Introduction to Packaging

1.0 INTRODUCTION

In today’s society, packaging is pervasive and essential. It surrounds, enhances and protects the goods we buy, from processing and manufacturing through handling and storage to the final consumer. Without packaging, materials handling would be a messy, inefficient and costly exercise, and modern consumer marketing would be virtually impossible.

The historical development of packaging has been well documented elsewhere and will only be touched upon here. Suffice it to say that the highly sophisticated packaging industries which characterize modern society today are far removed from the simple packaging activities of earlier times.

Packaging lies at the very heart of the modern industry, and successful packaging technologists must bring to their professional duties a wide-ranging background drawn from a multitude of disciplines. Efficient packaging is a necessity for almost every type of product whether it is mined, grown, hunted, extracted or manufactured. It is an essential link between the product makers and their customers. Unless the packaging operation is performed correctly, the reputation of the product will suffer and the goodwill of the customer will be lost. All the skill, quality and reliability built into the product during development and production will be wasted, unless care is taken to see that it reaches the user in the correct condition. Properly designed packaging is the main way of ensuring safe delivery to the final user in good condition at an economical cost.

1.1 Definitions

Despite the importance and key role which packaging plays, it is often regarded as a necessary evil or an unnecessary cost. Furthermore, in the view of many consumers packaging is, at best, somewhat superfluous, and, at worst, a serious waste of resources
and an environmental menace. Such a viewpoint arises because the functions which packaging has to perform are either unknown or not considered in full. By the time most consumers come into contact with a package, its job in many cases is almost over, and it is perhaps understandable that the view that excessive packaging has been used has gained some credence.

Packaging has been defined in a number of ways. A populist reference source defines packaging as:

- an industrial and marketing technique for containing, protecting, identifying and facilitating the sale and distribution of agricultural, industrial and consumer products.

The Packaging Institute International defines packaging as:

- the enclosure of products, items or packages in a wrapped pouch, bag, box, cup, tray, can, tube, bottle or other container form to perform one or more of the following functions: containment; protection and/or preservation; communications; and utility or performance. If the device or container performs one or more of these functions it is considered a package.

The UK Institute of Packaging provides three definitions of packaging:

a. a coordinated system of preparing goods for transport, distribution, storage, retailing and end-use;

b. a means of ensuring safe delivery to the ultimate consumer in sound condition at minimum cost;

c. a techno-economic function aimed at minimizing costs of delivery while maximizing sales (and hence profits).

It is important to distinguish between packaging as defined above, and packing which can be defined as the enclosing of an individual item (or several items) in a container, usually for shipping or delivery.
1.2 World Packaging Market

Figure 1. World Packaging Market by country in 1998

The top 18 Packaging Companies in the world are set out in table 1, based on turnover for the year 1998.

Table 1: The top 18 packaging companies throughout the world as in 1998

<table>
<thead>
<tr>
<th>Company</th>
<th>US$million</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.  Crown Cork &amp; Seal</td>
<td>8,300.0</td>
</tr>
<tr>
<td>2.  Smurfit - Stone Containers</td>
<td>7,624.0</td>
</tr>
<tr>
<td>3.  Tetra Pak</td>
<td>7,590.0</td>
</tr>
<tr>
<td>4.  Owens - Illinois</td>
<td>5,692.0</td>
</tr>
<tr>
<td>5.  International Paper</td>
<td>4,970.0</td>
</tr>
<tr>
<td>6.  Tenneco</td>
<td>4,459.0</td>
</tr>
<tr>
<td>7.  Pechiney International</td>
<td>4,325.0</td>
</tr>
<tr>
<td>8.  Saint Gobain</td>
<td>3,797.8</td>
</tr>
<tr>
<td>9.  Toyo Sikeen Kaisha</td>
<td>3,658.9</td>
</tr>
<tr>
<td>10. Jefferson Smurfit Group</td>
<td>3,624.1</td>
</tr>
<tr>
<td>11. Alcoa</td>
<td>3,370.0</td>
</tr>
<tr>
<td>12. Ball</td>
<td>3,305.3</td>
</tr>
<tr>
<td>13. Amcor</td>
<td>3,187.2</td>
</tr>
<tr>
<td>14. Rexam</td>
<td>3,000.0</td>
</tr>
<tr>
<td>15. Alcan</td>
<td>2,750.0</td>
</tr>
<tr>
<td>16. AssiDoman</td>
<td>2,719.0</td>
</tr>
<tr>
<td>17. Sealed Air/Cryovac</td>
<td>2,719.5</td>
</tr>
<tr>
<td>18. Sonoco Products</td>
<td>2,557.9</td>
</tr>
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</table>
The composition of the Australian market by material is set out in Figure 2 and the New Zealand Market is similar (see Table 2).

![Australian Packaging Market by Material in 1998](image)

**Figure 2. Australian packaging market by material in 1998**

**Table 2: New Zealand Packaging Production for 1996 (Robertson & Webber, 1999)**

<table>
<thead>
<tr>
<th>Material</th>
<th>Production</th>
<th>Percentage</th>
<th>tonnes</th>
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<tr>
<td>Aluminium</td>
<td></td>
<td>1.5%</td>
<td>9770</td>
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<tr>
<td>Glass</td>
<td></td>
<td>15.1%</td>
<td>96094</td>
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<tr>
<td>Paper</td>
<td></td>
<td>60.1%</td>
<td>382711</td>
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<td>Plastic</td>
<td></td>
<td>18.4%</td>
<td>117000</td>
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<tr>
<td>Steel</td>
<td></td>
<td>4.9%</td>
<td>31160</td>
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<tr>
<td>Total</td>
<td></td>
<td></td>
<td>636735</td>
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2.0 PACKAGING DEVELOPMENT

2.1 Early Packaging

(An excellent reference covering the History of Packaging Development is Hine, 1995) Examples of early packaging include flex woven baskets, leaves, gourds, wooden barrel, pottery containers and glass. Glass packaging has a very long history but early types of glass packaging were very expensive and very rare form of packaging.

Figure 3. A modern example of early types of packaging using bamboo, straw and paper used to package mangos.

2.2 Nineteenth Century Packaging Development

The 19th Century from 1800 – 1900 was a period of rapid development of packaging systems with the appearance of:

- metal cans (1818)
- paper bag (1850s)
- folding paperboard carton (1880s)
- Corrugated paperboard case (1890s)
- Tubes (eg toothpaste tubes)
- Milk Bottles ( 1860s)
Fruit and vegetables continue for the most part to be unpackaged and if any was shipped they would be in wooden boxes. The use of wooden boxes for packaging and shipping horticultural products continued until the end of the 20th century. Wooden boxes were phased out in NZ with the development of strong and cheap corrugated cases and then finally by the use of reusable plastic crates.

### 3.0 FUNCTIONS OF PACKAGING

Although the definitions given above cover in essence the basic role and form of packaging, it is necessary to discuss in more detail the functions of packaging and the environments where the package must perform those functions.

#### 3.1 Containment

This function of packaging is so obvious as to be overlooked by many, but it is probably the basic function of packaging. With the exception of large, discrete products, all other products must be contained before they can be moved from one place to another. The "package", whether it be a milk bottle or a bulk cement rail wagon, must contain the product to function successfully. Without containment, pollution could become widespread.

The containment function of packaging makes a huge contribution to protecting the environment from the myriad of products, which are moved from one place to another on numerous occasions each day in any modern society. Faulty packaging (or under packaging) could result in major pollution of the environment.

A study of packaging systems in China (Packaging Today – Australia 1979) found that:

- 17.5% of the country’s cement is lost in transit
- 50% of grain
• 20% of all glass is damaged before it can be used

• 40% of microscopes are broken before reaching the buyer.

While in North America, Northern Europe and Australasia only 2% - 3% of food is lost through spoilage, in developing countries food spoilage and damage is estimated to be between 30 to 50% of production. This is supported by information from Russia from the 1970s and 1980s, where a lack of packaging, distribution and storage facilities resulted in annual losses of:

• 45% of fresh vegetables

• 55% of fresh fruit

• 70% of potatoes

• 50% of grain

• one million tons of meat

• one and a half million ton of fish

A study by Harvey Alter of US Chamber of Commerce provides strong evidence that packaging saves waste. It shows that there is a strong relationship between the amount of packaging waste and the amount of food waste in municipal solid waste (MSW) worldwide: as the amount of packaging increased, the amount of food waste is decreased. Note this could also be partly accounted for by the high use of refrigerators in the countries that have high packaging waste figures.

### 3.2 Protection

This is often regarded as the primary function of the package: to protect its contents from outside environmental effects, be they water, moisture vapour, gases, odours, microorganisms, dust, shocks, vibrations, compressive forces, etc., and to protect the environment from the product.
This is especially important for those products such as toxic chemicals which may seriously damage the environment.

In the case of the majority of food products, the protection afforded by the package is an essential part of the preservation process. For example, aseptically packaged milk and fruit juices in cartons only remain aseptic for as long as the package provides protection; vacuum-packaged meat will not achieve its desired shelf life if the package permits oxygen to enter. In general, once the integrity of the package is breached, the product is no longer preserved.

Packaging also protects or conserves much of the energy expended during the production and processing of the product. For example, to produce, transport, sell and store 1 kg of bread requires 15.8 megajoules (MJ) of energy. This energy is required in the form of transport fuel, heat, power and refrigeration in farming and milling the wheat, baking and retailing the bread, and in distributing both the raw materials and the finished product. To produce the polyethylene bag to package a 1 kg loaf of bread requires 1.4 MJ of energy. This means that each unit of energy in the packaging protects eleven units of energy in the product. While eliminating the packaging might save 1.4 MJ of energy, it would also lead to spoilage of the bread and a consequent loss of 15.8 MJ of energy.

Since the 1980's consumer demand for tamper-evident packaging has increased. In 1982 six people died from cyanide in the US following the malicious tampering of Tylenol painkiller capsules. The UK baby food market suffered a dramatic downturn in 1990 after a series of tampering incidents involving glass deliberately added to the baby food containers. Along with requirements for child-resistant closures on pharmaceutical and house hold chemicals, the need for tamper-evident features is necessarily increasing the complexity of packaging and hence its protection features.

### 3.3 Convenience

Modern industrialized societies have brought about tremendous changes in life styles and the packaging industry has had to respond to those changes. One of the major changes has been in the nature of the family and the role
of women. Now an ever-increasing number of households are single-person; many couples either delay having children or opt not to at all; there is a greater percentage than ever before of women in the work force.

All these changes, as well as other factors such as the trend towards "grazing" (i.e. eating snack type meals frequently but on-the-run rather than regular meals), the demand for a wide variety of food and drink at outdoor functions such as sports events, and increased leisure time, have created a demand for greater convenience in household products: foods which are pre-prepared and can be cooked or reheated in a very short time, preferably without removing them from their primary package; condiments that can be applied simply through aerosol or pump action packages; dispensers for sauces or dressings which minimize mess, etc. Thus packaging plays an important role in allowing products to be used conveniently.

Two other aspects of convenience are important in package design. One of these can best be described as the apportionment function of packaging. In this context, the package functions by reducing the output from industrial production to a manageable, desirable "consumer" size. Thus a vat of wine is "apportioned" by filling into bottles; a churn of butter is "apportioned" by packaging into 10 gram minipats and minitubs; a batch of ice cream is "apportioned" by filling into 2 litre plastic tubs. Put simply, the large scale production of products which characterizes a modern society could not succeed without the apportionment function of packaging. The relative cheapness of consumer products is largely because of their production on an enormous scale and the associated savings which result. But as the scale of production has increased, so too has the need for effective methods of apportioning the product into consumer-sized dimensions.

An associated aspect is the shape (relative proportions) of the primary package in relation to convenience in use by consumers (e.g. easy to hold, open and pour as appropriate) and efficiency in building into secondary and tertiary packages. In the movement of packaged goods in interstate and international trade, it is clearly inefficient to handle each primary package individually. Here packaging plays another very important role in permitting primary packages to be unitized into secondary packages (e.g. placed inside a corrugated case) and then for these secondary packages to be unitized into a tertiary package (e.g. a stretch-wrapped pallet). This unitizing activity can
be carried a further stage to produce a quaternary package (e.g. a container which is loaded with several pallets). If the dimensions of the primary and secondary packages are optimal, then the maximum space available on the pallet can be used. As a consequence of this unitizing function, materials handling is optimized since only a minimal number of discrete packages or loads need to be handled.

3.4 Communication

There is an old saying that "a package must protect what it sells and sell what it protects". It may be old, but it is still true; a package functions as a "silent salesman". The modern methods of consumer marketing would fail were it not for the messages communicated by the package. The ability of consumers to instantly recognize products through distinctive branding and labelling enables supermarkets to function on a self-service basis. Without this communication function (i.e. if there were only plain packs and standard package sizes), the weekly shopping expedition to the supermarket would become a lengthy, frustrating nightmare as consumers attempted to make purchasing decisions without the numerous clues provided by the graphics and the distinctive shapes of the packaging.

Other communication functions of the package are equally important. Today the widespread use of modern scanning equipment at retail checkouts relies on all packages displaying a Universal Product Code (UPC) that can be read accurately and rapidly. Nutritional information on the outside of food packages has becomes mandatory in many countries.

But it is not only in the supermarket that the communication function of packaging is important. Warehouses and distribution centres would (and sometimes do) become very inefficient and uncontrolled if secondary and tertiary packages lacked labels or carried incomplete details. UPCs are also frequently used in warehouses where hand-held barcode readers linked to a computer make stock-taking quick and efficient. When international trade is involved and different languages are spoken, the use of unambiguous, readily understood symbols on the package is imperative.
When items of high value are transported the secondary and tertiary packaging may contain deliberate misinformation with only the UPC providing the correct information. The cosmetic industry use this regularly, where there is not even an easily recognised company name, in an attempt to reduce pilfering.

3.5 Exercise

Investigate and compare the functions of packaging with regard to packaging of a soft summer fruit with a fruit like kiwifruit or apples

4.0 PACKAGE ENVIRONMENTS

The packaging has to perform its functions in three different environments. Failure to consider all three environments during package development will result in poorly designed packages, increased costs, consumer complaints and even avoidance or rejection of the product by the customer.

4.1 Physical Environment

This is the environment in which physical damage can be caused to the product. It includes shocks from drops, falls and bumps; damage from vibration arising from transportation modes including road, rail, sea and air; and compression and crushing damage arising from stacking in warehouses and during transportation, or in the home environment.

4.2 Ambient Environment

This is the environment which surrounds the package. Damage to the product can be caused as a result of gases (particularly oxygen), water and water vapour, light (particularly UV radiation), and the effects of heat and cold, as well as micro- and macro-organisms which are ubiquitous in many warehouses and retail outlets. Contaminants in the ambient environment
such as exhaust fumes from automobiles and dust and dirt can also find their way into the product unless the package acts as an effective barrier.

### 4.3 Human Environment

This is the environment in which the package interacts with people, and designing packages for this environment requires a knowledge of the vision and strength capabilities and limitations of humans, as well as legislative and regulatory requirements. Since one of the functions of the package is to communicate, it is important that the messages are received clearly by consumers. In addition, the package must contain information required by law such as product description and nett weight.

To maximize its convenience functions, the package should be simple to hold, open and use by the consumer. For a product which is not totally consumed when the package is first opened, the package should be able to be resealed and retain the quality of the product until completely used. Furthermore, the package should contain a portion size which is also convenient for the intended consumers; a package which contained too much product that deteriorated before being completely consumed clearly contains too large a portion.

### 4.4 Exercise

Determine the environments that packaged vegetable products will have to operate in and discuss the impact these may have on the type of packaging you would choose.

### 5.0 THE FUNCTIONS ENVIRONMENTS GRID

The functions of packaging and the environments where the package has to perform can be laid out in a two way matrix or grid as shown in Figure 4. Anything that is done in packaging can be classified and located in one or more of the function environment intersects.
The grid provides a methodical yet simple way of evaluating the suitability of a particular package design \textit{before} it is actually adopted and put into use. As well, the grid serves as a useful aid when evaluating existing packaging.

Separate grids can be laid out for distribution package analysis, for corrugated package analysis, for legal/regulatory impact, or for any mix of package related concepts that is of interest.

![Figure 4. The functions/Environments grid for evaluating package performance](image-url)
Missing from the grid is an opportunity to evaluate the likely environmental impact of the package. This aspect is now becoming so important an element in package design that it should be considered fully in its own right and in addition to the evaluation carried out using the grid shown in Fig. 4.

A distinction is usually made between the various "levels" of packaging.

- A primary package is one which is in direct contact with the contained product. It provides the initial and usually the major protective barrier. Examples of primary packages include metal cans, glass bottles, and plastic pouches. It is frequently only the primary package which the consumer purchases at retail outlets.

- A secondary package contains a number of primary packages, e.g., a corrugated case. It is the physical distribution carrier and is sometimes designed so that it can be used in retail outlets for the display of primary packages.

- A tertiary package is made up of a number of secondary packages, the most common example being a stretch-wrapped pallet of corrugated cases.

- A quaternary package is frequently used to facilitate the handling of tertiary packages in interstate and international trade. This is generally a metal container up to 12 m in length which can hold many pallets and is intermodal in nature. That is, it can be transferred to or from ships, trains, and flatbed trucks by cranes. Certain designs are also able to have their temperature, humidity and gas atmosphere controlled and this is necessary in particular situations such as for the transportation of frozen foods or fresh fruits and vegetables.
6.0 CONCLUSION

A knowledge of the functions of packaging and the environments where it has to perform will lead to the optimization of package design and the development of real, cost-effective packaging. Despite the wide number of functions which a package must perform, this book focuses almost exclusively on the protective functions of the package and possible food package interactions in relation to the ambient environment. Package performance in the physical environment is usually considered under the heading of packaging engineering. The communication function of package performance in the human environment is properly the major concern of those with a primary interest in marketing and advertising. For those focusing on the convenience-in-use aspects of packaging, books in the area of consumer ergonomics are the best source of information.

7.0 REFERENCES


8.0 ADDITIONAL MATERIAL AND READINGS
Worldwide, as packaging goes up, food waste goes down (after Alter, 1988).
2000 MASS BALANCE
PACKAGING MATERIAL SUMMARY TABLE

<table>
<thead>
<tr>
<th>MATERIALS</th>
<th>PRODUCTION (TONNES)</th>
<th>CONSUMPTION (TONNES)</th>
<th>COLLECTION (TONNES)</th>
<th>COLLECTION AS A % OF CONSUMPTION</th>
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</thead>
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<tr>
<td>ALUMINIUM</td>
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<td>6 965</td>
<td>3 450</td>
<td>50%</td>
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<td>120 810</td>
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<td>308 770</td>
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</tr>
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<td>PLASTICS</td>
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<td>28 385</td>
<td>10 750</td>
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<td>TOTAL</td>
<td>694 710</td>
<td>582 405</td>
<td>287 380</td>
<td>49%</td>
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SOLID WASTE MANAGEMENT STRATEGY

Re-Think

Re-Move

Re-Duce

Re-Use
Re-Cycle
Re-Cover

Re-Turn

Re-Ord

Re-Lax
NEW ZEALAND MUNICIPAL SOLID WASTE COMPOSITION
(Total = 2,712,000 tonne)
A PARADIGM FOR PACKAGING

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Michigan State University
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USA

The development of this paradigm was not a one-step process. It has grown over years of learning, practicing, researching, consulting, and teaching packaging. The model appeared in my mind, in an early form, long ago. After much thought and discussion with colleagues, both within and outside of the School of Packaging, it took its present shape. Then it became necessary to find a name, or descriptor for the model, other than "A Paradigm for Packaging." The name that appeared and found favor with many of the faculty at the School of Packaging was "Socio-Scientific Discipline." This name has proven especially useful when describing to prospective students what packaging is. The name, coupled with the model, has been in use by our advising staff for about four years.

A SOCIO-SCIENTIFIC DISCIPLINE

Packaging is a socio-scientific discipline which operates in a world society to provide delivery of goods to the ultimate consumer of those goods in the condition intended for their use. It operates as a system of product, packages, and distribution, within three environments: Physical, Atmospheric, and Human. In these environments, packaging performs three functions: Protection, Utility, and Communication. The functions interact with the environments in a way that can be conceived as a matrix, with every function reacting with every environment in some way.

The Packager addresses the problems and opportunities which exist at each juncture of interaction between function and environment. He/she must analyze social, scientific, environmental, and business problems and create solutions which contribute to the betterment of the world, its environment, and its people.

THE ENVIRONMENTS

The three environments exist together, exerting influence on the package simultaneously. They are separable only for the purpose of analysis for understanding and management. Not only do they exert their influences simultaneously, the influence of any one of them may interfere with the influence of another, or with a package design intended to serve another environment. The environments are:

Physical. This environment is exemplified by three elements: vibration in road, rail, air, or sea transport; shock from drops, falls, and bumps; and crushing from stacking during transport or storage.

Atmospheric. This environment includes humidity, heat, cold, rain, sun, odors, gases and vapors of all kinds.

Human. This environment contains the human strengths and frailties of vision, strength, weakness, dexterity, memory, cognitive behavior, etc. It includes such results of human activity as liability, litigation, legislation, and regulation. This is the most recently named and defined of the three environments. It has always existed, of course, but it was never accorded much attention. Its identity and description gained prominence during and since the period of consumer activism that started in the 1960's.

THE FUNCTIONS

The three functions also exist together. At any time a package or package system can be evaluated as performing any one of the functions to some degree, and the value of that performance could be assessed as positive, negative, or zero. A function often is assessed separately without regard for the value assumed by the other two. This kind of assessment ignores the system concept of the package, and is often the reason for failure of a package design that was thought to be very good with respect to a single function. The most astute packagers (package developers) utilize development techniques that maximize the consideration of all three functions simultaneously. The three functions are:
Protection. Protection of the product from the environment, or the environment from the product. Examples include protection from shock and vibration, crushing, humidity, heat, rusting, and the like. Protection of children from poisoning is also included.

Utility. To make the product more useful; make the product easier to use. This can apply to something as simple as containing the product so it is easier to carry, stack, or count. It can also apply in filling operations, storage, use of the product, handling, transport, among others.

Communication. This multifaceted function includes getting the consumer to buy the product. Indeed, its first appearance in modern packaging practice was in the form of the "Silent Salesman." This was in recognition of the post-World War II array of supermarkets and the need for products on the supermarket shelf to command the attention of the passing shopper. In more recent years, the function has come to include communication about how to use the product, how to use the product safely, and how to use it economically. Failures in this area have resulted in litigation. Communication is accomplished by word text, by symbols and pictographs, by size, shape, and color.

THE MATRIX

The matrix of functions and environments serves to emphasize the interactions among these functions and environments. When used to its fullest advantage, it also forces us to remember that functions and environments are interacting continuously and simultaneously. As a tool, and part of the paradigm, the matrix starts as a blank form which is to be filled in at each node with information pertinent to the particular analysis being done.

The completed matrix (Figure 1) is one example of how the matrix might be used. In this completed matrix, cushioning, barrier films, and child-resistant packaging each provide protection in a specific environment. A stretch-wrapped pallet load provides utility in the physical environment, and directions on a package provide utility in the human environment. Wet strength corrugated board provides greater protection from crushing in the atmospheric environment of high humidity and in the physical environment, while at the same time providing utility by making the packages easier and cheaper to handle in high humidity environments.

SOME USES OF THE MATRIX

Industrial Application. Seminar attendees from various companies were told about this model, and then asked to fill out a blank matrix form to describe their job, the product and its packages, or the product/package/company/market interaction as they saw it. Since we were experimenting with a new concept, we encouraged creativity and flexibility. A number of individuals found a rich mixture of interactions going on with their packages. In all, some twenty people used the matrix to view their jobs from a different perspective. A survey afterward told us that use of the matrix concept gave them a new awareness of packaging. At least half of the attendees felt that the matrix could be of at least some use in their work. One person said the matrix is now a part of the package development process in his company.

Educational Application. Distribution of Course Content: The matrix can be used to record the degree to which the function/environment interactions are treated in courses offered. I prepared such a record for undergraduate packaging courses, with the result shown in Figure 2. Each course is listed at any interaction node where its content deals with the subject. Some courses should properly appear in nearly every node, while others will appear in only a few. The overall pattern should reflect the breadth and depth of coverage of packaging achieved by the educational unit. The assignments in this example are mine, they do not reflect a consensus of the faculty. The purpose is to show the technique.

Distribution of Faculty Time: The amount of time (annually) allocated by faculty at the School of Packaging to teaching and research in subjects at each of the nodes of interaction can be estimated. This value can be converted to percentage of time.

Continued on Page 4
Questions arise about whether all products will have the same intensity of interaction at the nodes. Other questions arise about the intensity of effort that an educational program should put forth to achieve a given purpose. If we give the matrix a third dimension, and call it, generically, intensity, we can create other pictures of our matrix concept of packaging.

Intensity Models for Products. Figures 3 and 4 represent intensity models for food packaging and auto parts aftermarket packaging, respectively. Food products are more "fragile" in all respects than most auto parts, and so a higher intensity of need, care, activity, and interaction would be involved for these products than for auto parts. This is reflected in the matrices. Other product categories such as cosmetics

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**FIGURE 2**

spent, which then reflects the concentration of effort at each of the nodes.

Communication with Faculty Outside of Packaging: At the present time, MSU is developing Transcollegiate Courses which are intended to help educate undergraduates for the complexities of the changing multinational, multi-cultural societies in which they will live and work. These courses will bring together faculty and students from many colleges to study these complexities, using some commonly shared life experiences as a base. Using the matrix paradigm as a concrete model, we have interested some 15 faculty members from as many different Departments and at least four Colleges in a Transcollegiate Course with the working title "The Disruptive Package." The Departments which are interested in the idea are as diverse as Food Science and Advertising, Statistics and Marketing, and Art and Nursing. The paradigm has already helped this diverse group to see the common interest in the theme, and it may become a part of the foundation of a transcollegiate course, if it does result.

**THE THIRD DIMENSION OF THE MATRIX**

The two-dimensional matrix is handy for writing down interactions, and for doing some counting and gathering of information. The counting leads immediately to thinking about the intensity of the interactions at the nodes of the matrix, or the intensity of the effort exerted at the interaction.
and pharmaceuticals, e.g., have somewhat different needs from one another, and this can be reflected in small differences in specific interaction nodes, such as protection in the atmospheric environment.

Intensity Models for Education. Matrices can be developed to represent different views of the intensity of educational effort that we might think necessary for different courses of study of packaging. An appropriate matrix would show the broad education and moderate intensity at all interaction nodes that we usually provide to the undergraduate student studying for the baccalaureate degree. These students need a preparation that equips them to take hold quickly in whatever packaging specialty they may find themselves upon graduation.

Clearly, a different matrix would represent the Master of Science program content distributions that might be appropriate for physical distribution, food or pharmaceutical packaging, or Human Safety. Yet other matrices would represent other content distributions that might be appropriate for study at the Ph.D. level in physical distribution, food and pharmaceutical, human factors, and a broad, general knowledge Ph.D.

Comparison of the intensity matrices would demonstrate differences in the subject matter of study among them. The Master’s study plan provides for intense study of only a limited number of the interaction nodes, and that study is more intense than for the baccalaureate degree. The candidate is learning some specific research skills that apply to his/her field of choice. The Ph.D. program requires an expansion of the breadth of study. The candidate is making use of the research skills already learned, and is expanding his/her understanding of interactions in order to attain the global view needed to perform at the Ph.D. level. □


(This paper is an edited and condensed version of the paper delivered by Prof. Lockhart at the 1st International Symposium on Packaging Education sponsored by the International Association of Packaging Educators, Chicago, IL, November 14, 1994. Several illustrations in Dr. Lockhart's original paper are not included in this newsletter.)

IT IS BETTER TO BE APPROXIMATELY RIGHT THAN PRECISELY WRONG.
- Buffett