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The Expanding Role of the Food Distribution Industry into Greater Standardization of Package, Product, Container

Dimensional Standardization of Shipping Containers, Pallets, and Transport Equipment

Food 70's

Discusses problems of national and international standardization of packages, containers, pallets, and transportation equipment

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INTRODUCTION

● Standards are established to give direction to the future.

Two hundred million consumers in 1969 spent \$103.6 billion for food. The food industry includes 800,000 firms employing the equivalent of 5.3 million full-time workers (1). The food industry, because of its vital importance and size, should play an influential and responsible role in giving direction to the future of standardization.

Packaging is an important part of the food industry. The largest user of packaging is the food and beverage market which accounts for an estimated 60 percent of the total national packaging bill--\$32 billion in 1969 (2).

Having established the importance of the food industry and the importance of packaging within the food industry, let us examine some of the problems involved and how standardization of packaging pallets, and transport equipment can benefit the food industry and the consumer.

It is not my purpose to advocate involuntary standardization in any form but to suggest that we should aim at a higher degree of voluntary standardization of packaging, pallets, and transport vehicles through cooperative research and voluntary action on the part of industry that will benefit industry and consumers.

BENEFITS FROM AND NEED FOR STANDARDIZATION

Reductions in marketing costs can be achieved through the use of standardized package sizes. In addition to a lower inventory investment in packaging materials, mass production of the fewer types of consumer packages and shipping boxes is facilitated. Size standardization can help make more efficient use of storage space at all levels of distribution and simplify, expedite, and cut the costs of handling and shipping (3,4,5).

Recently, food industry spokesmen have become more vociferous in expressing opinions on the need for greater efforts toward standardization of shipping containers, pallets, and transport equipment to achieve greater efficiencies in food marketing (6,7).

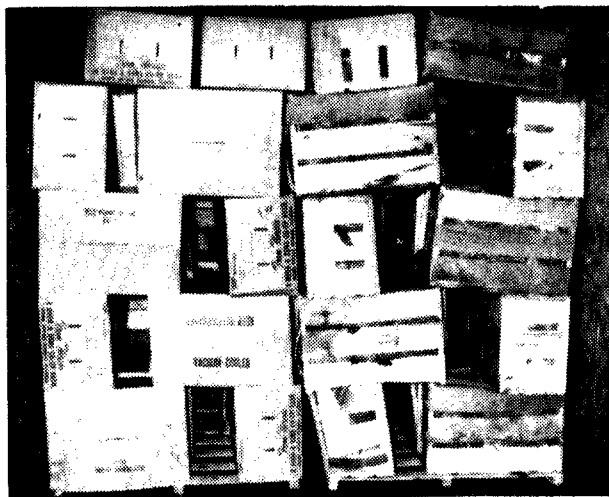
PROBLEMS

There are many facets to the problems involved in attaining dimensional standardization of shipping containers, pallets, and transport equipment. First and foremost is the big problem called "incompatibility." Incompatibilities--dimensionwise--are many: packages, shipping containers, processing lines, packaging machinery, storage facilities, handling equipment, pallet racks, trucks, rail cars, ships, airplanes, doorways, and retail display shelves and equipment. The role of the food industry is to provide some leadership in resolving these incompatibilities.

The most serious aspect of the incompatibility of shipping containers, pallets, (or other plan-view-size configurations such as slipsheets), and transport equipment is the loss of space or "cube" in transport vehicles used for long distance shipments. Figure 1. Loss of space on a pallet in storage means inefficient use of storage space and therefore, higher storage costs per unit. Though, as a rule, storage costs are modest as compared with transportation costs. The additional cost of unused space in transport vehicles caused by shipping unit loads may be entirely offset by the savings gained from more efficient loading and unloading of the product if the distance over which the product is transported is short. However, when transport distances are long, costs of transport become relatively high compared to loading and unloading costs. The importance of long distance transport costs compared to loading and unloading costs was shown in a recent study on the costs of shipping unitized citrus from California to Eastern markets. This study showed that the transportation cost from California to New York City was 95 cents per box of citrus compared to a cost of 2 cents for loading and receiving. This does not give much opportunity for recovering the cost of unused space by savings in loading and unloading unit loads. The author of this study cited as an example, "If a unitized loading method resulted in a car load of 108 cartons (2 pallets) less than a hand loaded car, the cost of shipping from California to Georgia

FIGURE 1

WASTED SPACE IN A
PALLETIZED LOAD OF VEGETABLES



would be 8 cents greater per carton in the unitized shipment. This is based on

carloading of 1,404 cartons compared to 1,512 cartons and a per-car base shipping charge." (8)

The importance of the loss of cube in transport equipment caused by the incompatibility of containers, pallets, and transport equipment was recently stated by A. R. Van Hoven, Grand Union Co., Paterson, New Jersey. He said, "Our research has shown that this pallet (the 40-by-48-inch pallet) will lose cube used in our present equipment." (9)

Another example of the loss of cube in transporting palletized products was cited by T. Richard Battaglia, Chairman, Standardization and Palletization Committee, National Peach Council, when he recently said, "A truck 21 feet long can carry 590 crates (of peaches) stacked six high, and on pallets carries only 480." (10)

From an international point of view, the problem of the incompatibility of shipping containers, pallets, and transport equipment is even more serious because of the longer distances involved in transport. This is particularly important to us in the United States in our efforts to maintain or expand our overseas markets because higher costs of transport places us in a greater competitive disadvantage. The most commonly used pallet in the United States, the so-called GMA 48-by 40-inch pallet which is roughly equivalent to the internationally recognized 120-by 100-cm pallet does not at all fit well the 8x8x10-20-30-40-foot cargo containers adopted by the International Standards Organization (ISO). One solution to this problem is to build cargo or van containers 8-1/2 feet-wide to facilitate the placing of two 48-inch pallets side by side in the transport vans.

Many people are now giving more thought to changing various Federal and state laws that currently prohibit the use of transport equipment over 8 feet in width over the highway to allow for an additional 6 inches, making a total width of 102 inches. Three Canadian provinces, Ontario, Manitoba, and Alberta, now permit 102-inch wide truck semi-trailers on their highways (11).

Although the incompatibility of shipping containers and pallets to transport equipment seems most obvious in van containers or truck trailers, it is also a serious problem facing other modes of transportation such as railroad and ocean-going ships. Railroad cars are made in a number of

different lengths and widths and no single pallet fits them all well. Many ocean-going ships are not designed to facilitate efficient loading or unloading of unit loads and the most commonly used pallets on ships, the 48- by 72-inch pallet, is too large to use in trucks or rail cars.

Although incompatibility of shipping containers, pallets, and transport equipment, particularly in long distance transport seems to be the most serious facet of the overall problems confronting standardization, especially from a national viewpoint, there are many other factors to be considered in our efforts to achieve standardization of containers, pallets, and transport equipment. Interests of package "users," such as wholesalers, retailers, hotels, restaurants, and hospitals need to be given consideration. For example, from the retailers' point of view, fast-moving items such as bread and milk, should be shipped to retail stores in larger size containers than slow-moving items such as caviar. Years ago, produce wholesalers frequently cut in half the wood boxes in which lemons were packed and shipped in to provide the smaller stores with a quantity of lemons that could be sold before they spoiled or dehydrated. Some food distributors have to repack products from large shipping containers into smaller boxes to meet the needs of small retailers or institutional users' requirements. The development of standard size containers would help meet the varied needs of different users and still permit efficient physical distribution.

Although food processors and manufacturers give some attention to retailers' needs, many of our shipping containers have been designed mainly to fit the inside of railroad cars and trucks without much consideration of the needs of the package user. The size of the shipping containers depends upon the number of consumer units packed within them and the number of units that should be packed in them depends in part on the users' requirements. Too many units in a shipping container is inefficient for two reasons. Either shelf space is used inefficiently because of slow product turnover, or restocking of shelves is inefficient when shelves are stocked for optimum turnover. Of the wide range of processed food products, few have a weekly turnover rate of more than one case per week in the average supermarket.

Some marketing specialists, particularly people responsible for the efficient

operation of food warehouses and distribution centers, believe standardization of shipping containers should be geared to efficient handling and storage in warehouses. Materials handling equipment is expensive; labor costs are high, land and overhead costs, particularly in urban centers of population, are high. Unused space in storage racks in grocery warehouses is costly. The efficiency with which packages of different size and shape can be combined on the same pallet reduces warehousing costs. In a recent study, it was found that 1,200 different sizes and shapes of shipping cartons were stocked in a typical food chain warehouse (7).

To the warehousemen, height of the shipping container is a very important factor to consider in standardization. Standardization of the height of containers would assure efficient use of space in storage racks. Most shipping container standards, however, are designed to control the length and width of a container. For many products the height must vary with the nature and shape of the product. For example, the height of 2-layer fresh peach boxes, or one-layer boxes of honeydew melons has to vary with the size of the diameters of the peaches or melons packed in the box. Standardization of the height of containers would be particularly difficult for the fresh fruit and vegetable industry.

The more warehousing operations are automated, the greater the necessity to design the shipping containers and materials handling equipment and storage racks to make them compatible with one another. The use of computers and other automatic data processing equipment such as the automated checkout counter will eventually make possible closer inventory control, and automatic ordering and restocking of inventories.

More attention may need to be given to the use of returnable containers, dollies, or mobile carts to help solve the problem of disposal of package solid waste at retail stores. Some cities restrict the burning of package waste under certain conditions and this often results in non-reusable containers piling up in retail stores. These restrictions are causing some retailers to demand the use of more returnable containers by their suppliers.

Another way of reducing the problem of disposal of package solid waste is to eliminate or partially eliminate shipping containers. There are four

ways this can be done: (1) bundle wraps--consumer packages unitized with shrink film or Kraft paper; (2) tray-wraps--shallow shipping trays overwrapped with shrink-film; (3) sleeve boxes--corrugated boxes with no ends and (4) open top or sideless containers band wrapped with shrink or stretch film. All of these relatively new ways of packaging food products for shipment are predicated on the use of a pallet, slipsheet, skee-pallet, or some other type of base on which the utilized consumer packages can be assembled into a unit load. Self-supporting consumer packages are particularly adaptable to this type of unitizing. The standardizing of package dimensions is also affected because it is likely that most of these unitized packages will have to be stacked directly on top of one another in registered fashion instead of interlocked or cross-tied, as many distributors prefer. Many physical distribution specialists such as Charles W. Ebeling of General Foods Corporation and our session chairman, D. L. Anderson, believe there is a bright future for expansion of some form of "bundle packaging" and the corollary development of shrink film overwrapping unit loads to reduce distribution costs by (1) less product and container damage, (2) better utilization of space in transport vehicles through heavier loading, (3) increased efficiencies in handling, and (4) lower packaging materials costs.

RESEARCH ON STANDARDIZATION AND MULTIPLE UNIT HANDLING

Research and service work on the standardization of shipping containers for fresh fruits and vegetables has been undertaken by the Department for many years. Some of the research work was aimed at getting the industry to voluntarily adopt some standardization themselves. This was the purpose of the report, "Types and Sizes of Containers Used for Prepackaged Tomatoes." In this study 115 consumer packages differing in one or more dimensions and 225 master shipping containers were found being used in this country in 1954 for prepacked tomatoes. The number of different sizes of consumer packages and shipping containers used for prepackaged tomatoes is certainly much lower today than at the time that study was made.

In another study reported under the title of "Variation and Quality of Fiberboard Used in Master Containers for Prepackaged Tomatoes," great variation was found in the amount of

fiberboard used in constructing boxes holding the same quantity of tomatoes. A shallow long narrow box used much more fiberboard in its manufacture than a box more cubical in shape. The amount of fiberboard used for shipping containers for prepackaged tomatoes ranged between 33 to 107 square inches per tray of tomatoes packed in them. Master shipping containers that held 20 trays of tomatoes use much less fiberboard per tray than those that held only 10 trays of tomatoes. Two-layer containers generally use much less fiberboard per tray than one-layer containers. Figure 2.

FIGURE 2

COMPARISON OF DOUBLE LAYER VS. SINGLE LAYER CONTAINERS FOR TOMATOES



As more and more people become concerned with the disposability of package solid waste, more attention will be given to standardizing sizes and types of containers that are simplified in their construction so that they result in less waste material to dispose. (It is estimated that the per capita consumption of packaging materials will increase by 136 pounds from 525 pounds in 1966 to an annual total of 661 pounds by 1976 (12).

Another way of designing containers with less package solid waste is to design packages which will perform more than one function in the marketing system.

Many of our recent packaging research projects have been oriented toward designing and constructing shipping containers that are more suitable for multiple-unit handling in unit loads. This work got considerable impetus in the late 50's and early 60's from many reports we received on the inadequacy

of the packaging of U.S. products in foreign markets. In response to these complaints we initiated more research to assure delivery of our products in better condition and in the types and sizes of containers desired by our overseas customers.

Frozen meats and poultry and fresh fruits and vegetables were usually trucked from point of origin or processing plant to our ports of embarkation where they were unloaded, placed on the pier, reloaded on stevedore-type pallets, hoisted over the side of the ship, and then lowered down into the holds of the ships. A great deal of container damage and product damage occurred during the process. More damage occurred when the individual packages were unloaded at various foreign ports.

Several studies were initiated to explore the merits of palletizing agricultural products at point of origin so that they could be transported to the ports as unit loads and loaded on the ships on the original pallets and unloaded as unit loads. We made numerous palletized test shipments of citrus fruits, apples, pears, grapes, celery, and bags of dried peas during the last few years. However, the overseas shipment of palletized loads of perishable products has not been entirely satisfactory. We experimented with various types of strapping materials such as nylon, polypropylene, rayon, as well as steel in holding the boxes together on pallets but the strapping frequently became loosened during transit to the ports and during their handling on and off ships. Not all of our experimental shipments of palletized food products arrived in Europe in much better condition than comparable break-bulk shipments.

In 1965, in cooperation with American exporters of food products, we began experimenting with the use of small van containers. These small van containers insure much better condition of perishable products on arrival than is possible with break-bulk shipments. Containerization permits the packing of the product in the original shipping container in the truck trailer at point of origin which was then hauled to the port of embarkation and then loaded intact aboard ship, unloaded in the foreign port, and trucked to the final receiver. This provided for more gentle handling and greater assurance of satisfactory arrival condition of the product than break-bulk shipments palletized or non-palletized.

We conducted many experiments on containerized shipments of frozen poultry to overseas markets. The more gentle handling that shipping containers received on containerized ships made it possible to use less costly shipping containers. For shipping frozen turkeys in van containers from the U.S. to European markets, we found that we could save 6.7 cents per box by using 225-lb.-test corrugated boxes without strapping instead of using 275-lb.-test corrugated boxes with strapping. Although many people believe that ultimately more and more products will be shipped to overseas markets in unit loads in van containers, at present practically none of our exported fresh produce and frozen poultry and meat is shipped in unit loads in van containers. However, if we learn how to standardize our shipping containers and pallets so that they will fit van containers with less loss of space, the trend toward more unitized shipping in van containers would appear inevitable.

Another example of how standardizing the dimensions of shipping containers can affect savings in physically moving products from the farm to market can be illustrated by our research on celery shipping containers. A Federal marketing order for celery in Florida permits the celery industry to stipulate the dimensions of containers used in shipping celery outside of the State. For many years celery has been cut to a standard 16 inches. In cooperation with the Florida celery industry committee administering the marketing order, we tested the merits of packing and shipping celery cut to 14 inches. Obviously a smaller size container was needed for celery cut to 14 inch lengths than for celery cut to 16 inches. This reduced the amount of material required to manufacture the container. This not only reduces the cost of manufacturing the container, it helps to conserve our resources and solve the problem of disposal of package solid waste. Use of the smaller crate permits the trucking of more celery from the field to the packing plant on a given size truck and it enables shipping more celery per truckload, before encountering state truckload weight limits on highways, from Florida to consuming markets. It is estimated that \$750,000 could be saved annually by adoption of the smaller standard size celery crate. This smaller crate was adopted beginning in the 1970 fall season by the Florida celery industry.

Numerous industry groups are

experimenting with the development of shipping containers designed for palletization or unit loading. This summer we cooperated with the southern peach industry in redesigning their shipping containers to make them fit 48- by 40-inch pallets more efficiently to reduce loss of space in transport vehicles and to meet demands of receivers to have an even number of shipping containers stacked on a pallet.

The California Grape and Tree Fruit League have made a number of experimental shipments during the past year with various size containers and various size pallets. Many receivers are reluctant to pay more for palletized unit loads, particularly if they are on non-standard size pallets which they cannot use in their warehousing operations. Moreover, for truck shipments the receivers' unloading costs are not reduced if the trucker does the unloading.

Palletization does offer some not so obvious economies. Truck congestion is reduced in receiving markets because less time is required to unload. Also less costly packaging materials often can be used in the manufacture of the shipping containers. For example, polystyrene foam boxes, while too fragile, under some conditions, for individual handling in break-bulk shipments, can be used for packing and shipping fruit if palletized and strapped in unit loads.

Some research has been done on palletization of agricultural products for shipment by air freighter. The equivalent of 2,735 rail carlots of fresh fruits and vegetables were shipped by air out of the State of California in 1969 (13). Many of these commercial shipments are on pallets or in cargo containers. However, many air freight shipments of food products are made in the belly compartments of passenger aircraft. Most of our shipping containers do not fit well in these belly compartments; fresh figs, for example. Not many markets can absorb a carlot shipment of figs at one time but the equivalent of 41.7 carlots were shipped by air in 1969. The containers traditionally used for shipping figs are poorly designed for shipment in the belly-pit compartments of airplanes. The size and construction of the wood slatted fig containers make it impossible to stack them registered on top of one another in the rounded contours of the belly containers. Some shippers experimented with palletizing shipping

containers of fresh figs to help assure better condition upon arrival. But some of these palletized units were shipped on their sides instead of in an upright position. But one cannot blame the airlines for shipping pallets on their sides in the belly containers, if the dimensions of the unit load are completely incompatible with the dimensions of the belly containers.

Flowers are one of the most important agricultural products shipped by air. Air freight costs are high. It costs about \$10 a box to ship roses or chrysanthemums from California to New York. Most of the flower containers were designed with little consideration being given to the requirements of air transport. A part-telescope container (shoe box in design) is less efficient in utilization of space than a regular slotted container. A long horizontal (casket type) box is easier to mishandle than a more vertical type shipping container. We are currently conducting research to develop shipping containers whose dimensions will conform to the standard pallets or cargo container dimensions adopted by the airlines. We are trying to design the containers to make more efficient use of space in the aircraft and to find ways to pack the flowers within the shipping containers as densely as possible to reduce transport costs per flower.

We have completed a survey of the shipping containers used for marketing fresh fruits and vegetables and are currently making a similar survey of shipping containers used in the meat industry. These surveys may be followed with a similar sample survey of the dry grocery industry although we are hoping to assemble enough data on dry groceries from various industry groups to develop some recommended dimensional size containers for the food industry.

To indicate how this work is progressing, I would like to give you some results of our fresh fruit and vegetable survey. The survey was made in only two cities, New York and Los Angeles 1965-66. Four warehouses-- 3 chain store distribution warehouses and one independent warehouse--were selected in each city. All of the containers found in any one week in those four warehouses were measured and weighed. The inside measurements were taken in inches as that is the customary way containers are measured for manufacturing purposes in this country. The outside dimensions were

measured in centimeters. The survey was replicated during each of the four seasons of the year in order to sample commodities marketed seasonally.

A tabulation of the number of the types and sizes of containers we found that were being used for fresh fruits and vegetables in Los Angeles and New York in 1965-66 is shown below:

Number of Commodities - 49
 Number of Dimensional Size Containers (1/4-inch increments)- 371
 For Selected Commodities:
 Apples 40
 Tomatoes 35
 Lettuce 27

The percentage of the 371 containers palletizable with over 90 percent of the space occupied on selected size pallets was:

48 by 40 inches 19.7
 120 by 100 centimeters 12.9
 54 by 44 inches 22.4
 44 by 36 inches 19.4

We have tabulated the dimensions, net weights, point of origin, and related data on all of the different sizes and types of shipping containers found in use in these two cities for each of the 49 commodities covered in the study. These data can be used by industry groups in their efforts to study the relative merits of standardizing on various size containers or pallets.

Some industry leaders in the United States have expressed the opinion that the several hundred different sizes of

fruit and vegetable containers being used in this country might be replaced by four different size containers (14).

The OECD also has proposed adoption of four different size containers for the international trade of fresh fruits and vegetables. We summarized all of the data obtained in our survey into four size groups of containers. Following the general size groupings used by the OECD, Table 1 shows the average dimensions for the 50 most popular size containers found in the New York and Los Angeles warehouses.

We cannot market all fruits and vegetables in the same size container because of the variations in the size of the product, value of the product, rate of sale or turnover in the stores, and other user requirements. The "small" size group of containers in Table 1 represent boxes used for fresh sweet cherries, avocados, limes, and other relatively high value fruits. The "medium" size boxes represent the typical orange or apple box and it is probably the most commonly used size container in the fruit and vegetable industry. An example of the "medium large" size group of shipping containers is the one used for shipping honeydew melons. Honeydew, Persian, or Casaba melons are fairly large in diameter and a greater width container is needed to efficiently accommodate this size product. Other large size products such as cabbage, which is also generally relatively lower in value, are packed in the "large" containers.

The efficiency with which these 50 most

TABLE 1. -- Average Outside Dimensions of the 50 Most Commonly Used Fruit and Vegetable Containers, New York and Los Angeles, 1965-66 Classified in 4 Size Groups

Size Group	No. of Different Size Containers in Group	Outside Dimensions (Length and Width)	
		Inches	Centimeters
Small	11	16-1/2 x 12-5/8	42.1 x 32.1
Medium	19	19-1/2 x 12-1/4	49.4 x 31.0
Medium Large	9	18-1/2 x 14-7/8	47.0 x 37.7
Large	11	23-3/4 x 15-7/8	57.8 x 40.4
TOTAL	50		

popular size shipping containers used in the fresh fruit and vegetable industry can be palletized on four selected size pallets is shown in Table 2.

the acceptable degree of efficiency with which containers fit on pallets. Therefore, one must conclude that fresh fruit and vegetable containers have not been designed for efficient palletization

TABLE 2. --Pallet Utilization Efficiency of the 50 Most Common Dimensional Fresh Fruit and Vegetable Containers in New and Los Angeles

Pallet Size	Small Containers (10)	Medium Containers (19)	Medium Large Containers (9)	Large Containers (11)	All (50)
	Percent	Percent	Percent	Percent	Percent
48- x 40-in.	83.1	84.9	80.5	78.3	82.3
120- x 100-cm	83.3	86.4	83.1	80.1	83.9
54- x 44-in	91.6	84.9	83.6	83.4	85.8
44- x 36-in	88.9	80.5	83.8	71.9	79.1

Generally, as you will note in the table, the smaller containers can be more efficiently palletized than large containers. Containers can generally be more efficiently palletized on large size pallets than small size pallets, also evident in Table 2. Most important, however, examination of the data in Table 2 shows that none of these popular size shipping containers are efficiently palletizable. Only the small containers when palletized on the 54- x 44-inch pallet meet the 90 percent of over criteria sometimes used in determining

or unitized handling in the food distribution system.

Table 3 shows three alternative groups of different size containers which might be considered for use by the fresh fruit and vegetable industry. The four OECD recommended container sizes, that is 40 by 30-, 50- by 40-, and 60- by 40-cm, do not deviate from the average dimensions of the four size groupings of the 50 most popular size containers found in the New York and Los Angeles survey. The 40- by 30-cm

TABLE 3. -- Dimensional Size Containers for Consideration in Use of Fresh Fruits and Vegetables and Pallet Utilization Efficiency

	Small (208 sq. in.) Dimensions (O.D.)	Medium (239 sq. in.) Dimensions (O.D.)	Medium Large (275 sq. in.) Dimensions (O.D.)	Large (361 sq. in.) Dimensions (O.D.)
OECD Recommended <u>1/</u>	40 x 30 cm. (186 sq. in.)	50 x 30 cm. (232 sq. in.)	50 x 40 cm. (310 sq. in.)	60 x 40 cm. (372 sq. in.)
8 x 12 in. module <u>2/</u>	16 x 12 in. (192 sq. in.)	20 x 12 in. (240 sq. in.)	20 x 16 in. (320 sq. in.)	24 x 16 in. (384 sq. in.)
9 x 11-1/4 in. module <u>3/</u>	18 x 9 in. (162 sq. in.)	22½ x 11¼ in. (253 sq. in.)	22½ x 15 in. (337 sq. in.)	22½ x 18 in. (405 sq. in.)

1/All 100 percent palletizable on 120- x 100-cm. pallets.

2/All 100 percent palletizable on 48- x 40-inch pallets.

3/Palletizable on:

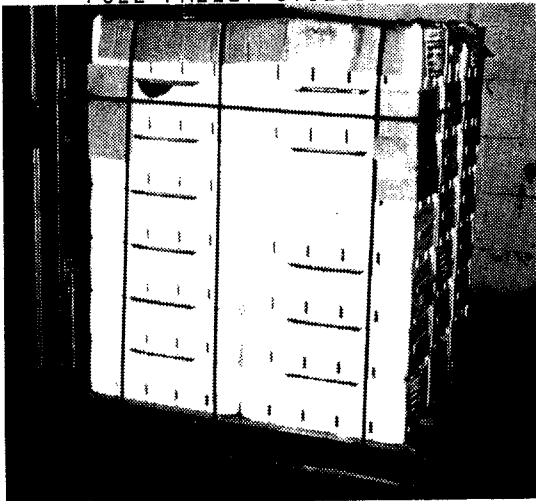
	Small	Medium	Medium Large	Large
54- by 45-inch pallet	100%	84%	84%	100%
45- by 45-inch pallet	100%	100%	100%	80%
45- by 36-inch pallet	100%	93%	91%	100%

OECD container is slightly smaller than than our average small container which is 42- x 32-cm. The 50- by 30-cm. container is approximately the same size as our similar size container which is 49- by 31-cm. The OECD medium large container, 50- by 40-cm., is slightly larger than our average medium large container which is 47- by 38-cm. Also the OECD 60- by 40-cm. container is slightly larger than our average 58- by 40-cm. "large" container. The OECD dimensional containers fit the 120- by 100-cm. pallet with 100 percent of the space utilized and thus it appears that the changes in dimensions that would be necessary to make our containers fit a 120- by 100-cm. pallet are not too great.

By using an 8- by 12-inch module as a guide we could select four dimensional size shipping containers that would give 100 percent efficient utilization of space on our 48- by 40-inch pallet. Figure 3. This would not require a tremendous change in the present sizes of our shipping containers now in use. Four other size containers are listed in Table 3 for consideration. Their selection was based upon the 9- by 11-1/2-inch module which might be considered for use on 54- by 45-inch pallets, 45- by 45-inch pallets, or 45- by 36-inch pallets. Although these sizes of pallets are not used to any extent in this country at the present time, they may offer some advantages with respect to efficiently unitizing shipping containers in the ISO 8-foot-wide cargo containers. These suggested size shipping containers are not offered as a recommendation but to indicate what can be done by the food industry on a voluntary basis to make some progress in standardization.

FIGURE 3

CONTAINERS PROVIDING FULL PALLET UTILIZATION



PRESENT STATUS OF STANDARDIZATION

"The most popular sizes of pallets employed today in world commerce are as follows:

Inches	Millimeters
48 x 72	1200 x 1800
48 x 64	1200 x 1600
40 x 48	1000 x 1200
48 x 40	1200 x 1000
32 x 48	800 x 1200
40 x 64	1000 x 1600
40 x 40	1000 x 1000
32 x 40	800 x 1000
36 x 36	900 x 900

"The first two sizes represent the most popular pallets for ocean transportation, the first being the leading stevedore pallet, and the second being employed for cargo in the ship's hold. The third and fourth sizes are the most popular in the U.S. for interchange purposes. The fifth size is the standard for the international pallet pools in Western Europe. The sixth size is popular in the intercoastal trade of Western Europe. The last three sizes are popular in various countries of the world including the U.S."(15).

The United Fresh Fruit and Vegetable Association in a recent survey reported that receivers of fresh produce reported receiving in 1969 about 70 percent of their palletized shipments of produce on the 48- by 40-inch pallet (16). The 32- by 40-inch pallet represented about 24 percent of their receipt of palletized shipments.

Pending the development and adoption of standard size shipping containers, pallets, and transport equipment, an interim solution is to find out how to more efficiently use present containers on various size pallets and in various size unit loads. This is most efficiently done by the use of automatic data processing techniques. One such computer program is offered to the public by a private consulting firm on a fee basis. Their program is known as "Space I." "The term 'space I' is an acronym for Scientific Pattern Alternatives Computed Electronically" (17). This program determines the most efficient pallet patterns for the various size shipping containers presented for analysis.

The General Foods Corporation also uses computer programming for developing the most efficient pallet patterns for any given size of case (18). An article written by Charles W. Ebeling, Manager,

Physical Distribution Services, General Foods Corporation, entitled, "New Computer Program Gives Instant Pallet Patterns" describes the procedure employed in their program. They estimate that by stacking containers on pallets efficiently with a maximum packing density on a 48- by 40-inch pallet they can save 1.5 cents per container. The savings would result from larger unit loads, greater storage density, and reduced damage costs.

Researchers in the universities and in the government and private industry should continue to experiment under commercial conditions and in laboratories with the development of shipping containers designed to be handled and transported through the physical distribution system in some type of unit load. But these efforts need to be coordinated on some universally accepted premise.

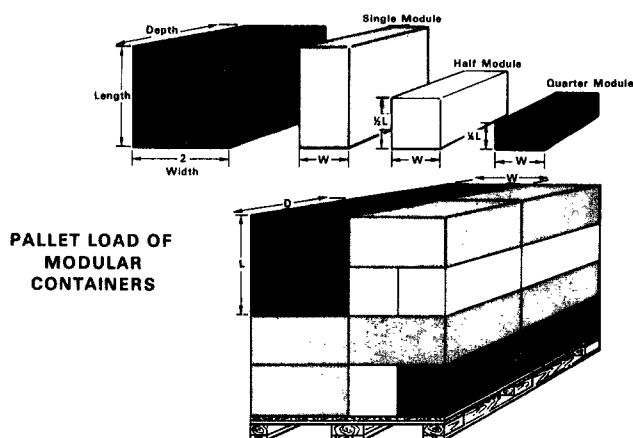
One premise that has been offered is that because the railroad tracks are laid and the highways are all built, the standard dimensions for unit loads should fit present transport equipment. This premise has been accepted most widely but it has not resulted in much action. Moreover, there seems to some lack of unanimity on the stability of dimensions of transport equipment. Already German manufacturers are making van containers 6 inches wider than the ISO 8-foot-wide van container (19). The consideration that is being given by the various countries to amending their laws to permit highway trailers to be constructed in 8-1/2-foot-widths indicates some need for consideration of developing pallets and other plan-view-size configurations, as well as shipping containers with dimensions that will efficiently fit the wider transport equipment.

Table 4 shows how four plan-view-sizes of unit loads would fit selected types of transport equipment--40-foot cargo containers or truck trailers, and 50-1/2-foot and 40-1/2-foot box cars. The width of insulated transport equipment to handle frozen or perishable foods is slightly less than that shown in the table. These data show that the problem of efficiently utilizing space for various unit loads in transport equipment is not easily solved. Eventually better reconciliation of the dimensions of transport equipment and unit loads will have to be resolved.

Another premise that has been advanced is to start at the other end of the

of interaction and adopt a common denominator module as a guide. A "module" is defined in the dictionary as a standard or unit of measurement. Adoption of a common denominator module will permit all shipping containers, pallets, transport equipment, facilities, etc., to be designed and manufactured in multiple units of that given module so that they will fit--one with another. Two proposed module sizes of containers are 8 x 12 and 9 x 11-1/4 inches. If some agreement can be achieved in the development of a common denominator module, then the entire production, manufacturing, and distribution operations of (or segments of) the food industry can ultimately plan their facilities and packages to attain compatibility at some time in the future.

FIGURE 4
PALLET LOAD OF MODULAR CONTAINERS



PALLET LOAD OF
MODULAR
CONTAINERS

Western Europe has been attempting to standardize package dimensions based on a module where width and length are in the ratio of one to the square root of 2. The width of any given module is the same as the length of the next smaller module so that the areas of successive packages are related by the factor of 2. In other words, one size is always contained twice in the next larger size.

The dimensions of containers are not always given in the same order; however,

the modular concept requires that the length of the next larger container in a series shall always be twice the width of the smaller. The dictionary is not a very good source of information for deciding which is the length, width, and depth of a container but the most usually accepted definitions in the U. S. are: Length--the larger of the two dimensions of the open face; width--the lesser of the two dimensions of the open face; and depth--the distance between the innermost surfaces of the box measured perpendicular to the length and width.

Leadership in standardization is being provided in the United States by the American National Standards Institute (ANSI). They have committees developing recommended standard dimensions for shipping containers, pallets, and transport equipment. The ANSI Committee for Packaging Dimensions is drawing up standard dimensions for shipping containers that fit specified plan-view-size configurations in uniblock or interlock patterns as a guide for packagers, shippers, and distributors in the U.S. for all products--foods and non-foods. This should be an important step toward achieving more standardization some time in the future.

DEFINITIONS

Plan View Size: The rectangular space defined by the intersection of the floor by four vertical planes which totally enclose all extremities of a unit load when it rests in a storage or shipment position. Plan-view-sizes are slightly larger than the size of pallets or slipsheets because of the overhang of containers placed on the pallets, bulge

of individual containers caused from filling, compression or settling and from stacking the containers improperly on the pallet or slipsheet.

Uniblock: A pattern of stacking individual containers on a pallet or slipsheet or in some other type of unit load configuration with all the package lengths in one direction and all of the widths in the other direction and utilizing 100 percent of the area.

Interlocking: A unit load arrangement in which the third layer is like the first; and the fourth layer is like the second and there is no vertical seam on the outside of, and to the full height of, the unit load. Interlocking patterns may or may not utilize 100 percent of the area.

CONCLUSION

The solution to the problem of incompatibility of containers, pallets, and transport equipment lies in the adoption and use of standardized shipping containers that will fit standardized plan-view-size unit load configurations that in turn will fit transport equipment reasonably well in the future. It is most important that we develop shipping container dimensions that insure the use of all the space on unit load configurations because it is inevitable that some space will not be efficiently used by the unit loads in transport equipment. Development of recommended standard size units, voluntary industry use of them, and continued cooperative research and revision of them is essential to achieve a highly efficient food distribution system. ●

TABLE 4.--Utilization of Transport Equipment by Various Size Unit Loads

Type	Width (ID) Inches No.	Length (ID) Inches No.	Area Sq. In. No.	Plan-View-Size of Unit Loads							
				48- by 40-in.		54- by 45-in.		45- by 36-in.		45- by 45-in.	
				Utili- zation Percent	Units No.	Utili- zation Percent	Units No.	Utili- zation Percent	Units No.	Utili- zation Percent	Units No.
40-ft. cargo container	92	472	43,459	92.8	21	89.5	16	96.9	26	93.2	20
50-1/2-ft. rail box car	110	606	66,660	86.4	30	94.8	26	94.8	39	80.0	26
40-1/2 ft. rail box car	110	486	53,460	86.2	24	90.9	20	93.9	31	75.8	20

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