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A Comparative analysis of a returnable/reusable packaging system

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A COMPARATIVE ANALYSIS OF A RETURNABLE/REUSABLE PACKAGING SYSTEM

by

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M.S. DEGREE THESIS

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A Comparative Analysis of a
Returnable/Reusable Packaging System

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I would like to dedicate this to my grandparents.

They have always inspired me to try to be a better person.

PROLOGUE

At the time this study was conducted, Masland Industries was a publicly traded tier one automotive supplier. A tier one supplier sells components directly to the automotive company, rather than selling parts as a sub-supplier (tier two). Approximately one year after the conclusion of the study, ownership of the company changed hands. It was purchased by Lear Corporation in 1996 in a $384.8 million dollar stock buy back. At that time the company became the Masland Division of Lear Corporation. Currently, the former company is known as the Floor Systems Division of Lear Corporation. All manufacturing and fabrication plants have remained in the same locations. Almost all corporate support personnel have relocated to offices in Southfield and Plymouth, Michigan.

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ABSTRACT

The primary objective of this study was to determine if the implementation of a returnable/reusable container system was financially viable for a specific company. The study attempted to document all cost parameters involved in making a capital budgeting decision regarding returnable containers. The specific cost parameters applicable to this project were then identified. The actual cost associated with each parameter was then obtained either through quotation or calculation. Several capital budget decision making cost analysis methods were presented. One method which best represented the project's qualifying factors was then chosen. The analysis was completed and the results were presented. The results of this study determined that it would be a financially viable decision to implement a returnable container system at this company.

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CHAPTER 1 - INTRODUCTION AND REVIEW

The last decade has been one of tremendous growth and emphasis on product packaging. Packaging Suppliers have worked to improve the physical characteristics of packaging materials. New technologies and materials have given designers opportunities to utilize design concepts that only a few years ago were unthinkable. These have facilitated a higher quality level of containers in the distribution channels. However, these improvements do not come without a cost. One of the ways many companies have tried to justify those costs is through the use of returnable/reusable containers.

As more companies have explored the use of returnable/reusable containers, the market has grown at a rate of 20 percent a year.[1] Automotive companies have always been proactive when it comes to returning, reusing and recycling distribution packaging material. Therefore, it is easy to see why the automotive industry is currently the largest single user of returnable containers.[2] In this industry, returnable containers are seen as a technological change that is necessary to produce non-defective parts, reduce the cost of packaging, and control product quality.

Returnable/reusable containers are sturdy, multiple use packaging often specific to the product and the needs of the distribution environment. They should be lightweight, have a good return ratio, and be easy to repair. New plastic materials used for returnable containers are collapsible, nest, stack and have an increased life of up to twenty years. This is in comparison to steel, which often rusts out before its life expectancy.

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[1] Karen Auguston, "Returnable Containers: Why You Need Them Now," Modern Materials Handling November, 1993, pp. 40.

[2] Wendee V. Uxa, "Returnable/Reusable Containers in the Automotive Industry and the Related Capital Budgeting Investment Decision," Thesis. Michigan State University 1994, p. 2.

MATERIAL SAVINGS

Returnable container systems can reduce packaging material costs over time when compared to one-way expendable container systems. That is because returnable containers are designed to last for many trips. The result is a significant savings in packaging material replacement and disposal costs. While the initial investment is high, most container systems typically pay for themselves over a long life cycle. In many cases, the containers themselves outlive the product they carry. Similarly, lightweight plastic containers have many benefits over expendable corrugated boxes. The principal benefits are savings in packaging purchase costs and disposal costs.

Some people would argue that plastic containers really won't save money. The point they make is that the container is nothing more than a tool. The secret to saving money is to redesign the parts or product delivery system. Reusable containers are a part of that redesign, but so are automatic data collection, ergonomics, employee empowerment and other factors.[3] Therefore, implementation requires planning, adequate justification, management approval and backing, coordination between manufacturer and customer and appropriate follow up. However, since containers are easier to quantify, they often get all the focus when implementing a new returnable container system. There are also many other areas that require consideration and influence in justifying a returnable container system.

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[3] Clyde E. Witt, "Plastic Containers Won't Save You Money," Material Handling Engineering, October, 1994, pp. 20.

PRODUCT QUALITY

Returnable containers may also offer other savings in terms of decreased product damage due to low cost, low quality generic packaging. In the past, distribution packages have been relatively standard containers that the product is made to fit into. Research has shown that returnable packaging can be more efficiently tailored to fit specific products and their distribution systems. This inherently allows the package to fit the specific quality requirements of the product. Similarly, a key element in the container's design is maintaining the integrity of the product to be shipped. With an astute design, a single container can function as an in-line tote, a product assembly platform, a fixture to hold parts, and a returnable container that nests or folds flat for return shipping.[4]

SOLID WASTE REDUCTION

The Environmental Protection Agency (EPA) has outlined three approaches to solid waste reduction. The first two deal with reduced packaging per unit, and increased product life cycles. The third approach is substituting single-use "disposable" products with reusable products. It states that reusable products should be engineered to increase the number of times that an item may be reused.[5] This approach can be applied to the packaging as well as the product. High volume products should be the center of attention for waste reduction because they contribute the most to municipal solid waste stream.[6] This fits into many corporate policies which believe there is an obligation to protect the environment.

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[4] Auguston, p. 41.

[5] United States Environmental Protection Agency, Resource Recovery and Waste Reduction, third report to Congress by the Office of Solid Waste Management Programs (Washington D.C., 1974) p. 16.

[6] Mark A. Plezia, "An Energy Comparison Between Polycarbonate and Glass Half-Gallon Milk Bottles Used in a Returnable Refillable System," Thesis. Rochester Institute of Technology 1991, p. 4.

Reusable containers reduce the waste a company generates. This is one of the most important benefits of a returnable container system. Less trash means less labor required to collect and clean. Less trash also equals lower dumping fees which equals better numbers on the bottom line. That is measurable.[7] It is also one of the many benefits the automotive industry has taken note of:

> With the advent of environmental awareness, the cost of disposal has soared. Knowledgeable groups are projecting a continued rise in these costs. Traditional methods of disposal - landfill and incineration - are becoming more costly or simply unavoidable. In some areas, landfill and incineration operations have been banned by legislation. In other areas, landfills require separation and sorting of materials or even restrict certain types of waste altogether. As a result, waste disposal is no longer just an environmental issue but an economic one as well.[8]

There are many examples of how seriously this issue has been taken. General Motors set a goal of zero-landfill for packaging material by 1994 for eight of its midsize auto assembly plants. It set specific guidelines for suppliers whether they are shipping in expendable or reusable containers. "Wasteful, excessive, and non-recyclable packaging will not be acceptable" [9] This policy was strictly enforced and expanded over time to additional assembly plants. Chrysler was able to eliminate 209 tons per day of expendable packaging solid waste by switching to 100 percent returnable containers at one plant.[10] The estimated savings of $8 million/year only included a reduction in packaging material expense. It did not include savings from elimination of waste disposal.

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[7] Witt, p. 20.

[8] David N. Koenck, "Many Happy Returns," Actionline, September, 1993, p. 25.

[9] Tom Andel, "New Ways to Take Out the Trash," Transportation and Distribution, May, 1993, p. 25.

[10] Helen Richardson, "Cutting Packaging Also Cuts Costs," Transportation and Distribution, October, 1989, p. 26.

HOUSEKEEPING

One of the many intangible benefits of returnable packaging systems is visual management. They allow for a neater, less cluttered production area. Returnable containers also tend to increase visibility and identification of parts. Another advantage is that if the containers are plastic, they hold up extremely well in a variety of environmental conditions. The containers are waterproof, resist chemicals and rust, and do not absorb liquids or odors from previous loads. All of these items lead to improved housekeeping.

ERGONOMICS

Another less-visible savings attributed to returnable containers are ergonomic benefits. The premise is that reusable containers make ergonomic sense, not because they are plastic or metal, but because they are reusable. It is possible to build ergonomic features into returnables when they are designed. This is due to the fact that reusable containers are part of a system. For instance, when a system is designed, an engineer reviews how containers are presented to the assembly worker. Weight, height and presentation of standard-sized containers are all considerations that help reduce injuries and enhance productivity.[11] Also, less direct labor may be required in handling, opening, and moving the containers. This elimination of labor allows for production efficiencies to be gained. Other features of returnable systems are also considered crucial to implementation success.

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[11] Witt, p. 20.

KEY SYSTEM FEATURES

When evaluating what products may lend themselves to a returnable packaging system, there are several features which can be the key to success. According to the 1991 Ford Packaging Guidelines, "Economic factors that influence the use of the returnable packaging include: material, quality, labor, freight, cleaning, disposal, recycling and tooling costs."[12] These are certainly all important areas which should be considered.

Ideally, a manufacturer should be in a closed-loop distribution system with its suppliers. Creating a system requires commitment from Purchasing, Information Management, Manufacturing, and Shipping/Receiving departments. A program's success is dependent on the involvement of all partners and/or suppliers. They have to be committed to the process. All partners in this venture should understand that some economical method of returning the containers is at the core of the system. Accurate tracking and return along the loop are also critical components of the system.

Another consideration is that returnable containers are not really a direct substitute for expendable packaging. Unlike expendable packaging, returnable containers typically require a high initial capital investment. In order to protect that investment, some type of control system is necessary to ensure that the containers remain captive in the distribution system.[13] Without this feature in place, creating a successful returnable system would be extremely difficult.

It is also essential to determine the necessary number of returnable containers required for one cycle. Distance between supplier and manufacturer is the first important

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[12] Ford Manufacturing and Material Handling Engineering Standards Department, Ford Packaging Guidelines for Production Parts, February, 1991, p. 12.

[13] Auguston, p. 40.

variable. It determines the cycle time between shipments. Cycle time is important because the longer the cycle time, the more containers are needed.[14] When more containers are needed, the capital investment increases, and the chance for a successful payback period declines. While no one wants to underestimate product distribution cycle times (and risk running out of containers) it becomes a detriment to the implementation economics if cycle times are inflated beyond what is required.

These considerations fall in line with the thoughts of a just-in-time distribution system. When this concept is in use, it creates an excellent environment for savings from implementation of a returnable container distribution system. Dedicated shipping routes, shorter delivery distances, shortened delivery time, smaller inventories, and a partnership relationship between manufacturer and a smaller number of suppliers all contribute to the ideal setting for the use of returnable shipping containers.[15] There are many examples of successful returnable systems in place in the automotive industry.

EXAMPLES

In reviewing the options of one time investment for returnable packaging versus the spending of variable dollars for expendable packaging over the life of the model, Chrysler material handling engineering showed a payback in less than one year. Savings are realized by suppliers eliminating purchase of expendable paperboard cartons and wood pallets and passing the savings on to Chrysler. Additionally the plant saves the cost of disposing of the expendable packaging.[16] Recordable benefits at Chrysler include

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[14] Uxa, p. 13.
[15] Uxa, p. 7.
[16] "Chrysler Does It Again," Modern Materials Handling, January, 1993, p. 45.

improvements in part quality, packaging quality, and cost reductions including packaging material, handling costs, inventory, and disposal. Intangible benefits include visual management (neat house), decrease in use of forktrucks, and better visibility and identification of parts. There were some negative aspects of returnables at Chrysler as well. These included sudden volume shifts causing container shortages, varied manufacturing plant locations, limited supplier resources, part engineering changes requiring increased package development, cleaning and firehazard problems, and inadequate container control.

At Toyota Motor Manufacturing's Georgetown, Kentucky assembly plant, over 91 percent of parts are received in returnable containers. Dedicated route carriers make deliveries from suppliers up to 16 times per day. Dunnage (internal packaging) is left inside the return container for re-use.[17] This allows Toyota to be able to plan consistent transportation routes, reduce material handling, and reduce costs associated with assembly and disposal of expendable packaging.

Taking the concept to the next level was General Motor's Saturn plant in Spring Hill, Tennessee. The plant was designed with a concept of 100 percent returnable containers. Components remain in the containers and move directly from staging to the assembly line. Reusables also reduced the space usually dedicated to handling disposable containers, packaging and trash.[18]

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[17] "Container System Saves Millions In Transport," Transportation and Distribution, September, 1992, p. 101.

[18] "Reusable Containers Keep Assembly Line Moving At Saturn," Material Handling Engineering, December, 1993, p. 72.

PURPOSE

While these are all excellent examples of returnable/reusable container systems that worked for each individual company it would be difficult to make general assumptions based on their outcome. A comprehensive study would be more successful if it were based on specific circumstances. The results from a case study would be beneficial in understanding which returnable system variables were critical to a new container implementation. That is, discovering which variables would generate the most savings, and which would create the greatest risk for failure. An evaluation of distribution system costs should be done to compare expendable containers with returnable containers for both costs and benefits. Packaging material expense and freight costs are the two most obvious factors to include in a cost justification, but there are many other considerations. A complete analysis will also improve the probability that the predicted results are consistent with the actual results.

This information demonstrates a need for further study in the area of returnable/reusable container systems. It specifically shows that continued work to increase the database of case studies for economic justification of returnable containers is critical in understanding and quantifying which implementation parameters are key to a systems success. In this context, an analysis was completed utilizing the specific circumstances of a corporation within the automotive industry. The results of that analysis are described and presented in this thesis.

CHAPTER 2 - PROJECT PARAMETERS

CORPORATE BACKGROUND

Masland Industries is a leading designer and manufacturer of interior systems and components for the North American automotive industry. Its primary manufacturing facility of in-process materials is located in Carlisle, Pennsylvania. This facility manufactures both tufted and non-woven carpet products in roll form. This material is then sent to one of seven fabrication plants throughout North America to be made into finished automotive carpet. Masland is considered a “tier one” supplier in the automotive industry, producing over two million automotive carpets per year.

In order to manufacture tufted carpet, the company relies on receiving several raw materials from outside suppliers. These materials include the fiber product, weaving substrate and backing material. One of the key materials is the actual fiber product. The fiber may be one of several materials such as nylon, polypropylene, or bulk continuous fiber (BCF). These materials are currently purchased from one key supplier with two backup suppliers. CAMAC Corporation in Bristol, Virginia currently supplies 80 percent of the fiber product used by Masland. Both companies have entered into a “partnership” to help foster cooperation and increase manufacturing efficiencies. Brainstorming sessions were held and one of the ideas brought forth was to make improvements in the packaging of CAMAC’s products. It was believed that this would be beneficial to both parties.

PRODUCT PARAMETERS

The product is approximately eleven pounds of fiber wound around a 3/16" thick, recycled chipboard core. (Figure 1) The frame of reference for this product's measurement is always weight in pounds. It is also generally accepted that anything referred to as a "cone" is an eleven pound unit of fiber. During the manufacturing process, cones are loaded onto a corresponding helical-shaped spindle in the creel area. The fiber is then fed through an industrial weaving loom which utilizes up to 80 cones simultaneously.

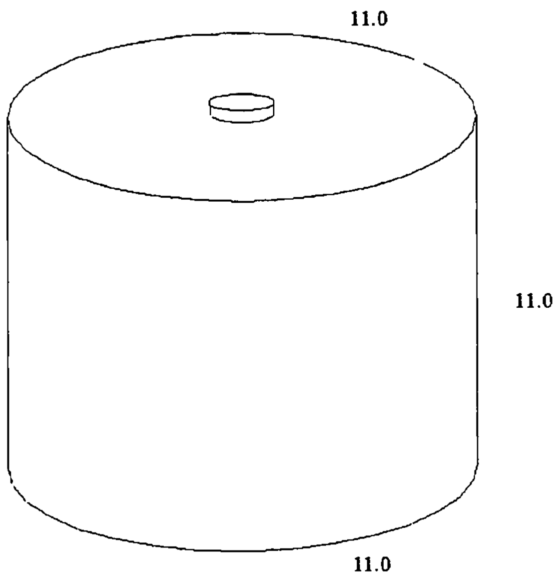

Figure 1 – Illustration of Carpet Fiber on Cone

PACKAGE PARAMETERS

Currently this product is shipped in a one-way expendable package. This package consists of a bottom tray with 4" sides made out of 200# kraft corrugated paperboard. Nine cones of fiber are placed on the tray in a 3 x 3 configuration. A 200# kraft corrugated layer pad is placed on the cones and nine more cones are placed on the layer pad. This is repeated until there are four layers of cones. On top of the fourth layer, a top tray with 4" sides made out of 200# kraft corrugated is placed on the cones. This entire "package" is then stretch wrapped with approximately two layers of 80 gauge linear low density polyethylene (LLDPE) applied with a 150 percent pre-stretch. (Figure 2)

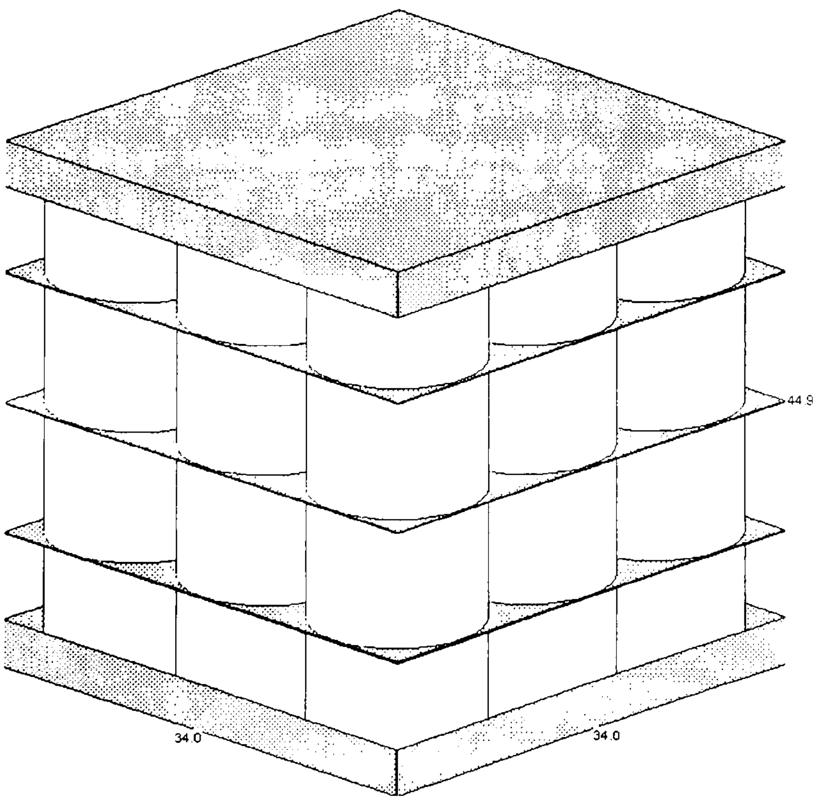

Figure 2 – Expendable Shipping Package for Fiber

DISTRIBUTION ENVIRONMENT

The outside dimensions of the unit load package are 34" x 34" x 45" The unit load is loaded onto a trailer by a clamp truck in a bundled unit format: no pallets are used. The bundled units are double stacked. A typical full truck load contains 72 units and carries between 30,000-34,000 pounds of material. The sales contract has a clause that states if the outbound weight is greater than 30,000 pounds, CAMAC will pay for the freight charges. If the outbound weight is less than 30,000 pounds, Masland must pay for the freight charges. This was put in place to ensure that Masland ordered in full truck load quantities whenever possible. Masland's procurement personnel will typically pull forward their forecasted requirements in order to fulfill this requirement.

All shipments are received by Masland at an off-site warehouse. The bundled units are unloaded by a clamp truck driver. They are then placed on pallets, logged into inventory, and placed in a warehouse location. Material is then sent in a "milkrun" format to the production receiving area in quantities sufficient to support the following eight hours of production.

MANUFACTURING PROCEDURE

Material requests are sent by the tufting machine operator to the production receiving area. Once the material arrives from the off-site warehouse, it is transported by forklift to the tufting machine area. It is received on a pallet in a bundled (stretch wrapped) unit of 36 cones. The assistant machine operator must then remove the stretch wrap and reload the cones into a "creel cart." The creel carts are large steel bins on wheels that resemble old fashioned coal mining carts.

The creel is a large frame that holds up to 160 cones of fiber at one time. It is made up of eight rows separated by narrow aisles. Only one half of the cones are being used at any one time. The other half of the cones are loaded so that the material can be spliced in so that production does not need to stop. Due to the delicate nature of the fiber material, and the size of the machine, space is very limited. The aisles between the creel rows are only 29-½" wide. The bundles of cones are too wide to fit through the creel aisles. That is why the cones must be reloaded into the creel carts. The carts were specially fabricated in house to fit between the creel rows. They are on wheels to help facilitate easier movement up and down the aisles. However, in order to minimize the number of trips made back to the bundles, the carts were made 40" tall (37" of bucket, 3" of wheels). This creates ergonomic problems due to the bending required and the awkward position encountered when lifting the bottom layer of cones. It is also an extremely inefficient use of time for the assistant operator to constantly have to reload the carts to refill the creel. Typically, the creel needs to be refilled once in an eight hour shift.

Once a unit load of product has been unloaded, assistant operators are responsible for clean-up. They place the stretch wrap and any miscellaneous refuse into a garbage can. The kraft corrugated is then stacked off to the side in a pile for pick-up by the groundskeeper. Finally, the pallets are stacked for pickup by the production receiving area lift truck driver. The operators are only allowed to manually stack them four pallets high to reduce any safety concerns. The pallets are then collected by the lift truck driver when the next load of material is brought out to the line. They are then sent back over to the off-site warehouse for reuse by the clamp truck driver when off loading trailer loads.

AREAS FOR CURRENT SYSTEM IMPROVEMENTS

The existing unit load package is shipped in a bundled format with no pallet. This creates an extra material handling step at Masland's offsite warehouse. One clamp truck driver must off load the material and place it on pallets to facilitate its movement through the rest of Masland's system. It would be beneficial to eliminate the need for this step and its corresponding labor cost in the receiving area.

The unit load package has an outside dimension of 34" x 34" x 45" Due to the width of this package, it must be reloaded at the creel into narrower carts to be loaded on the machine for production. It is believed that the assistant machine operator's time could be better utilized if this need for reloading was eliminated. There are also safety concerns over the poor ergonomics involved in the current creel cart loading and unloading. The reduction in loss time accidents due to creel loading injuries would be an additional tangible and intangible benefit.

Another issue with the current package is the quality of the cones when they reach the creel. Due to poor package protection, the cones incur damage to both the outer layer of fiber as well as the chip board core. The core is of particular concern because any nicks in the edge or deformation of the end of the core may cause the fiber to catch or break. This results in downtime on the machine while the operator restrings the creel. The cost of this downtime is expensive in both operator labor and machine time. Any efforts that could improve the quality of the fiber product and core were considered critical.

One more area for consideration is the amount of packaging material that needed to be disposed of from the bundled units. The total tare weight of the combined materials is 7.2 pounds. This is broken down as 6.2 pounds of kraft corrugated material and approximately one pound of stretch wrap and any miscellaneous refuse. It has been determined that material disposed of from the tufting area represented 75 percent of all material disposed of from Masland at this location. It requires one groundskeeping person in this area for approximately one hour per day just to collect this packaging material. The kraft corrugated layer pads and caps are sent to the bailer to be prepared for recycling. The stretch wrap and other materials are placed in solid waste disposal containers for pickup. Any reduction in the volume of packaging waste from the current bundled unit is considered a cost benefit for both groundskeeping labor and material disposal. There are also safety concerns in having the operators stack the pallets and kraft corrugated materials. Many minor injuries are a result of this action and could be avoided if this material were eliminated or reduced.

PROPOSED PACKAGING ALTERNATIVES

Several options have been suggested that would help address the areas of concern with the current expendable packaging. These include redesigning the package into a more user friendly expendable format, and redesigning the package into a returnable/reusable container. The option which seems to have the most merit proposes a system which would utilize a returnable/reusable container. However, before any of these options are put in place, it is believed that a comparative financial analysis must be conducted. This analysis would present quantified cost information for both container systems from which a conclusion as to which is more cost efficient can be made. Also, it is generally accepted that an economic study be done before any major project is undertaken.[19]

The returnable system proposed would consist of a bottom pallet molded out of high density polyethylene (HDPE) with an interlocking pocket design. A single sided plug separator would then be laid on the pallet. Six cones of product would be loaded onto the corresponding plug in a 2 x 3 configuration. A double sided plug separator would then be placed on top of the cones, and the next layer of six cones would be loaded. This is repeated until there are four layers of cones. A single sided plug separator would then be places on the top layer. A top pallet, identical to the bottom pallet, would be placed upside down over the top layer. The entire unit is then stretch wrapped with approximately two layers of 80 gauge LLDPE applied with a 150 percent pre-stretch. (Figure 3)

[19] Edmund A. Leonard, Managing the Packaging Side of the Business. (New York: AMACOM, 1977) p. 42.

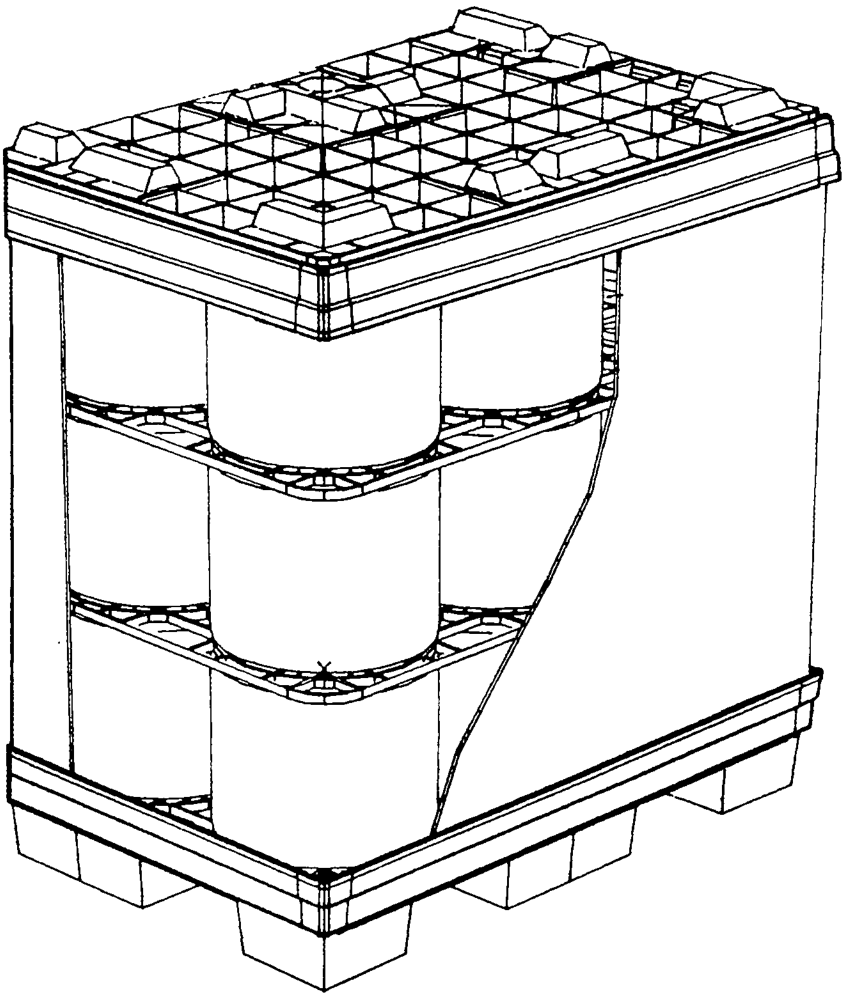

Figure 3 – Proposed New Returnable Package

There is some debate over which packaging system is more cost efficient. With an expendable packaging system, the greatest problem currently is the cost of disposal. This is regardless of whether it is solid waste disposal or recycling. With a returnable system the greatest problem is the return freight cost. The trade-off between these two items may be the largest deciding factor in which system is chosen.

CHAPTER 3 - RESEARCH METHODS

COST COMPONENTS FOR CONSIDERATION

There are six elements of packaging costs:

1. Development costs, which include design, models, cost estimating, and evaluating samples.
2. One time costs, which include tooling for production.
3. Material costs, which include cost of primary pack, transport of the packaging supplies, storage and handling, losses due to damage/pilferage, and inspection.
4. Packaging machinery, which involve service and maintenance, alone with utility costs.
5. Packaging process costs, which include direct and indirect labor, overhead expenses, and incidental materials.
6. Distribution costs, which include storage and warehousing of finished goods, transportation to the customer, and the cost of quality (protecting against, replacing, or loss of sales from, damaged goods).[3]

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[3] Edmund A. Leonard, Packaging: Specification, Purchasing, and Quality Control. (New York: M.Dekker, 1987) p. 24-25.

Three of these elements will be eliminated from consideration because it is believed that their effects on the outcome of this analysis are negligible. This is due to the inherent similarities of both systems. These elements are development, machinery, and one time costs. The three remaining elements, material, packaging process, and distribution costs, will be further broken down into individual cost steps and analyzed.

DISTRIBUTION SYSTEM STEPS WHICH GENERATE COST

LOCATION	STEP #	OPERATION
product manufacturer's premises	1	purchase packaging materials
	2	receive packaging materials
	3	place materials in storage
	expendable	
customer's premises	4	open shipping unit, remove product
	5	dispose of shipping unit
	returnable	
customer's premises	6	store empty shipping containers for return
	7	handle returns into storage area
	8	handle onto transport vehicle
	9	record, dispatch, and relate to deposits
	10	transport to manufacture's depot
product manufacturer's premises	11	examine, clean, rehabilitate and repair or dispose of container
	12-14	repeat steps 1-3 above, as required by losses

METHODOLOGY

The first step in analyzing a task of this scope is proper documentation of the current expendable packaging system. This documentation will include the item generating cost, the type of cost associated with it, and the method used to establish the actual cost figure.

1. Manufacturing of containers – material costs. Current expendable packaging is purchased by the supplier, CAMAC. This cost is rolled into the piece price they charge Masland per pound of material. This information was considered proprietary by the supplier and would not be provided. Therefore the package, as it arrived at Masland, was taken apart into its component pieces. Basic material specifications were then written and sent to Masland's suppliers for quotation.
2. Receipt of product at warehouse – labor costs. A time study will be done to determine the labor charges incurred due to the type of package used. The procedure documented by the time study is shown in Appendix A.
3. Internal requirements for reloading of product – labor costs. A time study will be done to determine the labor charges incurred due to the reloading of product from the shipping package to another container for use at the creel. The procedure documented by the time study is shown in Appendix A.
4. Disposal of containers – labor and disposal cost. The labor charges incurred from the collection and preparation of the packaging material for disposal will be determined. Also, the current disposal costs will be calculated by determining the average tonnage of packaging material currently being

disposed of. This will be done by taking the weight of the current container and multiplying it by the annual production volume of the product line. This figure will then be used with the cost per ton of both solid waste disposal, and recycling fees, to determine the total disposal cost.

The second step is proper documentation of the proposed returnable packaging system. This documentation will include the item generating cost, the type of cost associated with it, and the method used to establish the actual cost figure. Only items that are unique to the returnable system will be documented.

1. Manufacturing of containers – material costs. These figures will be obtained by competitively quoting the new packaging items through the Purchasing Department.
2. Unitization of containers for return shipment – labor costs. A time study will be done to determine the labor incurred due to the need to unitize the containers for return to the supplier location.
3. Transportation of returning containers – shipping costs. This will be determined by using the annual weight/volume of the containers shipped and applying it with the current negotiated contracts for less than truckload (LTL) shipments.

The third step in the process will be to document all of the intangible benefits and/or detriments to using either system. These items may include worker safety, good housekeeping, user friendliness of package, and employee perception towards their contribution in the solution. While most of these items are not "quantifiable", an attempt will be made to determine their impact on the possible implementation of a new packaging system.

Using all of the cost figure information, a decision matrix will be set up to help facilitate choosing a course of action. The output information will show which is the most economical method to package the fiber product.

CHAPTER 4 - DATA ANALYSIS

The data presentation and analysis will follow the order of documentation outlined in the methodology. The first item that will be quantified is the current expendable packaging. Follows is a listing of materials and estimated costs, based on Masland supplier quotes for comparable material.

TABLE 1 – Expendable Packaging Cost per Pound Product

Component	Est. Cost	Quantity	Total Cost
tray 200# kraft 34 x 34 x 4 *	$ 0.52	2	$ 1.04
layer pad 200# kraft 34 x 34 *	$0.41	3	$ 1.23
80 gauge stretch wrap	$ 0.30	1	$ 0.30
	Total Cost per Unit Load		$ 2.57
	Cost per Pound		$ 0.0065

*annual volume of 6000 pieces, release quantities of 500 pieces

It must be noted that the cost of packaging per pound of material is an estimate completed by Masland. It may vary slightly from the actual amount of packaging material cost shown in the piece price for this product. Therefore, it will not be used in the cost analysis for this project. However, its estimated impact will be included as an intangible benefit and shown as an add-on for the sake of comparison.

The second item that must be quantified are the direct labor costs in receiving incurred due to the type of package used. The current packaging does not arrive on a pallet and must therefore be palletized before it can be received into inventory. A time study documenting the necessary steps is presented in Appendix A. Labor costs for future years were calculated using projected hourly wages and forecasted amounts of incoming materials. The following labor costs are due to this receiving step.

TABLE 2 -- RECEIVING LABOR COSTS

year	lbs/year (K)	lbs/unit	units/year	time/unit (min.)	labor rate/hour	labor rate/minute	total cost
1995	2,491	396	6,290.4	1.875	$15.05	$0.251	$2,958.46
1996	4,225	396	10,669.2	1.875	$15.50	$0.258	$5,167.89
1997	8,559	396	21,613.6	1.875	$15.50	$0.258	$10,469.11
1998	8,785	396	22,184.3	1.875	$15.50	$0.258	$10,745.54
1999	8,785	396	22,184.3	1.875	$15.50	$0.258	$10,745.54

The third item that must be quantified is the direct labor costs in manufacturing – the tufting department – incurred due to the type of package used. The current packaging arrives in a unit load configuration that is too large to load directly onto the machine. Therefore it must be reloaded into a creel cart in order to be moved to the machine for loading. A time study documenting the necessary steps for reloading is presented in Appendix A. Labor costs for future years were calculated using projected hourly wages and forecasted amounts of incoming materials.

Also, there is a considerable amount of product damage that could be avoided by improving the packaging. This damage causes a sizable amount of downtime. All downtime due to product quality defects incurred because of packaging was documented. The following are labor costs for reloading and machine downtime.

TABLE 3 -- TUFTING LABOR COSTS

year	reload time (min./operator)	operators/ shift	shift/day	reloading hours/day	labor rate/hour	reloading cost/day	reloading cost/year	downtime /year (hrs.)	downtime cost/year	**total labor cost/year**
1995	50	2	3	5.0	$15.10	$75.50	$18,120.00	414.0	$6,251.40	$24,371.40
1996	50	4	3	10.0	$15.50	$155.00	$37,200.00	837.6	$12,982.80	$50,182.80
1997	50	5	3	12.5	$16.00	$200.00	$48,000.00	1097.6	$17,561.60	$65,561.60
1998	50	5	3	12.5	$16.00	$200.00	$48,000.00	1097.6	$17,561.60	$65,561.60
1999	50	5	3	12.5	$16.00	$200.00	$48,000.00	1097.6	$17,561.60	$65,561.60

The next item that must be quantified is the direct labor costs incurred in the building and grounds department due to the type of package used. The current packaging contains a large amount of corrugated board and a smaller quantity of stretch wrap that must be collected each day. Labor costs for future years were calculated using projected hourly wages and forecasted amounts of incoming materials. (Table 4)

It has also been noted that this packaging material represents 75 percent of all material disposed of from this plant. The number of container pulls and the annual cost for solid waste disposal has also been documented. The cost for future years has been projected using the forecasted amount of incoming material. However, future year cost was calculated using current price figures, even though it is firmly believed that disposal prices will continue to increase. (Table 5)

TABLE 4 -- GROUNDS LABOR COSTS

year	collection time (hour/day)	labor rate/hour	total time (hours)	total cost
1995	1	$14.36	240	$3,446.40
1996	2	$14.36	480	$6,892.80
1997	2.75	$14.36	660	$9,477.60
1998	2.75	$14.36	660	$9,477.60
1999	2.75	$14.36	660	$9,477.60

TABLE 5 -- SOLID WASTE DISPOSAL COST

YEAR / MONTH	CONTAINER PULLS	COST per MONTH	
93 January	5	$525.00	
93 February	4	$420.00	
93 March	3	$315.00	
93 April	5	$525.00	
93 May	7	$735.00	
93 June	6	$630.00	
93 July	6	$630.00	
93 August	6	$630.00	
93 September	7	$735.00	
93 October	7	$735.00	
93 November	5	$525.00	1993 Total:
93 December	3	$315.00	$6,720.00
94 January	6	$630.00	
94 February	5	$525.00	
94 March	6	$630.00	
94 April	6	$630.00	
94 May	7	$735.00	
94 June	6	$630.00	
94 July	6	$630.00	
94 August	9	$945.00	
94 September	6	$630.00	
94 October	10	$1,050.00	
94 November	9	$945.00	1994 Total:
94 December	8	$840.00	$8,820.00
95 January	10	$1,050.00	
95 February	7	$735.00	
95 March	8	$840.00	
95 April	9	$945.00	
95 May	8	$840.00	1995 YTD Total:
95 June	8	$840.00	$5,250.00
			1995 Projected: $10,500.00
	TOTAL COST	**$20,790.00**	

** It is believed that material received from the tufting department represents a minimum of 75% on average of this total cost

The next item that will be quantified is the proposed returnable packaging. Follows is a listing of materials and quoted costs.

TABLE 6 – Returnable Container Cost per Unit

Component	Piece Cost	Quantity	Total Cost
plastic trays *	$ 26.00	2	$ 52.00
single sided separator **	$ 11.70	2	$ 23.40
double sided separator	$ 12.40	3	$ 37.20
80 gauge stretch wrap	$ 1.25	1	$ 1.25
	Total Cost per Unit		**$ 113.85**

* tooling cost of $25,000 – to be amortized by tray supplier
** tooling cost of $56,000 – to be amortized by tray supplier

In order to establish the total number of containers that would need to be purchased for each year, cycle times needed to be established. Based on the manufacturing and shipping requirements, a number for the days of inventory of racks was determined. Then using this number, and the forecasted pounds of material that would be required for each year, the number of required containers per day was calculated. This was repeated for each year that would be included in the project analysis. The material forecast and the cycle time/rack requirements for each year through 1999 are shown in Tables 7 – 12.

TABLE 7 -- TUFTING MATERIAL FORECAST

		POUNDS/MODEL YEAR (000)				
PLATFORM	ANNUAL VOLUME	1993	1994	1995	1996	1997
A 1	579,000	2,236	2,281	2,281		
A 2	600,000				2,507	2,507
B 1	103,000		699			
	310,000			2,104	2,104	2,104
C 1	383,000			1,518	1,518	1,518
C 2	103,000	255	300			
	333,000			970	970	970
D 1	135,000		945	945	945	945
E 1	170,000			741	741	741
TOTAL		2,491	4,225	8,559	8,785	8,785

TABLE 8

Tufting Department

Returnable Container Analysis for 1995 — **Shipped from Bristol, VA**

A. Container Specifications:

	Length	Width	Height
Part Size:	11	11	11
Container Size:	36	24	51
Est. Container Weight:	55		
Standard Pack Qty:	24 cones		

B. Container Requirements:

1. **Days of inventory for containers:**

5	days @ CAMAC
1	days in transit
8	days @ Masland - Lear
1	day in process
1	days in transit
0	day safety stock
16	days total

Forecasted Volume: 2491000 lbs.

2. **Requirements:**

Standard Pack	Annual Volume	Containers Required Per Year	Daily Volume	Containers Required Per Day	# Days Inventory	Total Containers
24	226454.55	9435	943	39.3	16	628

C. Cost / Savings Calculations:

1. **Potential Expendable Packaging Savings:**

Stk No.	Desc.	Qty per Std. Pck	$$ ea	$$ per Std. Pck
99999	tray	2	$0.5200	$1.04
99998	layer pad	3	$0.4100	$1.23
99997	strch wrap	1	$0.3000	$0.30
	Total per std pck			$2.57

Pricing per vendor quote on investigational specs.

Total per piece $0.0065 US

Yearly Expendable Packaging Cost= $0.0065 /lbs * 2491000 lbs/yr = $16,191.50 $$/yr

2. **Proposed Returnable Container Cost:**

Container Cost:	$113.85
Total Cost per Container:	$113.85

Vendor Name: various

Capital Required = 628 containers * $113.85 / container = $71,497.80

3. **Return Freight Cost:**

Return Freight:	$400 per trip
Return Ratio:	1 to 1

From Carlisle,PA to Bristol,VA per Masland Transportation

Annual Freight = $400 per trip * (9435 cont./yr / 136 cont./trailer) = $27,741.18

D. Trailer Cube Requirements:

	Total	Length	Width	Height
Trailer size:		626	98	110
Container Size:		36	24	51
Containers/trailer:	136	17	4	2

Trailers per day = 39 containers/day / 136 containers/ trailer = 1

TABLE 9

Tufting Department

Returnable Container Analysis for 1996 — **Shipped from Bristol, VA**

A. Container Specifications:

	Length	Width	Height
Part Size:	11	11	11
Container Size:	36	24	51
Est. Container Weight:	55		
Standard Pack Qty:	24 cones		

B. Container Requirements:

1. Days of inventory for containers:

4 days @ CAMAC
1 days in transit
7 days @ Masland - Lear
1 day in process
1 days in transit
0 day safety stock
14 days total

Forecasted Volume: 4225000 lbs.

2. Requirements:

Standard Pack	Annual Volume	Containers Required Per Year	Daily Volume	Containers Required Per Day	# Days Inventory	Total Containers
24	384090.91	16003	1600	66.7	14	933

C. Cost / Savings Calculations:

1. Potential Expendable Packaging Savings:

Stk No.	Desc.	Qty per Std. Pck	$$ ea	$$ per Std. Pck
99999	tray	2	$0.5200	$1.04
99998	layer pad	3	$0.4100	$1.23
99997	strch wrap	1	$0.3000	$0.30
	Total per std pck			$2.57

Pricing per vendor quote on investigational specs.

Total per piece $0.0065 US

Yearly Expendable Packaging Cost = $0.0065 /lbs * 4225000 lbs/yr = $$/yr $27,462.50

2. Proposed Returnable Container Cost:

Container Cost: $113.85
Total Cost per Container: $113.85

Vendor Name: various

Capital Required = 305 containers * $113.85 / container = $34,724.25

3. Return Freight Cost:

Return Freight: $400 per trip — From Carlisle,PA to Bristol,VA per Masland Transportation
Return Ratio: 1.5 to 1

Annual Freight = $400 per trip * (16003 cont./yr / 204 cont./trailer) = $31,388.24

D. Trailer Cube Requirements:

	Total	Length	Width	Height
Trailer size:		626	98	110
Container Size:		36	24	51
Containers/trailer:	136	17	4	2

Trailers per day = 66 containers/day / 136 containers/ trailer = 1

TABLE 10

Tufting Department

Returnable Container Analysis for 1997

Shipped from Bristol, VA

A. Container Specifications:

	Length	Width	Height
Part Size:	11	11	11
Container Size:	36	24	51
Est. Container Weight:	55		
Standard Pack Qty:	24 cones		

B. Container Requirements:

1. Days of inventory for containers:

3 days @ CAMAC
1 days in transit
6 days @ Masland - Lear
1 day in process
1 days in transit
0 day safety stock
12 days total

Forecasted Volume: 8559000 lbs.

2. Requirements:

Standard Pack	Annual Volume	Containers Required Per Year	Daily Volume	Containers Required Per Day	# Days Inventory	Total Containers
24	778090.91	32420	3242	135.1	12	1621

C. Cost / Savings Calculations:

1. Potential Expendable Packaging Savings:

Stk No.	Desc.	Qty per Std. Pck	$$ ea	$$ per Std. Pck
99999	tray	2	$0.5200	$1.04
99998	layer pad	3	$0.4100	$1.23
99997	strch wrap	1	$0.3000	$0.30
	Total per std pck			$2.57

Pricing per vendor quote on investigational specs.

Total per piece $0.0065 US

Yearly Expendable Packaging Cost = $0.0065 /lbs * 8559000 lbs/yr = $$/yr $55,633.50

2. Proposed Returnable Container Cost:

Container Cost: $113.85
Total Cost per Container: $113.85

Vendor Name: various

Capital Required = 688 Containers * $113.85 / Container = $78,328.80

3. Return Freight Cost:

Return Freight: $400 per trip From Carlisle,PA to Bristol,VA per Masland Transportation
Return Ratio: 3 to 1

Annual Freight $400 per trip * (32420 cont./yr / 408 cont./trailer) = $31,788.24

D. Trailer Cube Requirements:

	Total	Length	Width	Height
Trailer size:		626	98	110
Container Size:		36	24	51
Containers/trailer:	136	17	4	2

Trailers per day = 135 containers/day / 136 containers/ trailer 1

TABLE 11

Tufting Department

Returnable Container Analysis for 1998 — **Shipped from Bristol, VA**

A. Container Specifications:

	Length	Width	Height
Part Size:	11	11	11
Container Size:	36	24	51
Est. Container Weight:	55		
Standard Pack Qty:	24 cones		

B. Container Requirements:

1. Days of inventory for containers:

3 days @ CAMAC
1 days in transit
6 days @ Masland - Lear
1 day in process
1 days in transit
0 day safety stock
12 days total

Forecasted Volume: 8785000 lbs.

2. Requirements:

Standard Pack	Annual Volume	Containers Required Per Year	Daily Volume	Containers Required Per Day	# Days Inventory	Total Containers
24	798636.36	33276	3327	138.6	12	1663

C. Cost / Savings Calculations:

1. Potential Expendable Packaging Savings:

Stk No.	Desc.	Qty per Std. Pck	$$ ea	$$ per Std. Pck
99999	tray	2	$0.5200	$1.04
99998	layer pad	3	$0.4100	$1.23
99997	strch wrap	1	$0.3000	$0.30
	Total per std pck			$2.57

Pricing per vendor quote on investigational specs.

Total per piece $0.0065 US

Yearly Expendable Packaging Cost = $0.0065 /lbs * 8785000 lbs/yr = $57,102.50 ($$/yr)

2. Proposed Returnable Container Cost:

Container Cost: $113.85
Total Cost per Container: $113.85

Vendor Name: various

Capital Required = 42 containers * $113.85 / container = $4,781.70

3. Return Freight Cost:

Return Freight: $400 per trip — From Carlisle,PA to Bristol,VA per Masland Transportation
Return Ratio: 3 to 1

Annual Freight = $400 per trip * (33276 cont./yr / 408 cont./trailer) = $32,611.76

D. Trailer Cube Requirements:

	Total	Length	Width	Height
Trailer size:		626	98	110
Container Size:		36	24	51
Containers/trailer:	136	17	4	2

Trailers per day = 138 containers/day / 136 containers/ trailer = 2

TABLE 12

Tufting Department

Returnable Container Analysis for 1999 **Shipped from Bristol, VA**

A. Container Specifications:

	Length	Width	Height
Part Size:	11	11	11
Container Size:	36	24	51
Est. Container Weight:	55		
Standard Pack Qty:	24 cones		

B. Container Requirements:

1. **Days of inventory for containers:**

3 days @ CAMAC
1 days in transit
6 days @ Masland - Lear
1 day in process
1 days in transit
0 day safety stock
12 days total

Forecasted Volume: 8785000 lbs.

2. **Requirements:**

Standard Pack	Annual Volume	Containers Required Per Year	Daily Volume	Containers Required Per Day	# Days Inventory	Total Containers
24	798636.36	33276	3327	138.6	12	1663

C. Cost / Savings Calculations:

1. **Potential Expendable Packaging Savings:**

Stk No.	Desc.	Qty per Std. Pck	$$ ea	$$ per Std. Pck
99999	tray	2	$0.5200	$1.04
99998	layer pad	3	$0.4100	$1.23
99997	strch wrap	1	$0.3000	$0.30
	Total per std pck			$2.57

Pricing per vendor quote on investigational specs.

Total per piece $0.0065 US

Yearly Expendable Packaging Cost= $0.0065 /lbs * 8785000 lbs/yr = $$/yr $57,102.50

2. **Proposed Returnable Container Cost:**

Container Cost: $113.85

Total Cost per Container: $113.85

Vendor Name: various

Capital Required = 0 containers * $113.85 / container $0.00

3. **Return Freight Cost:**

Return Freight: $400 per trip From Carlisle,PA to Bristol,VA per Masland Transportation

Return Ratio: 3 to 1

Annual Freight = $400 per trip * (33276 cont./yr / 408 cont./trailer) $32,611.76

D. Trailer Cube Requirements:

	Total	Length	Width	Height
Trailer size:		626	98	110
Container Size:		36	24	51
Containers/trailer:	136	17	4	2

Trailers per day = 138 containers/day / 136 containers/ trailer = 2

Another item that must be quantified is the direct labor costs associated with the unitization and loading for return shipment of the returnable containers. It is believed that the labor involved in moving the containers from the manufacturing area to the off-site warehouse would be equal to the current labor used in moving the pallets. Therefore it was not included in the labor calculation. A time study documenting the necessary steps to load the containers onto a trailer is presented in Appendix A. Labor costs for future years were calculated using projected hourly wages and forecasted amounts of trailers required for return shipments. (Table 13)

TABLE 13 -- SHIPPING LABOR COSTS

year	return ratio	containers/ trailer	trailer/year	time/trailer (min.)	labor rate/hour	labor rate/minute	total cost
1995	1:1	136	69.4	26	$15.10	$0.252	$1,804.40
1996	1.5:1	204	78.5	37	$15.50	$0.258	$2,904.50
1997	3:1	408	79.5	71	$15.50	$0.258	$5,644.50
1998	3:1	408	81.5	71	$15.50	$0.258	$5,786.50
1999	3:1	408	81.5	71	$15.50	$0.258	$5,786.50

The Transportation Department at Masland determined that the price for a dedicated return trailer load from Masland in Carlisle, Pennsylvania to CAMAC in Bristol, Virginia is $400.00 per trailer. This figure will be used for all subsequent years included in this analysis. It is believed though that this rate may drop if the Transportation Department were able to negotiate rates using accurate volumes of guaranteed backhaul shipments.

The transportation cost of returning the containers is calculated for each year as follows:

TABLE 14 – Return Freight Cost

trailers/year = (240 days/yr ÷ (136 racks/trailer ÷ required racks/day)) ÷ return ratio

annual cost = $ 400.00 x number of trailers/year

Year	Return Freight Cost
1995	$ 27,741.18
1996	$ 31,388.24
1997	$ 31,788.24
1998	$ 32,611.76
1999	$ 32,611.76

Safety concerns were raised because of the poor ergonomics involved in the loading and unloading of the creel carts. There have also been accidents involving the movement and stacking of wooden pallets in the manufacturing area. All recordable accidents involving either of these areas was documented for the previous three years. A time study for recordable accidents is on file at Masland for plant tracking purposes. It is divided into three areas: first aid administered by immediate supervisor, first aid administered by plant nurse, OSHA recordable incident. This time study is presented in Appendix A. The costs associated with these accidents are considered intangible and are not included in the project analysis. However, they are presented in Appendix B for the sake of documentation.

All of the applicable items of cost were then put into the decision matrix. It was determined that the cost analysis would be completed using a five year period of time. This length was chosen based on the recommended life span of the returnable containers. The matrix then calculated both the annualized savings for each year, and the cumulative savings throughout the period of analysis. These figures are shown in Table 15.

A second matrix was also constructed to include the packaging material savings. This was merely done to illustrate the potential of the program if CAMAC were to offer a piece price reduction on the fiber material. (Table 16)

TABLE 15 -- TOTAL PROJECT COST / SAVINGS

event	1995	1996	1997	1998	1999
tufting labor	$18,120.00	$37,200.00	$48,000.00	$48,000.00	$48,000.00
receiving labor	$2,958.46	$5,167.89	$10,469.11	$10,745.54	$10,745.54
grounds labor	$3,446.40	$6,892.80	$9,477.60	$9,477.60	$9,477.60
machine down time	$6,251.40	$12,982.80	$17,561.60	$17,561.60	$17,561.60
recycling avoid.	$2,616.00	$5,292.84	$6,935.44	$6,935.44	$6,935.44
solid waste avoid.	$7,875.00	$15,933.14	$20,877.91	$20,877.91	$20,877.91
total savings	$41,267.26	$83,469.47	$113,321.66	$113,598.09	$113,598.09
container cost	$71,497.80	$34,724.25	$78,328.80	$4,781.70	$0.00
shipping labor	$1,804.40	$2,904.50	$5,644.50	$5,786.50	$5,786.50
return freight	$27,741.18	$31,388.24	$31,788.24	$32,611.76	$32,611.76
return trailer/year	69.4	78.5	79.5	81.5	81.5
annual savings	($59,776.12)	$14,452.48	($2,439.88)	$70,418.13	$75,199.83
cumulative savings	($59,776.12)	($45,323.63)	($47,763.51)	$22,654.62	$97,854.44

TABLE 16 -- TOTAL PROJECT COST / SAVINGS WITH PIECE PRICE REDUCTION

event	1995	1996	1997	1998	1999
tufting labor	$18,120.00	$37,200.00	$48,000.00	$48,000.00	$48,000.00
receiving labor	$2,958.46	$5,167.89	$10,469.11	$10,745.54	$10,745.54
grounds labor	$3,446.40	$6,892.80	$9,477.60	$9,477.60	$9,477.60
machine down time	$6,251.40	$12,982.80	$17,561.60	$17,561.60	$17,561.60
recycling avoid.	$2,616.00	$5,292.84	$6,935.44	$6,935.44	$6,935.44
solid waste avoid.	$7,875.00	$15,933.14	$20,877.91	$20,877.91	$20,877.91
piece price reduction	$16,191.50	$27,462.50	$55,633.50	$57 102.50	$57,102.50
total savings	$57,458.76	$110,931.97	$168,955.16	$170,700.59	$170,700.59
container cost	$71,497.80	$34,724.25	$78,328.80	$4,781.70	$0.00
shipping labor	$1,804.40	$2,904.50	$5,644.50	$5,786.50	$5,786.50
return freight	$27,741.18	$31,388.24	$31,788.24	$32,611.76	$32,611.76
return trailer/year	69.4	78.5	79.5	81.5	81.5
annual savings	($43,584.62)	$41,914.98	$53,193.62	$127,520.63	$132,302.33
cumulative savings	($43,584.62)	($1,669.63)	$51,523.99	$179,044.62	$311,346.94

One of the more traditional methods for making capital budget decisions is the "payback period" This is the amount of time necessary to break even on the initial capital investment. In order to calculate this, the figure for container investment must be totaled as though all containers were purchased at the beginning of the analysis time frame. Then using the annual savings, a break even time is calculated. The total container investment for the five year period is $189,332.55. When this is put into the equation, the payback period for the project is 3.70 years. If the piece price reduction is included the payback period is 2.64 years.

It was believed that this type of financial analysis did not accurately reflect the viability of implementing the system. That is because calculating a payback period assumes that the entire capital outlay is made at the beginning of the project. In this case that assumption would not be appropriate, because the capital investment would be spread out over several years.

Another method for making capital budget decisions is using "Net Present Value" This is the measure of the absolute value of an investment in terms of today's dollars. If the NPV result is positive, it is a profitable project. It will generate a cash flow that recovers the initial investment and the opportunity cost of not being able to use the funds for other projects.[21] This calculation is:

$$NPV = \frac{\sum CF_T}{(1+R)^T} - \text{Investment}$$

CF – the net savings for each period (T)
R – the discount rate

[21] Mike Mazzeo, "Evaluating Returnable Packaging Investments: Why We Love NPV," Paper presented at the Current Issues in Returnable Packaging Seminar, Michigan State University, September 1996.

Using a discount rate of 10 percent, a time period of 1 through 5 years, and an investment of $189,332.55, the NPV for this project is $17,037.59. When the piece price reduction is included, the NPV is $170,709.62.

While using NPV is a more comprehensive method of financial analysis than the traditional payback period, it was believed that it also did not accurately reflect the feasibility of implementing the system. That is because calculating Net Present Value also assumes that the entire capital outlay is made at the beginning of the project. In this case that assumption would not be appropriate, because the capital investment would be spread out over several years. Since the capital is spread out, the discount rate for funds would change throughout the life cycle of the project. This change cannot be accounted for in the calculation.

CHAPTER 5 - DISCUSSION AND CONCLUSION

CONCLUSION

Several methods of analysis were shown. Regardless of the method used, implementation of a returnable container system for the fiber product appears to be a financially viable decision.

One of the key contributors to the potential success of this system is the fact that a closed loop distribution system exists between CAMAC and Masland. This allows for a more economical return of the containers due to the utilization of the inbound trailers for the return shipment. It also minimizes the need for any tracking system for the containers. This function will become inherent to the system through the use of shipping records and Bills of Lading. This allows for the avoidance of any additional cost to meet this requirement.

Another contributor to the systems potential success is the relatively short distance between the supplier and manufacturer. This allows for a predictable cycle time between shipments. A predictable cycle time is critical in establishing the number of containers needed to support the distribution channel and manufacturing requirements. In turn, accurately predicting the number of containers needed is essential to determining the amount of capital required to implement the system. The capital requirement is often the critical factor in determining if a returnable system is feasible. Also, any reductions in the cycle time during the life of the project would directly benefit the speed of recovering the capital investment.

This container system would also greatly reduce the direct labor required to load the creel. Since the unit load is narrow enough to fit between the creel rows it would no longer be necessary to reload the cones into a cart. A movable base unit would be constructed to allow rolling movement of the unit load. The cones could then be loaded directly from the unit load onto the creel. This would improve the ergonomics involved in the assistant machine operator's job. In turn, it is believed that this would reduce the number of recordable accidents, and their associated cost. It would also improve operator morale and offer the potential for higher productivity.

The proposed returnable container system would also help eliminate any product damage due to poor packaging. The sturdier nature of the container will help protect the product better through the distribution environment. Also, the design of the separators used between the layers of cones should eliminate any problems due to core damage of the cones. This will also help to eliminate down time on the machine and the associated labor cost due to poor product quality.

Usage of the returnable system would allow for the source reduction of 6.2 pounds of corrugated per unit load. This eliminates the tipping fees and disposal costs incurred to recycle the material. It also helps to lessen the environmental impact of materials disposed of from Masland. This allows Masland to rightfully promote itself to both customers and community as an environmentally conscientious corporation. Further, reduction of packaging waste saves in labor costs to collect and dispose of the material. It also creates a neater production area and improved housekeeping.

RECOMMENDATIONS FOR FUTURE STUDY

Returnable containers have been in use for forty years, however information about their use has mostly been published within the last ten years. Industry magazine articles, which account for much of this published information, are merely examples of returnable containers in use at various companies, or information regarding the containers themselves. Almost none of the literature outlines the parameters involved or the analysis needed to determine if implementation of returnable containers is appropriate. This thesis has attempted to document all parameters involved, determine which parameters are applicable to this specific project, and outline the financial analysis needed to make a capital budget decision.

A majority of the users of returnable container systems are in the automotive industry. These containers have made an impact within the industry as a means for both improving product quality and controlling costs. There are many reasons for the predominance of use within this industry. One is the continued upper management support for returnable containers. Management has recognized the potential benefits of reduced material costs, ergonomic improvements, and source reduction savings. Also, the high production volumes within the industry lend themselves to establishing quicker pay back of capital investments. This makes implementation of returnable systems much more cost effective. In addition, many automotive suppliers have positioned themselves in geographically favorable areas relative to their customers. This increases the chances that a closed-loop distribution system can be put in place. It also allows for minimum cycle times to be established. These are both critical factors in the success of a returnable system.

It is believed that usage of returnable/reusable containers will continue to increase. As the long term benefits are documented, their usage will continue to spread into other industries. Additional studies should be conducted to determine if other cost parameters are involved and can be cross-referenced by industry. Also, any research which could document financially viable methods to implement returnable systems in a non-closed-loop distribution environment would be critical to their continued expansion and usage. Finally, work should be completed to develop a computer program which could handle all potential combinations of cost parameters. The program should then correspondingly utilize the most appropriate method of capital budgeting analysis. This would prove to be an invaluable asset to the field of returnable/reusable packaging.

APPENDIX A

TIME STUDY FOR RECEIVING LABOR COST

Action	Time (min.)	Rate ($/hr.)
stock handler opens seal and trailer	1.0	$15.10
fork lift driver retrieves and lays out 8 empty pallets	6.0	$15.10
clamp truck driver retrieves 4 stretch bundles (2x2 stack) from trailer and places on empty pallet	1.0	$15.10
clamp truck driver takes top 2 bundles and places on next pallet	0.5	$15.10
fork lift driver stacks one pallet full on second pallet full and takes to an empty locations	0.5	$15.10
procedure steps 3-5 repeated 3 times	6.0	$15.10
Time per Driver	15.0	
TOTAL for 16 units	30.0	$7.55

TIME STUDY FOR TUFTING RELOADING LABOR COST

Action	Time (min.)	Rate ($/hr.)
stretch wrap and corrugated cap removed from pallet	3.0	$15.10
top layer of cones loaded into cart	4.0	$15.10
layer pad removed	0.25	$15.10
steps 2-3 repeated 3 times	12.75	$15.10
pallet and corrugated stacked off line	5.0	$15.10
procedure steps 1-5 repeated	25.0	$15.10
TOTAL per operator	50.0	$12.58

TIME STUDY FOR SHIPPING LABOR COST

Action	Time (min.)	Rate ($/hr.)
stock handler opens dock door	1.0	$15.10
fork lift driver retrieves stack of 6 containers from staging and loads onto trailer	1.0	$15.10
procedure step 2 repeated 22 times	22.0	$15.10
dock closed, paperwork generated	2.0	$15.10
Time per Driver	26.0	
TOTAL for 135 units	26.0	$7.55

TIME STUDY FOR RECORDABLE ACCIDENT COST

MINOR ACCIDENT - SUPERVISOR:

Action	Time (min.)	Rate ($/hr.)
accident occurs	0.5	$15.10
victim stops working	2.0	$15.10
witness stops working	2.0	$15.10
supervisor is notified		
victim time	2.0	$15.10
witness time	2.0	$15.10
supervisor time	2.0	$18.00
first aid supplies obtained		
victim time	5.0	$15.10
supervisor time	5.0	$18.00
½ time – wound treated		
victim time	5.0	$15.10
supervisor time	5.0	$18.00
accident investigated		
victim time	10.0	$15.10
witness time	10.0	$15.10
supervisor time	10.0	$18.00
victim returned to work station	5.0	$15.10
Victim Total	29.5	$7.42
Witness Total	14.5	$3.65
Supervisor Total	22.0	$6.60
ACCIDENT COST		**$17.67**

TIME STUDY FOR RECORDABLE ACCIDENT COST

MINOR ACCIDENT - NURSE:

Action	Time (min.)	Rate ($/hr.)
accident occurs	0.5	$15.10
victim stops working	2.0	$15.10
witness stops working	2.0	$15.10
supervisor is notified		
victim time	2.0	$15.10
witness time	2.0	$15.10
supervisor time	2.0	$18.00
½ time – victim sent to health center		
victim walks to center	5.0	$15.10
witness walks to center	5.0	$15.10
victim's time to see nurse	5.0	$15.10
nurse's time to see victim	5.0	$18.00
witness returned to work station	5.0	$15.10
accident investigated		
victim time	10.0	$15.10
supervisor time	5.0	$18.00
nurse time	10.0	$18.00
paperwork completed		
nurse time	15.0	$18.00
victim returned to work station	5.0	$15.10
case entered on computer	2.0	$18.00

Victim Total	34.5	$8.68
Witness Total	14.5	$3.65
Supervisor Total	7.0	$2.10
Nurse Total	32.0	$9.60
ACCIDENT COST		**$24.03**

TIME STUDY FOR RECORDABLE ACCIDENT COST

MAJOR ACCIDENT - OSHA RECORDABLE:

Action	Time (min.)	Rate ($/hr.)
accident occurs	0.5	$15.10
victim stops working	2.0	$15.10
witness stops working	2.0	$15.10
supervisor is notified		
victim time	2.0	$15.10
witness time	2.0	$15.10
supervisor time	2.0	$18.00
½ time – victim sent to health center		
victim walks to center	5.0	$15.10
witness walks to center	5.0	$15.10
victim's time to see nurse	5.0	$15.10
nurse's time to see victim	5.0	$18.00
witness returned to work station	5.0	$15.10
accident investigated		
victim time	10.0	$15.10
supervisor time	5.0	$18.00
nurse time	10.0	$18.00
paperwork completed		
nurse time	15.0	$18.00
victim returned to work station	5.0	$15.10
case entered on computer (nurse)	2.0	$18.00
insurance form typed and sent (nurse)	10.0	$18.00
Victim Total	34.5	$8.68
Witness Total	14.5	$3.65
Supervisor Total	7.0	$2.10
Nurse Total	42.0	$12.60
ACCIDENT COST		**$27.03**
		plus supplies & medical costs

APPENDIX B

RECORDABLE ACCIDENT COSTS

NAME	DATE	INJURY TYPE	COST
RUSSELL, P L	1/9/92	minor / supervisor	$17.67
FAHNESTOCK, R E	1/17/92	OSHA recordable	$101.20
WERT S J	3/16/92	minor / supervisor	$17.67
HOSTETTER, R L	4/9/92	minor / nurse	$24.03
WRIGHT, K L	4/22/92	minor / supervisor	$17.67
KEIM, W J	5/8/92	minor / supervisor	$17.67
SCHWENK, D V	7/16/92	minor / nurse	$24.03
KEIM, W J	7/17/92	minor / supervisor	$17.67
FRAKER, W	8/13/92	minor / supervisor	$17.67
PINE, D R	9/22/92	minor / nurse	$24.03
SHULER, TJ	9/24/92	minor / supervisor	$17.67
GARDNER S L	10/5/92	minor / supervisor	$17.67
KEEFAUVER, C K	10/15/92	minor / nurse	$24.03
KEEFAUVER, C K	10/29/92	minor / supervisor	$17.67
MARTIN, R E	11/2/92	minor / supervisor	$17.67
DRISCOLL, N L	12/3/92	minor / nurse	$24.03
PENNABAKER, F M	12/6/92	minor / supervisor	$17.67
STARRY, L F	12/7/92	minor / supervisor	$17.67
BLOSSER, E A	12/14/92	minor / nurse	$24.03
KEEFAUVER, C K	1/17/93	OSHA recordable	$135.20
SCHWENK, D V	1/29/93	minor / supervisor	$17.67
SHULER, TJ	3/6/93	minor / supervisor	$17.67
PRESSLER, E P	3/6/93	minor / nurse	$24.03
HOSTETTER, D J	3/13/93	minor / supervisor	$17.67
SWAB, C F	3/15/93	minor / supervisor	$17.67
SCHLUSSER, R E	3/18/93	minor / nurse	$24.03
SCHWENK, D V	4/11/93	minor / supervisor	$17.67
CONRAD, J A	5/16/93	minor / supervisor	$17.67
DOWNIN, E P	5/24/93	minor / nurse	$24.03
DOWNIN, E P	6/7/93	minor / supervisor	$17.67
CONRAD, J A	6/19/93	OSHA recordable	$110.20
WHISLER, C P	5/27/93	OSHA recordable	$88.20
SMITZ, W R	7/29/93	OSHA recordable	$76.20
WILSON, L J	9/3/93	minor / supervisor	$17.67
CASSELL, L K	10/10/93	minor / nurse	$24.03
GARDNER S L	10/6/93	minor / supervisor	$17.67
SHERIFF, L D	10/22/93	minor / supervisor	$17.67
REED, D A	10/24/93	minor / nurse	$24.03
CONRAD, J A	12/12/93	minor / supervisor	$17.67
GARDNER S L	1/15/94	minor / supervisor	$17.67
SCHLUSSER, R E	3/3/94	minor / nurse	$24.03
TRITT, L K	3/5/94	minor / supervisor	$17.67
LEE, S N	4/13/94	minor / supervisor	$17.67
SEIBERT, T	4/19/95	minor / nurse	$24.03
		TOTAL COST	**$1,282.81**

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