

**EMGT 835 FIELD PROJECT:  
The Future of Injection Molding in Food Packaging for  
the United States**

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## **EXECUTIVE SUMMARY**

The injection molding process has been used for many years to produce food packaging in the United States. It is important to understand the forces in both the food industry and packaging industry to determine the role of injection molding in the future. Food manufacturers are responding to consumer and retailer demands to develop new products and packages that address a wide variety of needs. Innovation is a key for the future of both food and packaging manufacturers. European companies continue to lead their counterparts in the United States with the development and implementation of new packaging materials and processes. Plastic remains the fastest growing packaging material as it can be formatted in both flexible and rigid packaging forms. Flexible packaging and its many variations are growing and amassing increased market share due to their price and available features. The demand for inexpensive packaging, and increased use of packages that can provide barrier properties threaten the future of injection molding. Continued development of materials, and processing equipment as well as the use of in mold labeling and integrated tamper evident packaging are opportunities for injection molding. The environmental issues associated with packaging will have an increasing effect on the United States food and packaging industries with growing consumer awareness. Packaging manufacturers should expect increasing competition from Asia.

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## **INTRODUCTION**

The focus of this project is to analyze how injection molded plastics will be used for United States food packaging over the next five years. As an employee of Berry Plastics, the largest producer of injection molded food packaging in the United States, it is essential that Berry Plastics understands what forces affect the food packaging market and how they will change in the future. One objective of this work is to understand how food manufacturers, consumers and retailers are changing and what trends are being created in the food industry. Another objective is to analyze and understand competitive packaging materials and processes. Environmental concerns, the global economy, and the effects of industry consolidation are also evaluated.

## **PROCEDURE and METHODOLOGY**

Five different procedures were used to gather data for this project:

- Direct interactions
- Survey of industry personnel
- Periodical research
- Literature search
- Competitor analysis

### **Direct Interactions**

The first direct interaction is accomplished in my job as a Specialty Sales Manager for Berry Plastics. My job function is to work with food manufacturers in the design, development, and execution of new packaging. My daily work requires direct contact with raw material suppliers, equipment and tooling vendors, co-workers, customers and occasionally competitors. Another direct interaction with all facets of the food packaging industry was through my attendance at the annual Pack Expo in Chicago, IL in November 2004. Lastly I participated in the “Packaging that Sells II Conference” in June 2004. This conference was focused on market trends and how packaging can help sell a brand or product.

### **Survey of Industry Personnel**

A total of 40 surveys were sent to a variety of professionals in the food packaging industry. These surveys were sent to key industry personnel including food manufacturers, toolmakers, raw material suppliers, competitors, and a variety of coworkers from Berry Plastics. This survey was e-mailed to the participants who replied via email or fax. Due to the policies of the participant’s employers, many of the participants must remain anonymous. A total of 25 surveys were returned. The compiled results are shown in Appendix A.

The survey was designed to solicit feedback regarding the future of injection molding in food packaging applications. The participants in the survey represent a cross section of individuals who have a vested interest in the ongoing utilization of injection molded food packaging. The success of toolmakers, machine manufacturers and resin manufacturers is largely dependent on the success of injection molders. The future of Berry Plastics and other injection molded packaging manufacturers is dependent on the ongoing successful development of injection molded food packaging. Finally, food manufacturers need injection molded food packaging to meet their packaging needs.

The survey was designed in three sections. Section one contained a series of 23 questions with a choice of weighted responses. The next section asked the participants to rank different food packaging materials relative to the cost and timing for developing a new package. The final section contained four essay questions allowing the participants to provide direct feedback.

## Periodical and Literature Research

This information was gathered using the resources of the University of Kansas library system and its on-line databases. Further information was also obtained from personal subscriptions to the following periodicals:

- Plastics News
- Food and Drug Packaging
- Packaging World
- Plastics Engineering
- Injection Molding Magazine
- Packaging Digest

## Competitors Analysis

Packaging company websites were searched for information regarding capabilities, innovations and trends in food package. Table 1 summarizes those companies and their websites.

Company Name	Primary Process	Location	Web Address
Superfos	Injection Molding	Denmark	<a href="http://www.superfos.com">www.superfos.com</a>
Tetra Pak	Paper	Sweden	<a href="http://www.tetrapak.com">www.tetrapak.com</a>
Graham Packaging	Blow Molding	United States	<a href="http://www.grahampackaging.com">www.grahampackaging.com</a>
Double H Plastics	Injection Molding	United States	<a href="http://www.doublehplastics.com">www.doublehplastics.com</a>
Airlite	Injection Molding	United States	<a href="http://www.myairlite.com">www.myairlite.com</a>
Huhtamaki	Paper, Rigid and Flexible plastics	Finland	<a href="http://www.huhtamaki.com">www.huhtamaki.com</a>
Elopak	Paper, Blow molded Plastics	South Africa	<a href="http://www.elopak.com">www.elopak.com</a>
International Paper	Paper	United States	<a href="http://www.internationalpaper.com">www.internationalpaper.com</a>
Polytainers	Injection Molding	Canada	<a href="http://www.polytainersinc.com">www.polytainersinc.com</a>
Alcoa	Metal	United States	<a href="http://www.alcoa.com">www.alcoa.com</a>
Pliant	Flexible plastic	United States	<a href="http://www.pliantcorp.com">www.pliantcorp.com</a>

Pechiney	Flexible plastics and blow molding	France	<a href="http://www.pechineyplasticpackaging.com">www.pechineyplasticpackaging.com</a>
Neoplex	Flexible plastics	Denmark	<a href="http://www.neoplex.dk">www.neoplex.dk</a>
Cryovac	Flexible plastics	United States	<a href="http://www.sealedair.com">www.sealedair.com</a>
Linpac		United Kingdom	<a href="http://www.linpac.com">www.linpac.com</a>
Pactiv	Flexible plastics	United States	<a href="http://www.pactiv.com">www.pactiv.com</a>
Amcor	All	Australia	<a href="http://www.amcor.com.au">www.amcor.com.au</a>
Mondi Packaging	Paper, flexible plastics	France	<a href="http://www.mondipackaging.com">www.mondipackaging.com</a>
Visy Industries	All	Australia	<a href="http://www.visy.com.au">www.visy.com.au</a>
Owen Illinois	Glass, Injection molded plastic	United States	<a href="http://www.o-i.com">www.o-i.com</a>
PrintPack	Thermoform and flexible plastics	United States	<a href="http://www.printpack.com">www.printpack.com</a>
Letica	Injection and thermoform	United States	<a href="http://www.letica.com">www.letica.com</a>
Sonoco	Composite cans, flexible plastics	United States	<a href="http://www.sonoco.com">www.sonoco.com</a>
Silgan	Metal and Rigid Plastic	United States	<a href="http://www.silgan.com">www.silgan.com</a>
Rexam	Metal, Glass, Rigid Plastic	United Kingdom	<a href="http://www.rexam.com">www.rexam.com</a>
FabriKal	Thermoform Plastics	United States	<a href="http://www.fabrikal.com">www.fabrikal.com</a>
Weidenhammer	Composite Cans	Germany	<a href="http://www.weidenhammer.de">www.weidenhammer.de</a>

**Table 1 – Packaging Companies**



## BACKGROUND

One of man's greatest struggles for survival has been a steady supply of food. Storing and delivering food has been done since pre-historic times. Food items were stored in animal bladders and horns or plants such as gourds. This early packaging evolved into pottery and baskets. Modern food packaging materials include paper, glass, metals, and plastics. Each of these materials has a unique and colorful history that has led to the development of the wide variety of food packaging materials and processes used today. The ongoing innovation and development of new materials, shapes, and processes in food packaging is another step in this continuum.

Modern food packaging must meet five basic criteria.<sup>85</sup>

- Containment. The packaging must be able to hold the product.
- Protection. A package must protect and preserve the food that it is holding from the environment both at a macro, microscopic and in some cases atomic level.
- Communication. Packaging must proclaim what it is holding and in most cases help "sell" the product.
- Compatible. Food packaging must be compatible with the filling process. This includes the ability to satisfy heat, pressure, sanitation and high speed processing requirements.
- Consumer/Retailer Needs. A food package must interact with and satisfy the needs of the consumer and the retailer.

All food sold at retail is packaged in some fashion with the exception of some fresh foods. Food packaging can be divided into two general categories; flexible and rigid. Flexible packaging includes all types of bags, sleeves, and pouches, as shown in Figure 1. Materials used in the production of flexible packages are: paper, plastics, metal foils and composite laminates.

Rigid packaging includes all cans, bottles, jars, cups, containers, and closures as seen in Figure 2. Materials used to produce rigid packaging include glass, metal, paper, plastics and composites.



Figure 1 – Flexible packaging



Figure 2 – Rigid Packaging

## RESULTS

### Food Packaging Market

In 2003, the global market for all packaging was approximately \$300 billion. About \$100 billion of packaging was used in the United States. Food packaging in the United States is approximately a \$60 billion industry that is expected to reach \$74 billion by 2008.<sup>55</sup>

The global market for rigid and flexible packaging reached \$135 billion in 2001, with an additional \$80 billion in corrugated containers.<sup>53</sup> In the United Kingdom plastics are expected to represent 39% of all food packaging by 2008. Plastic packaging is growing at a rate twice that of the second fastest growing material for food applications which is metal.<sup>53</sup>

The food packaging market will continue to grow. Average annual household expenditures for “food at home” increased by 1.0 % from 2001 to 2002.<sup>94</sup> At the same time 13.2% of the average annual household income is spent on food purchases. With the population of the United States growing and projected to reach 309 million by 2010 it is reasonable to predict the requirements for food and its packaging will continue increasing.

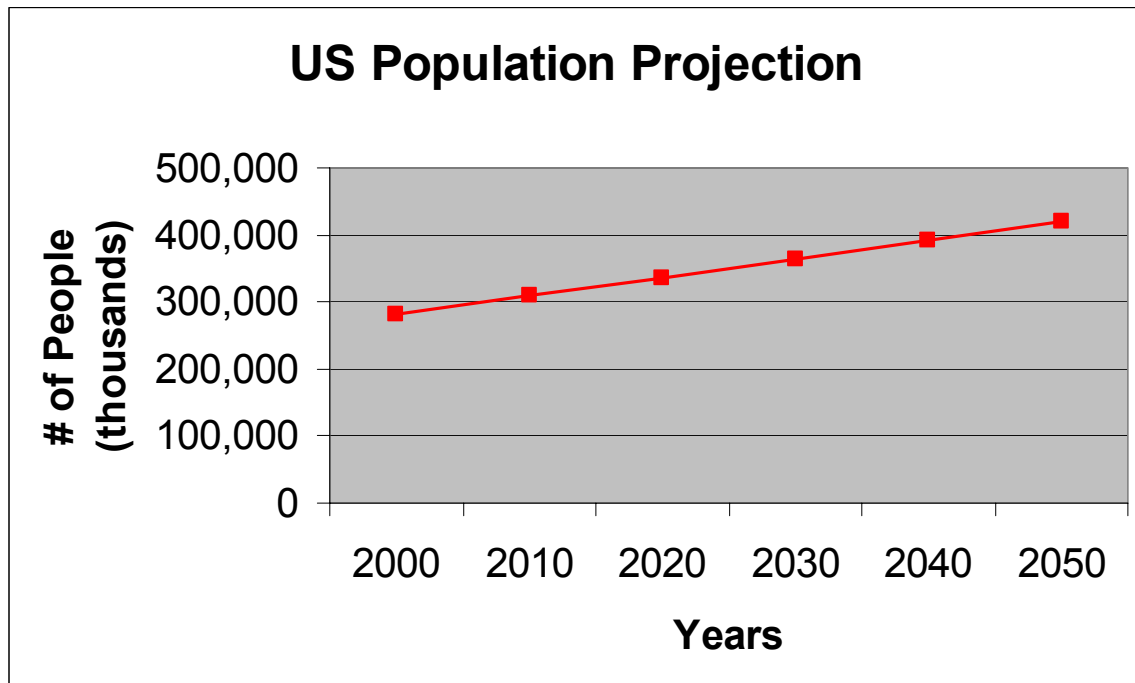


Figure 3. United States Population Projection<sup>95</sup>

## Expectations for Food Packaging

Retail food packaging provides a variety of services for the manufacturer, retailer and consumer of food products. The primary purpose of food packaging is to deliver the products from the manufacturer to the consumer while at the same time protecting the food from a hostile environment. Packaging allows food to be prepared in mass and distributed throughout the country. Packaged foods are a critical element of the society of the United States. The pace of life in the United States results in food purchases generally being purchased two to three times per week.<sup>38</sup> Without packaging this would not be possible. While it may be nostalgic to think of fresh food purchased and prepared daily, this does not seem likely in the future.

The demand for packaging to “sell” the product at the retail shelf, offer convenience for the consumer, be easy to replenish for the retailer, and ultimately be a cost effective method for delivering the product has never been higher. Additionally there is a growing requirement that a package meet all the required criteria but also have elements of style.<sup>102</sup> Consumer purchasing processes have elevated the need for packaging style and for packaging to be a selling tool. Properly designed packaging can even create an emotional bond between a consumer and the product.<sup>38</sup>

Most consumer purchases are done impulsively, and it has been shown that the buying decision of an individual item is less than ten seconds.<sup>99</sup> Packaging is critical in establishing contact with the consumers and the selling process.<sup>98</sup> Much package development relies on focus group studies. Because these focus groups allow consumers significant amounts of time to evaluate a product it removes them from their normal role as a purchaser.<sup>99</sup> Packaging must be designed to engage a consumer in a few seconds since 70% of all purchasing decisions are made at the point of purchase.<sup>98</sup> Additionally with the fragmentation of media the effectiveness of advertising to reach consumers is reduced.<sup>38</sup> Thus the importance of packaging for reaching consumers continues to increase.

As food products evolve, consumer and retailer expectations rise, and competition between food producers increases, packaging suppliers and designs must evolve and innovate. Competition between food manufacturers to launch innovative new products is fierce. In the United States a total of 33,678 new packaged goods were launched in 2003.<sup>68</sup> Of these product launches 8.5% received an innovation rating because they offered a breakthrough in either packaging, technology, or merchandising.<sup>68</sup>

Consumers see fast paced innovation in all parts of their lives. The development of new clothing, electronics, and even automobiles happens quickly. Surrounded with all of this innovation, it is critical that food producers innovate. At least one major US food manufacturer’s declining earnings were attributed to the failure to innovate.<sup>64</sup> As food manufacturers innovate and create new products, new packaging requirements and innovations will be a part of the successful launch of a food product or the invigoration of a mature product.<sup>73</sup>



## Consumer Trends in Food Packaging

Consumer convenience is an ongoing trend for food packaging. Food producers are using packaging to keep up with consumer demands for packages that are portable, resealable, ovenable, microwavable, easy to open, easy to grip, etc. Consumers have been found to pay more than twice for a product that is formatted in convenient packaging.<sup>75</sup>

Examples of convenience packages are shown in Figure 4. The introduction of zippered closures on flexible packages created an obvious convenience so that now it is almost impossible to find packages without this feature. Microwave soup cups have sold over seven million units in the first ten months without reducing sales of the traditional metal cans.<sup>4</sup> This sales growth is the result of packaging that created new usage occasions through convenience. Salads are being packaged in bowls to facilitate hurried consumers.<sup>43</sup>



Figure 4 Convenience Packages

One consumer convenience has grown so big it has become its own trend. Consumers need products that are compatible with their fast pace and fluid world. “To go” or “on the go” packaging of food products is a dominate trend in the development of both

packaging and food products.<sup>25</sup> Furthermore packages are being made with integrated utensils for additional consumer convenience and purchases from vending machines.<sup>45</sup> Another example of innovative packaging for the “to go” market is a dual chamber cup holding milk and cereal.<sup>71</sup> Figure 5 shows examples of these “to go” packages.



**Figure 5 “To Go” Packages**

Children play an increasingly important role in the purchasing of food in the United States. Conveniences such as easy opening, portability and easy to prepare foods are some of the influences of children. About 90% of all mothers indicate that their 6 – 10 year olds influence buying decisions.<sup>40</sup> Families with children account for 45% of retail refrigerated grocery sales in 2002.<sup>10</sup> Half of all children make their own lunch, and nearly a third put dinner on the table for the family. Children are virtually unanimous in their desire to cook.<sup>40</sup>

Packaging can help meet the needs of children by providing an opportunity to customize a meal. In addition packaging can help kids stay on the go. Lastly, kids are cooking meals from scratch. As food manufacturers react to these needs meal kits and other concepts will continue to grow that meet the needs of children that like to cook. Yogurt in tubes is a great example of an innovation that meets the needs for a healthy, on-the-go, and fun package. Examples of packages that have been influenced by children are shown in Figure 6.









microwave cooking can be used for more than defrosting and re-heating. Finally the creation of self heating and self cooling packages are new levels of active packaging.<sup>48</sup>



**Figure 8 – Shelf Stable Packages**

Color, graphics, and shapes that give a package a sense of style are a growing part of package design. Color and graphics are commonly used practices to catch a consumer's attention to a package or brand and have been used since the earliest modern packages.<sup>39</sup> The creation of the full body shrink sleeve allows for high end economical high end graphics on unique shapes.<sup>44</sup> However, the addition of stylistic elements that do not provide a functional benefit to the design of food packaging is a growing trend and companies work to improve brand recognition and generate consumer excitement. Examples are shown in Figure 9.

Round rigid packaging is the most common shape for rigid packaging in paper, metal and plastic forms. The round shape is easiest to manufacture for all three materials. However, packaging food into rigid containers in non-round shapes is another growing trend as shown in Figure 10. Non-round packaging creates opportunities to improve efficiency in freight, storage, master cartons, retail displays and storage in the consumer's home. Non-round has been proven to increase truckload efficiency by as much as 33% over round containers.<sup>56</sup> Furthermore, a non-round package can improve the interface between the consumer and the product. Recently a square one liter milk

container was developed to improve how it fit into a refrigerator door either upright or lying down.<sup>19</sup> The development of new decorating techniques including the full body shrink sleeve<sup>20</sup> and in mold labeling that can be incorporated into a package at high speeds are fostering development of non-round shapes for rigid packages. Non-round packaging is another growing trend in the United States that is more common in Europe.



**Figure 9 – Non functional shape elements**

The murders of seven people in Chicago in 1982 that resulted from taking Tylenol capsules laced with cyanide were the first victims of product tampering.<sup>96</sup> This case led to the development of all types of tamper evident packaging. Tamper evident packaging is not a new trend. Tamper evidence for rigid plastic containers in the United States is dominated by secondary seals in the form of either shrink bands that encapsulate the lid to the container or membranes that are heat sealed to the container. Both of these methods require packaging components and equipment at the food processing plant. Caps and closures with integrated tear strips or breakaway bands are common tamper evident features used on bottles of all material types. The new trend that is more common in Europe is the use of integrated tamper evident structures on rigid plastic packages. These tamper evident packages provide a benefit to the food manufacturer by eliminating the need for secondary seal and the equipment and labor used for their installation. Another option for elimination of a secondary seal is the full body shrink sleeve. When applied after the product is filled, the sleeve decorates the container but



also creates a tamper evident cover over the package.<sup>57</sup> Examples of tamper evident packaging are shown in Figure 11.



Figure 10 – Non Round Food Packaging

Another growing trend in food packaging is the use of aseptic packaging to create shelf stable packed foods as an alternative to traditional canning. Aseptic packaging allows perishable foods and dairy products to be stored at room temperatures.<sup>6</sup> Aseptic packages require the food to be sterilized prior to being packed into a sterilized package. Therefore the packaging materials do not have to withstand the heat and time required in a traditional retort process. On the other hand, the packaging materials must be delivered in a sterilized fashion or be put through their own sterilization process prior to filling. Generally non-metal aseptic packages are made from a composite laminate of paper and plastics to achieve the structure and barrier properties required to meet the food products needs.



**Figure 11 – Tamper Evident Packaging**

### **Retail Trends in Food Packaging**

Besides meeting the needs of both the food manufacturer and the consumer, food packaging is increasingly being asked to meet the needs of the retailer. The ability for retailers to keep their shelves stocked, receive and move product through distribution, and efficiently display the products to the consumer are addressed through packaging. Packages are designed to “fit” onto shelves and incorporate elements that improve their ability to stack. In some situations cut away boxes or trays are used both for display and restocking.

Over the past 20 years food retailers have been consolidating through a series of mergers and acquisitions as well as closures of some independent operators. The result is the top five United States food retailers command 69% of the sales of the top 15 retailers as shown in Figure 12. Wal-Mart has become the largest food retailer in the United States with 29% of this same share. Wal-Mart amassed a 9% share of all fresh produce sales and a 9.7% share of all fluid milk sales in 2002 across all retail sectors.<sup>10</sup> These large retailers are looking for methods to differentiate their stores from their competition. Given the size of these retailers and the volume of product they sell, food producers are

increasingly creating new products or new packaging configurations specific to the retailer. The use of food packaging to create differentiation contributes to the need for packaging innovations.

An additional effect of retailer consolidation is the growth of private label, store brands, or house brands. Historically private label manufacturers respond to innovations in products or packages from the brand name products by imitating the product and package. However, as seen in Europe, consumers are becoming loyal to private labels. This loyalty is creating a bond between the consumer and the retailer, thus fueling the desire for additional private labeling.<sup>38</sup> In Europe private labeling captures over 50% of the available shelf space at some retailers.<sup>82</sup> This growth and energy with private labels has converted them from “copy cats” of name brands to innovators of new food products and or packaging. Much of this innovation is being captured in new packaging. This trend is catching on in the US as new product and packaging innovations are being introduced by private label manufacturers.<sup>41</sup> In addition private label manufacturers continue to emulate innovation from brand names that offer convenience to the consumer or retailer.

As a result of Wal-Mart’s growth as a food retailer, case ready meat is another growing trend in food packaging. Fueled by advantages to the retailer (reduced out of stocks, longer shelf life and reduced costs), this trend will continue to grow. In 2001, all of Wal-Mart’s case ready meats and poultry were offered in case ready packaging.<sup>47</sup> Longer shelf life is achieved through the use of modified atmospheric packaging and barrier packaging. Case ready has been available for years in both poultry and ground beef, but is now moving to other areas. Case ready also provides benefits to the consumer by both reducing prices and allowing the inclusion of recipes and cooking instructions. This consumer information is leading to additional sales of less popular meats. Simpler processing is achieved by using antimicrobial films that allow the creation of a modified atmosphere inside a package without requiring the food processor to use a traditional nitrogen flush after filling the package. Although these packages cost more, the benefit of increased shelf life makes the package worthwhile for the retailer.<sup>35</sup>

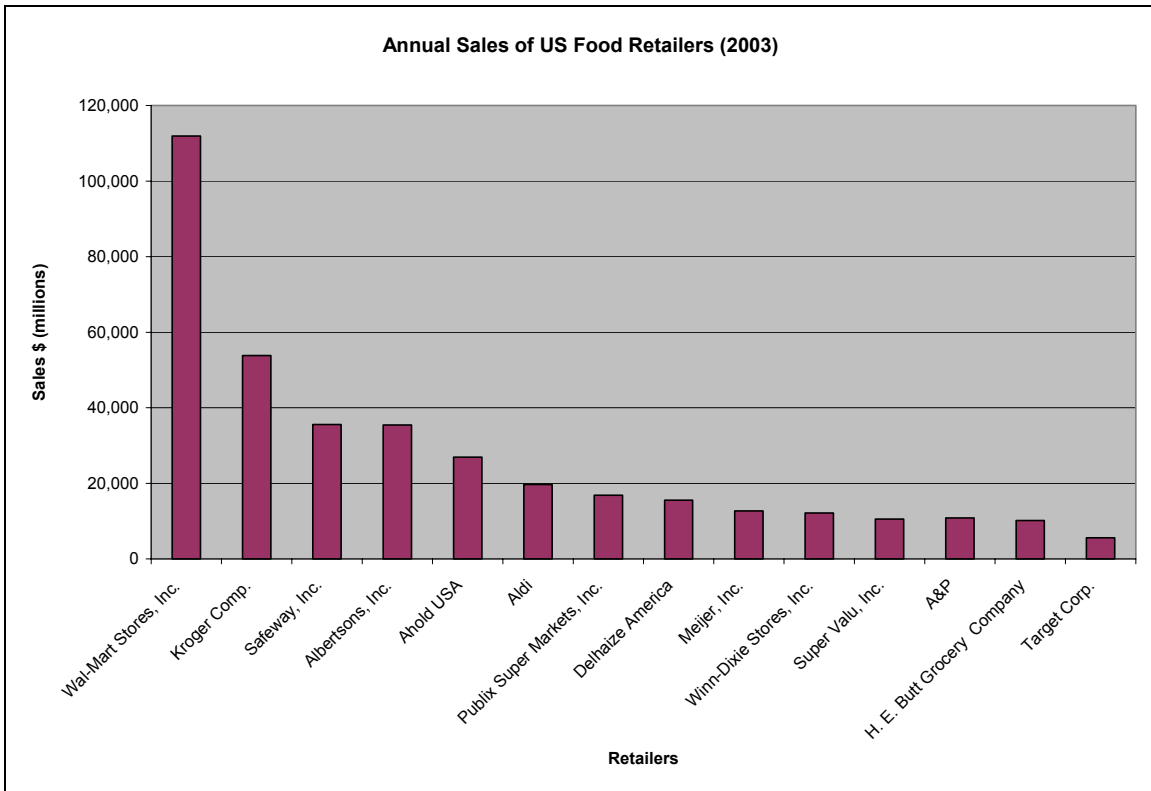


Figure 12 – United States Food Retailers (2003) <sup>103</sup>

### Environmental Impact

Since the 1970's food packaging has been under increasing pressure from governments and consumers to reduce its impact on the environment. The historical response to this pressure has been to reduce the use of packaging, encourage the reuse of packaging and recycle the components from packaging. Many packaging manufacturers in Europe are acknowledging their responsibility to address environmental issues.<sup>29</sup> Furthermore, some European countries are considering deposits on plastic containers to increase recycling.<sup>30</sup> Recycling of plastic packaging in Europe is targeted at 22.5%.<sup>32</sup>

Source reduction has resulted in packaging manufacturers and their supplies using technology to reduce the use of packaging materials. Glass, paper, plastic and metals have all been made thinner and lighter to address source reduction. Furthermore, packaging has moved from rigid containers to flexible packages to reduce packaging at the source. While it may seem that the food industry has been responding to environmental concerns regarding source reduction it is most likely competition between the packaging suppliers and the food manufacturers desire to reduce costs that have fueled this effect.

The reuse of packaging materials is a combination of education and pragmatism by consumers. Education of consumers regarding the effects of packaging has encouraged people to reuse packaging materials. Rigid packaging, primarily plastic containers and glass jars remain the most commonly reused packaging. However the growing trends of on the go and convenience foods offset some of the traditional re-use opportunities.

In 2001 recycling was a \$236 billion industry employing 1.1 million people in the United States.<sup>97</sup> It is a growing industry that is integrating the efforts of the public and private sectors together. However, the amount of material being recycled is still only a fraction of the amount being used for packaging. An important issue for the recycling industry is sorting the products in the waste stream. Many modern food packages are composite forms of multiple materials. Some examples of these are; flexible plastic films with a foil laminate, plastic coated papers, paper tubes with steel end caps, plastic container and steel containers with paper labels. While this use of composites benefits the food manufacturers, it can pose problems for recycling.

A new area of environmental awareness is the use of renewable resources for the creation of the packaging. Currently paper and glass packaging have a significant advantage in this area and are using this advantage to combat the consumer preference for plastics. Since paper and glass are products from renewable resources, they can claim and market this environmental advantage to consumers.<sup>23</sup> However, the continued development of corn based polymers will help plastics overcome this advantage.

Biodegradable packaging materials are a good alternative to traditional materials when recycling is not economical or is impractical. European use of bio-based packaging is increasing. Tesco, the largest retailer in the United Kingdom, has switched to biodegradable polymers for all of its bags and is looking to use these materials in their other packaging.<sup>31</sup> As development continues, the price and performance of the biodegradable polymers will improve. Furthermore, the demand for packaging to address solid waste concerns and a growing public awareness will fuel the growth. Despite the appeal to consumers, biodegradable packaging remains a niche. Survey results indicate that 41% of American consumers ranked nature-based packaging “very desirable”.<sup>28</sup> Approximately 75% of those people would be willing to pay a premium for bio-based packaging. However, this willingness to pay a premium for packaging could easily be supplanted with tough economic situations.<sup>27</sup> A recent study found that 28% of consumers had never heard of biodegradable plastics<sup>28</sup>, but 36% of the consumers had not only heard of but had purchased biodegradable plastic packaging. Nearly 65% of the respondents would purchase products in biodegradable packaging but only if the pricing was the same as traditional packaging. Increased consumer awareness and education, combined with additional development to reduce costs making biodegradable plastics competitive could fuel this market to grow exponentially in the United States.<sup>28</sup>

## **Business effects on Food Packaging**

### **Global Economy Impact**

Low labor costs, reduced environmental and safety requirements, and rapidly expanding economies give Asian countries the ability to provide cost effective packaging to the United States. Besides these local advantages, examples of higher prices for identical raw materials and capital equipment charged to United States companies compared to their counterparts overseas have been documented.<sup>9</sup> Although transportation can create logistical and supply chain issues that must be overcome, the use of local distributors and warehouses minimize this effect. Low capital costs and faster product development times will continue to draw people to procure packaging materials from Asia. Low labor costs in Asia allow the development or customization of packages to meet the needs for short run quantities at a reasonable cost. Finally, increased investment by domestic companies in Asia will increase exposure and build relationships that could impact domestic packaging producers. As retailers, food producers and packaging manufacturers become more global, they will be exposed to new products, processes, and packages. This exposure will lead to increased opportunities.

### **Merger and Acquisition impact**

The continuing growth of Wal-Mart and the consolidation of other food retailers will result in large companies that will leverage food producers to meet both their needs as well as those of the consumer. Much of this demand will take the form of innovative new products and the supporting packaging. In addition, further consolidation of the consumer packaging industry is very likely since the top ten global companies only hold a combined 15% of the global packaging market.<sup>42</sup> The United States plastics industry has been actively consolidating since 1993 with 1,849 transactions.<sup>42</sup> The results are significantly larger companies with greater capabilities and more global orientation. The result for food producers are large demanding customers and a limited number of packaging suppliers. However, Wal-Mart's growth strategy in the United States relies on name brand products to give consumers a good feeling when shopping at their stores.<sup>5</sup> Packaging suppliers will need to provide cost effective, innovative packaging solutions to help brand name products meet these demands.

## **Analysis of Flexible Packaging**

Flexible packaging can be defined as packaging that takes its shape from and conforms to the product that it is holding. Early examples of flexible packaging are bags of flour and sugar. Films made from paper, plastic, and foils are used for packaging butter, cheese, cereal, pasta, beans, etc. Sometimes films are formed into bags, and these bags are used as either the primary package or as an inner liner to another package. Flexible packaging is common throughout a retail store as shown in Figure 1.



Flexible packaging continues to take market share from rigid packaging due to high end graphics, barrier properties, low cost, and innovation. The development of slider or zipper to re-close bags has provided great convenience to the consumer and thus increased growth. Demand for plastic film materials rose to 35% of the global demand of 320 billion pounds for packaging thermoplastics in 2002.<sup>26</sup> Film grade of polyethylene have increased to 50% of the total global demand.<sup>26</sup> To meet the demand for lower cost films, manufacturers are moving from 5 – 7 layer structures to 9 layers which allow increased usage of lower priced commodity resins as part of the polymer structure.<sup>26</sup>

Innovations in flexible packaging are allowing standup pouches to replicate a rigid box when they are filled. Pouch demand is rising 7% annually and is expected to reach \$5.2 billion in 2008.<sup>1</sup> Pouches are a low unit cost package with the environmental benefit of source reduction. However, the inability to practically recycle some of the laminated standup pouches is an issue, although this is being addressed by the development of new polymers. Another concern for the standup pouch is the lack of vertical compression strength thus requiring additional packaging for transport.

The United States market for barrier films in 2003 was \$2 billion.<sup>33</sup> New structures have allowed flexible barrier films to create multi layer standup pouches and metalized films. These flexible solutions offer both lower cost and consumer convenience. The development of antimicrobial, oxygen scavenging, odor absorbing, and moisture protecting polymers is being translated into films used in flexible packaging. The ability for these barrier films to provide shelf stability to food products is creating many opportunities for flexible packaging at the expense of metals, paper and glass.<sup>35</sup>

The development of a retortable pouch is not new, but it is making its way into mainstream America. The United States military has been using this method to precook and package ready to eat foods without refrigeration for over 25 years.<sup>80</sup> Commonly used in Europe for retail food packaging, the retortable pouch is another example of a trend being exported to the United States. Annual volumes for retort pouches reached 4 billion for soup, 1.5 billion for baby food, and 5 billion entrees in 2003.<sup>51</sup> The uses of these materials are allowing flexible packaging to replace metal cans for a variety of products including tuna.

Another application for flexible package is the full body shrink sleeve. This increasingly popular method provides high end graphics that can applied to almost any size or shape of rigid package. If the shrink sleeve is applied after the product is filled it can provide the added benefit of tamper evidence.

### **Analysis of Rigid Packaging**

Rigid food packaging is made from glass, metal, paper and plastic as shown in Figure 2. Glass has many advantages including heat resistance, microwave resistance, is reusability, barrier properties and is inert. Because glass is inert it continues to be a

common packaging method for beverages. Glass is highly recyclable. An innovation in glass packaging is an integrated chamber allowing the consumer to chill the contents on demand. Glass packaging is expensive, has limited ability to be decorated and is very breakable. Plastic bottles and jars continue to expand their application at the expense of glass.<sup>17</sup> Various plastic materials and laminates have been used as replacements for glass containers.

Metal packaging has advantages including heat resistance, durability, retortability, and barrier properties. However, metal packages have limited ability to be reused, are expensive, and require extensive equipment to allow the containers to be filled and sealed. The strongest market for metal packaging is beverage containers. In 2003, European metal beverage cans usage increased by 5%.<sup>11</sup> As packaging formats continue to evolve, innovation is a key for the future for metal packaging manufacturers.<sup>11</sup> The development of an aluminum bottle is one innovation that will help this industry.<sup>13</sup> Another innovation for metal cans is the development of a reclosable metal can.<sup>15</sup> Lastly, metal cans have been equipped with pop tops that no longer require an opener. Despite these innovations, metal packaging will continue to lose market share for food packaging to other materials like paper and plastic.

Paper is by far the most common type of packaging used for food in the United States. Paper containers take the form of boxes, cups, bags, straight wall cans and are found in virtually every aisle of the store. Paper offers high end graphics, low cost, is recyclable and is created from a renewable resource. Paper packages can be produced and shipped as rigid containers or sent as flat sheets that are formed by the food manufacturer as part of the filling process. This type of in plant forming reduces the freight and inventory costs associated with preformed packaging. Paper can be laminated to offer shelf stable barrier properties,<sup>75</sup> microwave and conventional oven capability<sup>8</sup>, ability to re-close, and hot fill applications. Like plastics it is produced in a wide variety of shapes and sizes and is used for both flexible and rigid applications. While plain paper is readily recyclable, its many laminated forms are difficult to impossible to handle. In general, plastics are expected to take market share from paper in both rigid and flexible forms.

Rigid plastic food packaging includes jars, bottles, cups, tubs, trays and buckets. These products are produced using three primary processes that provide different characteristics and benefits to the packages. The processes for rigid plastic food packaging are:

- Thermoform
- Blow Molding
- Injection molding

Thermoforming produces rigid plastic food packages in the form of trays, cups, and tubs. Thermoform packages can be produced using a variety of polymers that will give the package a variety of features including barrier properties, heat resistance, freezer resistance, microwavability, and conventional oven compatibility. Since thermoforming can utilize laminated plastic sheets it can create rigid containers with the high barrier properties found in flexible packaging. Because of its flexibility and diversity plastic

thermoform packages continue to capture larger market share. Development of deep draw technology is allowing thermoform manufacturers to produce containers with tall slender geometries in polypropylene. Previously tall thin parts were limited to polystyrene due to the tight processing requirements for polypropylene. As a result, thermoform polypropylene is the fastest growing material for drink cups. Machines that thermoform, fill and seal allow food producers to integrate the manufacturing of the package into the production of the food. These machines use plastics sheet to thermoform the containers in line thus eliminating the freight and inventory costs associated with a preformed rigid package.

Blow molding produces a wide variety of bottles and jars that are used for everything from beverages to dry powders as shown in Figure 13. Because a wide variety of polymers can be used for blow molding, these packages are compatible with many products and processes. These materials meet a variety of objectives from hot fill, clarity, barrier properties, and price. Development of hot-fill bottle that does not require vacuum panels allows the plastic bottle to have the look of glass will further erode the market share of glass packaging.<sup>46</sup> Extrusion blow molding allows the use of laminated plastics films to create high barrier properties found in flexible packaging. Like glass containers, blow molded packaging is very freight intensive. As a result, blow molders have setup many operations near the food producing plants to minimize this expense. In some cases joint ventures with or vertical integration by the food manufacturers have resulted in blow molding operation inside the food producing operations.<sup>22</sup> Many of the applications for blow molded packages are at the expense of glass. However, low development cost and new high end graphics through the use of full body shrink sleeves have resulted in new blow molded packages that have taken market share from both rigid paper and injection molded packages.

Almost all blow molded and glass containers require a closure. The majority of closures are plastic and produced using either compression or injection molding. The future for closures is directly linked to the fortunes of glass and blow molded plastic packaging. Closure innovation helps fuel the growth of blow molded food packaging. Closures meet the needs of consumers by providing ease of use, dispensing characteristics, style, and reclosability.



**Figure 13 - Blow molded containers**

Injection molded rigid packaging comes in a wide variety of shapes and sizes. For food packaging injection molded products are made predominately from grades of polypropylene, polyethylene and, to a lesser extent, polystyrene. The process of injection molding produces plastic containers that are the most dimensionally accurate rigid plastic packages. Injection molded packages are easy to re-close and are the most commonly reused rigid packages. Hinged parts, flip tops, and twist open packages are easily created using injection molded plastic. Injection molded packaging can be finished with a variety of textures or a high polish. They can also be decorated through direct printing, shrink sleeves, pressure sensitive labeling, and in mold labeling. The ability to print directly on an injection molded package provides a cost effective solution for many of today's rigid plastic food packages. Despite some industry opinion that consumers have a perception that injection molding creates value added product, results from the survey taken for this report refute that opinion.

Despite these advantages injection molded food packaging is expected to lose market share to both rigid thermoform containers and to the growing use of flexible packaging. This loss of market share is due to a combination of high package costs, and more importantly, the limitations of injection molded packages. Currently the injection molding process can only cost effectively produce monolayer structures for food containers. This monolayer limitation precludes injection molding for utilizing the high

barrier polymers available to the other plastic processes. Furthermore, injection molding requires the use of high melt flow resins to produce cost effective products. The requirement for high melt flow resins limit the process to simple polymers that will not allow it to produce containers that can withstand high temperatures. Food producers cannot use the retorting process, and consumers are unable to use a traditional oven preparation with injection molded plastic packages. New injection molded packages have a high upfront capital cost and long lead time due to the complexity of the molds. The factors of high upfront capital cost and slow speed to market are recognized as key ingredients in the development of new food packaging and could impact the use of injection molding for new products versus other types of packages.

Injection molded food package is fully recyclable, and given its monolayer structure easy to identify and sort. Furthermore, when injection molded containers and lids are direct printed, or labeled using a plastic film based label through an in-mold or pressure sensitive process, the recyclability is enhanced by eliminating any co-mingling of raw materials found in so many other food packages.

Innovators of injection molded food packages are working to overcome the limitations of the process to allow food manufacturers to continue to take advantage of its benefits. The development of new polymers that allow the injection molding process to produce thinner walled and lighter weight parts is continuing. Polymer development has been an ongoing process for over 40 years and has been a big reason for the successful growth of the plastic packaging industry. This development is expected to continue to provide meaningful results. In addition, the manufacturers of injection molding machines and automation systems will continue to develop equipment that will increase daily output, reduce labor costs and help injection molding stay competitive with other rigid packaging options. The development of biodegradable polymers, and polymers from renewable resources that are suitable for injection molding food packaging would enhance the environmental record of rigid plastic food packaging. Biodegradable polymers remain only a small portion of the polymer market. European use of biodegradable polymers is only expected to hit 10% of the market by 2010.<sup>27</sup> Additional developments for injection molding include the use of bi-injection. Bi-injection allows different resins to be molded into the same part during a single molding process. Currently, this process is used to combine different colors of the similar resins or to add thermoplastic elastomers to create a part with a soft rubbery feel. The use of bi-injection molding to add resins with barrier properties to an injection molded container is a worthy exercise. The development of desiccant polymers that would improve the moisture barrier of injection molded containers is underway. Coralfoam is a new process can create parts with thick wall sections that have a foam structure allowing them to process quickly and with reduced weight.<sup>24</sup> These foam sections also create insulating properties that can prove beneficial in the development of food packages for hot products. Combining injection and compression molding is a new process called Impak. Impak allows a weight reduction of 33% and a cycle time reduction of 50% compared to a traditional injection molded container.<sup>24</sup> If successfully developed, Impak could eliminate the price advantage currently enjoyed by thermoform container manufacturers. A summary of rigid food packaging alternatives and their properties are presented in Figure 14.

	<b>Glass</b>	<b>Metals</b>	<b>Paper</b>	<b>Composite Cans</b>	<b>Thermoform</b>	<b>Blow Molding</b>	<b>Injection Molding</b>
<b>Package Cost</b>	High	High	Low	Low	Low	Low	Low
<b>Durable</b>	No	Yes	No	No	Yes	Yes	Yes
<b>Barrier Properties</b>	Yes	Yes	Yes	Yes	Yes	Yes	No
<b>Reusable</b>	Yes	Yes	Rarely	Rarely	Rarely	Rarely	Yes
<b>Dimensional Stability</b>	Yes	Yes	No	Yes	No	No	Yes
<b>Renewable Source</b>	Yes	No	Yes	Yes/No	Potential	Potential	Potential
<b>Recyclable</b>	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<b>Bio-degradable</b>	No	No	Yes	No	Potential	Potential	Potential
<b>Integrated Tamper Evidence</b>	No	Yes	No	Yes	No	No	Yes

**Figure 14 – Rigid Packaging Alternatives**

## CONCLUSIONS

The trends of food packaging in the United States have followed the development of new materials, processes, and packaging found in Europe. The breakdown of food packaging by filled volume in Europe 2002 is shown in Figure 15. This high usage of plastic for food packaging is good news for both flexible and rigid plastic manufacturers. The following are areas where food packaging in Europe is ahead of the United States. These areas are all expected to follow the historical trends and become more important in packaging in the United States.

- Requirements for packaging with barrier properties,
- Packaging that is evaluated for its environmental impact
- The use of non-round shapes for rigid containers
- Active packages that enhance microwave cooking
- Packaging with integrated tamper evident features

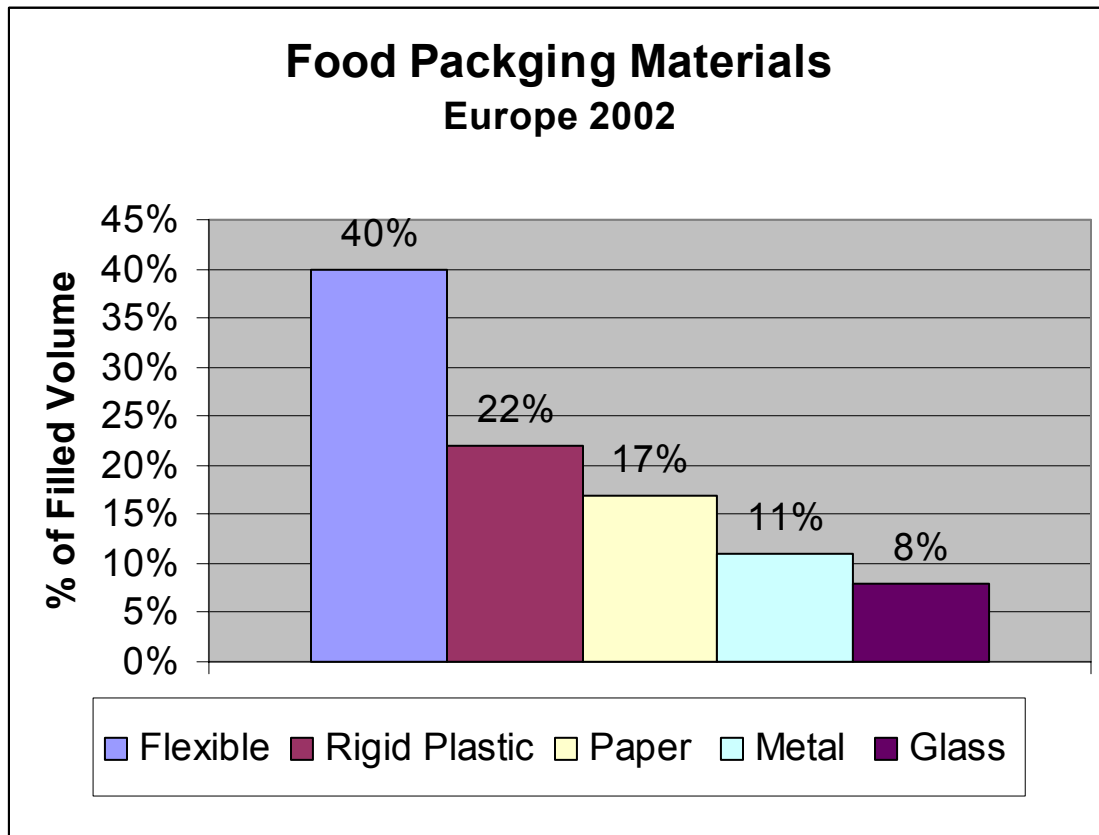


Figure 15 – Food packaging in Europe 2002 <sup>2</sup>

Flexible packaging is expected to grow in its use as a food package. The growth in flexible packaging is expected because it is price competitive, innovating rapidly, extremely versatile and has a growing consumer acceptance. The environmental impact of flexible packaging is varied. It provides source reduction, and can be made using

renewable, recyclable and biodegradable materials; however, in its many laminated forms its ability to be recycled is limited.

Injection molding is currently a significant contributor to food packaging in the United States. Although it is expected to lose opportunities to flexible packaging alternatives as well as thermoform and blow molded plastics, it will remain a force in the industry. Resin and technological developments will help keep injection molding competitive with other rigid packaging alternatives. The uses of non-round shapes, in mold labeling and integrated tamper evidence are all initiatives that will help injection molding prosper. If a cost effective method for adding barrier and high heat resistance can be added to an injection molded container future opportunities would expand faster. One possible avenue for creating these barrier properties is through the use of noble metal nanoparticles.<sup>100</sup>

In general, almost all forms of manufacturing in the United States are losing opportunities to Asia. Food packaging should not expect to be any different. Meanwhile the global nature of business requires the packaging suppliers understand the increasing variety of packaging alternatives that are used around the globe. The consolidation of retailers is resulting in large powerful companies that are putting increasing pressure on food manufacturers to meet their demands. Packaging suppliers that understand this pressure and are able to respond quickly with a variety of packaging options will be in demand.

Environmental policies are a significant part of virtually every European packaging manufacturer. As environmental awareness grows among United States citizens, food producers and packaging manufacturers will need to be prepared to respond. The ability for injection molded plastic packages to be recycled and the potential for them to be produced from renewable and or biodegradable materials represent advantages for future growth of injection molding.



## **SUGGESTIONS FOR ADDITIONAL WORK**

The research for this project uncovered a number of market trend reports that are available for purchase. These reports have similar content and structure to this report are likely more detailed in their analysis and cost from \$900 to \$4,200. One of these reports titled “Rigid Food Packaging” can be purchased at [www.marketresearch.com](http://www.marketresearch.com). It is the suggestion of the author that one of these reports be purchased to evaluate and compare its findings.

Research the feasibility of developing injection molded packages that have barrier properties and or high heat resistance. Investigate the limitations for developing injection molded food packages made from biodegradable or renewable polymers. Also warranted is further exploration into the Impak process. If successful this process could provide injection molders the means to meet the competitive price pressures of thermoform manufacturing.

Investigate the desire from food producers for a packaging manufacturer that has global resources and can produce both flexible and rigid packaging using a wide variety of materials and processes. Also, investigate the food manufactures interest in developing relationships with injection molded suppliers that are willing to setup operations very near or inside the filling operation. Finally, work with food manufacturers to evaluate the total system cost of product and how a packaging supplier can develop “win/win” relationships.

Lastly, investigate the effect of taking a leadership role in the United States regarding the environmental issues regarding food packaging. Determine if there are market opportunities for both food and packaging manufactures to develop packages that are environmentally friendly through their entire life cycle.

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## **APPENDIX**

The following is a consolidation of the 25 surveys that were collected as part of this research

# UNIVERSITY OF KANSAS

## Engineering Management Program

### North American Food Packaging Survey

### RESPONSES

1. In your opinion will thermoforming take market share from injection molded food packaging in North America over the next five years?

- 9\_\_ Very Likely
- 9\_\_ Likely
- 3\_\_ Unsure
- 4\_\_ Unlikely
- 0\_\_ Very Unlikely

2. In your opinion will flexible plastic packaging take market share from injection molded food packaging in North America in the next five years?

- 4\_\_ Very Likely
- 12\_\_ Likely
- 6\_\_ Unsure
- 3\_\_ Unlikely
- 0\_\_ Very Unlikely

3. In your opinion will paper packaging take market share from injection molded food packaging in North America in the next five years?

- 1\_\_ Very Likely
- 1\_\_ Likely
- 5\_\_ Unsure
- 17\_\_ Unlikely
- 1\_\_ Very Unlikely

4. Will the requirement for barrier properties in packaging increase over the next 10 years?

- 13\_\_ Very Likely
- 9\_\_ Likely
- 1\_\_ Unsure
- 2\_\_ Unlikely
- 0\_\_ Very Unlikely

5. Do you think the benefits of a barrier package justify the additional expense for the packaging?

- 6\_\_ Very Likely
- 13\_\_ Likely
- 3\_\_ Unsure
- 2\_\_ Unlikely
- 1\_\_ Very Unlikely

6. Do you think the inability to incorporate barrier properties in an injection molded package negatively affect the use of injection molding to create food packaging?

- 3\_\_ Very Likely
- 12\_\_ Likely
- 4\_\_ Unsure
- 6\_\_ Unlikely
- 0\_\_ Very Unlikely

7. Do you think environmental concerns will affect the growth of all type plastic packaging for food over the next five years?

- 2\_\_ Very Likely
- 4\_\_ Likely
- 8\_\_ Unsure
- 10\_\_ Unlikely
- 1\_\_ Very Unlikely

8. Do you think paper packaging has an environmental advantage over plastic packaging?

- 3\_\_ Large advantage
- 8\_\_ Slight advantage
- 10\_\_ Neutral
- 3\_\_ Slight disadvantage
- 1\_\_ Large disadvantage

9. Do you think glass packaging has an environmental advantage over plastic packaging?

- 1\_\_ Large advantage
- 6\_\_ Slight advantage
- 9\_\_ Neutral
- 7\_\_ Slight disadvantage
- 2\_\_ Large disadvantage

10. Do you think metal packaging has an environmental advantage over plastic packaging?

- 0\_\_ Large advantage
- 6\_\_ Slight advantage
- 9\_\_ Neutral
- 8\_\_ Slight disadvantage
- 2\_\_ Large disadvantage

11. Do you think that use of all types of plastic packages will grow faster than paper packages for food applications over the next five years?

- 11\_\_ Very Likely
- 12\_\_ Likely
- 1\_\_ Unsure

1\_\_\_ Unlikely  
0\_\_\_ Very Unlikely

12. Do you think the use of all types of plastic packages will grow faster than glass for food applications over the next five years?

14\_\_\_ Very Likely  
11\_\_\_ Likely  
0\_\_\_ Unsure  
0\_\_\_ Unlikely  
0\_\_\_ Very Unlikely

13. Do you think the use of all types of plastic packages will grow faster than metal for food applications over the next five years?

15\_\_\_ Very Likely  
9\_\_\_ Likely  
1\_\_\_ Unsure  
0\_\_\_ Unlikely  
0\_\_\_ Very Unlikely

14. Do you think the manufacturing of food packaging in Asia will take market share from North American packaging manufacturers over the next five years?

14\_\_\_ Very Likely  
9\_\_\_ Likely  
2\_\_\_ Unsure  
0\_\_\_ Unlikely  
0\_\_\_ Very Unlikely

15. Do you think the manufacturing of food packaging in Europe will take market share from North American packaging manufacturers over the next five years?

1\_\_\_ Very Likely  
11\_\_\_ Likely  
6\_\_\_ Unsure  
7\_\_\_ Unlikely  
0\_\_\_ Very Unlikely

16. Do you think the upfront capital costs of injection mold tooling will inhibit the growth of injection molded food packaging?

1\_\_\_ Very Likely  
0\_\_\_ Likely  
2\_\_\_ Unsure  
20\_\_\_ Unlikely  
2\_\_\_ Very Unlikely

17. Do you believe consumers have a high perceived value of injection molded packages when compared to thermoformed containers?

- 1\_\_\_ Very Likely
- 10\_\_\_ Likely
- 3\_\_\_ Unsure
- 9\_\_\_ Unlikely
- 2\_\_\_ Very Unlikely

18. Do you believe consumers have a higher perceived value for injection molded packages when compared to blow molded containers?

- 3\_\_\_ Very Likely
- 11\_\_\_ Likely
- 2\_\_\_ Unsure
- 8\_\_\_ Unlikely
- 1\_\_\_ Very Unlikely

19. Do you believe that re-usability of injection molded packages enhances the future of injection molded packages when compared to thermoforming and blow molding?

- 1\_\_\_ Very Likely
- 8\_\_\_ Likely
- 6\_\_\_ Unsure
- 10\_\_\_ Unlikely
- 0\_\_\_ Very Unlikely

20. Do you feel that the unique and detailed shapes that can be obtained through injection molding enhance the future for injection molding?

- 10\_\_\_ Very Likely
- 13\_\_\_ Likely
- 2\_\_\_ Unsure
- 0\_\_\_ Unlikely
- 0\_\_\_ Very Unlikely

21. How important is speed to market in the development of a new food package?

- 20\_\_\_ Very Important
- 5\_\_\_ Important
- 0\_\_\_ Neutral
- 0\_\_\_ Unimportant
- 0\_\_\_ Not a concern

22. How important is upfront capital cost in the development of a new food package?

- 13\_\_\_ Very Important
- 10\_\_\_ Important
- 2\_\_\_ Neutral
- 0\_\_\_ Unimportant
- 0\_\_\_ Not a concern



23. Please rank the following in order from fastest to slowest in time required to develop a new food package from initial concept to commercialization. (1 is the fastest)

- 1 \_\_\_ Formed paper container
- 3 \_\_\_ Thermoform container
- 6 \_\_\_ Injection blow molded container
- 3 \_\_\_ Extrusion blow molded container
- 2 \_\_\_ Glass container
- 5 \_\_\_ Metal container
- 7 \_\_\_ Injection molded container

24. Please rank the following in order from most expensive to least expensive capital required to develop a new food package from initial concept to commercialization. (1 is the most expensive)

- 7 \_\_\_ Formed paper container
- 5 \_\_\_ Thermoform container
- 1 \_\_\_ Injection blow molded container
- 5 \_\_\_ Extrusion blow molded container
- 4 \_\_\_ Glass container
- 3 \_\_\_ Metal container
- 2 \_\_\_ Injection molded container

25. Do you feel that injection molding has reached the pinnacle of its technological development?

- 1 \_\_\_ Very Likely
- 1 \_\_\_ Likely
- 1 \_\_\_ Unsure
- 13 \_\_\_ Unlkely
- 9 \_\_\_ Very Unlikely

26. Please list the positive characteristics of a plastic injection molded food package as compared to other materials or plastic processes.

Decorating, Reusability, Lid Fit.

Plastic IM food packaging offers superior quality due to the tight tolerances it can hold. The stack strength and overall integrity of the package offers spot packing opportunities which saves on corrugated costs to our customers. Tamper resistant/evident designs can be incorporated into the design due to the sidewall strength. The advancements in PP materials and higher melt indexes have enabled IM packaging to be price competitive in the marketplace. IM packaging is perceived as value added to the consumer due to reuse in the home.

Shape, design flexibility

Printing, nestability,, clarified, tamper evident, durability, manufacturing

Unique shape, tamper evidence, flip top, twist to open, reclosability

Printable, won't break compared to glass, consumers perceive that is clean, manufacturing process can be sanitary so no pre-food wash is necessary.

Perception of value added product, design options, dimensional stability

Ability to make complex detail such as tamper evidence (vs. thermoform); I can easily imagine more opportunities in plastic development (improvement in barrier properties, strength, injection characteristics). Weight vs. glass and metal

High quality finished part yielded from an accurate repeatable process. Finished goods are suitable for high speed filling equipment and provide a larger "window" for filling processes. Part features are better defined

Highly customizable, precise tolerances, material distribution control.

Barrier, rigid, consistent

Reusable, durable, strength, integrity, perceived value by consumer, consistent parts, decorating

Durability, reclosability, distribution friendly, reusability, decorating options, functional features

Recyclable, inexpensive, durable, unlimited colors, suitable for high volumes, almost unlimited size and shape, dimensional stability

Requires the least energy to produce pellets and products compared to metal and paper. Recyclable, most attractive (quality printing and IML), TE, Rigid (strength), yet can be malleable (i.e. copolymer PP), priced efficiently

Aesthetics, interesting shapes, lightweight, product visibility, dimensional accuracy, recyclability

It is more rigid

Plastic injection molded packages offer some unique design and TE options. Rigid packaging provides post-use value to the consumer.

Stacking strength, sealing integrity, IML capabilities

Cost at high volumes, design options

Designed in repeatable, consistent characteristics for filled and unfilled stackability. Consistent and reliable features for high speed feeding to automation equipment. May be more cost effective capital for lower volume requirements. Variety of colors simpler to

change. Ability to provide textures in the same package. Print speeds can be faster with a part that de-nests faster.

Part design flexibility for functionality and strength. Dimensional accuracy in all areas of the part; easy to print in high quality; consistent operation of filling lines. Attractive sheen or gloss on part surfaces; option to engrave or texture surfaces.

Repeatability: wall thickness, surface finish, dimensions. Robustness

High quality, greater design flexibility, greater options for decorating, easier incorporation of tamper evidence, larger period of higher percentage of capital cost amortization.

Quality, dimensional stability, surface finish

27. Please list the disadvantages of a plastic injection molded food package when compared to both other materials and other plastic processes.

Reusable, lighter for shipments, user friendly, consumers prefer plastic.

The major disadvantage of IM is the lead-time and cost of tooling. The inability to offer barrier properties also offers a disadvantage in some food applications requiring a longer shelf life. As state adopted recycling programs gain more popularity, IM packaging will continue to gain momentum in the marketplace.

Cost

Mold cost, profile and shape, lead-time

Tooling expense, cycle time, printing graphics

More expensive in some cases, barrier concerns, print quality

Increased tooling costs, inflexible design changes

Investment required for IML, quality of graphics not as good, fluctuation of raw material costs, tooling investment

Limitations in light weighting. Material performance at comparable wall sections. High capital cost for tooling, especially for non-round.

Timing for molds, capital costs, part costs

Tooling, volatility to energy costs, tooling lead-time

Cost, barrier properties, capacity constraints (tooling size), cost of entry

Capital costs, barrier capabilities, shape limitations, speed to market

Short shelf life, high startup costs, difficult to make gross design changes, high decorating costs

Not as strong as metal, printed graphics less in quality than paper packaging, equally as cost efficient in high volumes as thermoforming, but not in as many products (i.e. stadium cups).

Capital expense is high, does not have premium image as glass packaging, barrier packaging limited and very expensive

Equipment and tooling are expensive with little flexibility and output rates are slower than TF

They do not offer barrier characteristics and are perceived to be bad for the environment.

Cost is also an issue.

Part cost, tooling cost, barrier capabilities

High capital costs, decorating costs, lack of multilayer options

Capex required. Difficulty and expense required to make minor modifications after the tool is finished. Weak gate area and susceptibility to pinholes at the gate.

Tooling cost. Some alternatives may sometimes allow faster time to market. Some alternatives may sometimes offer a functional package at a lower cost.

Could be expensive, barrier properties, thermal resistance

Plastic is more expensive than paper, slower than thermoforming, limitations in designs (part thickness, etc)

Upfront capital cost, barrier capabilities, and tooling lead times.

28. Please list any areas of innovation that you believe will enhance the future of injection molding for food packaging (i.e. IML, Tamper Evidence, etc.)

IM will continue to reduce wall thickness and provide a superior package for a reduced cost.

Higher melt PP resins will allow reduced sidewall, higher mold cavitation and future cost reductions. Advancements in IML cavitation will offer superior decorating options at a competitive price. Introduction of environmentally friendly materials at competitive market prices

IML, T/E, Clarified 5 gallon pail

IML will address graphics limitations of direct printing on IM.

Thinner walls, machine improvements that will speed up cycle times and take-out orient parts, colors are easier in some cases, mold improvements such as 4 level high cavitation, IML but I hear thermoform may use IML too

Increased barrier properties, lower costs tooling/designs, greater flexibility in the IM process

Definitely IML and TE, development of polymer properties such as oxygen barrier, UV barrier, clarity, impact strength

There is more interest in IML, but developments are being made in shrinksleeving and TF IML that will detract from IM. There is some new technology for barrier IM that could be attractive for small volume barrier applications. Also large tonnage applications and larger cavitations tooling is putting IM back into a competitive position with TF

Bi-injection, multifunctional parts (TE and tightness)

Lightweight w/same structural integrity

IML, TE, Bi-injection to get barrier properties in the future, versatile use of different resins (one resin does it all, clear, freezer. Microwave, etc)

Further development of stack mold technology, continued resin development, thermoform IML

IML, Bi-injection, Gas Assist, Metallocenes, rapid prototyping, high clarity resins, aroma resins

Continued improvements in melt flow characteristics of resins. Continued improvements in injection molding machines (faster clamp and injection with accurate control). Big company interest and consumer acceptance of rectangular packaging in the US

Barrier packaging (more options at lower cost), alternative materials such as PP vs. PE Innovation in the areas of resin development offers a great deal of hope for processors.

Increased costs must be limited.

Barrier

IML, multilayer capability

I believe that some type of barrier properties will develop for injection molded packaging. Some process that combines injection/compression molding to speed process and reduce weight

Opportunity to include high value IML technology. Opportunity to make the part reusable in consumer's eyes. Ongoing potential to lightweight for cost savings.

Opportunity to make robust tamper evident features with innovative open headed tubs and lids. Ongoing improvement to operational efficiencies with higher productivity stack molds with higher mold cavitation in a single machine.

IML, Tamper evidence, high output systems (larger faster machines, higher cavitation molds, new automation methods).

IML

New resin technology, high speed large tonnage machines (larger cavitation). IML, two shot molding, insert molding, assembly in the molding process

29. Please include any additional comments that you believe are relevant to this analysis.

Interesting to look at the future of IM. Seems like every time that a competing process threatens IM, the tool makers and machine manufacturers improve the process. The new PP high flow resins will keep IM alive and well for many years to come.

Plastics in general will continue to increase in food packaging because of lightweight, shape flexibility and breakage resistance.

Capital costs for injection molds could decrease if mold are built by the Chinese, Koreans, etc and ran in USA factories

Pricing stability is critical when planning to launch a product line in this packaging. There will always be a market for IM. People/customers want to differentiate. If everyone is moving to TF, then the next trend will go to IM as leader will want to have a perceived value package. We see the cycle all the time. The EU goes from paper to plastic and back again almost every 7 years. Starbucks's brand makes paper appear to be the "value" package. Pet food went from flexible film bags back to paper. The brands (Hill, Iams, etc) dictate the "value" and the packaging they use become the perceived value package. It can be paper plastic, glass, etc.

Compare feedstock or raw material availability for plastics vs. paper, metal and glass in the future.



When looking at capital cost – for a food container it more often is a question of total system cost – not just mold cost but filling, processing capital required at the packing plant

Theoretically TF is the most cost effective method – but consider these thoughts-----  
Capex for a TF line is huge, requiring large volume commitment. Marketers are asking for more differentiation, which eats into large volumes that could be consolidated onto large TF lines. As TF processes become more sophisticated, so do the molds – the argument that TF molds are “cheap”, no longer holds water. Also, there are no reputable, progressive, reliable and innovative TF machine manufacturers – OMV comes close, they are failing miserably in North America. Due to 2 issues – first the typical European arrogance issue. Second due to the fact that they are a packaging producer and supplier as well as an equipment vendor – does this create a conflict?

Considering the past, trends in this industry have been driven both by consumer demands, and companies that focus on vision, technology, and development of the most appropriate value-added production for each given application. Looking forward, these factors will continue to be key determinants of growth and market share for different packaging alternatives. Considering the continuing demand to have more integral value added features, (such as tamper evidence and/or IML packaging) injection molded packaging holds a unique position to add value, while maintaining the advantages of a simple, single step process.

Packaging will continue to grow and evolve, the technologies brought forth in Europe are a good general indicator of where the North American market is heading. North American tends to be 5 – 10 years behind. IML will definitely be the next largest growth sector for technology in Injection Molding and Thermoforming.

Thank you participating. Completed forms can be emailed to [Meissbach@aol.com](mailto:Meissbach@aol.com) or faxed to Ken Meissbach’s attention at 785-842-302