This is to certify that the

Masters

thesis entitled

Returnable/Reusable Containers In The Automotive Industry And The Related Capital Budgeting Investment Decision

presented by

WENDEE VALENTINE UXA

has been accepted towards fulfillment of the requirements for

Masters degree in Packaging

Diana Twede

Major professor

Date June 28, 1994

RETURNABLE/REUSABLE CONTAINERS IN THE AUTOMOTIVE INDUSTRY AND THE RELATED CAPITAL BUDGETING INVESTMENT DECISION

By

Wendee Valentine Uxa

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

School of Packaging

1994

ABSTRACT

RETURNABLE/REUSABLE CONTAINERS IN THE AUTOMOTIVE INDUSTRY AND THE RELATED CAPITAL BUDGETING INVESTMENT DECISION

By

Wendee Valentine Uxa

Returnable container distribution systems offer significant potential cost savings over traditional single use packaging systems, but they require a large initial investment. Returnable/reusable systems can provide a reduction in material costs, utilization of full cube in trailers and reduction in disposal costs.

The goal of this research is to explore returnable container distribution systems and to determine how the related packaging investment decisions are made. A case study analysis of ten leading automotive assembly companies was used in order to understand factors that influence such decisions.

Three distinct types of automotive returnable systems were revealed depending on the method used for cost justification, ownership of the containers and percentage of returnable container use. All ten companies studied report financial gains from returnable container systems and plan to increase their usage. Two of the companies reported a decrease in overall transportation costs even with the addition of return freight expense.

ACKNOWLEDGMENTS

My sincere and heartfelt appreciation to Dan, my parents, my entire family and dear friends, for their love, support and encouragement. All of you are what make my efforts worthwhile.

I also thank the members of my graduate committee, Michael Mazzeo, Paul Singh and especially Diana Twede. Your support and guidance have meant a great deal to me.

This research would not have been possible without the contributions of those who participated in the case studies. I thank Peggy Bradley, Steven Buchholz, John Butler, Art Davis, Ed Dunkerley, James Frisbee, Michael Kennedy, Michael Langlois, Jim Lesch, David McCulloch, James Pajot, and Mark Raney. Your time and your insight are much appreciated.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Nearly every industry operation is involved in a continuous effort to reduce costs and improve profit margins. A potential area for significant cost reduction exists in the adoption of returnable containers. Returnable container systems can reduce material costs, improve utilization of full cube on trailers and reduce disposal costs. In returnable containers systems specially designed, multiple trip packages are used in place of traditional one trip, expendable containers which are primarily made of corrugated fiberboard. Some of the less tangible benefits of a returnable container system include, improved product protection, improved plant housekeeping and better ergonomics.

There are many types of returnable/reusable containers, including, plastic and steel bins, modular container systems, collapsible plastic or steel racks, corrugated fiberboard and plastic sleeve packs, plastic trays and plastic totes. This research will focus primarily on the fast growing use of plastic returnable container systems in the automotive industry.

Automotive companies and their suppliers have been using returnable steel racks for decades, primarily for shipping large bulky items. But metal racks are heavy, non collapsible, and often poorly utilize truck cube. Plastics allow for lightweight and flexible sizes and dimensions. They are also designed to utilize trailer cube space efficiently. This helps to reduce the total number of truck shipments to an assembly plant (Lyman 1988, 197).

Frequent deliveries and smaller inventories due to Just - In - Time delivery systems have led assembly companies and suppliers to expand returnable container use to nearly every type of component. The automotive industry is currently the largest single user of returnable containers.

The container investment for a single modular bin with a five year use life may be several hundred dollars, versus a few dollars for a one time use corrugated fiberboard container. It is easy to see that initial container expense for an entire distribution system can be millions of dollars.

Therefore, returnable distribution containers should be considered a corporate asset rather than an expensed item. Thinking of packaging as a long term asset is a new idea for most material handling professionals, since packaging has always been considered an expense.

Returnable container investment decisions require a different approach. Returnable/reusable containers are sturdy, multiple use packaging often specific to the product and the needs of the particular distribution environment. "Implementation requires planning, adequate justification, management approval and backing, coordination between producer and customer and appropriate follow up" (Tomey 1984, 9).

An evaluation of distribution system costs should be done to compare expendable container costs with returnable container costs and benefits. Use of a sophisticated, reliable financial evaluation method is very important. It allows for the most profitable container selection. It also makes it more likely that actual investment results reflect the predicted results. Major purchase investment decisions are best when they are based on an accurate predictions.

The "Payback Period" method is often the only evaluation technique used to evaluate a returnable container purchase decisions. This is usually because material handling managers are unfamiliar with other capital budgeting techniques. But Payback Period is an unsophisticated method of financial evaluation. It does not consider the time value of money and it ignores all cash flows after the payback period.

Net Present Value is not difficult to calculate and it offers more reliable results than the Payback method. Net Present Value sums the cash flows over the life of the project and discounts them by the current cost of capital. The result is a measure of the absolute value of an investment in terms of today's dollar value. Another advantage of the Net Present Value technique is that comparing different investment projects is accurate and reliable. These, and other capital budgeting techniques are described in this research.

The goal of this research is to explore returnable container distribution systems and to determine how the packaging investment decisions are made. A case study analysis of leading automotive assembly companies was used in order to understand the many factors that influence such decisions. Some of the basic research questions are: 1) What type of returnable container system is being used? 2) To what extent are returnable containers being used? 3) What is the percentage use of plastic returnables? 4) When was the system implemented? 5) How was the returnable container system decision made? 6) What factors contributed most to the decision process? 7) What capital budgeting method(s) were used? 8) What were the financial results of implementing a returnable container distribution system. 9) What were the other results? 10) What are the future trends in returnable container systems?

Individual case results will be used to gain an overall understanding of how returnable container systems contribute to the firms's profitability. An attempt will be made to determine which variables generate the most savings, and those that pose the greatest problems. Furthermore, the capital budgeting methods used by each firm will be related to overall decision results including profitability of the container system.

LITERATURE REVIEW

General Background

For decades, the words, "distribution package" and "corrugated fiberboard shipping container" have virtually been synonymous. Little thought went into the type of distribution package to use, only the size and shape of corrugated fiberboard box that would be best.

Primarily, the regulations of transportation trade associations, including, The American Trucking Association and the Association of American Railroads long ago established guidelines for the distribution packaging they were willing to transport.

"The effect has been to create a virtual monopoly in the distribution packaging industry for corrugated shipping container suppliers. The railroads' Rule 41 and the truckers' equivalent Item 222 precisely limit the properties of the corrugated board" (Twede 1988, 87).

Before corrugated fiberboard was widely used, common carriers dictated what packaging material could be used. In the early 1900's, railroads eastbound from California required wooden crates for all shipments, and embargoed corrugated boxes. Corrugated use was discouraged because it was not as profitable. It used less of the railroad-owned forest and forest products (Boxboard Containers 1950, 52).

A 1912 lawsuit, by a corrugated fiberboard manufacturer, against the Southern Pacific Railroad, brought about more widespread use of corrugated fiberboard. The court decision required equal rates for corrugated and wood containers, as long as the corrugated board conformed to certain fabrication guidelines. These guidelines are the basis of today's Item 222 requirement of bursting strength and basis weight stamped on virtually every corrugated package.

Transportation Deregulation

Major transportation deregulation in the 1980's set the stage for many changes in the transportation industry, including the advancement of returnable containers. One of the most important things deregulation permitted was the development of a logistical environment suitable for just-in-time delivery systems. The Motor Carrier Act of 1980 and the Staggers Rail Act of 1980 increased competition and allowed carriers to negotiate for rates and services provided. Prior to the passage of the Motor Carrier Act, the Interstate Commerce Commission decided who could be a trucker, what a trucker could haul, where it could be hauled, and at what prices. These restrictions kept trucking firms from competing with each other and fostered inefficiencies and unreliability of service (Clouse 1990, 7).

Due to deregulation, price controls were lifted and carriers were allowed to set prices that accurately reflected the actual cost of providing services. Shippers have become oriented toward a total, integrated logistics operations, rather than simply purchasing transportation alone. These services include inventory management, handling and warehousing.

Just - In - Time Delivery Systems

The objective of Just - in - Time (JIT) delivery is to purchase the required items in very small quantities just in time for consumption.

Just-in-time systems require co-operation between carrier, shipper and consignee. "When larger volumes are given to only a few carriers, it provides incentives for the carriers to deliver better service and to understand the needs of the shipper" (Clouse 1990, 8). This partnership relationship makes both sides more flexible and open to changes that may benefit both parties.

JIT systems also brought about more dedicated route shipments. When the supplier and manufacturer or user are within a relatively close distance, the carrier can have trucks dedicated exclusively to the JIT shipment. Depending on the volume, delivery can be daily, or in some cases every few hours. For example, Lear Seating is now supplying a General Motors Corporation plant with seats within three hours of receiving the production order. The Suburban and Blazer seats are loaded and delivered according to computer transmissions of which seat types and colors are required for production. This synchronized delivery concept further eliminates the need for either party to keep costly stores of inventory (Gould 1993, 41).

Just-in-time, and the changes brought with 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.

Returnable Container Use in the Automotive Industry

The automotive industry has been using returnable steel racks as shipping containers since before 1950. These original racks were owned by the railroads and were required to stay inside the railcars. Therefore they were returned in dedicated railcars. In the mid 1950's General Motors began using their own steel racks for rail shipments. These mobile racks protected the parts from transit damage, dramatically reduced loading and unloading labor time and allowed for much better stackability of parts. They also allowed better space utilization within railcars (Cassaroll 1988, 4).

The racks were designed to accommodate many different types of parts, rather than being part specific. Many similar racks are still being used today. Primarily they are used for large bulky items such as sheet metal stampings (hoods, doors, etc.).

In the early 1980's auto companies began looking at returnable shipping containers for smaller parts shipped by truck. As discussed earlier, frequent JIT shipments and minimal inventories made this an attractive possibility. Lightweight plastic containers have many benefits over expendable corrugated boxes. The principal benefits are savings in packaging purchase costs and disposal costs.

One Chrysler assembly plant was able to reduce annual corrugated fiberboard box purchase costs by $10 million. They did this by switching to returnable containers in 1985 (Pashall 1986, 76). Their returnable system uses collapsible bins and racks in both steel and plastic. They also use modular plastic containers. The containers and dunnage are sent from the assembly plant to a central accumulation area where they are cleaned and sent back to the correct vendor (Pashall 1986, 4).

General Motor's Saturn plant in Spring Hill, Tennessee was designed with a concept of 100% returnable containers. Components remain in the containers and move directly from staging to the assembly line. The assembly location should have only enough containers to support the number of vehicles produced in one hour. "In the area where workers install seat belts, reusable containers have shortened the total assembly line length by nearly 50 feet. Reusables also reduced the space usually dedicated to handling disposable containers, packaging and trash" (Material Handling Engineering 1993, 72).

Toyota Motor Manufacturing's Georgetown, KY assembly plant will save $3.6 million annually on transportation costs associated with Camry production, due to a returnable container system. Over 91% of parts are received in returnable containers. Modular stackable plastic totes are used for maximum cube utilization. Toyota was able to increase shipping space efficiency by 21%. Dedicated route carriers make deliveries from suppliers up to 16 times per day. For each shipment picked up by a supplier, a load of empty containers is returned to the source. Dunnage (internal packaging) is left inside the return container for re-use (Transportation and Distribution 1992, 11).

Currently, according to its Packaging Manual, Toyota Motor Manufacturing allows the use of expendable shipping containers only if it is unavoidable (1993, 2). The Packaging Manual, provides supplier guidelines and specifications for development of successful returnable packaging programs. The concept statement also states that with a returnable system, Toyota is able to plan consistent transportation routes, reduce material handling, and reduce costs associated with assembly and disposal of expendable packaging (1993, 3).

Other Industries Using Returnable Containers

The Auto industry is currently the largest user of returnable containers, but many others are taking advantage of their benefits. Returnable container systems can save money in transportation and material handling. They have also been able to solve distribution problems and contribute to the efficiency of automated systems.

Bergen Brunswig Drug Company began using returnable totes for their 37 U.S. distribution centers in 1988. They use a customized container, in two different sizes. It works within their highly automated distribution center as well as with conveyors in other facilities. Brunswig received dramatic savings in packaging material and labor savings by eliminating carton assembly and manual taping operations. Additional benefits are: better cube utilization within distribution vans, reduced merchandise damage and better use of warehouse space since corrugated cartons were once staged on the floor (Beck 1988, 76).

In the appliance manufacturing industry, GE Appliance is able to negotiate reduced prices from suppliers, because they no longer need to purchase expendable distribution packaging. GE receives fewer damaged parts and has eliminated the sorting and repacking of parts for delivery to the assembly line. The stackability of returnable containers also allows them to increase storage density (Andel 1993, 26).

There are many other examples of different industries using returnable plastic distribution packaging. Hoover Vacuum uses collapsible plastic pallet boxes to ship parts manufactured in Texas, and assembled in Mexico to their Ohio distribution center (Modern Materials Handling 1991, 59). Texas Instruments' Defense Systems and Electronics Group was able to implement a reusable system that can accommodate "a multitude of handling equipment" (Beck 1988, 61). Other examples include fast food suppliers, international juice shipments in plastic drums, and furniture products (Andel 1993, 27).

Environmental Issues

One of the most important benefits of a returnable container system is the elimination of packaging waste. Environmental concerns are becoming more and more important in the United States and abroad. Increasingly, State legislation prohibits some types of packaging waste or makes it very expensive to dispose of.

For example, the German government now requires manufacturers to take responsibility for the waste management costs of its products. Disposal of transport packaging has become the responsibility of the shipper. Also, one of the cases presented in this research implemented a returnable container system because of strict Wisconsin environmental landfill legislation.

The following paragraph is from Actionline, a publication by the auto industry. It demonstrates the automotive company view of environmental issues.

> 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 (Koenck 1993, 25).

General Motors has set a goal of zero-landfill for packaging material by 1994 for eight of its midsize auto assembly plants. They have set specific guidelines for suppliers whether they are shipping in expendable or reusable containers. "Wasteful, excessive, and non-recyclable packaging will not be acceptable" (Andel 1993, 25). GM's zero-landfill goal may be a benefit to the environment, but it is likely an even greater benefit to GM's pocketbook.

Chrysler's Jefferson North plant in Detroit was able to eliminate 209 tons per day of expendable packaging solid waste by switching to 100% returnable containers. "The savings to Chrysler are spectacular" (Richardson 1989, 26). After a payback period of less than 1 year, they will have savings of more than $8 million each year. The estimated savings only includes a reduction in packaging material expense. It does not include savings from elimination of waste disposal.

The Cost Justification Analysis

The decision to implement a reusable distribution container system should be a carefully planned decision. It requires a major change in material handling operations. It also requires a large initial investment for the purchase of durable containers.

Packaging material expense and freight costs are the two most obvious factors to include in a cost justification, but there are many other considerations. It is important to include every variable so an accurate and profitable decision can be made. A complete analysis will also ensure that the predicted results are consistent with the actual results.

A side by side comparison of annual expenses for an expendable packaging system versus a returnable system is the normal recommended practice. Some companies do this on a part by part basis. Others base the decision on a 100% plant-wide change. Someplace in between, such as an 80% change or by supplier often turns out to be the most economical way to implement a returnable system. Cost comparisons should be carefully planned and it is important to include all of the variables.

According to the 1991 Ford Packaging Guidelines, "The factors that influence the use of returnable packages include: material, quality, labor, freight, cleaning, disposal, recycling and tooling costs" (1991, 4). These are the major variables, but the list is not very specific. Container expense will depend on the particular product requirements and any special handling needs. Products with high cost expendable packaging are usually good candidates for returnable containers.

In order to compare package container costs, it is essential to determine the necessary number of returnable containers required for one cycle. Distance between supplier and manufacturer is the first important variable. It determines cycle time between shipments. Cycle time is important because the longer the cycle time, the more containers needed. Therefore it will increase initial container expense. There will be a constant flow of containers inbound, outbound and being filled at the supplier.

Returnable containers require the added expense of return transportation. This is another reason that the close proximity of suppliers is a factor. The longer the distance, the higher the transport cost, especially if the packages must be returned in less than truckload (LTL) quantities. The "milkrun" delivery system, or dedicated route shipments can reduce transportation costs. These types of contract arrangements with shippers are also a result of JIT delivery systems.

Another way to reduce the expense of return freight is the use of containers with sloped sides that nest within each other or collapse to a nearly flat configuration (called knock-down containers). Therefore three to four times more empty containers can be returned in one shipment. This method reduces return transportation costs if a milkrun system is not used.

Knock-down containers require manual labor, and therefore more expense, to set up and collapse. Also, containers shipped knocked-down can not accommodate reusable dunnage.

Labor is an important consideration. Returnable containers require operations for sorting, tracking, cleaning and repair. The labor costs for set up of corrugated fiberboard boxes, packing and repacking should be reduced or in some cases, eliminated. Returnables are usually ergonomically designed for safe and easy manual handling. Ergonomically designed containers can cut handling costs by reducing workers compensation claims. Because they will be of uniform size and shape, some manual labor tasks can be reduced. Returnable containers increased compatibility with automated systems, conveyors and flow racks that deliver the product from receiving directly to the manufacturing or assembly operations.

Reusable packages are designed for the optimum fit between the product and the material handling system. An increase in cube efficiency within trailer or boxcar is often one of the largest cost savings offered by the new handling system. The sturdiness of returnables allows for double stacking regardless of the container contents. The load can be completely supported by the package, rather than the product. Toyota was able to "increase shipping space efficiency by 21% over their previous system" which results in a direct savings in transportation costs (Transportation and Distribution 1992, 98).

In the case of some tray packs, the package can be designed so that particularly strong points of the product bear the load, therefore protecting the sensitive areas of the product and reducing the size and weight of the package. This can also reduce product damage. Tray packs can maximize the amount of product that fits within a trailer and they have a very good return ratios. On the outbound transportation trip they take up very little space relative to the inbound load size. One drawback is that tray packs are part specific, and usually have higher tooling and design costs.

An important benefit of returnable containers is reduced product damage. There are other potential benefits that may be difficult to identify initially. Toyota was also able to minimize the risk of repetitive motion trauma, maximize production floor space efficiency and minimize scrap packaging, such as stretch wrap (Transportation and Distribution 1992, 100). Another advantage is that plastic containers hold up extremely well in a variety of environmental conditions. They are waterproof. They resist chemicals and rust. They do not absorb liquids or odors from previous loads. Also, housekeeping is improved, since the production shop floor will not be cluttered with empty boxes and recycling bins.

Large items, delicate products, and more expensive items generally require the most costly expendable packaging. Large corrugated fiberboard boxes and those with a lot of interior dunnage generally have more expendable packaging that requires disposal. It is a good idea to begin a returnable or reusable justification analysis with those products.

All of the possible variables to include in an expendable versus returnable cost justification have not been discussed here. The major influences were mentioned, as well as some of the hidden, or less obvious variables. A comprehensive study can only be done based on specific circumstances.

It is important for the assembly plant and part supplier to work together. Every variable that contributes to material handling expense should be included in the comparison. It will improve the accuracy of the cost-justification. Therefore a profitable distribution system decision will be the result. In addition, the actual results will accurately reflect forecasted savings.

Capital Budgeting

Capital budgeting refers to the decision making process used to evaluate investments in fixed assets. It involves measuring the after tax cash flows associated with investment proposals and evaluating the attractiveness of these cash flows relative to the project costs. The investments usually involve large cash outlays and commit the firm to a particular course of action over a long time horizon. Therefore, if a capital budgeting decision is incorrect, reversing it tends to be costly (Keown 1991, 291). In order to keep up with competitors, technology advancements, and changes in market preferences, firms need to continually evaluate new business ventures and replace worn out assets with new ones (Freeman and Hobbes 1991, 36). Capital budgeting decisions can influence a firm's long range success or failure.

It is important that the person or people making an investment decision understand capital budgeting techniques, including their advantages and disadvantages. In the case of this research, it would be the Logistics or Material Handling Manager deciding on a returnable container system investment.

In most cases, a selection between several available investments is made by a manager, in this situation a Material Handling Engineering Manager. Once the decision is made, cash flow data on only the chosen investment is sent to the Finance department for capital budgeting evaluation.

Most department managers base decisions on payback period analysis. This is unfortunate because payback analysis has some serious drawbacks. The best and most profitable decision may be overlooked. Financial departments use sophisticated capital budgeting techniques, but only on the investment decision selected and submitted by department management. The best opportunity may never reach them for analysis. It is important, and profitable for department managers be aware of, and know how to use capital budgeting techniques.

J. White estimates that fewer than 10% of all material handling investments are justified using quantitative methods. He recommends the Net Present Value technique (White 1993, 31).

Techniques are generally classified as either naive or sophisticated. Sophisticated methods incorporate the concept of discounted cash flows. "Future cash flows are discounted to reflect the reduction in current value of future cash flows because investors require a return on their investment to cover the time value of money and the risk of their investment" (Freeman and Hobbes 1991, 36). This research will examine the four most common capital budgeting techniques; Payback Period, Accounting Rate of Return, Internal Rate of Return and Net Present Value. The first two, payback period and accounting rate of return, are naive techniques.

Payback Period

Payback Period is the amount of time necessary to break even on an investment. "Periods may be years, months, weeks or other appropriate time frames. A short Payback Period is attractive because, at the end of the Payback Period, the cash invested in the project is recovered" (Bryne 1992, 40). The accept or reject criteria involves whether or not the payback period of the project is less than or equal to the firm's maximum desired Payback Period.

It is calculated by adding each period's cash flow to the initial investment until the sum equal zero. If the threshold is less than or equal to the firm's maximum cutoff time, the project should be accepted (Bryne 1992, 42).

The disadvantages of payback period are numerous. First, as a naive method it does not discount the cash flows. It does not consider the time value of money. Second, all cash flows after the Payback Period are ignored. Two investments with the same payback period, and the same cash flows up until that time would be evaluated as equally beneficial. One project's following year cash flow may be millions more than another project's. They would be rated equally profitable by the Payback Period technique (Bryne 1992, 42).

Payback Period is simple to calculate and easy to talk about. It is often sufficient for the analysis of small scale investment decisions that do not warrant additional time and effort for sophisticated financial evaluation. The payback method is also a good first benchmark or screening device for potential investments. Therefore it is a popular technique. Often it is the only evaluation method used to evaluate an investment decision. Limiting investment decisions to payback analysis can be a costly mistake.

Accounting Rate of Return

Accounting Rate of Return (ARR) is another technique that is considered a naive form of capital budgeting.

$$\frac{\text{Average Annual Project Income}}{\text{Average Annual Project Investment}} = \text{ARR}$$

It is also called book rate of return or average return of book value. ARR is calculated by adding up the after tax accounting profits and dividing by the investment life in years. This number is divided by the average investment cost. The average investment is the sum of initial expenses added to the expected salvage value divided by two.

The accept or reject criteria involves whether or not the project's ARR is greater than or equal to a minimum acceptable level set by the firm (Brealey and Meyers 1991, 301). As with Payback Period the ARR accept/reject cutoff is also arbitrarily set by the firm. Often the ARR minimum is set equal to the average rate of return on existing, or book investments. Therefore it is often referred to as "book rate of return". If the proposed project has a higher return rate than current company investments, it is considered an acceptable project.

Companies with high rates of return on their existing book investments may reject good projects, and companies with low rates of return may accept bad projects (Brealey and Meyers 1991, 79).

Accounting rate of return does not discount the profits, therefore it does not consider the time value of money. Distant returns are considered just as valuable as immediate receipts. Also, ARR uses accounting income rather than cash flows, which can be very different amounts. The accountant deducts operating expenses from cash flows. The remaining capital expenditures are depreciated according to an arbitrary schedule. Accounting cash flows do not accurately reflect returns of an investment. According to Brealey and Meyers, "Payback is a bad rule. Average rate of return is probably worse" (1991, 79). It ignores the time value of money and is not based on the cash flows of a project.

Internal Rate of Return

There are several widely accepted capital budgeting techniques that use discounted cash flows, and account for the time value of money. Internal Rate of Return (IRR) and Net Present Value (NPV) are the two most often used sophisticated capital budgeting methods. They determine what a sum of money collected in the future is worth today by dividing by the discount rate. Discount rate is also called cost of capital. It is the average cost of money a firm uses for investments (Bryne 1992, 40).

Internal Rate of Return is the discount rate at which the sum of the discounted cash flows, less the initial investment, is equal to zero.

$$\sum_{T=1}^{N} \frac{CF_T}{(1+IRR)^T} - \text{Investment} = 0$$

The accept/reject decision is based on the firm's cost of capital. If the IRR is higher than the cost of capital (the discount rate) the project is acceptable. It will produce a higher rate of return than necessary simply to cover its costs. If the IRR is less than the cost of capital, the project should be rejected because it will not be profitable. Internal Rate of Return is also good for comparing two potential investments because the project with the higher IRR will earn a higher rate of return.

Internal rate of return is a reliable and well respected capital budgeting technique. It does, however, have some drawbacks. First, it is difficult to understand and difficult to calculate. Financial tables or special software are often required to calculate it. The only other way to calculate IRR is by trial and error. This means plugging in different variables until the IRR value selected makes the formula result in zero.

Second, it is possible to have two or more IRR values that correctly solve the equation. (DeCarte's rule of change in sign of Cash Flows) As if this is not confusing enough, there are also cases in which no internal rate of return exists (Brealey and Meyers 1991, 84). There can be additional problems with IRR when ranking projects of different scale, or projects which offer vastly different cash flows over time. The internal rate of return method may not accurately rank these types of projects relative to each other.

Although there are some disadvantages to internal rate of return, it is much better than payback period or accounting rate of return. IRR is widely used and usually results in sound investment choices.

Net Present Value

The problems with IRR can be overcome by using the Net Present Value (NPV) technique of capital budgeting. It is easier to use, easier to calculate and does not have many of the pitfalls of internal rate of return.

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

Net present value is a 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 cash flows that recover the initial investment and the opportunity cost of not being able to use the funds for other investments. If NPV is less than zero it will not be profitable, and the project should be rejected.

The NPV calculation sums the cash flows over the life of the project and discounts them by the current cost of capital. The investment cost is then subtracted out. The result is a measure of the absolute value of an investment in terms of today's dollars. NPV is not difficult to evaluate. If it is positive, the investment will generate enough revenue to return the initial expense and the cost of using those funds for 'n' number of years and not investing them in the capital market. It is important that NPV accept/reject criteria is quantifiable. It is based on a numeric formula, not an arbitrary selection made by management.

Another advantage of the Net Present Value technique is that comparison of different investment projects is accurate and reliable. The higher the NPV result, the more valuable the project will be. Since the results are in current value terms, it accurately shows the value added by each project.

The principal of value additivity states that the value of the whole is equal to the sum of the parts. This means that the sum of the present values of two different projects is equal to the present value of a composite project.

$$NPV\ (A + B) = NPV\ (A) + NPV\ (B)$$

For example, the NPV of Project A added to the NPV of Project B is equal to the NPV of a composite project of A and B combined. This rather simple sounding concept is a benefit that the Net Present Value technique has over other capital budgeting methods. The Value Additivity Principal is not possible with most other methods because they result in ratios. A ratio is a number relative to another number, and they cannot be added and subtracted accurately in the way that values can be (Brealey and Meyers 1991, 914). Net present values are measured in today's dollars, they can be added together.

Suppose project B has a negative NPV. If it is tacked onto Project

A, the joint project (A + B) will have a lower NPV than A on its own. "Therefore, one is unlikely to be misled into accepting a poor project (B) just because it is packaged with a good one (A)" (Brealey and Meyers 1991, 75).

Many people without a Finance background believe net present value is difficult to calculate. Actually, it is nearly as simple as payback period and much easier than calculating internal rate of return. The firm's discount rate is the only additional information needed. The discount rate, or the cost of capital can be identified with a telephone call to the firm's financial department. Then the formula can be easily applied and investment decisions can be made with confidence.

RESEARCH METHODS

A case study method was selected as the most appropriate means to satisfy research goals. Case study research is most appropriate in new areas of research, or when the goal of the research requires development of new theory. It can offer new insights into a topic or identify areas where additional research may be appropriate. There has been very little research on returnable packaging, and even less on the decision process of implementing a returnable container distribution system. Although there are many articles reporting the use of returnable systems, few can be considered actual research. Furthermore, no in depth analysis has been found relating a packaging investment decision to the capital budgeting decision function.

William Boulton describes the role of case research in theory development:

> Case research can readily be applied to new areas which require systems thinking. In the earliest periods of research, long before you have developed any theory, data must be gathered in an attempt to describe the territory raise basic questions about its interrelationships and processes....In fact, one might argue that statistical techniques are seldom used to improve theory, only to accept or reject hypotheses....You need only to find one example in which the theory does not hold to reject or modify a theory (1989, 9).

Furthermore, he argues, in management, large sample research does little more than determine how many firms are using a practice or technology. It cannot adequately explore firms which are most advanced in applying new concepts and technologies.

The automotive industry was selected as the focus of the research. The automotive industry has been an innovative user of returnable containers. The industry has been using a limited number of returnable steel racks for decades. In the past decade, the automotive industry has been steadily increasing it's use of returnable plastic containers. High volumes of continuous production, which requires a constant inflow of delivered components also leads to a situation where returnable containers are viable.

It was further decided to limit the study to vehicle assembly companies rather than including component supply base companies. Both assembly companies and components suppliers are concerned with the economic impact of returnable shipping container systems, but suppliers ultimately must abide by the decisions of the assembly company. In order to sell their products their shipping methods must conform to the requirements of the assembly company.

First, a survey was developed and edited several times. The editing process served to clarify research goals. The survey focuses questions toward the returnable container system, its decision process and how the financial investment decisions are made. The questionnaire's purpose is to guide the interview process and insure all relevant topics are discussed. It is not meant to limit the questions and discussion within each case study. The survey should to lead to open discussion of each participant's returnable container system and how it was developed.

The next step was to target the survey sample respondents. They were selected to represent the major auto companies in North America, General Motors, Ford and Chrysler. Other assembly companies were selected to obtain a cross section of corporation sizes and production philosophies. Some companies were included because of their innovative programs in returnable container use, or their long standing dedication to the use of returnable container systems. The most appropriate contact person was determined and contacted to secure their cooperation and willingness to participate.

Interviews were conducted in person whenever possible, using the survey to guide the questioning. Some participants were faxed the survey. After the results were received, by mail or fax, or following the personal interview, there were follow-up telephone interviews. In some case studies, a second or third person was interviewed to get additional information and confirmation of results.

The results are described and presented in this thesis. This case study research method uses case description and analysis as its base. The analysis was a two step process. It includes an analysis of each case, independent of the others, and a cross-case analysis of overall results. Within case analysis allows a familiarity with the data and an understanding of how each firm handles a logistical system change. Cross-case analysis is used to identify cross-case patterns and support the conclusions.

CASE STUDY RESULTS

Auto Alliance International Inc.

Auto Alliance International Inc. is a joint U.S. manufacturing venture between Mazda and Ford Motor Company. The company began using plastic returnable shipping containers at start up production in September, 1987. Currently, 85% of incoming part volume is received in some type of returnable packaging. The Flat Rock, Michigan plant has the capacity to produce 240,000 vehicles per year. They have close to 4,000 active part numbers, shipped from 160 different suppliers. Returnable packaging includes molded plastic totes and plastic corrugated totes. They also use a variety of modular returnable packaging. All of it is purchased by suppliers, based on Auto Alliance packaging specifications.

Suppliers are responsible for final container design and performance. They are not limited to standard sizes, and can select any container manufacturer they feel is most appropriate. It is their responsibility to do any cost justifications regarding the choice of logistical packaging.

For other investment decisions the Auto Alliance Finance department uses several capital budgeting methods, including, internal rate of return, accounting rate of return and net present value methods. Primarily they rely on internal rate of return (IRR) for final investment decisions. The minimum acceptable IRR varies from project to project and due to current economic circumstances.

Auto Alliance did not want to publicize the forecasted annual savings or the actual results of using a returnable container system. According to the Packaging Section Leader, Peggy Bradley, the returnable system is considered a cost saving program. Results will be lower than initial expectations because tracking has proven to be difficult and costly. Many supplier invoices have been submitted for lost and damaged containers.

They use a milk run transportation system for pickup and return of reusable shipping containers. In order to solve some tracking problems, Auto Alliance is aggressively seeking new carriers experienced with returnable container tracking and ones that will take more responsibility for container routing.

Caterpillar

Caterpillar has a goal of 100% returnable containers for their approximately 400 North American suppliers. They first began using returnable packaging in 1982. Currently 90% of parts are received in returnables. Only 2 - 3% of those are plastic containers. Their first use of plastic containers was in 1986. Primarily they rely on reusable wood crates or steel tubs. The facility handles over 12,000 different part numbers. They are presently increasing their use of plastic stackable tray packs.

Packaging Engineering has implemented a program to reduce internal dunnage. As much as 85% is now being returned with the shipping container for reuse. They purchase returnable logistical packaging for their North American suppliers and get an immediate piece price reduction from each supplier. Nearly 250 overseas suppliers ship in expendable corrugated containers. The distance makes return freight and the high number of returnable containers needed uneconomical.

Caterpillar Packaging Engineering does a cost justification on a part number by part number basis. They use internal rate of return as a capital budgeting method. The minimum corporate IRR is 16%. Any IRR greater than 16% would be approved by the Accounting department, and upper management.

According to John Butler, Packaging Engineering, few returnable packaging investment requests have been rejected. The department can override any rejection if part quality or worker safety is an issue. In most cases the cost justification is acceptable and container purchase is approved. They use 5 years as a minimum container use life, and returnables often last much longer. Since 1982 they have not replaced any plastic returnable containers.

Reusable wooden crates have a one year use life but have a less expensive initial purchase cost. Caterpillar is increasing their use of plastic reusable containers because the longer use life makes it more economical than wood, even if the inial purchase price is greater.

Caterpillar reports a savings of over $25,000 per year in solid waste disposal. Actual results showed an annual system wide savings of 1.5 times greater than the predicted savings. Packaging Engineering suggests that the increased savings may be due to a container uselife of nearly double the first prediction. Annual Caterpillar sales are near $500 million and they have total investments in plant assets of nearly $250 million. The total investment in returnable packaging is reported to be $50,000.

Chrysler Corporation

Chrysler first began using plastic returnable containers (in addition to steel racks) in 1984 for production of minivans St. Louis, Missouri and in Windsor, Ontario. Their Jefferson North plant, in Detroit, Michigan was the first location to implement a 95% reduction in expendable corrugated containers.

Eleven U.S. and Canada assembly plants have eliminated between 25% and 95% of disposal costs. The lowest use of returnable containers was 17% and the highest was 57%. Material Handling Engineering estimates that at the end of 1993, the amounts will have increased considerably.

Two additional assembly plants, Belvidere and Sterling Heights, Michigan plants are at 95% corrugated elimination. Another plant, Newark, New Jersey has climbed to a 75% elimination.

As facilities incorporate new model production, they will automatically be evaluated for 55% or 95% corrugated elimination. It is possible that all North American assembly plants will be 95% corrugate waste free by the year 2000.

Chrysler owns all returnable containers used by their suppliers. Cost justification is based entirely on a waste reduction and material cost savings analysis. As a new model of production is being planned, Chrysler automatically approves funding for returnable container purchases eliminating 55% of expenses related to corrugated packaging. Chrysler owned supplier plants are first to receive reusable containers.

Internally, the Material Handling department does an analysis based on waste disposal elimination. After the initial 55% reduction, they determine if it is economical to fund up to 95% elimination of corrugated shipping containers.

The analysis is done on a pass or fail basis. If it is economical, 95% of corrugated fiberboard expense will be replaced with returnable containers. If it is not economical, returnable container use will be limited to the 55% reduction. According to Michael Kennedy, MHE, it has always proven economical to approve a 95% elimination of disposable packaging expense. Chrysler has a total returnable container investment of approximately $2 billion. They predict an elimination of up to $80 or expendable packaging per vehicle produced at one assembly plant scheduled for the 95% elimination rate.

Chrysler uses Profitability Index (PI) for capital budgeting analysis. If the PI is greater than one, it is considered a good investment. If PI is less than one, it is not an acceptable investment.

The profitability index is Net Present Value (NPV), turned into a ratio by dividing the results by the initial investment expense. It will always yield the same accept or reject criteria as Net Present Value calculation.

In NPV calculation, the project should be accepted if the result is greater than the cash outlay. Similarly, in calculating the Profitability Index, whenever the present value (the numerator) is greater than the original cash outlay (the denominator), the result will be greater than one. Therefore, the two capital budgeting methods will always result in the same accept or reject decision.

Ford Motor Company

Ford North American Assembly Operations consists of 17 plants that receive a total of about 50,000 different part numbers. Overall 85% of incoming component volume is in returnable/reusable containers received from over 700 supply sources. Several Ford owned supply plants ship virtually 100% of outgoing components in returnable containers. They include an engine plant, transmission and chassis plant, a plastic trim plant and their climate control division.

Ford World Headquarters Material Handling Engineering supplies and controls containers. The centrally owned returnables are usually part specific steel racks and generic steel bins (Figure 1). Although they are slowly increasing use of returnable plastic containers, 85% are made of steel. According to James Frisbee, They find it cost prohibitive to move from returnable racks to plastic containers. Ford finds it difficult to justify a plastic container purchase when they already own steel returnables that provide many of the same benefits.

Ford uses plastic returnable containers for some programs, like company owned supply sources mentioned above, and when specific circumstances give them an advantage over steel racks. In some cases, increased cube utilization within a trailer or decreased labor may lead to plastic returnables being selected.

Non-metal returnable packaging used most often is a collapsible plastic pallet box. Part specific pallet tray packs are another popular choice. They also use sleevepacks with corrugated plastic or fiberboard sides.

Material Handling Engineering does a payback analysis on any proposed container purchase. If the investment is favorable, the project is submitted to the Controllers Office for capital budgeting evaluation. Internally Ford calls their method, Time Adjusted Rate of Return (TARR). It is the same formula as Internal Rate of Return (IRR). The minimum acceptable return rate fluctuates according to current economics but it

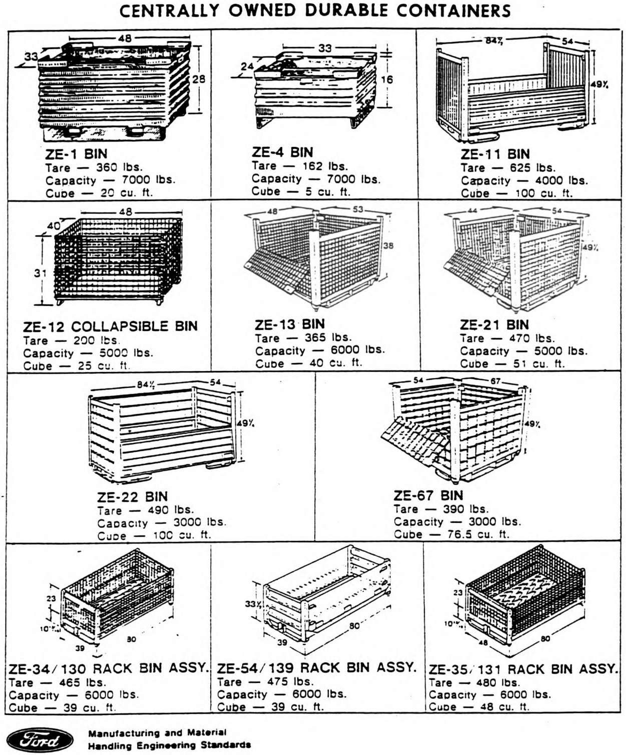


Figure 1: Ford Standardized Metal Containers

has been 35% for some time. If the TARR result is 35% or greater, the investment project is acceptable.

Metal returnables are used from program to program, for many different models of production over many years. They are put on the accounting books as a capital investment.

Plastic returnable distribution packages are considered an expense. Average plastic returnable container uselife has proven to be 6 years or more, but they are not considered a capital investment. Dunnage is usually expendable, therefore it is expensed.

Ford Body and Assembly, Material Handling Engineering has no official container tracking system. They determine the number of containers received by the assembly plant, and try to return the same number. Ford does have an internal container repair facility.

The Utica, Michigan trim plant ships nearly 100% of outgoing material in plastic returnable containers. They save $1.00 per Taurus/Sable interior door panel by replacing expendable corrugated containers with reusable plastic containers. "The reusable containers pay for themselves in just nine months and are projected to save $5 million over the next three years (Koenck 1993, 27).

Another Ford owned supply source, the Romeo, Michigan engine plant, ships 100% of outgoing product in returnable containers. According to Ed Dunkerley, they produce 400,000 engines annually. Containers are owned and tracked by Ford Engine Division.

The program began in 1988 to improve quality and eliminate corrugated dust from getting inside engine components. It was so successful, and profitable, other engine plants are adopting returnable container programs as new models of production are started. Division wide Ford produces four million engines per year.

The Utica engine plant currently saves approximately $2.00 per engine, $800,000 per year, due to returnable containers. In addition, 93% of incoming components are received in supplier owned returnable containers.

General Motors Corporation

General Motors is the world's largest full-line vehicle manufacturer. In addition to long term use of reusable steel racks, for large bulky parts, General Motors Corp. began using a returnable container system in 1985 for production of LeSabre vehicles at their Buick City, Michigan assembly plant. According to James Pajot, close to 90% of incoming parts are received in modular tote packs, pallet sleeve packs or other returnable container types.

Recent corporate restructuring has changed the way returnable packaging decisions are made. They have made a corporate level decision in support of reusable shipping packages. Previously the decision was determined at the plant management level, on a piece by piece basis. GM's goal is to have 100% of company owned suppliers, known as allied suppliers, use returnable packaging. Their 28 allied suppliers ship to 3 North American assembly plants.

Based on the overall philosophy of 100% returnable containers, they do not perform extensive cost justifications. Past analysis has shown consistently positive results. When original studies were done in 1984 the payback period was in the two year range. More current studies show an approximate one year payback period.

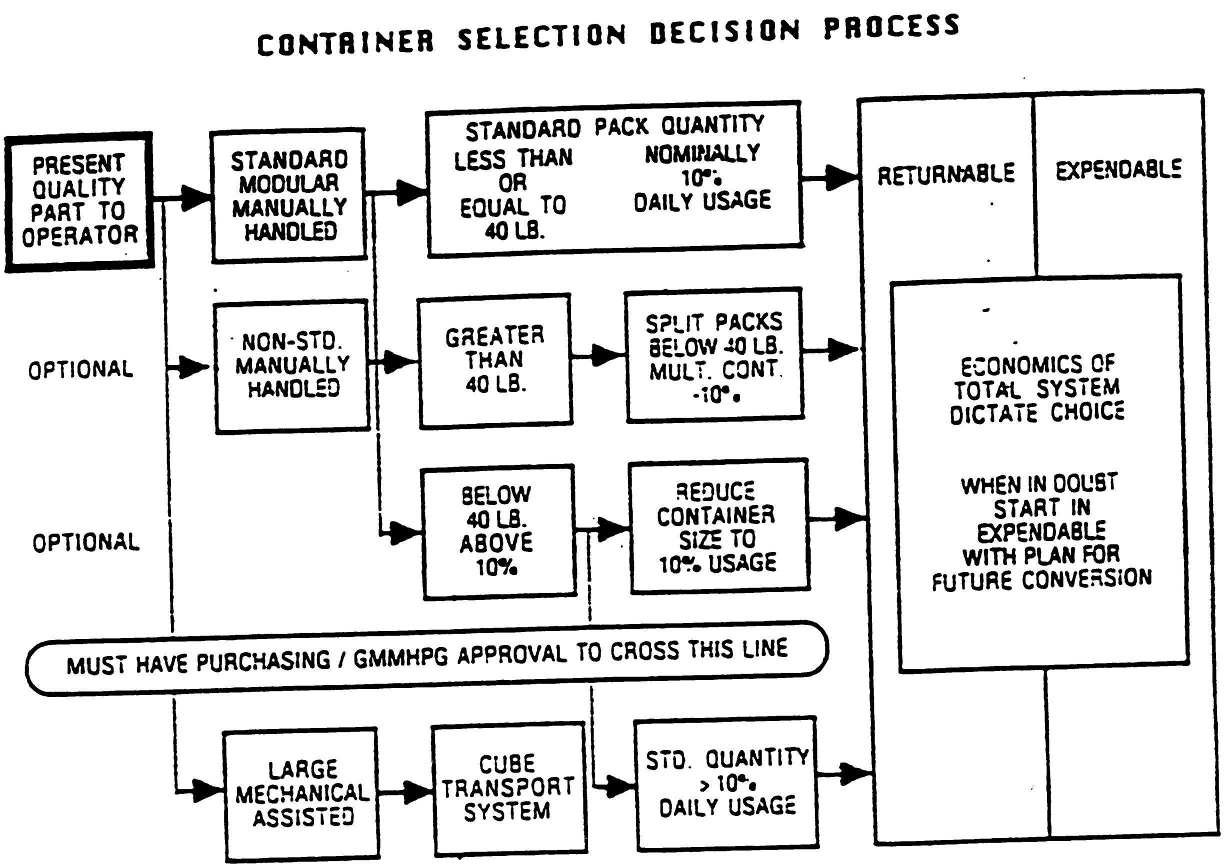
General Motors feels that returnable container use is an environmentally sound decision that supports strategic goals to reduce disposal costs and eliminate landfill of packaging material.

General Motors is less likely to incorporate returnable packaging for outside supply sources. Figure 2 shows GM's container selection process. The cost justification analysis is more in depth. Often expendable containers are used while returnable container design and cost justifications are arranged.

For tax purposes, the container investment is considered an expense. The initial investment is large enough to be a long term asset, but containers are not physically in control of General Motors. They are not easily inventoried, since containers are always circulating within the logistical system. For these reasons, GM feels it must consider returnable containers an expensed item.

General Motors Corporation purchases all reusable/returnable containers. Some purchase exceptions are, glass racks and steel wheel racks from non-allied sources. Suppliers provide those specialty containers.

GM purchases the returnable shipping containers and receives a piece price reduction from suppliers. The Buick City assembly plant employs an independent third party consolidator to track, sort, clean repair and return their containers. Originally they planned to use a bar code system to sort and track containers internally. The third party system has proven more efficient. They also are using more and more generic containers, primarily AIAG standard footprint pallet boxes. Standardization of containers facilitates efficient return



Source: GM 1738 Packaging and Identification Requirements for Production Parts

Figure 2: GM Container Selection Process

shipping. Other assembly plants, that sort and track in house are investigating the use of a third party consolidator.

Honda of America Manufacturing Inc.

Honda of America Manufacturing Inc. consists of four U.S. assembly plants, three in Ohio and one in North Carolina. The Marysville, Ohio assembly plant began operations in 1979. Its 3,632,000 square foot facility produces motorcycles, passenger cars and all terrain vehicles since. Only Marysville and East Liberty Ohio locations produce vehicles, The Anna, Ohio plant makes engines, and the Swepsonvelle, N. Carolina plant produces lawn mowers.

The East Liberty, Ohio location began using returnable containers in 1989, at production start up. The Marysville plant began using them in 1983. They were using a limited number of baskets, carts and steel racks. In 1991 they began to increase use of returnable packaging. Currently 70% of incoming components are received in returnable containers. Of those, 45% are in plastic returnable, The plant handles 6,425 different part numbers, from 345 different suppliers. They use a combination of modular trays and sleeve packs, as well as wire baskets and steel racks.

Every pack is some fraction of 60 units in order to fit in with their lot quantity production system. Production is done in batches of 60. They can contain some combination of 5, 10, 15, 20 or 30 unit pieces. Manually handled shipping containers are also designed with ergonomic weight limits and reach requirements. The Transportation department goes to great efforts to cube out shipping trailers, and the Packaging department is working toward better cube utilization within individual shipping containers. The constraints of the 60 unit lot quantity make this a difficult task.

Honda of America purchases all returnable packaging for their suppliers. The suppliers then give Honda a piece price reduction. In the past four years, Honda has invested a total of $16.3 million in returnable packaging. Original predictions forecasted a program savings of $6 million annually. The actual annual savings due to a returnable container system is reported to be $10.9 million.

In addition to the greater than expected savings, Honda was surprised that many suppliers requested returnable containers. They have also benefited from a 35% reduction in the number of truck loads sent to landfill.

Honda uses the payback method when considering a selection between expendable or returnable shipping containers. The payback period must be one year or less for the investment to be acceptable. Some exceptions to the one year rule are for safety or quality assurance. Although Honda uses one of the least sophisticated analysis method, they do a comprehensive cost benefit analysis. They are careful to consider the variables that influence the decision in the payback analysis, including, material cost, cleaning, repair, damage reduction, ergonomics, transportation, cube efficiency, solid waste reduction, sorting, tracking and labor rates.

John Deere, Horicon Works

The Horicon, Wisconsin assembly plant of John Deere implemented use of some returnable containers in 1989. They were prompted to increase usage by tough Wisconsin State legislation that strictly limits landfill or burning of shipping containers by 1995. They designed, and are implementing an innovative returnable container system to streamline material handling procedures, increase product quality, provide a better working environment and reduce costs.

John Deere began the program in 1989. They plan to have full implementation by December, 1994. At that time over 60% of purchased component dollar volume will be received in returnable containers. All other packaging will be recyclable. In October, 1993, 30% of purchased component dollar volume was in returnables. As of January 1994, they have surpassed the 50% mark, with over 2,500 P/N in returnable packaging. Nearly all, 93%, are plastic returnable containers. They have approximately 12,000 active part numbers, received from 200 different suppliers.

The John Deere Horicon Works packaging system has been very successful. It was carefully planned prior to implementation. The planning stages included representatives from engineering, purchasing, manufacturing, transportation and other departments. The planning group selected 10 standard container sizes, a combination of modular totes, stackpaks and collapsible plastic bins. All meet AIAG standards. Returnables are purchased and tracked by Deere. The supplier then provides Deere with an immediate piece price reduction.

As a result of the planning, the assembly area layout was changed. Standardized container sizes allow efficient use of a flexible racking system. Inbound containers are delivered directly to one of 54 point-of-use docks around the assembly area. They strive for a two container system, one for the worker to pick from, and one for backup and refilling. They prefer a maximum of 4 - 8 hours of inventory at each point of assembly. A milkrun, or dedicated route delivery system is used for continuous redistribution of containers to suppliers as often as necessary.

Even with the addition of return freight for empty containers, John Deere claims to have reduced overall freight costs. They credit this to strict route management, cubed out trailers and by aggressively seeking out low cost carriers.

As a result of their returnable container system, John Deere Horicon Works has been able to exceed the requirements of Wisconsin's strict environmental legislation. Additionally they have shown an 18% reduction in inventory levels, thereby getting better use of floorspace and better housekeeping. Other benefits include increased part protection and better ergonomics from containers designed for manual handling.

The monetary benefits of their system are even more impressive. John Deere Horicon Works expects to save over $600,000 due to returnable containers in 1993. They will save more than $1.7 million per year starting in 1996. Reduced freight costs have previously been mentioned. Savings are from a reduction in packaging material costs, reduced labor cost of sorting for recycling, and reduced landfill fees.

Deere primarily uses the internal rate of return (IRR) technique for capital budgeting. They also use accounting rate of return and determine payback period. Their returnable container system has a 2.7 year payback, considerably longer than is generally acceptable. The internal rate of return technique shows a 72% return which greatly surpasses the 18% minimum acceptable IRR for John Deere investments. This shows a long payback is more than made up for with the high rate of return. Also, the project is reported to have a 35.1% accounting rate of return. The company considers a returnable container investment as a long term investment with an 8 year use life.

A total annual savings of 1.2% was predicted by Deere. The actual savings will be 1.3% of total annual sales. Some of the estimated annual savings are a $2.5 million reduction in corrugated costs, a $100,000 annual reduction in wood pallet expense and a $300,000 savings in waste disposal. Returnable container investment is 0.2% of annual sales, or $2 million.

Saturn Corporation

Saturn has used a 100% returnable container philosophy since it began production in July 1990. The decision was based, in part, on a study at the University of Tennessee. The study, done in May, 1988 was based on research by William G. Sullivan on the justification of advanced manufacturing technologies. He developed a procedure, and a computer model, to link intangible decision factors with capital expense decisions. His JUSTLAN model has been modified to evaluate an investment decision between expendable packaging and returnable container packaging for Saturn Corporation.

Figure 3 details the JUSTLAN Methodology Flowchart, a process for including strategic business goals within an investment evaluation. A list of strategic attributes or benefits is developed, using a group consensus technique. These attributes are the non-monetary aspects of each containerization method that the group feels are essential to the guiding principals of the company.

Importance of each attribute is determined by each group member. They rate each alternative with respect to each attribute or benefit. The

JUSTLAN METHODOLOGY

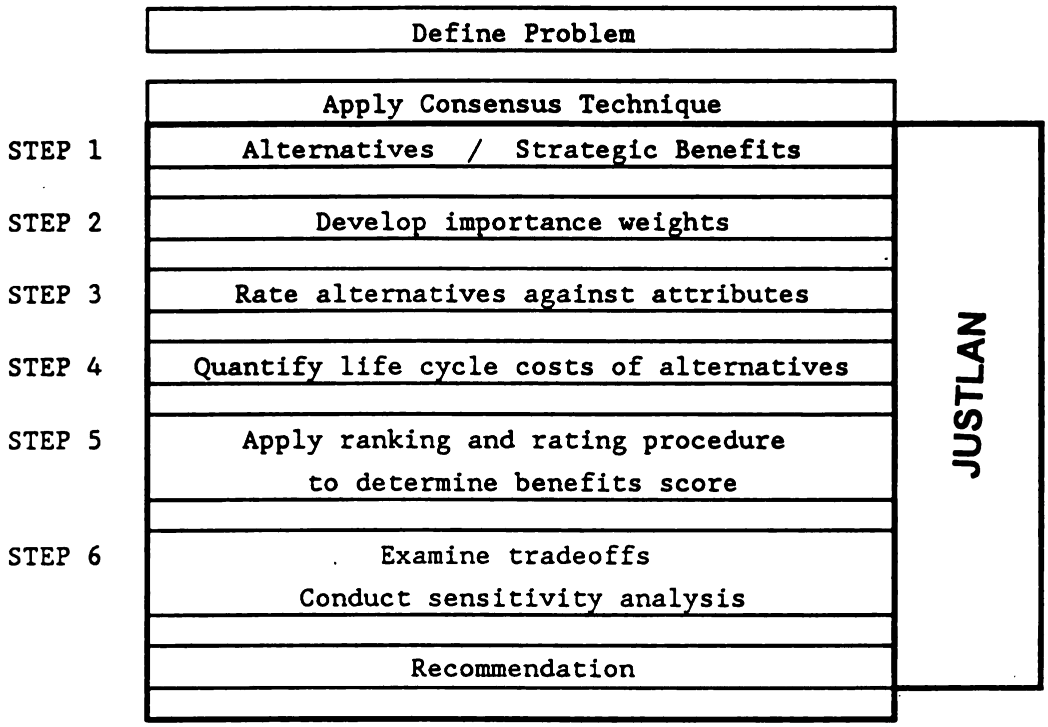


Figure 3: Justlan Methodology Flowchart

next step quantifies the results of each participant. Finally, the previous two measures are combined to determine an overall benefit score. It is a relative measure of the non-monetary benefits of that container alternative. The highest, or best ranking is +5. The worst is -5. Sensitivity analysis is performed prior to the recommendations.

Returnable containers were rated considerably higher in safety, people relations, product quality, environment considerations and material handling (Table 1). Supplier relations is the only attribute area in which expendable containerization outranks returnable. Expendables received +5, and returnable -4.

A standard net present value analysis of each container option was done with a five year use life. The standard NPV analysis is compared to the results of the JUSTLAN program that incorporates the weighted attribute. The program determines a benefit score for each alternative.

Results show net present value slightly higher for the expendable packaging choice. After the JUSTLAN program is applied, the returnable containerization option has a much higher value score than expendable packaging

It is not clear how extensively Saturn used the program before deciding on a goal of 100% returnable containers. Packaging professionals, at Saturn were very helpful. They were also very protective of all but the most general company information.

According to James Lesch, Saturn Material Flow Coordinator, Packaging Body Systems, over 90% of production parts are received in returnable containers. Close to 50% of those are standard modular plastic totes on plastic pallet bases. They are all purchased by the supplier. Suppliers fill out a Packaging "Buy-Off" form for approval of all new packaging.

Table 1: **JUSTLAN ATTRIBUTE SUMMARY**

ATTRIBUTE	**RETURNABLE**	**EXPENDABLE**
Safety & Ergonomics	+5	-4
People Relations	+4	-3
Supplier Relations	-4	+5
Product Quality	+2	-1
Production & Scheduling Ctrl	0	0
Environmental	+5	-5
Material Handling	+4	-2

The 11 - 12 page form is very detailed and must be signed by every Saturn department effected by the container decision. It details, cycle time, safety stock, quality issues, unusual container features and number of containers needed.

After returnable container systems are purchased by suppliers, Saturn amortizes the purchase investment over a one year period, based on the expected volume of each part number. The supplier is given a container purchase allowance for every part purchased by the assembly company. After one year Saturn has essentially paid for the container, therefore the supplier must give them a reduction in piece price for subsequent use of the containers. The supplier is still considered the owner of the container, and is responsible for tracking, cleaning, repair and replacement.

Toyota Motor Manufacturing USA

Toyota uses a philosophy of 100% returnable containers. Expendable corrugated shipping containers are used only when unusual circumstances prohibit the use of returnables. More than 90% of their 3,000 plus active part numbers at the Camry plant are received in returnable packaging.

Toyota Motor Manufacturing (TMM) uses a standard milkrun system for all inbound and outbound shipments within 500 miles of their Georgetown, Kentucky assembly plant, which includes more than 90% of the plants supply base.

Close to 60% of returnable packages are stackpacks. These plastic injection molded containers conform to AIAG standards and have a 48" x 45" pallet footprint. Their second most common returnable package is the sleevepack. Toyota sleevepacks are made of triple wall corrugated or plastic corrugated. Typically they are for bulky, lightweight parts. They are less expensive than other returnable containers, but their use life is not as long.

Toyota uses a variety of other returnable packaging including, steel racks, vacuum formed trays pallets, structural foam molded containers, molded trays and plastic corrugated containers. Most dunnage is returned with the container for reuse. All of the manually handled containers are loaded into gravity feed flow racks for efficient operator use. Empty containers are picked up from the operator station and stored in their appropriate area awaiting the next return trip to each supplier. Their milkrun system uses a just-in-time allocation that picks up from suppliers as often as 16 times per day.

Toyota Motors makes extensive use of soft sided trailers for quick and efficient loading and unloading. When the soft sides are removed, or rolled up, the trailer load can be accessed from the two longest sides, rather than the usual method of using only one shortest end.

The Georgetown, Kentucky Camry facility manufactures approximately 240,000 vehicles annually. They estimate annual transportation and packaging cost savings in excess of $3.6 million due to using returnable containers in place of expendable packaging. Savings of $30 million per year are expected for the returnable container program.

The supplier owns and is responsible for the returnable containers. They perform their own cost justifications and the purchase investment is amortized over one year. After that year of being paid slightly more that the part value for each part sold, supplier must give Toyota a piece price reduction.

According to D. McCulluch, location, or distance between supplier and the assembly plant, and volume are the biggest deciding factors in whether or not to use returnable packaging. They also look at packaging costs, disposal costs, and length of project life.

Volvo GM Heavy Truck Corporation

Volvo is the largest industrial group in the Nordic region, including car, truck, bus, and marine vehicle production. In addition to production in Sweden and Europe they have a complete truck program in the United States. The Volvo truck group is the world's second largest producer of heavy trucks and buses. Volvo's estimated share of the world market for trucks is 10%. Total U.S. truck group production is approximately 23,000 vehicles per year.

Volvo worldwide has been using returnable packaging since the 1960's and in the U.S. since 1984. The U.S. truck group began using plastic returnable containers in 1987. Currently 80% of incoming components are in returnable shipping containers. Only a small amount of those, about 2%, are in plastic returnable containers. The most commonly used material is wood crates. As new programs are started, they are increasing the use of plastic returnable containers.

They use a modular system with 5 different container sizes that all fit a standard pallet base. Local suppliers are the main users of the modular system. Volvo also uses some part specific, thermoformed tray packs. Design costs and tooling charges make them more costly. Therefore, approval of a part specific returnable container undergoes a more intensive cost justification.

Volvo has approximately 20,000 different part numbers and a supply base of 2,000 vendors. Four hundred of those are core suppliers. The containers are owned by Volvo's worldwide corporation. One of the greatest benefits of their returnable system has been a reduction in damage rates.

For tax purposes the containers are treated as an expensed item. When they are cost justified by the Packaging department, they are treated as an asset, with a six year use life. The department estimates a $100 per vehicle savings due to use of a returnable container system.

Volvo's payback analysis uses a two year payback period as the minimum acceptable return time for a project to be accepted. The annual savings from using a returnable container system is estimated at $2.3 million.

CONCLUSIONS

The Three Types of Returnable Container Systems

Analysis of the cases reveals three distinct types of returnable container systems, depending on the method used for cost justification, ownership of the containers and percentage of returnable container use. These factors also contribute to how returnable container profitability is reported and how closely the profits are monitored.

The three types are: (1) very high percent use of supplier owned containers with very little cost justification by the assembly company; (2) medium to high percentage of corporate owned returnable containers with considerable attention to justification; (3) and companies with many plants that have varying degrees of primarily corporate owned returnable containers and moderate to high attention to cost justification.

One type of returnable container system uses a very high percentage of supplier owned containers with only a small amount of cost justification by the assembly company. The companies in this group are Auto Alliance, Saturn and Toyota. All three have had a philosophy of 100% returnable container use nearly from their production start-up in the late 1980's. They have a high percentage of plastic returnable containers which are supplier owned and maintained. The suppliers' container investments are amortized over one year and then the assembly company receives a piece price reduction for the elimination of expendable packaging expense.

Auto Alliance and Saturn were unwilling to disclose financial data regarding returnable packaging. Since they have suppliers select and cost justify container purchases, the lack of data may be because it is unavailable. Often an analysis is done on a part number basis only. It may not be centrally collected or summarized for total plant production.

Toyota attributes plant wide savings of over $30 million annually to their returnable container system. That translates to $125 of savings per vehicle produced.

Another type of returnable container system has moderate to high percentage of corporate owned containers. When the assembly company takes ownership of the shipping containers there tends to be a much greater emphasis on their cost justification.

This category includes Caterpillar, Honda of America, John Deere and Volvo GM Heavy Truck. These companies use corporate owned returnable containers to gain an immediate piece price reduction from suppliers. With the exception of John Deere, which recently began using returnable packaging, they all have returnable percent usage nearly as high as companies with 100% returnable container philosophies.

Since these companies own and track their returnable containers, they have more centralized and available financial information. All except Volvo consider the containers as a capital investment rather than an expense.

The third type of returnable container system includes many plants, each with varying use rates of corporate owned returnable containers with moderate attention to cost justification. The third category includes the three domestic U.S. automotive manufacturers, Chrysler, Ford and General Motors.

Table 2: **Three Types of Returnable Container Systems**

Type 1	Type 2	Type 3
* Near 100% Use	* Med/High % Use	* Various % Use
* Supplier Owned	* Corporate Owned	* Corporate Owned
* Low Cost Just.	* Med/High Cost Just.	* Med. Cost Just.
Auto Alliance	Caterpillar	Chrysler
Saturn	Honda of America	Ford
Toyota	John Deere	General Motors
	Volvo Truck	

These corporate giants have many different plants, each using returnable containers at varying rates. Different Chrysler plants receive between 17% and 95% of incoming material in returnable containers. The number of plants, at various stages of container implementation make it difficult to establish centralized financial data on the Big Three's distribution systems.

Size disparity also helps to explain the difficulty in gathering centralized financial information. The annual production volumes of the seven other cases studied are less than half the volume produced by the smallest of the Big Three domestic auto manufacturers.

There is another factor that contributes to the problem of gathering information from the three largest automotive assembly companies. Other automotive assembly companies tend to have more recently built, smaller scale operations. Therefore they use a different approach for internally supplied components. They are able to incorporate an "under one roof" program where, for example, sheet metal stamping and painting operations are done on site. The sheet metal is then transported to an adjacent building for assembly.

U.S. domestic operations, with many more assembly operations have corporate owned supply manufacturers which supply several assembly locations. Each assembly location may be hundreds of miles away. For example, Ford has separate corporate divisions for Engine, Transmission, Plastic Trim, Glass, Electronics and Climate Control components. Each has independent management and each division distributes to Body and Assembly Operations which has 34 plants across North America.

Chrysler is the most aggressive at increasing the use of returnable containers. They plan to eventually bring all production facilities up to

95% rates of corporate owned returnable distribution packaging, as long as the overall purchase can be cost justified. Thus far, each Chrysler plant evaluated has been approved for purchase of containers up to the 95% level of incoming component volume. They have a centralized material handling department to control the analysis and funding decision.

Ford and General Motors have corporate ownership of most containers, but in some cases, they are supplier owned. General Motors has purchased returnables for most corporate owned suppliers. They seem to be in no rush to encourage outside supply sources into reusable distribution packaging. Ford has several corporate owned component or sub-assembly plants with nearly 100% incoming and outgoing returnable packaging. They also have a very large investment in steel racks and bins that make it difficult to justify purchase of plastic returnable containers.

Overall domestic automotive manufacturers are increasing returnable/reusable shipping container use. In all domestic companies, first priority is given to implement returnable container purchases for company owned supply sources. With the exception of Chrysler programs, and a few other specific situations, they are less likely to fund corporate owned containers for outside suppliers. In other situations they encourage supplier owned returnable containers.

There is a great deal of upper management support for returnable packaging, but implementing it takes time, resources and centralized planning. It will take longer for large, sprawling corporations to fully implement returnable systems and take full advantage of the cost savings available.

Assets Still Being Expensed?

One of the most interesting facts about returnable shipping packages is that in more than half of the cases, for tax purposes, they are considered an expensed item. Only Caterpillar, Chrysler and John Deere report them as a capital investment. It is also interesting that these three use a sophisticated capital budgeting technique to evaluate the investment. Honda also considers them as an asset but their returnable containers are supplier owned.

As defined in the Capital Budgeting section of this paper, an investment asset requires a large cash outlay and charts a particular course of action, over a relatively long time period. Implementing a returnable container system requires a major material handling system change to include the addition of return transportation for the empty containers. The changes clearly commit a firm to a particular course of action for a considerable length of time.

The dollar amounts invested in returnable packaging are staggering. For example, Honda of America has a returnable container investment of over $16.3 million and Chrysler will spend more than $35 million to purchase returnable packaging for a single assembly plant.

Clearly a returnable container system fits the definition of an investment asset. It should be treated as such. Why then are returnable containers so often treated as an expensed item?

One reason is that individual containers are relatively inexpensive and may not meet corporate minimum dollar values for an asset. Another reason is that containers are difficult to inventory since they are not kept in one location.

The Problem With Payback Period

Returnable/reusable container investments can be, and usually are, millions of dollars. Still, most packaging and material handling professionals use the Payback Period method to decide if a purchase can be cost justified. A sophisticated capital budgeting method could possibly lead to acceptance of more returnable container investments.
More importantly, the cost justification analysis results would more accurately reflect the true profit potential of a purchase decision.

Payback Period does not discount cash flows by the discount rate (also called the cost of capital) and it ignores all cash flows after the initial payback. Both of these factors significantly change the return on the investment.

Internal Rate of Return (IRR) is the most widely used method by finance departments in the cases studied. Usually sophisticated capital budgeting is only done by the finance department. The finance department evaluates decisions already selected by packaging or material handing departments.

It makes sense that the decision makers, at the engineering level be able to use and apply investment evaluation techniques that lead to selection of the most profitable option. Payback Period analysis has some drawbacks that may not lead to the best decision. IRR is popular with finance departments but Net Present Value (NPV) is easier to calculate and easier to understand. (A detailed comparison of the different techniques can be found in the Capital Budgeting section of this paper.)

Consider an investment decision between two types of returnable container systems. Project A and Project B both have an initial investment of $1,000 and a lifespan of six years. The current cost of capital is at 10%. The cost of capital is the average cost of money a firm uses for investments. This includes costs such as interest and dividends (Bryne 1992, 40). The project cash flows are shown in Table 3. The NPV formula and calculations are below.

$$NPV = \frac{CF_1}{(1.K)^1} + \frac{CF_2}{(1.K)^2} + CF_3 + CF_4 + CF_5 + \frac{CF_6}{(1.K)^6} - INV$$

$$NPV\ (A) = \frac{500}{(1.10)^1} + \frac{500}{(1.10)^2} + 200 + 200 + 200 + \frac{100}{(1.10)^6} - 1000$$

Where: CF = Cash Flows
K = Discount Rate
INV = Initial Investment

$$NPV\ (A) = \frac{500}{1.10} + \frac{500}{1.21} + \frac{200}{1.331} + \frac{200}{1.464} + \frac{200}{1.611} + \frac{100}{1.771} - 1000$$

NPV (A) = \$335.24

$$NPV\ (B) = \frac{400}{1.10} + \frac{400}{1.21} + \frac{400}{1.331} + \frac{400}{1.464} + \frac{400}{1.611} + \frac{400}{1.771} - 1000$$

NPV (B) = \$742.11

Payback Period calculations show that Project A, with a payback of two years, is better than Project B, with a payback of 2.5 years.

Payback Period calculation implies that after two years the initial investment of $1,000 is completely returned. Furthermore it suggests that all cash flow after the payback period are pure profit. This is misleading due to the effects of the time value of money.

The discount rate takes into account that one dollar two years from now is worth less than one dollar. It is worth less because a dollar earned today can earn interest over time. A dollar two years from now is

Table 3: **NET PRESENT VALUE vs PAYBACK PERIOD**

Initial Investment is $1,000
Project Lifespan is Six years
Assume the discount rate is 10% (the Cost of Capital)

Year	Project A	Project B
1	500	400
2	500	400
3	200	400
4	200	400
5	200	400
6	100	400
Payback Period	2 yrs	2.5 yrs
Net Present Value	$335.24	$742.11

worth its face value minus inflation. For example, one dollar received two years from now at a 10% cost of capital is worth only 82.64 cents.

Taking into account the time value of money, a $1,000 investment recouped in two years, with a 10% discount rate, has a present value of only $867.76. This shows how Payback Period evaluation could lead to unrealistic expectations since the true break even point is some time later than payback period analysis implies.

Payback Period calculations also ignore all cash flows once the assumed payback is obtained. The containers in Project A are less durable than those in Project B. After two years Project A has a need for repair and replacement of many containers. This significantly reduces cash flows in the later years of the project.

Project B's containers are more durable so cash flows remain constant over the six year project lifespan. Although it takes longer for the initial investment to be returned, overall profits are greater.

NPV calculation method shows the overall profitability, and adjusts cash flows to their worth in terms of current dollar values. Net Present Value calculations include all cash flows over the entire project length, not just cash flows at the beginning of the project. NPV also reflects the true worth of an investment by discounting future cash flows by the cost of capital.

By incorporating the time value of money, the true profit potential of an investment can be evaluated. For this example, NPV calculations accurately show Project B, with a Net Present Value of $742.11, is more than twice as profitable as Project A, with a Net Present Value of $335.24.

This example also illustrates how important container uselife can be. The longer it can be used without replacement, the more profitable the overall system will be. There is no additional tooling charge and no containers to purchase. If one more year of container use is added to Project B, its present value becomes $947.45.

Returnable Containers and Profitability

The most significant way in which returnable containers contribute to profitability is through reduction of overall packaging material expense and subsequent packaging material disposal expense. An investment in durable reusable containers eliminates the need for continuous purchase and disposal of expendable shipping containers. All of the companies studied in this research have concluded that returnable container systems contribute to overall corporate profitability. In the long run they are less costly than traditional expendable container systems.

One of the most prohibitive variables in a returnable container cost justification is the added freight cost of returning the containers to the supplier. Careful logistical system management and a close working relationship with contract carriers may make outbound transportation expenses more manageable. Adapting transportation systems to fit the needs of returnable container routing may even be able to reduce freight expenses.

Toyota and John Deere both report a decrease in overall transportation costs after implementation of their returnable container systems. Toyota will be able to reduce $3.6 million annually just in transportation expense. This is mainly due to increased truck cube utilization. John Deere cites close route management and the use of low cost carriers for the transportation savings. These two companies, and

Table 4: **RETURNABLE CONTAINER USE SUMMARY**

COMPANY	CONTAINER OWNERSHIP	USE (% VOLUME)	PLASTIC (% RET CONT)	CAPITAL BUDGET METHOD
Auto Alliance	Suppliers	85%	60%	Supplier
Caterpillar	Corporate	90%	3%	IRR
Chrysler	Corporate	17 - 95%	40 - 60%	PI (NPV)
Ford	Corporate	85%	15%	TARR (IRR)
General Motors	Supplier/Corp	Varies	Varies	N/A
Honda	Corporate	70%	45%	Payback
John Deere HW	Corporate	50% +	93%	IRR
Saturn	Suppliers	90% +	50%	N/A
Toyota	Suppliers	90% +	60%	Supplier
Volvo Truck	Corporate	80%	2%	Payback

Table 5: **RETURNABLE CONTAINER SAVINGS SUMMARY**

COMPANY	CAPITAL BUDGETING TECHNIQUE	ANN. SALES N.AMERICA (MILLIONS)	ANN. PRODUCTION N. AMERICA	ANN. SAVINGS (MILLIONS)
Auto Alliance	IRR	N/A	240,000	N/A
Caterpillar	IRR	$500	5,000	0.1
Chrysler	PI (NPV)	$33,550	2,175,450	N/A
Ford	TARR (IRR)	$51,900	13,100,000	N/A
General Motors	N/A	$113,489	4,856,000	N/A
Honda	Payback	$16,122	953,000	$10.9
John Deere	IRR	$1,053	N/A	1.7
Saturn	N/A	N/A	N/A	N/A
Toyota	N/A	N/A	240,000	30.0
Volvo Truck	Payback	N/A	23,000	2.3

many others use a milkrun delivery system for incoming parts.

Because of the variety of cost justification procedures and rates of returnable container use, it is difficult to summarize overall industry profitability derived from implementation of returnable container systems. However, it is clear that all of the automotive companies are reporting financial success from the switch. Of companies that made overall savings data available, annual savings were between $100,000 and $30 million. The savings represent between 0.02% and 16.14% of total annual sales.

Results show firms with high rates of container use and centralized planning are the biggest financial gainers. They are also more aggressive in pursuing an increase in their returnable container use.

Companies that have the most success relating returnable container investment evaluations to overall profitability have several common links. (1) They own the containers. (2) They consider returnable containers a corporate asset. (3) They are more likely to use sophisticate capital budgeting techniques. (4) They are more likely to compare actual results with predicted results.

It should also be noted that these companies have relatively small production volumes, therefore tracking, control and follow up of returnable container systems is more manageable. Also, corporate ownership of returnable containers gives more incentive to track profitability. It also makes financial information easier to obtain.

This is not meant to suggest that corporate owned returnable container systems are more profitable than supplier owned returnable container systems. It means only that conclusions have been drawn from these cases because the data was available.

Caterpillar and John Deere Horicon Works have taken the most effort to relate sophisticated capital budgeting techniques to returnable container investment decisions, including follow-up research of actual results. They both consider corporate owned containers as an asset and they both use IRR technique at the packaging decision level.

Follow-up studies regarding returnable container system profitability, in both cases, showed greater than predicted savings. John Deere reported a slight increase in profitability. Caterpillar found more than double the predicted annual savings.

Honda of America uses Payback Period to evaluate corporate owned returnable containers. They also reported annual savings of nearly double their predicted savings.

Greater than expected savings may be due to returnable containers having a longer than expected use life. Honda uses a four year use life to evaluate returnable containers. They report being able to use the containers in their system for approximately six years. Caterpillar uses a five year uselife when evaluating investment projects, but in the past eight years they have not needed to replace any plastic returnable containers.

Trends and Predictions

Based on this research, it is clear that the use of returnable container systems is profitable and increasing rapidly. As the rate climbs, I predict suppliers will increasingly locate plants near assembly facilities. Large original equipment manufacturers will have a manufacturing or distribution site located near every assembly plant it supplies components to. The trend of more truck than rail transport will also continue. The above factors contribute to shorter cycle times and therefore substantially fewer containers that must be purchased. Close proximity of suppliers also reduces transportation costs.

Dedicated route delivery systems, or milkrun delivery appears to be the most cost effective transportation system for returnable containers. See Figures 4 and 5 for a comparison of traditional and milkrun container flow systems. Continuous dedicated route systems reduce the amount of inventory on the shop floor and provide a better means of negotiating set routes with carriers.

As the number of dedicated routes shipments increases, assembly companies will further reduce their supply base. This means they will prefer one main supplier over several sources for the same component. Other manufacturers will be able to supply to the main source. A reduction in supply base allows simplification of carrier routes and promotes a partnership relationship between the parties.

Milkrun systems do not benefit greatly from containers with high return ratios. The carrier will return to the supply location, for the next shipment, regardless of how full or empty the trailer is. Therefore, high cube, rigid returnable containers, which do not require additional labor to set up or knock down, will become more and more popular. They can also accommodate returnable dunnage.

Sorting and tracking of returnable containers appears to be a major problem. There is a trend toward standardized, modular containers, rather than part specific containers. Sorting and tracking is simplified because, with modular containers, suppliers only need the right number of the right size container. They do not require their exact container back.

Similarly, internal dunnage will continue to be expendable. Reusable dunnage, like part specific containers must be returned to a

MILKRUN CONTAINER FLOW

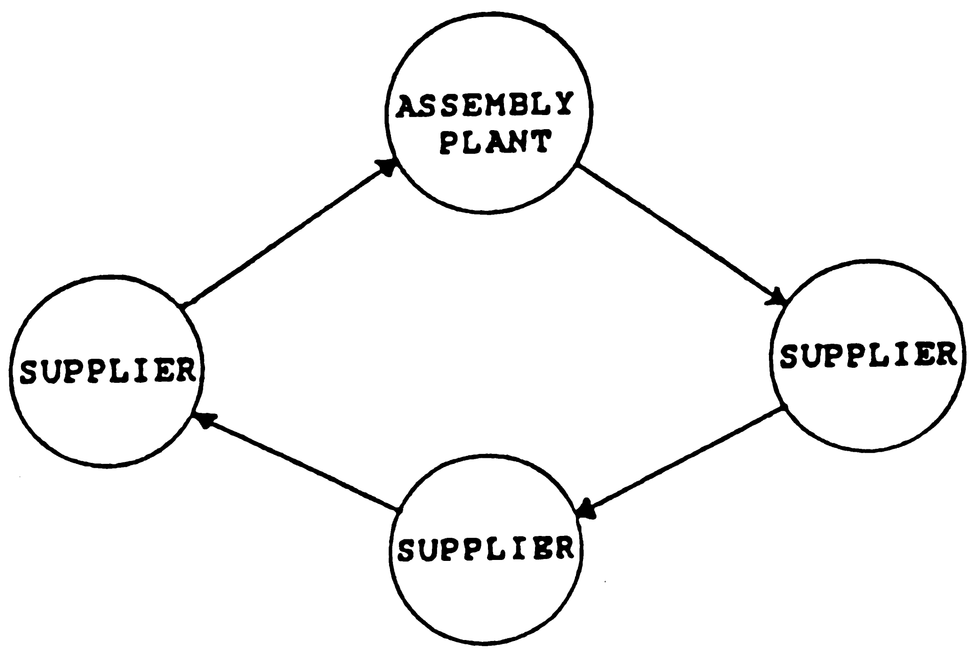


Figure 4: Milkrun Container Flow System

TRADITIONAL CONTAINER FLOW

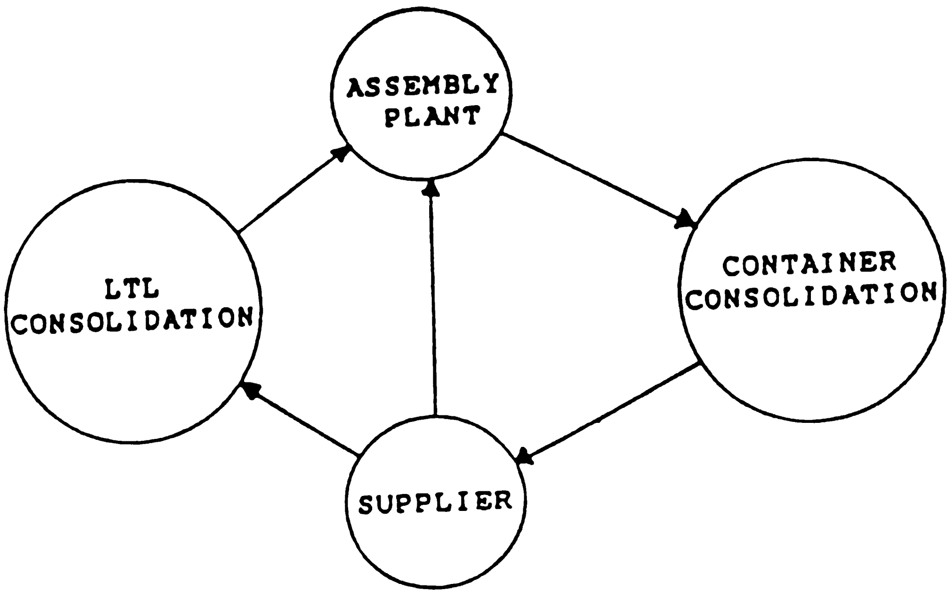


Figure 5: Traditional Container Flow System

specific supplier. With the use of modular containers, returned to any one of several suppliers it is not cost effective to sort, track and return internal dunnage. It should be easy to separate from the container, and highly recyclable.

Recommendations for Future Research

Container tracking is one of the biggest problems for returnable container systems. Just - in - time delivery requires the right containers be returned to the supplier at the right time. What is the most cost efficient means to accomplish that? Research into whether the supplier or the manufacturer, or a third party, is best suited for tracking would be beneficial to many companies.

Although the addition of return freight can be the most expensive part of a returnable container system, some companies have been able to reduce overall transportation costs with a returnable packaging system. Research into route management for reduction of overall costs is recommended. The milkrun delivery system is reported to be cost effective. What contributes most to the savings? What is the best way to implement such a system?

One of the most important variables for a profitable returnable container system is the length of container uselife. Returnable container manufacturers often report five years as the average uselife. Many case study participants report considerably longer use rates. A study of actual container uselife could enhance the accuracy of cost justification evaluations.

Progressive manufacturing companies are taking JIT one step further by using synchronized delivery systems. Returnable containers can be an integral part of designing for such a process. Loading and unloading of components, in a specific order, can be facilitated with container design. The containers are usually ergonomically designed for manual handling. Damage free components are essential when every part is accounted for. Synchronized delivery using returnable packaging offers many areas for future research.

Another subject for returnable container research is regarding container selection. Is it best to use part specific containers that provide more protection, or generic containers that can be returned to any supplier? Similarly, is it more cost effective to use returnable or expendable dunnage? How do containers with efficient return ratios, such as knock down or stacking models, compare with straight walled, rigid containers. The latter can accommodate returnable dunnage, and do not need labor to set up. On the other hand, they require more frequent return rates and take up more floor space.

Some companies allocate use of returnable containers only when it is profitable for a particular part number. Others prefer 100% returnable containers so that there is only one type of system to manage. Overall, profitability of the "winners" more than makes up for the economic losers. Is it more profitable to have a 100% returnable container system or some lesser portion?

Physical testing of the mechanical properties of different types of containers is recommended. They can be tested by container design, material used, or method of production. There is a need for independent research comparing load capacity, cubic efficiency and damage rates after simulation of transportation conditions.

This research has shown that returnable/reusable distribution containers used in the automotive industry are profitable investments that significantly reduce packaging and material handling expenses. Returnable container systems can provide a reduction in material costs, improve utilization of the full cube in trailers and reduction in disposal costs. In some cases, even with the required addition of return freight, a reduction in overall transportation costs was achieved.

The fact that all ten automotive assembly companies studied plan to increase their use of returnable container systems supports the conclusion that returnable container systems are often a very profitable investment. A careful cost justification analysis of each situation is important. The decision to implement a reusable container system requires much more than an investment in a large number of plastic bins. It requires a major change in material handling operations. Therefore the decision should be carefully planned and evaluated.

It is important to incorporate all of the distribution system cost variables, and also to use a sophisticated capital budgeting technique. A few of the variables to consider are: packaging material expense, freight costs, labor, cleaning, tracking, repair, utilization of cube space, disposal, recycling, and product quality.

It has been shown in this paper that Net Present Value is the most accurate and most simple to use evaluation method available. There are also other appropriate methods, including Internal Rate of Return, that are appropriate. Payback Period calculations evaluate profitability only up to the assumed payback point. Sophisticated capital budgeting methods (IRR and NPV) most accurately predict the profit potential of an investment over the entire project life span.

APPENDIX

APPENDIX: SURVEY
RETURNABLE/REUSABLE PLASTIC SHIPPING CONTAINERS

Name: . . . .

Title: . . . .

Company: . . . .

Mailing Address: . . . .

Phone: . . . .

Fax: . . . .

1. When did your facility first implement a returnable container system?

_______________ a plastic returnable system? . . . .

2. What % of parts are received in returnable containers? . . . .

in plastic returnable containers? . . . .

3. How many different parts are handled by your facility(s)? . . . .

4. How many different suppliers ship to your facility(s)? . . . .

5. Who owns (purchased) the returnable containers? Supplier or Assembly Company? . . . .

6. How was the required number of packages for each part determined? . . . . . .

. . . .

7. What type of container is primarily used? (ex: modular, tray packs, nestable ...)

. . . .

FINANCIAL QUESTIONS

1. What is the size of your facility(s), in terms of, What are the total annual sales?

   . . . .

   What is your total investment of property, plant and equipment? . . . .

2. Your investment in returnable containers is ____________% of total annual sales?

3. Your investment in returnable containers is ____________% of total plant assets?

4. For tax purposes, how are the returnable containers treated?

   a) as an expense, and they are amortized over a ________year uselife.

   b) as an asset, and they are depreciated over __________years.

5. How are/were the returnable containers treated for decision making purposes?

   a) as a <u>short term</u> investment?

   b) as a <u>long term</u> investment?

6. What do you consider as the average uselife of a returnable plastic shipping container? . . . .

7. What is used as the number of return trips per container? . . . .

8. At the end of a returnable containers uselife is there any salvage value? . . . . .

   If YES, What is the salvage value, and how is it obtained? (for example: is it $$ from sale of the container, $$ from recycling of containers, or other) . . . .

   . . . .

9. What is the cost advantage (or disadvantage) of using a returnable container system, per unit of production? For example: $$/vehicle savings or $$/plant savings, $$/model year savings, $$/carline or $$/part number? . . . .

10. What financial method(s) were used to make the decision?

    Payback Period Yes / No

    If Yes, What was the Payback Period? . . . .

    What is the minimum Payback Period for a project to be approved? . . . .

    Internal Rate of Return Yes / No

    If Yes, what was the IRR? . . . .

    What is the IRR cutoff for a project to be approved? . . . .

    Net Present Value Yes / No

    If Yes, what was the NPV? . . . .

What is the minimum NPV for a project to be approved? . . . .

<u>Accounting Rate of Return</u> Yes / No

If Yes, what was the ARR? . . . .

What is the minimum ARR for a project to be approved? . . . .

<u>Other Method</u> Yes / No

If Yes, Please describe . . . .

. . . .

11. Please indicate the variables that were considered in order to justify a returnable container system. Also, please rate each consideration as to how important it was to the decision.

Packaging Material Cost . . . .

Cleaning and Repair . . . .

Damage Reduction . . . .

Ergonomics and Safety Issues . . . .

Inbound Transportation . . . .

Cubic Efficiency . . . .

Line Layout Changes . . . .

Outbound Transportation . . . .

Solid Waste Reduction . . . .

Sorting . . . .

Tracking . . . .

Labor (Increase or Decrease?) . . . .

Other . . . .

12. What was the annual cost savings associated with solid waste reduction? . . . .

13. What was the predicted total annual % savings due to changing from expendable to returnable containers? . . . .

14. What was the actual total annual % savings due to changing from expendable to returnable containers? . . . .

15. What was the nature of the savings? (For example: labor cost, fixed cost, variable cost, etc.) . . . .

16. Please describe any differences in expected results and actual results. . . . . . .

. . . .

. . . .

17. Please fill in the following for the past two years.

Annual Corrugated Box Expense . . . .

Annual Wood Pallet Expense . . . .

Annual Cost of Solid Waste Disposal . . . .

LIST OF REFERENCES

LIST OF REFERENCES

Automotive Industry Action Group (AIAG) Dimensional and Functional Guidelines for Returnable Containers Transported by Truck Southfield, Michigan RC-1 Jan. 1986.

Automotive Industry Action Group (AIAG) Returnable Containers Management Guideline Southfield, Michigan RC-5 June 1989.

Andel, Tom. 1993. New Ways To Take Out The Trash. Transportation and Distribution, May, 24-29.

Auguston, Karen. 1993. Returnable Containers: Why You Need Them Now. Modern Material Handling, November, 40-42.

Beck, Larry. 1989. Drug Company Prescribes Returnable Shipping Totes. Modern Materials Handling, February, 76-77.

Beck, Larry. 1989. Making Sure Your Container System Stacks Up. Modern Materials Handling, May, 63-65.

Beck, Larry. 1988. Cut Handling Costs With The Right Container. Modern Materials Handling, April, 60-62.

Boxboard Containers, 1950. The Memory Book of Box Making. October, 161.

Bradley, Peggy, Auto Alliance. Interview by author, November 1993.

Brealey, Richard A and Stewart C. Meyers. 1991. Principles of Corporate Finance. 4th ed. McGraw Hill New York.

Bryne, Patrick M. 1992. Target Projects That Add Value. Transportation and Distribution, October, 39-42.

Buchholz, Steven, John Deere Horicon Works. Interview by author, December 1993.

Butler, John E., Caterpillar. Interview by author, December 1993.

Cassaroll Joseph J. 1988. Reusable/Returnable Logistical Packaging Systems. Council of Logistics Management Annual Conference Proceedings. October 9-12, Vol II.

Clouse, Van G.H. and Yash, Gupta P. 1990. Just-In-Time and the Trucking Industry: Implications of the Motor Carrier Act. Production and Inventory Management Journal, Fourth Quarter, 7-11.

Davis, Art, Ford Body and Assembly Operations. Interview by author, 13, Sept 1993.

Dorsi, Thomas M. and Stowers, Joseph R. 1991. Effects of a Deregulated Environment on Motor Carriers: A Systematic, Multi-Segment Analysis. Transportation Journal, Spring, 4-26.

Dunkerley, Edward, Ford Engine Division, Interview by author 1, March 1994.

Eisenhardt, Kathleen M. 1989. Building Theories From Case Study Research. Academy of Management Review, 14.4 532-550.

Ford Manufacturing Engineering. 1991. Packaging Guidelines For Production Parts, February, 3.

Freeman, Mark and Hobbes, Garry. 1991. Capital Budgeting: Theory Versus Practice. Australian Accountant, September, 36-41.

Frisbee, James S., Ford World Headquarters. Interview by author, 9 December 1993.

Gould, Les 1993. Handling Reliability Is a Non-Negotiable Demand Here. Modern Materials Handling, September, 41-42.

Kennedy, Michael, Chrysler Corporation. Interview by author, 8 December 1993.

Klammer, Thomas and Koch, Bruce and Wilner, Neil. 1992. Justification of High Technology Capital Investment- An Empirical Study. The Engineering Economist, 37.4 341-353.

Knill, Bernie. 1992. How IBM Looks At Distribution Packaging Costs. Material Handling Engineering, June 10.

Knill, Bernie. 1992. Tote Boxes: Up-Front Planning Pays Off. Material Handling Engineering, September, 93-98.

Koenck, David N. 1993. Many Happy Returns. Actionline, September, 25-28.

Langlois, Michael, Volvo GM Heavy Truck Corporation. Interview by author, November 1993.

Lesch, Jim, Saturn Corporation. Interview by author, November 1993.

Liggett, Hampton R. and Sullivan, William G. 1988. A Decision Support System For Evaluating Investments In Manufacturing Local Area Networks. Manufacturing Review, 1.3 151-157.

Lyman, Steven B. 1988. Returnable/Reusable Containers In The Automotive Industry: A Case Study. Council of Logistics Management Annual Conference Proceedings. October 9-12, Vol II.

Material Handling Engineering, 1993. Reusable Containers Keep Assembly Line Moving At Saturn, December, 72.

Material Handling Engineering, 1991. Packaging's Future Less Is Becoming More Important, June 79-80.

McCallum, John S. 1992. Using Net Present Value In Capital Budgeting. Business Quarterly, 66-70.

McCulloch, David, Toyota Motor Manufacturing. Interview by author, November 1993 and February 1994.

Modern Materials Handling, 1991. Re-Usable Containers Cut Costs For Hoover Vacuum, October, 59.

Pajot, James, General Motors Corporation. Interview by author, 4 October 1993.

Pashall, Michael R. 1986. Returnable Container Systems Boost Handling Economy. Modern Material Handling, October, 74-75.

Pashall, Michael R. 1986. Returnable Containers Save Automakers Over $20 Million. Modern Materials Handling, October, 76-78.

Raney, Mark, Honda of American. Interview by author, February 1994.

Richardson, Helen L. 1989. Cutting Packaging Also Cuts Costs. Transportation and Distribution, October, 26-28, 45.

Tomey, Richard D. 1984. Returnable Packaging Components In Physical Distribution Systems. SPHE Journal, Vol 4, 9-13.

Torok, Douglas B. 1990. How To Select The Right Container For Your In-Plant Handling. Material Handling Engineering, July 73-74.

Torok, Douglas B. 1989. Returnable Containers For JIT Handling. Material Handling Engineering, November, 48-49.

Toyota Motor Manufacturing USA, Inc. 1993. Packaging Manual, August.

Transportation and Distribution, 1992. Container System Saves Millions In Transport. September, 98-102.

Trunk, Christopher. 1993. Making Ends Meet With Returnable Plastic Containers. Material Handling Engineering, October 79-83.

Twede, Diana. 1988. The Process of Distribution Packaging Innovation: The Effect of Distribution Channel Structure. Ph.D. dissertation, Michigan State University.

White, John A. 1993. Justifying Materials Handling Investments. Modern Materials Handling, September, 31.

Witt, Clyde. 1993. Returnable Distribution Packaging Saves Money. Material Handling Engineering, February, 14.