management learn of the various issues related to this and possibly other strategic decisions.
Figure 1: The ANP Model for Selecting a Reverse Logistics Provider in an Agile Environment.
Bibliography:


