THESIS

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AN ANALYSIS OF CURRENT PROBLEMS
FACING THE GLASS CONTAINER INDUSTRY TO DETERMINE
THE INDUSTRY'S FUTURE GROWTH OPPORTUNITIES

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MARK S. BACHELOR

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of the requirements for

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Major professor

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AN ANALYSIS OF CURRENT PROBLEMS FACING THE GLASS CONTAINER INDUSTRY TO DETERMINE THE INDUSTRY'S FUTURE GROWTH OPPORTUNITIES

By

Mark Stuart Bachelor

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ABSTRACT

AN ANALYSIS OF CURRENT PROBLEMS FACING THE GLASS CONTAINER INDUSTRY TO DETERMINE THE INDUSTRY'S FUTURE GROWTH OPPORTUNITIES

By

Mark Stuart Bachelor

This study was primarily undertaken as a result of major problems the glass container industry has faced in recent years. These problems include increased competition from plastic containers and the enactment of mandatory deposit legislations in various states resulting in reduced demand for new, single-service glass containers, and increased excess production capacity.

With the information derived from two surveys (consumer and industry), as well as current available literature, the glass container industry should experience two to three percent annual growth during the next five years. This rate will be dependent, however, on favorable trends in the United States economy and the industry's own ability to continue productivity improvements and new container innovations.

DEDICATION

This thesis is dedicated to my parents, Gene and Joyce Bachelor, and to my sister, Lynn Adams. Without their support, love, and encouragement this thesis would not have been possible.

I would also like to give special recognition to Dr. Michael Richmond, whose patience, guidance, and positive encouragement were instrumental in the completion of this thesis.

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I. INTRODUCTION

This study was conducted to determine the current status of the glass container industry in order to predict where the industry will be heading during the next five years. The project was undertaken primarily as a result of major problems the glass beverage container industry has faced in recent years. These problems have caused extensive changes within the industry and forced marginal producers out of business. Two main problems are:

1. The increased competition from plastic containers which have captured the large size soft drink market with the 2-liter plastic bottle. Other plastic bottles are also making serious inroads into smaller size beverage container markets.
2. Mandatory deposit laws on beverage containers in nine states have resulted in reduced demand for new, single-service glass containers.

As a result of this drop in new glass container demand, producers have been faced with costly excess production capacity. Most manufacturers have also experienced increased operating costs, particularly in energy and labor, forcing them to layoff workers and shut down inefficient production facilities. In order to offset losses in their glass container divisions, many companies have diversified into other areas with higher profit margins and future growth potentials.

In this study we analyzed how the glass container industry descended into its current position by discussing the history and general nature of the industry, which has made it particularly vulnerable to changes in technology and legislation.

Besides current industry literature we also relied on two surveys for sources of information. One survey consisted of interviews with four marketing executives from major glass container manufacturers. The other was a telephone survey of 200 consumers in the Greater Lansing area. This survey was conducted to determine consumer attitudes toward beverage containers and mandatory deposit legislation in Michigan.

With the information obtained from these surveys and current literature, clarification of current problems facing the glass container industry is discussed in detail. To predict future growth opportunities, various trends within the glass container industry are examined. These include product line diversification, increased recycling efforts, futher cost reductions, and continued new product innovations to meet the needs of a changing market.

Glass has been very important in the field of packaging for many years and now, because of numerous changes in attitudes, technologies, and economics, it is fighting for survival in a low growth and fiercely competitive environment.

II. HISTORY AND CHARACTERISTICS OF THE GLASS CONTAINER INDUSTRY

Glass is one of the oldest materials known to mankind. It is believed the Egyptians were using glass as early as 3,000 B.C. Pliney wrote of sailors in the first century using blocks of soda from their cargo to make a fire on the beach and discovered the soda fused with sand to form glass (19). Most of today's glass is essentially that of Pliney's tale. Glass is still primarily made of silica, the major component of all sand, which is fused together with other ingredients such as soda and lime. The soda quickens the melting of the silica and the lime hardens the finished product.

The first actual glass manufacturing industry in the United States was established in James Towne, Virginia, during the first year of the settlement's existence in 1608. More than a hundred years passed before our first really successful glass industry was established. It was founded by German-born Caspar Wistar in Salem County, New Jersey, in 1739. Initially they turned out only a small amount of bottles, but later the workmen were producing many types of containers including bowls, dishes, drinking glasses, and preserve jars.

The national census of 1810 listed only twenty-two glass houses in the United States. At this time England was taking measures to protect her own industry from this new competition by passing laws preventing glassworkers from leaving the country. Around 1820, the American glass industry finally began to develop. After the War of 1812, England's glassworkers were now allowed to leave for America. This, along with

new tariffs set up to protect America's glass industry, led the way for glass production on a new and much larger scale (9).

In 1903, Michael J. Owens introduced a machine that would revolutionize the glass container industry. He had invented an automatic bottling machine. Up until that time a worker could produce only eighteen dozen bottles a day working twelve to fourteen hours. With this new machine delivering a swift and endless supply of bottles, an almost unbelievable production rate of one million bottles per week was soon reached. The specification measurements of the bottles produced could be so identical to each other that automatic capping and sealing machines were now also possible. Glass bottles began to provide safe, sanitary, inexpensive, and reliable containers for medicines, foods, beverages and many other items that started to appear on store shelves (9).

Since the turn of the century, the glass container industry has emerged as an employer of thousands of workers nationwide who, with the aid of modern technology, currently produce billions of containers in the United States each year.

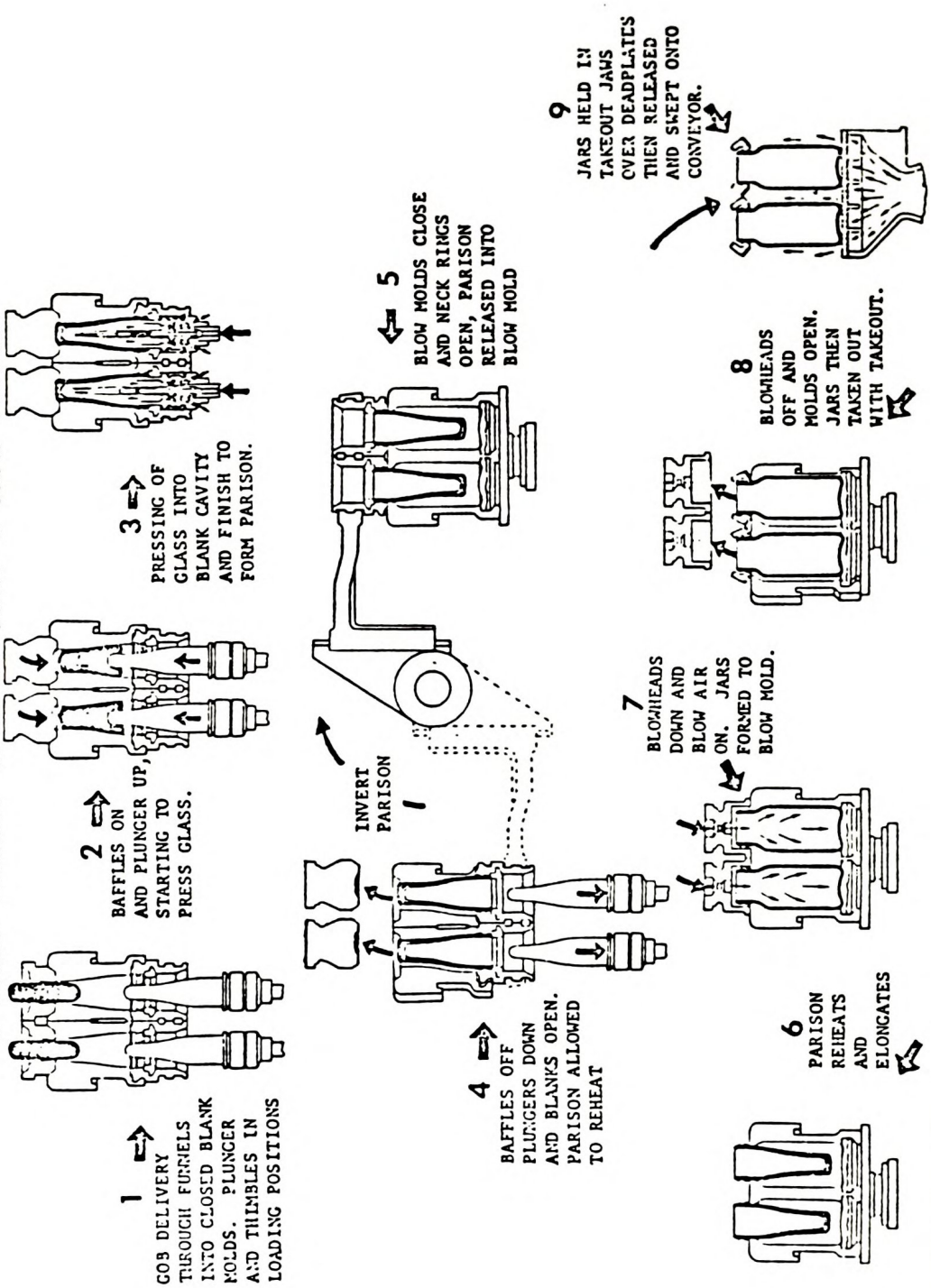
Manufacturing Process

Glass is defined as a transparent, hard, brittle substance that is an inorganic product of fusion, cooled to a rigid condition without crystallizing (12). It is produced by mixing sand, soda ash, limestone, and cullet (broken glass) together and then feeding the mixture into a large (60 feet long by 40 feet wide) furnace. This furnace is lined with firebrick and is located high above the bottlemaking machines. From the furnace the glass then flows through a narrow opening or

"throat" below the surface. The throat allows the glass to flow into a smaller chamber which holds back impurities usually floating on the surface. The molten glass then flows into a "feeder" that allows the glass to stream out of the furnace tank where it is then cut into "gobs" by shears (20).

These molten gobs flow down a chute into a blank mold where they are forced by blown air into the neck ring at the bottom of the mold, forming the bottle's finish (Figure 1). At this point, the bottle is also blown into its general shape and is now called a parison. The blank mold then opens and the parison is inverted and transferred to a second mold (called a blow mold) where it is reheated, elongated, and blown into the final shape of the bottle. After the blow mold opens, takeout jaws carry the bottle to a conveyor that transports it to the annealing lehr. With new, high-speed bottlemaking machines it is currently possible to blow four parisons into bottles at one time (called a quadruple-gob bottle making machine).

Glass jars are manufactured in basically the same fashion as bottles. The main difference is that the glass is pressed into the blank mold instead of blown, as in the case of a bottle where a pronounced shoulder is required. The container must be run through an annealing lehr where the temperature is raised to 1,000^{o}F and then held for about fifteen minutes. The temperature is gradually lowered allowing the containers to cool slowly in order to prevent internal stresses, that make glass susceptible to breakage, from building up. Strains in glass, known as cords, if not relieved can produce a weak container that could suddenly break, causing product loss and possible injury. After the container has been produced, coatings are then



Source: Owens-Illinois, 1982.

Fig. 1.

applied to increase the strength and scratch resistance of the surface as well as to provide a surface more adhering to labeling. Various hot and cold end coatings are frequently used. These include tin chloride, titanium, silicone, and polyethylene. By coating glass containers, strength can be increased as much as three times that of uncoated glass (12).

Raw Material Availability

As previously mentioned, the main raw materials used in the manufacture of glass are sand or silica, soda ash (Na_2CO_3), and limestone ($CaCO_3$). Silica is the primary ingredient normally comprising about 75% of the composition. The soda ash makes up about 15% of the mixture and represents the greatest cost. Limestone accounts for the majority of the remaining 10% of the mixture. Cullet is commonly added to hasten the melting and make the glass more workable. It also reduces the cost by accounting for 20 to 40 percent of the total mixture. Cullet primarily replaces portions of the silica and soda ash. Pure silica makes excellent glass but, unfortunately, has a very high melting point (3,133^{o}F) that is extremely costly to obtain (20). The soda ash is converted to sodium oxide which, when added to the mixture, reduces this melting point nearly in half. Carbon dioxide is given off and helps to promote the mixing process. Limestone is added to make the glass insoluble, while providing hardness and chemical durability. Trace amounts of other materials are frequently added, including lead and aluminum, to improve glass properties. The purpose of lead is to improve clarity, but it also tends to soften the glass. Alumina is often used to increase the durability and hardness of the glass (12).

The three raw materials used in the production of glass are plentiful, easy to obtain, and relatively low in cost. The only area of possible concern might be in the acquisition of soda ash. Limestone and sand are readily available, although not always as close to the plants as the manufacturers would like. Soda ash, on the other hand, is primarily mined in Wyoming with 70% of its markets being east of the Mississippi River (8). The estimated 30 million tons of soda ash reserves could easily supply the world's demand for the foreseeable future. However, bad weather, freight costs, and possible mining or rail labor strikes could provide barriers to the accessibility of the material (11).

Rail transportation plays a major role in the distribution of soda ash. As shipments travel east, severe weather can prevent both rail and trucks from making deliveries or returning for reloading. The possibility of a serious shortage is increased because many glass container manufacturers operate with limited raw material storage facilities, permitting only a few days supply. The glass container industry must, therefore, rely heavily on its raw material suppliers. These suppliers invest heavily in equipment and transporting facilities in order to provide reliable delivery service to the manufacturers. Computerized order processing and shipping equipment, as well as automated bulk-handling facilities, are primary examples. They also purchase entire rail car fleets and then stockpile the loaded cars in eastern locations so they can be drawn on in case of emergencies (8).

As long as glass container producers continue to work closely with their raw material suppliers, no major supply interruptions should be experienced in the foreseeable future. Cost containment on raw

materials should continue, with no significant shortages or price increases anticipated (13).

The Glass Industry

The glass industry in the United States is divided into three main areas:

1. Glass containers, which includes beverage, food, medicine, cosmetics, toiletries, and cleanser bottles and jars.
2. Flat glass, which includes sheet or window glass, plate, laminated, and safety glass.
3. Pressed and blown glass, which includes lighting and electronic glass, kitchen, table, as well as art and novelty glass (10).

Glass containers account for the largest segment of the industry, more than doubling the other two segments combined in dollar value of shipments during 1982. In looking at glass containers specifically, beverage containers (beer, soft drink, wine, and liquor bottles) accounted for nearly two-thirds of all shipments, followed by food containers (27%), with all types of containers combining for only 8 percent of total glass container shipments. The total value of glass container shipments in 1982 was over 5 billion dollars. Beer containers represented the largest glass container market, accounting for nearly 2 billion dollars of this total. Soft drink beverage containers represented over 1 billion dollars of glass container shipments. Considering the tremendous amounts of money represented by beer and soft drink glass container markets, it is not surprising that these markets

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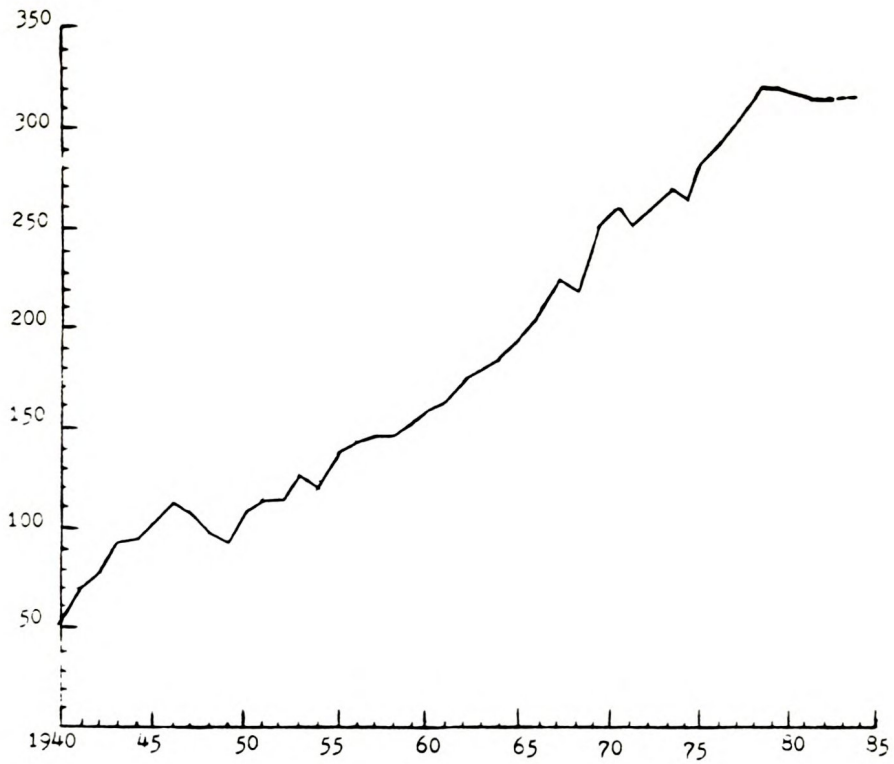
have grown increasingly competitive with other types of beverage containers.

Metal cans accounted for 61.0% of total packaged beer in 1982 and glass bottles the remaining 39.0%. In the soft drink sector, metal cans represented 65%, glass bottles 29%, and plastic bottles the remaining 6% of total shipments (3).

Glass Container Shipments to Present

Since 1949, total domestic glass container shipments have generally increased each year, with few exceptions, until 1979 (Figure 2). Shipments steadily increased through World War II as great amounts of steel and tin were required in war production and, therefore, provided little competition to glass containers. In 1948, however, shipments of glass containers decreased for the first time since the start of the war. At this time adequate supplies of metal cans were becoming available (16).

Economy related effects on cnsumer purchasing were major causes of declines in shipments during the recessions of 1954, 1957-58, 1971, and 1974-75. Another important reason for reduction in shipments during those years was the expirations of labor contracts. Although no labor strikes actually took place, there were significant amounts of hedging to build inventories to higher levels in case strikes did occur. This stockpiling of inventories only helped to accelerate recessions within the industry during these years by creating false demands, price increases, long lead times, and other negative stimuli. But when no



Source: U.S. Department of Commerce
Bureau of the Census

Fig. 2. Domestic Glass Container Shipments
(In Millions of Gross)

strikes took place, supply threats diminished and these false stimulants became depressants on the purchasing environment for glass containers (14).

In 1968 a decline in glass container shipments was caused by a work stoppage. There was a 51 day strike by industry workers in February and March of that year. Shipments during 1968 were 3% below 1967 figures which were partially inflated due to unusually heavy purchasing during the latter part of the year in anticipation of expiring labor contracts (10).

As previously noted, until 1979 declines in glass container shipments during the past 30 years were primarily caused by downturns in the economy or strikes. But in 1979, two unprecedented events took place that severely affected the industry. One was the introduction of the 2-liter plastic soft drink bottle and the other was the enactment of mandatory deposit legislations in several states.

Glass container shipments by tonnage also declined in 1979 reflecting a decrease in average bottle size as market share of the 2-liter plastic bottle increased. The effect of the bottle bill in Michigan on new glass bottle shipments is exemplified by the Carling Brewery in Frankenmuth. Since the enactment of the bill, Carling's purchases of new glass bottles has dropped to one-tenth the number purchased prior to the bill (18). Glass container manufacturers were suddenly faced with overcapacity that, along with increasing costs, reduced earnings and forced marginal producers out of business.

After years of 2-3% annual growth, the declines in 1979 and 1980 resulted in major changes within the industry. Producers were forced to shut down non-productive furnaces and manufacturing plants in order to

reduce costly labor forces. Companies began investing millions of dollars into new equipment in order to increase production efficiency. Owens-Illinois, for example, has invested 550 million dollars into new equipment since 1978 resulting in increased operating efficiency and a reduction of the total work force (4). Currently, Owens-Illinois is running at their highest level of capacity since the mid-1950's. This seems to be a trend within the industry (21).

Analyzing the recent problems that have confined the growth of the glass container industry, it becomes apparent the industry has certain characteristics that make it particularly vulnerable to changes in technology and legislations. Some of these characteristics will be more fully discussed in the following pages.

The Glass Container Industry

The glass container industry is capital intensive and highly concentrated. The industry consists of about 30 companies operating 126 plants in 29 states throughout the United States. The four largest companies (Owens-Illinois, Anchor Hocking, Brockway, and Thatcher) accounted for 54% of shipments in 1982, while 77% was concentrated in the eight largest (3).

Employment in the labor intensive glass container industry in 1982 was estimated at 61,100, representing a 10% decrease since 1979. Closing of marginal plants and laying off workers in response to a drop in glass container demand contributed to the decline. Payrolls in 1982 accounted for an estimated 30% of the value of industry shipments, compared to 13% in the metal can industry. However, computerization,

increased automation, and technical innovations have helped to alleviate upward presure on labor costs (3).

The glass container industry is also energy intensive. Energy costs, primarily fuel for the melting furnaces, accounted for nearly 9% of the value of industry shipments in 1982. The industry relies heavily on natural gas which has seen costs quadruple during the past decade. The amount of energy use has been reduced, however, through better furnace design, preheating and advance burning, improved combustion systems, and computerized furnace firing controls. These fuel conservation measures have resulted in an overall energy improvement of almost 20% since 1972 (3).

Growth in the glass container industry is strongly dependent on the United States economy. Depressed business conditions, resulting in decreased levels of consumer expenditures for non-durable goods, produce adverse effects on glass container demand. The reasons for these declines vary. For beverge containers (beer, soft drink, liquor, and wine bottles), demand for beer and soft drink bottles tend to be most affected by recessions. Although people are assumed to drink more beer during a recession, figures show they are not purchasing more of it in glass bottles. Keg sales of beer usually increase during a recession as more beer is being consumed in bars which, consequently, tends to decrease package beer sales. As for soft drinks, history also shows the consumer buying less during a recession. Soft drink beverages are commonly perceived as a luxury item, one that can be replaced by less expensive drinks (such as powdered mixes) when money starts getting tight. Liquor and wine bottles are also not "recession proof", although they do not tend to be affected as much as beer and soft drink

containers. This is probably because these two beverages are not heavily purchased by lower income groups who tend to be the most affected by a recession (21).

Glass food container demand also drops off during a recession, although not to the extent of beverage container demand. The consumer generally keeps lower inventories of food during recessions. As unemployment rises, people tend to buy food in smaller quantities than normal. More "hand-to-mouth" purchases take place since consumers do not have the extra income enabling them to stock up (21).

The glass container industry strongly resembles the metal can industry in many respects. Both industries have been experiencing marginal sales gains in recent years due to the relatively slow growth of food and beverage markets. Because the two industries share the same basic markets, a market share gain by one usually results in a loss by the other. Besides sharing common markets that are nearing saturation, the lack of new market opportunities and the continuing threat from plastic bottles further erodes market share. The two industries also experience common problems of low profit margins, excess capacity, changing market demands, environmental restrictions, and governmental regulations.

Foreign Trade

Although the United States is the world's largest producer of glass containers, foreign trade is limited because their high weight to value ratio discourages profitable transport over long distances. As a result, glass container exports in 1982 amounted to less than 1% of the total value of shipments. Mexico and Canada have traditionally

accounted for over half of United States glass container exports. Canada is also a major supplier of glass containers to the United States, accounting for over 50% of total imports. Favorable exchange rates have helped to increase the amount of glass containers imported from Canada. Most imported glass containers are specialty bottles used to package items such as wine, liquor, perfume, and toiletries. Imports have risen at a higher rate than exports during the past ten years, but still represent a very small portion of total United States glass container consumption (3).

III. CURRENT STATUS

Continued recessionary pressures during 1982 have lowered glass container/unit shipments to 315 million gross, 1.3% below 1981. Competition, particularly from plastic bottles, forced glass container manufacturers to seek new markets for their products. These efforts were made tougher by poor economic conditions.

Beer packaging represented the largest glass container market during 1982, accounting for 36% of total industry unit sales. Non-refillable glass containers accounted for 97% of beer bottle shipments; about 78% of these units were 12-ounce bottles (3).

The soft drink beverage market remained very competitive in 1982 and to help compete with other packaging materials, the glass container industry developed a thin-walled, lightweight, prelabled glass container. Developed as a single-service, non-refillable container, it quickly gained retailer and consumer acceptance during the 1980-82 period. This bottle allowed glass container manufacturers to increase market share in the important 10 and 16 ounce segment of the market.

Glass containers face less competition in the food packaging market than in the beer and soft drink beverage markets. This is primarily due to the unique properties glass containers have. These include chemical inertness, transparency, strong preservative abilities, long shelf life, and resealability.

The most significant shift in glass container production in recent years was caused by the loss of the large size (32-ounce) soft drink bottle market. This has forced the industry to concentrate on the production of 10 and 16 ounce (see Note below) standard shaped, single service soft drink bottles and has resulted in a reduction of bottle sizes as well as total glass container shipments (tonnage).

In an effort to reduce excess capacities at the beginning of 1980, producers shut down furnaces and closed non-profitable plants. As a result, capacity utilization increased from 80% in 1980 to approximately 85% by the end of 1982. Although this increase in the utilization rate is a positive sign, the operating rate must continue to rise in order to bring the demand-supply relationship for glass containers into a more appropriate balance. If this increase does not continue it will remain difficult for producers to raise prices to offset continually increasing operating costs.

Because of the high costs incurred when starting a production run, glass container producers are now reluctant to accept short production runs and, considering high costs of labor and capital investments for new machinery, downtime is critical. Because of this, the industry trend is towards increased standardization and longer production runs. Owens-Illinois, for example, will no longer accept production runs that are not at least five days in length (21).

NOTE: Although the term "16 ounce" is used frequently in this study, it should be noted that the industry is converting to the metric (half-liter) size container.

As a result of reduced labor costs, decreased excess capacity, installation of new high-speed machines, and increased bottle-size standardization, industry productivity increased 6% in 1982. If these advances keep improving and operating rates continue to get better, more productivity gains should be experienced in 1983. Capital investments by glass container companies are now being directed toward areas that will increase productivity (such as installing new triple-gob bottle making machines) rather than new plant construction.

Mandatory Deposit Legislation

In the past 15 years, people have become increasingly concerned with clean-up and preservation of the environment. Non-returnable beverage containers have been charged as being significant contributors to litter in the nation and as a major drain on energy and natural resources. In July 1983, New York became the ninth state (joining Oregon, Vermont, Maine, Iowa, Connecticut, Massachusetts, Delaware and Michigan) to pass legislation related to non-returnable containers. When New York's container law went into effect, approximately 25% of the United States population became covered by State packging regulations designed to reduce litter (22). Mandatory deposit legislations, also referred to as "Bottle Bills", have continued (up until recently) to be implemented by individual State governments at an increasing rate since the first one in 1972. This is a factor that glass container manufacturers fear might result in declines in total beer and soft drink consumption.

Although the impact of such legislation on beer and soft drink consumption has been negligible to date, there is a noticeable drop in

demand for new glass containers in states that have enacted bottle bill laws (22). This is likely due to the increase in demand for returnable bottles, which can be refilled up to 30 times (18). Although a 12-ounce non-returnable bottle costs the bottler approximately 6 cents (compared to 9 cents for a returnable), the differential in initial cost is more than offset by repeated use of the returnable (21).

The beverage container industry is vehemently against mandatory legislations and would like to develop its own programs. However, they have not yet done so on any large scale. Although bottle legislation results in higher prices on beverages as well as causing many inconveniences (storing and returning empties, etc.), the majority of consumers are willing to pay these extra costs. The final decision on whether or not a state will enact bottle bill legislation rests in the hands of the voters. In Michigan, where 60% of the voters originally voted for the bottle bill, a poll taken two years later revealed 75% would now vote for the same legislation (2). Our survey of 200 people in the mid-Michigan area also showed this trend. Unfortunately for glass container manufacturers, these surveys indicate that, despite certain flaws, people are in favor of the mandatory bottle legislation and are willing to pay the price.

Competition from Metal and Plastic Containers

Glass containers face significant competition from plastic containers in the fight for market share within the container industry. Conversely, the standardized 10 and 16-ounce single-service, pre-labeled glass bottle is now beginning to threaten metal can domination of the soft drink vending market. Recently, glass container

producers have also introduced 44-ounce glass bottles, designed to compete with the standard 46-ounce metal can for various food products.

Even though glass container manufacturers see further opportunities to gain market share at the expense of metal cans, they are quite worried about the impact plastic bottles are currently making in the lucrative beverage container market. Consumer acceptance of the polyethylene terephthalate (PET) bottle (especially in the soft drink beverage market) is having a tremendous effect on the United States packaging industry. PET bottles have taken over the 2-liter size soft drink market and are improving sales in the one-half and 1-liter size markets. Approximately 40% of 1982's estimated shipments of plastic containers for foods and beverages were PET bottles; another 40% were high density polyethylene plastic milk continers (3).

The success PET has had in the marketplace is obvious when looking at the amount of resin produced. The relative changes in resin manufacture for all types of plastic containers for the period 1972-82 is shown in Table 1.

The estimated 1982 resin consumption for PET bottles was 18 times that of 1977. This exemplifies the tremendous increase in PET bottle manufacture in recent years. The success of PET bottles has enabled plastic bottle producers to become a major factor in United States food and beverage packaging.

Table 2 shows the relative changes in the markets for United States plastic bottles convering the period 1972-82. From this table we observe that shipments of plastic containers for foods and beverages have more than doubled during the 1972-82 period. Virtually all of the markets for plastic bottles increased during this period.

TABLE 1

RESINS CONSUMED IN BOTTLE SHIPMENTS
(MILLIONS OF POUNDS)

Type of Resin	Resins Consumed 1972	1977	1982[e]
Polyethylene			
Low and medium density	35	48	126
High density	623	779	1,027
Polyvinyl Chloride	62	79	94
Polypropylene	n.a.	28	50
Polyethylene terephthalate (PET)	n.a.	25	450
All other resins	21	3	5
TOTAL	741	962	1,752

e = Estimated
n.a. = Not Available

Source: U.S. Industrial Outlook 1983.

TABLE 2

PLASTIC CONTAINER SHIPMENTS
(MILLIONS OF UNITS)

Plastic Container Market	Shipments 1972	1977	1982[e]
Food and beverage	1,440	2,333	6,050
Household chemicals	2,569	3,106	3,000
Medicine and health	1,059	1,729	2,275
Toiletries and cosmetics	1,390	2,119	2,000
Industrial chemicals	327	296	350
Automotive and marine	92	148	250
Other	26	20	525
TOTAL	6,903	9,751	14,450

e = Estimated

Source: U.S. Industrial Outlook 1983.

Although plastic bottles have made dramatic impacts into the food and beverage container markets, they continue to face technological problems that must be overcome before further penetration can be made on a large scale. Loss of carbonation, flavor, and aroma volatiles have prevented the use of plastic bottles in smaller sizes. While the loss of carbonation in the 1/2-liter size plastic bottle has been improved, consumers have still not readily accepted it. One of the major stumbling blocks to the 1/2-liter's growth is the continuing problem of taste. Consumers apparently feel that the product does not taste as good in plastic as it does in glass (an opinion that was mentioned numerous times during the consumer survey).

The loss of carbonation and flavor concerns has kept the plastic bottle out of the 12-ounce beer container market. But, the plastic beer bottle has been marketed with some success in 1-liter sizes. The surface area to volume ratio is greater in smaller containers, thus resulting in unallowable carbonation loss. This is because the surface area of the container (which is directly related to the permeation rate) is actually larger in relationship to the contents in smaller sizes and, therefore, the loss of carbonation is greater.

One of the greatest advantages plastic containers have over other types of containers is light weight, resulting in lower distribution costs. However, this same light weight can cause problems on filling lines when attempts are made to run at the high speeds that glass and metal containers can achieve.

Shelf life is another important concern for plastics. Since plastic containers in the past have provided limited food preservation,

they have only recently entered this market. Plastics also tend to react with certain substances, thus further restricting their usage.

These technological problems have limited the penetration of plastic bottles in the beer and food container markets, but the battle between glass and plastic containers for the soft drink beverage market is fierce. The greatest competition is currently between the plastic and glass half-liter size bottles. Plastic bottle producers have been facing price disadvantages when compared to glass containers. This is because glass container manufacturers are determined to maintain market share through price discounting (15).

Until the previously mentioned plastic container problems are solved, further penetration into the soft drink container market should not continue at such an alarming rate. However, plastics should make gains in the distilled spirit and wine markets at the expense of glass. In November 1982, a ruling which allowed PET bottles to be used for distilled spirits was passed by the federal government's Bureau of Alcohol, Tobacco and Firearms. PET bottles have already been introduced in the United States wine industry with favorable results. The extent to which plastic bottles can penetrate these markets, currently dominated by glass containers, is of paramount concern to the glass container industry.

Energy Requirements and Environmental Impacts of Glass, Metals, and Plastic Containers

During the late sixties and early seventies, public interest in the management of resources was centered on the adverse effects of air, water, and land pollutants. Since the mid-seventies, public attention

has turned to the conservation of our nation's energy and natural resources.

In order to truly consider all of a product's resource and environmental effects, we must evaluate the stages and processes the product will encounter during its entire life cycle. For a beverage container these include raw material extraction, manufacturing, transportation, container packaging, and final disposal of the product. Such analyses can be useful in determining the inputs and outputs at each stages of a beverage container's life cycle.

The Arthur D. Little Company, an independent research firm, carried out such a study to determine life cycle energy usage for beverage containers made from glass, steel (tin-free and tinplate), and aluminum (17). To determine energy requirements of various containers, they divided the life cycle of each container type into eight different stages or processes and then analyzed each one for energy use. Energy credits were given for steel and aluminum scrap since it was assumed that these scraps could be recycled to some extent. The energy requirements for each container type were then summed to obtain the life cycle energy use for each system.

The first container type analyzed was the beer industry's 12-ounce container. The results are depicted in Table 3. Analyzing the results in Table 3, we see that the non-refillable glass bottle requires the least energy over the container's life cycle. If we use seven trips as an average trippage factor, then the refillable glass bottle becomes the most energy efficient container using 1.69 MM BTU's/1000 containers. The aluminum and 3-piece bimetallic cans (welded) are at the other end of the table, requiring the most energy.

TABLE 3

LIFE CYCLE ENERGY ANALYSIS OF BEVERAGE CONTAINERS: BEER

Type of Container	Million BTU Per 1000 Containers
Non-refillable Glass Bottle	3.32
Refillable Glass Bottle (one trippage)	4.80
2-piece, Steel Can 85 lb/BB	3.70
2-piece, Steel Can 103lb/BB	3.92
2-piece, Bimetallic Can 85 lb/BB	4.05
2-piece, Bimetallic Can 103 lb/BB	4.27
2-piece, Aluminum Can	5.00
3-piece, Bimetallic Can: Soldered	4.62
3-piece, Bimetallic Can: Welded	4.49

Source: Arthur D. Little, Inc., 1982.

Regarding soft drink containers, it was difficult to compare the various metals with the two glass containers on an equivalent size basis because the metal containers analyzed were 12-ounce, while the two glass containers evaluated were 16-ounce. The results of the energy requirement analysis for soft drink containers is presented in Table 4.

In order to obtain a more relevant comparison, volume was also used to compare the 2-piece bimetallic can (85 lb/BB) with the refillable glass container. Table 5 shows the results of this comparison.

Using volume as the more equivalent base, it is evident that the refillable 10-ounce glass bottle with a trippage factor of seven is the most energy efficient soft drink beverage container analyzed. The 2-piece all-steel and the 2-piece bimetallic cans proved to be the most efficient metal containers. The 2-piece steel can is not commercially available.

TABLE 4

LIFE CYCLE ENERGY ANALYSIS OF BEVERAGE CONTAINERS: SOFT DRINKS

Type of Container	Million BTU Per 1000 Containers
Non-refillable Glass Bottle	4.66
Refillable Glass Bottle (one trippage)	6.46
2-piece, Steel Can 85 lb/BB	3.51
2-piece, Steel Can 1031b/BB	3.73
2-piece, Bimetallic Can 85 lb/BB	3.87
2-piece, Bimetallic Can 103 lb/BB	4.09
2-piece, Aluminum Can	4.83
3-piece, Bimetallic Can: Soldered	4.44
3-piece, Bimetallic Can: Welded	4.31

Source: Arthur D. Little, Inc., 1982.

TABLE 5

LIFE CYCLE ENERGY ANALYSIS OF BEVERAGE CONTAINERS BY VOLUME: SOFT DRINKS

Type of Container	Million BTU Per 1000 Gallons
2-piece Bimetallic Can 85 lb/BB (12 oz)	41.3
Refillable Glass Bottle (10 oz) with trippage factor of seven	22.8

Source: Arthur D. Little, Inc., 1982.

Based on the results of this study we see that glass containers, refillable and non-refillable, are more energy efficient than metal containers on an equivalent volume basis. As the degree of post-consumer scrap increases, aluminum cans approach 3-piece bimetallic cans in terms of energy efficiency.

As exemplified in the study, the number of trips a refillable glass beverage container makes has a great effect on the life cycle energy requirements. Table 6 shows this effect of trippage on life cycle energy. A trippage factor of seven reduces life cycle energy requirements for delivery of 1,000 gallons of soft drinks to 22.8 million BTU's for the 10-ounce soft drink glass bottle. Similarly, for delivering 1,000 gallons of beer the life cycle requirements are 17.8 million BTU's over seven trips for the refillable 12-ounce container. This container becomes more energy efficient than the non-refillable beer container at only two trips, whereas the 10-ounce refillable soft drink bottle becomes more efficient than the 16-ounce non-refillable glass bottle at three trips.

TABLE 6

ENERGY ANALYSIS OF REFILLABLE BEVERAGE CONTAINERS: GLASS BOTTLES
(MILLION BTU/1,000 GALLONS BEVERAGE)

Number of Trips	10-Ounce Soft Drink (Million BTU)	12-Ounce Beer (Million BTU)
1	82.2	51.2
2	47.7	31.8
3	36.1	25.3
5	26.7	20.0
7	22.8	17.8
10	19.8	16.2
12	18.7	15.5
15	17.4	14.8

Source: Arthur D. Little, Inc., 1982.

A similar study was conducted by Franklin Associates who compared the 32-ounce glass (refillable and non-refillable) soft drink bottle with the one-liter non-refillable PET plastic container (6). This study also used the "life cycle" approach to evaluate total energy consumption for each container type. In addition, they included several categories which rated overall resource and environmental "impacts" for each container system. The results of this study are summarized in six environmental impact categories that include energy use, raw material use, air and water pollutants, industrial solid wastes, and postconsumer solid waste.

Table 7 shows the results of the comparison for the 32-ounce non-refillable glass bottle and the 1-liter PET container. The high scenario is for a PET bottle with a polyethylene base cup and corrugated shipper, while the low scenario represents a freestanding PET bottle (no base cup) with reusable plastic shippers. Both container systems had aluminum closures.

TABLE 7

SUMMARY OF IMPACTS:
NON-REFILLABLE 32-OUNCE GLASS AND 1-LITER PET
SOFT DRINK CONTAINER SYSTEMS
(Based on 1,000 Gallons of Soft Drink Delivered)

Impact Category - Units	32-Ounce NR Glass	1-Liter PET Low	1-Liter PET High
Energy - Million BTU	50	26	36
Raw Material - lb.	6,495	54	338
Air Pollutants - lb.	164	84	123
Water Pollutants - lb.	25	12	21
Industrial Solid Waste - cu. ft.	11.6	2.3	3.1
Postconsumer Solid Waste - cu. ft.	119	71	71

Source: Franklin Associates, 1978.

Analyzing the results in Table 7, PET containers show a significant margin in every category implying that PET bottles produce less impacts than non-refillable glass bottles. This is primarily because of the differences in weight of the PET and glass containers. The weight of PET containers are only 6 to 11 percent the weight of equivalent glass bottles (6).

The comparison of 1-liter, non-refillable PET bottles and refillable 32-ounce glass bottles are summarized in Table 8. This comparison is complex because the impacts of refillable glass bottles are dependent upon trip rate. Table 8 shows, for each impact category, the glass bottle trip rates at which the refillable glass impacts are equivalent to non-refillable PET impacts (1 trip). For example, it takes the glass bottle 4.1 trips at the high scenario before its petroleum and natural gas energy consumption is reduced to the equivalent amount required by the non-refillable PET bottle.

TABLE 8

TRIP RATE EQUIVALENT FOR REFILLABLE GLASS BOTTLE COMPARED TO 1-LITER NON-REFILLABLE PLASTIC SOFT DRINK BOTTLE

	32-Ounce Refillable Glass	
Impact Category	High	Low
Petroleum and Natural Gas Energy	4.1 trips	4.8 trips
Total Energy	3.4 trips	4.7 trips
Air Pollutants	3.5 trips	4.9 trips
Water Pollutants	4.6 trips	--
Industrial Solid Waste	9.0 trips	15.7 trips
Postconsumer Solid Waste	4.4 trips	4.4 trips

Source: Franklin Associates, 1978.

As shown in Table 8, at lower trip rates PET produces less impacts, while at higher trip rates the refillable glass bottle impacts are lower. Based on the results of this study, they determined that the overall impacts of PET bottles are equivalent to those of refillable glass bottles having a useable life in the range of 4 to 6 trips.

The results of these types of studies provide a basis for comparing environmental impacts of beverage containers. However, only natural resources and environmental pollution effects have been considered. When determining the type of container system to use in a specific situation many complex factors must be taken into account including convenience, economics, competition, social and governmental concerns, as well as resource and environmental issues. Therefore, results of studies like these should not be viewed as the only criteria for basing decisions on which type of container system to use. They do, however, provide important inputs into the decision making process.

Recycle, Reuse and Energy Recovery

When examining potential ways to reduce resource and environmental impacts of beverage containers, three methods can be used including recycling, reusing, and recovering the energy content of the container. For each type of container it is possible to recover the material after use and recycle it by remelting and reprocessing.

The greatest energy savings potential derived from recycling systems are for aluminum containers. These savings are limited, however, because aluminum cans must be made from a blend of 25 to 50 percent virgin material, with the remainder scrap, as it is not possible to manufacture cans from all-recycled aluminum (17). Still, economic

benefits to the aluminum container industry are worth the effort since it is more economical to convert recycled aluminum back into can stock than it is to make can stock directly from bauxite ore (5).

Considering the plastics used in packaging today, the most logical for large scale recycling is PET. The problem, as far as the container industry is concerned, is that the recovered PET is not considered pure enough to go back into producing food and beverage containers. There are, however, many alternate uses for the resin produced. The main source of PET bottles is currently the nine mandatory deposit states. Attempts to recycle PET bottles in other states have generally not been effective to a large degree (5).

Contamination of recycled material has also been a problem in the steel container industry. Recovered "light ferrous" materials (those from which can stock is made), currently contain organic contaminants from unused contents along with non-ferrous contaminants such as tin and lead. When these materials are present in recovered steel, the types of products that can be produced from the recovered material are limited. Processes that will reduce these contaminants will result in recycled steel being used for a wider variety of products (5).

The recycling of glass containers is usually accomplished by one of two methods. Glass is either cleaned and refilled, as previously discussed, or crushed and used as cullet in the manufacturing of new glass.

The glass industry averages about 20% cullet usage in glass container production, but up to 50% may be used in certain container systems (7). Three-quarters of this is in-house generated and one-quarter is publicly recovered glass (5). Efforts are currently being

made by glass container manufacturers to increase the overall cullet percentage used in the glass mixture.

A major problem that must be faced is the recycling of glass containers with cap and ring closures which could contaminate recycled glass. New machines are being developed for removal of these components and there is also the possibility of having the consumer remove them before disposal. Probably the simplest and most economic solution is to have the closure considered when the original container is being designed in order to develop a closure system that will not contribute to recycling problems.

Another major concern is the continuing problem of sorting the glass by color. Some of the solutions to this problem might include requiring the consumer or retailer to do the sorting, developing more efficient separating machinery, and promoting the increased use of emerald green glass for packaging. If this particular type of green can be used, the glass container manufacturer would be able to use higher amounts of mixed cullet. This should help to reduce some of the problems of recycling used glass containers.

Container reuse requires that the container can be returned, washed, and refilled. Presently, only glass containers have the capability of being reused satisfactorily and the real benefits are related to the number of trips that the refillable glass container can endure.

Energy recovery methods for beverage containers are currently available for only the PET bottle. A PET bottle that has been discarded may be incinerated, along with waste components, and the combustion

energy recovered (6). When material recovery and recycling are not possible, energy recovery could be an alternative.

Recycling, reuse, or energy recovery methods that have been discussed can be effectively used for beverage container systems. By employing these techniques, resources can be conserved and pollution reduced. However, these methods will be effective only to the extent to which they are actually implemented. Currently, the reuse of glass refillable bottles and recycling of aluminum are the only two beverage container systems which use these techniques on any large scale.

IV. CONSUMER SURVEY ON BEVERAGE CONTAINERS

Materials and Methods

In order to assess consumer attitudes toward beverage containers and mandatory deposit legislation in Michigan, a telephone survey was conducted with 200 people within the Greater Lansing area. This survey was administered during the period of June 8 through June 22, 1983. The respondents were randomly selected from the recently published 1983-84 Lansing Area telephone directory. The method of selection consisted of choosing the fifth (a randomly selected number) residential number from each of the 250 applicable pages of the directory. In order to obtain the desired 200 useable respondents, the additional 50 numbers (25% safety factor) were needed to offset no answers, disconnected numbers, refusals, as well as willing respondents who were unable to participate in the survey because they did not purchase beer and/or soft drink beverages.

Each of the 250 telephone numbers were called at least once, with "no answers" being attempted three times (at various intervals of the day) before being considered unreachable. When a possible respondent was reached, the person was asked if he or she was at least 18 years of age and if they purchased beer and/or soft drink beverages from stores. If the person answered no to either question, he or she was then asked if another person in the household who met the criteria was available to take part in the survey. When the answers to both questions were yes, the interview was conducted.

This survey was performed under the controlled guidelines set forth in "Mail and Telephone Surveys", a text that was referred to frequently during the survey's design and implementation (9a). The suggestions and recommendations of an experienced survey specialist (23) were also used to ensure validity and consistency in survey techniques.

The questionnaire used for this survey, as well as additional results not essential to this study, can be reviewed in Appendices A and B, respectively.

Results and Discussion

The results of the survey were categorized by overall frequency distribution as well as demographically by sex, age, income, and education. To determine whether the demographic data obtained from the survey was statistically significant, Chi-square tests were applied. Only the results that fell at or below a 0.05 level of significance were considered to be meaningful enough to be used in the study.

It should be mentioned that age and, to a lesser extent, education were by far the most significant demographics. Income levels and sex of respondents did not prove meaningful to any acceptable significance levels in most tabulations.

There were 139 female (69.5%) and 61 male (30.5%) respondents taking part in the survey. Although this may appear to be an excessively high percentage of females, it should be taken into account that in the average household the female(s) do the majority of food and beverage purchasing. (See Appendix B for distribution of respondents by age, education, and income.)

Respondents were asked if they had purchased any beer and/or soft drinks from a store during the past two months. Out of 200 total respondents, 116 (58.0%) indicated buying both beer and soft drinks, 75 (37.5%) said they bought only soft drinks, and the remaining 9 respondents (4.5%) had purchased beer only.

Soft Drink Container Purchases

Of the respondents who said they were soft drink beverage purchasers, nearly two-thirds (64.4%) indicated that they usually bought them in glass bottles. This compared with 14.1% who usually purchased soft drinks in metal cans, 10.5% who purchased them in plastic bottles, and 11.0% who indicated they were uncertain about their type of soft drink container (Table 9).

TABLE 9

TYPE OF CONTAINER RESPONDENTS USUALLY BUY
FOR SOFT DRINK BEVERAGES
(N = 191)

Container Type	% of Respondents
Glass Bottle	64.4%
Metal Can	14.1
Uncertain	11.0
Plastic Bottle	10.5
TOTAL	100.0%

Respondents were then read a list of nine decision factors they might consider important when choosing a type of soft drink container. Each factor was considered individually by the respondent. They were

asked whether a particular factor was very, fairly, or not important in their decision when choosing a type of soft drink container. Taste of the soft drink in the container was chosen by the highest percentage (65.4%) of respondents as a very important decision factor (Table 10). Price and current "specials" were selected as very important factors by 57.0% and 54.5% of the respondents interviewed, respectively.

TABLE 10

FACTORS CONSIDERED IMPORTANT WHEN CHOOSING
A TYPE OF SOFT DRINK CONTAINER
(N = 191)

	% of Respondents		
Factor	Very Important	Fairly Important	Not Important
Taste of soft drink in container	65.4%	15.2%	19.4%
Price	57.0	28.3	14.7
Current "Specials"	54.5	17.3	28.2
Ease of opening container	35.6	29.3	35.1
Ease of handling and return	28.8	34.0	37.2
Container not being breakable	27.4	22.6	50.0
Ease of storing container	26.7	28.3	45.0
Clarity (can see soft drink)	26.7	18.8	54.5
Weight of container	14.7	20.9	64.4

NOTE: Each factor was considered individually.

Respondents were then asked to indicate which of the factors they considered to be most and second most important when choosing a type of soft drink beverage container. Of these nine factors, taste of the soft drink in the container was indicated as the most important factor by 43% of the respondents, while price was mentioned by 28.5% as most important (Table 11). Analyzing this data more specifically by age of

respondents, we observed that respondents who considered taste important to the greatest extent is the under 21 group (95.2%). The older the respondent, the less important taste becomes, as indicated by only 63.9% of the over 50 category choosing taste of soft drink in the container as an important decision factor (Table 12).

TABLE 11

FACTORS CONSIDERED MOST AND 2ND MOST IMPORTANT WHEN CHOOSING A SOFT DRINK CONTAINER

Factor	Most Important (N = 179)	2nd Most Important (N = 164)
Taste in Container	43.0%	15.9%
Price	28.5	29.9
Container Not Being Breakable	6.7	5.5
Ease of Handling and Return	6.1	5.5
Current "Specials"	5.6	15.2
Clarity (Can see soft drink)	3.4	6.7
Ease of Opening	2.8	8.5
Weight of Container	2.2	2.4
Ease of Storing	1.7	10.4
TOTAL	100.0%	100.0%

TABLE 12

RESPONDENTS INDICATE THE IMPORTANCE OF TASTE OF SOFT DRINKS IN CONTAINERS BY AGE (N = 191)*

		Age of Respondents			
Importance of Taste	Total %	Under 21 %	21-30 %	31-50 %	Over 50 %
Very Important	65.4	71.4	75.4	58.5	55.6
Fairly Important	15.2	23.8	14.5	16.9	8.3
Not Important	19.4	4.8	10.1	24.6	36.1
TOTAL	100.0	100.0	100.0	100.0	100.0

*Chi square test significant at 5% level.

Beer Container Purchases

The type of container for beer most often purchased by respondents was again the glass bottle (60%), compared to 32.8% of respondents who usually buy beer in metal cans, and 7.2% who indicated purchasing beer in other types of containers (Table 13). Analyzing beer container purchases by age, we observed that all the respondent categories except the over 50 group generally purchased beer in glass bottles (Table 14). Only one-third of the over 50 class indicated buying beer in glass bottles, while over half (55.6%) purchase the product in metal cans.

TABLE 13

TYPE OF CONTAINER RESPONDENTS USUALLY PURCHASE FOR BEER
(N = 125)

Container Type	% of Respondents
Glass Bottle	60.0%
Metal Can	32.8
Other	7.2
TOTAL	100.0%

TABLE 14

TYPE OF BEER CONTAINER RESPONDENTS USUALLY PURCHASED BY AGE
(N = 125)**

	Age of Respondents				
Container Type	Total %	Under 21 %	21-30 %	31-50 %	Over 50 %
Glass Bottle	60.0	61.5	77.8	47.5	33.3
Metal Can	32.8	38.5	18.5	40.0	55.6
Other	7.2	0.0	3.7	12.5	11.1
TOTAL	100.0	100.0	100.0	100.0	100.0

**Chi square test significant at 1% level.

These results can at least partially be explained by Tables 15-17. Although taste and price were again indicated as the most important factors when choosing a type of beer container, 61.7% and 15.8% respectively (Table 15), two other factors proved to be very important to the over 50 group. The ease of handling and return of beer containers was indicated as being a very important factor by 55.6% of the over 50, beer purchasing respondents (Table 16). This was the only group in which over half of the members chose this factor as being very important. The over 50 class also displayed the greatest percentage of respondents (44.4%) that indicated the weight of the container was a very important decision factor (Table 17). Based on these data, at least part of the reason the over 50 group preferred metal cans to glass bottles for beer was because of the importance this group placed on containers being lightweight and easily handled and returned as compared to younger respondent groups. This is probably because the elderly have more trouble carrying and lifting the more heavy, cumbersome glass bottles.

TABLE 15

FACTORS CONSIDERED MOST AND SECOND MOST IMPORTANT WHEN CHOOSING A BEER CONTAINER

Factor	Most Important (N = 120)	2nd Most Important (N = 99)
Taste in Container	61.7%	17.2%
Price	15.8	33.3
Container Not Being Breakable	5.8	4.0
Current "Specials"	5.0	14.1
Clarity (Can see soft drink)	5.0	5.1
Weight of Container	2.5	2.0
Ease of Opening	1.7	6.1
Ease of Storing	1.7	3.0
Ease of Handling and Return	0.8	15.2
TOTAL	100.0%	100.0%

TABLE 16

RESPONDENTS INDICATE IMPORTANCE OF EASE OF HANDLING AND RETURN OF BEER CONTAINERS BY AGE (N = 125)**

Importance of Ease of Handling and Return	Total %	Age of Respondents: Under 21 %	21-30 %	31-50 %	Over 50 %
Very Important	27.2	7.7	20.4	30.0	55.6
Fairly Important	22.8	69.2	37.0	22.5	16.6
Not Important	40.0	23.1	42.6	47.5	27.8
TOTAL	100.0	100.0	100.0	100.0	100.0

**Chi square test significant at 1% level.

TABLE 17

IMPORTANCE OF WEIGHT OF BEER CONTAINERS
BY AGE (N = 125)*

		Age of Respondents			
Importance of Weight	Total %	Under 21 %	21-30 %	31-50 %	Over 50 %
Very Important	16.0	15.4	11.1	10.0	44.4
Fairly Important	18.4	7.7	18.5	22.5	16.7
Not Important	65.6	76.9	70.4	67.5	38.9
TOTAL	100.0	100.0	100.0	100.0	100.0

*Chi square test significant at 5% level.

Classifying beer container purchases by income reveals another significant trend (Table 18). The greatest percentage of glass bottle purchasers (82.1%) were represented by the lowest income group, making under $10,000 per year. For the highest income group ($40,000 per year or more), the opposite was true. Only 30% of the respondents in this category indicated purchasing beer in glass bottles, while 65% usually bought beer in metal cans. To some extent this can be explained by the fact that less expensive beers are usually sold in returnable, standard size glass bottles which carry the cheaper five cent deposit.

TABLE 18

TYPE OF CONTAINER RESPONDENTS USUALLY PURCHASE FOR BEER BY INCOME (N = 115)*

		Income of Respondents				
Container Type	Total %	Under $10,000 %	$10,000-$19,999 %	$20,000-$29,999 %	$30,000-$39,999 %	$40,000 Or More %
Glass Bottle	61.7	82.1	65.0	58.1	68.8	30.0
Metal Can	32.2	7.1	30.0	38.7	25.0	65.0
Other	6.1	10.8	5.0	3.2	6.2	5.0
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

*Chi square test significant at 5% level.

Respondents were also asked if they would buy beer in a plastic bottle (Table 19). Analyzing the results in Table 19 we notice that although nearly half (48.8%) of the respondents indicate they would not buy beer in plastic, an even greater percentage (51.2%) said that they would or might consider purchasing beer in a plastic container. These results indicate that if plastic beverage container manufacturers can solve their current technological problems and produce a small size plastic beer container with an acceptable shelf life, they may have quite a sizeable market that would consider buying it.

TABLE 19

RESPONDENTS INDICATION WHETHER OR NOT THEY WOULD PURCHASE BEER IN A PLASTIC BOTTLE (N = 125)

Response	% of Respondents
No	48.8
Yes	25.6
Uncertain	25.6
TOTAL	100.0

Mandatory Deposit Legislation

Respondents were asked to choose their greatest dislike of the Michigan bottle bill from a list of six issues concerning the bill. They indicated most often (33.1%) the higher prices resulting from the bill as the issue they disliked the most (Table 20). Even those surveyed who were strongly in favor of the bill tended to dislike paying higher prices in order to be provided with a manadatory deposit legislation in their State. Analyzing respondents' opinions toward these issues by age we noticed that, for nearly all of the issues, the older the age bracket the smaller the percentage of respondents who dislike the generally negative aspects of the bottle bill (Table 21). When the issue of higher prices as a result of the bill was broken down by respondents' educational background, another distinct trend emerged (Table 22). In general, the more educated respondents tended to not dislike paying higher prices as a result of the bill as much as the lower educated respondents. Based on these results we can conclude that the older and more educated a person is, the more likely he will be in favor of mandatory deposit legislations.

TABLE 20

ISSUE THAT RESPONDENTS DISLIKE MOST CONCERNING
THE BOTTLE BILL IN MICHIGAN
(N = 130)

Greatest Dislike of Bottle Bill	% of Respondents
1. Higher prices as a result of bill	33.1%
2. Returning containers	17.7
3. Storing containers in home	14.6
4. Possible health hazards	13.1
5. Paying a deposit	11.5
6. Cleaning of containers	10.0
TOTAL	100.0%

TABLE 21

RESPONDENTS BY AGE EXPRESS OPINIONS TOWARD ISSUES CONCERNING BOTTLE BILL IN MICHIGAN
(N = 200)

Issue Concerning Bottle Bill	Total	Age of Respondents: Under 21 %	21-30 %	31-50 %	Over 50 %
1. Higher prices as a result of bottle bill**					
Dislike	47.0	76.2	56.8	40.9	23.1
Neither like nor dislike	37.0	19.0	28.4	47.0	46.2
Like	16.0	4.8	14.8	12.1	30.7
2. Having to pay a deposit**					
Dislike	33.0	47.6	43.3	28.8	12.8
Neither like nor dislike	36.0	23.8	37.8	42.4	28.2
Like	31.0	28.6	18.9	28.8	59.0
3. Having to store container**					
Dislike	32.0	42.9	37.8	31.8	15/4
Neither like nor dislike	43.5	33.3	48.6	43.9	38.5
Like	24.5	23.8	13.6	24.3	46.1
4. Health hazards connected with storing and handling containers**					
Dislike	27.0	47.6	33.8	22.7	10.3
Neither like nor dislike	57.5	52.4	52.7	62.1	61.5
Like	15.5	0.0	13.5	15.2	28.2
5. Having to return containers					
Dislike	21.0	33.3	17.6	24.2	15.4
Neither like nor dislike	22.5	9.5	27.0	27.3	12.8
Like	56.5	57.2	55.4	48.5	71.8
6. Cleaning of dirty containers**					
Dislike	20.0	33.3	25.7	16.7	7.7
Neither like nor dislike	55.0	52.4	51.3	68.2	41.0
Like	25.0	14.3	23.0	15.1	51.3

NOTE: Each column totals 100%.
*Chi square significant at 5% level.
**Chi square significant at 1% level.

TABLE 22

RESPONDENTS BY EDUCATION LEVEL EXPRESS OPINIONS TOWARD PAYING HIGHER PRICES AS A RESULT OF THE BOTTLE BILL (N = 199)*

		Education of Respondents			
Paying Higher Prices	Total	Some High School %	Completed High School %	Some College %	Completed College %
Dislike	46.7	71.4	43.1	53.3	38.3
Neither like nor dislike	37.2	14.3	36.9	43.3	36.7
Like	16.1	14.3	20.0	3.4	25.0
TOTAL	100.0	100.0	100.0	100.0	100.0

*Chi square test significant at 5% level.

The bottle bill also affected respondents' beverage buying habits (Table 23). As shown in the table, the percentage of respondents that agreed changes in their buying habits as a result of the bill had occurred, varied between 5.0 and 10.7 percent. Of the four changes discussed, the change that the highest percentage (10.7%) of respondents agreed took place was the switching of beer brands to a brand offering the cheaper five cent deposit glass bottle. When these same four changes in buying habits were analyzed by respondents' education levels, another significant trend was noticed (Table 24). In nearly all instances, the lower the educational level of a group, the greater the affect of the bottle bill on beverage buying habits.

TABLE 23

HOW THE BOTTLE BILL HAS AFFECTED RESPONDENTS' BEVERAGE BUYING HABITS

Change in Beverage Buying Habits	% of Respondents Agree	Neither	Disagree
1. Switched beer brand to brand offering standard size glass bottle requiring cheaper 5¢ deposit (N=131)	10.7	0.8	88.5
2. Now buy more beverages in larger size containers requiring a smaller total deposit. (N=200)	10.1	4.5	85.4
3. Buy more beverages in containers not requiring a deposit (for example, wine, Kool-Aid, etc.) (N=200)	6.0	4.0	90.0
4. Buy less of beverages that do require a deposit (N=200)	5.0	1.5	93.5

TABLE 24

HOW BOTTLE BILL HAS AFFECTED BEVERAGE BUYING HABITS OF RESPONDENTS BY EDUCATION

Change in Beverage Buying Habits	Total %	Education of Respondents: Some High School %	Completed High School %	Some College %	Completed College %
1. Switched beer brand to brand offering standard size glass bottle requiring cheaper 5 cent deposit. (N = 70)					
Agree	10.0	33.3	13.2	2.4	11.4
Neither agree nor disagree	0.8	0.0	0.0	2.4	0.0
Disagree	89.2	66.7	86.8	95.2	88.6
TOTAL	100.0	100.0	100.0	100.0	100.0
2. Now buy more beverages in larger size containers requiring a smaller total deposit. (N = 199)**					
Agree	10.1	21.4	10.8	8.5	8.3
Neither agree nor disagree	4.0	28.6	1.5	5.1	0.0
Disagree	85.9	50.0	87.7	86.4	91.7
TOTAL	100.0	100.0	100.0	100.0	100.0
3. Buy more beverages in containers not requiring a deposit. (Ex. wine, Kool-Aid, etc.) (N = 199)**					
Agree	6.0	14.3	6.2	6.7	3.3
Neither agree nor disagree	4.0	21.4	6.2	1.7	0.0
Disagree	90.0	64.3	87.6	91.6	96.7
TOTAL	100.0	100.0	100.0	100.0	100.0
4. Buy less of beverages that do require a deposit. (N = 199)**					
Agree	5.0	21.4	6.2	1.7	3.3
Neither agree nor disagree	1.5	14.3	0.0	1.7	0.0
Disagree	93.5	64.3	93.8	96.6	96.7
TOTAL	100.0	100.0	100.0	100.0	100.0

**Chi square test significant at 1% level.

The final portion of the survey was primarily directed at the respondents' attitudes toward the effectiveness of the Michigan bottle bill. When resondents were asked if they were generally pleased with the results of the bottle bill, 83% indicated that they were (Table 25). When asked if they were voting on the bill today would they vote for it, 81% of the respondents said they would (Table 26). Remember that this survey was conducted in Michigan, a state where only 60% of its voters originally voted for the bottle bill.

TABLE 25

RESPONDENTS INDICATE WHETHER THEY ARE PLEASED WITH RESULTS OF THE BOTTLE BILL
(N = 200)

Pleased With Results	% of Respondents
Yes	83.0%
No	9.5
Uncertain	7.5
TOTAL	100.0%

TABLE 26

RESPONDENTS INDICATE WHETHER THEY WOULD VOTE FOR THE BOTTLE BILL TODAY
(N = 200)

Vote for Bottle Bill Today?	% of Respondents
Yes	81.0%
No	11.0
Uncertain	8.0
TOTAL	100.0%

Survey Conclusions

To what extent plastic containers will be able to erode future glass container market share will largely depend on the ability of plastic manufacturers to solve the technological problems that currently face small size plastic bottles. Although the majority of respondents interviewed prefer glass bottles to other beverage container types, there did exist a sizeable percentage who would consider buying beer in plastic bottles if the choice was made available to them. The future of the glass beverage container industry will be most dependent on its own ability to continue productivity improvements and new container innovations, such as the lightweight, Plasticshield glass bottle which has become very popular for carbonated beverages.

The results of this study should not give the impression that people are generally beginning to favor mandatory deposit legislations. During the elections of last November, voters defeated proposals in California, Colorado, Arizona, and Washington that would have required deposits on soft drink and beer containers (1). What these results do imply is that the longer a State has a bottle bill legislaton, the more people tend to like the benefits (such as reduced litter) that the bill provides. This indicates that once a State votes in a bottle bill legislation, it will probably have this bill for many years to come. This consequence is one that all beverage container manufacturers should be aware of.

Survey Considerations

No survey would be complete without mentioning the limitations involved. A telephone survey is a relatively quick and inexpensive interviewing technique. It also has a major limitation in that not all households have telephones. Even those who do are not always listed in telephone directories. Because of this, a large portion of the population, generally considered to consist primarily of households with lower than average incomes, is not represented.

The time of year this survey was conducted could also be considered a limitation. This survey took place in June, primarily between the hours of 5:00 p.m. and 9:00 p.m. on weekdays. Unfortunately, the first really nice weather of the year took place during the two week period this survey was conducted. Daylight savings time also assured that the entire survey took place before sunset. These factors only helped to increase the percentage of households that could not be reached during these hours as a higher than average amount of people were outside enjoying the good weather and, therefore, unreachable by telephone.

Because this survey was conducted in a city that contained a major university, the population included a larger than average percentage of college educated people. Although respondents' education levels were fairly well distributed, this overeducated population must be considered.

Finally, because of time and financial restraints, only 200 people were interviewed for this survey. This relatively small sample size must also be taken into account.

Diversification

A major trend within the glass container industry in recent years has been emerging diversification of products and services provided by manufacturers. The return on invested capital has not been high enough to justify large reinvestment of funds into glass containers. Managements have gone into areas such as plastics, insurance, and financial services in attempts to find higher returns. This diversification into other business should continue as glass container producers look to offset the maturity, lower returns, and slow growth of the industry. Owens-Illinois, for example, is moving into the new generation of high technology plastics packaging and further increasing diversification into health care management and supplies. They are anticipating that by 1988, glass containers will account for only 35% of total sales, down from 50% in 1983. The type of product manufactured by Owens-Illionis is no longer their primary interest. If a product cannot produce a sufficient return on investment, it will no longer be produced by them (4).

Cost Reduction

If the glass container industry is to continue to increase operating efficiency, production costs (particularly in energy and labor) must be further reduced. Successful glass container producers will continue plant modernization by installing multiple-gobbing machines, computer controlled gas melting processes, and energy saving recovery of heat in the manufacturing process. Efficiency improvements

in energy use will continue by the increasing use of recycled glass. Glass is alone among packaging materials because it can be totally recycled to reproduce the original product, namely, a glass jar or bottle. Cullet melts quicker than the basic raw materials, providing significant energy savings. It also conserves raw materials and helps to ease the problem of solid waste disposal. With continued improvements of cullet treatment in recycling centers, a higher percentage of cullet will be used in the glass mixture. The total system of glass recycling is estimated to save almost 40 percent of the energy required to make containers from new materials (7).

Although labor and raw material costs should not increase substantially through 1987, decontrol of natural gas prices scheduled for 1985 could result in large increases in energy costs. It will therefore become even more important for glass container manufacturers to maximize fuel conservation efforts.

Continued cost reductions will enable manufacturers to improve their operating rates and pricing incentives. A measure frequently used by glass container producers to determine operating rates is to compare the square footage of the furnace capacity with the actual amount of glass being pulled from the furnace. Although this measure is not totally accurate, if operating rates could get up around 90% (currently estimated at 80 to 85%) the manufacturer's ability to raise prices would strengthen.

Changing Demographics

Long range demographic factors could result in relative shifts among the glass bottle markets. The low birth rates of the past decade may reduce soft drink consumption during the next ten years as the teenage population declines. However, gains in the 25 to 44 age group (a traditionally heavy beer and wine consuming segment) could compensate for losses in soft drinks. Glass container manufacturers must react to the needs of these changing markets in order to stay competitive in the battle for beverage container market share. Another factor that must be considered is the increasing health and diet consciousness of current generations. Today's consumer tends to be more aware of alcohol and sugar consumption than any era before. The degree to which this trend continues will determine its effects on future alcohol and soft drink consumption.

Competition

The plastic bottle threat during the next several years will continue to come from the half-liter size soft drink bottle. Restrictions to the growth of this bottle will include plastic's technical problems, price disadvantages, and public acceptance of this type of container. If these same problems can be solved for the small size plastic beer container, competition could also occur in this market. Plastic bottles will begin to make gains in the distilled spirits and wine markets at the expense of glass. These gains will be most noticeable in large size container markets.

Even though plastic bottles pose a major threat to the glass container industry, the greatest competition will likely occur between

single-service glass bottles and metal cans in both retail and vending markets. The 10 and 16 ounce glass bottle will continue to move into the metal can dominated soft drink beverage vending market during the next five years. Increased standardization will allow glass to become more price competitive. The cube efficiency incorporated into glass container design enables them to be double stacked in vending machines and thus overcome a major distribution drawback.

Another area that will see increased competition between glass bottles and metal cans will be the large-size food container market. Glass container producers have introduced 44-ounce glass bottles, designed to compete with the standard 46-ounce metal can for a variety of food products (3).

Aseptic packaging will continue to move into the fruit juice and milk container markets where carbonation loss prevention is not required. Aseptic milk and juice packaging using hydrogen peroxide as a sterilizer was approved by the FDA in January 1981, and is beginning to make impacts into these markets. Depending on consumer acceptance, aseptic containers could become a major competitor of glass bottles during the next five years particularly in fruit juice container markets.

Deposit Legislation

To what extent mandatory deposit legislation will continue to affect the glass container industry remains uncertain. The drive for a national bottle bill by proponents of deposit legislation was temporarily halted by the defeat of bottle bill legislations in four western states during recent elections (November 1982). The defeat of

the bill in Washington marked the third time in a decade that voters in that state have turned down a deposit proposal. Although it is doubtful that the issue of mandatory deposits will fade away, it seems likely (considering the November results) that state legislators may begin assigning lower priorities to bottle bills. Glass container manufacturers must continue to encourage recycling in order to bring it up to levels acceptable to the voting public.

Interviewing Glass Container Industry Executives

To help determine where the glass container industry will be heading during the next five years, a series of telephone interviews with four industry executives were conducted during June 28 and 29, 1983. The four people interviewed were marketing executives from the four largest glass container manufacturers in the United States. Companies represented were Owens-Illinois, Anchor Hocking, Thatcher, and Brockway Glass. The questionnaire format that was used for these interviews is included in Appendix C.

The executives were asked what they felt were glass container's greatest advantage over other types of containers. Two of the respondents answered the inertness of glass while the other two mentioned impermeability as the biggest advantage. When asked what they felt were glass container's greatest disadvantage, two indicated breakability and the other two said the weight of glass relative to other container types.

The four respondents were read a list of ten problem areas currently facing the glass container industry. For each one they were asked to indicate whether they felt this problem would have no, some, or

much influence on future growth of the glass container industry (Table 27). The only problem area where the majority of the executives (3 of 4) agreed would definitely influence future growth was unutilized capacity. When they were asked to indicate the problem that will have the most influence on future growth of the industry, unutilized capacity was again chosen by three of the four respondents. The problem of too much capacity is apparently expected to cause still more problems during the next five years. The remaining executive indicated the current recession as having the most influence on future industry growth. The four persons were then asked which problem would have the second most influence on the industry. Two of them indicated weight of glass, one said increasing energy costs, while the other mentioned competition from plastic containers.

TABLE 27

INDUSTRY EXECUTIVES INDICATE PROBLEMS THAT WILL INFLUENCE GLASS CONTAINER'S FUTURE
(N = 4)

Problem	Number of Executives		
	No Influence	Some Influence	Much Influence
Competition from 2-liter plastic bottle	1	2	1
Competition from other plastic containers	1	1	2
Competition from the metal can	3	1	0
Mandatory deposit laws	0	4	0
Increasing labor costs	0	3	1
Increasing energy costs	1	1	2
Unutilized capacity	0	1	3
Current recession	0	2	2
Weight of glass	0	2	2
Plastic liquor bottles	0	4	0

NOTE: Each problem was considered individually.

The four executives were asked what overall change in glass container market share during the next five years could be expected. Two executives felt glass container market share will slightly decrease, one said it will remain about the same, while the other felt a slight increase would occur.

Three of the four indicated that their companies have diversified into new areas during the past five years. As previously mentioned, this does appear to be a trend within the industry. The areas into which these companies have diversified include plastic and metal containers, high technology plastics, health care, and financial services.

When the respondents were asked if they foresaw any new markets for glass containers during the next five years, three of the four said yes. Microwave containers, juice bottles, and increased use of glass containers for food products were mentioned as new potential markets.

In order to determine the impact of bottle bill legislations on the four companies, the executives were asked if the legislations have had no, small, or great effects on company glass container sales volume during the past five years. Three of the four indicated bottle bills as having small effects, while the other executive (from Owens-Illinois) said they have had great effects on his company's glass container sales volume.

All four of the respondents said that labor and energy costs, compared to total operating costs, have increased during the past five years. Increased unionization, fringe benefits, workers compensation, and rising natural gas prices were mentioned as causes.

In order to offset these rising labor and energy costs all of the executives indicated that their companies have taken actions to increase capital utilization. These included installing new triple and quadruple gobs, high speed bottle making machines and shutting down inefficient production facilities.

All of the respondents also said the current recession has had a slight effect on glass container sales volume. The decline in new glass container demand has made it difficult for manufacturers to increase prices in order to offset rising operating costs. All of the executives indicated that it has been over a year since their company has had a glass container price increase. Two of them said they could foresee no price increases during the next six months, while the other two were uncertain whether their company's would be raising glass container prices.

Finally, the four were asked if they foresaw any problems with raw material availability during the next five years. All respondents indicated they did not.

Although these interviews did tend to reinforce the assumptions of current and future trends within the glass container industry, they should not be taken as indicative viewpoints for the entire industry. It should be taken into account, however, that the four companies together represent over half of the industry's sales volume.

Future Growth Opportunities

As previously mentioned, growth of the United State glass container industry is strongly dependent on favorable trends in the United States economy. With gains in disposable income, lower interest rates, and an

expected decline in the rate of inflation, United States glass container shipments should grow at an annual rate of 2 to 3 percent during the next five years.

This rate could change, however, depending on the glass container industry's ability to develop new products to meet the continually changing needs of the consumer. Glass microwave containers, for example, were frequently mentioned by the industry executives interviewed as having tremendous future market potentials. The rate of glass container growth will also be dependent on technological developments by the industry in order to make further cost reductions possible. A recent example of this is the effects lightweighting has had on the industry. Improved design methods and manufacturing techniques have enabled producers to make glass bottles with thinner walls while maintaining container strength. This has resulted in less glass being required, which not only cuts distribution costs and saves raw materials but also helps to achieve faster production speeds.

It can be safely stated that the main influence on future growth of the glass container industry will not come from competitors or legislators, but from the industry's own internal developments that will enable it to reach previously unattainable markets.

VI. SUMMARY

Based on favorable trends in the United States economy, the glass container industry should experience two to three percent annual growth during the next five years. This rate is dependent, however, on the industry's ability to continue productivity improvements and new container innovations. Also having an influence will be the actions of competitors and the efforts of state legislators attempting to pass mandatory deposit legislations.

To what extent plastic containers will be able to erode future glass container market shares will largely depend on the ability of plastic manufacturers to solve technological problems that currently face small size (1/2-liter) plastic bottles. A sizeable percentage of respondents in the consumer survey indicated they would consider buying beer in plastic bottles if the choice was made available to them.

The drive for national bottle bill legislation has been temporarily halted by the defeats of proposals in four western states during the 1982 elections. The results of the consumer survey implied that the longer a state has a bottle bill, the more people tend to like the benefits (such as reduced litter) the bill provides. This indicated that once a state votes in bottle bill legislation, it will probably have this bill for many years to come.

The majority of the industry executives interviewed felt that overcapacity would continue to be the greatest problem facing the glass container industry during the next five years. They indicated breakability and weight as being glass container's greatest disadvantages when comparing them to other types of containers.

Microwave containers, juice containers, and increased use of glass containers for food products were mentioned as potential new markets for glass containers. The majority also indicated that their company's have diversified into other product areas producing higher returns than glass containers. This seems to be a trend within the industry.

Despite the glass container industry's competitive environment, the industry does appear to have a stable future and will likely be around for a long period of time. The industry will remain highly competitive, however, and management will face a difficult job in coming years.

APPENDIX A

CONSUMER SURVEY QUESTIONNAIRE

Telephone Interview - **Consumer Beverage Container Buying Habits**

Interviewer Initials _____ Phone Number _____

Interview Status:

____ Completed

____ Disconnected

____ No Answer

____ Busy

____ Refused

Sex of Respondent:

____ Male

____ Female

INTRODUCTION: Hello, I am _____ a packaging student at Michigan State University. We are doing a Lansing area research study on beverage containers and your telephone number was drawn in a random sample of the area. I have a few questions I would like to ask you which will take only a few minutes.

Consumer Survey

1) During the past 2 months have you bought any beer and/or soft drink beverages from a store?

___ Soft drinks and beer

___ Soft drinks only

___ Beer only (Go to #7)

___ Neither (End of survey, thank respondent)

2) Do you usually buy soft drinks in metal cans, plastic bottles, or glass bottles?

___ Metal Cans

___ Plastic Bottle

___ Glass Bottle

___ Uncertain

3) I am going to read to you some factors that you might consider important when choosing a type of soft drink container. For each one please indicate whether you feel this factor is very important, fairly important, or not important in your decision when choosing a type of soft drink container.

	Very	Fairly	Not Imp.
1) Taste of soft drink in container	___	___	___
2) Ease of handling and return	___	___	___
3) Weight of container	___	___	___
4) Ease of storing container	___	___	___
5) Current "Specials"	___	___	___
6) Clarity of container (can see soft drink)	___	___	___
7) Ease of opening container	___	___	___
8) Price	___	___	___
9) Container not being breakable	___	___	___

4) Now, of the factors we have just discussed, which one do you feel is the most important when choosing a type of soft drink container? If you like, I would be happy to read them again.

#___ Most important factor

Which is the second most important factor?

#___ Second Most Important Factor

5) This question refers to your buying of soft drinks in the large 2-liter plastic bottle. About how many times during the past two months have you bought soft drinks in this type of bottle?

___ Never, what don't you like about them? _____
_____ (Go to #6)

___ 1-2

___ 3-4

___ 5-6

___ 7 or more

What do you like most about this type of bottle? _____

_____

6) I would now like to find out if you are a light, moderate, or heavy buyer of soft drink beverages. We define a moderate buyer as one who in an average week buys 1-2 six packs of twelve ounce cans or 1 carton of eight half-liter bottles or 1 two-liter plastic bottle. Based on this definition of a moderate buyer, would you consider yourself a light, moderate, or heavy buyer of soft drink beverages?

___ Light

___ Moderate

___ Heavy

*If respondent does not buy beer, go to #12

7) Do you usually buy beer in metal cans or glass bottles?

___Metal Can

___Glass Bottle

___Other, please explain._____

8) If it were available, would you buy beer in a plastic bottle?

___ Uncertain

___ No

___ Yes

9) I am going to read to you a list of factors that you might consider important when choosing a type of beer container. For each one please indicate whether you feel this factor is very important, fairly important, or not at all important in your decision when choosing a type of beer container.

	Very	Fairly	Not Imp.
1) Taste of beer in container	___	___	___
2) Ease of handling and return	___	___	___
3) Weight of container	___	___	___
4) Ease of storing container	___	___	___
5) Current "Specials"	___	___	___
6) Clarity of container (can see beer)	___	___	___
7) Ease of opening	___	___	___
8) Price	___	___	___
9) Container not being breakable	___	___	___

10) Now, of the factors we have just discussed, which one do you feel is the most important when choosing a type of beer container? If you like, I would be happy to read them again.

#___ Most Important Factor

Which is the second most important factor?

#___ Second Most Important Factor

11) Now I would like to find out if you are a light, moderate,or heavy buyer of beer in bottles and cans. We define a moderate buyer as one who in an average week buys 1-2 six-packs or 3-4 quart bottles of beer. Based on this definition of a moderate buyer, would you consider yourself a light, moderate, or heavy buyer of beer in bottles and cans?

___ Light

___ Moderate

___ Heavy

12) I am going to read to you six different statements about glass bottles in general. For each one please indicate whether you agree, disagree, or neither agree nor disagree with the statement.

	Agree	Neither	Dis.
1) Glass bottles are just too heavy.	___	___	___
2) I like the taste of a beverage in glass.	___	___	___
3) Glass bottles are too hard to handle and return.	___	___	___
4) I wish glass bottles were offered in more sizes.	___	___	___
5) The price of a beverage is less in glass bottles.	___	___	___
6) I like the "feel" of a glass bottle as compared to other container types.	___	___	___

13) Would you say that during the past year your buying of beer and soft drinks in all types of containers has remained about the same, increased, or decreased?

___ Remained about the same

___ Increased

___ Decreased

14) I would now like to find out your feelings on the bottle bill in Michigan. This is the law that requires you to pay a deposit on beer and soft drink containers. I am going to read to you six different issues which you may or may not like about the bottle bill. For each one please indicate whether you like, dislike, or neither like nor dislike the issue concerning the bottle bill.

	Dis.	Neither	Like
1) Having to return containers	___	___	___
2) Having to store containers in home	___	___	___
3) Having to pay a deposit	___	___	___
4) Higher prices on many beverages as a result of the bottle bill	___	___	___
5) The health hazzards connected with storing and handling containers	___	___	___
6) The cleaning of dirty containers that is sometimes required before returning	___	___	___

*IF RESPONDENT DIDN"T INDICATE ANY DISLIKES GO TO #16

15) Now, of these issues concerning the bottle bill we have just discussed which one do you dislike the most?

#___ Greatest dislike

16) I am now going to read to you several statements about how the bottle bill may have affected your beer and/or soft drink buying habits. For each statement please indicate whether you agree, disagree, or neither agree nor disagree.

	Agree	Neither	Dis.
1) As a result of the bottle bill I now buy more beverages in containers that don't require deposits. For ex. fruit drinks, Kool-aid, draft beer, wine	___	___	___
2) As a result of the bottle bill I now buy less beer and/or soft drinks	___	___	___
3) As a result of the bottle bill I now buy beer and/or soft drinks in larger size containers, requiring a smaller total deposit to be paid.	___	___	___
*ASK BEER DRINKERS ONLY 4) As a result of the bottle bill I have changed my beer brand to a brand that offers the cheaper 5c standard 12 oz size glass bottle. For ex. Strohs, Pabst, Gobel	___	___	___

17) In general are you pleased with the results of the bottle bill?

___ Yes

___ No

___ Uncertain

18) If you were voting on the bottle bill today, would you vote for it?

___ Yes

___ No

___ Uncertain

19) This question is concerned with the recycling of containers which enables them to be reused again. Which type of container plastic, metal, or glass, do you feel is the easiest to recycle?

___ Plastic

___ Metal

___ Glass

___ Uncertain

20) In which of the following age brackets do you fall? Are you under 21, 21-30, 31-40, 41-50, 51-60, or over 60?

___ Under 21 ___ 41-50

___ 21-30 ___ 51-60

___ 31-40 ___ Over 60

21) What was your approximate total household income in 1982 before taxes were deducted? Was it under $10,000, 10,000 or greater but under $20,000, $20,000 or greater but under $30,000, $30,000 or greater but under $40,000, or $40,000 or greater?

___ Under $10,000

___ $10,000-$19,999

___ $20,000-$29,999

___ $30,000-$39,999

___ $40,000-or greater

22) What was your last grade completed in school?

___ Some high school or less

___ Completed high school

___ Some college or special training

___ Completed college or more

23) This completes the survey. Do you have any additional comments about glass, metal, or plastic containers that you would like to mention?

_____

_____

_____

* THANK YOU VERY MUCH FOR YOUR TIME

APPENDIX B

ADDITIONAL CONSUMER SURVEY RESULTS

TABLE 28

NUMBER OF TIMES DURING PAST TWO MONTHS RESPONDENTS BOUGHT SOFT DRINKS IN 2-LITER PLASTIC BOTTLES
(N = 190)

2-Liter Purchases	% of Respondents
None	38.9%
1-2	30.0
3-4	11.1
5-6	6.3
7 or more	13.7
TOTAL	100.0%

TABLE 29

FACTORS CONSIDERED IMPORTANT WHEN CHOOSING A TYPE OF BEER CONTAINER
(N = 125)

	% of Respondents		
Factor	Very Important	Fairly Important	Not Important
Taste of beer in container	81.6	12.0	6.4
Price	45.6	32.0	22.4
Current "Specials"	41.6	28.8	29.6
Ease of storing container	28.0	28.8	43.2
Ease of Opening	28.0	25.6	46.4
Ease of handling and return	27.2	32.8	40.0
Container not being breakable	21.6	22.4	56.0
Clarity (can see beer)	20.0	11.2	68.8
Weight of container	16.0	18.4	65.6

NOTE: Each factor was considered individually.

TABLE 30

RESPONDENTS EXPRESS OPINIONS TOWARD STATEMENTS CONCERNING GLASS CONTAINERS
(N = 200)

Statement About Glass Containers	% of Respondents Agree	Neither	Disagree
1. I like the taste of a beverage in glass.	77.5	14.5	8.0
2. I like the "feel" of a glass bottle as compared to other container types.	46.0	25.5	28.5
3. I wish glass bottles were offered in more sizes.	36.5	26.5	37.0
4. The price of a beverage is less in glass.	21.5	44.5	34.0
5. Glass bottles are just too heavy.	21.5	14.0	64.5
6. Glass bottles are too hard to handle and return.	20.0	16.0	64.0

TABLE 31

RESPONDENTS INDICATE WHETHER THEIR BUYING OF BEVERAGES DURING THE PAST YEAR HAS CHANGED
(N = 199)

Change in Beverage Purchases	% of Respondents
Remained about same	77.9%
Increased	14.1
Decreased	8.0
TOTAL	100.0%

TABLE 32

RESPONDENTS EXPRESS OPINIONS TOWARD ISSUES CONCERNING THE BOTTLE BILL IN MICHIGAN
(N = 200)

Issue Concerning Bottle Bill	% of Respondents Dislike	Neither	Like
1. Higher prices on beverages as a result of bottle bill.	47.0	37.0	16.0
2. Having to pay deposit.	33.0	36.0	31.0
3. Having to store containers in home.	32.0	43.5	24.5
4. Health hazards connected with storing and handling containers.	27.0	57.5	15.5
5. Having to return containers.	21.0	22.5	56.5
6. Cleaning of dirty containers.	20.0	55.0	25.0

NOTE: Each issue was considered individually.

TABLE 33

RESPONDENTS BY AGE INDICATE HOW BOTTLE BILL HAS AFFECTED LARGE SIZE CONTAINER PURCHASES
(N = 199)

Buy More Beverages in Larger Size Containers**	Total %	Age of Respondents Under 21 %	21-30 %	31-50 %	Over 50 %
Agree	10.1	19.0	9.6	12.1	2.6
Neither Agree nor Disagree	4.5	19.0	2.7	3.0	2.6
Disagree	85.4	62.0	87.7	84.9	94.8
TOTAL	100.0	100.0	100.0	100.0	100.0

**Chi square test significant at 1% level.

TABLE 34

RESPONDENTS INDICATE WHICH CONTAINER TYPE THEY FEEL IS EASIEST TO RECYCLE
(N = 200)

Container Type	% of Respondents
Metal	36.5%
Glass	36.0
Uncertain	19.0
Plastic	8.5
TOTAL	100.0%

TABLE 35

DISTRIBUTION OF RESPONDENTS' AGE BRACKETS
(N = 200)

Age Bracket	% of Respondents
Under 21	10.5%
21-30	37.0
31-50	33.0
Over 50	19.5
TOTAL	100.0%

TABLE 36

DISTRIBUTION OF RESPONDENTS' INCOME LEVELS
(N = 200)

Income Level	% of Respondents
Under $10,000	19.0%
$10,000 - 19,999	19.0
$20,000 - 29,999	24.5
$30,000 - 39,999	10.5
$40,000 or Greater	15.5
Refused	11.5
TOTAL	100.0%

TABLE 37

DISTRIBUTION OF RESPONDENTS' EDUCATION LEVELS
(N = 200)

Education Level	% of Respondents
Some High School	7.0%
Completed High School	32.5
Some College/Special Training	30.0
Completed College	30.0
Refused	0.5
TOTAL	100.0%

APPENDIX C

QUESTIONNAIRE FORMAT USED FOR INTERVIEWING
INDUSTRY EXECUTIVES

Industry Survey

1. What types of containers do you produce besides glass?

___ None
___ Plastic, % of total container sales volume? ____
___ Metal, % of total container sales volume? ____
___ Other, % of total container sales volume? ____

2. What do you feel is the greatest advantage glass containers have over other type containers?

_____

3. What do you feel is their greatest disadvantage? _____

_____

4. I am going to read to you ten problem areas facing the glass container industry today. For each please indicate whether you think this problem will have much influence, some influence, or no influence on future growth of the G.C. industry?

	NO	SOME	MUCH	
1) Competition from the 2-liter plastic bottle	___	___	___	1
2) Competition from other types of plastic containers	___	___	___	2
3) Competition from the metal can	___	___	___	3
4) Mandatory deposit laws	___	___	___	4
5) Increasing labor costs	___	___	___	5
6) Increasing energy costs	___	___	___	6
7) Unutilized capacity	___	___	___	7
8) Current Recession	___	___	___	8
9) Weight of glass	___	___	___	9
10) Plastic liquor bottles	___	___	___	10

5. Now, of these problem areas we have just discussed which one do you feel will have the most influence on future growth of the G.C. industry? If you like, I would be happy to read them again.

_____ Most Influence
Which one will have the second most influence?
_____ Second Most Influence

6. This question concerns change in G.C. market share of total container sales during the next 5 years. Do you feel G.C. market share will greatly decrease, slightly decrease, remain about the same, slightly increase, or greatly increase during the next 5 years?

___ Greatly Decrease
___ Slightly Decrease
___ Remain the Same
___ Slightly Increase
___ Greatly Increase

7. Do you foresee any <u>new</u> markets for glass containers during the next five years?

___ Uncertain
___ No
___ Yes, please explain: _____

8. Has your company diversified into any new areas during the past 5 years?

___ No, do you plan to?
___ No, ___ Uncertain, ___ Yes, explain: _____

___ Yes, please explain: _____

9. This question concerns energy consumption in three different operations namely, production, transportation, and recycling of containers. As I read each operation please tell me which container type, plastic, metal, or glass, you feel requires the least energy consumption, which one requires the most energy consumption.

	<u>Least</u>	<u>Most</u>
1. Production of containers		
2. Transportation of containers		
3. Recycling of containers		

10. Now, based on this discussion of energy consumption, which container type do you feel requires the least amount of total energy required to produce, transport, and recycle?

___ Least total energy required
Which container type do you feel requires the most total energy consumption to produce, transport, and recycle?

___ Most total energy required.

11. This question concerns bottle bill legislations which requires mandatory deposits on most beverage containers. During the past 5 years would you say that bottle bill legislations have had a great effect, small effect, or no effect on your company's G. C. sales volume?

___ No effect
___ Small effect
___ Great effect

12. Concerning G. C. monthly sales fluxuations, would you say that monthly sales fluxate greatly (more than 10%), somewhat (10% or less), or very little at your company?
___ Very little
___ Somewhat
___ Greatly

13. During which months does your company experience its peak sales?

_____

What about low G. C. sales months?

_____

14. This question refers to changes in energy costs as compared with total operating costs for G. C. production at your company. Would you say that energy costs as a percentage of total operating costs for G. C. production have greatly increased, slightly increased, remained about the same, slightly decreased, or greatly decreased at your company during the past 5 years?

___ Remained the same (Go to #15)
___ Greatly increased
___ Slightly increased
___ Slightly decreased
___ Greatly decreased
What has caused this change? _____

_____

15. What about changes in labor costs as compared to total operating costs for G. C. production? Has this percentage greatly increased, slightly increased, remained about the same, slightly decreased, or greatly decreased during the past 5 years?

___ Remained the same (Go to #16)
___ Slightly increased
___ Greatly increased
___ Slightly decreased
___ Greatly decreased
What has caused this change? _____

_____

16. Has your company taken any action to increase capital utilization during the past 5 years?

___ No

___ Yes, please explain: _____

_____

17. At what level of capacity are you currently operating?

_____

18. This question has to do with the effect the current recession has had on your company's G. C. sales volume. Would you say the current recession has had a great effect, slight effect, or no effect on G. C. sales volume?

___ No effect (Go to #19)
___ Slight effect
___ Great effect
Could you please explain this effect? _____

_____

19. What about inventory turnover for G. C. at your company during the current recession. Has inventory turnover for G. C. increased, remained about the same, or decreased during this recession?

___ Uncertain (Go to #20)
___ Remained the same (Go to #20)
___ Increased
___ Decreased
What do you feel has caused this change? _____

_____

20. Does your company forecast G. C. demand?
___ No
What do you base production on? _____

_____(Go to #21)

___ Yes
How far into the future do you forecast G. C. demand?
___ less than 1 month
___ 1-3 months
___ 4-6 months
___ 7-12 months
___ more than 1 year.

21. How long has it been since your conpany has had a G. C. price increase?

___ less than 1 month
___ 1-6 months
___ 7-12 months
___ more than 1 year

22. Do you foresee any G. C. price increases during the next 6 months?

___ Uncertain
___ No
___ Yes

23. What would you say has been the average profit margin for G. C. at your company during the past year?

___ Zero
___ 1-3%
___ 4-6%
___ 7-9%
___ 10% or more

24. Do you foresee any problems with raw material availability during the next 5 years?
___ Uncertain
___ No
___ Yes, please explain: _____

_____

25. In conclusion, how do you feel in general about the future of the G. C. industry? _____

_____

26. Would you like a copy of the results of this study sent to you?

___ No

___ Yes, What is your mailing address? _____

_____

Thank you very much for taking the time to answer these questions. Your assistance with this study has been appreciated.

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