Marketing Research Report No. 827

Packaging Produce In Trays At The Central Warehouse

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PREFACE

During the past few years, most supermarkets have reported that sales of produce as a percentage of total store sales have decreased, while operating costs of produce departments have increased. The improved packaging systems and techniques described in this report present the industry an opportunity to lower the cost of selling produce substantially.

This report is one of a series of publications dealing with the packaging of produce at the central warehouse. It covers the results of research on produce items that are typically packaged in trays.

The study was conducted under the general supervision of R. W. Hoecker, Assistant Director, Transportation and Facilities Research Division, Agricultural Research Service.

Related publications previously issued by the U.S. Department of Agriculture are: MRR 278, "Packaging and Price Marking Produce in Retail Food Stores," October 1958; MRR 721, "Packaging Produce at the Central Warehouse," November 1965; and ARS 52-7, "Produce Packaging at the Central Warehouse—Bananas," October 1965.

The following firms cooperated with the researchers by allowing the use of their facilities for this study: Publix Super Markets, Inc., Lakeland, Fla.; Red Owl Stores and Super Valu Stores, Hopkins, Minn.; and Safeway Stores, Landover, Md. The author would like to thank the many manufacturers of equipment and packaging materials who contributed time and materials.

Any trade names used or equipment illustrated in this publication are solely for the purpose of providing specific information. Mention of commercially manufactured products does not imply endorsement by the Department of Agriculture over similar products not mentioned.

Much of the research on which this report is based was conducted by Paul Shaffer, formerly with the Agricultural Research Service.

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Packaging Produce In Trays At The Central Warehouse

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SUMMARY

Sales of fresh produce in retail stores in the United States amounted to approximately $5.2 billion in 1965. About 33 percent or $1.7 billion was sold in prepackaged produce departments. Included in the $1.7 billion were about 567 million packages of produce, packaged in trays, at store level. Costs for the lowest cost method of packaging at store level amounted to 7.20 cents per package. Packaging at the warehouse with the methods described in the report cost 4.80 cents per package, a difference of 2.40 cents per package or potential savings of $13.6 million annually.

While the costs of materials for warehouse packaging were higher than for the lowest cost store method, and costs of containers were also incurred in warehouse packaging, the costs of labor, equipment, and space used were lower than for store packaging.

Cost of overwrapping packages at the store in sheeted cellophane averaged 8.56 cents per package. Sleeve wrapping with one-way shrink-type polyvinyl chloride cost 7.28 cents and overwrapping with stretch-type polyvinyl chloride cost 7.20 cents per package. These costs included labor, materials, equipment, and space.

A single packaging line at the warehouse operated on a one shift basis can produce about 2.5 million packages annually with proper production scheduling. A two-line packaging operation can produce up to 5 million packages. When compared with the lowest cost store method (overwrapping with stretch-type polyvinyl chloride), a single-line warehouse operation breaks even at an annual volume of about 530,000 packages. The break-even point for a double line is about 900,000 packages. Savings for a single packaging line range from $7,575 per year at an annual output of 750,000 packages to $67,750 at 2.5 million packages. Savings for the double line range from $55,250 per year at 2.5 million packages to $141,000 at 5 million.

These savings are partly based on the assumption that when retail stores shift to warehouse packaging, equipment no longer needed can be sold and the space saved at the store can be utilized for other activities. While savings stated can be fully realized for new stores, some existing stores might be unable to realize the full savings. If the equipment and space savings were not included as savings for the existing stores, savings through warehouse packaging at a volume of 3 million packages annually would be 0.61 cent per package and the break-even point between the lowest cost store method and a single warehouse packaging line would be about 1.1 million packages per year.

Since costs were based on good operations and skilled operators at store level, when in reality many store operations are less than good and operators often are unskilled part-time personnel, savings through warehouse packaging would probably be greater than those projected. Operations and materials usage can be properly supervised at a central location far more easily than at store level.

INTRODUCTION

Customers in most modern supermarkets select their own produce. There are, however, two types of self-selection: (1) Bulk, where produce is displayed in bulk displays and sold by piece or weight and priced at a station in the department or at the checkout, and (2) prepackaged, where all items are either prepackaged or unitized and prepriced. Many supermarkets operate between these extremes. In one survey (*8*), it was estimated that 77 percent of all produce departments were self-service and one out of three supermarkets sell all or nearly all produce packaged.[1] The trend in packaging is upward; some estimate that by 1970, 60 to 75 percent of fresh fruit and vegetables will be packaged before reaching the retailer (*9, p. 21*).

A suitable container for shipping packaged produce to the retail store is a thermoplastic container with bails. The container stacks or nests and has dimensions of 29 by 17 by 6¾ inches. If these containers are incorporated into the refrigerated display case in the retail store, there would be additional savings of 0.30 cent per package in display labor costs and product rotation.

Firms converting to warehouse packaging should adjust traditional store level gross margins downward to reflect the transfer of packaging costs from the store to the warehouse.

The operator of the produce department has two decisions to make relating to the operation of the department: Shall he sell produce bulk or prepackaged (or some combination of the two merchandising systems) and, if he sells all or part of the produce packaged, where should the packaging be performed? The alternative packaging locations are at the growing area, by a specialized packer in the terminal market, at the central warehouse, or at the retail store.

When produce operators first began to convert from bulk to the prepack method of merchandising, the packaging was usually performed in the backroom of the store. By adding film, trays, and a table or bench, it was relatively easy to convert to a prepack operation. However, as the volume of prepackaged produce increased, it became necessary to add better tables for wrapping, automatic scales, label printers, label applicators, and conveyors to reduce labor costs. The overriding question at that time was customer acceptance. Packaging at the store had the following advantages:

- Produce had a longer shelf life as compared with bulk display.

- Packaging output could be more easily adjusted to changing sales as compared with source or terminal packaging.

- The operator was able to merchandise special packages such as mixed fruit packages and salads.

Essential to the success of a prepackaged department was close maintenance of product quality to gain customer acceptance of packaging. Packaging at store level provided a "fresher" package, which was especially important where wrapping films became dull or lost shape from moisture and handling.

With improvements in wrapping materials and techniques, several firms have switched the packaging of trayed items to the warehouse to take advantage of specialized high-speed equipment that would reduce labor costs and have a high volume potential. Other advantages of warehouse packaging are: Central quality control by produce experts; better disposal of off-grade produce; receiving the product in larger than standard containers to lower costs of shipping containers and handling; and improved supervision.

The objective of this report is to evaluate and develop improved methods, equipment, layout, and operating practices for packaging produce at the central warehouse and to compare costs of central warehouse packaging with the most commonly used systems of packaging produce at the retail store. Research on the packaging of produce in the retail store was reported in a previous report (*7*). The study reported here measures the direct and indirect costs of packaging at the store and central warehouse. It does not measure the merchandising effectiveness of the packaging techniques used, the effect of rewrap costs on total system costs, or the possible differences in product shrinkage when packaging in either location.

This report is limited to those higher volume produce items that are typically packaged in a tray (or folding box). These items include table-sized round fruit typically packaged six per tray (apples, oranges, peaches, and pears which henceforth will be referred to as "6-pack") and beans, corn, grapes, lemons, plums, squash, and tomatoes.[2] The report does not evaluate the alternative packaging materials available but develops labor and materials costs only for the several methods and materials used most frequently at the store and warehouse. The equipment used in the cost analysis of warehouse packaging is that most commonly used by firms that centrally package trayed produce.

Labor costs are based on the standard time to perform the job at the stated wage rates. Labor

[1] Italic numbers in parentheses refer to Literature cited, p. 32.

[2] Table-sized fruit is the larger fruit which typically is sold in packages or bulk display; for example, sizes 88, 100, and 113 apples and oranges. Smaller apples (150 and 163) and oranges (126, 144, and 163) are frequently sold in polyethylene bags. A previous ARS publication (*6*) reported on methods of packaging produce in polyethylene bags at the central warehouse.

Beans as used in this report are green, stringless, pole, and yellow wax.

rates include an allowance of 15 percent to cover fringe benefits. The standard time is defined as the time for a skilled operator to perform a task using prescribed methods, layout, and equipment while working at a normal pace. It includes a 15-percent allowance for fatigue and personal time. This allowance is reduced to 10 percent for warehouse-packaging lines because of the use of specialized equipment and because most of the warehouse employees do not handle heavy containers. In addition, line delays included in the standards provide periodic rests. All equipment and packaging materials are quoted at list prices.

In several instances, it was necessary to weight packaging costs by the relative movement of the item. The trayed produce movement of several firms was averaged to obtain the following percentages:

Packaged tray item	*Percent*
Apples, oranges, peaches, and pears, 6-pack	44
Beans	15
Corn, 3 or 5 ears	5
Grapes	13
Lemons, 5-pack	9
Plums, 8-pack	3
Squash (yellow and zuchinni)	4
Tomatoes, 4-pack (vine ripe and hothouse)	7
Total	100

Not every firm in the study packaged these items or the package sizes listed above. These sizes have been used throughout the report because they represent the most typical product and size mix.[3]

Some tray-produce packaging is performed by terminal packers in metropolitan areas. Their equipment and packaging techniques are similar to those used at the central warehouse but are beyond the scope of this report.

DESCRIPTION OF WAREHOUSE TRAY PACKAGING

Tray packaging of produce at the warehouse level involves the following activities:

- Receiving and storing product.
- Scheduling production.
- Feeding the packaging lines.
- Placing product in trays or folding boxes.
- Wrapping the filled trays.
- Weighing and labeling.
- Shrinking film on wrapped packages with heat.
- Packing finished product into containers for store shipment.
- Storing the packaged product.
- Selecting and delivering produce orders to the stores.

In the firms studied, produce was received from both motor and rail carriers in standard shipping containers with the exception of some locally grown items that were packed into field crates. One inherent advantage of centralized produce packaging is the ability to receive produce at the warehouse in large containers and thereby reduce shipping container costs. This is not being done now on a very large scale, but it offers potential savings that may be realized in the future (*6*).

Most of the palletized items were transported directly by forklift truck to a multipurpose cooler maintained at about 34° F. with a relative humidity of 90 percent. Some products, such as corn, were covered with ice in the cooler.

Orders from stores were recapped on a daily basis and placed in two groups—nearby stores and distant stores. Each item for distant stores was packaged in the morning and selected and shipped to stores in the afternoon. Items for nearby stores were packaged in the afternoon and selected and shipped in the late afternoon.

As required, pallet loads were transported by forklift to the packaging lines. In most of the operations studied, this was not a full-time job for a forklift operator. Shipping containers were opened and dumped onto filling stations by the line feeder. This was heavy work and usually done by a man. The packaging line area was typically refrigerated at 50° F.

Tray filling consisted of obtaining product from product-feed belts or turntables incorporated into the tray-filling station. Empty trays or folding boxes were obtained from master containers, or from shelves; produce was placed into the tray; and the filled trays positioned on conveyors feeding the automatic packaging machines. Female operators were typically used for tray filling.

The automatic wrapping machines used in the firms studied overwrapped the packages in shrinkable film. While these machines were also capable of sleeve wrapping, none of the firms studied used this technique for warehouse packaging.

If the packaged item was sold on a per package basis, a label imprinted with the commodity description and price was automatically applied by a labeler unit installed on the wrapping machine. If sold by weight, the packages were weighed and labeled by semiautomatic equipment requiring an operator or by automatic weighing and labeling equipment. Scales were equipped with a tare de-

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[3] Since the study began, several firms have reported that the sales of tray-packaged yams and baking potatoes are increasing. The inclusion of these items in the product mix would not materially affect the cost comparisons among the various systems studied.

vice whereby the weight of packaging materials was subtracted from total package weight to compute the package price.

Labeled packages typically moved by conveyor through a heat-shrinking device which caused the film to tighten, resulting in a more attractive package.

After heat shrinking, packages moved by conveyor to a turntable where a male employee obtained packages from the turntable and placed them in containers for store shipment. The shipping container rested on a tare-weight scale and the net weight or package count was recorded on a packing slip and placed in the container.

The packaged produce was stored by commodity groups on pallets in the 34° F. cooler. Some firms

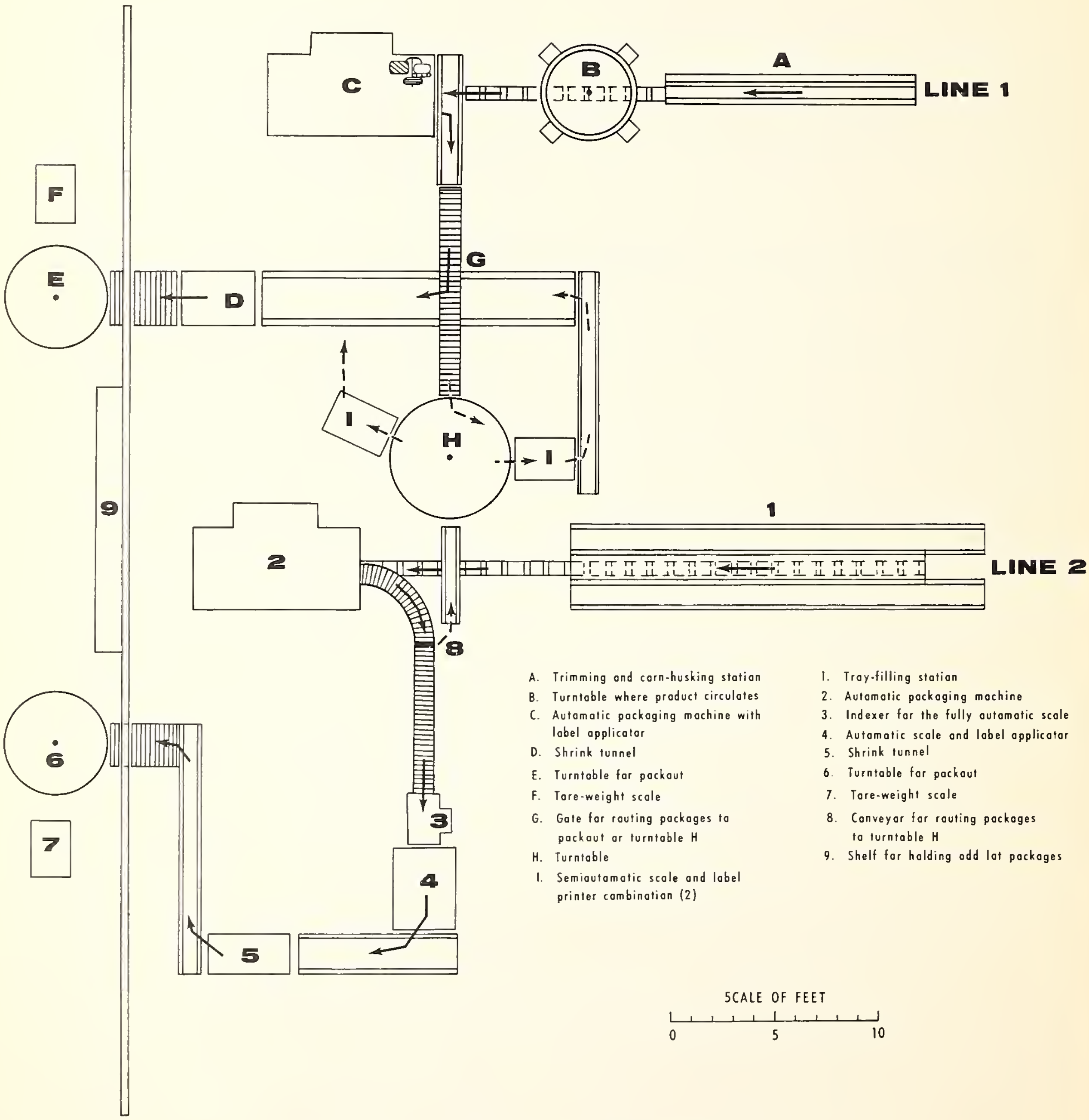

FIGURE 1.—Layout used in one firm for warehouse packaging.

used pallet racks; others with adequate storage space did not use racks but planned to install them when necessary.

Order selection personnel used walkie-type pallet jacks that were electrically powered, and store orders were typically placed into trailers on pallets. Refrigerated trailers were used for store delivery.

A tray-packaging operation used by a warehouse participating in this study is shown in figure 1. This layout fulfills many of the basic requirements for an efficient yet flexible arrangement.

Line 1 was used for packaged items that were sold by either count or weight. Items typically sold by count were 6-packs of fruit, 3- to 6-pack baking potatoes, and 3 and 5 ears of corn. A corn-trimming machine, not shown in the layout, was installed at the beginning of line 1 when processing corn. Corn husking and items requiring manual trimming moved over trimming station (A). Product to be trayed circulated on a turntable (B); the trays or folding boxes were positioned on a tray-holding shelf mounted on the turntable framework. Product was trayed and placed on the conveyor located under the turntable and transported into the automatic wrapping machine (C). If the item was sold by count, a labeling device on the wrapping machine printed the necessary information and applied the label to the package. Packages then moved by conveyor to the shrink tunnel (D) and to the packout turntable (E). If the items packaged on line 1 were to be sold on a catch-weight basis, then a gate at point (G) routed packages to a turntable (H) where they were weighed and labeled by two operators using semiautomatic scales and label printers (I). Packages were then put on conveyors and moved through the shrink tunnel to the packout station.

Items packaged on line 2 were sold on a catch-weight basis. Beans, squash, brussel sprouts, okra, rhubarb, and small fruit were typically packed. Product was dumped on the U-shaped portion of the tray-filling station and conveyed to the workers on feed belts. Empty trays or folding boxes were stored on an overhead shelf located over the cleated conveyor feeding into the machine. Product was obtained from the feed belt in front of the worker, placed into the tray, and filled trays placed on the cleated conveyor. Filled trays moved to the automatic packaging machine (2), and then to the automatic weighing and labeling station (3 and 4), through the shrink tunnel (5), and to packout station (6). In the event of a breakdown of the automatic weighing and labeling station, packages would be routed to the weighing and labeling station of line 1 by a small belt conveyor (8).

The typical procedure followed in this firm was to package items for stores outside the city during morning hours, 7:30 a.m. to 11:00 a.m., and for city stores in the afternoon. When packaging corn, this firm placed a corn-trimming machine at the beginning of line 1. Corn for all stores was processed at the end of the morning run and only one set-up was required. When processing corn, employees from line 2 were shifted to line 1 to achieve a balanced operation between trimming, husking, and packaging. This particular firm had an advantage since it could shift employees between bagging operations and tray packaging, thus avoiding expensive unproductive idle time. This mobility helped management balance the various lines.

CENTRAL PACKAGING EQUIPMENT, LAYOUT, AND WORK METHODS

An important phase in shifting produce packaging to the central warehouse is the selection and the arrangement of equipment to achieve maximum efficiency and lowest overall costs. The layout should provide a balanced operation with line feeding and tray filling geared to the capacity of the packaging machine, weighing and labeling, and the pack-out operation. Another important provision in the layout is flexibility. It should be possible to route output to another line in the event of a machine breakdown to avoid complete shutdown.

Line Feeding

Line feeding consists of obtaining produce in pallet-load quantities from the cooler by forklift truck and transporting the produce to the packaging line where a line feeder, typically a male operator, opens master containers and places the produce on the product-feed belt. On all items except grapes and asparagus, one man can supply two packaging lines. One man can also packout for two packaging lines unless the combined line output exceeds 45–50 packages per minute.

The operations observed having two lines used a line feeder for each line. For many items, however, each feeder obviously had considerable unavoidable delays, particularly with items such as beans, which require above average tray-filling time.

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One solution would be to position gravity-feed conveyors at the beginning of each line upon which open master containers could be placed. One line feeder serving two lines could then be assisted by the first tray filler at peak periods. While lifting full containers is not desirable for female operators, dumping a prepositioned container requires relatively little effort.

Tray Filling

The arrangement of the feed table will have an effect on the productivity of tray or box handling. One firm used three types of feed-belt arrangements In one arrangement, the product circulated

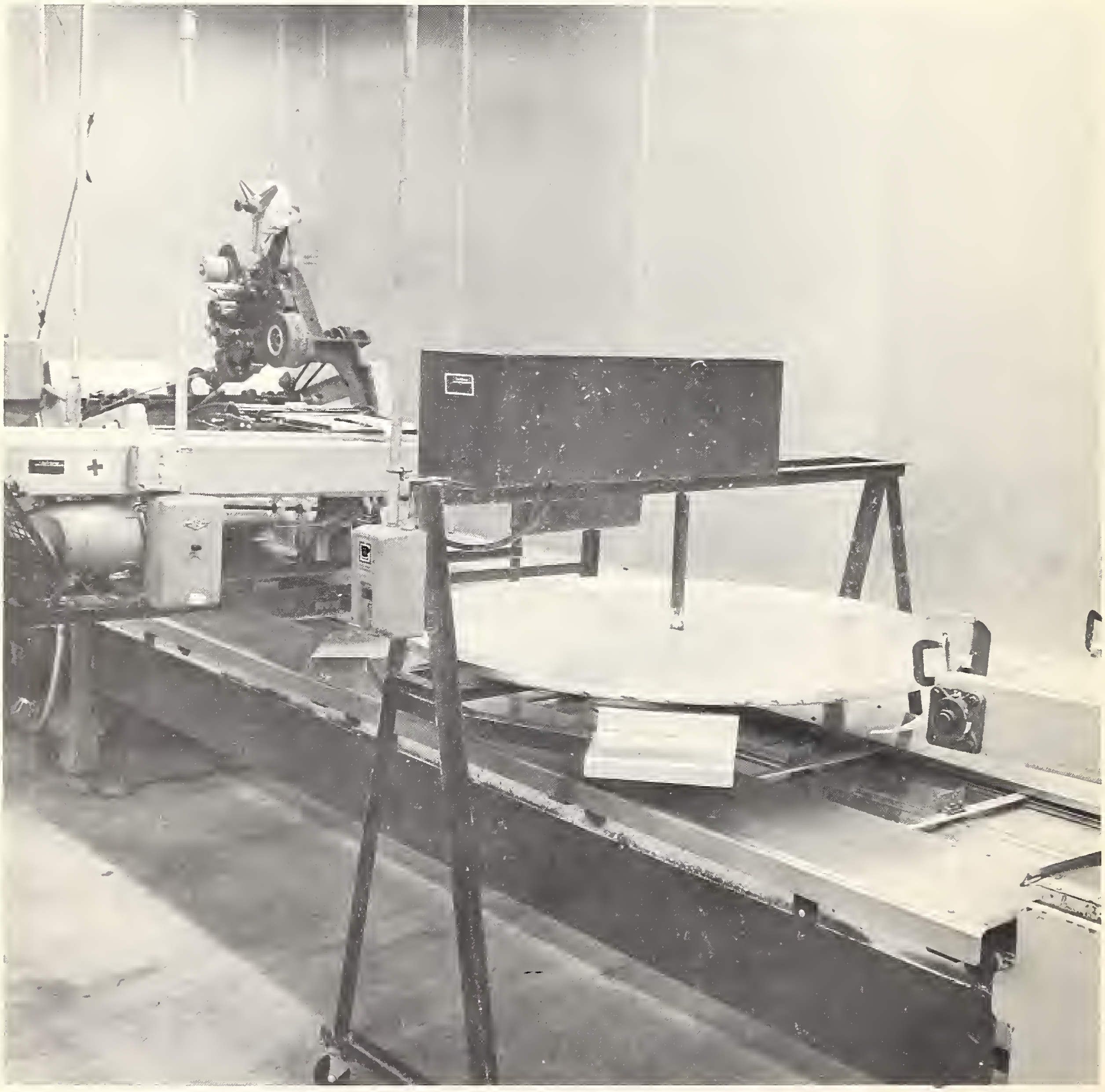

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FIGURE 2.—Lazy-susan type of tray-filling table.

TABLE 1.—*Labor requirements per package for tray handling on 3 types of feed-belt layouts*

Types of feed-belt layout	Box-handling time		
	Obtain and form box	Place filled box in slot	Total
	Minute	*Minute*	*Minute*
Place tray onto cleated conveyor to the side of the turntable	0.037	0.017	0.054
Overhead feed belt	.049	.049	.098
Feed belt level with produce and between operator and produce	.046	.046	.092

on a turntable directly over the cleated conveyor feeding the wrapping machine (fig. 2). The filled tray was moved only 18 inches and the slots were always visible. This arrangement required 0.054 minute to obtain and open box and to place the filled box in the slot (table 1). In the second arrangement, the product-supply belt was directly over the cleated conveyor feeding into the wrapping machine. The operators had to bend to check whether a slot was available and to place the filled box in the slot. In the third arrangement, the feed belt to the machine was between the product and the operator. This improved the box handling time, as compared with the second method, but was, by far, the least efficient method of filling the box or tray because of the long reach to obtain produce.

Filling the trays or boxes requires the most labor. This time can be reduced by providing a work place which locates product, trays, and the package disposal within the optimum reach area of the worker.[4] Ideally, the filling should be done on a shelf or ledge between the product and the operator. This will allow the operator to use two hands, working from product to tray. The feed conveyor to the wrapper can be located above the product or beyond the product on the same level (fig. 3).

The method of placing the product in the tray or box will affect productivity. The time per package to place six apples in a box when an employee obtains three in each hand was 0.15 minute. When he obtained four (two in each hand) and then used one hand to hold the four in place while obtaining the final two, the time was 0.17 minute, a difference in productivity of 14 percent. When traying five pears, the time to obtain three and then two was 0.14 minute, while the time to obtain two, then two more, and a final one was 0.17 minute. The three and two method was 17.6 percent more efficient than two, two, and one.

[4] For optimum work areas, see (*7, p. 10*).

The average time to fill a tray of beans varied from 0.33 to 0.52 minute per package. The beans were straightened and placed carefully in the box, otherwise a stray bean could cause the wrapping machine to malfunction. In studies of produce packaging at the retail store, a device was developed to improve the tray filling of beans (see (*7, p. 12*) for "nest technique"). A row of beans was alined in the bottom of a special nest box. The rest of the beans were randomly placed in the next box. The box to be used as the package was placed on top of the nest box, the two boxes were turned over, and the filled box was wrapped. Only one row of beans was handplaced yet the package was most attractive. This device could be modified and be incorporated in the packaging line for such items as beans, okra, and squash.

An important factor in controlling overall costs is crew size, especially the number of fillers on the line. Too many fillers are on the line whenever filled trays or boxes are being placed on the temporary storage shelf, rather than being placed in the feed slot on the conveyor. This results in double handling. Too few fillers are on the line when there are many empty feed slots or when the automatic labeler is not operating at capacity. Some flexibility must be allowed in the number of fillers from run to run to allow for differences in product quality. A suggested crew arrangement for several items is given in table 2.

TABLE 2.—*Suggested crew distribution for a trayed produce packaging line in a central warehouse* [1]

Item	Crew distribution			Total
	Line feeder	Fillers	Packout	
	Number	*Number*	*Number*	*Number*
6-pack (apples, lemons, oranges, peaches, pears)	½	4	1	5½
Beans	½	11	½	12
Corn	1	3	1	5
Grapes	1	5	½	6½
Lemons	1	4	½	5½
Plums	1	5	½	6½
Squash	½	5	½	6
Tomatoes	½	4	½	5

[1] Weighing and labeling performed by the automatic labeler used in conjunction with the electronic computing scale or packages sold by count and labeled automatically by a labeling unit.

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FIGURE 3.—A tray-filling table with the feed conveyor to the machine located beyond the product on the same level.

The equipment used for feeding the filled trays into the wrapping machine will also affect the productivity of the tray fillers. For instance, the use of an intermittent feed device (indexer) connected to a belt conveyor, rather than a cleated conveyor, will increase productivity. The intermittent feed device will lower labor costs because the operators do not have to check whether the conveyor slot is empty and perhaps wait for another. In one test where lemons were packaged six per box and placed directly in conveyor slots, the time to fill the box and place it in a slot was 0.095 minute. When the boxes were filled and 50 percent placed temporarily on a holding shelf, the time was 0.120 minute. The extra handling required 26 percent more time or 2.5 minutes per hundred packages.

The Wrapping Machine

A principal reason for moving the packaging function to the central warehouse is to lower labor costs through the use of specialized equipment. Available equipment is not fully automatic since the produce must be handplaced in the tray or box. The packaging machines used will take the filled tray and sleeve wrap or completely overwrap it. A machine commonly used for packaging produce is illustrated in figure 4. This machine makes a bottom and end seal on folding boxes and a bottom seal on trays.

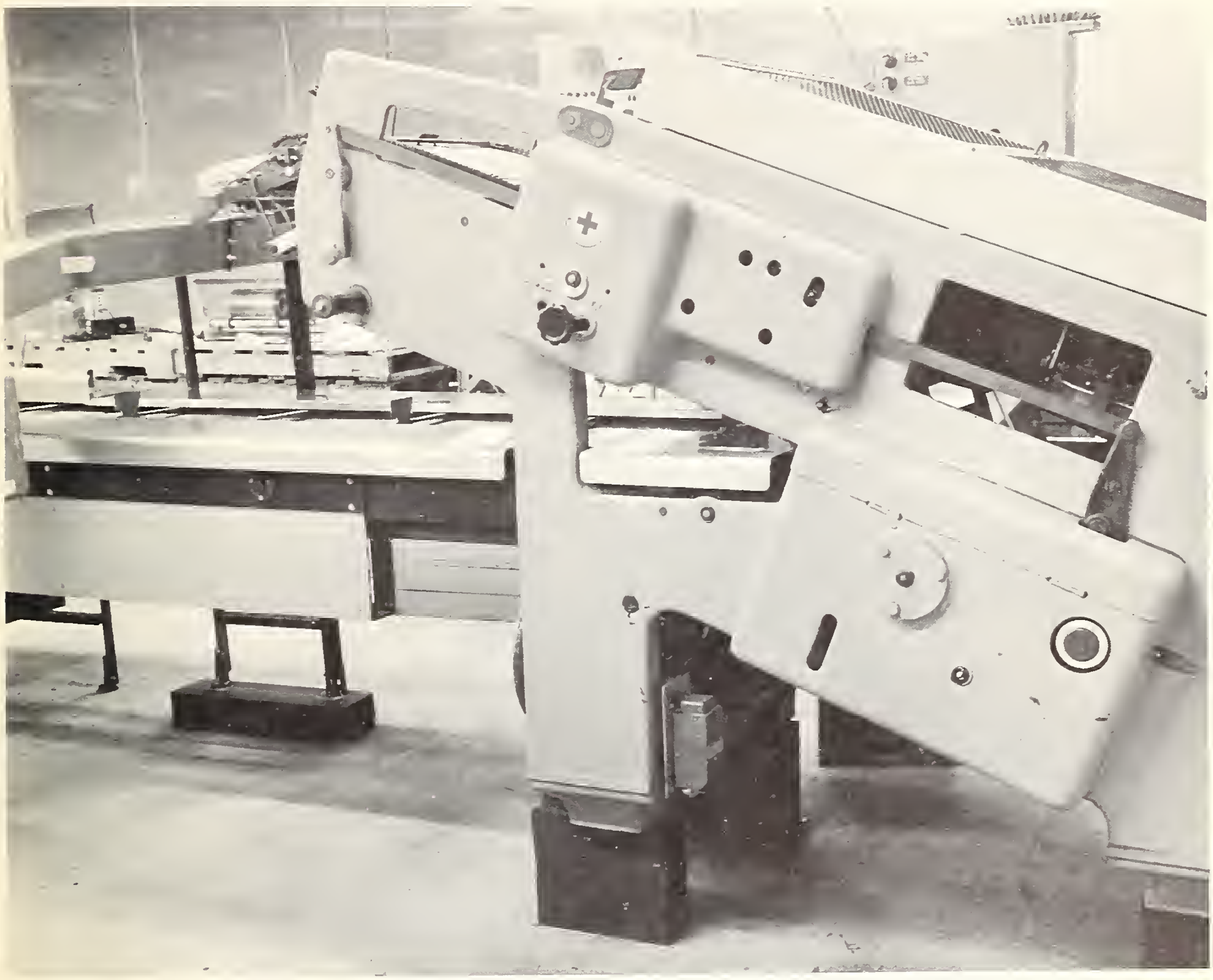

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FIGURE 4.—An automatic packaging machine used for warehouse packaging.

Weighing and Labeling

Packaged produce is priced by catchweight, even weight, or count. When packages are sold on an even-weight or a count basis, a preprinted label identifying the product and giving weight or count and price can be used. On the automatic wrapping machine, the label for count or even-weight items is automatically applied by a labeler unit (fig. 5).

The typical method of pricing studied was catchweight. Packages were weighed on an electronic computing scale that weighed the packages and printed the label. The label was applied to the package either manually or by an automatic labeler. When the labeler was used, the packages were moved from the wrapper onto the scale for weigh-

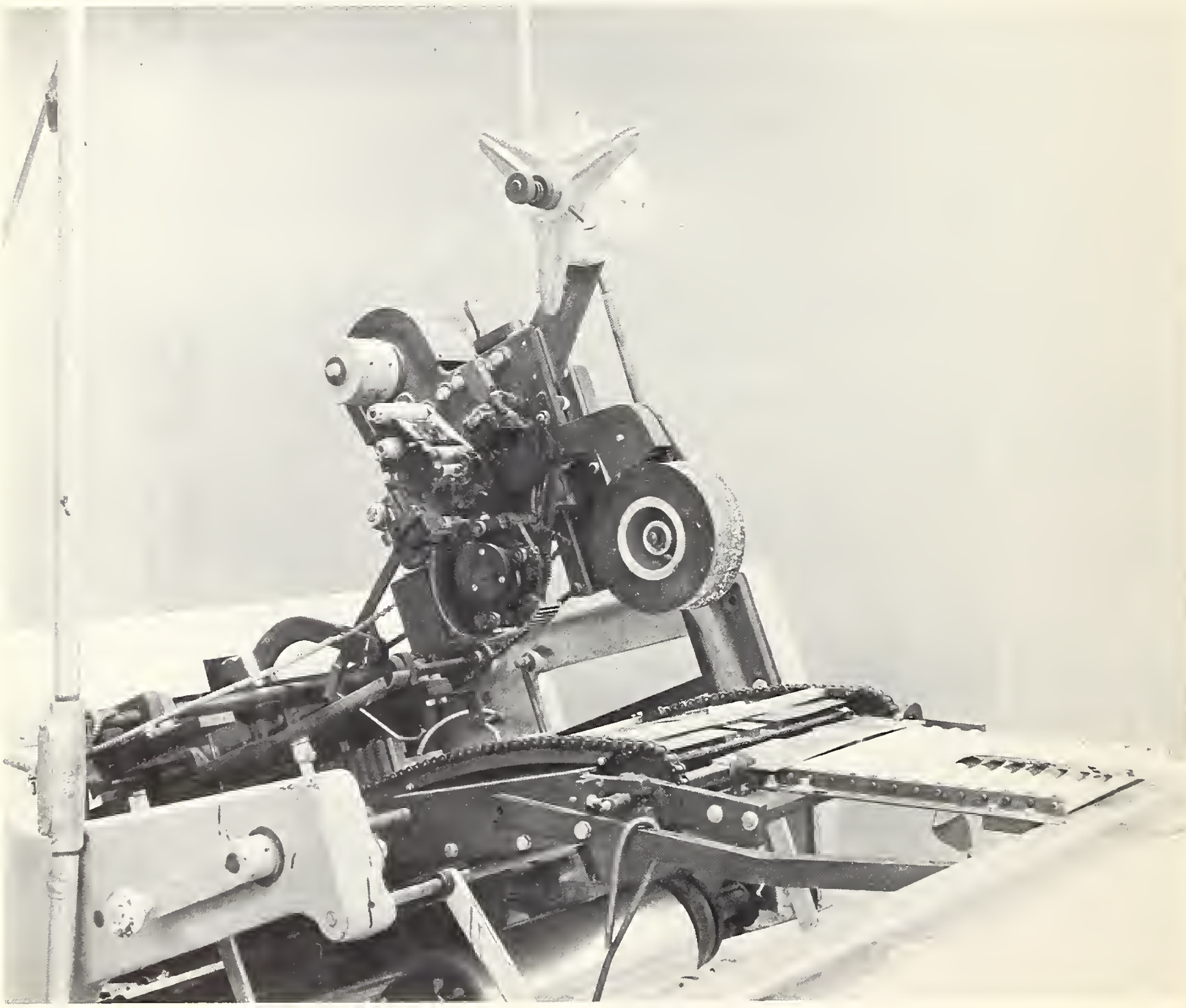

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FIGURE 5.—Labeler unit for items sold on an even-weight or a count basis.

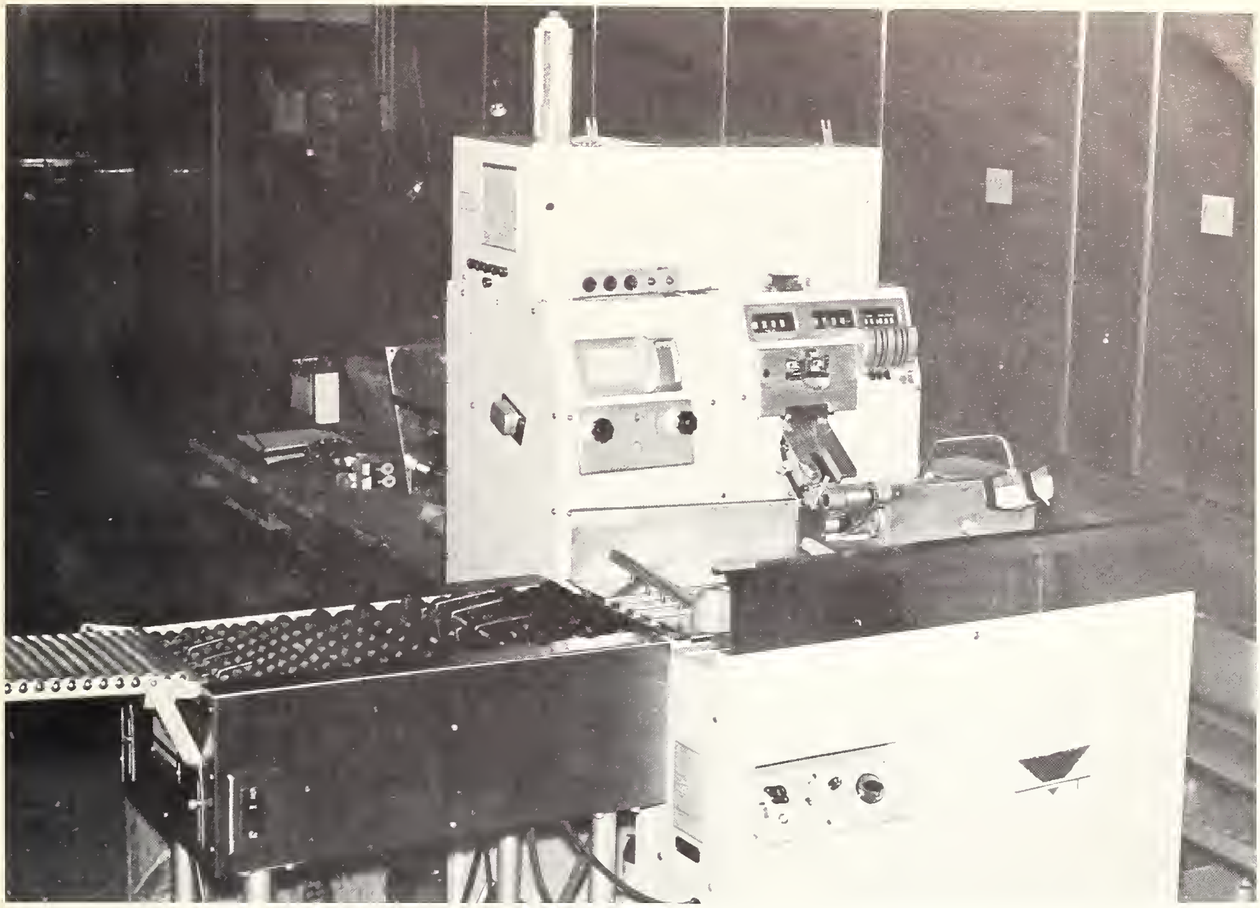

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FIGURE 6.—Automatic scale and labeler for catchweight items.

ing (fig. 6), then to the labeler through a shrink tunnel (fig. 7), and to a turntable for packing into a container for shipping to the store. Some firms conveyed the packages to a cooler and filled shipping containers there.

An indexing device to move the package from the wrapping machine to the scale and automatic labeler is required. The indexer adjusts the flow rate of the packages to the cycle speed of the automatic scale and labeler. The wrapping machine may also be connected to the indexer by conveyor to facilitate automatic weighing and labeling. When an operator uses the electronic computing scale and manually applies the label, the effective rate is 25 packages per minute, excluding the time required to set the tare weight and price per pound in the scale, to change the commodity identification insert, and other miscellaneous weighing functions. The automatic labeler will eliminate the person at the weighing station except for setup time for each product run.

The potential savings through the use of the automatic labeler compared with the semiauto-

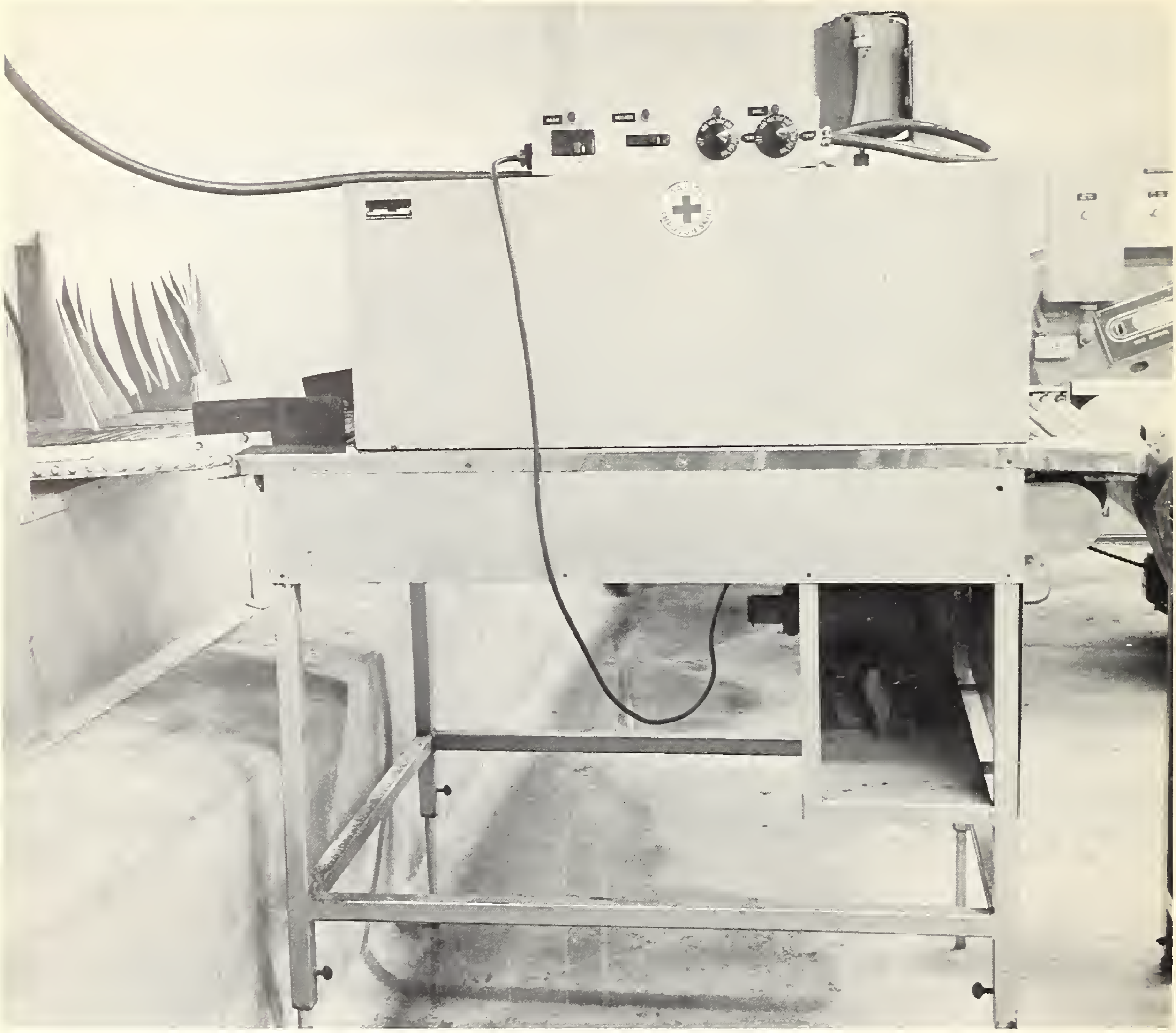

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FIGURE 7.—A shrink tunnel used for shrinking film on wrapped packages at the warehouse.

matic scale and operator (fig. 8) is 0.040 minute per package. At an average rate of $2.50 per hour (female employees), savings would be 0.17 cent per package. If 2½ million packages are automatically weighed and labeled, the potential savings for the automatic labeler (excluding depreciation and interest charges) would be $4,170. At this rate, the semiautomatic labeler would be paid for out of savings in less than one year.

Because of the possibility of malfunction in the weighing and labeling equipment, a provision should be made in the layout to route the packages from the wrapping machine to a supplementary weighing and labeling station rather than to shut down the line. Firms using the fully automatic weighing and labeling equipment typically provide semiautomatic equipment to be used for such emergencies.

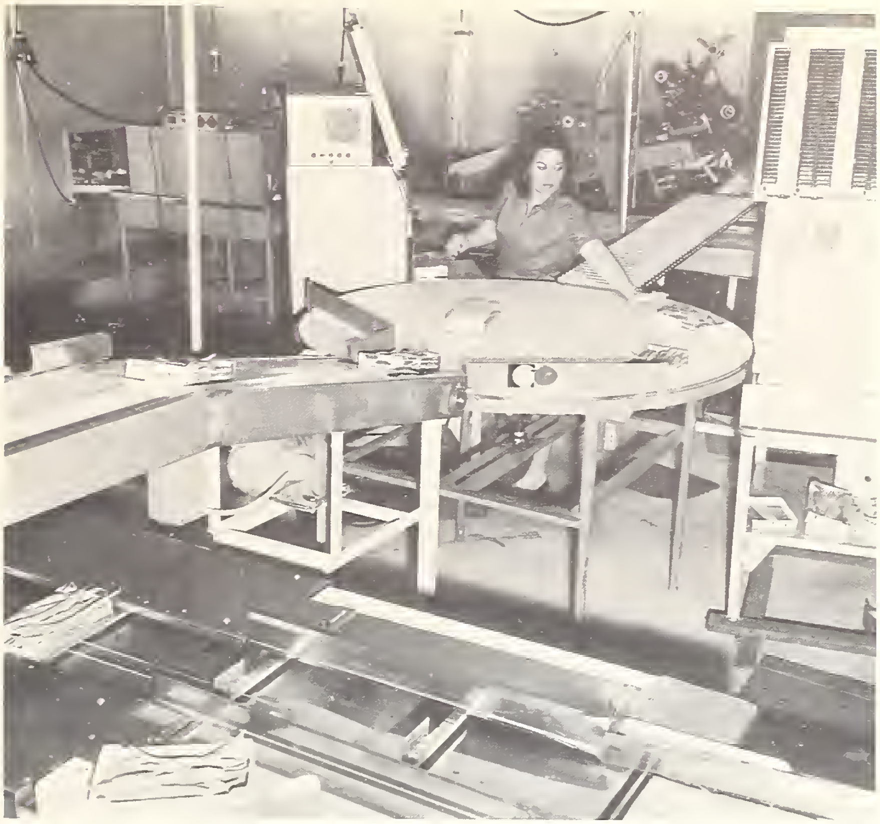

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FIGURE 8.—A semiautomatic scale and operator.

Filling Shipping Containers

Filling shipping containers, called "packout," for a two-line operation generally requires two men who obtain the packaged produce from turntables and pack master containers for store shipment. The task, however, involves more than merely packing containers. Empty containers must be obtained and positioned for use, net weight or count must be recorded and a packing slip placed in the container, leftover partial containers of packages from previous runs must be worked in with like items, and full pallets of containers moved to the store selection area. In a two-line operation, one operator assists the other during delays occurring in line changeovers. The tare-weight scales should be portable to facilitate the use of two operators on one turntable.

If the packaging line layout provides for a U-shape flow so that the finished product is moved to a single turntable in the packaging area, two tareweight scales adjacent to the turntable would allow one man to do most of the packout with a second man assisting. The second man can also assist on the packaging line and do other activities such as cleanup and line dumping.

One problem that arose in one firm studied concerned items that were in partly filled containers left over from previous runs and stored in stacks of wire baskets. For an employee to obtain individual items, he had to move several containers. This problem could be eliminated by installing shelving in the packout area to hold such containers and making items readily accessible.

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Packaging Materials

The packages commonly used for tray-packed produce are trays (paperboard or pulp) with either a film overwrap or sleeve wrap that leaves the ends of the package open and folding boxes that are usually overwrapped. If shrinkable films are used, a shrink tunnel is essential. Generally, a central warehouse packaging operation will have a wrapping machine that can be used with different films and with either trays or folding boxes. The film or tray deemed best for each item may then be used.

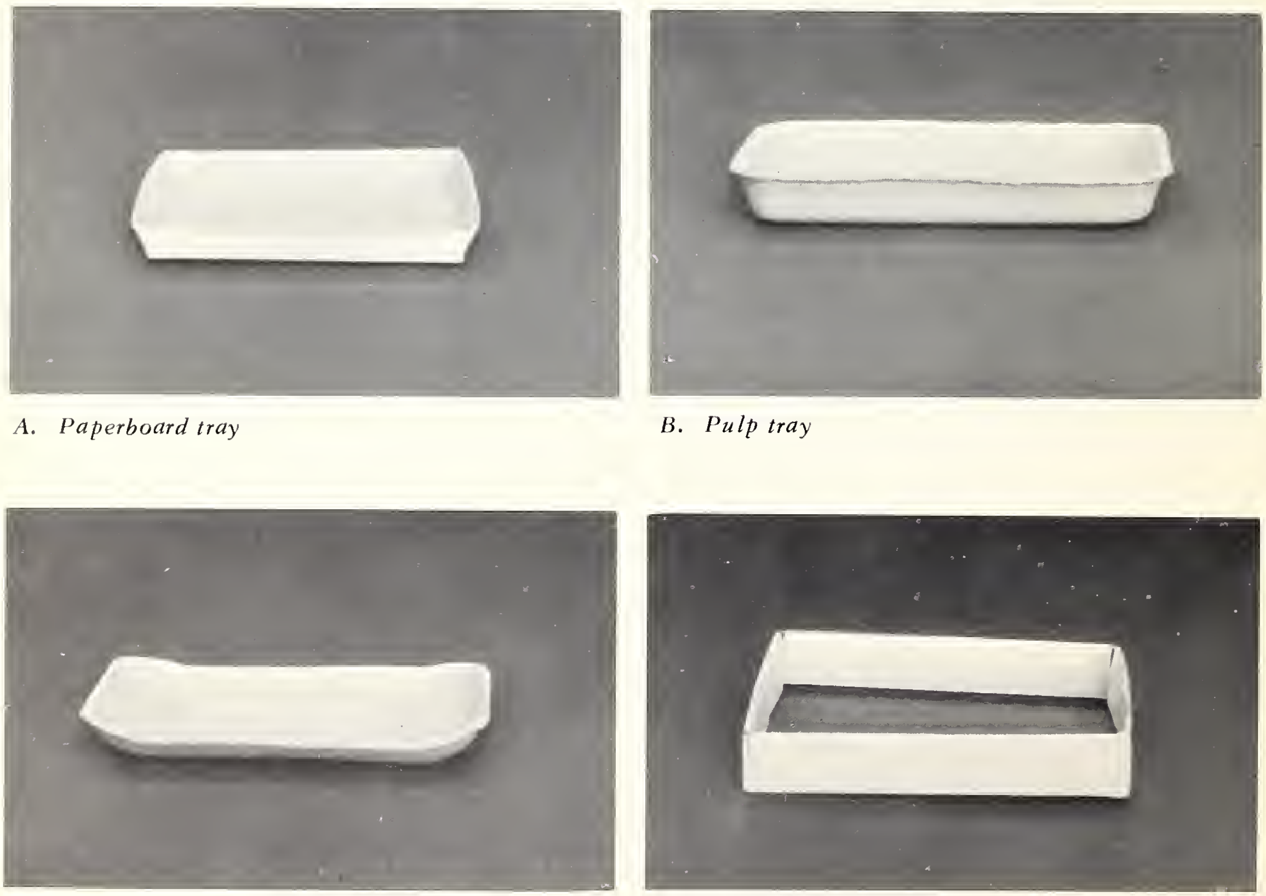
Trays and folding boxes

The pulp tray is fairly rigid with a lip around the top edge that limits bruising. Round fruit packed in these trays will not come in contact with fruit in an adjacent tray either on display or in the warehouse-to-store shipping container. Some pulp trays also have molded indentations to hold the item, preventing it from moving about in the tray. The pulp tray, because of its rigidity, lends itself to sleeve wrapping and is used with shrink-type films.

The paperboard tray uses less film than the pulp tray; it can be printed; and it is flexible enough to adapt to slightly different sizes of fruit.

The square sides on the folding box make the box ideal for use on automatic wrapping machines, but it is more costly than a tray. The folding box can be printed and comes in different colors.

The three types of trays and the folding box are illustrated in figure 9. In one firm, corn (five ears per package) was packaged either in trays or fold-



A. Paperboard tray

B. Pulp tray

C. Pulp tray with molded indentation

D. Folding paperboard box

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Figure 9.—Trays and folding box used in warehouse packaging.

ing boxes. The cost of packaging materials was 0.55 cent per package less for the tray operation, while labor costs for both tray and folding box were identical (table 3).

Films

During the early years of produce packaging, cellophane was the most commonly used film. Acetate was used in some instances, especially where the produce had a high rate of respiration.[5] The items were either completely overwrapped with sheeted cellophane or were enclosed with a band of film (roll stock) slightly wider than the package. Perforated film was used for the overwrapped packages to provide for respiration. Recently, several new plastic films have been used. These films are usually transparent and some shrink when exposed to heat. The types most commonly used are polyethylene, polystyrene, polyvinyl chloride, and polypropylene.

Not one of the new plastic films has emerged as an all purpose film for packaging produce. Polyethylene is widely used for bagged produce items, for shipping-container liners, and as a coating on films to increase their strength and flexibility. Polystyrene, a crisp film of excellent clarity and good shrinkage characteristics, provides permeability for respiration.

Polyvinyl chloride is a soft, clinging film which is available either oriented or unoriented.[6] The unoriented polyvinyl chloride (stretch film), which is manually stretched at the time the package is wrapped, is frequently used to overwrap packages on a wrapping device. This device consists of one or more rolls of film on a metal roller that has an adjustment for tension, a place for wrapping the package, a hot wire to sever any given length of film from the roll, and a hot plate for sealing the film. After the film is cut on the hot wire and the first seal made on the hot plate, the two ends are pulled tight and the last two seals made. This results in an attractive, tight package that does not require heat shrinking. This type of film and package is well suited for store packaging.

The polyvinyl chloride two-way shrinkable film is used to overwrap packages, usually on a wrapping machine. When polyvinyl film is used for overwrapping, it should be perforated to allow for respiration.

[5] Fruits and vegetables are living commodities, and in the respiration process they use up oxygen and give off carbon dioxide and water vapor. It is necessary on many items to use a permeable or perforated film which does not interfere with respiration and also allows for a controlled escape of water vapor from the package (*4*).

[6] Plastic films to be shrunk by heat after the package is wrapped are oriented (stretched) during the manufacturing process. The film can be oriented in one direction (uniaxially) or in more than one direction (biaxially). In practice, uniaxially oriented films are used for sleeve wraps and biaxially oriented films for full overwraps.

TABLE 3.—*Comparative costs of materials for packaging corn in trays or folding boxes*

Item	Costs of materials for—	
	Tray	Box
	Cents	*Cents*
Film	[1] 0.81	[2] 0.71
Tray or box	.73	1.38
Total materials	1.54	2.09

[1] 15×18 inches, 270 square inches at 3 cents per 1,000 square inches.
[2] 14×17 inches, 238 square inches at 3 cents per 1,000 square inches.

The newest member of the "poly" family is polypropylene, a clear, strong film. The sealing temperatures, however, are more critical than for the other poly films. Because of its strength, a lighter gage film can be used, hence a higher yield than regular gage film and a lower cost.

Just as there is no one film that is ideally suited to all types of produce, there is no universal type of package.

A sleeve wrap will provide excellent ventilation; so a film for this type of package will not require breathing qualities. But in some instances, especially in refrigerated display cases with a high air flow, the sleeve wrap permits too much exposure, resulting in some drying out of the produce. Film requirements for sleeve wrapping are clarity, good shrink, and a minimum of corner wrinkling.[7]

Several items, such as beans, brussel sprouts, and grapes, require a complete overwrap to prevent merchandise from falling out of the tray. Other items are overwrapped because the produce is better protected than in a sleeve wrap. The film on these packages is usually perforated.

In warehouse packaging, labor requirements for machine wrapping of sleeve-wrapped and overwrapped packages are the same. Sleeve wrapping uses less film. But, on the other hand, a thicker gage film may be required than for a complete overwrap. The choice of film is very important because of differences in cost of film.

Many of the warehouse packaging operations studied used polyvinyl chloride two-way shrink film and the overwrap method. If these operators

[7] Corner wrinkling occurs when round items such as apples, pears, peaches, plums, oranges, and lemons are packaged with shrinkable film and the package processed in a heat tunnel. It can be due to moisture on the surface of the fruit or the low temperature of the fruit (*3*).

used the sleeve-wrap method with one-way shrink film, cost would be 0.289 cent less per package.

The overwrap method for the typical package required 238 square inches (14×17 inches) of film or a cost of 0.714 cent, at 3 cents per 1,000 square inches for 0.50 mil polyvinyl chloride two-way shrink film. The sleeve-wrap method used 170 square inches (10×17 inches) or a cost of 0.425 cent, at 2.5 cents per 1,000 square inches, for 0.75 mil one-way shrinkable film, a difference of 0.289 cent per package.[8]

Containers for Shipping Packaged Produce To the Retail Store

A limitation on produce packaging at the warehouse has been the availability of a suitable returnable shipping container. Some firms are using the shipping container in which produce is received for repacking. Most produce items, especially round fruit, occupy more space in a shipping container when packaged in a tray than in bulk. Therefore, extra containers are required to handle the packaged output. More importantly, the packages will not fit properly in the shipping container when they are placed upright; so the packages are often packed on their side or end. This causes bruising and affects package appearance—especially for sleeve-wrapped packages.

The selection of a container for shipping packaged produce to the retail store should be based on the container's stacking stability when full; the space the container takes when empty; the container's durability and cost; and the container's ability to deliver produce to the store in good condition (*6, p. 61*).

Dimensions

1. The container should accommodate the largest number of packages of the most commonly used sizes for a variety of items. If one type of container cannot handle all central packaging requirements, then perhaps two sizes of containers can do this.
2. For ease of handling, the container should not be too long or wide. A container over 24 inches long increases strain on the worker when lifting because he must spread his arms wide apart to handle it. When a container is over 20 inches wide, it is harder to handle because the center of gravity moves farther away from the body, placing the strain on the back.
3. The container should not weigh more than 40 pounds when full if women are to handle it or more than 70 pounds for men.
4. The container should not be so deep that the produce may be bruised.
5. The container should not be so small that the cost of the extra handling and the inventory will be prohibitive.

The dimensions of a container for tray-packaged produce are determined by the size of the packages. If the produce is packaged in trays, the most commonly used sizes are the No. 2 (8×5½ inches), No. 1½ (8×3½ inches) and No. 1 (5×5 inches or 5½×5½ inches). These three sizes have a common dimension of either 5½ or 8 inches and will fit equally well in a container that is 17 inches wide (fig. 10).

The length of the container depends on the desired capacity and the size of tray. Four No. 2 trays would require a length of 22 inches plus a tolerance for oversize fruit and ease of packing. The container will hold eight No. 2 trays per layer. This would also accommodate three rows of four No. 1 trays or 12 trays per layer. The smaller size No. 1 (5×5) would only require 21 inches for 12 trays per layer. A 23-inch-long container would readily accommodate two rows of six No. 1½ trays or 12 trays per layer. The container would have to be 29 inches long to accommodate an additional row of trays. The capacity of two containers of different lengths is given in table 4. Each container would be 17 inches wide at the inside base dimension.

The capacity of a 29-inch-long container increases 25 percent for the most commonly used trays (No. 1 and No. 2), resulting in fewer trips and handlings.

[8] The use of a sleeve-wrap with *one-way shrinkable* polyvinyl chloride may require some modification of the wrapping machine.

TABLE 4.—*Comparison of package capacity for a 17- by 23-inch and a 17- by 29-inch container for selected sizes of packages when packages are double stacked*

Size of tray	Packages for— 17- by 23-inch container	Packages for— 17- by 29-inch container
	Number	*Number*
No. 1	24	30
No. 1½	24	28
No. 2	16	20

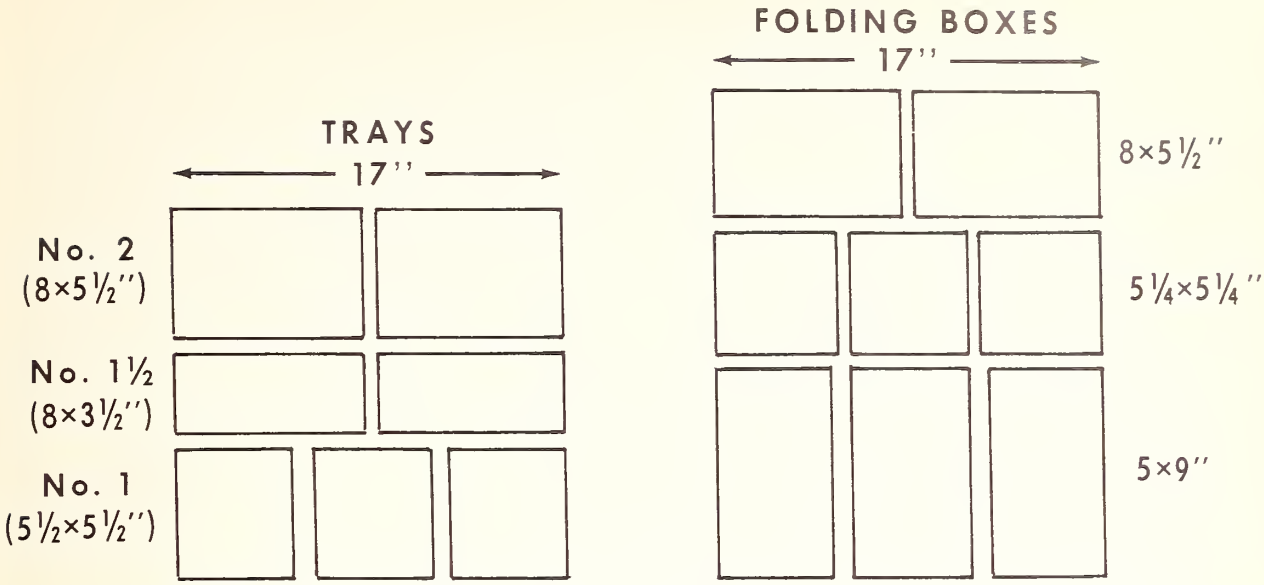

FIGURE 10.—Dimensions for trays and folding boxes to determine design of returnable container for packaged produce.

Standardizing sizes of tray with at least one common dimension simplifies the problem of determining size of the container. If, for special considerations, the produce merchandiser in a firm introduces a package with odd dimensions, a special container may be required for these packages. Or a standard container might be used and some packages placed on end. This method of packaging is not recommended as it may cause bruising or affect package appearance. For instance, a size 14 tray with dimension of 6×6 inches would not lend itself to the 17- by 23-inch or the 17- by 29-inch container.

The size of a folding box is comparable to the tray because they are both designed to fit a given quantity of produce such as six apples, three ears of corn, or four tomatoes. The smaller container will hold 16 packages of either the No. 2 tray or the 8- × 5½-inch box, 24 packages of No. 1 or 1½ trays, or 24 5¼- × 5¼-inch boxes. The larger container will hold 20 packages of No. 1 trays, or 28 No. 1½ trays or 5¼- × 5¼-inch boxes. The smaller container will hold 12 9- × 5-inch folding boxes with much wasted space while the larger container accommodates 18 boxes with better space utilization.

One large firm that packs at the central warehouse uses three sizes of wire containers to adjust to different items and sizes of orders. The container is galvanized, has a bail which permits double stacking, and is tapered to allow for nesting. Dimensions of small and large containers follow:

	Small (inches)	Large (inches)
Outside top	22⅞ x 19	26⅞ x 24¾
Inside bottom	21⅞ x 17¹⁵⁄₁₆	25 x 22¼
Clear depth	2⅞	7¾

A medium-size container also used has the same dimensions as the small container, but it is approximately 1 inch deeper. The packaged produce is packed on a count or weight basis. The approximate capacity of the containers is given in table 5.

A new container, developed for tray-packaged produce, incorporates most of the principles of

TABLE 5.—*Capacity of small, medium, and large containers for trayed produce items used in one firm*

Item	Size of container	Packages per container [1]
		Number
6-packs	Large	18–24
Beans	Large	28–32
Corn (3)	Medium	24
Corn (5)	Large	24
Grapes	Medium	24
Lemons	Small	12–14
Lemons	Large	40
Squash	Large	28–32
Tomatoes	Small	12–14
Tomatoes	Large	18–24

[1] The number of packages per container varies because different sizes of folding boxes are used for the item. For example, 6 small apples will require a smaller tray or box than 6 large apples.

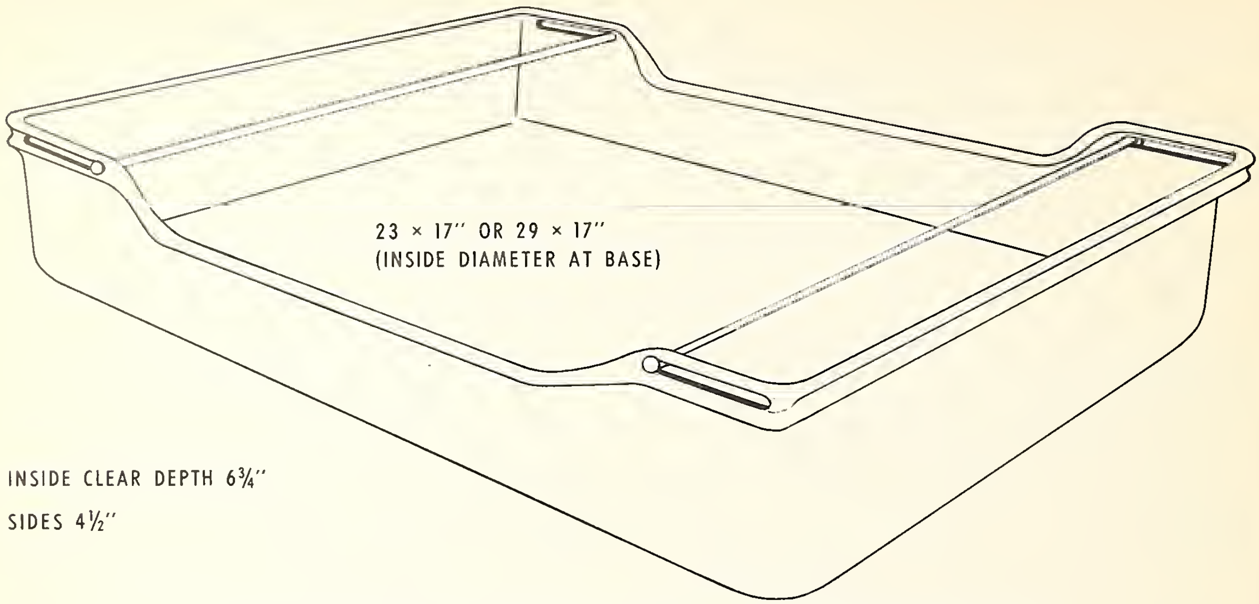

FIGURE 11.—Reusable warehouse-to-store container for tray-packaged produce.

good design and has many good handling features. It is a polyethylene container, 29×17 inches at the inside base and 6¾ inches of clear stacking depth. Sliding bails are incorporated in the curved molding at each corner. They are moved toward the center of the container for stacking and are recessed in the end molding for nesting. The containers are partly open at the sides and can be perforated to provide ventilation when they are used to display the product in a refrigerated display case. The empty weight is approximately 5 pounds and the cost (depending on quantity purchased) is approximately $5. The recommended dimensions for the container are given in figure 11.

Configuration

1. The container should have nesting ability when empty and should not wedge so that it is difficult to obtain single containers.
2. The container, when full, should stack without any danger of slipping or falling into the lower container.
3. The container should have flush interior lines without bulky interior bracing to achieve maximum space utilization.
4. The container should not have any recesses that would trap dirt.
5. The container should be designed to incorporate features that will give secondary usage such as a display container.
6. The container should provide for coding (if necessary) and identification of contents.
7. The container should be compatible with other containers so that they can nest or stack together.

Material

1. The container should be lightweight, to maximize the ratio of product to total weight.
2. The container should be able to withstand temperature extremes without cracking or sagging.
3. The container should have a long life, withstand handling abuses, and have a uniform weight for tare purposes.
4. The container should have the approval of the Food and Drug Administration for food handling.
5. The container should be strong enough to support a stack which utilizes the full interior height of the delivery vehicle, generally 84 inches.

Materials handling system

1. The container must be an integral part of the firm's delivery system.
2. The container should fit on the warehouse pallet without any loss of space.
3. The container should contribute to overall savings from warehouse packaging to display in the store and savings at one level should not be more than offset by higher costs at another.

Displaying Produce in the Shipping Containers

A method of displaying produce on large pans or flat containers, called "tray display" (*2*), has been developed to avoid handling of individual packages and to encourage product rotation.

Under certain conditions, shipping containers for centrally packaged fruits and vegetables can be used for tray display by placing the whole container in the display case. These conditions are that the containers be of proper size and construction, that the containers retain reasonably good appearance, and that the packages in the container be properly arranged. The 17- by 29-inch containers can be used lengthwise in the case or two containers can be placed, one in front and one in the back, in the "checkerboard" fashion. A lengthwise display is illustrated in figure 12.

The old containers are removed from the displays, new containers placed on display, and the merchandise in the old containers checked and returned to the top of the display to help insure rotation.

The use of trays for display is recommended where a reasonably large amount of display space for produce is available. Tray display can also be used for featured items. Use of this method would result in a saving at the retail store of 1.19 minutes per full container of packages or 0.06 minute per package or 0.30 cent per package (table 6). A firm with an annual volume of 5 million trayed-produce packages per year has a potential saving of $15,000 from the use of this method.

TABLE 6.—*Labor requirements to display packaged tray produce in the returnable warehouse-to-store container and when individual packages are displayed by hand* [1]

Item	Display individual packages by hand	Display packages in container
Time per master container:	*Minutes*	*Minutes*
Place packages on display	1.25	0.52
Rotate, rearrange, police	.66	.44
Other display handling	.21	.24
Takedown	.41	.19
Redisplay	.23	.18
Total time per container	2.76	1.57
Time per package [2]	.138	.078
	Cent	*Cent*
Cost per package [3]	.69	.39

[1] For additional details, see Anderson and others (*2*).
[2] At 20 packages per container.
[3] At $3 per hour.

A. *Containers stack when full and nest when empty*

B. *Lengthwise display in refrigerated counter*

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FIGURE 12.—Displaying package produce in warehouse-to-store returnable containers.

COSTS OF PACKAGING AT THE STORE AND CENTRAL WAREHOUSE

This cost analysis of retail and warehouse packaging is developed to help answer the question of where and how to package. Costs of warehouse packaging are developed for overwrapping with polyvinyl chloride two-way shrinkable film on all items. Trays were used for all items except beans, grapes, and tomatoes, which were placed in folding boxes suited for these items when packaged by machine. This study does not evaluate the many different materials available for produce packaging but only those in widest use both at the store and central warehouse.

Costs of packaging at the store are based on using three methods and three packaging films. The first method studied was overwrapping with cellophane; the second, overwrapping with polyvinyl chloride stretch film; and the third, sleeve wrapping in polyvinyl chloride one-way shrinkable film. Trays were used in all three methods.

Costs of materials and equipment are based on manufacturers' stated prices at the time the study was conducted. No discounts for volume or other reasons are considered. Labor costs are based on the wage rates stated. Summary data on costs and detailed costs in the appendix are presented in such a way that individual firms may develop their own costs by substituting their wage rates and current materials costs.

Costs of Packaging at the Central Warehouse

Costs of packaging at the central warehouse include materials, packaging labor (both direct and indirect), equipment, containers, and warehouse rent, utilities, and insurance (sometimes called warehouse burden).

Materials costs

The costs of materials for warehouse packaging are based on using trays for all items except beans, grapes, and tomatoes. A folding box was used for packaging grapes and beans since these items have a tendency to overhang the tray which creates problems in the wrapping machine and for packaging tomatoes to increase protection from bruising. Average cost of this combination of trays and folding boxes was 1.07 cents per package. Polyvinyl chloride two-way shrinkable film was used on all items. Average cost of film for warehouse packaging was 0.61 cent per package. Total costs of materials ranged from 2.46 cents per package for beans to 1.23 cents for plums. Average cost for materials was 1.76 cents per package (table 7).

TABLE 7.—*Costs of materials for overwrapping selected trayed produce items in polyvinyl chloride 2-way shrinkable film at the central warehouse* [1]

Item	Percentage of movement	Tray or box			Film		Label [3]	Total material
		Size	No.	Cost	Size [2]	Cost		
	Percent	*Inches*		*Cents*	*Inches*	*Cent*	*Cent*	*Cents*
Apples, oranges, peaches, pears, 6-pack.[4]	44	8 x 5½ x 1	2	0.79	15 x 16	0.72	0.08	1.59
Beans	15	8 x 5½ x 1¼		1.84	12 x 15	.54	.08	2.46
Corn, 3 ears	5	8 x 5½ x 1	2	.79	14 x 16	.67	.08	1.54
Grapes	13	7¼ x 4¼ x 1½		1.43	12 x 13	.47	.08	1.98
Lemons, 5-pack	9	5½ x 4½ x 1	14	.69	12 x 14	.50	.08	1.27
Plums, 8-pack	3	8 x 3½ x 1	1½	.65	12 x 15	.50	.08	1.23
Squash	4	8 x 5½ x 1	2	.79	15 x 15	.68	.08	1.55
Tomatoes, 4-pack	7	5¼ x 5¼ x 1¼		1.56	10 x 15	.45	.08	2.09
Total or weighted average	100			1.07		.61		1.76

[1] Polyvinyl chloride shrinkable film 0.50 mil biaxially oriented at 3 cents per 1,000 square inches.

[2] Film yields are based on a 1½-inch overlap on package width. A bottom seal is used on the package ends except for beans, grapes, and tomatoes which are packed in the folding box and the ends sealed.

[3] Outside printed label at $1.91 per roll of 2,340 labels. Preprinted labels used on top labeler for even-weight packages are 75 cents per thousand.

[4] 6-pack is the most typical package. To provide a variety of package sizes, some firms package 4- and 8-pack units.

Direct labor

Direct labor costs include the costs of line dumping, tray filling, and packout. Weighing, labeling, and wrapping were performed automatically, and machine adjustments were made by members of the direct labor crew. Production output was adjusted to reflect delay—time lost for cleanup, changeover, equipment breakdowns, and other delays. The production speed of 26 packages per minute was adjusted to 23 packages per minute to reflect these delays.

At 23 packages per minute, daily output from the crew arrangement shown in table 8 would be about 11,000 packages per 8-hour day or 2,750,000 packages per year with the product mix used in this report. A single packaging line could, therefore, handle this volume if peak production were maintained. However, to allow for seasonality of some items, the effective output of one line should be figured at 2.5 million packages per year.

The average crew size was 7½ workers, 2 full-time males and 5 females plus a male line loader intermittently. Crew size ranged from a high of 13.5 workers for beans to a low of 5 for corn. If the central warehouse also has a bagging line, personnel can be shifted to assist on tray filling for slow items such as beans. A smaller crew may be used, but this would decrease line speed.

Since this analysis of warehouse tray packaging is based on an annual output of 3 million packages, a second line would be required. The second line would be manned only part of the time and part-time personnel would be used or personnel shifted from the bagging line to achieve the desired output.

Cost for corn included trimming at a separate work station. While some firms in centralized packaging used a corn-trimming machine, the author believes that the use of such a machine would not be justified at this volume level. The same labor time for trimming corn was used for both the warehouse and store labor analysis.

Direct labor for the packaging line averaged 0.382 minute per package and costs per package 1.83 cents (table 8).

Indirect labor

There are other members of the packaging crew who devote a part of their time to the packaging of tray-type items. The forklift operator devotes approximately one-half of his time to line-filling; a mechanic spends an estimated hour daily on repair and preventive maintenance; and the foreman devotes all his time to supervision.

Average costs for indirect labor are as follows:

Forklift operators, 18 hours per week at $3.49 per hour	$63
Mechanic, 6 hours per week at $3.94 per hour	24
Foreman, 40 hours per week at $4.30 per hour	172
Cost per week	259
Cost per year	13,468
Cost per package ... cent	0.45

TABLE 8.—*Direct labor costs per package for the packaging of selected trayed produce items at the central warehouse*

Item	Production rate: Percentage of movement	Production rate: Packages per minute: Actual	Production rate: Packages per minute: Adjusted [1]	Crew size: Male	Crew size: Female	Line time per package	Labor per package	Allowance for personal and fatigue (10 percent)	Total labor per package	Average wage rate per minute [2]	Total direct labor cost per package
	Percent	*Number*	*Number*	*Number*	*Number*	*Minute*	*Man-minute*	*Man-minute*	*Man-minute*	*Cents*	*Cents*
Apples, oranges, pears, and peaches, 6-pack	44	30	26	2.0	4.0	0.038	0.228	0.023	0.251	4.7	1.18
Beans	15	20	18	1.5	12.0	.056	.784	.078	.862	4.4	3.79
Corn	5	30	26	2.0	3.0	.038	.190	.019	.209	4.8	[3] 2.74
Grapes	13	20	18	2.0	6.0	.056	.448	.045	.493	4.6	2.27
Lemons	9	30	26	1.5	4.0	.038	.201	.021	.222	4.6	1.02
Plums	3	30	26	2.0	5.0	.038	.266	.027	.293	4.6	1.35
Squash	4	20	18	1.5	6.0	.056	.420	.042	.462	4.5	2.08
Tomatoes	7	25	22	2.0	4.0	.045	.270	.027	.297	4.7	1.40
Total or weighted average	100	26	23	1.9	5.5	.044	.347	.035	.382	4.6	1.83

[1] After allowances for cleanup, changeover, and equipment breakdowns, the effective workday is approximately 7 hours.
[2] Based on an average hourly wage (including 15 percent fringe benefits) of $3.50 for male and $2.50 for females.
[3] Includes 0.30 minute per package at 5.8 cents per minute for corn trimming.

Equipment costs

The costs of equipment are based on a double-line installation with automatic packaging machines, automatic weighing and labeling, feed tables, and a shrink tunnel. Costs include accessories such as the turntable, conveyors, a forklift truck at one-third usage, freight, installation, miscellaneous costs, depreciation, interest, and scale maintenance. Total annual costs were $10,433 and the average cost per package at an annual output of 3 million packages was 0.35 cent per package (table 9). A suggested arrangement for this equipment is presented in figure 13.

Container costs

The cost of containers in this report consists of depreciated cost of the containers, interest on invested capital, loss of space in delivery vehicles, cost of warehouse storage space, and the labor cost to return the empty containers to the packaging line.

A tray-packaging operation for produce in a central warehouse with an estimated annual volume of 3 million packages would require a minimum of 1,923 containers. These containers would make an average of 1½ round trips per week from the warehouse to the store and back. An allowance of 20 percent for peak volume periods would increase the requirements to 2,308 containers.[9] With an estimated cost of $5 per container depreciated over a 5-year period, the cost per year would be $2,308 and per package, 0.077 cent.

The interest on the capital investment of $11,540 is calculated at a rate of 6 percent for one-half the life of the equipment and prorated for the 5 years. This gives a cost per package of 0.011 cent.

When nest-and-stack containers are shipped to the store there is a theoretical loss of space in the delivery vehicles which is especially critical when shipping to out-of-town stores. In one test, receiving units per cubic foot were compared with shipping units per cubic foot to determine utilization. Receiving units per cubic foot is the density of nonpackaged produce in conventional shipping (grower-to-warehouse) containers. Shipping units per cubic foot is the density of packaged produce in warehouse-to-store containers. In one test, the loss of space was equal to 9.3 percent of trailer capacity. This is equivalent to 13,950 containers per year at 5.1 cents per container trip and adds a cost of 0.025 cent per package.

Another cost assigned to warehouse produce packaging is the warehouse space required to store temporarily the reserve inventory and the empty containers. Approximately one-third of the containers (769) will be stored temporarily in the warehouse on 10 pallets racked three high and occupying 56 square feet of space at a cost of $2.25

[9] 3 million packages ÷ 52 weeks ÷ 20 packages per container ÷ 1.5 trips per week × 120 percent = 2,308 containers.

TABLE 9.—*Annual cost of equipment for a 2-line installation for the central warehouse packaging of trayed produce items* [1]

Item	Initial cost
EQUIPMENT	
Line I:	*Dollars*
Automatic packager	7, 125
Top mechanical tamper	425
Plastic film sealing unit	1, 250
Infeed extension, with 20-foot table and conveyor	5, 108
Top labeler unit	1, 975
Side discharge conveyor	525
Electronic computing scale	4, 990
Automatic labeler	2, 550
Commodity inserts and rack [2]	159
Total line I	23, 907
Line II:	
Same as line I except for top labeler	21, 932
OTHER EQUIPMENT	
Turntable, 6 foot diameter	400
Discharge belt 12 in. by 10 ft	325
Shrink tunnel	800
Takeaway belt 18 in. by 10 ft	425
Packout, tare-weight scales, 2 at $860	1, 720
Reserve electronic scale	4, 990
Corn-trimming device and work station	400
Freight	750
Installation	2, 000
Wheel-type conveyor 88 ft	760
Forklift truck [3]	2, 000
Miscellaneous	1, 000
Total initial cost	61, 409
OTHER COSTS	
Depreciation [4]	7, 676
Scale maintenance, 3 at $305	915
Interest [5]	1, 842
Total annual cost	10, 433
	Cent
Cost per package [6]	. 35

[1] All equipment at list price.
[2] Rack cost $50 plus 80 inserts at 90 cents and 20 special inserts at $1.85.
[3] A forklift truck cost $6,000 but is only required for about 20 hours per week.
[4] All equipment is depreciated to zero in 8 years.
[5] Total initial investment is $61,409. Interest on invested capital is at a rate of 6 percent and is calculated for one-half the life of the equipment and prorated over 8 years.
[6] Based on 3 million packages per year.

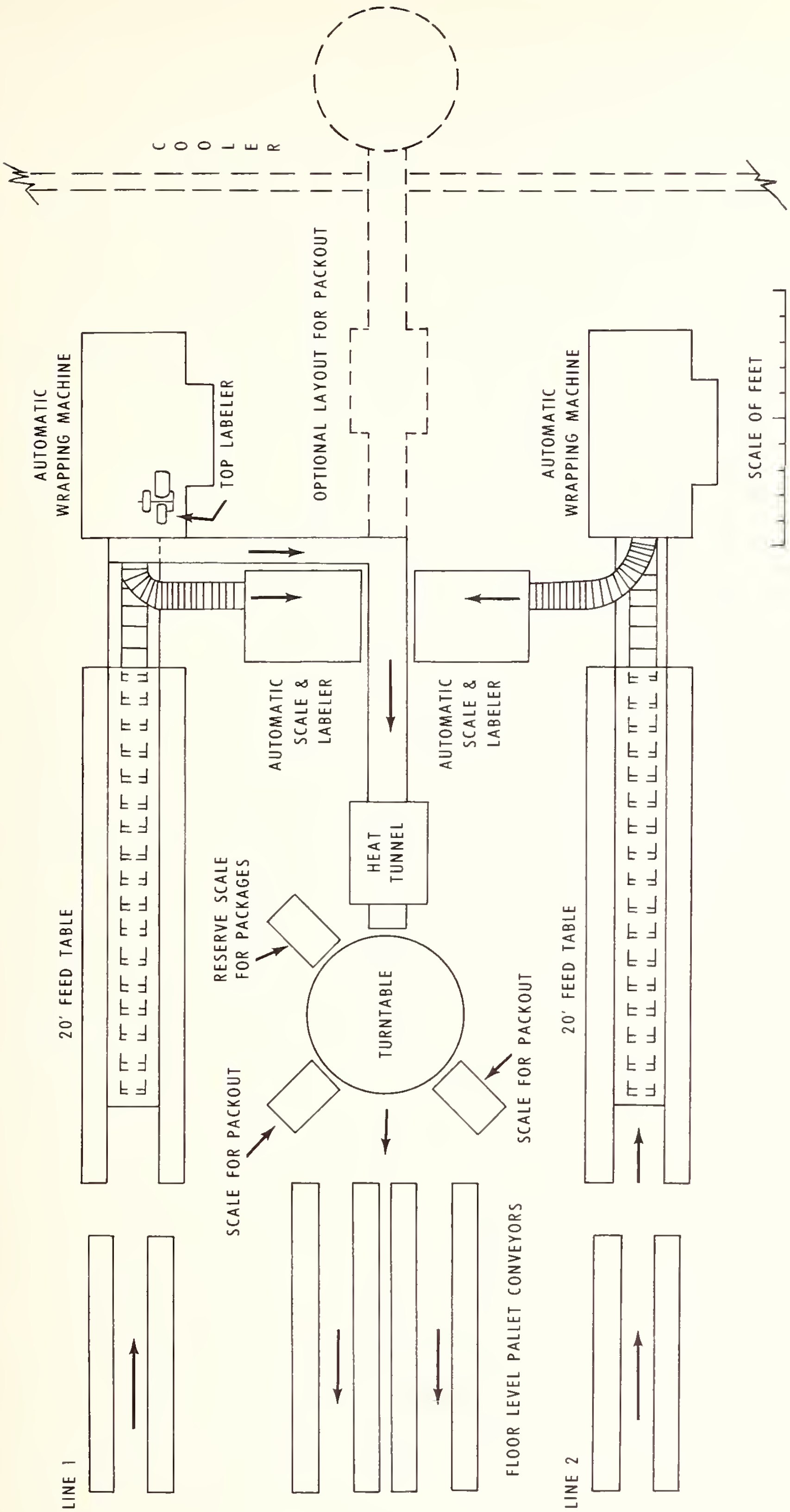

FIGURE 13.—A double-line layout for warehouse tray packaging.

per square foot. (See section on warehouse costs, below.) This cost per package is 0.004 cent.

After display of packaged produce, the containers must be returned to the warehouse. The labor required to handle the empty containers from the store to the truck and from the truck to the warehouse is 0.147 man-minute per container. The cost for this labor amounts to 0.04 cent per package (table 10).

Based on these considerations, the total cost of warehouse-to-store containers is 0.157 cent per package.

Item	*Cost per package*
	Cent
Container	0.077
Interest	.011
Loss of trailer space	.025
Warehouse storage space	.004
Labor to handle	.040
Total cost per package	.157

Warehouse costs

The typical warehouse charge for rent, utilities, and insurance was $2.25 per square foot. An area of 3,150 square feet for processing and storage is adequate for two packaging lines with a capacity of 5 million packages per year. At an average annual output of 3 million packages, warehouse charges are 0.24 cent per package (3,150×2.25÷3,000,000). This charge represents only the cost of the additional space for produce packaging, since the produce must be handled through the produce warehouse whether it is packaged or not and the cost of space for stacking the empty containers has already been considered.

Total cost of warehouse packaging

To determine total costs for warehouse packaging, labor (both direct and indirect), materials, equipment, burden, and container costs were applied to each item packaged. The equipment and burden were charged to each item on the basis of the packaging line time per package. For example, an item with a line time of 0.05 minute per package would be charged half as much equipment and burden charges as an item with a line time of 0.10 minute per package.

TABLE 10.—*Cost of returning empty produce containers to the warehouse*

Labor element	Per container
	Man-minute
Move containers to dock	0.018
Load in trailer	.046
Unload at warehouse	.070
Transport to prepack line	.013
Total time per container trip	.147
	Cent
Labor cost at an average wage rate of $3.28 per hour [1]	0.81
Cost per package	.04

[1] Composite of retail labor at $3 per hour and warehouse labor at $3.50 per hour.

The item incurring the most costs when packaged at the warehouse was beans because of the extensive time required for tray filling, increased materials cost due to the use of the folding box, and above average equipment and burden changes. The total cost for beans was 7.62 cents per package. The lowest cost item was lemons (3.41 cents), which had the lowest labor cost of any item and below average materials cost.

The average cost per package of all items packaged at the warehouse was 4.80 cents (table 11). Since equipment costs are based on 3 million packages per year and the facility capable of producing about 5 million packages (depending on the items packaged), there would be a potential reduction in equipment costs of 0.14 cent per package, a reduction of 40 percent, if maximum output were achieved. At this rate, total costs would average 4.66 cents per package.

Costs of Packaging at the Retail Store

Costs at the store level include materials, labor, equipment, and space. These costs are based on packaging 1,000 trayed items weekly in stores with an average weekly produce volume of $3,000.

Materials costs

Regardless of whether trayed items are overwrapped or sleeve wrapped, the same size of tray is used. Firms using the sleeve-wrap technique typically use the pulp tray. This type of tray is better suited for sleeve wrapping than the paperboard tray because it is more rigid. Costs of the two types are identical, ranging from 0.65 cent for the No. 1½ to 0.79 cent for the No. 2. The average cost, 0.75 cent, was determined by weighting costs of various sizes of trays by the frequency of use.

TABLE 11.—*Total costs per package for packaging selected trayed produce items at the central warehouse*

Item	Percentage of movement	Line time per package [1]	Materials [2]	Labor: Direct [3]	Labor: Indirect [4]	Equipment [5]	Containers [6]	Warehouse charges [7]	Total cost
	Percent	*Minute*	*Cents*	*Cents*	*Cent*	*Cent*	*Cent*	*Cent*	*Cents*
Apples, oranges, peaches, and pears, 6-pack	44	0.038	1.59	1.18	0.45	0.30	0.16	0.21	3.89
Beans	15	.056	2.46	3.79	.45	.45	.16	.31	7.62
Corn, 3 ears	5	.038	1.54	2.74	.45	.30	.16	.21	5.40
Grapes	13	.056	1.98	2.27	.45	.45	.16	.31	5.62
Lemons, 5-pack	9	.038	1.27	1.02	.45	.30	.16	.21	3.41
Plums, 8-pack	3	.038	1.23	1.35	.45	.30	.16	.21	3.70
Squash	4	.056	1.55	2.08	.45	.45	.16	.31	5.00
Tomatoes, 4-pack	7	.045	2.09	1.40	.45	.36	.16	.25	4.71
Total or weighted average	100	.044	1.76	1.83	.45	.35	.16	.24	4.80

[1] Line time per package is used as a basis for prorating equipment and warehouse charges. Using the formula:

$$\frac{\text{Line time per minute per package}}{\text{average line time per package}} = \frac{\text{equipment cost per package}}{\text{average equipment cost per package.}}$$

For example: For the 6-pack equipment charge: $\frac{0.038}{0.044} = \frac{X}{0.35}$ $X = 0.30$ cents.

[2] See table 7, p. 20.
[3] See table 8, p. 21.
[4] See p. 21.
[5] See table 9, p. 22.
[6] See p. 22.
[7] See p. 24.

Costs of film for overwrapping with cellophane are based on using a diagonal wrap, the nest technique (7), a hand iron for sealing, and current costs for second-quality sheets at 3.4 cents per 1,000 square inches.[10] Average film costs for overwrapping the typical package with cellophane was 0.69 cent. Total materials costs for the cellophane-overwrap operation including the label cost was 1.52 cents (table 12).

The second method studied was overwrapping with a polyvinyl chloride stretch film. The film costs for overwrapping in polyvinyl chloride stretch film are based on film yields achieved with the packaging device, using roll stock and hot-wire cutoff, described earlier in this report. Average film costs were 0.45 cent per package and with an average tray cost of 0.75 cent. Total cost of materials was 1.28 cents (table 12).

The third method analyzed was sleeve wrapping with polyvinyl chloride one-way shrinkable film. A band of film was placed around the package, the film cut on the hot wire and the bottom sealed on the hot plate. The ends of the package were left open and the film on each end overhung the package about an inch. The package was then passed through a shrink tunnel and the film shrunk. Since this technique is not suited for either beans or grapes, these items were completely overwrapped in the less costly stretch-type polyvinyl chloride. Costs of materials for sleeve-wrapping were 0.75 cent for the tray, 0.41 cent for film, and 0.08 cent for the label. Total costs were 1.24 cents for the average package.

[10] The choice of using the hand iron or the hotplate for sealing is up to the individual operator. Previous research (7) indicated that the hand iron will produce better film yields than the hotplate. On the other hand, labor costs are slightly higher when using the hand iron.

TABLE 12.—*Average cost of materials per package for selected produce items when wrapped by 3 methods at the retail store* [1]

Method	Cost per package for— Tray	Film	Label	Total materials
	Cent	*Cent*	*Cent*	*Cents*
Overwrapping with cellophane and the nest technique	0.75	0.69	0.08	1.52
Overwrapping with polyvinyl chloride stretch film and a wrapping device	.75	.45	.08	1.28
Sleeve wrapping with polyvinyl chloride one-way shrinkable film and a wrapping device	.75	.41	.08	1.24

[1] See tables 19–21 for detailed costs.

Labor costs

Labor costs for the three packaging methods include obtaining merchandise, tray filling, wrapping, weighing and labeling, trash handling, and other miscellaneous activities directly concerned with packaging. Costs of performing these functions were developed through time-study techniques. In addition to the regular elements such as tray filling, wrapping, weighing, and labeling, time per package was also determined for the irregular elements, such as moving product to the wrapping stations, master container and empty box handling, and miscellaneous wrapping elements.[11] The highest cost item from a labor cost standpoint was beans and the lowest was tomatoes. The average labor cost per package was 5.27 cents for overwrapping with cellophane, 4.13 cents for overwrapping with polyvinyl chloride stretch film, and 4.10 cents for sleeve wrapping with polyvinyl chloride one-way shrinkable film (table 13).

Equipment costs

The costs of equipment for store-level packaging were developed for the three methods of packaging using straight-line depreciation over an 8-year period with no salvage value. An interest charge of 6 percent per year for one-half of the life expectancy prorated over the total life expectancy was also applied. Total equipment costs including interest and scale maintenance was 0.98 cent per package for overwrapping with cellophane, 1 cent for overwrapping with polyvinyl chloride stretch film, and 1.14 cents for sleeve wrapping with polyvinyl chloride one-way shrinkable film (table 14).

[11] See table 25 for the irregular packaging elements.

Burden for store packaging

The average new supermarket in 1965 had average sales of approximately $2 million and an average area of 20,000 square feet (*8, p. 23*). The average charge for rent, utilities, and insurance in food stores was 2.56 percent of sales (*5, p. 69*). An area of 160 square feet is required for the tray-packaging operation in a $3,000 produce department packaging 1,000 trays per week. This evaluation assumes that the space released, when packaging is removed from the store, can be utilized for other store functions. The burden charge used was $2.56 per square foot.[12] This charge amounts to $410 per year for the tray packaging area, or 0.79 cent per package ($410÷52,000 packages).

[12] $2,000,000×2.56 percent=$51,200÷20,000 square feet.

TABLE 13.—*Average time requirements and labor cost per package for 3 methods of wrapping selected produce items in the retail store* [1]

Item	Percentage of movement	Overwrap with sheeted cellophane		Overwrap with polyvinyl chloride stretch film		Sleeve wrap with polyvinyl chloride shrink film	
		Time	Cost [2]	Time	Cost [2]	Time	Cost [2]
	Percent	*Minutes*	*Cents*	*Minutes*	*Cents*	*Minutes*	*Cents*
Apples, oranges, peaches, pears, 6-pack	44	0. 989	4. 94	0. 782	3. 91	0. 774	3. 87
Beans	15	1. 407	7. 04	1. 041	5. 20	1. 041	[3] 5. 20
Corn, 3 ears [4]	5	1. 136	5. 68	1. 063	5. 32	1. 055	5. 28
Grapes	13	1. 108	5. 54	. 854	4. 27	. 854	[3] 4. 27
Lemons, 5-pack	9	. 910	4. 55	. 642	3. 21	. 634	3. 17
Plums, 8-pack	3	. 962	4. 81	. 761	3. 80	. 753	3. 77
Squash	4	1. 107	5. 54	. 919	4. 60	. 911	4. 56
Tomatoes, 4-pack	7	. 750	3. 75	. 634	3. 17	. 626	3. 13
Total or weighted average	100	1. 055	5. 27	. 826	4. 13	. 820	4. 10

[1] Table 22 shows labor requirements for cellophane; 23, for polyvinyl chloride stretch film; 24, for polyvinyl chloride one-way shrinkable film; 25, irregular elements for cellophane.
[2] Average cost of labor, including fringe benefits, was $3 per hour.
[3] Labor cost for beans and grapes are based on a complete overwrap.
[4] Costs for corn include 0.30 minute per package for trimming.

TABLE 14.—*Annual cost of equipment for packaging trayed produce items using 3 methods of wrapping at the retail store*

Type of equipment	Number required	Cost of equipment[1]		Cost per year		
		Per item	Per year	Overwrap with cellophane	Overwrap with polyvinyl chloride stretch film	Sleeve wrap with polyvinyl one-way shrinkable film
		Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Packaging tables[2]	2	150	38	38		
Overhead tray storage rack[2]	2	30	8	8		
Film holder[2]	2	15	4	4		
Weighing table[2]	1	50	6	6	6	6
Display cart[2]	2	50	12	12	12	12
Cooler storage rack for packaged produce	1	90	11	11	11	11
Conveyors[3]		200	25	25	25	25
Packaging flats[2]	40	3	15	15	15	15
Label printer and projected reading scale	1	1, 795	224	224	224	224
Label applicator	1	100	12	12	12	12
Commodity inserts and rack[4]	1	209	26	26	26	26
Roll film packaging device (table model—3 rolls)	1	128	16		16	16
Stand for roll-film device	1	50	6		6	6
Roll-film packaging stand with film automatically positioned	1	285	36		36	36
Scale maintenance[5]		36	36	36	36	36
Heat-shrink tunnel	1	500	62			62
Interest on invested capital[6]				91	93	108
Total equipment cost				508	518	595
				Cent	*Cents*	*Cents*
Average equipment cost per package at 52,000 packages per year				. 98	1. 00	1. 14

[1] All equipment at list price and all equipment is depreciated to zero in 8 years.
[2] For details of equipment design and construction, see MRR 278 (*7*).
[3] 20 feet of 18 inch wide wheel-type conveyor with 4 "H"-type stands.
[4] 125 commodity inserts at $0.90 and 25 inserts at $1.85 ($159) and commodity insert racks ($50).
[5] Annual maintenance charge is $39.95 with the first year free.
[6] Interest is based on a rate of 6 percent for one-half the life of the equipment prorated over 8 years. Initial equipment investment is approximately $3,048 for cellophane overwrap, $3,112 for stretch-type polyvinyl chloride overwrap, and $3,608 for the one-way shrinkable polyvinyl chloride sleeve wrap.

Total cost of store packaging

To determine the total cost for the three store-packaging systems, the materials, labor, equipment, and burden costs were applied to each item packaged. The equipment and burden were charged to each item on the basis of the time required for packaging as was done in the analysis of warehouse packaging.

The lowest cost system for store packaging, which amounted to 7.20 cents per package, was overwrapping with stretch-type polyvinyl chloride film. Costs ranged from 9 cents per package for corn to 5.67 cents for tomatoes.

The next lowest cost method was sleeve-wrapping with one-way shrinkable polyvinyl chloride film. Costs averaged 7.28 cents per package and ranged from 9.04 cents per package for corn to 5.65 cents for tomatoes.

While labor costs for the sleeve-wrap method were lower than for the polyvinyl stretch film overwrap, 4.10 cents per package as compared with 4.13, and materials cost was lower, 1.24 cents against 1.28 cents, these savings did not offset the higher equipment costs of 1.14 cents for the sleeve wrap as compared with 1 cent for the overwrap. This difference is due to the cost of the shrink tunnel required for the shrink film used on the sleeve wrap.

The highest cost system studied was overwrapping with cellophane, which had higher costs for labor and materials than the "soft film" systems. Costs per package averaged 8.56 cents and ranged from 11.03 cents for beans to 6.35 cents for tomatoes (table 15).

TABLE 15.—*Total cost per package for 3 methods of wrapping selected trayed produce items in the retail store* [1]

Item	Percentage of movement	Cost per package		
		Overwrap with cellophane	Overwrap with polyvinyl chloride stretch film	Sleeve wrap with polyvinyl chloride one-way shrinkable film
	Percent	*Cents*	*Cents*	*Cents*
Apples, oranges, peaches, pears, 6-pack	44	8. 23	6. 98	7. 02
Beans	15	11. 03	8. 80	8. 99
Corn, 3 ears [2]	5	9. 08	9. 00	9. 04
Grapes	13	8. 75	7. 21	7. 37
Lemons, 5-pack	9	7. 38	5. 72	5. 71
Plums, 8-pack	3	7. 77	6. 54	6. 62
Squash	4	8. 89	7. 93	8. 00
Tomatoes, 4-pack	7	6. 35	5. 67	5. 65
Weighted average		8. 56	7. 20	7. 28

[1] Detailed costs for the 3 methods are presented in appendix tables 26–28.
[2] Includes 1.50 cents per package for trimming corn.

Comparison of Store and Warehouse Packaging Costs

The final cost comparisons in this report are based on the various costs of labor, film, burden, and other costs shown and the product mix previously given. Costs and product mix of individual firms will probably vary from these. For individual firms to obtain a more accurate evaluation of costs, each should substitute its own costs and product mix where available.

Comparison of costs on a per package basis

The lowest cost method of packaging at the store was overwrapping with polyvinyl chloride stretch film—7.20 cents per package. Costs of warehouse packaging at a volume of 3 million packages per

TABLE 16.—*Comparison of lowest cost store level packaging method with central warehouse packaging*

Item	Percentage of movement	Packaging costs		Savings from warehouse packaging	
		Lowest store method	Warehouse	Per package	Percentage of store costs
	Percent	*Cents*	*Cents*	*Cents*	*Percent*
Apples, oranges, peaches, pears, 6-pack	44	6. 98	3. 89	3. 09	44. 27
Beans	15	8. 80	7. 62	1. 18	13. 41
Corn, 3 ears	5	9. 00	5. 40	3. 60	40. 00
Grapes	13	7. 21	5. 62	1. 59	22. 05
Lemons, 5-pack	9	5. 72	3. 41	2. 31	40. 38
Plums, 8-pack	3	6. 54	3. 70	2. 84	43. 42
Squash	4	7. 95	5. 00	2. 95	37. 11
Tomatoes, 4-pack	7	5. 67	4. 71	. 96	16. 93
Weighted average		7. 20	4. 80	2. 40	33. 33

year was 4.80 cents per package, a difference of 2.40 cents or a reduction of 33 percent in packaging costs over retail store packaging. Savings ranged from 3.60 cents per package for corn to 0.96 cent per package for tomatoes (table 16).

Costs of materials were higher for warehouse packaging, 1.76 cents per package compared with 1.28 cents at store level and the warehouse also had container costs of 0.16 cent per package. Savings through warehouse packaging are due to: (1) A higher level of productivity and slightly lower labor rates, $2.76 per hour for warehouse labor as compared with $3 per hour for store labor. Labor costs for store packaging was 4.13 cents per package compared with 2.28 cents at the warehouse. (2) Lower equipment costs—0.35 cent per package at the warehouse and 1 cent at store level. (3) Less burden costs—0.24 cent per package for the warehouse and 0.79 cent at the store (table 17).

Savings through warehouse packaging

Annual savings from shifting packaging from the store to the warehouse ranged from $7,575 annually for a single-line operation producing 750,000 packages to $141,000 for a double line with an output of 5 million packages (table 18).

TABLE 17.—*Average costs per package for warehouse packaging and the lowest cost store method*

Item	Materials	Labor	Equipment	Burden	Containers	Total
	Cents	*Cents*	*Cents*	*Cent*	*Cent*	*Cents*
Store packaging	1. 28	4. 13	1. 00	0. 79	----------	7. 20
Warehouse packaging	1. 76	2. 28	. 35	. 24	0. 16	4. 80
Difference in favor of warehouse	—. 48	+1. 85	+. 65	+. 55	—. 16	+2. 40

TABLE 18.—*Annual savings through central warehouse packinging at different levels of volume*

Packages per year (thousands)	Costs of packaging at— Store [1]	Warehouse [2]	Savings Per package	Per year
	Dollars	*Dollars*	*Cents*	*Dollars*
Single-line operation:				
750	54, 000	46, 421	1. 01	7, 575
1,000	72, 000	55, 796	1. 62	16, 200
1,250	90, 000	65, 171	1. 98	24, 750
1,500	108, 000	74, 546	2. 23	33, 450
1,750	126, 000	83, 921	2. 40	42, 000
2,000	144, 000	93, 296	2. 53	50, 600
2,500	180, 000	112, 046	2. 71	67, 750
Double-line operation:				
2,500	180, 000	124, 738	2. 21	55, 250
3,000	216, 000	143, 488	[3] 2. 42	72, 600
3,500	252, 000	162, 238	2. 56	89, 600
4,000	288, 000	180, 988	2. 68	107, 200
4,500	324, 000	199, 738	2. 76	124, 200
5,000	360, 000	218, 488	2. 83	141, 000

[1] Polyvinyl chloride stretch film overwrap at 7.20 cents per package.

[2] Direct labor, materials, and container cost per package times number of packages plus indirect labor, warehouse burden, and equipment costs.

[3] Previous savings reported for this level of volume was 2.40 cents per package. The difference is due to using 2 place accuracy in cents per package for indirect labor, warehouse burden, and equipment cost in previous tables. 2.42 cents is the more precise figure.

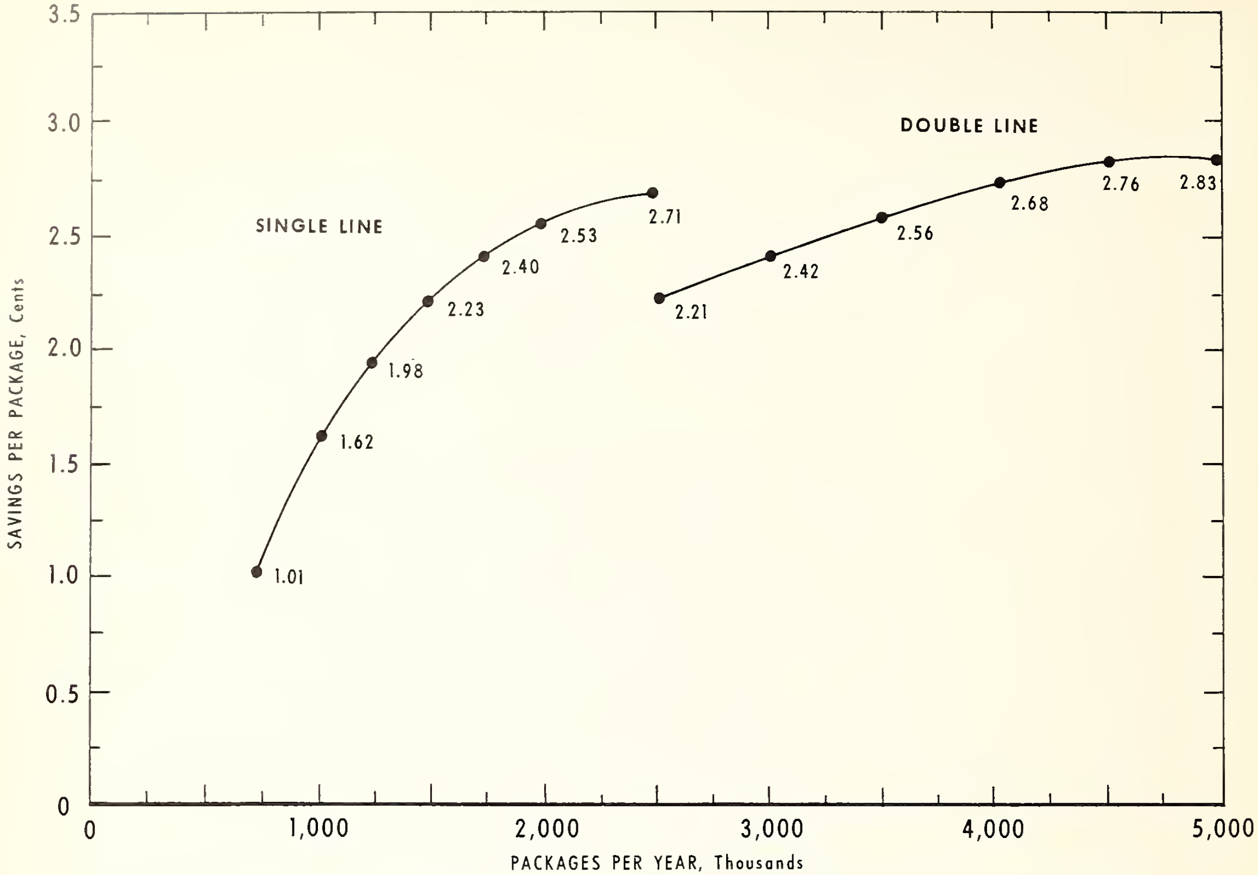

FIGURE 14.—Savings per package from central warehouse packaging at different volume levels.

Savings per package decline when annual production exceeds an annual volume of 2.5 million packages because at this point a second line would be required but not fully utilized (fig. 14). Additional savings per year are achieved with higher volume but at a decreased rate. But after the 4 million package level is attained, savings per package continue to increase up to 5 million packages. At this point a third line would be required.

Break-even costs

To determine the break-even point, store and warehouse packaging costs developed in this study were substituted into a break-even formula (see exhibit A, p. 39). The break-even point between the polyvinyl chloride overwrap operation at the store and warehouse packaging was at an annual volume of 898,202 packages for a double-line installation at the warehouse. However, a single packaging line can produce up to 2,500,000 packages annually. Equipment costs for the single-line operation were $6,240 annually as compared with $10,433 for a double line.[13] The break-even point for a single-line operation was 530,319 packages per year (fig. 15).

[13] See table 29, p. 38, for equipment costs for a single-line installation.

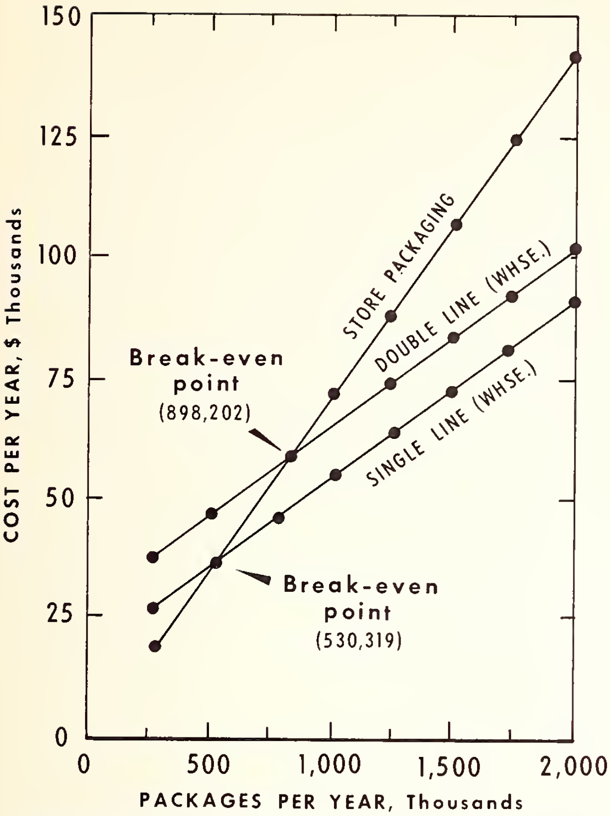

FIGURE 15.—Comparison of the lowest cost method of store packaging with the costs of single- and double-line warehouse packaging.

Gross profit performance

The gross profit of the produce department will be somewhat lower when shifting to prestore packaging since warehouse labor, equipment, materials, and burden charges are added to the store's cost price for produce. However, the net profit of the retail department may actually increase. Stores converting to central prepackaging should, therefore, make adjustments in gross margin to reflect this difference. A previous report (*6*) illustrates a method of adjusting gross profit at store level to reflect the added value of packaging.

Removing the tray packaging function from a $3,000 produce department selling 1,000 packages per week will lower store costs $72 per week, or 2.4 percent of sales for the entire department. A box of produce that costs the retailer $5.46 delivered and yields 20 packages that will sell for 39 cents each ($7.80 a box) provides a gross margin of 30 percent. However, packaging costs of 7.2 cents per package ($1.44 a box) leaves only 4.5 cents a package to cover other costs (90 cents a box). If the warehouse packages this item at a cost of 4.5 cents a package (90 cents a box), the product would cost the retailer 31.8 cents a package ($6.36 a box). If the product still sold for 39 cents, this would leave the retailer the same 4.5 cents to cover other costs plus 2.7 cents added profit. Here the gross margin has been reduced to 18.5 percent, but the retailer actually gained 54 cents per box.

DISCUSSION

This study assumes that the savings in equipment and space released at the store through shifting to warehouse packaging can be fully realized. For future stores, the savings as reported could be fully realized since the initial expenditure for equipment and space could be eliminated to a large extent. Older stores often need additional frozen food storage coolers or similar equipment. During remodeling particularly, additional space can be used. However, old equipment often has a low resale value and frequently space saved is so located it cannot be utilized for other uses in the short run.

If we assume that no savings will occur for existing stores in equipment and space, savings through warehouse packaging would decrease 1.8 cents per package or net savings for existing stores of about 0.61 cent per package at a volume of 3 million packages per year. If the savings in equipment and space are completely discounted, the break-even point for a single-packaging line would be about one million packages per year.[14]

[14] Using the equation in exhibit B, p. 39: $0.0541P$ (labor and materials at store) $= 0.0315P + 18{,}296$ (warehouse costs for a single line) $P = 1{,}102{,}169$ packages per year.

Another factor for consideration is that store level costs for labor and materials were based on good work methods and proper use of materials. Since many produce departments use part-time unskilled help, store packaging costs typically are higher than those reported. This is particularly true for costs of packaging film. Excessive use of film at store level resulting from too much overlap on the packages, choice of the incorrect size of film, and film used in rewraps or lost through improper storage can result in higher film costs at store level than those stated. On the other hand, the costs of labor and materials for warehouse packaging are usually more closely supervised and controlled. The average firm is more apt to achieve the costs as presented in this report at warehouse than at retail level.

Several additional factors may accelerate the shift to warehouse packaging:

1. A continuing shortage of trained personnel for store perishable departments.
2. Increased labor costs.
3. Little likelihood that store level productivity can be further increased with packaging in the store.
4. Better control of produce quality through centralization.
5. Better control of store inventories through improved ordering procedures based on past movement records.
6. More variety possible at store level because stores can more readily order limited quantities of slow movers, such as okra, artichoke, and eggplant.
7. Increased sales because packaged merchandise is available for maintaining full displays.
8. Less production scheduled at the store and personnel can concentrate on merchandising, selling, and menu advice.
9. The potential exists for the development of a quality reputation in private label produce through centralization.

Some retailers argue that produce packaging anywhere is not feasible because of customer reluctance to accept packaging. However, an analysis of items sold in these same so-called "bulk" stores reveals that more than half of the volume is sold in packaged form. One essential ingredient for a successful packaging program is proper handling and rotation of produce at store level. Another is the maintenance of adequate store movement records for proper ordering.

There may be further developments in the future which will improve warehouse packaging. Improvements in and standardization of shipping containers are needed. Bulk shipment by pallet containers offers a major potential savings.[15] Development of a lower cost folding box suitable for warehouse packaging is needed to reduce warehouse materials costs.

[15] For example, if apples were received in pallet containers containing 800 pounds, this would eliminate 20 shipping containers at 58 cents each or $11.60 per pallet. When the total cost of the pallet shipment is $3.20, the saving is $8.40 for 320 tray packs at 2.5 pounds or 2.6 cents per tray pack.

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APPENDIX

TABLE 19.—*Cost of materials per package for overwrapping selected trayed produce items in sheeted cellophane in the retail store*

Item	Percentage of movement	Tray		Film [1]		Label [2]	Total costs
		Size	Cost	Size	Cost		
	Percent	*Number*	*Cent*	*Inches*	*Cent*	*Cent*	*Cents*
Apples, oranges, peaches, pears, 6-pack	44	2	0. 79	15 x 15	0. 76	0. 08	1. 63
Beans	15	2	. 79	15 x 15	. 76	. 08	1. 63
Corn, 3 ears	5	2	. 79	13 x 14	. 62	. 08	1. 49
Grapes	13	1½	. 65	13 x 14	. 62	. 08	1. 35
Lemons, 5-pack	9	14	. 69	13 x 13	. 57	. 08	1. 30
Plums, 8-pack	3	1½	. 65	13 x 14	. 62	. 08	1. 35
Squash	4	2	. 79	13 x 14	. 62	. 08	1. 49
Tomatoes, 4-pack	7	14	. 69	13 x 13	. 57	. 08	1. 34
Total or weighted average	100		. 75		. 69	. 08	1. 52

[1] 3.4 cents per 1,000 square inches for second-quality cellophane sheets.
[2] Cost of printed outside label is $1.91 per roll of 2,340 labels.

TABLE 20.—*Cost of materials per package for manually overwrapping selected trayed produce items in polyvinyl chloride stretch film in the retail store*

Item	Percentage of movement	Tray		Film [1]		Label [2]	Total costs
		Size	Cost	Size	Cost		
	Percent	*Number*	*Cent*	*Inches*	*Cent*	*Cent*	*Cents*
Apples, oranges, peaches, and pears, 6-pack	44	2	0. 79	15 x 18	0. 50	0. 08	1. 37
Beans	15	2	. 79	15 x 17	. 47	. 08	1. 34
Corn, 3 ears	5	2	. 79	15 x 18	. 50	. 08	1. 37
Grapes	13	1½	. 65	14 x 14	. 36	. 08	1. 09
Lemons, 5-pack	9	14	. 69	12 x 16	. 35	. 08	1. 12
Plums, 8-pack	3	1½	. 65	14 x 14	. 36	. 08	1. 09
Squash	4	2	. 79	15 x 17	. 47	. 08	1. 34
Tomatoes, 4-pack	7	14	. 69	12 x 16	. 35	. 08	1. 12
Total or weighted average	100		. 75		. 45	. 08	1. 28

[1] At 1.84 cents per 1,000 square inches for 0.60 mil film. Overlap on the bottom of the packages averaged 3 inches.
[2] Cost of printed outside label is $1.91 per roll of 2,340 labels.

TABLE 21.—*Cost of materials per package for sleeve-wrapping selected trayed produce items in polyvinyl chloride one-way shrinkable film in the retail store*

Item	Percentage of movement	Tray Size	Tray Cost	Film [1] Size	Film [1] Cost	Label [2]	Total costs
	Percent	*Number*	*Cent*	*Inches*	*Cent*	*Cent*	*Cents*
Apples, oranges, peaches, and pears, 6-pack	44	2	0.79	10 x 18	0.45	0.08	1.32
Beans [3]	15	2	.79	15 x 17	.47	.08	1.34
Corn, 3 ears	5	2	.79	10 x 18	.45	.08	1.32
Grapes	13	1½	.65	14 x 14	.36	.08	1.09
Lemons, 5-pack	9	14	.69	7 x 16	.28	.08	1.05
Plums, 8-pack	3	1½	.65	10 x 14	.35	.08	1.08
Squash	4	2	.79	10 x 17	.42	.08	1.29
Tomatoes, 4-pack	7	14	.69	7 x 16	.28	.08	1.05
Total or weighted average	100		.75		.41	.08	1.24

[1] Polyvinyl chloride uniaxially oriented shrinkable film 0.75 mil at 2.5 cents per 1,000 square inches. Overlap on the bottom of the packages averaged 3 inches.

[2] Cost of printed outside label is $1.91 per roll of 2,340 labels.

[3] Cost for beans and grapes are based on a complete overwrap with polyvinyl chloride stretch film at 1.84 cents per 1,000 square inches.

TABLE 22.—*Total labor requirements per package for overwrapping selected trayed produce items in cellophane in the retail store*

Item	Percentage of movement	Regular wrap elements per package: Obtain cello	Position empty tray	Fill tray	Seal: First	Seal: Second	Seal: Third	Place package aside	Total	Other packaging elements [1]	Total wrap time	15-percent allowance	Standard time per package
	Percent	*Minute*	*Minute*	*Minute*	*Minute*	*Minute*	*Minute*	*Minute*	*Minute*	*Minute*	*Minutes*	*Minute*	*Minutes*
Apples, oranges, peaches, and pears, 6-pack	44	0.050	0.043	0.187	0.104	0.074	0.093	0.044	0.595	0.265	0.860	0.129	0.989
Beans	15	.057	.050	.425	.104	.137	.144	.042	.959	.265	1.224	.183	1.407
Corn, 3 ears	5	.041	.037	.095	.073	.073	.068	.036	.423	[2] .565	.988	.148	1.136
Grapes	13	.054	.044	.266	.109	.082	.098	.045	.698	.265	.963	.145	1.108
Lemons, 5-pack	9	.041	.037	.100	.120	.083	.106	.040	.527	.265	.792	.118	.910
Plums, 8-pack	3	.046	.037	.211	.092	.068	.084	.033	.571	.265	.836	.126	.962
Squash	4	.032	.035	.346	.130	.051	.073	.030	.697	.265	.962	.145	1.107
Tomatoes, 4-pack	7	.037	.035	.102	.056	.064	.060	.033	.387	.265	.652	.098	.750
Total or weighted average	100												1.055

[1] See appendix table 25.

[2] Includes the time to trim corn by the full-face method at 0.10 minute per ear (*1, p. 10*).

TABLE 23.—*Labor requirements per package for overwrapping selected trayed produce items in polyvinyl chloride stretch film in the retail store*

Item	Percentage of movement	Regular wrap elements	Irregular wrap elements [1]	Total wrap time	15 percent personal and fatigue allowance	Standard time per package
	Percent	*Minute*	*Minute*	*Minute*	*Minute*	*Minutes*
Apples, oranges, peaches, and pears, 6-pack	44	0.423	0.257	0.680	0.102	0.782
Beans	15	.648	.257	.905	.136	1.041
Corn, 3 ears	5	.367	[2] .557	.924	.139	1.063
Grapes	13	.486	.257	.743	.111	.854
Lemons, 5-pack	9	.301	.257	.558	.084	.642
Plums, 8-pack	3	.405	.257	.662	.099	.761
Squash	4	.542	.257	.799	.120	.919
Tomatoes, 4-pack	7	.294	.257	.551	.083	.634
Total or weighted average	100					.826

[1] Irregular elements when using the wrapping device are the same as for the cellophane overwrap, table 25, with the exception of element numbers 17, 18, 20, 24, and 30.
[2] Includes the time to trim corn by the full-face method at 0.10 minute per ear (*1, p. 10*).

TABLE 24.—*Labor requirements per package for sleeve-wrapping selected trayed produce items in polyvinyl chloride one-way shrinkable film in the retail store*

Item	Percentage of movement	Regular wrap elements	Irregular wrap elements [1]	Total wrap time	15 percent personal and fatigue allowance	Standard time per package
	Percent	*Minute*	*Minute*	*Minute*	*Minute*	*Minutes*
Apples, oranges, peaches, and pears, 6-pack	44	0.416	0.257	0.673	0.101	0.774
Beans [2]	15	.648	.257	.905	.136	1.041
Corn, 3 ears	5	.360	[3] .557	.917	.138	1.055
Grapes [2]	13	.486	.257	.743	.111	.854
Lemons, 5-pack	9	.294	.257	.551	.083	.634
Plums, 8-pack	3	.398	.257	.655	.098	.753
Squash	4	.535	.257	.792	.119	.911
Tomatoes, 4-pack	7	.287	.257	.544	.082	.626
Total or weighted average	100					.820

[1] See footnote 1, table 23.
[2] Labor costs for beans and grapes are based on a complete overwrap.
[3] Includes the time to trim corn by the full-face method at 0.10 minute per ear (*1, p. 10*).

TABLE 25.—*Labor requirements for the irregular elements in overwrapping selected trayed produce items in cellophane in the retail store*

Element No.	Item	Total time per occurrence	Frequency of occurrence	Weighted elemental time: Per study	Weighted elemental time: Per package [1]
	Move product to wrap stations:				
1	Obtain product from cooler (4 cases per trip)	*Minutes* 0. 374	*Percent* 25. 0	*Minutes* 0. 094	*Minute*
2	Open container	. 358	100. 0	. 358	
3	Position box on wrap table	. 124	100. 0	. 124	
4	Obtain supply of trays/temporary storage	. 187	7. 9	. 015	
5	Obtain supply of trays/permanent storage	. 846	2. 0	. 017	
6	Obtain repacks for packaging	. 308	5. 3	. 016	
7	Walk to scale	. 161	42. 1	. 068	
8	Obtain tub	. 378	7. 9	. 030	
9	Dump produce in tub	. 161	42. 1	. 068	
	Total time for moving product to wrap stations			. 790	0. 040
	Master container and empty box handling:				
10	Move full master container to conveyor	. 050	100. 0	. 050	
11	Position empty master container on table	. 081	100. 0	. 081	
12	Place empty box or carton on conveyor	. 052	100. 0	. 052	
	Total time for master container and empty box handling			. 183	. 009
	Miscellaneous wrapping elements:				
13	Reposition full box on table	. 109	66. 7	. 073	
14	Position supply of trays on table	. 104	100. 0	. 104	
15	Place excess trays in holder	. 089	51. 5	. 046	
16	Fill tray holders	. 512	9. 4	. 048	
17	Obtain nest tray and plate	. 088	20. 3	. 018	
18	Punch holes in film	. 629	17. 2	. 108	
19	Clean	. 237	17. 2	. 041	
20	Reposition cellophane	. 059	9. 4	. 006	
21	Rewrap package	. 425	28. 1	. 119	
22	Sort bad merchandise	. 213	23. 4	. 050	
23	Obtain one item to fill out tray	. 121	1. 6	. 002	
24	Clean iron	. 603	4. 7	. 028	
25	Remove wrappers	. 292	70. 3	. 205	
26	Remove dividers	. 114	70. 3	. 080	
27	Rearrange packages in master container	. 184	3. 1	. 006	
28	Rearrange merchandise on tray	. 115	3. 1	. 004	
29	Open poly box liner	. 281	6. 2	. 017	
30	Place extra film aside	. 092	6. 2	. 006	
31	Wipe hands	. 446	10. 9	. 049	
32	Check package	. 042	1. 6	. 001	
	Total time for the miscellaneous wrapping elements			1. 011	0. 50
	Weighing and labeling:				
33	Ring-up and attach label 130	2. 600	100. 0	2. 600	
34	Adjust scale and printer	. 279	100. 0	. 279	
35	Master container handling	. 300	100. 0	. 300	
36	Miscellaneous weigh elements	. 136	100. 0	. 136	
	Total time for weighing and labeling			3. 315	. 166
	Total time			5. 299	. 265
	15 percent allowance for personal and fatigue			. 795	. 040
	Standard time			6. 094	. 305

[1] Based on 20 packages per study.

Table 26.—*Total cost per package for overwrapping selected trayed produce items in cellophane in the retail store*

Item	Percentage of movement	Labor [1]		Materials [2]	Equipment [3]	Burden [3]	Total cost per package
	Percent	*Minutes*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
Apples, oranges, peaches, and pears, 6-pack	44	0. 989	4. 94	1. 63	0. 92	0. 74	8. 23
Beans	15	1. 407	7. 04	1. 63	1. 31	1. 05	11. 03
Corn, 3 ears	5	1. 136	5. 68	1. 49	1. 06	. 85	9. 08
Grapes	13	1. 108	5. 54	1. 35	1. 03	. 83	8. 75
Lemons, 5-pack	9	. 910	4. 55	1. 30	. 85	. 68	7. 38
Plums, 8-pack	3	. 962	4. 81	1. 35	. 89	. 72	7. 77
Squash	4	1. 107	5. 54	1. 49	1. 03	. 83	8. 89
Tomatoes, 4-pack	7	. 750	3. 75	1. 34	. 70	. 56	6. 35
Total or weighted average	100	1. 055	5. 27	1. 52	. 98	. 79	8. 56

[1] Average cost of labor, including fringe benefits, was $3 per hour.
[2] All materials at list price.
[3] All equipment at list price (table 14). Average equipment cost per package was 0.98 cent and average burden cost per package was 0.79 cent. Equipment and burden costs are prorated to each item on the basis of the packaging time for individual items.

Table 27.—*Total cost per package for overwrapping selected trayed produce items in polyvinyl chloride stretch film in the retail store*

Item	Percentage of movement	Labor [1]		Materials [2]	Equipment [3]	Burden [3]	Total cost per package
	Percent	*Minutes*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
Apples, oranges, peaches, and pears, 6-pack	44	0. 782	3. 91	1. 37	0. 95	0. 75	6. 98
Beans	15	1. 041	5. 20	1. 34	1. 26	1. 00	8. 80
Corn, 3 ears	5	1. 063	5. 32	1. 37	1. 29	1. 02	9. 00
Grapes	13	. 854	4. 27	1. 09	1. 03	. 82	7. 21
Lemons, 5-pack	9	. 642	3. 21	1. 12	. 78	. 61	5. 72
Plums, 8-pack	3	. 761	3. 80	1. 09	. 92	. 73	6. 54
Squash	4	. 919	4. 60	1. 34	1. 11	. 88	7. 93
Tomatoes, 4-pack	7	. 634	3. 17	1. 12	. 77	. 61	5. 67
Total or weighted average	100	. 826	4. 13	1. 28	1. 00	. 79	7. 20

[1] Average cost of labor, including fringe benefits, was $3 per hour.
[2] All materials at list price
[3] All equipment at list price (table 14). Average equipment cost per package was 1 cent and average burden cost per package 0.79 cent. Equipment and burden costs are prorated to each item on the basis of the packaging time for individual items.

TABLE 28.—*Total cost per package for sleeve-wrapping selected trayed produce items in polyvinyl chloride one-way shrinkable film in the retail store*

Item	Percentage of movement	Labor [1]		Materials [2]	Equipment [3]	Burden [3]	Total cost per package
	Percent	*Minutes*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
Apples, oranges, peaches, and pears, 6-pack	44	0.774	3.87	1.32	1.08	0.75	7.02
Beans [4]	15	1.041	5.20	1.34	1.45	1.00	8.99
Corn, 3 ears	5	1.055	5.28	1.32	1.47	1.02	9.04
Grapes [4]	13	.854	4.27	1.09	1.19	.82	7.37
Lemons, 5-pack	9	.634	3.17	1.05	.88	.61	5.71
Plums, 8-pack	3	.753	3.77	1.08	1.05	.72	6.62
Squash	4	.911	4.56	1.29	1.27	.88	8.00
Tomatoes, 4-pack	7	.626	3.13	1.05	.87	.60	5.65
Total or weighted average	100	.820	4.10	1.24	1.14	.79	7.28

[1] Average cost of labor, including fringe benefits was $3 per hour.
[2] All materials at list price.
[3] All equipment at list price (table 14). Average equipment cost per package was 1.14 cents and average burden cost per package 0.79 cent. Equipment and burden costs are prorated to each item on the basis of the packaging time for individual items.
[4] Costs for beans and grapes are based on a complete overwrap with polyvinyl chloride stretch film.

TABLE 29.—*Annual cost of equipment for a single-line installation for central warehouse packaging of trayed produce items* [1]

Item	Initial cost
	Dollars
Equipment:	
Automatic packager	7,125
Top mechanical tamper	425
Plastic film sealing unit	1,250
In-feed extension with 20-foot table and conveyor	5,108
Top labeler unit	1,975
Side discharge conveyor	325
Electronic computing scale	4,990
Automatic labeler	2,550
Commodity inserts and rack [2]	159
Total	23,907
Other equipment and charges:	
Turntable, 6-foot-diameter	400
Discharge belt 12 in. by 10 ft	325
Shrink tunnel	800
Takeaway belt 18 in. by 10 ft	425
Packout, tare-weight scales	860
Reserve electronic scale	4,990
Corn-trimming device and work station	400
Freight	375
Installation	1,500
Wheel-type conveyor 68 feet	588
Forklift truck [3]	1,000
Miscellaneous other costs	750
Total initial cost	36,320
Annual cost:	
Depreciation [4]	4,540
Scale maintenance 2 at 305	610
Interest [5]	1,090
Total annual cost	6,240

[1] All equipment at list price.
[2] Rack cost $50 plus 80 inserts at $0.90 and 20 special inserts at $1.85.
[3] A forklift cost $6,000 but is only required for about 10 hours per week.
[4] All equipment is depreciated to zero in 8 years.
[5] Total initial investment is $36,320. Interest on invested capital is at a rate of 6 percent, calculated for one-half the life of the equipment, and prorated over 8 years.

EXHIBIT A.—*Determining break-even point between manually overwrapping produce with polyvinyl chloride stretch film at store level and a 2-line warehouse packaging operation using polyvinyl chloride shrinkable film*

A general formula for determining the break-even point is as follows:

Store costs per year = *Warehouse costs per year*

Store costs per package × number of packages = Number of packages × total cost per package of materials, direct labor, and containers + cost per year of indirect labor, burden, and equipment

Where:

		Dollars
Store costs per package for polyvinyl chloride stretch film overwrap	=	0. 0720
Warehouse materials costs, overwrap with polyvinyl chloride shrinkable film	=	. 0176
Direct warehouse labor per package	=	. 0183
Container cost per package	=	. 0016
Cost per year for indirect warehouse labor	=	13,468. 0000
Warehouse burden costs per year [1]	=	7,088. 0000
Warehouse equipment costs per year	=	10,433. 0000

P = Number of packages per year

Store costs = *Warehouse costs*

1. $0.0720P = P\,(0.0176+0.0183+0.0016)+13{,}468+7{,}088+10{,}433$
2. $0.0720P = 0.0375P+30{,}988$
3. $0.0720P-0.0375P = 30{,}988$
4. $0.0345P = 30{,}988$
5. $P = 898{,}202$

At 898,202 packages per year, the costs of a 2-line warehouse packaging operation would equal the costs of manually overwrapping packages with stretch-type polyvinyl chloride in the retail store.

[1] 3,150 square feet at $2.25 per square foot.

EXHIBIT B.—*Determining break-even point between manually overwrapping produce with polyvinyl chloride stretch film at store level and a single-line warehouse packaging operation using polyvinyl chloride shrinkable film*

A general formula for determining the break-even point is as follows:

Store costs per year = *Warehouse costs per year*

Store costs per package × number of packages = Number of packages × the total cost per package of materials, direct labor, and containers + cost per year of indirect labor, burden, and equipment

Where:

		Dollars
Store costs per package for polyvinyl chloride stretch film overwrap	=	0. 0720
Warehouse materials costs, overwrap with polyvinyl chloride shrink film	=	. 0176
Direct warehouse labor per package	=	. 0183
Container cost per package	=	. 0016
Cost per year for indirect warehouse labor [1]	=	7,106. 0000
Warehouse burden costs per year [2]	=	4,950. 0000
Warehouse equipment costs per year [3]	=	6,240. 0000

P = Number of packages per year

Store costs = *Warehouse costs*

1. $0.0720P = P\,(0.0176+0.0183+0.0016)+7{,}106+4{,}950+6{,}240$
2. $0.0720P = 0.0375P+18{,}296$
3. $0.0720P = 18{,}296$
4. $0.0345P = 18{,}296$
5. $P = 530{,}319$

At 530,319 packages per year, the costs of a single-line warehouse packaging operation would equal the costs of manually overwrapping packages with stretch-type polyvinyl chloride in the retail store.

[1] Forklift operators 10 hours per week at $3.49 per hour or $34.90; mechanic 4 hours per week at $3.94 per hour or $15.76; foreman 20 hours per week (assuming one-half of work week will be devoted to other packaging operations) at $4.30 per hour or $86.00; total indirect labor per week $136.66, total per year $7,106.

[2] 2,200 square feet at $2.25 per square foot equals $4,950 per year.

[3] See table 29.

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