

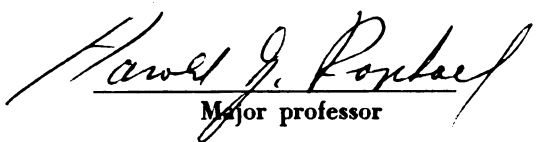


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THE POSSIBLE IMPACT OF NEW PACKAGING SYSTEM CONCEPTS
ON TRADITIONAL CORRUGATED BOX MARKETS

presented by

David L. Olsson

has been accepted towards fulfillment
of the requirements for
the Ph. D. degree in Forest Products


Major professor

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ABSTRACT

THE POSSIBLE IMPACT OF NEW PACKAGING SYSTEM CONCEPTS ON TRADITIONAL CORRUGATED BOX MARKETS

By David L. Olsson

Packaging of products for storage and shipment has a history which extends back 5000 years to stone cosmetic kits of Mesopotamia. Over the years since that time, various package forms have become dominant methods for the shipment of goods. Some, such as leather bags, kegs, barrels, and wooden boxes have nearly completely disappeared from use.

Packages serve several functions in the distribution of goods to the market place. Packages protect the product and protect the environment, make goods convenient to handle, store, ship, and use, and motivate the customer to buy the product and use it correctly. Shipping packages accomplish these functions within a distribution system which extends from the product-producing center, through the distribution channel, to the point where the consumer uses the product and disposes of the package.

New forms of shipping container systems which consider the requirements of the product within a systematic framework are competing for markets traditionally held by corrugated boxes. The goal of the shipping container in each use situation should be to compliment and promote a balance of all the components of the system, to get the most efficient, lowest cost, greatest profit result, with the greatest benefit occurring in favor of the consumer.

David L. Olsson

Paper or plastic film overwrap systems are now being properly applied to products, meeting demands in the distribution system for overall efficient and economic operation. Advances in distribution technology, including increased usage of cargo containers, are changing the shipping environment, as well.

All of these factors are being felt within the corrugated box industry. Because the paper and paperboard industry is capital-intensive, it is economically difficult for this industry to adapt, to meet changing distribution wants and needs. Thus, it is increasingly important that the corrugated box supplier consider his product as only one component in an overall system; as helping to produce an end result, rather than as an end in itself.

THE POSSIBLE IMPACT OF NEW PACKAGING SYSTEM CONCEPTS
ON TRADITIONAL CORRUGATED BOX MARKETS

By
David L. ^{Laurens} Olsson

A THESIS

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To

Anita, Davey, and Kristen

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CHAPTER 1

INTRODUCTION

"When any great design thou dost intend,
Think on the means, the manner and the end."
--Denham

With this brief couplet, Denham reminds the reader to consider all of the forces that impact upon a scheme or project, from inception to completion. He probably was not thinking about packaging, or the factors that influence the development and use of the package as it carries a product to the consumer. But the thought is nonetheless apt.

In the manufacturing and marketing of any product, from canned beans to jet engines, from toys to television sets, it falls to the package system to safely carry the product to the consumer. As new products are developed, the market changes as consumers' needs and desires change. Then, as product manufacturers adapt to changing markets, and, as new packaging materials appear, the package changes in response to new shipping system requirements and marketing needs, and package makers are required to respond with new package forms, as well.

1.1 SCOPE OF THE TOPIC

Ever since man first thought highly enough of the fruit of his labor to protect it from harm, he has looked to some form of package to contain the result of his craft. Over the centuries, packaging of products has developed to the point where nearly every product which

is made goes into a package. One major function of the package is to carry goods safely and economically to the consumer.

The intent of this paper is to demonstrate four interrelated factors regarding the development and continued use of a particular form of shipping container, the corrugated paperboard box, in the face of competition from new forms of shipping containers:

- 1) that packaging in general, and specifically the design, development and use of shipping containers, is a systematic function; that is, one which can be treated in an orderly manner;
- 2) that a change in the packaging for distribution of a product leads to a modification of package- or distribution-system components;
- 3) that the economic framework and profit orientation of an industry influence the ability of that industry to adapt to a changing packaging and distribution system, and,
- 4) that the total cost of distributing a product to a consumer is a more significant cost in the development and application of a shipping container system, than any single component's cost.

In discussing the above points, the author assumes that packaging of products today, for distribution, is an interdisciplinary function which cuts across many traditional business functions. Packaging influences, and is influenced by, the requirements of the marketing, advertising, purchasing, production, quality control, product development, legal, and physical distribution functions of any product-producing company.

1.2 RESEARCH DESIGN

Material presented in this paper will be developed primarily from three sources:

An extensive survey of current literature on packaging and related topics will comprise the bulk of the discussion of packaging history and current industry practice in regard to shipping container manufacture and use. Also, much of the argument that the package must respond to a changing market will come from the literature. This survey is intended to represent an objective cross-section of various writers' considered theory and published opinion.

A second area of information will be developed from comments of responsible individuals in the packaging field. Authors of some of these comments will be unidentified. Many individuals are quite willing to discuss trends and the application of packaging materials specifically to shipping containers as a means of sharing ideas, but not for publication. Their requests for anonymity will be carefully respected.

Finally, much of the material on the concept of packaging as a systematic function will reflect the opinion and experience of this writer. These thoughts reflect the study of the topic area, discussion of it in university-level courses in packaging, informal discussion with colleagues, and reflections of the author upon his experience in packaging as an investigating reporter and field editor for a major technical business publication in the packaging field.

1.3 DEFINITION OF PACKAGING

Packaging, as a segment of contemporary industry, and as the field is recognized today, beggars description. Paine (20), in an attempt to define the field of packaging says that it is "the art, science, and technology of preparing goods for transport and sale." He recognized the insufficiency of this definition, and added, "Packaging may be defined as a means of ensuring the safe delivery of a product to the ultimate consumer in sound condition at the minimum overall cost." Each of these definitions is only partly correct when they are taken individually. A definition of packaging must include at least both of the concepts quoted above.

Packaging today embraces that segment of business and industry activity which is concerned with the safe and efficient transfer of a product from the point where it is manufactured to the point where it is completely used up, and the package safely and conveniently disposed of. This definition includes the design, development, and testing of packaging materials and packages. It includes the relationship of the quality control, production, advertising, marketing, and legal aspects that affect the development and use of the package. It also includes concern for the safe, efficient movement and storage of the package as it passes through the distribution channel.

Hanworth describes packaging relationships this way: Packaging is related to raw materials and their properties, problems and machinery of production, conversion, and packing; distribution, selling, research, advertising, merchandising, and making of a profit (14). It should be noted, as contained in Paine's latter definition, that all of this is to take place within the context of the "minimum overall cost."

One may increase one cost--for example, that of transportation--while reducing other costs to accomplish an overall lower cost. Other costs which might be lowered, so to meet the condition of the definition, might be packaging materials or packing costs, materials handling costs, labor costs, or waste or loss due to damage incurred by the product. The goal is to trade off an increased cost in one area with one or several decreases in cost in other areas, so to obtain the efficient distribution of goods at the lowest total cost.

In any instance, the underlying objective of the package has been the same throughout the history of its existence--to stimulate the movement of goods. In so functioning, the art of packaging has progressed through various stages, each one of which has been dictated by human needs and desires (7).

Packaging has responded to new developments in existing marketing organizations and new classes of retail operation such as the supermarket. It has had a great effect on our society, as well, with the development of mass-production coming partly out of the mass-merchandising of goods sold through wholesale and retail outlets capable of moving large volumes of goods to a convenience-oriented society (13).

1.4 CHANGES IN THE DOMINANT FORM OF SHIPPING CONTAINER

Packaging has existed for many centuries as a means of making goods convenient to transport, while protecting these goods from contamination. Early package forms were clay pottery and animal skins. More refined forms of packaging showed up as paper or glass containers, and wooden casks.

Over the many years that packages have been used to carry goods safely, various forms of containers have developed, become dominant, and have either completely or nearly completely disappeared from use. One sees today, for example, either very little, or no clay pottery commonly used as a packaging material. Paper, on the other hand, has been used for the packaging of goods almost from its inception in its present form early in the second century A.D.

Later, the wooden barrel and the nailed wooden box were dominant forms of shipping containers. The nailed wooden box was the major package form for transporting finished goods from manufacturer to consumer through the 19th, and well into the 20th century. A landmark court decision (The Pridham Decision), eliminated discriminatory freight rates against corrugated shipping containers, and from 1914 onward, corrugated board shipping boxes have become the dominant package form used for domestic transportation of goods from manufacturer to consumer.

According to a recent source, paper and paperboard packaging materials account for more than 50 percent of all packaging materials consumed in the United States in 1965. Of this proportion, paperboard used in shipping containers accounted for 44 percent of the total of paper and paperboard consumed. This means that paperboard shipping containers accounted for more than 22 percent of the value of all packaging materials consumed.

Other shipping container materials accounted for smaller shares: steel drums, 2.5 percent; nailed wood and wirebound boxes, 2.2 percent; paper shipping sacks, 2.1 percent; fibre drums, 0.5 percent. The data indicated that corrugated board shipping containers accounted for the

largest proportion of the value of shipping containers purchased in 1965--some 75 percent of the total value of shipping containers used (41).

There is now a rapid growth in the use of plastic materials in the form of shipping containers. Plastics have, in many instances, more desirable physical and motivational properties than paper and paperboard. And, in some cases, the cost of plastic materials is decreasing, while the cost of paperboard is, at best, static.

Packages, specifically shipping containers for the carrying of goods to the point of sale (or on, to the point of use), fulfill many functions. Further, the most efficient and economical package can be developed only when one considers all packaging requirements. These must be considered within a framework which includes the broad scope of human wants and needs, the development and application of new packaging materials, and technological advancement in physical distribution.

As new needs and new desires create new demands in the marketplace, new technological innovations appear. New packages appear to satisfy needs or desires, or to accommodate the new technology. Because of the continuing emergence of new products, and the development of new packaging materials (or new application of existing materials), there must be a continuing flow of packaging innovation to meet the demand of today's convenience-oriented consumers. This may mean a continuing evolution of shipping container development which is responsive to current distribution technology and marketing requirements. It may mean the acceptance of a new, dominant form of shipping container to meet these requirements.

CHAPTER 2

HISTORY OF SHIPPING CONTAINERS

"If men could learn from history, what lessons it might teach us! But passion and party blind our eyes, and the light which experience gives is a lantern on the stern, which shines only on the waves behind us." --Coleridge

Packaging as it is recognized today, has evolved from a long history of containers which were used for the shipment of goods. In its earliest form, the package was not used primarily for shipment, but rather merely as a device for containing such goods as oil-based perfumes. This use was indicated by alabaster "make-up kits" which date from the year 3000 B.C.

One early recorded use of containers used for shipping is contained in the writings of Herodotus, the Greek historian. It was noted in his historical account that the Persians imported water into Egypt (following their conquest of Egypt in the Persian Wars of 530 B.C.) in earthenware wine vessels.

Leather bags used for transporting wines appeared prior to the time of Christ, and were followed by glass containers which were used by the Romans as early as 79 A.D. (49). Paper, in a form similar to that extant today, was invented near Canton, China, in 105 A.D., by Ts'ai Lun, Minister of Agriculture in the Han Dynasty. This was the first material in thin sheet form to be felted from fibres of rags of silk, hemp, or linen. Paper superseded, by the 10th Century, both parchment and papyrus (its antecedents) which date to 1500-1000 B.C. (15).

Shipping boxes made of wood appeared prior to 1800, but the development of nail-making machines in 1800 greatly increased the use of wooden boxes. Prior to 1800, boxes were constructed by the use of dowels, or hand-made nails (49). The wooden shipping container--that is, the nailed wooden box--became the dominant form of shipping container in the United States during the 19th Century.

A machine to grind wood into wood pulp was constructed in 1867. This was followed by the introduction of mass-produced paper and paperboard, and finally the development of corrugated paperboard in 1882. It was not, however, until 1894 that the corrugated box appeared, and not until 1903 that corrugated fibreboard boxes were authorized for shipment by rail throughout the United States (5, 49). Most of the development of paper took place outside of the United States, first in China, and later in Europe. Paperboard, however, as used in cartons and shipping boxes has been principally a United States development (5).

Other packaging forms developed following the Renaissance. Glass bottles began to substantially replace leather bags and earthenware jars by the early 1600's. Captain John Smith established the first American glass bottle factory at Jamestown, Virginia, in 1608. Tinplate appeared in Europe in the early 1700's, and moved into England from Germany in 1730 (49).

The most recent category of packaging material to be developed is that of the various plastic materials. It has been only within the last few years that these materials have been used in the form of shipping containers. Polyvinyl chloride was first introduced in 1927; polyethylene first produced in England in 1942, and first made in the United

States for the Navy, and was the first plastic material to reach a billion-pound annual market. Polypropylene was introduced first in 1957 (3, 50, 61). These materials have been used in shipping container form to various degrees: polyethylene is popular for carboys: large-capacity containers for liquids. As a shrinkable film overwrap for enclosing canned goods in corrugated paperboard trays, polyvinyl chloride film is by far the most widely-used plastic material, although other types of film are being evaluated.

It is important to note that the earliest forms of packages were used primarily for storage of valuable products. The concept of using the package to make goods portable, that is, to make them capable of transport, came later. This transport capability was followed by a concern for making the package protect the product during shipment. Only recently, in terms of the 5000 years of packaging history has it fallen to the shipping container to render the product attractive, as well as protecting it and making it transportable.

In some instances today, a major feature of the shipping container is its contribution to the convenience of the product user, handler, or producer, and its relation to advertising and marketing efforts of the firm. Market-oriented packaging as it is known today began to evolve around 1900. Branding, quality, storage and handling capabilities, and point-of-purchase display power became important packaging attributes. As the marketing problems became paramount, the pressure to improve packaging increased to its present high level (2).

And now the application of the systems concept to nearly every aspect of man's social life and technology is making its impact felt

in the world of packaging. More and more, today, the package must fit efficiently and economically into a packaging- and product-distribution system. This system concept requires that system components be responsive to human wants and needs as they change, and responsive to changing technology. A package, considered within the systems framework, then, must also be responsive to changes in human wants and needs and changing technology. As components in the system change, the package will be affected, and may be required to adapt, as well.

CHAPTER 3

THE ORIGIN AND DEVELOPMENT OF CORRUGATED PAPERBOARD

"Let the intermediate ends be warrantable, and the
ultimate end worthy." --Benjamin Whichcote

Corrugated paperboard which is used in the construction of shipping boxes is typically constructed of three plies--the top liner, the corrugating medium, and the bottom liner. The liner materials are glued to the fluted corrugating medium, typically with a starch adhesive (12, 23). The corrugating medium and both liner components are typically single ply paperboards. A typical medium is 0.009 inches thick and various grades weigh from 26 to 36 pounds per 1000 square feet. Liner boards are correspondingly thicker, and various grades weigh from 33 to 110 pounds per 1000 square feet, depending upon their intended use (6, 12).

3.1 THE ORIGIN OF CORRUGATED BOARD

The earliest recorded appearance of paperboard in the United States occurred about 1728, according to Bettendorf. The Dard Hunter Paper Museum at the Institute of Paper Chemistry at Appleton, Wisconsin, has a sample of paperboard which was made by hand at Milton, Massachusetts, in 1728. It was formed either by pasting layers of paper together, or by dipping a hand mold (that is, a screen in a wooden frame) into a vat of water-suspended fibres more than one time.

Machinery for the continuous production of paper and paperboard did not appear until the end of the 18th Century. Nicholas-Louis Robert patented a papermaking machine in France, on January 18, 1799. Henry Fourdrinier, his brother Sealy, and John Gamble experimented with

the original Robert machine in England, improved it, and patented it in England on April 20, 1801 (5). This concept--forming paper on a moving wire screen--was the basic design of the Fourdrinier papermaking machinery which is broadly used today. It is one of two basic types of paper-making machinery.

The cylinder papermaking machine was invented by John Dickenson, an Englishman. It had a single cylinder, and was a variation of the Fourdrinier design. It was patented January 19, 1809. The principle difference between the cylinder machine and the Fourdrinier machine was that stock--that is, wood fibres in a water suspension--flowed over the Fourdrinier screen, while in the cylinder machine a cylinder revolved in a vat or tank of such stock (5).

Paperboard liners and corrugating medium may be made on either the cylinder or Fourdrinier machine. Typically, the corrugating medium is a semichemical paperboard made in a short-cook and mechanical pulping operation. Liner boards typically are Kraft paperboard, made from the pulp of a short-cook sulfate pulping process.

3.2 THE DEVELOPMENT OF CORRUGATED BOARD

According to Bettendorf, the development of paperboard for use in shipping containers occurred largely in the United States. In 1870, the first multi-cylinder paperboard-producing machine was installed in the George A. Shyrock mill in Chambersburg, Pennsylvania. The first corrugated material used for packing around glass and other fragile articles was invented by Albert L. Jones in 1871.

It was not, however, until 1894 that the first corrugated board suitable for making shipping boxes appeared. This was developed by

Henry D. Norris and Robert H. Thompson at their mill in Brookville, Indiana.

Acceptance of corrugated board shipping boxes for containers in which to ship freight dates from 1903 when the Official Classification permitted their use for cereals. Lamp chimneys were, however, shipped in corrugated board containers even prior to official recognition of the corrugated box as a legitimate shipping container (5, 42).

From this beginning, the use of corrugated board for shipping containers grew slowly at first, being used for shipping home-canning jars in 1905. Solid fibreboard shipping boxes dominated the fibre shipping box market at the rail level, but both forms grew in acceptance. Most of the development and use of fibre shipping containers was in the Eastern and Midwestern parts of the United States (29).

3.3 THE PRIDHAM DECISION: DEMISE OF WOODEN BOXES

In 1912, the R. W. Pridham Company of Los Angeles, California, invested several thousand dollars in equipment to make corrugated paper-board for shipping boxes. As the company prepared to make the corrugated boxes, it found a potential deterrent to the use of such boxes in the railroad freight tariffs.

Railroads had general "class" rates which applied to small-volume shipments shipped in less-than-carload lots, and "commodity" rates which, in general, applied to large-volume, carload lots of product. Class rates were usually higher than commodity rates.

Railroad tariffs at that time (1912) applied class rates to goods shipped in corrugated boxes locally within California, or locally within the Midwest region. The tariffs also provided for commodity rates

on goods shipped westbound into California terminals. For goods shipped eastbound in corrugated boxes, however, from California, the western railroad tariffs applied the class rate. The tariff read that commodity rates would apply only to articles packed in boxes "made entirely of wood or wood and metal completely enclosing the contents" (15, 29, 42).

This unequal application of commodity rates to the movement of goods left merchandise moving eastward under the class rates. These class rates were usually 20 percent higher than commodity rates, and were "'in some instances as much as 400 percent in excess of the commodity rates,' according to Pridham case testimony" (29).

After a request by Pridham Company representatives, the management of the western railroads indicated that rates on eastbound shipments of goods in corrugated boxes would be lowered. This was not done, because of pressure exerted on the railroads by lumber and wooden box manufacturing companies.

Hearings on the legality of discriminatory rates on eastbound shipment of goods in corrugated boxes were held in Los Angeles during the period of January 25 - 27, 1913, and in Chicago from April 4 - 10, and April 28 to May 6, 1913, by Interstate Commerce Commission Special Examiners.

After 11 months of consideration of the testimony, the ICC ruled that there was no reason for any different practice on eastbound trans-continental traffic than on traffic moving westbound, and the western railroads were required to amend the rule regarding boxes in their commodity tariff so that it would apply shipping rates equally to corrugated paperboard shipping boxes.

Thus, the ICC took notice of the discrimination in rates, and noted that in reality the western railroads were not hostile to the fibre package, but felt constrained to yield to the influence of the lumber interests, whose tonnage from the Pacific Coast was "no mean item" (15, 29).

It was the lumbering people who opposed the introduction of "flimsy substitutes" for the nailed wood box. They claimed that damage would increase if corrugated boxes were allowed to be shipped in carload lots by rail. It was claimed that 10 to 15 percent of all lumber cut would be wasted because it was fit only for boxmaking. In all, 14 claims were made by the lumbermen against the fibre box, showing why it would not work. All were successfully refuted.

In the final analysis, it was a matter of shortsightedness and selfishness which prompted the lumbering companies to take the stand that they did. They wanted to sell wood boxes. They were shown to be wrong; that a properly designed, properly made, and properly employed corrugated shipping box would safely carry merchandise.

Bettendorf points out that no amount of ridicule, scorn, falsification of test results, nor pleas for sympathy could deny the suitability of the corrugated board shipping box. As a result, the nailed wood box--the dominant form of shipping container of its day--was replaced by the corrugated box.

3.4 GROWTH IN THE USE OF CORRUGATED BOARD

In 1910, 150,000 tons of paperboard were used by converters. At this time, the solid fibre shipping box accounted for the greater share

of the use of containerboard. By 1920, companies manufacturing corrugated and solid fibre boxes consumed 970,000 tons of board, a six-fold increase in ten years. This rapid expansion of the use of fibreboard in the manufacturing of shipping boxes was due, at least in part, to the Pridham decision (5).

TABLE 1

CONTAINERBOARD TONNAGE CONSUMED BY CONVERTERS (27)

Year	Consumption
1910	150,000 tons
1920	970,000 tons
1930	1,860,000 tons
1940	3,100,000 tons
1950	10,926,000 tons
1960	15,676,000 tons
1964	19,343,000 tons

In the late 1920's, the introduction of Kraft paperboard strengthened corrugated and solid fibreboard shipping boxes because it was a better quality, stronger pulp. This allowed the use of less material (by weight) to obtain a shipping box with given strength properties. This allowance of a lighter weight shipping box resulted in an increase in the number of boxes manufactured per ton of paperboard. Thus, the increase in tonnage (doubling between 1920 and 1930) does not show the full impact of the increasing numbers of fibre shipping boxes in the marketplace (5).

By 1929, paperboard production had increased to 4.4 million tons.

This increased by mid-century to 10.9 million tons. During this time, the relative proportion of paperboard, in comparison to all fibre products produced, increased. In 1929, paperboard accounted for 40 percent of the total, and paper and paperboard together accounted for 95 percent of the total woodpulp consumption. By 1953, paperboard represented 52 percent of total woodpulp consumption. "This indicates the relatively greater growth in the paperboard industry compared with the paper industry, which has largely been the result of the use of paperboard in packaging" (1).

Of the various types of paperboard produced, materials used in fabricating corrugated board--liner materials and corrugating medium--account for nearly 58 percent of the total output.

TABLE 2
PAPERBOARD PRODUCTION -- 1965 (27)

<u>Type</u>	<u>Production (M Tons)</u>	<u>Percent of Total</u>
Liner Materials	8,384	40.7
Corrugating Medium	3,465	16.8
Container Chipboard	295	1.4
Folding Boxboard	3,269	15.9
Special Food Board	2,043	9.9
Other Bending Board	286	1.4
Set-up Box Board	645	3.1
Other Nonbending Board	442	2.1
Special Paperboard Stock	1,692	8.2
Cardboard	91	0.5
TOTALS	20,612	100.0

"Of the two major types of containerboard, corrugated and solid fibre, the latter is now but a small fraction of total production. From a peak in 1931, when solid fibre accounted for about 23 percent

of combined containerboard output, it fell off to about six percent at the beginning of World War II." Use of solid fibre for weather-proof ("V") boxes raised this proportion to about ten percent by 1944, and there was also a slight increase during the Korean War in 1950. Since then, there has been a trend toward the use of corrugated board for shipping boxes, as opposed to the use of solid fibre. By 1965, solid fibre accounted for less than two percent of containerboard output.

In the corrugated containerboard category, the major type produced is single wall board, which accounts for about 93 percent of all corrugated board output (1).

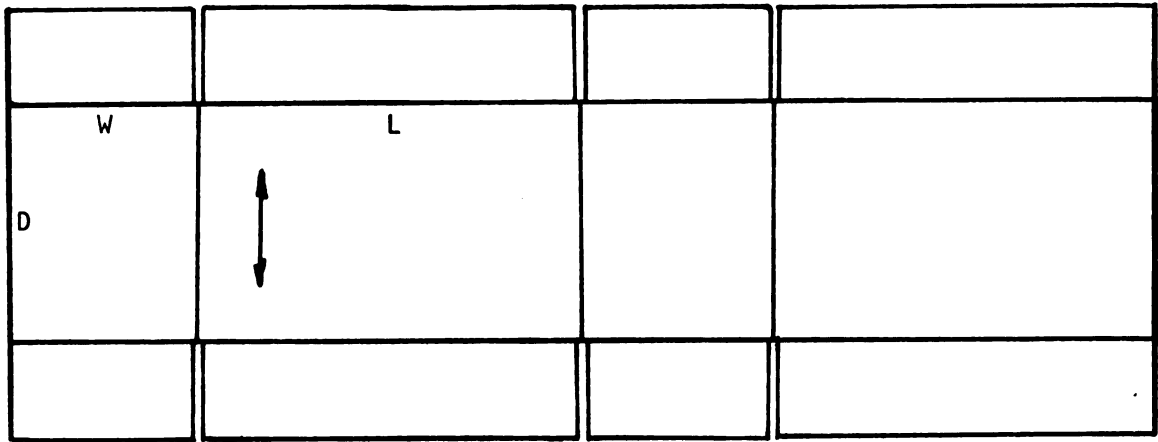
3.5 THE CORRUGATED SHIPPING CONTAINER

The corrugated shipping container has grown from its inception less than 75 years ago to become the dominant form of shipping container. There are a number of basic styles of corrugated boxes which may be constructed. However, the typical box--the standard of the industry--is the Regular Slotted Container (RSC). "It is far and away the most widely-used corrugated container, for it is usually the most economical style which can be produced" (62). (See Figure 1.)

Corrugated board is a versatile material. It may be manufactured into an ordinary shipping container, or it may be made into an "eye-catching, four-color merchandising display..." The corrugated shipping box can be made rigid and strong, or it may be flexible. It provides cushioning when needed, handles and stores easily, and may be easily adapted to use on automatic production line machinery. It can be fashioned into nearly any size and shape of box. "In short, corrugated can be called upon to fulfill just about any requirement that modern

FIGURE 1

TYPICAL CORRUGATED BOARD REGULAR SLOTTED CONTAINER

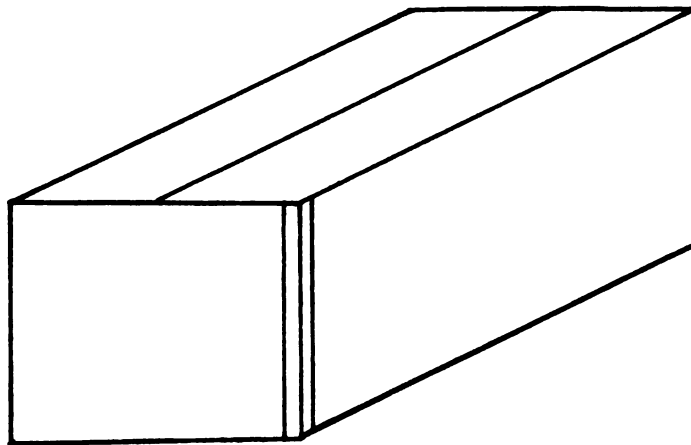


BOX BLANK



TOP LINER
CORRUGATING MEDIUM
BOTTOM LINER

BOARD COMPONENTS



packaging demands of it. Yet it is one of the lowest-cost shipping mediums available" (1, 62).

"Furthermore, increased cost of shipping and the growing utilization of air transport have both emphasized the need for a strong, lightweight container to keep shipping costs at a minimum" (1).

According to Welshenbach, it is "difficult to think of commodities that are not or cannot be shipped in a corrugated container." The styles and types available are limited only by economics and the imagination of the designer. Many different liners, partitions, pads, corner posts, and other auxiliary corrugated constructions may be used as a part of the shipping box when specialized bracing, reinforcing, or support is needed.

"By virtue of remarkable utility, exceptional strength characteristics, light weight, and low cost..." corrugated packaging materials are widely used to fulfill the various functions of the package. And, such shipping containers, when empty, require a minimum of storage space prior to being moved to the packaging operation (12).

In summing up: in comparison to nearly any shipping container one would care to consider, it may be said that the corrugated box has many advantages. It is lightweight in comparison to the nailed wood box. It is strong enough to withstand imposed stacking loads, when properly designed and using strong enough materials. It is versatile and adaptable. It may lend itself to automatic filling, closing, and sealing. It is relatively inexpensive for the job it performs. The corrugated box can be made to fulfill all of the functions of the package.

CHAPTER 4

THE FUNCTIONS OF THE PACKAGE

"The price for tomorrow's packaging successes is undoubtedly time and effort spent now in learning how to use the new medium." --Robert D. Lowry

The package--any package, from a small plastic film pouch for an individual serving of some product, to a house-sized crate for a diesel engine--serves, to varying degrees, three primary, essential functions in the movement of goods from the point of production to the point where the product is used or consumed. The functions that any given package serves are:

I. Protection

A. Product

B. Environment

II. Utility/Convenience

III. Motivation

The successful performance of this series of functions must be accomplished if the package is to succeed in effectively moving goods to a consumer. These functions are interrelated, and failure in one of the functions may cause the over-all failure of the entire product-package system. All of these functions are of importance throughout the life of packaged goods. Performance in any function may vary from barely acceptable to excellent, and the adequacy of the package as a whole reflects the composite of the suitability of performance in any given individual function.

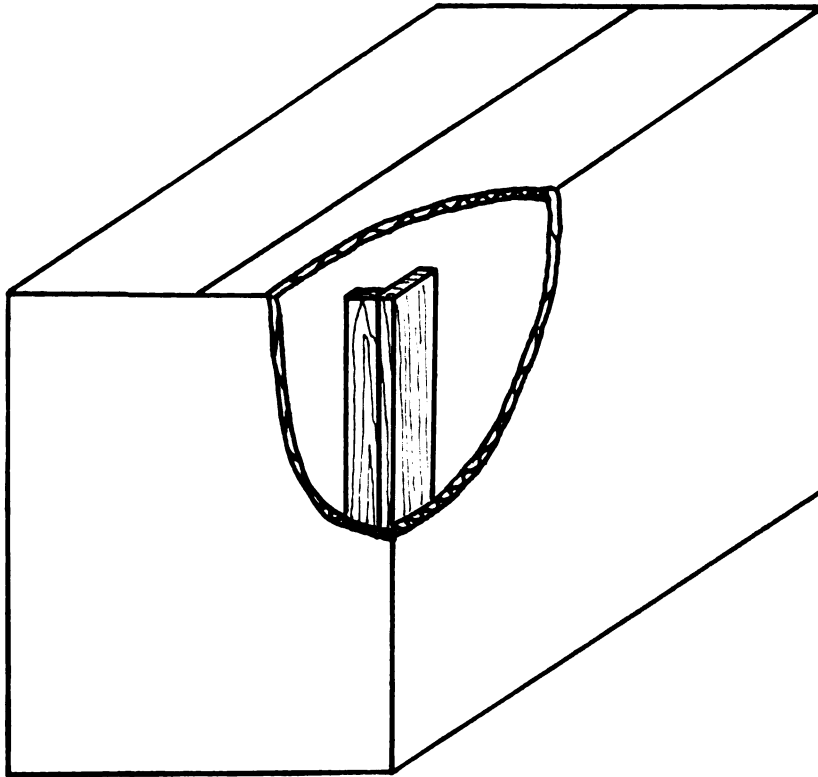
4.1 PROTECTION OF THE PRODUCT

Many writers indicate that protection of the product is the major function of the package, and was one of the earliest functions to be fulfilled by the package (8, 13). As Charlton put it: "In its simplest form and from earliest times the package offered at least a limited protection to the contained product" (7). Some of the earliest containers in recorded use were used to protect wines, oils, and perfumes from being harmed by the environment surrounding the product in its package. That is, clay pots and other early stone vessels or skin bags were used to keep contaminants away from these products. They were not always successful, however, as Herodotus wrote about the water imported into Egypt during the Persian wars--many individuals became sick and died from contaminated water (49).

The more modern wooden, corrugated, or other form of shipping container is used to give a measure of product protection. Regarding corrugated boxes, it is a point of tariff regulation (as shown by the previously-cited Pridham decision) that corrugated boxes are supposed to be capable of giving adequate protection for products against damage in shipment. The major issue of the Pridham case was that corrugated board boxes could provide adequate product protection, and that they should not be subject to penalty by the unequal application of freight rates.

This is still true today. Corrugated boxes protect various products from mechanical damage in many ways. For the most part, corrugated boxes protect products packed inside from such common contaminants as dirt and grime. They give some amount of protection to contents against damage due to shock or from loads applied by stacking, as in warehousing (see Figure 2). They protect contents from damage by puncturing of the container by

FIGURE 2



Illustrating the placement of wooden cornerposts in a corrugated paperboard shipping container, to provide

PROTECTION FOR THE PRODUCT

against high compressive loads such as applied in warehouse stacking when boxes contain unusually heavy product loads.

a sharp object, or impact, and in many instances the shipping container also protects the contents from loss due to pilferage (20, 47, 65).

4.2 PROTECTION OF THE ENVIRONMENT

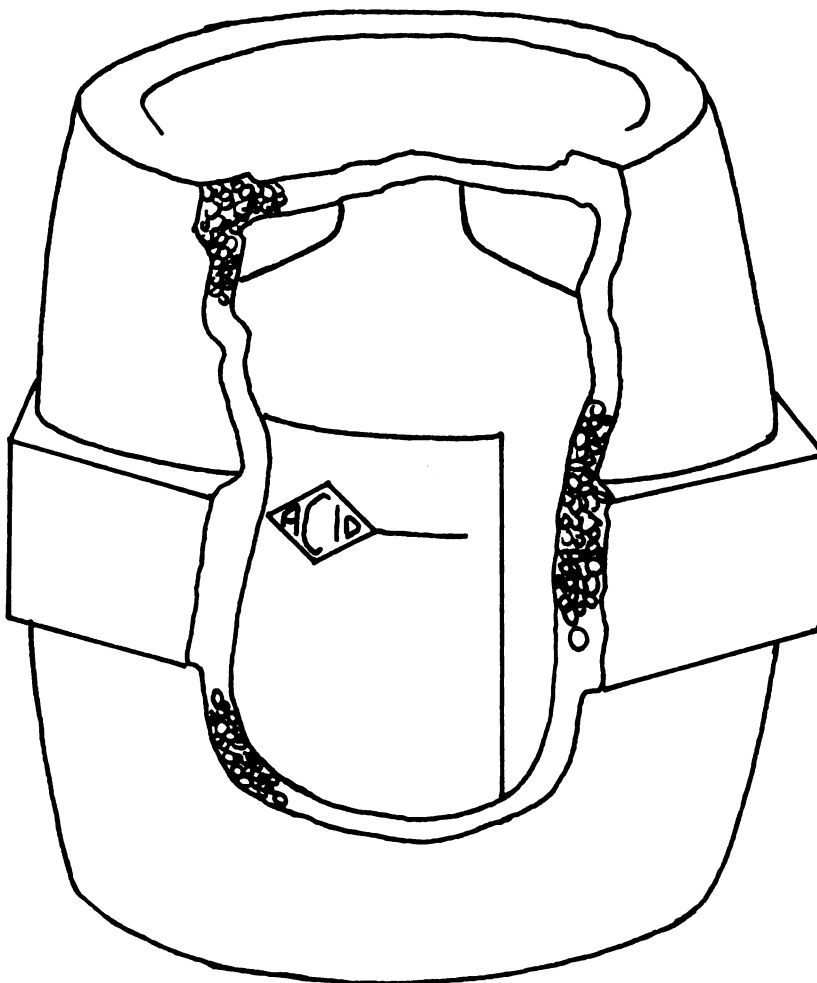
Protection of the environment through which the packaged article travels is also a recognized function of the package. Here, concern for the welfare of people, machinery, transportation equipment, and other facilities which come into contact with, or surround, the packaged product come into account. This is to say that the package must be constructed in such a manner that the individual who handles the package in the course of the work day--or even a casual passerby--is not injured or harmed in some way because of a package failure.

One obvious instance of a package providing protection for the surrounding environment is graphically shown by the container which holds, for example, an acid, or an explosive. Here, the package protects people, production facilities, material handling facilities, storage and transportation facilities from harm by the product (see Figure 3).

The package may be required to give protection to an individual as he handles it. For example, the package should not tear, or otherwise fail, when a person is trying to lift or carry it. If it does fail, the individual may fall, or perhaps have an object from the package drop upon his foot, thus injuring him.

Corrugated paperboard shipping boxes may provide such protection to the environment when they are properly designed with such a goal in mind. They may be used in conjunction with other materials, for example, to contain a liquid product which could harm the environment in some manner

FIGURE 3



Illustrating the placement of a primary container for a hazardous product into an expanded polystyrene shipping container to give

PROTECTION FOR THE ENVIRONMENT

against the hazardous product. The primary container and closure protect the environment from the product. The plastic shipping container (illustrated cut away) provides cushioning for the primary container, completing the protective system.

if the package should fail: acid--corrosion; milk--staining; syrup--sticking; and so on.

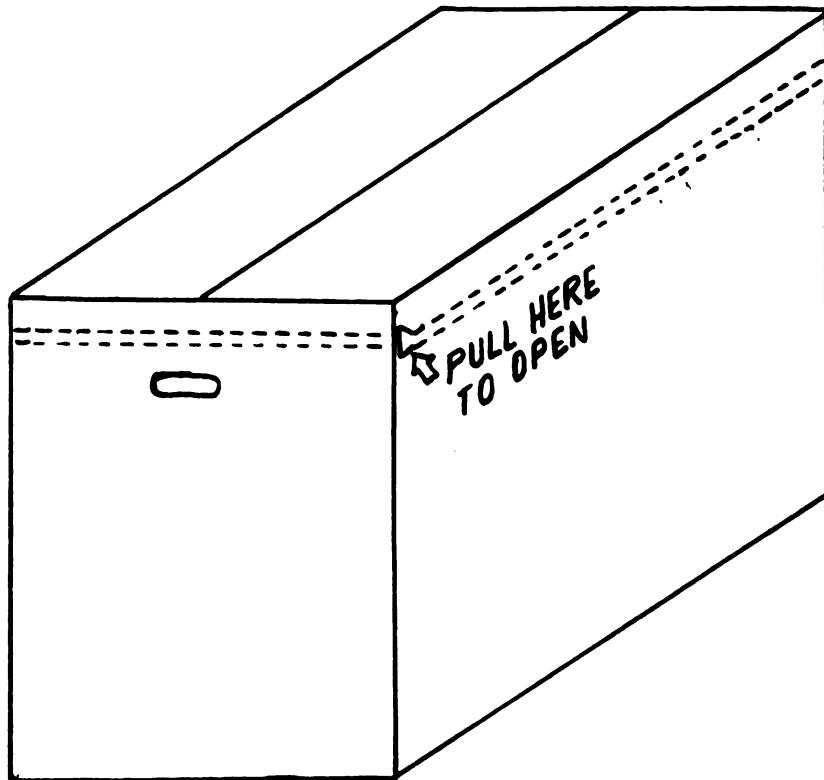
Corrugated boxes may also provide protection of the environment by carrying warnings of hazard, or directions for safe handling and storage. Exemplary of the former concept is the legend, "DANGER! EXPLOSIVES!" An example of printed directions for storage which may contribute to protection of the environment are the legends, "THIS SIDE UP," including, perhaps, the illustration of an arrow, and "CENTER OF GRAVITY," including an "X" or a target.

4.3 UTILITY OF THE PACKAGE

The utility function of the package is probably one of the earliest recognized, along with protection of the contents. Packages were a convenient way to accumulate a product to keep it in a single place. Barrels and pails to contain oils and other liquids provided utility in these early package forms.

While this still holds true today, the utility of a package is measured also in large part by the convenience which it provides. A properly-designed package should be convenient and efficient to fill, seal, convey, store, transport, open, and sometimes, reclose (7, 8, 13, 20). By convenience is meant, in part, the capability of promoting efficiency in handling and use (see Figure 4). Packages which are inconvenient to fill slow down a production line, with a corresponding lack of efficient operation and loss of productive capacity. Packages which are inconvenient to handle and convey reduce materials handling capability, with a corresponding economic loss. Packages which do not allow full utilization of warehousing facilities because of insufficient stacking strength cause waste and

FIGURE 4



Illustrating the placement of hand holes in the ends of a container, and the application of a tear-open strip to fulfill the

CONVENIENCE

function of the package, making it easy and efficient to handle, and easy to open without tools.

increased cost. Packages which are inconvenient to open, to use the product from, and to reclose, when necessary, are held in poor regard by the user of any product, regardless of whether it is a consumer, industrial, or military item; and economic loss to the producing firm may result because of the failure of the package.

Another measure of package utility is gauged by the ease with which the product may be removed from the container. It is important, for example, to the managers of a production line in an automobile plant--or in any mass-production line situation--to have various components packed in such a manner as to facilitate transportation to the production line area, and to enhance (that is, make efficient) the removal of such parts by the assembly-line worker.

The attribute of being able to easily and conveniently remove a product from the package is called "use-out" capability in the industrial arena. Among the first people to recognize the economic advantages to be gained by using packages providing this utility was the late Henry Sommer, packaging engineer at Oldsmobile Division of General Motors Corporation in Lansing, Michigan. He began working with representatives of companies supplying Oldsmobile with automobile components as early as the period encompassing World War II, to improve the "use-out" characteristics and capabilities of incoming packages.

A third aspect of package utility is illustrated by the re-use capability of some packages: either to refill, for example, a corrugated board box with more of the same type of packages as originally filled it, for reshipment; or by a customer using a large, decorated metal container for a waste basket in his home.

Corrugated shipping boxes may provide the utility/convenience function of the package in the various manners listed above. The prominent example of such a container is the Regular Slotted Container which usually runs very well on automatic production line machinery which sets up, loads, closes, seals, conveys, and stacks such containers. Additionally, some corrugated board shipping boxes are designed to be convenient to reclose after use of part of the product.

Use-out capability is demonstrated daily in automobile assembly line operations where parts for automobiles are quickly and efficiently reached and removed from the container by production line workers.

Reuse capability in corrugated boxes is demonstrated in the container which carries empty glass containers from a glass bottle manufacturing plant to the plant where an end product is filled into them. At the packing plant, the glass containers are removed from the shipping box, and filled and closed. Filled glass containers are then loaded into the same boxes--"reshippers," as they are called--and shipped through the physical distribution channel from producer to the consumer.

4.4 MOTIVATION OF THE CONSUMER

The final function of the package, and the function most-recently recognized and developed, is that involving motivation. With the advent of the supermarket, and the resulting self-service concept, it fell more and more to the package to motivate the consumer to buy the packaged product (7, 8, 66). As Charlton wrote: "With the advent of retail distribution came the realization of the value of the package in merchandising--an appreciation of the fact that the package could serve to attract attention and help build consumer sales."

Embraced in the concept of motivation is designing and manufacturing the package in such a way as to enhance its appeal to a potential customer. As explained by Harry Pearlman, President, Swanee Paper Corporation: the package is the most direct expression of the product itself. The package is the key factor in transmitting impressions of quality, softness, and the like (22).

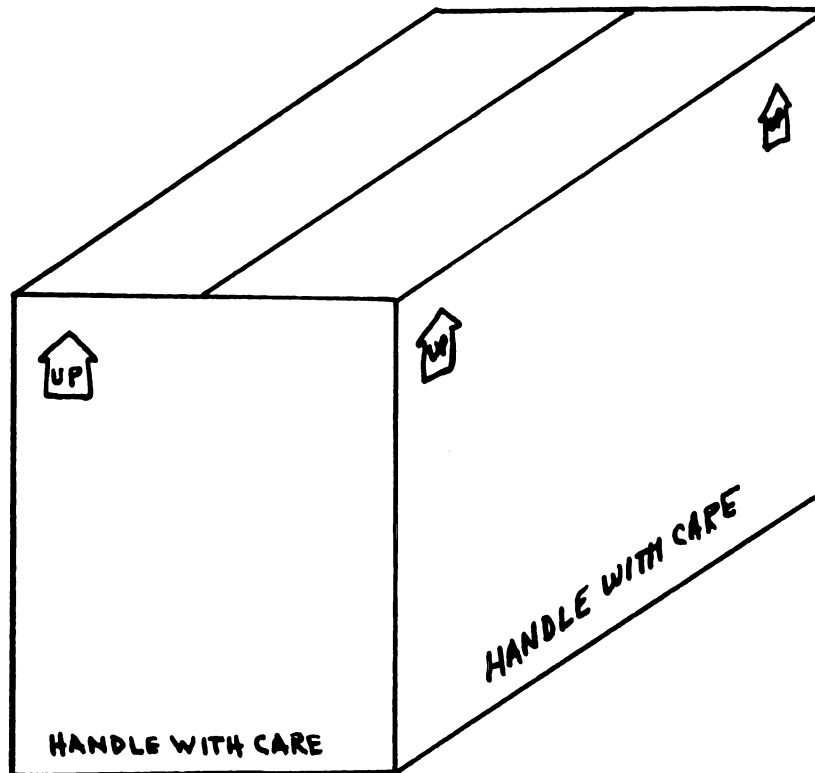
Also involved within the framework of motivation is the concept of inducing the purchaser of the packaged product to use the product properly and safely, thus to have a satisfactory experience so he will purchase the product again. In considering shipping containers, the package should provide product identification for convenience in retrieval from storage, and should motivate careful handling of the package where appropriate (see Figure 5).

Here, too, the corrugated board shipping box provides motivational aspects, especially with the recent introduction of pre-printed, bleached top liners for boxes. Bright, attractive designs, in high-quality printing, are now being applied to corrugated board shipping boxes. This quality imagery may promote sales of consumer and industrial types of products.

To sum up: the functions of a package are to protect the product from a frequently hostile environment of heat, light, dust, dirt, humidity or water, shock, vibration, insect infestation, and pilferage, among other conditions. It should also protect the environment, including passersby, from sticky, staining, corrosive, powdery, or poisonous products, among others.

The package also makes a product convenient to use, especially in certain instances where the product is rendered in a form otherwise not easily

FIGURE 5



Illustrating the use of caution labels which may be applied to a shipping container to fulfill the

MOTIVATION

function of the package. Here, legends are intended to motivate a handler to keep the package in an upright position, and to handle the shipping container with reasonable caution. Product brand name or other product information might also be provided.

obtained--for example, aerosol spray paints in a pressurized package, which eliminates the need for a compressor and spray gun in the consumer's home, but which gives an equivalent result. Packages make products convenient to store, handle, transport, and use, as well.

And the package may motivate the consumer to buy the product in the first place, to use it safely, efficiently, and properly, and to buy it again. Many package forms, including the corrugated board shipping box, accomplish these functions, singly, in pairs, or all three in a given package.

As a result of what the package is required to do, it is found to affect a broad segment of management attention in the contemporary corporation. As Paine wrote, all of the operations which are carried out in a commercial enterprise after the product has been made will either be a part of the packaging process, or will be considerably influenced by packaging considerations.

CHAPTER 5

PACKAGING CONSIDERED AS A SYSTEMATIC FUNCTION

"If a few little efforts are made, here and there, to begin thinking about the range of possibilities, there will be material to sketch out, as in a great chess game, some preliminary questions, so that better players than ourselves can ultimately develop a strategy." --Gardner Murphy

Packaging is one factor in a broad spectrum of industrial activity. The series of packages which make up, in combination, the package system has many functions to fulfill, many performance requirements to meet. The package system includes all of the packages used to contain the product (primary, secondary, shipping container, as appropriate) and convey it safely, efficiently, and economically to the consumer. It can accomplish these many jobs only when it is designed in the first place with the intention to accomplish given goals within a larger, all-encompassing distribution system. One must consider how the package will perform in the distribution channel and the use situation, and how it is to be disposed of, in addition to how the package is to perform within the product-producing plant.

5.1 THE OVERALL VIEW

To successfully develop a package for shipping a product to market, information may be gained, and specific requirements will need to be met, at many points on a broad continuum of business activity. The requirements for a package may begin to be formed at the time some raw material comes out of the ground. These requirements do not cease until the package is disposed of. This is illustrated in Figure 6. On the one hand,

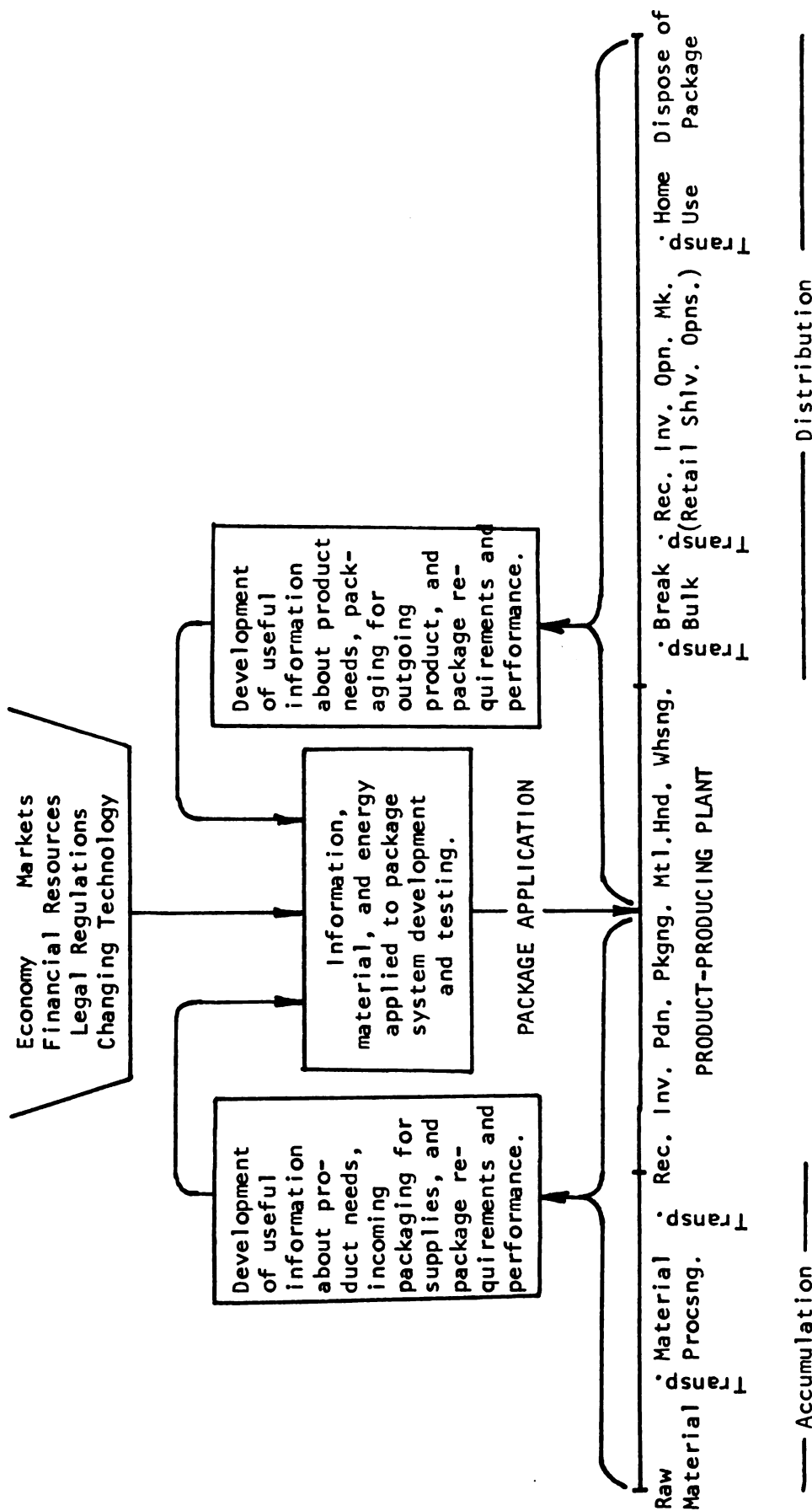


FIGURE 6

The Business Activity Continuum, showing the conversion of a raw material into a useful product which is packaged, sold at retail, and used by a consumer. Sources of information about the product and its packaging requirements are shown, along with the development of useful information from all segments of business activity. The interaction of society, the economy, its financial characteristics, and legal restrictions on packaging and marketing of a product are shown, in addition to the impact of changing technology in packaging and distribution.

some natural resource, or raw material, such as ore or natural gas or a food crop is taken out of the ground. These may be modified by a series of processes into many end products: iron ore into steel into typewriter frames; natural gas into its components, and polymerized (for example) into polyethylene, a packaging material; trees into pulp into paperboard into corrugated board shipping containers; crops into food products.

At the product-producing plant, the raw product is processed, and finally is packaged and prepared for shipment in some sort of packing operation. The filled container goes from the end of the production line into the manufacturer's storage facility, is carried to the break-bulk point for distribution to the retail store, thence into the consumer's home. The individual package there surrenders its contained product, and is disposed of.

Information about packaging may be developed at any point along this continuum. The testing and application of a material for packaging will be affected by the product, the mechanical and atmospheric environment, consumer preferences, producer's needs, costs of packing, handling, storage, transportation, display, use, disposal, and changes in manufacturing and distribution technology.

While the specification of incoming packages is becoming more common, so to meet the requirement for efficient handling within the producing plant, this discussion of a systematic approach to packaging will consider primarily the package for shipment of goods from the product-producing plant. Similarly, while primary packages (that is, a package in direct contact with the contained product) alone may carry a unit-of-use of some product into the consumer's home, this discussion considers primarily the shipping container which carries a product which is sold at the retail

level. It is true that some shipping containers carry a product to the consumer's use point. And it follows for this situation that the protective, utilitarian, and motivational functions of the package must operate until the individual consumer uses the product and disposes of the container. This discussion, however, considers primarily the shipping box which normally is disposed of at the retail level.

5.2 FRAMEWORK FOR PACKAGING EFFICIENCY

According to previous discussion, one measure of productive efficiency or economy is cost: the cost of making a product and moving it to market. This is included in Paine's definition of packaging, as well: packaging is to be accomplished within the framework of the lowest overall cost. The formal, dictionary definition of efficiency equates efficient operation with cost in terms of time, energy, or money.

If total cost is a measure, or the measure, of overall efficiency or economy of some service, then a study of packaging and distribution costs should point the way to packaging and distribution efficiency or economy.

One cannot, then, separate the dollar cost from the systematic analysis of the process of packaging a product for distribution to a retail store. This is within the scope of this paper.

The operations that are performed in packaging for distribution take place at many points: in the product-producing plant, in the producer's warehouse, in transportation to the break-bulk point, in the break-bulk operation, in transportation to the retail store, and in the retail storage and display operations. Schematic representation of this segment of the packaging and distribution system is given in Figure 7.

FIGURE 7

Influence on Package Operation	Loading Product Into Package					Break-Bulk Operation			Sale of Product at Retail		
	Transportation	In-Plant Storage	Transportation	Warehousing	Break-Bulk Operation	Transportation	Retail Store	Sale of Product at Retail			
Machine Stresses	Shock Vibration Handling	Stacking loads Time Temperature Humidity	Shock Vibration Handling	Stacking loads Time Temperature Humidity Pilferage Insect/ Rodent Infestation	Handling Case-opening Shock Vibration	Shock Vibration Handling	Handling Opening Price-marking Shelving Disposal of Shipping box				

Illustrating the components in, and the extent of, the environment through which the shipping container and other components of the package system move a product from the point where it is produced to where it is sold.

5.21 Packaging Costs In The Producing Plant

Factors influencing packaging costs at the point where a product is manufactured are many and varied. This paper will not consider the cost of a primary (that is, unit) container--the package which directly contains the product, or its components. Only costs which affect the efficient, economical use of the shipping box will be considered. This is not to say that the unit container does not have an impact on the suitability of the shipping container which completes a system. Rather, this paper will consider the primary container as a constant, and assume that any shipping container application is made properly, and will meet product and primary package packing requirements.

Now, if a company is currently using a regular slotted corrugated board shipping box, there will be certain costs involved in receiving such containers, inspecting them, moving them to storage, storing them, inventorying them (that is, maintaining inventory control), moving them to the production line, using them in the production line, moving case-packed goods into in-plant storage facilities, and supervisory and overhead costs associated with all of these activities.

To accomplish an economic survey of shipping container costs in the packing plant, one would want cost data on labor for receiving, inspecting, and transporting the incoming containers to storage. The cost of storing the containers would probably be prorated on the basis of floor space used for storage, at some annualized rate. Labor for moving the shipping boxes to the line, and using them on packaging production line machinery should be considered. Also, cost of electric power, or other power, adhesives, imprinting ink, and/or other filling, closing, sealing, and package-handling costs should be determined. Then, the labor cost for palletizing

and moving finished goods to storage, equipment depreciation, indirect labor costs for supervision, other overhead expenses, and scrap costs should be calculated.

If one were to consider a new package system, then, a corrugated board tray utilizing a shrink film overwrap, for example, a new set of operating costs would need to be considered. First would be the cost of the new packaging materials. If, for example, 24 cans of some processed food product were packaged in a regular slotted container, one would determine the cost of that package. This would be compared with the cost of two corrugated board trays (each holding 12 cans), and a certain, required area of plastic shrink film. In current package-costing practice, many package users stop at this point, considering only the cost of the packaging material delivered to the packer (that is, the product-producing plant). A comparison which considers only the packaging materials cost will not give a true picture of the total, overall operating and distribution cost.

Thus, the cost of receiving the new form of container, of inspecting and storing of trays and shrinkable film, must be considered. The cost of purchasing, installing, testing, proving, and (finally) operating the new machinery required to run canned goods in trays must be calculated. The power requirements, maintaining, and other operating costs should be compared with conventional corrugated board case-packing machinery costs. Also, a higher level of competence for employees running this new machinery might be required, and this labor cost should be determined. If there is a change in operating speed, the added or reduced cost of production (if it is slower or faster) should be calculated. And, indirect labor, other overhead, and scrap costs for the new system would need to be determined,

and added together with all of the preceding costs to get a total for using the new package system in the product-producing plant.

These costs must be gathered carefully, and compared in total to make a meaningful comparison. But, one cannot stop at this point. One must consider all of the other interrelated costs in the remainder of the physical distribution system.

5.22 In-Plant Storage Costs

The cost of storing packaged goods in the product-producer's warehouse has been discussed in great detail by economists and physical distribution analysts. In general, these writers agree that storage costs should be minimized to gain distribution economy. Turnover time should be minimal to avoid long-term inventory costs, waste due to spoilage or change in the market, or the like.

In studying the comparative cost or efficiency of two different shipping container systems in in-plant storage, the following costs should be determined:

The cost of moving goods into the warehouse; labor, equipment operating expense, equipment depreciation, equipment maintenance, supervisory and other overhead expense, and any other cost associated with moving the product into storage.

The cost of maintaining stored stock; spoilage of product, damage to containers and product, restacking (if necessary), inventory control, cost of capital in inventory, insurance, and other overhead costs.

The cost of loading stored product onto transportation equipment; cost of locating and retrieving stored goods, labor for

movement of goods onto transportation equipment, equipment operating and maintenance expense, depreciation cost, inventory control and billing, and other overhead costs.

All of the costs of moving packaged goods into storage, storing and retrieving them, and loading them into transportation equipment would be determined, and compared for two (or more) shipping package systems. If one package is easier, faster, or more convenient to handle, or stores with less product loss or mechanical damage, this will show up in this segment of total operating and distribution costs.

5.23 Comparison Of Transportation Costs

A number of factors influence the cost of moving goods to a distant warehousing point for the breaking down of large shipping loads into smaller units of product which go to a retail store.

Perhaps the dominant cost factor here in comparing two shipping container systems would be the difference in the weight of the shipping packages. In transporting goods on most common carriers, the package gets shipped at the same rate as that which is charged for the product. Assuming that the weight of 24 cans of some processed food item, for example, does not vary, the weight of the shipping container for one package system might be significantly different than the other, leading to a shipping cost saving. A small difference in weight for one caseload would be multiplied by the number of cases in a palletload, and thence in a truck trailer or railroad carload.

Other costs of transporting goods to a commercial or captive warehouse (that is, break-bulk point), would include the cost of loading and

unloading the train car or trailer load, by hand, or semi-automatically, or automatically; the cost of transferring the goods to storage; cost of receiving and inspecting the goods; cost of loss due to damage in shipment; inventory, direct and indirect labor, overhead, and insurance costs; costs of breaking out individual cases from palletloads and reassembling them for shipment to a local distribution point, and the cost of loading the goods into a truck for local delivery should be determined in an economic analysis of shipping container system efficiency.

5.24 Cost Of Shipment To A Retail Store

In many respects, the cost of moving the product from a warehouse to a retail store would be similar to the costs of moving goods from a product-producing plant to the break-bulk point.

While the individual warehouser would be working with individual cases as opposed to palletloads, and small trucks instead of over-the-road rigs, the steps are essentially the same, and costs could be determined in a manner similar to that considered previously. At this point, however, shipping container weight probably would not be a factor.

The cost of package retrieval, of loading onto the delivery truck, of unloading the truck and transferring of cased goods to the retail store, would be considered. Also, the costs of billing, equipment operating expense, damage and loss, and the like, would need to be calculated in order to make a thorough cost analysis for two or more shipping container systems.

In this situation, a utilitarian feature which makes a shipping container easier or more efficient to handle would probably contribute to a lower total distribution cost. Hand holes, or similar devices in shipping

boxes demonstrate the utilitarian function of the package, and may contribute significantly to distribution efficiency. The time required to load one style of shipping container into a delivery truck may be less than for a second style, with a corresponding decrease in the cost of distribution.

5.25 Retail Store Operation

There are several aspects of cost that are directly determined by the shipping container which carries a product to the retail store. Since many retail stores operate on the premise of a rapid product turnover, and do not have large-capacity storage facilities (in essence carrying products directly from truck trailer to display shelf), inventory costs might be safely ignored at this point.

However, in retail grocery store operations where shipments of canned, processed foods are displayed, the various handling, opening, price-marking, shelving, and display costs might point up significant advantages for one shipping container system as opposed to another.

Data on the cost of labor for moving a case of product from the receiving dock to the store aisle should be determined. The time required to open and price-mark a case of goods, and place the goods on a shelf or in a mass display should also be determined. In this operation, damage to the packaged product in the opening, price-marking, and shelving operations should be considered, and may be significantly different for different shipping container systems. For example, a package which allows a reduction in damage to primary containers from case-opening knives probably will present a significant cost differential.

Labor cost for these operations is a significant part of retail grocery store operations. A package which facilitates opening, price-marking, and display operations would contribute significantly to lower, total distribution cost (48).

Also, in comparing the efficiency of two different forms of shipping containers, one might contribute to greater product turnover than another. Part of the job of the primary, or unit, package is to motivate the individual consumer to buy the product. If one shipping container form contributes to greater product turnover because of increased effectiveness in accomplishing the motivational function of the package, then that shipping container would be the more efficient, giving a corresponding increase in contribution to profit, or decrease in operating cost.

Thus, there are many points in the distribution system which affect the efficiency of a shipping container within the package system, and thus the cost of using the container system. The base cost of the shipping container delivered to the product-producing plant may not be the significant cost issue. Rather, the cost of labor for handling one system or another may be the more significant factor in the calculation of total distribution cost.

In some instances, costs for either system, or any package system, will be identical, or nearly so. The costs of inventory control, indirect labor, overhead, insurance, cost of capital in inventory, and billing costs, for example, may not be significantly affected by a particular form of shipping container.

Materials cost, shipping cost, loss due to damage or product spoil-

age, and direct labor for handling and displaying operations, on the other hand, may be significantly different.

Determination of the cost of one shipping package delivered to the product-producing plant, in comparison to the delivered price of some other shipping package, by itself, will not give a useful, overall picture of the cost of using one or the other of the systems. Suppliers of packages which sell shipping containers on the basis of delivered price alone are short-sighted, and do neither themselves nor their customers justice in determining an efficient, low-cost application of the shipping package.

Finally, it should be noted that the calculation of these costs does not occur in an unregulated, static environment. The impact of increasing Federal, state, and local regulation has an affect on the package system. Various regulations may affect the efficiency of a shipping container in a direct manner. Also, the shopping habits of the individual consumer change, and this influence on changing marketing techniques must be considered in relationship to the shipping package.

5.3 THE IMPACT OF A CHANGING MARKET

Some companies have come to operate under the assumption that the package means even more than its contents. Yesterday, packaging was an afterthought in the marketing of a product. Today, with self-service the major thrust of marketing effort, the package is the main tool, and managers recognize that package structuring must take a high place in corporate planning (19).

Thus, it more and more falls to the package to represent, in essence, what it is that a company has to sell. Effective design requires the integration of various criteria: state of the current market, the intended

purchaser, the function of the package at various points--storage, home, and so on; and consideration must be given to the total cost for doing this. The consumer is a key element in an evaluation of the contribution of the package. Assessing this contribution poses several questions: How does the package contribute?, Are these contributions significant?, How much do the contributions cost? (2, 19).

If packages promote the sale of a product, then the package develops higher net-profit power in the degree to which it decreases cost, speeds sales, increases income (or all three) throughout the entire production and distribution cycle. A higher-net-profit package is one "that earns money by any means possible." This may be accomplished through reducing package cost, increasing sales of the product, selling the product for more money because of increased value due to packaging, or the like (10). It is well, also, to remember that the cost of any package is the sum of all of its disadvantages. Packaging material cost is not the only criteria; cheap packaging materials may result in higher distribution costs because of damaged and returned product (9).

5.4 SUMMARY OF THE SYSTEMS APPROACH

In the original design of the package for any product, one must view the package system as fitting into--complimenting--a larger distribution system. In considering the package which will contain the product, and its associated shipping container, one must consider how the package will perform within the producing plant. Various factors that affect the selection and ultimate performance and overall cost of the package are such items as (a) how the incoming packages will be received, inspected for incoming quality control, handled, and stored prior to production;

(b) how the packages will be carried to the production line area, filled with product, and relate to production line facilities; be closed, sealed, and moved to the outgoing storage area; (c) how the filled packages will be handled and stored within the packing plant.

The package design that ultimately gets selected will be affected by the physical distribution environment, and will affect the efficiency of physical distribution system components. The equipment which will be used to load packages onto transportation equipment, the mode of transportation employed, distribution handling and storage facilities, and the environment through which the package will move--including the factors of temperature, humidity, light, dust, shock, vibration, and the passage of time--must be considered at the time the package system is being designed, and will influence the testing and construction of the package which carries the product to the consumer.

The ultimate consumer of the product must be considered in the planning and design of the package system, as well. The manner in which the product is displayed, and how the consumer takes the product home (in the instance involving a consumer item)--or to the work area; the manner in which the product will be stored, and finally used, affect the design of the container system. Partial use of the product, or reuse of the container will pose different packaging requirements than if the product is consumed in one application. And, disposal of the empty package is more and more a pressing issue: this must be accomplished quickly and easily (and without polluting the environment) for any consumer, industrial, or military product.

All of the foregoing factors must be considered in the design of the

package system. All must be accomplished within the framework of the lowest total cost. Here is where trade-offs can be accomplished. Paying more for a package may result in increased sales and larger profits; changing the package structure may allow shipping with greater speed in a higher cost mode of transportation, reducing inventory costs, and/or overall handling cost as a result.

One must, then, view the total packaging and distribution system, and note the changing relationships of the package to the total system as either change. The goal is to balance all of the components of the system to get the most efficient, lowest cost, greatest profit result, with the greatest benefit occurring in favor of the consumer of the product. To attain this goal, an analysis of all costs incurred in using the package, as described within the preceding analytical framework, is required.

CHAPTER 6

THE DEVELOPMENT OF COMPETITIVE SHIPPING SYSTEMS

"No army or other force can withstand the pressure of an idea that has reached its time." --Hugo

The continuing development of packages fitting the systems concept from a shipping container standpoint has not been confined entirely to paperboard used in the manufacture of corrugated boxes. Suppliers of other types of containers have developed and proved the suitability of shipping containers of heavy-weight paper; of light-weight, single-ply board; or of certain plastic film materials. In general, the goal of such new container forms is the reduction of packaging, shipping, and handling costs. The results are frequently successful. In nearly every case, such an application has proved successful because all of the factors which are involved in getting a product safely to market have been considered: not merely the price of the package delivered to the product-producing plant.

Thus, the successful use of a new container form for shipping a product frequently follows the application of the systems concept to the development of the new shipping container. That is to say, a product producer looks at his product to determine the requirements it has in relation to the various package functions. The demands of the distribution system are also determined. A new package is then developed to meet these requirements at the lowest overall cost.

In many instances, a new container form will be lighter in weight than its predecessor, yet it will withstand the rigors of the handling and distribution system. Packaging materials cost may be higher for the new

shipping container, but this is frequently offset by handling economies occurring elsewhere within the distribution system. This change in package form is not haphazard, but represents a structurally-sound answer to a specific set of product-package-environment circumstances. The new shipping package represents a proper application of a new material in response to consumer wants and needs and changing marketing and distribution requirements or capabilities.

6.1 PAPER USED FOR SHIPPING CONTAINERS

It has been shown in several instances that a single ply of relatively heavy weight paper can be used to contain unit packages of a product, and transport the unit packages safely to the point of consumption. In many of these applications, a change was made from a corrugated board box to the paper overwrap.

The multi-wall paper sack has been used for many years for the packing of bulk products such as fertilizers, chemicals, and cement. These packages for bulk shipment, however, fill a different need than does the corrugated shipping container, and, for the most part, the products shipped in multi-wall paper sacks are not suited to shipment in corrugated boxes, and the applications of these two package forms are largely non-competitive. Therefore, this work does not consider the impact of multi-wall paper sacks on corrugated board shipping container markets.

As early as 1950, the General Electric company was considering the use of a plain kraft paper overwrap as a replacement for corrugated shipping boxes for lightweight products. The major reason, reported at that time, for considering the change from corrugated shipping boxes to a paper

overwrap for such lightweight products, was specifically to gain a saving in package cost (21).

More recently, a machine has been developed to enclose folding paper-board cartons of product within a 126-pound basis weight kraft paper overwrap. The express purpose of this machine is to provide shippers with automatic equipment to accomplish the shipping pack application with paper, to replace corrugated boxes at a reduction in weight and cubic space, according to the machinery manufacturer. Test shipments of cartons thus wrapped withstand rail shipment with less than one percent damage, and allow the shipper to stack four palletloads high in the warehouse instead of three because the paper bundles are smaller than the corrugated board boxes (38).

Aside from economic reasons, or space-saving or lower-weight package considerations, another pressure on corrugated boxes is induced by the current military commitments of the United States, abroad. One paper products manufacturer is reported to be evaluating paper overwraps for its products because the military requirements are drawing off large quantities of corrugated board for shipment of war materials. This company reports that, if a switch in shipping containers is made, there will be no return to corrugated boxes as long as there are no shipping problems.

At the 1966 annual meeting of the Fibre Box Association, this major point was made: "The paper overwrap is considered to be a greater competitive threat than is the shrink-film pack. Therefore, studies are now being conducted at the Institute of Paper Chemistry to acquire the kind of comprehensive statistics necessary to battle this threat at the shipper level" (44).

"Single-ply and reinforced paper shippers are a very real challenge to significant portions of the corrugated industry. ...The chief advantages of the paper overwrap systems are lower cost for the food manufacturer and easier disposal of the container by the retailer." For packing of grocery products, however, there are some disadvantages in shelving, storage, and damage" (24).

Light-weight packaging for shipment of products is being used because of technological advances in physical distribution equipment. Cargo containers are being used increasingly for the efficient movement of goods. Since the shipping environment is more carefully controlled by the use of "containerization," the shipping package does not have to withstand typical transportation rigors, and the shipping package can be made of lighter weight and less costly grades of materials.

Containers are getting wider use because of the ease of handling and the protection they offer. They can also provide seals which thwart much of the pilferage experienced in the export business, in particular. Because containers provide a shell for their contents, package users ought to have greater leeway in the type and amount of packaging they use for the individual items in the container. Wallace B. Tibbets, corporate packaging coordinator, Union Carbide Corp., New York (commenting on reducing packaging) says, "You've got a (package) that does a job for you as long as it's in the container, and what you save in material costs will usually outweigh the container cost" (36).

"Containerization is increasing in use among all forms of transportation. Putting your packages into containers which land, sea, and air carriers handle as intact units offers advantages. But if you keep on using the same packaging you had for noncontainerized shipments you are losing some of the savings the new shipping practices offer.

"The rub lies in finding out just how much or how little packaging you need when you ship your packages in containerized loads. ...Even so the rewards in solving these problems and in answering the question (how much protection for containerized shipment?) make the efforts worth while.

"I am not suggesting we take the corrugated box as a whipping boy and see how much we can cut out of it. This box enjoys too universal a use and reflects too much sound engineering in all quarters to warrant any summary or abrupt attack on it. It simply happens to be involved in an area of packaging that offers an intriguing challenge: to pinpoint how much packaging you need (in containerized shipments) without having the waste of over-packaging. The potential savings warrant the package users taking a hand in the problem themselves..." (55).

Shippers can cut costs of packaging for goods shipped in cargo containers, according to Glenn Mather, managing director of the Bulk Packaging and Containerization Institute, Inc. Goods shipped in such containers are in an environment that does not yet have minimum packaging standards (a' la Rule 41), and research in the area needs to be done to see how much can be taken out of current shipping packages that get placed in containers. Also concurring in the concept that packaging may be reduced for goods in cargo containers is Norman E. Bateson, director of research and development, Pullman-Standard, Hammond, Indiana.

According to Mather, the significance of the environment is that hazards faced by packages in a confined area such as a cargo container are less than faced in regular rail or motor freight shipment, and are also less than the hazards faced in air or surface trans-ocean shipment plus local transportation before and after the journey across the ocean. The proof of this lies in the results of container use to date (34).

In summing up, shipping boxes made of corrugated board are being eliminated or replaced on two fronts because of advances in technology-- improved papers and the successful application of paper overwraps to primary containers, and containerization. Primary benefits of changing to paper overwraps are lower package cost, lighter shipping weight and thus lower shipping cost, and less storage space is required for shipping package material. The challenge to the corrugated shipper by paper overwraps is considered significant by people in the paperboard industry.

6.2 PLASTICS USED FOR SHIPPING CONTAINERS

In addition to competition from paper overwraps, the corrugated box is being replaced in some instances by plastic materials, frequently in conjunction with corrugated board trays. A major recent development is that which uses a heat-shrinkable plastic film in combination with such a tray. The application of shrink-film systems to packaging of products for shipment has been carried on in Europe, prior to use in the United States, and use appears to be rather broadly-based.

The development of plastic films which may be induced to shrink upon the application of heat is relatively recent in concept, although the various films have existed for a number of years in some instances; polyvinyl chloride was developed in 1927. Other films were also developed several years ago--rubber hydrochloride in 1934, polyethylene and polyvinylidene chloride during the time of World War II. Shrinkable polyvinylidene chloride was developed in 1946. Each of the several shrink films have specific physical properties which must be considered in terms of the individual application. Although polyvinyl chloride is being widely used, polyethylene

has some advantages in shrinkable film form, as well, not the least of which is lower cost.

After about 30 years of struggling, plastics have become a mature member of the packaging industry. Since about 1950, plastics have begun what may become a major penetration of major paperboard markets. In a generalized comparison, Pickering (60) maintains that:

- for equivalent applications, plastics do a better job;
- consumers are willing and able to spend more for a product they consider to be superior;
- plastics costs, while high, are trending downward, while paperboard costs are static.

Plastics have several advantages, not all of which necessarily occur in any one given package. But the success of plastics is derived from favorable combinations of factors as they are applied to the problems of products to be packaged. Synthetic plastics raw materials are capable of being variously combined to give almost any property desired in an end product (3).

Important new package constructions, using the shrinkable film and tray structure for making a shipping container, which will contribute to growth of the use of this technique in the next five years are multi-packs, bundled and unitized pallets, and other combinations of products in over-wrapped trays. Some of these may greatly affect merchandising practices in many different product lines. "There is no modern type of retailing that cannot benefit from these types of packages and there are many uses developing for shipping and industrial-type packages as well" (56).

Shrinkable films have "muscles" for immobilizing many different types of products. The shrink is built in during manufacturing by controlled

stretching of the film to orient the molecules, and locking the film in this controlled, stretched state by cooling it. Stored shrink energy is released by heating the film to soften it, allowing the film to pull back toward its original unstretched condition.

For many shrink-packaging jobs involving a final shrink to tighten a loosely-wrapped package, only a small amount of shrink capability (five to ten percent) is needed. Balanced shrink in the longitudinal and transverse directions is preferred for most shrink-packaging operations.

Adequate tension to provide a tight package after shrinking falls in the 50 to 150 pounds per square inch shrink tension range. High tension (for example, 500 psi) is desirable for packages where the film becomes a structural part of the package. Above about 300 psi, care must be taken to prevent crushing or distorting the product or package.

Among other changes that occur when the film is shrunk are (a) an increase in thickness, (b) an increase in abrasion resistance, (c) an increased tear resistance, and (d) decreased tensile strength. Tensile strength, however, is increased five to ten times over unoriented film in the original stretching process (56).

One material which is being examined and used broadly as a shrink packaging material for shipping containers is polyvinyl chloride. Its popularity is due to a number of factors: its good physical properties, its ability to be compounded for a wide range of applications, and its ease of processing. The material has excellent water and chemical resistance, strength properties, and abrasion resistance; it may be colored if marketing requirements dictate; and it is self-extinguishing (50).

Thus far, the largest industrial venture into using a plastic film as a major component of the shipping package appears to be that sponsored by the Green Giant Company of LeSueur, Minnesota. This company used biaxially-oriented, 0.0015-inch thick polyvinyl chloride heat-shrinkable film in its film and tray packs.

In this application, twelve cans of processed vegetables are placed into a corrugated board tray, two trays are stacked atop one another, and the trays of canned goods are covered by the plastic film. The film is heatsealed at the bottom of the package, forming a sleeve, and the film is then shrunk around the canned goods and trays. This packaging application is called "Shrinkase."

To meet shipping environment requirements, any shipping container must stand up under the wear and tear of handling. The container should not split, nor continue to tear if punctured. It should not slip in a palletload; it must remain properly positioned. A shrinkable film must also meet an added requirement: once shrunk, it must not relax (53).

Original tests of Green Giant's shipping containers showed that the shrinkable film performed in a satisfactory manner. In mixed carloads--one-half regular corrugated shipping boxes, one-half shrink-film shipping containers--the shrink film container has been shown to resist handling and shipping abuse "as well as or better than the RSC. This was true not only for short hauls...but (also) for a recent shipment...from Chicago to Boston--a distance of over 1000 miles" (53).

Because the shrink film shipping containers are open at the ends, they provide built-in hand holes. In hand unloading of carload lots, actual experience has shown a time saving in favor of the shrink-wrapped cans. Cost of the system is decreasing as well, from 10 cents per case

at the start, to 7.5 cents per case in 1965 (about the same as the typical RSC), and "there is no question that Shrinkase costs will drop still further" (53).

Retailers receiving incoming shipments of these canned goods appear to be satisfied with this type of package. One survey (54) showed that 20 of 22 store owners or managers interviewed at random preferred the film-wrapped trays over the all-corrugated box. Damage to canned goods was not a factor; product identification, handling, pricing, and display advantages of the tray system were cited as the major reasons for preferring that packaging system. Other factors in favor of the tray system were scrap removal advantages and the easy opening capability of the system.

The two store owners who did not prefer the film-wrapped shipping case approach had specific reasons in their handling situations where the new system appeared not to fit. In one situation, an inclined conveyor to carry cased goods to a second-floor storage area could not carry the film-wrapped cases because of a lack of traction. This could be corrected, however, according to the survey. In the other situation, the store did not use mass displays of goods, nor tray packs, two of the major reasons for using this system.

There are some problems, however, with this system, according to another survey conducted for the Fibre Box Association. The shrink-film system is claimed to have some disadvantages in long-term storage during which the tops of cans are claimed to get rusty because of the open shipping case. Even so, this survey notes that the shrink pack is a real challenge to the corrugated industry because it possesses advantages in disposal, price marking, and shelving (24).

Shipping containers for canned fruits and vegetables and other grocery products are not the only application of this concept in the shipment of goods. A brewing company is using this type of package system for 12-packs of beer (40). A large trading stamp company is evaluating shrink-film packaging as a method for unitizing shipments moving from its suppliers to regional centers, and from such centers to local stores. It is reported that the technique looks promising for notions, cookware, and some hard goods--since the individual items are protected sufficiently by their own cartons, the film will cut down on overwrapping cost, reduce strays, and cut handling costs (36).

Shrink films are reportedly being used in Sweden for immobilizing glass containers in palletloads, and a United States automobile manufacturer is reported to be considering overwrapping new automobiles in a shrink-film pack to eliminate dealer clean-up costs. A large United States brewery is considering shrink wrapping six cans of beer; thus, there seems to be no practical size limit to which this concept must be applied.

"Hupp Corp., Warren, Mich., distributor of bumpers, fenders, hoods, and other replacement parts for autos and trucks...has switched from paper and cardboard wrappings to a polyvinyl chloride coating applied in an infrared oven. John J. Fannon, Jr., president of Hupp's Fannon products division, reports that the new packaging material costs more, but has improved service, cut distribution costs, and is adaptable to other industries" (37).

There are, then, different types of plastics materials which are currently replacing corrugated board boxes, either directly, or by changes in the form of a primary container which modifies the need for, or eliminates the need for, a corrugated shipping box.

6.3 THE POSSIBLE IMPACT OF COMPETITIVE PACKAGE SYSTEMS ON CORRUGATED BOARD BOXES

An exhaustive study of the supply and demand for wood pulp and paperboard, among other products of the forest, completed by the Stanford Research Institute, indicated that "the consumption of wood products in future years will be dependent on the prices of these products in relation to the prices of competing materials and to the general level of prices. Estimates of future consumption of timber products unrelated to price considerations are meaningless" (1).

Factors which influence the potential growth of the various end products from the forest--e.g., shipping containers and paper materials of all types--are influenced by "general levels of business activity, population, and changes in technology, as well as with changes in the degree of competition of substitute materials as influenced by relative prices, qualities, and consumer acceptance."

This report concluded that advancing technology in the pulp, paper, and paperboard industries would be such that prices for paper products would not advance faster than the general level of prices in the economy. A large supply of wood for pulp, improved pulping and papermaking techniques, and increased use of marginal woods are cited as evidence to support this conclusion.

The Stanford report also indicated that the total market for shipping containers would grow because "changing methods of merchandising require an ever-increasing use of display packages which, in turn, require shipping containers. ...The constant development of new consumer products... has also increased the consumption of shipping containers."

Christen (64) concurs with the Stanford report in defining the factors

which influence the consumption of paperboard products, adding also the standard of living as a criteria. Regarding the factor of the relative price of paper products in comparison with other available materials, he noted that "in addition to the technical conditions of production which affect the price of the products of the paper and board industry, one of the most important factors is the price and quality of substitutes.

"For some paper products (for example, newsprint, writing and book papers) there are no adequate substitutes at present, and the demand for them is consequently inelastic." However, much of the output of the forest products industry must meet competition from adequate substitutes; demand is more elastic, and the price of such products is affected accordingly. The products used in packaging are open to substitution by wood, glass, textiles, metals and plastics and must meet stiff competition from them.

Since the balance of supply and demand for paperboard products--here, specifically shipping boxes--will be governed by price, Christen noted for the paper and paperboard industry that it was "of extreme importance to the industry...that the price of paper and board products should not be so costly that consumption is seriously restricted."

Thus, much of the discussion of whether the corrugated box industry will continue to grow centers upon two points: cost of paperboard and substitution. The following comments reflect current writing upon these areas:

"Fibre box industry shipments probably will continue the long-term upward trend though at a slower rate, reaching almost 2.5 billion dollars in 1966, another record. This gain, however, represents a 3-percent increase in sales over 1965 as compared with the 7-percent gain over 1964 expected in 1965. Financial prospects in the industry appear to be improv-

ing largely as a result of increases in 1965 prices. These prices should hold through 1966 and compensate for some of the anticipated loss to competitive products" (28).

Prices in the industry are rising, and will continue to be forced upward. "Another upward price trend seemed to be in the making as (a West Coast supplier) announced price increases ranging from 3 percent to 6 percent, or an average of about 4 percent, on certain corrugated materials shipped from its plants on the West Coast, effective on or after January 1," 1966 (26). And: paperboard manufacturers are raising prices by an average of about 5 percent. This is the third round of industry-wide increases this year (35).

Quoting prices in a report on the business outlook for 1967, Paperboard Packaging magazine noted, "The trend of the market is definitely in the right direction (but) who is satisfied with it? In 1957 the over-all price of a thousand square feet of board was \$16.43; today it is \$16.46. This amounts to a rise of less than 2/10 of one percent, while the general economy's all-commodity price index has risen 7.75 percent during the same period" (44). In this report, the profit picture in the paperboard products industry was called "meager" and "vulnerable." "Price cutting has run rampant and everyone has suffered" (51). These comments reflect the squeeze put on profits of the converters by increasing prices of paperboard at the mill.

For the most part, costs of producing paperboard have been increasing in a manner similar to that in the rest of the economy, but converters have been forced to keep their prices down in order to compete effectively in the package market. This profit squeeze has been a serious problem to converters for a number of years.

The poor profit picture in the paper and paperboard industry is reflected in the stock market, and stock prices in paper increased less than one-third as much as the Standard & Poor's 425 industrial stock average. This was termed poor performance, and was ascribed to "the recurrent theme of industry overcapacity and continued price cutting which resulted in static-to-lower profit margins... To capsulize, the paper industry was not considered a growth industry in the popular sense of the word..." (57).

The profit-price situation may be summed up by stating that the increasing difficulty of converters to obtain a satisfactory profit has been much discussed, with much emphasis on the need for higher prices. The general trend of prices since 1960 has been down, and profits are slim; as a result, "something must be done" (63).

Thus, while plastics prices may be high in relation to paperboard prices, plastics prices have been slowly coming down (see Table 3), while paperboard prices have, at best, remained static. As has been indicated, prices of paperboards at the mill have been going up, putting a squeeze on converter profits. This has been roundly criticized by people in the paperboard industry.

Further, Christen, and the Standford report indicate that for paperboard to compete effectively, it cannot be priced higher than competing materials which may be substituted for paperboard. Some users are already paying a higher price to use some plastic materials in shipping containers, because of certain desirable properties of plastics.

If, then, the price of plastics continues downward, and paperboard prices move upward, as they appear to be doing, there may occur increasing

TABLE 3

COST TRENDS FOR SHRINKABLE FILMS -- 1955 - 1966
(Dollars/Pound of Resin, for One Mil Films)

<u>Film</u>	<u>1955</u>	<u>1959</u>	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>
Vinyl, Cast	.94	.87	.87	.83	.83	.83	.83	.83	.83
Extruded	.94	.73	.73	.65	.65	.60	.60	.60	.55
Polyethylene, Irradiated or X-linked			1.05	.90	1.05	1.05	1.05	1.05	1.00
Conventional								.44	.39
Saran	.95	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Polypropylene, Cast		.93	.70	.64	.63	.59	.55	.59	.59
Bi-axially Oriented						1.40	1.20	1.20	1.14

(Polyethylene, polyvinylidene chloride, and vinyl--including polyvinyl chloride--films are the three films used to the largest extent for shrink packaging, accounting for some 82 percent of total shrink film use in 1966. Vinyl films account for about half of the use of these "big three.")

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pressure on paperboard markets in the form of price competition from plastics. Operating within the framework of the "cost of the container delivered to the consumer product-producing plant," paperboard container suppliers run the risk of losing significant ground in the marketplace.

The second aspect of the capability of corrugated box markets to continue to grow, or to even maintain their present proportion, is involved in substitution of various container forms for the corrugated box. A number of other types of shipping containers that fulfill the several packaging functions, within the framework of the systems concept, are viable, and have been listed previously.

Serious inroads in corrugated box markets appear likely. Paperboard container suppliers have been maintaining static price levels in recent years, and have been cutting into profit margins to maintain their level of business. Prices for plastic materials have been going down, while the price of board at the mill has been, at best, constant. There seems no longer any way in which the paperboard converters and suppliers of corrugated boxes will be able to cut their prices in light of current production technology. Thus, plastic materials may well continue to cut into traditional board box markets on the basis of price alone, without consideration of certain physical and structural advantages of various plastic materials.

According to the United States Department of Commerce, "The dynamic fibre box industry faces its first serious competition...from other packaging products. Over the years, the industry has successfully absorbed large segments of the wooden box, barrel, and keg markets. A potential loss of 600,000 tons of boxes is threatened by the recent development of

shrink-wrapped fibre trays. This new system of shipment using a plastic overwrap in place of fibre...could present a strong market challenge to the box industry" (28). This figure represents about five percent of the total corrugated board annually produced (see Table 4).

TABLE 4 (27)

GROWTH IN TOTAL PRODUCTION OF CORRUGATED BOARD

	1950	1955	1960	1961	1962	1963	1964	1965
Liners	<u>3872</u>	<u>5109</u>	<u>5966</u>	<u>6356</u>	<u>6770</u>	<u>7124</u>	<u>7850</u>	<u>8384</u>
Medium	<u>1634</u>	<u>2193</u>	<u>2443</u>	<u>2664</u>	<u>2866</u>	<u>3022</u>	<u>3239</u>	<u>3465</u>
TOTAL*	<u>5506</u>	<u>7302</u>	<u>8409</u>	<u>9020</u>	<u>9636</u>	<u>10146</u>	<u>11089</u>	<u>11849</u>

* Total paperboard production in thousands of short tons,
excludes Hawaii and, for 1950, Alaska.

A more recent survey indicates that the estimated potential loss of corrugated box markets could be as much as 45 percent of the current total market (30). Some of the markets where the application of a paper or plastic overwrap material to provide a shipping container, with or without a tray as appropriate, could be accomplished are in the following categories: beverages, food and kindred products, paper and paper products, rubber and plastic products, fabricated metal products, textiles, soaps, cleansers, and cosmetics, stone, clay and glass products, electrical appliances, motor vehicles and equipment, toys, sporting goods, and other miscellaneous markets. These markets comprise 78.5 percent of current use for corrugated board. If, on the average, only half of each of these markets provided successful applications for this new package system, the potential loss to corrugated board would be some 38 percent of its current markets.

6.4 CORRUGATED BOARD INDUSTRY FACES A CHALLENGE

In relating how events led up to the previously-cited Pridham decision, Bettendorf describes packaging around the turn of the 20th Century:

"National distribution was handcuffed, imprisoned by 'standard' wood boxes--products adapting to them rather than their adapting to product. The concept had not yet been accepted that products, to move freely in society, must, like men, don clothes (boxes) tailored for the occasion. Tailoring is the unique property of paperboard boxes.

"The available tailored consumer packages and methods, to complete the revolution, awaited adulthood of a fully-tailored shipping package--the fibre box. It, designed to specific uses, systems, and conditions, would be key to unlocking local markets strangled by the LCL rail transit jungle" (29).

The Pridham decision was a landmark because it freed corrugated boxes from discriminatory shipping charges at the time that mass-production of goods and the development of national markets was occurring. Corrugated boxes became the dominant form of shipping package because they were adaptable, properly designed, properly constructed to meet specific use situations, and aggressively sold by people who knew their product, who understood the needs of their customers, and who tailored the package to suit use conditions.

One reason explaining why wood containers finally failed to maintain their primary position as the dominant form of shipping package was that wooden box manufacturers apparently did not foresee the development of national markets and mass-production of goods. Boxes made by a hand operation could not meet the volume requirements for packaging mass-produced goods.

Another major point that escaped the wood box manufacturers was that while the corrugated box might be scratched and dented during shipment, the goods arrived intact. The wood box manufacturer's criterion of success was whether the box survived, forgetting the contents.

Bettendorf describes the situation colorfully:

"Obdurately complacent, ignoring clear signals demanding better and more economical packages for mass-produced carload lots, wood box people were swept up and out by the freight movements of the times! They contrived with developing events, hidden to them by horse-age 'blindness,' to assist in the symbolic loading of a gun, pointed at their collective heads, inviting the Pridham case to come along, pull the trigger, and blow out their lazy brains" (29).

The corrugated box industry was revolutionary in its time, and made a great impact on the container market. Packaging has continued to grow and develop since that time, and the American economy has become increasingly subject to fast-moving social, economic, and technological change. The methods of producers, distributors, and retailers are evolving in new ways in response to this change. The response in all segments of the continuum from producer to consumer is directed toward one goal: profitable operation of the firm in an increasingly complex consumer market. The increasingly complex market, in switching from mass-production to mass-merchandising to mass-consumption, has been accompanied generally by narrowing profit margin; sophisticated business practices are required to maintain a suitable level of profit.

As in many industries, the paperboard industry has not always been responsive to customer requirements and needs, nor had the best interests of the national economy, or its customers, in mind, however, in the search for profits. Some of the early trade associations attempted to get various markets tied up in monopolies or maintain fixed prices and quotas.

Suits against such now-defunct trade associations as the National Container Association and the Corrugated Paper Patents Company struck down these attempts (15, 33). Some people in industry today maintain that such narrow-minded approaches to package marketing are still in evidence.

Over the past decade or more, companies have been involved in vertical integration--the assembling of a corporation which has control of the production process from timberland through pulp mill, paper mill, and converter, to the point where the product is ready for sale to package users. For the most part, in companies arising out of these mergers, the paperboard mills have tended to become the dominant force in the direction of the chain of production.

One result has been that paper mills have ignored the need for excess capacity, and have run at or near full capacity, costing and pricing at an unrealistically high operating rate. Running a mill at full capacity, pricing paperboard high, and converting boxes at a low price is self-defeating because the independent mill can cut its prices, or lower the quality of the product, that is, a corrugated box, by using lower quality corrugating medium, lighter-weight liners, or inferior quality liners. The integrated mill must, then, follow the quality down, or sell a high-quality product at a low-quality price to remain competitive. This cycle cuts profits. And it hampers the ability of the package-producing company to compete effectively in the marketplace.

The adaptability of the corrugated board industry to changing technology has come under fire from various leaders in the field for several years. Recently the attacks have become pointed:

Dr. Roy P. Whitney, commenting on how the paperboard industry is responding to a rapidly-changing technology: "In some respects, I think the record is excellent; in others, I believe there is cause for concern." Broadly speaking, research and development activities may be divided into two categories. The first is relatively the easier; it involves efforts to do better the things already being done, striving for increased efficiency, for higher yields, for improved properties, for lower costs in existing processes. The second is more difficult: it breaks away from tradition and aims at finding significantly better ways of accomplishing ends. Its objective is to develop new and better techniques and technologies, discarding the old when the new is shown to be better. "Here, I think our record is poor" (56).

J. B. Gilbert, commenting that historically the paperboard industry has been more concerned with manufacturing than marketing: "Effort has been made to operate at a profit, but, by and large, sophisticated marketing techniques are only now being developed which permit the laying down of marketing profit objectives and the measuring of performance by how closely it approaches these objectives. There is an awful temptation to use all available capacity. This is understandable when you consider the heavy capital investment required to finance production facilities. The proper answer, it seems to me, is for the company to concentrate more on producing what can be sold rather than selling what can be produced--but in a profitable manner" (59).

The editor of American Paper Industry commented on an area that is essentially unrelated to the corrugated box industry in particular, but which sums up succinctly the problem in the paper and paperboard industry taken as a whole:

"Someone has pointed out that not much tonnage is involved in paper clothes. The point to remember is that we're not selling tonnage of paper, we're selling clothes. For many years, the paper industry has regarded paper clothes as a gimmick. Even Scott Paper Company, master entrepreneur of marketing, misgauged the public's interest in paper dresses and now Scott is being deluged by demand for them.

"The fashion industry is serious... We should be" (25).

Considered within the framework of systems analysis, the analogy should be clear. The corrugated box industry should not regard itself as selling tonnage. The situation should be, rather, that of selling a consumer product delivered to the retail store display shelf. This is selling a result, not tonnage, and is in keeping with the mass-purchasing that is going on today.

The paperboard industry is admittedly a capital-intensive industry. That is, money is invested in plant and facilities to a greater extent than, for example, labor. The machinery in a typical paperboard producing and converting plant is expensive, and is geared to the efficient production of one basic commodity, paper--albeit in many grades. Because of the large capital investment in facilities, it is difficult to economically and quickly change such facilities to handle new or different products, and also economically difficult to adapt to a rapidly-changing market demand for new forms of packaging.

(To illustrate by analogy: railroads represent the classic capital-intensive industry. While trains get longer, and move larger cars at higher speeds, their basic service is still limited largely to the long-distance, high-tonnage haul. One cannot get a new siding at a plant, thence rail service, as quickly or as easily as simply driving a truck up to the plant loading platform. Similarly in the paperboard industry: paper machines get bigger, faster, and maintain a higher degree of control. But they

make only paper. As a truck is to a train, so are plastic packages more readily adaptable to a new physical distribution concept with a package which has custom-tailored properties.)

The end result then, in the paperboard mill and integrated company, is an emphasis on producing well the basic product. Admittedly, the paperboard industry requires large investments in production plants and equipment, and it seems wisest to operate such capital facilities as near to full capacity as possible. It is, on the other hand, economically shortsighted to sell all one can produce, at a loss, than to produce only what one can sell profitably, with an emphasis on serving the needs and wants of the consumer. Not serving the need or want of the customer, within the framework of the systems concept, has an impact on, and takes its toll in the ability of an industry to adapt to changing concepts and technologies.

It is not true, necessarily, that the plastics industry (or any other competitive industry), has more money, or even more capable management. It is, rather, a different, more responsive operating philosophy within the plastics industry which has exploited the package systems concept, and aggressively marketed a result as opposed to a product.

It is no longer true that "tailoring" is the unique property of corrugated board boxes. Just as mass production brought the need for "tailored" shipping containers, so have mass-merchandising and mass-consumption (along with a changing distribution system and improved distribution technology) brought the need for a "fully-custom tailored" packaging and distribution system to operate within this new framework. The need is evident, and it will be filled--with plastic packages, or with paperboard packages, perhaps, if the industry rises to the challenge.

The impact of this new systems concept on the paperboard industry must be considered all the more devastating in that in many instances where a paperboard package has been replaced by a plastic (or paper, or plastic/paperboard combination) package, it has been replaced at a higher dollar cost for packaging materials. To satisfy the demand of the market and the distribution system, then, these packages have had to offer a higher appeal, or greater functional value. The great numbers of plastic containers in today's market (primary containers, and increasing amounts of plastics used in shipping containers) are proof of the ability of plastics to provide functional value.

Implications for corrugated: changes in shipping containers will evolve around two significant points--automation in distribution, and total cost. Higher production speeds in the product-producing plant, and increasing use of machines in distribution to lower labor cost, and increasing concern for the total cost of getting the product to the consumer will dictate shipping package requirements in the immediate future. This latter point goes beyond the basic price of shipper and shelf package, and includes the costs of packing, handling, shipping, damage, warehousing, opening, pricing, shelving, and disposal (of the shipper) at retail.

The basic challenge to the corrugated box industry, therefore, is not the evolutionary changes in shipping methods themselves. Rather, the challenge comes from a new approach to solving physical distribution problems--that is, the systematic analysis of packaging and distribution. This means that producers of corrugated boxes who currently emphasize tonnage must reconsider current marketing practices and pricing structures.

It means considering the total cost of delivering a product to the consumer, which goes beyond the mere cost of the shipping package to the product producer.

If corrugated box manufacturers fail to become aware of the changes taking place in the problem-solving methods used in distribution, they stand to lose business to newer shipping systems. The supplier must design and develop packages which provide unique solutions to specific problems, thus selling a result (that is, a product delivered safely and economically) rather than merely a box delivered to a package user.

CHAPTER 7
SUMMARY AND ANALYSIS

"The only sure weapon against bad ideas is better
ideas."
--A. W. Griswold

The discovery, development, and commercial application of new types of plastic materials has become a frequent occurrence. Polyethylene, polyvinyl chloride, polyvinylidene chloride, polypropylene, "each new plastic film more exotic than the last, enters the packaging market to claim its rightful place. Nor is there, apparently, any limit to the number of materials that can compete successfully for the packager's attention, for the flexible-packaging market is expanding rapidly as new and old materials alike find broader application, taking the place of such 'conventional' packaging materials as glass, paper, steel and wood, or protecting and selling products never before marketed or packaged" (9).

In these latter instances, where a new product is developed, or an old one significantly modified, it is relatively easier for the package user to use new materials and concepts for packages for shipping because he does not have to break with precedent. If the people who consume the products manufactured at every hand, were not surrounded on every side by packages which invite attention and comparison, it would be easy for an indifferent manufacturer to remain insensitive to the need for updating and improving packages for his products. However, the consumer, and the materials-handler, are, for the most part, well-informed and alert to packages which provide useful protective, utilitarian, or promotional (or motivational) features.

7.1 CONCLUSIONS

It has been shown that the corrugated box has grown from an insignificant form of shipping container from the inception of corrugated board in 1894, to the dominant form of shipping container today. No other form of shipping package used for domestic shipment of goods compares in volume to the corrugated box.

The corrugated board shipping container has been demonstrated to be a practical, efficient container. It fulfills the various requirements of the several functions of a package: it protects the contained product from damage, and the environment from a hazard; it makes goods convenient to handle, ship, and store; and it may motivate the consumer to buy the contained product and use it properly and safely.

The corrugated board box is as nearly ideal as any package for shipping which is in current use can be. It is, in comparison to many other forms of shipping container, light in weight. This is desirable from a shipping cost standpoint. It lends itself readily to rapid, mass production, and it is made from an inexpensive (comparatively) material. It is, as a result, generally economical. It has many advantages, and it probably will not completely disappear from use as a shipping container, regardless of future technological developments, because there are many products for which the corrugated box is a singularly suitable container.

There appear to be, however, two serious threats to the current status of the corrugated box as the dominant form of shipping container. One is its price structure in relation to costs of other materials, notably plastics. The second, and probably more important, challenge comes from the economic problems which make it difficult for corrugated board suppliers

to change their patterns of production to meet changing physical distribution concepts brought on by mass merchandising and mass consumption of packaged goods.

The literature is full of comment by responsible, informed individuals that indicates this problem. The apparent incapability of the capital-intensive industry to adapt to changing technology and new distribution patterns, and the "mill-oriented" thinking that may be a result of the economics involved (which seems to be associated with recent mergers), may result in the loss of much of current corrugated board markets to competing packaging systems. If so, these losses will probably be to paper or plastic overwrap packaging systems.

There is an adage which says that history repeats itself. The possibility exists for the same thing to happen to the corrugated box that happened to the nailed wood box 50 years ago. The wood box did not diminish to a small percentage of the shipping container market because corrugated board was stronger. Corrugated board was not a stronger material in terms of bending resistance, tensile strength, or shear resistance in 1914, and it is not physically stronger than wood of the same dimension now. The wood box did not necessarily disappear because corrugated board was lighter in weight. Neither did it disappear, necessarily, because corrugated was more attractive in appearance.

The reason the nailed wood box could not effectively compete with the corrugated box was that corrugated box suppliers knew the capabilities of their product thoroughly, applied the development of the new (at that time) package properly to the shipping problems of products during the emergence of mass production, and aggressively and imaginatively sold their product.

A similar situation is developing today, with different materials as "adversaries." Corrugated board finds itself in the position of the wood box as the conventional or traditional material, "against" plastics. It is not, however, so much a matter of material versus material, as it is a production philosophy versus a market-oriented philosophy. An indictment has been made against the corrugated board suppliers that they are more interested in producing tonnage than providing service. This is where the issue of survival as the dominant shipping container material lies for corrugated board. It is not a matter of what can be done to improve the manufacture of corrugated boxes, today. It is, rather, a question of what impact the systems concept will have on corrugated board markets, tomorrow. Paper and plastic package systems are being developed to work effectively within the systems framework, and are moving into corrugated markets. The point should be clear: corrugated shipping systems must also be developed within a systems frame of reference.

Corrugated board will not diminish in importance because plastics materials are essentially stronger, lighter in weight, or more attractive. Nor, necessarily, because plastics are (or may become) cheaper; it was noted above that in many instances where plastics have replaced paperboard products, they have done so at increased cost.

In the final analysis, corrugated board may lose significant portions of its markets as the most widely used type of shipping container material because it is not being produced and sold under an operating philosophy which is geared to competition in today's market. Corrugated board is made from paper mill products which are mass produced in nearly any form that is requested, in an efficient, fast operations. The board is sold at

some profit to converting plants (in integrated mills), which then make packages and sell them to customers almost at cost, in order to get more orders for board at the mill.

Plastics, on the other hand, represent a new form of packaging material. Each new application must be carefully considered because there is little or no design precedent which can be relied upon so to make a casual application of the material to the product to be packaged. Thus, plastics are in the position of corrugated board 50 years ago, being applied properly and carefully to products in well-conceived and executed designs because the supplier and user must know what the product needs in order to make a suitable application. And, in many instances of application of a paper or plastic overwrap, cost of the package at the product-producing plant has not been the issue. Package costs in some instances have increased. Handling and shipping costs, among others, have come down enough, however, to offset the increased cost of packaging materials. This is the key issue for corrugated: How much does it cost to deliver the product to the customer? Not, how much does a corrugated box cost? Corrugated boxes are now the traditional package, in some instances casually applied to the use situation, and this is where the battle may be lost in an expanding market of product innovations.

7.2 RECOMMENDATION

It has been shown that some corrugated box markets are threatened by invasion by paper or plastic shipping packages. While the picture is not all negative, it should be a cause of serious concern on the part of corrugated box suppliers, thus to evaluate their competitive strategy.

Merely to react to the threat of being replaced by a material which is not necessarily less expensive for a given application (by further price cutting) will not be a sufficient response on the part of the corrugated box industry. (One obvious reaction to the threat of shrink-wrapped trays is to lobby for regulations which would require the net weight statements on canned goods to appear in the lower 20 percent of the label. This is negative, stifling progress, and self-defeating; the plastics industry would need only to counter with an all-plastic shipping container system. On the other hand, some grocery stores give boxes to their customers so they may carry their groceries home and reuse the box. Trays do not satisfactorily fill this utility function.)

In a more positive move to maintain present market dominance, the corrugated box manufacturers should exploit their product which can be efficiently manufactured to suit any product need, according to people in the paperboard industry. In many instances the shipping package user does not know what his product needs in terms of protection, or to make it convenient to store, ship, and use, or to make it sell. Nor, frequently, does he know how to find out and apply a suitable solution. Corrugated box suppliers should help the customer find exactly what his shipping system requirements are, then create a useful system to fulfill the need.

This thorough, imaginative analysis of what the customer requires to protect, convey and sell his product will have to be done within the framework of systematic analysis. This analysis will consider the various package functions throughout the production, packing, handling, storage, transportation, and displaying (and use and disposal), of the product and its package. Only then will a shipping container be correctly and properly applied as a suitable solution for the packaging of a product.

The result of this orderly analysis of package system requirements may show the need for using combinations of various materials with corrugated board. It may mean not recommending or using corrugated board at all where such application is shown to be inappropriate. It does mean that intelligent and informed applications of the corrugated box to shipping problems must be made by helping the product producer correctly evaluate his needs. It is the total cost of delivering a product to the display shelf (or, to the consumer's home) which is important, and the total efficiency of a system is a more important factor than the cost of any one component.

It would be advisable for the corrugated box industry to sponsor unbiased research aimed at finding the total cost of using a corrugated box to carry a product to the retail shelf. Such knowledge of price and cost factors would allow a box supplier to more effectively compete in the package systems marketplace.

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