AN ANALYSIS OF PACKAGING WASTE THROUGH A DISTRIBUTORSHIP WITHIN A SUPPLY CHAIN

THESIS

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TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

This thesis deals with supply chain management and in particular how waste is handled within the supply chain of a distributorship. The cost implications of waste within manufacturing processes has been given the majority of emphasis by businesses in recent years but has just recently been extended to other processes within a supply chain. This thesis is concerned not in the manufacturing of products but in the efficiency of handling packaging waste once removed from products.

The beginning sections of this thesis develop a working definition of supply chain and waste. Subsequent sections develop a model that applies to a distributorship and the creation and handling of waste. Also, contained in the section "Cost Structure" is an analysis of the possible cost implications of waste reduction or cost recovery. Next is the development and explanation of supply chain models. Finally a model is developed to fit a distributorship.

The last part of this thesis is concerned with the validation of my proposed model. During these later sections I will use information gathered from interviews with people in the distribution channel and apply it to the proposed model in order to explain how closely the envisioned model follows the actual practices used by the observed distributorship. With this done, I give recommendations on any adjustments or improvements the data suggest about the model for the distributorship, or the implications of any feedback that can enhance the model.

CHAPTER 2

SUPPLY CHAIN

Competitive Advantage

Recent strategy among firms has been one of cutting cost and optimizing internal processes to one of business growth (LRN, 2003). Companies are currently outsourcing non-core business functions to outside firms and sometimes overseas firms in an attempt to concentrate their focus on the core internal processes of the company. For example, Deere and Company currently purchased overseas parts that represent 82% of the cost of the good when sold, (Sheridan, 1999) this creates further complexity throughout the supply chain but is cost effective to the firm. This outsourcing process creates a leaner internal supply chain and can lead to a competitive advantage over rival firms by generating a higher degree of vertical integration.

Vertically integrating a firm by outsourcing non-core business functions allows the firm to focus only on the competencies that give the firm its competitive advantage over rival firms (Kluyver, Pearce, 2006). Although this trend of outsourcing to cut cost and vertically integrate gives companies more control over internal processes, it hinders their control of external suppliers and buyers. Therefore, when analyzing a distributorship, which is vertically integrated, in order to cut or recover cost from packaging, the firm is forced to communicate with multiple external suppliers.

Clearly, it is imperative that distributorships focus on their core competencies by communicating with suppliers, in order to improve cost efficiency. Through this communication the distributor can negotiate agreements on how products are packaged, and explore the potential of opening secondary supply chains to improve cost efficiency. These topics are elaborated in later chapters.

Competitive advantage can be defined as one person, nation or firm that can produce a good or service more cheaply or efficiently than a competitor (O'Sullivan, Sheffrin, 2001). In this case, moving products efficiently through a distribution center, while incurring as little cost as possible, would give a firm a competitive advantage over other competing firms. By creating the leanest supply chain possible, and by using cost cutting and recovery methods, a company could permanently reduce cost and deliver their product to consumers at a cheaper price, thus making the products more attractive to consumers while increasing sales.

Supply Chain

This thesis is based on the definition of supply chain developed by Christopher (1992) as, "...the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer. For example, a shirt manufacturer is part of a supply chain that extends upstream through the weavers of fabrics to the manufactures of fibers, and downstream through distributors and retailers to the final consumer." These upstream and downstream linkages offer firms an opportunity to try to minimize cost and gain competitive advantage over their competitors.

As can be seen through this definition, supply chain models operate on different levels of complexity, from the internal to the entire networked supply chain. Synergy, or the idea that the whole is greater than the sum of the parts, is a way to link and create value between supply chain channels. As more channels are added at each stage along a supply chain, synergies can enhance product and information flow, thus increasing efficiency in product delivery (Ferrell, Hartline, 2005). These interwoven channels offer cost saving opportunities and can be exploited to reduce inefficiencies and gain competitive advantage as alluded to in previous sections.

Categories of Supply Chains

Using Christopher's definition, the above section gives a broad umbrella in which all types and categories of supply chains can be placed. What is missing is a specification of the differences arising from one supply chain to another, in regards to complexity or stretch of a business or market. In the following definitions developed by Harland (1994), supply chains are further broken down into subcategories from internal to an entire supply chain network:

- The internal supply chain that integrates business functions involved in the flow of materials and information from inbound to outbound ends of the business.
- The management of dyadic or two party relationships with immediate suppliers.

- The management of a chain of businesses including a supplier, a supplier's suppliers, a customer and a customer's customer, and so on.
- The management of a network of interconnected business involved in the ultimate provision of product and service packages required by end customers.

(Harland, 1994)

As can be seen by the definitions developed by Harland, supply chain management has many roles and takes on many functions throughout a product's progression from raw materials to finished products or services. The definitions suggest there is a spectrum ranging from internal chains, those processes started and finished within a firm; to dyadic, two party relationships; to external chains; and finally, with many suppliers and demanders along a line and a network where there are multiple suppliers and demanders set up in a web type of fashion. This proposal and thesis will concentrate on a type of dyadic relationship that is part of a larger external supply chain.

Supply chains in the evolving arena of business strive to cut cost and minimize waste. Waste occurs almost at all levels throughout a supply chain, therefore it requires constant attention. The linkages of entities in all of the above definitions of supply chains add waste either in physical or non physical form. As alluded to above, the reduction or reuse of waste through secondary supply can result in permanent cost reductions giving the firm a lasting competitive advantage over other firms. In the next section, I will analyze waste as it pertains to supply chain management.

CHAPTER 3

WASTE

Waste Defined

Now that we have developed a working definition of a supply chain, I will analyze the production of waste within our chain. Waste can be categorized into two basic types; physical and nonphysical. Physical waste can be thought of as tangible waste, such as that generated during manufacturing, whereas nonphysical waste is intangible, and covers areas such as wasted labor hours or excessively long inventory lags. This paper will concentrate on physical waste and use a basic definition of waste as follows: any activity which consumes resources or creates cost without producing any form of offsetting value stream (Porter, van der Linde, 1995). Before we apply waste and secondary supply chain analysis, let's first define waste within a supply chain and the importance of analyzing it.

Waste is found in many varieties and is created throughout a product's life cycle, starting in manufacturing and ending usually at the customer's place of consumption. Some firms such as BMW and IBM, have adopted strategies to reuse components of used products that will cut cost. BMW has plans to reuse more than 80% of the plastics used in their cars; currently almost all of these plastics were land filled (Thierry, Salomon, Van Nunen, Van Wassenhove, 1995). Firms can benefit by reducing waste throughout the supply chain not only to save money, but also by developing a lasting competitive advantage over other firms. Simultaneously, firms can be socially responsible by cutting back on environmental damage.

A critical question is whether or what type of incentives businesses have to reduce this waste or, are these cost cutting strategies worth the time and effort? The answer should be affirmative. In 1987 under new environmentally strict legislation Dow Chemical redesigned its production process decreasing caustic waste by 6,000 tons per year and hydrochloric acid waste by 80 tons per year. This retooling of production processes only cost the company $250,000 and created an annual saving of $2.4 million (Porter, Van Der Linde, 1995).

Given these examples, it can be seen that waste reduction can be cost savvy and lead to a lasting competitive advantage for companies. These examples represent obvious areas where cost cutting has been advantageous and attracted the attention of managers.

Operation managers typically focus on minimizing waste streams with the largest cost. Typically this attention focuses on manufacturing and decreases as a product moves through a supply chain. With design focused on variables which determine weight, material content and disassembly properties, aims at making these products more "green" can lead to cost recovery further along the supply chain and determine their environmental impact (Eichner, Runkel, 2005). However, by isolating these waste streams and adding internal or external processes to either, recovering cost can create additional value streams. (Hicks, Heidrich, McGovern, Donnelly, 2002).

I will be analyzing packaging waste within the proposed distribution model once it is removed from products and no longer adds value, and its possible cost implications. Consumer goods giant Unilever saved $20 million in a project that integrated its packaging and logistics (Page, 2004). Using the definition to define packaging presented by Hitchens, taken from the European Community, we can define waste as: all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer. As products move through the supply chain they are packaged, for a reason fitting one of the criteria in the above definition, using one or a combination of, paper and board, plastic, light metal, glass, heavy metal and wood (Hitchens 2000).

As products move along a supply chain there are basically four ways of handling packaging as it finishes serving its purpose and becomes waste or creates cost without producing any form of offsetting value stream within a supply chain:

- Reuse
- Recycling
- Energy Recovery
- Landfill

Packaging, once removed from products, becomes a cost to the distributor because it then takes time and resources to dispose of the packaging that is now waste as it no longer serves a purpose in moving products through the supply chain channel. Therefore, some of the packaging materials, paper and board, plastic, light metal, glass, heavy metal, and wood, mentioned above will be removed at the distributorship and be reused, recycled, recovered or sent to a landfill.

It should be noted at this point that a distributorship would want to receive products in an efficiently packaged form to increase their ability to use cost recovery methods and open secondary supply chains, but this ultimately depends on the amount of control the distributor has over suppliers. However, end-of-life products are no longer ignored by firms but are instead regarded as an environmental liability, or an economic opportunity, or both (Geyer, 2004). This gives hope for closing loops in a supply chain and creating more economic and environmental efficiency in the future.

The first two handling methods, reuse and recycling, deserve special attention when dealing with packaging as waste because they offer the largest potential for cost recovery. Due to the fact that retailers are likely to be differentiated and have a low level of influence on suppliers, upstream distributors will have limited control over product packaging, but this can be improved through information sharing. Reuse and recycling will receive further attention in the following paragraphs.

Reuse is the reapplication of packaging materials to unpackaged material at a point further up the supply chain. This process requires reverse logistics in order for a firm to send the material back to the location of the original packaging. Although reusing packaging material via reverse logistics is a viable option, it does create problems. It can be extremely difficult, especially for a distributor with multiple products, to coordinate with all suppliers in order to develop fully integrated supply chains. Cost implications can further complicate the reuse method due to the fact that what may be desirable for one unit within the supply chain could be cost ineffective to another. A distributorship would have to search for multiple "win win" situations with each of their many suppliers.

Another barrier to full reuse integration is the lack of appropriate models for use as tools available to managers (Sheu, Yi-Hwa, Chun-Chia, 2005). Therefore, linking all channels through reverse logistics in order to reuse some packaging waste is rote with complications but it does offer a legitimate avenue for cost recovery and will be incorporated into later models.

Recycling is taking the packaging waste and creating a secondary supply chain where a recycling center would collect the material and offer some monetary payment for the packaging or at least reduce the sanitation cost of the distributorship. This payment would need to eclipse the cost of resources used by the distributorship in order to make this a viable option for the corporation. Although it may be advantageous for a distributor to work with suppliers to develop packaging methods that will lend easily to the recycling process it may not be cost efficient to the supplier. Therefore, increasing a product's packaging recyclability typically raises production cost while making the product's packaging more recycling friendly (Eichner, Runkel, 2005).

The third, energy recovery, is highly unlikely to be an option since distributorships are not typically in the position to burn packaging to fuel their warehouses or other facilities. The last option, of sending the packaging to the landfill, should be reduced in order to shift waste to reuse or recycling, and to recoup cost and reduce the waste sent to the landfill. This may well lead to more environmental efficiency and an attempt to reduce cost within the process. Therefore, in order for a distributor to be able to recover cost through recycling or reusing of packaging material, secondary supply chains will have to be adapted. These new secondary supply chains will hopefully reduce cost and lead to a competitive advantage alluded to in prior paragraphs.

Cost Structure

I will now introduce the profit function and some concepts introduced by Thomas and Maurice (2005) as it captures profit (π) defined as the amount by which revenues (TR) exceed costs (TC), shown in Equation 1.

$$\pi = TR - TC \tag{1}$$

Revenues are defined as the price of goods sold (P) times the quantity of goods sold (Q), shown below in Equation 2.

$$TR = P \times Q \tag{2}$$

This would be a complex equation in a distributorship due to the various types of products, brands, and prices. Costs will be equally difficult to quantify for the same reasons revenue is difficult to quantify.

Total cost for a distributorship or any business is defined as average variable cost of goods (AVC), multiplied by the quantity of goods sold (Q) plus a total fixed cost (TFC) displayed in Equation 3.

$$TC = (AVC \times Q) + TFC \tag{3}$$

Thus profit can be redefined Equation 4 below;

$$\pi = (P \times Q) - \{(AVC \times Q) + TFC\} \tag{4}$$

Using the Thomas and Maurice (2005) profit model and looking at our area of interest, distributorships and packaging waste, we notice that any cost recovery methods employed will affect the total cost of Equation 3. If we let a variable be referred to as CR, for cost recovery, and apply it to Equation 3 it can be shown as Equation 5,

$$TC = \{(AVC - CR) \times Q\} + TFC \tag{5}$$

For this equation only one product will be reflected in the variables in order to stay consistent but in reality it would need to be extended throughout the entire distributorship, to see the macro-effects of cost recovery.

In particular, cost recovery of packaging waste will affect the average variable cost and in turn affect the total cost, which when lowered, will cause increased profits, represented by Equation 6.

$$\pi = (P \times Q) - \{(AVC - CR) \times Q + TFC\} \tag{6}$$

The degree to which the cost recovery influences the cost structure of a distributorship will depend on the amount of cost that can be recovered through the secondary supply chains. However, even if the cost recovery per product is small when applied on a macro scale across an entire distributorship and then conveyed to all distributorships owned by a company, the recovery could be quite large and indeed advantageous.

CHAPTER 4

SUPPLY CHAIN WASTE MODELS

Development of the Models

In the following section I use the definitions and subcategories developed by Harland (1994) to propose four models demonstrating the principles stipulated for each category. Models give managers an idea of where they currently are and where they are going in the future; it also gives a big picture view of how a product moves through every process along a supply chain (Wood, 2004). Each model in the following sections adds complexity and covers a widening scope of a business' operations. These models help in developing an understanding of the final model I propose and which can be validated through research conducted on a distributorship.

The following models represent supply chains from the mere linear model to the more complex web of interconnected businesses. The varying complexity in supply chain models have forced enterprises to focus on both the internal and external to increase the financial and operational performance of each member of the supply chain through reductions in total cost, investments, and increases in information sharing (Ridha, Giles, Neubert, Bouras, 2005). Increasing performance in all these areas would ultimately help firms develop a competitive advantage, by developing efficient long term strategies to sustain growth for many years into the future. In the following sections models are developed to suggest a structure for how distributorships function within a supply chain.

Increasing Levels of Complexity in Supply Chain Models

Supply chains models have evolved over the years to take on many different roles and definitions in the business community. Today, most scholars believe there is no one definition to suit all varieties of supply chains in the business community. Possibly the simplest of these models is the input-output model, presented in Figure 1.
Input-output models have typically been applied to analyze the economic structure of regions in terms of flows between sectors or firms. This basic model shows interdependencies among production activities, giving stakeholders an idea of how change can affect the entities involved in the input-output process (Albino, Izzo, Kuhtz, 2002).

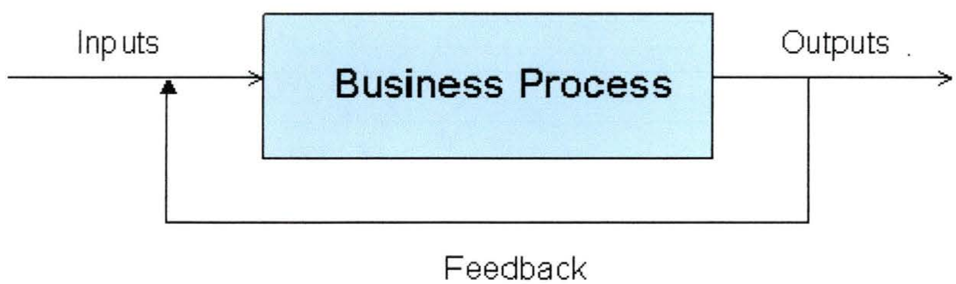

Figure 1 Input-Output Model

This model is seen as a process where inputs are purchased, transformed through business processes, and then outputs are produced. An example of this would be the process of a firm acquiring aluminum and transforming it into cans to sell to bottling companies.

A second model that adds labor and capital to the process of a supply chain is shown in Figure 2.

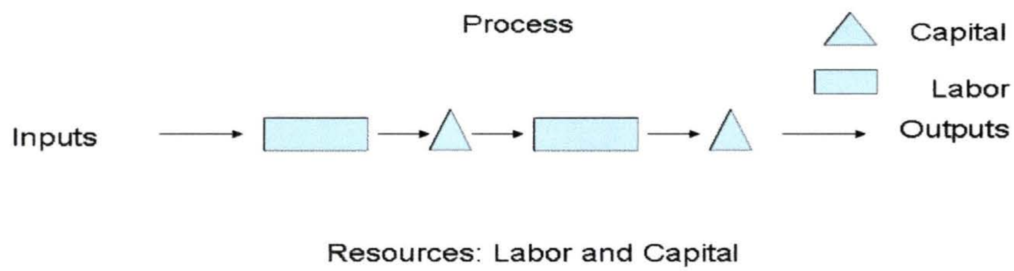

Figure 2 Labor and Capital
Adapted from Cachon, Terwiesch, 2006

In Figure 2 we see the process is broken down further and is more representative of the supply chain process. Factors of production in the form of labor (represented by triangles) and capital (represented by rectangles), are added to show how products entering a distributorship are manipulated. For instance products entering the distributorship are unpackaged by employees (ie labor) and forklifts (ie capital) are used to put the products in their respective storage areas. Although these two models are relatively simple when compared to an entire network of firms participating in a supply chain, they do demonstrate how models grow increasingly complex when more and more entities are represented graphically. The next section proposes four working models of supply chains as they incorporate increasing levels of complexity.

Internal Supply Chain

Internal supply chains deal with the management of the factors of production within a single organization or building. This model gives a firm the most immediate control of the factors of production. Given the close proximity of labor and capital, the management functions can be done throughout the entire internal supply chain, due to the lack of external forces affecting productivity.

For this study, a distributorship will serve as an example for our models. The internal supply chain of a distributorship is represented in Figure 3 below.

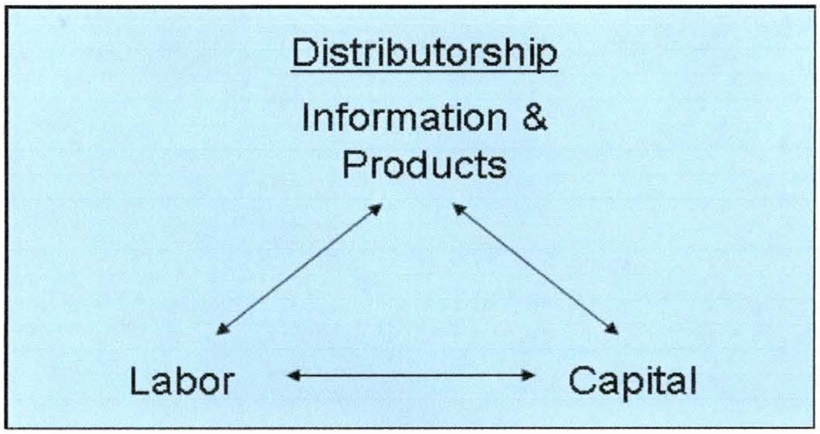

Figure 3 Internal Supply Chain

Illustrated in Figure 3 is the process of a product's movement through a distribution center. This particular model is only concerned with the supply chain within the distribution center. This model also incorporates the effect of labor and capital upon information and products. All three of these elements of the internal supply chain are coordinated in an effort to move inbound products to storage and eventually to out bound products as efficiently as possible. The arrows represent the interaction between human labor and the capital used to remove packaging and store products as well as the flow of information through the distributorship to coordinate the process.

An example of this would be a crate arriving at the distributor; the product must be unpackaged, a destination bound for storage, stored, retrieved and then shipped to a retailer. In this example, people supply labor, machines (forklifts, computers, compactors) provide capital, the product and storage information are manipulated by the two until the process is completed and the product leaves the warehouse. Taking a step back and viewing the supply chain from a more macro perspective we see the inclusion of a supplier.

Two Party Relationship

A slightly more complex model, referred to as dyadic or two party relationships, demonstrates the interaction between two separate entities (Harland 1994). Figure 4 gives a simple visualization of this relationship.

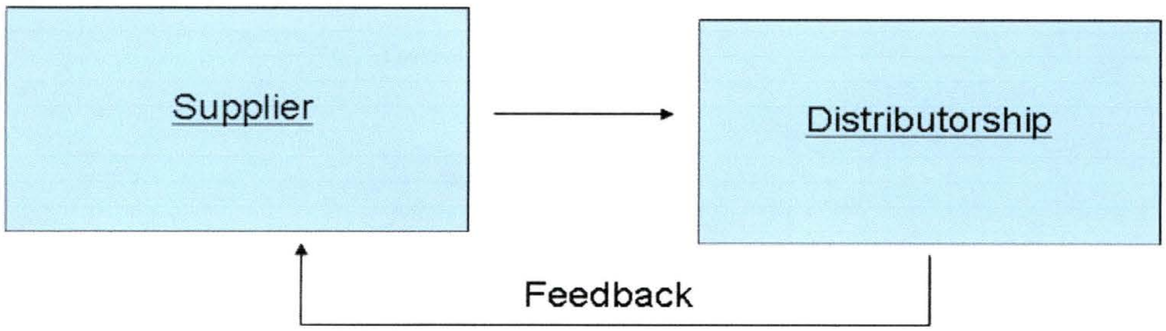

Figure 4 Two Party Relationships

Figure 4 shows a supplier providing products downstream to a distributorship represented by an arrow, then the distributorship sending back information in the form of orders or quality concerns. This model is slightly more complex due to the fact there are now two firms that must be managed. Even though this model visually seems less sophisticated, it is much more complex. Each box labeled Supplier and Distributorship contain the same internal supply chain represented in Figure 3. Now there are factors of production contained within each firm that are managed and coordinated in order to move a product from one point to another. Suppliers must manufacture a product using its factors of production and then send the finished good to the distributor where the distributor goes through the process shown in Figure 3. After the product has moved out of the warehouse to retailers, represented by the arrow labeled feedback, the distributor orders a replenishment of the product from suppliers. This is an information flow back to the supplier.

This model adds complexity due to the fact that more than one firm must be managed in order to complete the two party relationship supply chain. This added complexity results in a stream of a products movement better represented by the chain of businesses model developed below.

Chain of Businesses

The Chain of Businesses model represents the management of a chain of businesses including a supplier, a supplier's suppliers, a customer and a customer's customer, and so on. A product formulation from raw materials to end consumer is the idea behind this model and is extremely complex. Figure 5 gives a simple visual example of the Chain of Businesses model.

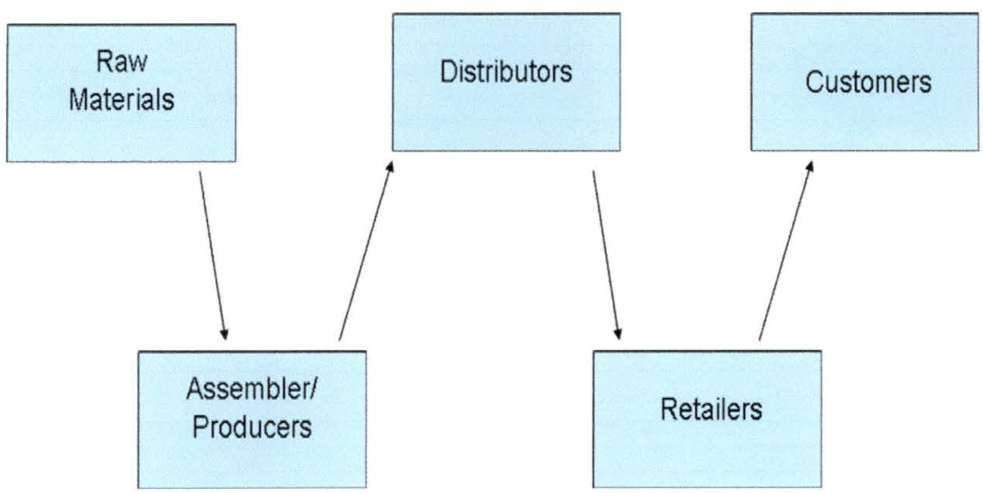

Figure 5 Chain of Businesses

Once again in this model an internal supply chain is represented by a box labeled according to position within the chain. This model is essentially a string of two party models that show a product's movement from raw material to consumer. The movement of products and information feedbacks are represented by the forward and reverse pointing arrows. An example of this would be cotton that is picked, woven into thread, turned into cloth, made into clothes, shipped to distributors, shipped to retailers and then finally resulting in the sale of the clothes to consumers.

This model, although, more complex than Figure 4, could be greatly more multifaceted. There could be more flows and firms with their own internal supply chains represented in the Chain of Businesses model depending on the amount of steps a product must go through throughout its life cycle. Figure 5 is the most compound model thus far, but it only represents the movement of one product. Figure 6 will put the distributor at the center a network of supply chains.

Supply Chain Network

The fourth and final working model of a supply chain discussed here is the Supply Chain Network represented in Figure 6.

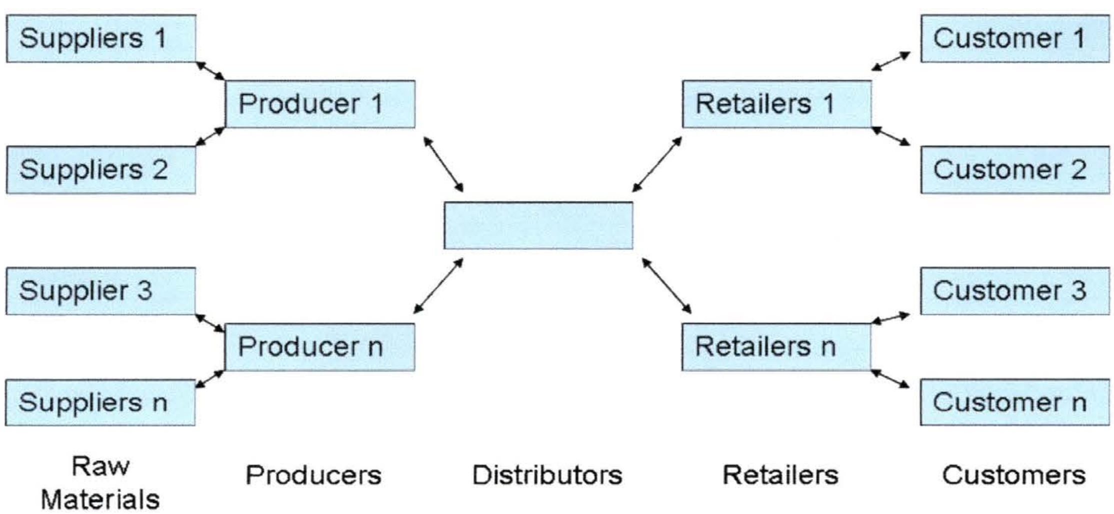

Figure 6 Supply Chain Network

Represented here is the management of a network of interconnected business involved in the ultimate provision of product and service packages required by end customers (Harland,1996). Here we can see multiple raw materials turned into multiple products passing through a distributorship and then on to multiple retailers and customers. This model simply shows how multiple products move from inception to ultimate consumer. In other words Figure 6 represents multiple Chain of Businesses models, formed by two party models which are connections between internal supply chains.

The complexity of the Supply Chain Network model can be astonishing when one thinks of all the different products and product brands offered at their local super market. Each product must start from raw materials to a finished product. This requires massive amounts of labor hours and productive capital to complete the product life cycle. Each product must pass through a distribution center – the focus of this study – specifically, the internal and two party relationships models of a distribution center.

CHAPTER 5

PROPOSED MODEL

I will analyze the supply chain of a distributorship and develop a model derived from the second and third definition of supply chain established by Harland (1996). The preliminary model was presented in Figure 3 and adapted here to a distributorship for concurrence.

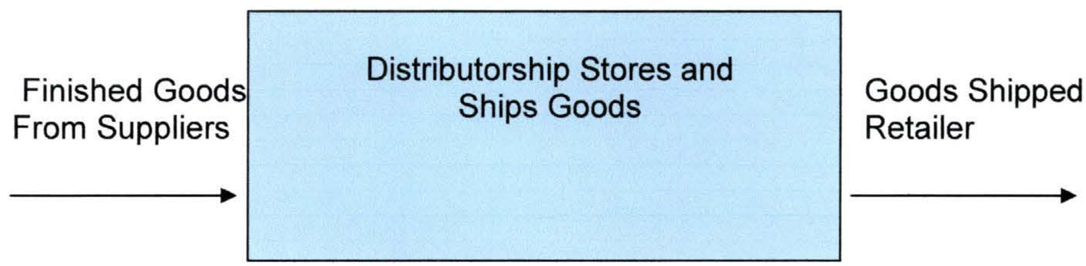

Figure 7 Preliminary Model for Distributorship

This model presents the basic operation of a distributorship in the supply chain. Finished goods are passed from manufactures or suppliers to the distributorship, then onto retailers and eventually to customers. This model is very simple and ignores the opportunity or existence of secondary supply chains, which can occur and be profitable opportunities for a firm.

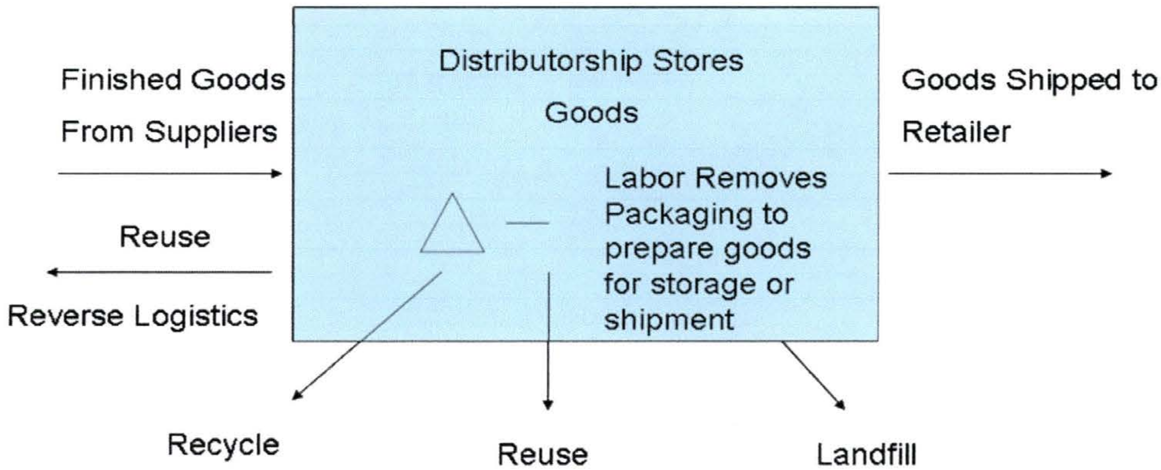

Figure 8 Proposed Model

In Figure 8 we see a distributorship represented by a box containing a triangle, representing labor. Labor is perceivably used within distributorships to remove packaging from goods entering a warehouse. After this unpacking occurs, the packaging material then leaves the distributorship in three ways represented by arrows flowing away from the distributorship labeled Recycle, Reuse and Landfill. The packaging material can then be sent back to the supplier via a preplanned system of reverse logistics, which could lower cost by reducing the amount a supplier would have to pay for new packaging material, and thus, the savings could be passed on to the distributorship. Another option for cost recovery is recycling, which would employ an outside business to collect the material and pay the distributor money in return for the packaging materials. The final outlet for the packaging material is the most cost ineffective, landfill, which is simply the option of throwing packaging material in the garbage to be disposed of in a landfill. This option offers no cost recovery and usually costs the distributorship a fee for the service.

Using this model when analyzing a distributorship, we can hope to encourage more of an emphasis on reuse and recycling than using traditional landfill methods.

However, even if this is not the case, we will still apply the model and analyze its potential when applied in an effective, cost efficient manner.

CHAPTER 6

VALIDATION OF MODEL

In the following section I use the data gathered through interviews to readapt the proposed model, Figure 8. The model will change slightly from the different insights gained from personal interviews with individuals that work within the distribution system of a major grocery store in the state of Texas. These interviews were conducted with the head of recycling, and an individual running the onsite management operations of a distribution center.

First contact was made with the corporate headquarters and the connection was made with the head of recycling. I asked her my set of interview questions and she recommended I talk to the head of a local distributorship to get a better understanding of the daily operations of a distribution center. I then contacted the onsite manager of a distribution center and emailed him the questions outlined below so he could preview them before the interview and use them as a guide.

1. Do you have a recommendation of a product that would be particularly interesting with regards to packaging?
2. How are the products bundled?
3. What types of packaging is involved when the particular product enters the warehouse?
4. How is packaging removed?
5. Where is the packaging sent next? (Recycled, Reused, or Landfill)
6. Cost and or weight of packaging removed?
7. How much is spent, on average, for waste removal in a year?
8. What is the cost recovery methods used from recycling?

9. How many of these products or product bundles move through a warehouse in a year?
10. How many distribution centers in the U.S.?
11. From where does the product enter the warehouse?
12. Is it possible for me to view this at one of the warehouse locations?

Although not all of the questions could be answered due to lack of information or for issues pertaining to confidentiality, the on-site operations manager reviewed the questions for a week and we scheduled a phone interview to go through the process of a product entering a distributorship, and the removal and processes involved in handling of packaging waste. These questions were used as a guide and the distributorship manager recommended cosmetics as a product that has extensive packaging and would lend itself to an interesting analysis.

After conducting the interview I then proceeded to adapt the answers and discussion topics to the model proposed in Figure 8. The two individuals selected for the interviews were in positions to give information about the entire supply chain process of a distributorship and had the necessary expertise in the field.

CHAPTER 7

DATA ANALYSIS

In Figure 8, I proposed a model to illustrate how a product possibly moves through a distributorship, taking advantage of secondary supply chains in order to recover cost through reuse and recycling. I will present the revised model below in Figure 9, based on the inputs from the interviews.

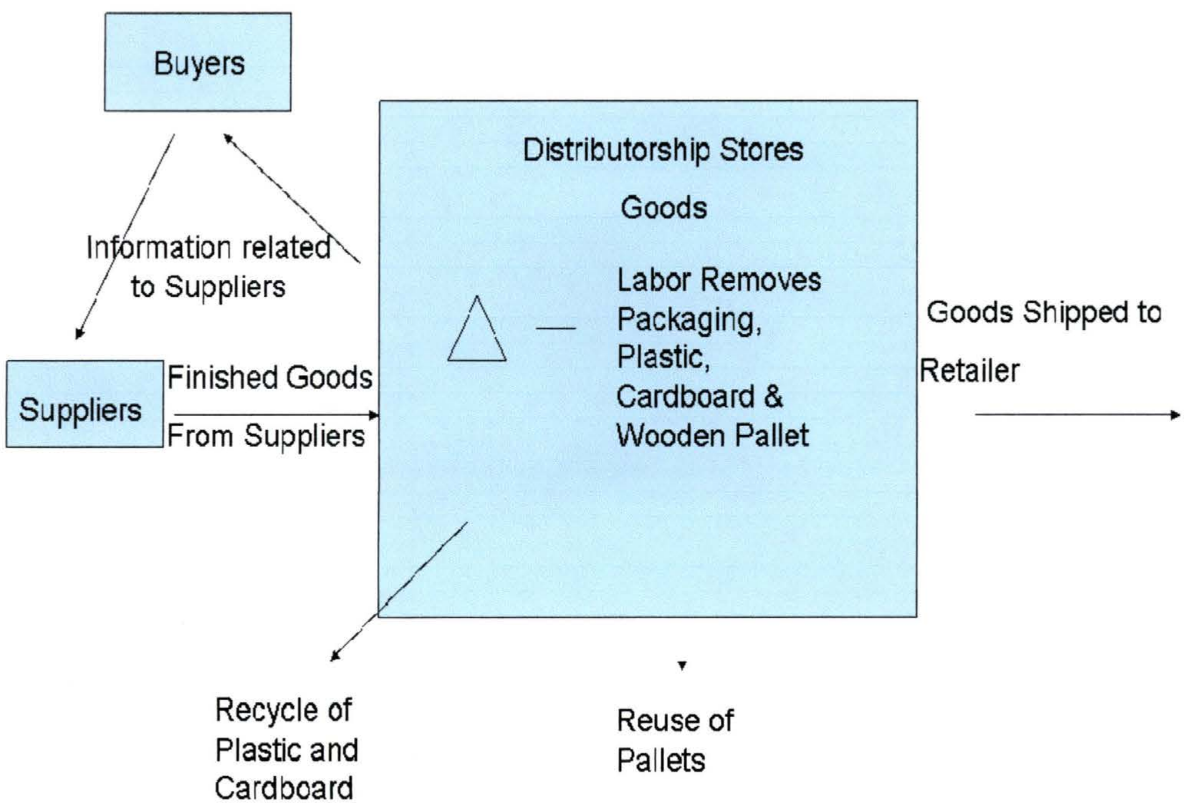

Figure 9 Validated Model

As can be seen Figure 9 closely resembles the model proposed in Figure 8. The product identified for analysis was women's cosmetics because of its packaging complexity. Cosmetics entering the distributorship come bundled on wooden pallets. On these pallets the makeup is contained in a cardboard box and then the cardboard boxes are wrapped in plastic. The product is removed from the pallets and then the plastic and cardboard is separated. Therefore, the packaging consists of the materials wood, plastic and cardboard.

The pallets are then gathered by a separate company that works within the distributorship strictly gathering pallets to reuse. Although the distributorship works separately from the pallet company they do benefit from the relationship. They do not have to pay for the pallets in the shipping cost, but the pallet company in turn does not pay the distributor for the pallets. This is a cost cancellation worked out between the two firms.

The plastic is cut from the cardboard which is time consuming but necessary for recycling. This plastic is then stored in recycling receptacles and picked up several times a week. Plastic is particularly interesting in that, once the recycling center collects the plastic, the center recovers almost 100% of the plastic in the recycling process. In all, the particular distributor exceeds shipping more than 200 tons of plastic to the recycling center a year. The distributor had no numbers on the amount of money saved on just the plastic from makeup and told me they only keep numbers on the aggregate recycling process.

Cardboard was also fully recycled. Once collected for recycling cardboard has an 80% recovery process through recycling. The distributorship ships in excess of 2000 tons of cardboard a year to the recycling center. Once again there was no specific cost information on cardboard recycling cost recovery.

In regards to the recycling of plastic and cardboard, the distribution center explained that although they did recover their cost of labor from the money paid to them by the recycling center, the main cost advantage was in the reduction of cost associated with sending garbage to the landfill. Even though the money paid by the recycling centers was small, it completely cut the cost of sending packaging to landfills. Recycling saved the distributorship on average, 10 to 15 trailers of landfill garbage a week due to recycling. Although there was no cost information on this, I think the savings would have to be substantial. It was also encouraging to find out that makeup packaging, as well as all plastic and cardboard, are 100% recycled with nothing moving to landfills.

Equation 6; $\pi = (P \times Q) - \{(AVC - CR) \times Q + TFC\}$, then can be used to show exactly how the reuse and recycling affects the cost equation for women's cosmetics. The wooden pallets would have no effect on cost since they are not paid for by the distributorship or are any costs recovered when the company collects the pallets for reuse. However, plastic and cardboard have an effect on profits. AVC would decrease due to the reduction in the amount of waste that the distributorship has to pay to have packaging waste removed and hauled to a landfill. Recycling of all plastic and cardboard packaging increases cost recovery (CR). Both of the factors work to positively increase profits. Although in the interviews the exact numbers were not available, the decrease in AVC of 10 to 15 trailers a week and the CR of all plastic and cardboard in excess of 200 and 2000 tons respectively is substantial. Equation 6 could be rewritten with arrows showing the increases and decreases to give an overall idea of the effect of packaging waste management on the effects of the cost structure of women's cosmetics.

$$\uparrow \pi = (P \times Q) - \{(\downarrow AVC - \uparrow CR) \times Q + TFC\}$$

CHAPTER 8

RECOMMENDATION

The distributorship did an exceptional job at recovering cost through reuse and recycling, I felt there were a couple of ways to improve the process. It was explained to me that they exercised little control but substantial relationships with their suppliers through their buyers represented in Figure 9. I think they could use these relationships to work on devising ways of making the packaging more removable and thus less time consuming to remove. The head of the distributorship explained to me that the connection of the plastic to the cardboard is difficult to remove. They could work with suppliers to create a more efficient style of packaging that lends itself more easily to recycling.

This can be accomplished by using the relationships with corporate buyers and have them communicate their needs for more efficient packaging back to suppliers. These relationships are represented in the Figure 9, Validated Model, by the arrows linking distribution centers to the buyers and then back to suppliers. During the interview it was conveyed that suppliers are open to distributor suggestions. I feel like these relationships could be used to increase efficiency within the distributorship.

Secondly, I would like to see more of a break down in the cost recovery information gathered by the distributor. They had almost no information on how much cost was recovered from the packaging of each individual product. By not keeping track of these types of activities they lose valuable information. If they would keep track of the individual cost structures they could pin point the areas where packaging was not being efficiently recycled or reused, and thus identifying opportunities for cost recovery described in the analysis of makeup. This would also aid them in deciding which suppliers to talk to in order to develop more efficient packaging methods.

The distributorship had no particular cost information on the effect of individual product's packaging management on the entire cost structure of the distributorship. Since the overall cost equation of a distributorship is the accumulation of the individual cost equations presented in Equation 6, a more in depth analysis could be done if we had the individual product cost structures to analyze the individual effect on the overall cost structure, and perhaps on the total fixed costs. In the example of women's cosmetics we found that wooden pallets had no effect on the product's cost structure, but that, for this product, 100% of plastic and cardboard are recycled but the cost benefit from the 100% recovery of plastic and cardboard could be offset somewhere else within the distributorship by an inefficiency in another product.

In the example of women's cosmetics the distributorship was efficient in their handling of packaging waste; this could be why it was offered as an example. It was also conveyed that they saved 10 to 15 trailers a week that would otherwise be sent to landfills, and that they sent in excess of 200 and 2000 tons of plastic and cardboard packaging waste to recycling centers. This seems highly desirable but some information could be lost in this aggregate analysis. In other words, it would be beneficial to know whether the amount of trailers saved from the landfill could be increased to, say, 20 or

25, and whether the tonnage could be increased over the current amounts sent to recycling centers. Both of these could result in significant cost reductions.

By keeping track of each individual product's cost structure and not just analyzing the aggregate, a distributorship could find areas where they lack efficiency. For example, positive effects observed in the area of women's cosmetics could be nullified or reduced by the negative effect of the packaging management of another product. However, it is obvious that, in the aggregate, the distributorship's positive effects are not completely nullified by inefficiencies elsewhere in packaging management, seen by the amount of trailers saved and packaging sent to recycling centers. Without individual product cost structure analysis it is difficult to locate these exact areas of inefficiencies that could be having negative effects on the overall cost structure of the distributorship. Relating this back to Equation 6, these products would have no CR or unaffected AVC.

After the distributorship breaks down the individual product's cost structure they could locate inefficiencies. Once located they could make decisions on their packaging waste management, or decide whether they need to communicate up the supply chain stream in order to receive products in a more efficient manner. This would allow the product's packaging cost to be recovered through reuse or recycling.

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