Methods of Increasing Labor Productivity in Multistory and Small One-Floor Grocery Warehouses

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PREFACE

This report is based on research undertaken to aid grocery wholesalers in reducing their warehouse labor costs through improved work methods and equipment in small 1-floor warehouses of less than 40,000 square feet and multistory warehouses. The work was conducted under the general supervision of R. W. Hoecker, head, Wholesaling and Retailing Section, Transportation and Facilities Branch.

Special credit is due the following wholesale grocery companies that made their warehouses available for detailed study: C. B. Ragland Co., Nashville, Tenn.; Central Florida Foods, Sanford, Fla.; Chastain-Roberts Co., Anniston, Ala.; Grocer's Wholesale Co-op., Des Moines, Iowa; H. Traub's Son, Inc., Savannah, Ga.; Krenning-Schlapp Grocery Co., St. Louis, Mo.; The Lewis Grocer Co., Indianola, Miss.; Ogburn Brothers, Mobile, Ala.; and Washington Wholesale Grocery Co., Washington, D. C.

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SUMMARY

The number of man-hours required in warehousing was reduced an average of 19 percent in 4 multistory and in 5 small 1-floor (less than 40,000 square feet) wholesale grocery warehouses studied, through improved work methods, use of better materials-handling equipment, improved physical layouts, and more nearly balanced work crews. Additional man-hour savings of 36 percent, for a total saving of 55 percent, can be expected after new facilities are constructed for 4 firms and recommended equipment is installed and in operation in 3 other firms. Since warehouse labor accounts for more than 50 percent of the total warehousing cost, methods of increasing productivity are of major concern to warehouse management.

During this study, the following objectives were given primary consideration: (1) Evaluation of present methods and development of new methods for use by wholesale grocers for increasing warehouse labor productivity in receiving merchandise, selecting orders, checking, and loading assembled orders; (2) to show the effect of improved methods on warehouse labor costs; and (3) to show by case study analysis the problems involved in determining whether a new warehouse or new equipment should be acquired. Warehousing operations were observed in 75 grocery warehouses located in various sections of the country. Many references in this report are based on general observations from these warehouses. Most of the study, however, relates to 5 firms operating in small 1-floor warehouses and 4 firms operating in multistory warehouses.

Increased labor productivity was achieved in receiving groceries using the following principles: (1) Separating the palletizing operation from the storing operation; (2) improving work crew balance; and (3) reducing the number of workers assigned to a particular operation.

In 4 firms, separating the palletizing operation from the forklift storing operation saved nearly 13 percent, or 115 man-hours weekly - the equivalent of more than 2 men. Improved work crew balance in receiving merchandise by conveyors saved 40 man-hours in 1 firm, 15 percent of the total receiving time in rail car and motortruck unloading. Two firms saved 50 man-hours by reducing the number of men in a palletizing crew. On a production per man-hour basis, a 2-man team produced 38 percent more than a 4-man team, and 23 percent more than a 3-man team. A weekly total of 2,420 man-hours used in the receiving operation in the 9 firms studied intensively was reduced to 2,215 man-hours, a reduction of more than 8 percent, through the use of these improved work methods.

The materials-handling equipment used for order assembly in the firms studied included 2-wheel handtrucks, 4-wheel handtrucks, elevators, and conveyor lines. With use of 4-wheel handtrucks, order filler production was 37 percent greater than with use of 2-wheel handtrucks, for assembly of individual retailer orders. In 1-floor warehouses, order filler production using the same assembly methods was 16 percent greater than in multistory warehouses where freight elevators were used. Based on the total warehousing operations of the firms studied, it was found that a conveyor system was the most efficient materials-handling equipment in multistory warehouses, although there

was a definite limit as to the number of cases that could be handled on a conveyor line during a given period of time.

Delay factors materially affecting order filler production in the firms studied included: (1) Improper crew balance; (2) waiting for retailer orders; (3) waiting for selector trucks; (4) hunting for a specific item; (5) doubling back over the same routes in the assembly of a given order; (6) waiting for a conveyor line to be cleared of orders assembled on it; and (7) waiting for merchandise to be brought from reserve storage. A saving of 822 man-hours, nearly 19 percent, was accomplished in the 9 firms through reduction of these delays in the order assembly operation.

In addition to the effects of the various types of materials-handling equipment used and the delay factors mentioned, order filler productivity was affected by the type of order assembly system and the size of retailer orders. With the 4 types of order assembly systems, productivity of order fillers ranged from 57 to 137 cases per man-hour in the assembly of a 30-case order. With the use of the individual retailer order assembly using 4-wheel hand-trucks, order fillers averaged 82 cases per man-hour on orders of 1 to 10 cases in size, while they averaged 201 cases per man-hour on orders larger than 75 cases.

In 2 firms, the number of men checking orders was reduced from 6 to 3 by the adoption of improved methods. By having order fillers arrange the merchandise on 4-wheel selector trucks as they assemble the order and having orders checked by 1 man rather than a 2-man team, checking labor was reduced 50 percent. For all warehouses studied, an average reduction of nearly 40 percent in checking man-hours was accomplished.

The use of 1 man rather than a 2-man team in the loading of delivery trucks reduced man-hour requirements almost 19 percent in the 9 firms. It was not possible to use 1-man loading of delivery trucks in every firm studied, owing to conditions of the loading dock. Individual firms using new methods saved as much as 25 percent in loading man-hours.

In addition to work methods and equipment, warehouse management controls useful in evaluating and developing a more efficient warehousing operation are: (1) Relationship of overtime labor costs to regular labor cost; (2) utilization of square and cubic warehouse space; (3) cost comparison of operations on a 1-, 2-, or 3-shift basis; and (4) the importance of transportation methods used for inbound and outbound merchandise on warehouse layout.

A thorough economic analysis of the total warehousing facility is needed when wholesale grocers are uncertain whether a new warehouse should be built. The answer to this question must be based on realistic cost estimates of land, building, equipment, insurance, taxes, and labor in the existing warehouse compared with a new warehouse. Answers to questions relative to the company objectives, market area, financing and alternative uses of capital to gain company objectives also have an important influence. Case studies of the analysis used and action taken by 3 firms attempting to answer the question are presented.

METHODS OF INCREASING LABOR PRODUCTIVITY IN MULTISTORY AND SMALL ONE-FLOOR GROCERY WAREHOUSES

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INTRODUCTION

The unloading of merchandise from common carriers, stacking it in the warehouse, selecting, checking, and loading it out on trucks by manpower has become more and more expensive. The average hourly earnings of nonsupervisory employees in the wholesale trade have increased nearly 68 percent from 1946 to 1955. 1/ A large number of wholesale grocers have reduced their labor costs per ton of merchandise handled by moving into modern 1-floor warehouses in order to utilize materials-handling equipment for increased labor productivity and obtain more space to handle an increased business volume. These changes have resulted in lower operating margins in the wholesale grocery industry in spite of higher hourly wage rates.

A previous research report describes how improved work methods, balanced work crews, and better utilization of equipment would increase labor productivity in modern 1-floor warehouses. 2/ However, a large number of wholesale grocers operate their business out of multistory warehouses and small 1-floor warehouses with limited use of labor-saving devices. Many wholesalers believe they can operate in these older buildings that are fully depreciated at a lower total cost at their existing business volume than would be possible in a new modern 1-floor building.

The primary objectives of this study were: (1) To evaluate present methods and develop new methods for wholesale grocers to use in operating multistory and small 1-floor warehouses in order to increase warehouse labor productivity in receiving merchandise, selecting orders, checking, and loading assembled orders; (2) to show the effect of improved methods on warehouse

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1/ U. S. Department of Labor, Bureau of Labor Statistics, Monthly Labor Review Table C-1, Hours and Gross Earnings of Production Workers or Nonsupervisory Employees, Wholesale Trade. Average hourly earnings for this classification of workers have increased from $1.14 to $1.91 per hour during the 10-year period. Similar increases for grocery warehouse labor have probably taken place.

2/ Bouma, John C. Methods of Increasing Productivity in Modern Grocery Warehouses. U. S. Dept. Agr. Mktg. Res. Rpt. 94, 30 pp. June 1955.

labor costs; and (3) to illustrate the type of analysis needed to determine whether a new warehouse or new equipment will be economically justified.

Warehousing operations were observed in 75 grocery warehouses located in various sections of the country. Many references in this report are based on general observations made in these warehouses. Most of the study, however, relates to 9 typical firms whose operations were studied intensively. Industrial engineering techniques, such as time and ratio delay studies, were used in obtaining data on various segments of the warehouse operations in these 9 firms.

Separate discussions are presented on methods of receiving groceries and assembling orders in small 1-floor and multistory warehouses. Different methods are used, the method depending on size of warehouse, how merchandise is moved between floors, floor load limits, varying ceiling heights, and methods of preparing retailer orders.

Five of the nine firms studied intensively had 1-floor warehouses ranging in size from 11,000 to 31,000 square feet. Three of these warehouses received and shipped groceries with a conveyor system. The remaining 2 firms had a palletized operation. These firms had business volumes in dry groceries ranging from approximately 1 to 5 million dollars annually.

Four of the firms studied intensively had multistory warehouses ranging from 36,000 to 150,000 square feet in size with from 2- to 5-floor levels. Two of these warehouses operated with a conveyor system for receiving and shipping groceries. The other 2 firms operated with a partial pallet system, elevators, and hand stacking. The firms operating out of multistory buildings had business volumes in dry groceries ranging from approximately 3 to 17 million dollars annually.

The productivity of warehousemen in the various operations does not always reach the levels indicated by standard data in this report. Variations of actual productivity from standard data are usually due to the rate at which the warehouseman works or the performance of additional duties or delays in the operation. For example, an order filler may not work at a normal pace. Such factors as age, reading ability, coordination, and motivation may cause his production to deviate from the normal work rate. Merchandise not suitable for handling on a conveyor system may be placed on top of cases on the line or on the tailgate of a delivery truck by the order checker. The checker may also substitute correct merchandise for merchandise improperly selected and he may be called upon to handle and record merchandise returned by delivery truck drivers. A delivery truck loader may have to wait for the assembled orders before he starts loading. These factors will cause a variation in production from the standard data.

Many operations in this study are identical to those in the modern 1-floor warehouses previously studied in Marketing Research Report No. 94. Where applicable the standard data determined in the former study are used in this report.

THE RECEIVING OPERATION

The grocery warehouse receiving operation usually begins when merchandise is spotted at the receiving platform by the common carrier. The operation includes placing merchandise on a pallet or conveyor line, moving merchandise to the storage point, stacking it, and placing it in the assembly line for selection by order fillers. The receiving operation required more than 27 percent of the warehouse man-hours. More than twice as many tons of merchandise were handled per man-hour in the receiving operation than in the shipping operation; nevertheless, receipts still had to be transferred case by case from the rail car or motortruck to a pallet, conveyor, or handtruck. For wholesale grocers, the cost of case-by-case handling in receiving merchandise has been unavoidable, except when merchandise is received by motortruck and the driver places it on the pallets. 3/

Rail cars conveyed approximately 55 percent of the merchandise receipts; motortrucks the remaining 45 percent in the firms studied. Even though more than half of the receipts were by rail car, the proportion of receipts by motortruck has been increasing substantially during the past decade.

The chief advantage the wholesale grocers attributed to receiving by rail was the convenience of being able to unload rail cars when the warehouse workload was light, whereas motortruck receipts had to be handled immediately upon arrival. Wholesale grocers stated advantages of receiving merchandise by motortruck include: (1) Truck drivers usually palletize merchandise in the truck, or place the merchandise on a conveyor line while unloading, thus eliminating the need for the firm to bear this cost; (2) there is less damaged merchandise on motortruck receipts; and (3) damaged merchandise is more easily handled. Merchandise damaged during transit in motortrucks is usually sent back to the shipper on the same truck on which it arrived. Merchandise damaged in rail transit usually is piled in the warehouse for inspection before claim adjustment is made, thus taking up valuable space and contributing to aisle congestion.

Methods of Receiving Groceries

In the 9 warehouses studied, 5 firms used a conveyor system and 4 firms palletized the merchandise in the receiving operation. In the warehouses having a pallet system, merchandise was palletized in the rail car and in most warehouses was moved from the rail car to the storage area and stacked with a forklift truck. In the warehouses having a conveyor system, a portable extension was put in the car or motortruck and the same conveyor line was used for both receiving and shipping merchandise. A case diverter was used to move merchandise from the main conveyor line to the stacking point (fig. 1).

3/ A recent development is the construction of a unit-load rail car that may eliminate case-by-case handling in the unloading of rail cars. The first car built has 5 compartments with overhead doors, and can be loaded or unloaded with a fork truck. Savings in manpower requirements in loading and unloading the unit-load rail car should be substantial.

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Figure 1.--A case diverter used with a conveyor system to bring merchandise close to the stacking point.

Labor productivity with the pallet system was greater than with the conveyor system, 364 cases per man-hour as compared with 273 cases per man-hour (table 1). More labor is required with the conveyor system than with the pallet system because merchandise must be handled twice; once when it is placed on the conveyor line in the car or motortruck and again when it is stacked in the warehouse. With the pallet system, merchandise is handled only once, when it is placed on the pallet. It is transported and stacked as a unit load with mechanical equipment.

The findings shown in table 1 are based on a 1,600-case car of No. 2 canned goods, weighing 60,800 pounds. Merchandise was stacked in the warehouse 200 feet from the car leaving a space open for hand stacking merchandise from the conveyor line or for forklift stacking in pallet quantities. The hand stacking was not more than 8 feet high. With both systems, 1 man was used in the rail car, and with the conveyor system, another man stacked the merchandise in the warehouse.

Table 1.--Comparative time required to unload and stack a rail car containing 1,600 cases of No. 2 canned goods weighing 60,800 pounds with a pallet and conveyor system

Element	Pallet system	Conveyor system
	Man-minutes	Man-minutes
Obtain cases and place on conveyor		125.39
Moving conveyor sections in rail car		17.23
Obtain cases and place on pallet	142.40	
Moving loaded pallet out of car	35.80	
Bringing empty pallet into car	2.24	
Forklift time for transportation and stacking	49.10	
Hand stacking cases at storage point		146.12
Moving conveyor section at storage point		17.23
Total	229.54	305.97
Fifteen percent personal and fatigue allowance	34.43	45.90
Total man-minutes	263.97	351.87
Man-hours required	4.40	5.86
Cases per man-hour	364	273

As shown in table 1, it took 17.01 minutes longer to palletize the merchandise in the car than it did to place the merchandise on the conveyor line; 142.40 minutes compared with 125.39 minutes. This difference in time was caused by the need to place merchandise on the pallet in an interlocking pattern. An interlocking pattern is usually called a merchandise "block." Merchandise stacked in this pattern has less tendency to fall when piled high in the warehouse. Figure 2 shows merchandise that was not stacked with an interlocking pattern; 2 cases were damaged by a fall. Figure 3 shows a typical merchandise pattern for palletizing 50 cases containing 24 No. 303 cans on a 32- by 40-inch pallet. Similar patterns should be used in hand stacking merchandise in the warehouse from the conveyor line.

Effect of Delay Factors on Productivity in Receiving Merchandise

Three important factors contributed to excessive delay in the receiving of merchandise:

1. Waiting for a forklift to remove palletized merchandise from the car or motortruck. In the warehouses using the pallet system, 2 men palletized merchandise in the car. The loaded pallet was then moved directly to storage by a forklift. Time studies of this operation showed the palletizing crew spent an average of 34 percent of their time in waiting for the forklift to remove the loaded pallet to storage.

2. One crew waiting on another crew to complete stacking of merchandise. This delay was most significant in warehouses with a conveyor system, and occurred frequently in the rail car or motortruck when merchandise backed up on the conveyor line excessively. It required more man-hours to stack the

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Figure 2.--Hand piled merchandise that was not piled with a merchandise block. The 2 cases on the floor were damaged by falling.

merchandise than to place it on the conveyor line because it was usually necessary to shift merchandise to make space for the new stock and also more time was required to high stack the merchandise in the warehouse. Forklift operators spent nearly 15 percent of their time in removing palletized merchandise from rail cars waiting for the palletizing crew to finish a pallet load of merchandise. In many instances, the palletizing crew also had to wait for the forklift.

3. Delays caused by having too many workers on the job. Wholesalers operating in the smaller warehouses frequently assign their entire warehouse crew to the receiving operation after all of the retailer orders are shipped. This results in lower production per man-hour. In 1 warehouse, a standard time was established for palletizing cases of twenty-four 14-ounce catsup with a crew of 2, 3, and 4 men. The productivity for 2 men in palletizing the merchandise was 400 cases per man-hour; for 3 men, 324 cases per man-hour; and for 4 men, 289 cases per man-hour. In other words, on a production per man-hour basis, 2 men produced 38 percent more than a 4-man team and 23 percent more than a 3-man team.

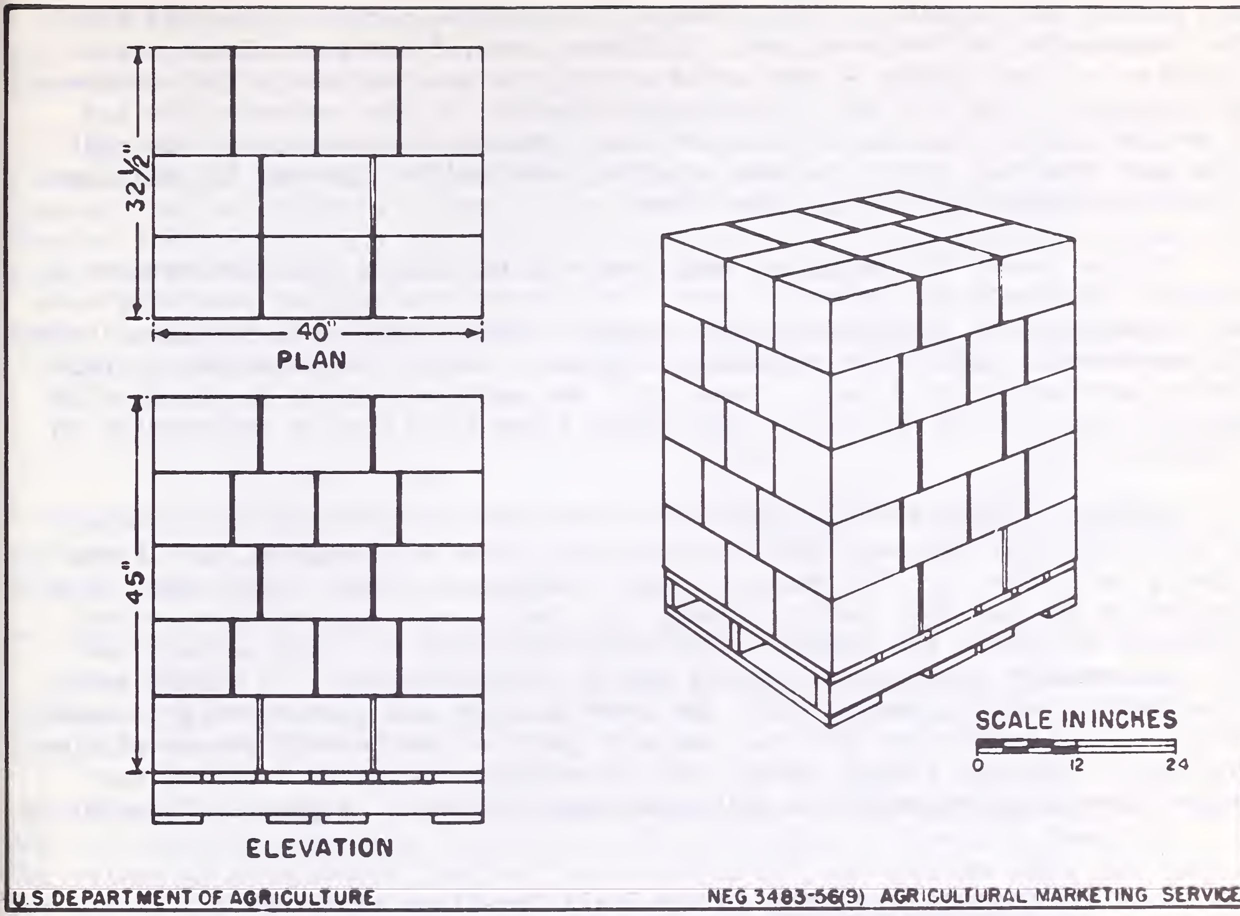

Figure 3.--A pattern for palletizing 50 cases of 24 No. 303 cans on a 32- by 40-inch pallet.

Improved Methods of Receiving Merchandise

The following methods were used to reduce the delays in the receiving operation in the firms studied. Delays caused by the palletizing crew having to wait for the forklift were eliminated by divorcing the palletizing operation from the forklift storing operation. This was accomplished by supplying the palletizing crew with a pallet jack in 1 firm and 4-wheel handtrucks in another to move palletized merchandise out of the car or motortruck onto the unloading dock for subsequent storage by the forklift. Sufficient room was provided near the rail car dock and l.c.l. dock for holding merchandise temporarily, before the fork truck moved it to storage, to eliminate aisle congestion in these areas. Two major advantages were gained by this separation: (1) It eliminated the waiting time by the palletizing crew for the forklift, or vice versa, resulting in increased production; and (2) it eliminated forklift delays caused by sharp turns on entering and leaving the car.

Delays caused by 1 crew waiting for another crew with the conveyor system of receiving merchandise were due to an improper balance between the number of men placing merchandise on the conveyor line and the number of men stacking the merchandise in the warehouse. In 1 warehouse, 2 men were placing merchandise on the line and 2 men were stacking the merchandise in the warehouse. By assigning 1 man the job of placing merchandise on the conveyor line and 3 men the job of stacking in the warehouse, an improved balance of the work crew was obtained, since the crew stacking merchandise also had to shift merchandise to make room for the new stock.

Delays caused by having too many men on a particular job were reduced by placing the excess men on other jobs. In 1 instance a regular receiving crew was established to eliminate delays caused by the necessity of handling incoming merchandise during the assembly operation. When 4 men were used to palletize merchandise in 1 car, 2 teams of 2 men each palletized merchandise in opposite ends of the car rather than using 4 men to palletize merchandise on 1 pallet.

Studies of the receiving operation have shown an increase of 38 percent in production per man-hour when 1 man working alone was compared with 2 men working as a team. 4/ The reasons 2 men working as a team produce less on a production per man-hour basis include: (1) Only 1 man was required in most instances to remove the loaded pallet and return with an empty pallet; and (2) team members get in each other's way in close quarters. In actual practice there is also a tendency for the team to adapt its rate of work to that of the slower member and the team members spend a considerable amount of time visiting. One man, though, should not be expected to unload a car of such heavy items as green coffee or 100-pound sacks of beans, sugar, or flour alone.

Grocery Receiving in the Small One-Floor Warehouse

The small 1-floor warehouse has several advantages over the multistory warehouse for efficient receiving of merchandise. Fewer man-hours are required to move merchandise horizontally to the storage point than horizontally and vertically as must be done in the multistory operation. The 1-floor warehouses observed also had proportionately more dock space for receiving merchandise from common carriers, resulting in less congestion around the dock and a more flexible workload schedule. More effective use of materials-handling equipment can be made in the small 1-floor warehouse than the multistory warehouse because of less restrictive floor load limits and wider column spacings.

Grocery Receiving in the Multistory Warehouse

In the multistory warehouse, merchandise had to be palletized or placed on the conveyor line, moved to the storage point, stacked, and placed in the order assembly line for selection by order fillers. An additional operation encountered was the transportation of merchandise between floor levels. This was accomplished in 2 of the warehouses by using a conveyor system and in

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4/ Marketing Research Report No. 94, p. 6 (see footnote 2).

2 others by using freight elevators. In the 2 warehouses using the pallet system and elevators, the elevator operating time accounted for more than 19 percent of the warehouse man-hours in the receiving operation.

Figure 4 shows a roller conveyor line with switches to direct the merchandise to the first-floor and second-floor levels. A belt conveyor line was used to move merchandise between floor levels in 2 multistory warehouses. Greater labor production per man-hour was achieved with the conveyor system in receiving merchandise in multistory warehouses (table 2).

Table 2.--Comparative labor productivity in the receiving of merchandise in multistory warehouses with the conveyor system and with pallets and elevators

Equipment used	Number of warehouses	Labor productivity
	Number	Tons per man-hour 1/
Conveyors	2	1.70
Pallets, elevators, and fork trucks	2	1.10

1/ The weight of receipts divided by man-hours for checking, unloading, transporting, stacking, and placing it in the order assembly line for selection by order fillers.

Man-hours required to operate elevators undoubtedly contributed to the low 1.10 tons per man-hour production with the pallet system and elevators. The volume of merchandise handled in the multistory warehouses using the pallet system and elevators was more than could be handled with a single line conveyor system. In addition to the use of elevators and forklift trucks in multistory warehouses with the pallet system of receiving merchandise, 4-wheel handtrucks were used for moving palletized merchandise from the rail car onto the elevator and to the proper floor level.

THE ORDER ASSEMBLY OPERATION

Order assembly in the grocery warehouse entails the grouping together of all merchandise ordered by the retailer from warehouse stocks. It includes picking up the invoice, selecting the merchandise from warehouse stocks, placing it on a handtruck, conveyor, or skid, moving it to the shipping dock, and selecting merchandise for individual orders at the shipping dock with 1 system of order assembly.

The warehouse man-hours used for the order assembly operation in the 9 warehouses ranged from 33 to 63 percent of the total warehouse man-hours, and averaged nearly 50 percent. The variation in percentage of man-hours between individual firms was largely due to materials-handling equipment, order assembly system, order size, and type of warehouse facility.

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Figure 4.--A roller conveyor system used for receiving merchandise from rail cars and motortrucks. Switches are used to direct merchandise to the proper floor level.

Materials-Handling Equipment for Order Assembly

The 2-wheel handtruck is still used extensively in many small 1-floor warehouses (fig. 5). It has the following advantages when compared with other materials-handling equipment: (1) Initial cost is low; (2) maintenance cost also is low; (3) narrower warehouse aisles can be used when compared with requirements for power equipment; and (4) it has versatile use in both receiving and shipping merchandise. For order assembly purposes, the 2-wheel handtruck has the following disadvantage which usually will more than offset the advantages. It will accommodate only a limited amount of weight and bulk, hence nearly 85 percent more travel time is required than with the 4-wheel handtruck.

The 4-wheel handtruck has the same advantages listed for the 2-wheel handtruck, plus the additional advantage of carrying approximately 3 or 4 times as much weight and bulk as the 2-wheel handtruck. In the order assembly

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Figure 5.--A 2-wheel handtruck of the type used in some grocery warehouses for receiving and shipping merchandise.

operation, this means fewer trips to the shipping dock with assembled orders. Handtrucks also have uses in addition to order assembly in the warehouse. Four-wheel handtrucks can be used in moving palletized merchandise out of rail cars for later storage by fork trucks (fig. 6).

Conveyor systems are used extensively for order assembly as well as for receiving. Four of the nine warehouses studied used conveyor systems for the assembly of merchandise. These firms employed electrically-powered belt boosters at intervals to re-elevate the merchandise to provide the necessary downgrade for gravity conveyors to operate between the selection points and the delivery truck. There are 2 basic types of conveyors used in grocery warehouses: (1) The wheel conveyor (fig. 7); and (2) the roller conveyor (fig. 8). Both types of conveyor operate satisfactorily in the grocery warehouse.

Some of the advantages of a conveyor system include: (1) Reduced travel time in order assembly, resulting in increased order filler production; (2) greater use of floor space because narrower aisles can be used when

BN-3133

Figure 6.--A line of 4-wheel handtrucks loaded with merchandise palletized in a rail car. The palletized merchandise will be moved to storage and stacked with a forklift truck.

merchandise receipts and shipments are made with a conveyor line; (3) use in buildings with floors too weak for a forklift operation; and (4) linking together separate buildings and different floor levels within 1 building.

A conveyor system has the following disadvantages: (1) Many items in the grocery warehouse such as sacked merchandise, brooms, and fragile case goods are not adaptable to conveyor handling and must be stored near the shipping dock for hand loading; (2) it is difficult to handle "call orders" along with the assembly of regular orders, and separate hours must be established for handling this business; and (3) it is more difficult to make full use of overhead space. An additional disadvantage of a conveyor system is that it has a more definite limitation on the number of cases that can be received and shipped on it in 1 day than other systems. This disadvantage would not ordinarily exist for grocery warehouses of less than 40,000 square feet.

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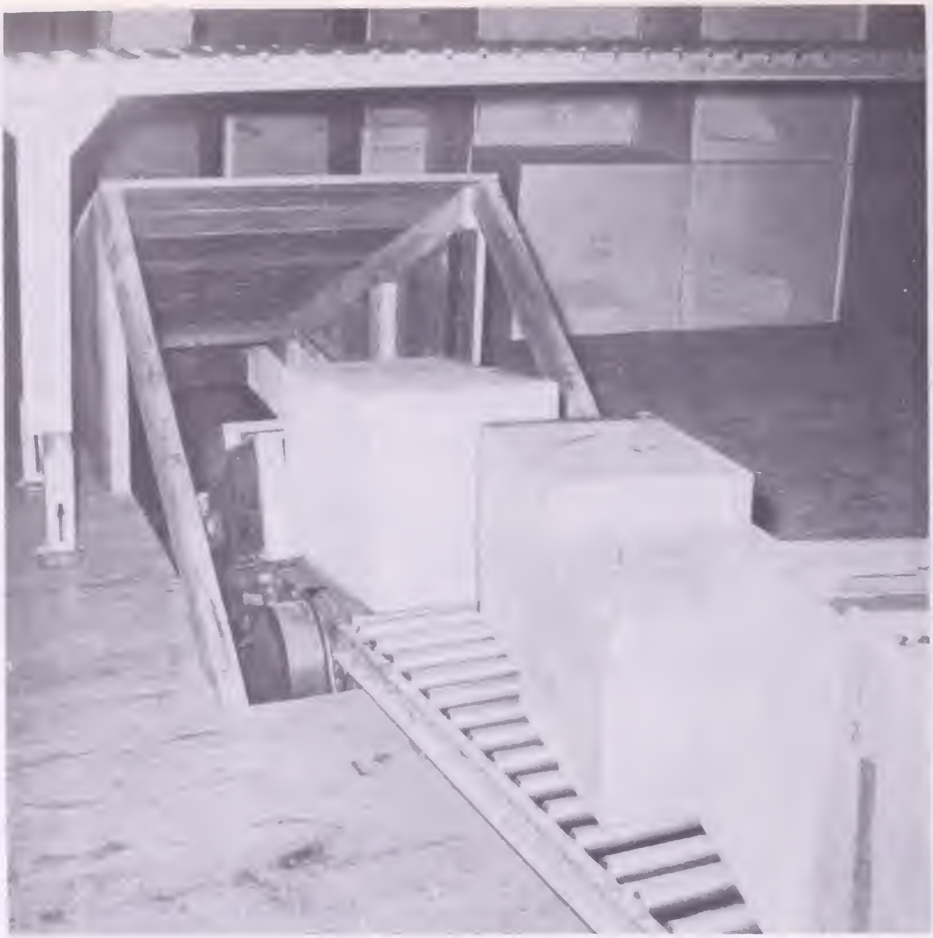
Figure 7.--A wheel type conveyor system in a 1-floor warehouse with electrically operated belt boosters to provide the necessary downgrade.

Systems for Order Assembly

Four systems of assembling orders were studied. The systems included:

System A - Truckload reassembled into individual orders.--With this system, the shipping clerk or another company employee prepared a tabulation of the number of cases of each item ordered for the truckload. The shipping clerk then sent a man out for a 2-wheel handtruck load and a second man for another handtruck load and so on for all merchandise going out on 1 delivery truck. The assignments continued with each order filler obtaining a number of cases of a particular item or as many as 4 or 5 items from warehouse stock until the total truckload of merchandise was stacked on the shipping dock near the tailgate of the truck. This merchandise was piled preparatory to reassembly into individual retailer orders and loading (fig. 9). The entire order assembly crew was then employed in unscrambling the individual retailer orders



BN-3135

Figure 8.--A roller type conveyor system near the down belt in a multistory warehouse.

and loading them in the truck. Figure 10 shows an order filler with part of a retailer order on a 2-wheel handtruck, waiting for the merchandise to be stacked in the truck.

System B - Individual retailer order assembly using 4-wheel handtrucks.--Invoices of orders to be loaded on each delivery truck were arranged in the sequence they were to be loaded. The invoices were then placed in the order box from which order fillers picked up enough invoices to make a load on a 4-wheel handtruck. The 4-wheel handtrucks usually carried from 25 to 35 cases. If more than 1 retailer order was to go on the handtruck, items for each order were placed in separate piles on the handtruck for easy checking.

System C - Shipping clerk calling items with conveyors.--The shipping clerk used a public address system to call items for order fillers to place on the conveyor line. A balanced work crew with this system included the shipping clerk, who, in addition to calling items to order fillers, checked the merchandise as it flowed into the delivery truck, 2 order fillers who placed merchandise on the conveyor line, and 1 delivery truck loader.

BN-3136

Figure 9.--Merchandise for a delivery truckload piled near the tailgate preparatory to segregating individual orders and loading.

System D - Order filler reading items with conveyors.--The warehouse order assembly area was usually divided into 4 selection areas and a repack room. Each retailer order was printed by automatic tabulating equipment with items grouped by selection areas. The order fillers placed the merchandise on the conveyor line in the sequence it was listed on the order. Usually all of the orders were placed in each section for 1 delivery truckload of merchandise. The orders were numbered in the sequence they were to be loaded. After assembly of the first order, the order filler started assembly of the second order, etc., until the load was complete. While order assembly was taking place, the checker usually controlled the flow of orders from each section and checked items as they flowed into the delivery truck.

Time studies were made on each of the systems of order assembly. Table 3 shows a comparison of the time required to assemble a 30-case order requiring 1,500 feet of travel using the 4 systems of order assembly.

Table 3.--Comparative time to assemble a 30-case order requiring 1,500 feet of travel using 4 systems of order assembly

Elements of order assembly	System A: Truckload reassembled into individual orders	System B: Individual retailer order assembly using 4-wheel handtrucks	System C: Shipping clerk calling items with conveyors	System D: Order filler reading items with conveyors
	Man-minutes	Man-minutes	Man-minutes	Man-minutes
Travel time	17.05	9.22	5.68	5.68
Selection time	6.48	3.24	4.65	4.65
Obtaining invoice and reading	--	1.09	--	1.09
Listening for item calls	3.82	--	3.82	--
Total time	27.35	13.55	14.15	11.42
Personal & fatigue allowance	4.10	2.03	2.12	1.71
Standard time	31.45	15.58	16.27	13.13
Cases per man-hour	57	116	111	137

BN-3137

Figure 10.--An order filler holding a 2-wheel handtruck while merchandise is being loaded in the delivery truck.

The total time shown in table 3 to assemble a 30-case order is divided into travel time (time to obtain selector truck and to go from 1 selection point to the next), selection time (time to obtain case and place on handtruck or conveyor line), time to obtain invoice and read it with the individual retailer order systems, and, with handtruck or conveyor systems, time for listening or waiting for shipping clerk to call items over the speaker.

Avoidable delay time for such elements as hunting for items, waiting for selector trucks, aisle blockage, forklifts, etc., was not included in the computations in table 3. Time spent in waiting for the shipping clerk to call items is included in the element "listening for item calls" (table 3) because this time was an unavoidable part of the operation.

Some of the advantages and disadvantages of each of the 4 systems were as follows:

System A - Truckload reassembled into individual orders.--Production of order fillers was 57 cases per man-hour with this system (table 3). The low productivity of order fillers with this system when compared with other systems is attributed to: (1) A greater amount of travel time because 2-wheel handtrucks will not carry as many cases as the 4-wheel handtrucks; (2) a greater amount of selection time--each item of merchandise must be selected twice; and (3) a greater amount of time was required to listen to the shipping clerk while items were called, than to read orders. Perhaps the greatest advantage of this system was that warehousemen with poor reading ability could be used to assemble orders.

System B - Individual retailer order assembly using 4-wheel handtrucks.--As shown in table 3, order fillers using this system for order assembly averaged 116 cases per man-hour in comparison with 57 cases per man-hour with system A. This increased production was due mainly to the reduction in travel time from 17.05 minutes to 9.22 minutes resulting from fewer trips and more merchandise per trip with the 4-wheel handtruck than with 2-wheel handtrucks. Only 1 selection of each item was necessary with this system, resulting in a decrease of 50 percent in selection time. Also order fillers spent about 71 percent less time reading items on the invoice than in waiting and listening while the shipping clerk called out items (1.09 minutes compared with 3.82 minutes).

System C - Shipping clerk calling items with conveyors.--Order filler production with this system averaged 111 cases per man-hour (table 3). The chief delay with this system was the time the order filler spent waiting and listening for the shipping clerk to call items. However, it was recommended that this system of order assembly be retained at 1 firm in which the study was conducted, due to the poor reading ability of order fillers, particularly on salesmen's handwritten invoices in that firm. With the use of preprinted order forms for order assembly, the problem of reading illegible handwriting would be reduced to a great extent. One of the disadvantages of this system was that the production of the entire shipping department was entirely dependent on the shipping clerk because he had to check the merchandise as it flowed into the delivery truck, in addition to keeping order fillers fully employed in assembling orders.

System D - Order filler reading items with conveyors.-- Order filler production averaged 137 cases per man-hour, the highest achieved with any system studied (table 3). This was the result of a decrease in travel time in comparison with handtruck systems and order fillers taking less time to obtain and read than when a shipping clerk called items over a public address system. Also the order fillers did not have to push loaded handtrucks, and walking at a faster rate reduced travel time. Selection time was greater than with the individual retailer order assembly using the 4-wheel handtruck system because order fillers had to carry cases a greater distance to conveyor lines than to a handtruck (table 3).

The Importance of Order Size on Order Filler Productivity

The productivity of order fillers increases as order size increases, largely because more of the total order assembly time is spent in selecting orders than is spent in travel.

Table 4 shows the productivity of order fillers in assembling 228 orders of various sizes in 2 warehouses. In 1 of these firms, order fillers read items with a conveyor assembly system and the other firm used the individual retailer order assembly with 4-wheel handtrucks.

Table 4.--Productivity of order fillers in the assembly of various size orders by 2 assembly systems

Order size	System B - Individual retailer order assembly using 4-wheel handtrucks		System C - Order fillers reading items with conveyors	
Cases	Cases per hour 1/	Orders timed	Cases per hour 1/	Orders timed
1 - 9	82	19	102	3
10 - 24	111	52	110	48
25 - 49	149	27	116	36
50 - 74	---	--	138	23
75 - or more	201	3	228	17
Total or weighted average	118	101	132	127

1/ Includes 15 percent personal and fatigue allowance.

Effect of Delay Factors on Order Filler Productivity

The productivity of order fillers, although largely dependent on the materials-handling equipment, the order assembly system, and the size of retailer orders, may be affected by many delay factors that prevent maximum output from being obtained. The following examples indicate how these factors, though often considered minor, become significant when the time loss is repeated over and over again.

In 1 small 1-floor warehouse using the individual retailer order assembly with 4-wheel handtruck system, it was found that order fillers spent an average of 5 percent of their time in waiting for items on the order to be assembled in the "valuables" or "repack room." Because items in the "repack room" are small and of relatively high unit value, 1 man was assigned the order assembly responsibility for these items and for maintenance of the stock. With the system used in this firm regular order fillers stopped at the "repack room" during the assembly of each order, handed the invoice to the "repack room" man, and waited for him to obtain the items on order. Investigation showed that 1 copy of the retailer orders was not used except for filing. Providing the "repack room" man with this copy to use in assembling items in his area before the regular order fillers arrived saved more than 3 man-hours per day.

Delays attributed to hunting for items and doubling back over routes previously traveled to pick up an item were frequent. These delays existed in all 9 of the warehouses, and averaged 12 percent of the order filling time. The warehouse locations were not numbered in any of these warehouses and orders did not list items in warehouse sequence. Orderly selection of merchandise was dependent upon the memory of order fillers. In 1 warehouse it was recommended that merchandise be placed in the warehouse selection area and on preprinted order books by family groups in accordance with warehouse layout. The order books would then be used in the assembly process and returned to the retailer with his order. The firm would keep a record of the number of cases shipped and dollar value of the order. This system also would reduce the amount of reading time by order fillers because orders would be in warehouse sequence and printed.

In some of the warehouses studied the cutting of cases for retail orders required from 1.5 to more than 8 percent of the order assembly time in the firms selling merchandise in less-than-case-lot quantities. The average time required to cut a case was 0.38 man-minute. Additional special handling, pilferage, breakage, and delays in truck loading and delivery of less-than-case-lots occurred in firms making such sales. The man-hour cost of performing this service was recovered in some firms by placing added charges on less-than-case-lot sales.

In 1 warehouse in which orders were called by the shipping clerk and assembled with conveyors, the order fillers spent approximately 15 percent of their time waiting for the shipping clerk to call for additional items. This delay occurred because there were more order fillers than the shipping clerk could keep busy and also check the merchandise as it flowed into the truck. By reducing the number of order fillers from 4 to 2, the firm saved 22 man-hours per week in the order filling operation. This saving was very important since much of it was in overtime man-hours.

In a warehouse with order fillers reading items with a conveyor assembly system, a considerable amount of the order filling time was spent in waiting for a work assignment, although the checker and loader were busy at all times. This delay was caused by an improper crew balance in the assembly, checking, and loading of orders. By reassigning areas in which each order filler assembled merchandise, the number of order fillers, including the repack room, was reduced from 5 to 4 men. Delay in waiting for orders was virtually eliminated and trucks were loaded in the same elapsed time with 4 order fillers as they were previously with 5 order fillers. Crew balance is an important factor in obtaining maximum productivity in all warehousing operations.

Time was wasted waiting for retailer orders in several of the firms studied. The delay in order filling time because of this factor in 3 warehouses ranged from 8.8 to 16.0 percent. To solve this problem in the warehouse having an 8.8 percent delay, an improved schedule was worked out for the warehouse workload as well as the office routine. The delivery schedule was arranged so that orders were in the warehouse a half day ahead of scheduled shipment. Improved crew balance, work organization, and warehouse management resulted from the new scheduling system. With this system, the workload by days of the week was more balanced although some retailers had to be induced to accepting delivery the second day rather than the first day, after placing their order. Before rescheduling the workload, enough order fillers were employed in this firm to handle the merchandise during the peak day of each week, resulting in labor not being fully utilized the other 4 days of the week. This situation existed in several of the other 9 firms studied. In 1 firm, the rescheduling of retailer orders resulted in a reduction in the number of regular order fillers from 14 to 13 men and also increased the production per man-hour.

In another firm with order fillers reading items with a conveyor assembly system, 7.3 percent of the order filler's time was spent in idleness waiting for the conveyor line to be cleared of merchandise, from filling prior orders. The productivity of order fillers and the checker exceeded the productivity of the truck loader who, in addition to loading, placed stop numbers on cases. This was corrected by having order fillers place the stop numbers on cases, resulting in increased productivity of the truck loader and a better work crew balance.

Approximately 7 percent of the order filling time was spent in waiting for 4-wheel selector trucks in 1 firm, because the supply of 4-wheel trucks was on the shipping dock awaiting unloading into delivery trucks. Orders were not assembled in the same sequence as they were to be loaded on delivery trucks. By coordinating the sequence of the 2 operations this excessive waiting was avoided and a total of 7 man-hours per day was saved in the order filling operation. This saving was accomplished by making the shipping clerk responsible for: (1) Arranging orders for each load; (2) assigning orders to order fillers; and (3) supervising the checking and loading operations.

Other order filler delays encountered during the study included: (1) Time spent in correcting mistaken order selections; (2) waiting caused by aisle blockage; and (3) time lost in waiting for a forklift to lower inaccessible merchandise or to bring merchandise to the selection area from reserve storage. These delays were not of major importance in the firms studied; however, they may be important in other firms.

Order Assembly in the Small One-Floor Warehouse

Although nearly 50 percent of the total warehouse man-hours was spent in the order assembly operation in the 9 firms, only 39 percent was required in the 5 small 1-floor warehouses. The reason for the smaller percentage is that order fillers assembled orders in a smaller area in 1-floor warehouses than in the multistory buildings and selection took place on 1-floor level. Only 1 of the 5 small 1-floor warehouses used automatic tabulating equipment for printing retailer orders; the remaining 4 firms assembled orders from invoices written by salesmen.

Order Assembly in the Multistory Building

The warehouse man-hours employed in the order assembly operation in the 4 multistory warehouses ranged from 46 to 63 percent of the total warehouse man-hours, or an average of 54 percent compared with 39 percent in the small 1-floor warehouses.

The systems used in the multistory warehouses were: (1) Individual retailer order assembly using a 4-wheel handtruck; and (2) order filler reading items with conveyor assembly. In the 4 multistory warehouses, order fillers read the retailer orders themselves and worked individually in assembling merchandise from warehouse stocks. A larger part of the total warehouse man-hours was required to assemble orders in the multistory warehouses than in the small 1-floor warehouses because of greater travel distance and elevator time. Table 5 shows the influence of elevator time on the productivity of order fillers in the assembly of a 30-case order.

Table 5.--Comparative time to assemble a 30-case order requiring 1,500 feet of travel in multistory warehouses and with elevators and conveyor lines

Elements of order assembly	System B - Individual retailer order assembly using 4-wheel handtrucks with elevators	System C - Order fillers reading items with conveyors
	Man-minutes	Man-minutes
Travel time	9.22	5.68
Selection time	3.24	4.65
Elevator time 1/	2.09	--
Obtaining invoice & reading	1.09	1.09
Total time	15.64	11.42
Personal and fatigue allowance	2.35	1.71
Standard time	17.99	13.13
Cases per man-hour	100	137

1/ Includes time to get elevator to the floor, open door, push in 4-wheel handtruck, close door, elevator time to rise 1 floor, open door, remove 4-wheel handtruck, close door, and to repeat the same elements on the return trip.

Order fillers assembled 100 cases per man-hour with the use of 4-wheel trucks and an elevator to move to the second floor (table 5). The order filler would assemble 16 percent more, or 116 cases per man-hour, when elevators were not required and the assembly of orders took place on 1 floor with 4-wheel handtrucks (table 3). The number of man-hours required to move merchandise from floor to floor in multistory warehouses varies with the volume of merchandise, number of warehouse floors, and the system of operating elevators. In 1 firm cooperating in this study, 3 men were employed to operate elevators. This firm could easily determine the added cost of handling merchandise into and out of the warehouse because of the constant number of man-hours required to operate elevators.

Some disadvantages, in addition to elevator costs, in the multistory building when compared with the 1-floor building are: (1) Lower stacking heights; (2) restrictive load limits on floor; (3) problems in placing merchandise due to supporting posts; (4) inability to use modern materials-handling equipment to the greatest advantage; and (5) difficulty in supervising and coordinating the warehouse workload with the crew divided between several floors.

CHECKING ASSEMBLED ORDERS

An average of more than 14 percent of the warehouse man-hours in the 9 firms was used to check assembled orders. In checking orders, the item description and number of units of each article ordered were compared with the items assembled. The percentage of warehouse man-hours spent in checking orders varied from 8 to 28 percent in the individual firms. The wide variation in percentages of warehouse man-hours is primarily attributed to systems of checking orders and work methods used.

Systems Used and Methods of Increasing Productivity in Checking Orders

During this study, the productivity of order checkers was measured by systems and methods used. With order assembly system A, the truckload reassembled into individual orders, the checker or shipping clerk checked several items after calling them to a laborer who placed the items on a short conveyor line (fig. 11) or a 2-wheel handtruck and pushed them into the truck for loading (fig. 10). When 2-wheel handtrucks were used for loading, this procedure was usually followed in cycles with 3 to 4 laborers picking up the items on the dock and moving them into the trailer. With this method, 418 cases per man-hour were checked (table 6).

Table 6.--Comparative productivity with 4 methods of checking retailer orders

Method	Checkers required	Time per case 1/	Cases per man-hour
	Number	Man-minutes	Number
Checking from assembled truckload......	1	0.1436	418
Unarranged order on 4-wheel handtruck..	2	0.1194	502
Arranged order on 4-wheel handtruck....	1	0.0497	1,208
Arranged order on conveyor line........	1	0.0502	1,196

1/ Includes 15 percent personal and fatigue allowance.

BN-3138

Figure 11.--A short conveyor line used to reassemble merchandise into individual retailer orders and load it in a delivery truck.

When order fillers assembled individual retailer orders on a 4-wheel handtruck in an unarranged fashion, the productivity in the checking operation with 2 men checking was increased 20 percent, from 418 cases to 502 cases per man-hour (table 6). With this system, 1 checker called out the items ordered and checked the side of the 4-wheel truck facing him while the other checked his side of the 4-wheel truck. A mark was placed on each case when found. Figure 12 shows 2 men checking an assembled order that is unarranged on a 4-wheel handtruck.

When 1 man checked arranged orders on 4-wheel handtrucks, production per man-hour more than doubled, or increased from 502 to 1,208 cases per man-hour, over having 2 men check unarranged orders as a team (table 6). To arrange orders on a 4-wheel truck, order selectors placed the first half of the invoice items on 1 side of the 4-wheel truck and the remaining half on the other side, eliminating the necessity of searching for each item on both sides of the selector truck. By having each man work individually, delays due to 1 checker waiting for the other were eliminated, resulting in increased production. In

BN-3139

Figure 12.--Two men checking an unarranged order assembled on a 4-wheel handtruck.

the 2 firms using the unarranged orders on 4-wheel handtruck method of checking, the number of checkers was reduced from 6 to 3 by the adoption of the arranged orders method of checking.

With 1 man checking merchandise arranged on the conveyor line (fig. 13), the productivity of order checkers was 1,196 cases per man-hour, about the same as in checking orders arranged on 4-wheel trucks. To arrange orders on conveyor lines, order selectors placed invoice items on the conveyor line in the same sequence as they appeared on the invoice. This enabled 1 man to check merchandise accurately as well as rapidly.

Evaluation of the Checking Operation

Some of the firms cooperating in the study duplicated their efforts, or double checked assembled orders. For example, the order fillers checked the assembled orders by piece count and item description and the order was again checked by a regular order checker. In these instances, the double checking

BN-3140

Figure 13.--One man checking an arranged order assembled on a conveyor line.

of all orders resulted in unnecessary work because of the small number of errors found in the second check.

With a good order assembly system some wholesalers question the value of checking all orders by both piece count and item description because so few order filler errors are discovered in such a check. One method of deciding how much checking should be done is to determine the cost of discovering errors and to weigh the cost against the need to eliminate such errors from the retailer's order. In 1 firm studied previously, this type of analysis led to the practice of sample checking. 5/

5/ Marketing Research Report No. 94, p. 19 (see footnote 2).

The use of sample checking and case counting 6/ has the following advantages: (1) It keeps order fillers from getting careless; (2) it can be used as a means of detecting order fillers who are careless or error prone; (3) reduced labor cost can be accomplished; and (4) if a case count is made on all orders, retailers can be trained to accept orders on that basis which would result in reduced labor cost in the delivery operation. Retailer complaints for incorrect merchandise received would be handled by the wholesaler who would supply the correct merchandise for the merchandise received in error. The use of sample checking and case counting on assembled orders can be readily utilized in those wholesale grocery firms having good working relationships with their customers.

LOADING ORDERS ON DELIVERY TRUCKS

The loading operation required nearly 9 percent of the total warehouse man-hours in the warehouses studied. This function, performed after the completion of the checking operation, involves the loading of merchandise in trucks for delivery to retail stores. Both straight-body and tractor-trailer trucks were used for delivering orders from the warehouses. The warehouse man-hours spent in loading orders varied from 6 to 18 percent and was directly related to the work methods and equipment used in the various firms.

Methods and Equipment for Loading Trucks

Delivery trucks were loaded either by a 2-man team or by 1 man alone. Merchandise to be loaded on trucks reached the loading area either by conveyor line or 4-wheel selector trucks. Table 7 shows a comparison of the productivity of truck loaders using various loading methods and equipment. Production data shown in table 7 includes time to obtain the loaded 4-wheel handtruck, push it inside the delivery truck and position it, to load the merchandise in the delivery truck, and push the empty 4-wheel handtruck out of the delivery truck. Time was allowed for placing the bridge plate between the dock and delivery truck with the 4-wheel handtruck system and setting up and taking down the conveyor line with the conveyor system.

Table 7.--Comparative productivity of truck loaders working singly and as a 2-man team when loading from 4-wheel handtrucks and conveyor lines

Loading method	Number of men	Standard loading time per case 1/	Cases loaded per hour	Cases loaded per man-hour
		Man-minutes	Number	Number
Selector trucks inside delivery truck	2	0.071	846	423
	1	.107	562	562
Conveyor line extended into delivery truck (merchandise placed on conveyor line by order fillers)	2	.052	1,154	577
	1	.085	707	707

1/ Includes 15 percent personal and fatigue allowance.

6/ For a complete description of sample checking and methods of determining whether a check is worthwhile, see Mktg. Res. Rpt. No. 13, Prod. & Mktg. Admin., U. S. Dept. Agr., 1952, page 23.

One man in loading delivery trucks from a 4-wheel handtruck averaged 562 cases per man-hour, while 2 men working as a team averaged 423 cases per man-hour (table 7). The production per man-hour with 1 man was 139 cases greater, or almost 33 percent more than when 2 men worked together using the same method. Lower production per man-hour with a 2-man team was obtained because: (1) Team members get in the way of each other in close quarters; and (2) only 1 man is required to remove the empty and to push in the loaded selector truck in most instances. In practice too, there is a tendency for the team to adapt its rate of work to that of the slower member and members of the team spend a considerable amount of time visiting. Figure 14 shows a 2-man team loading a delivery truck from a 4-wheel selector truck.

BN-3141

Figure 14.--Two men loading merchandise in a delivery truck from a 4-wheel handtruck.

Productivity of 1 truck loader was 707 cases per man-hour. Two loaders working as a team put out 577 cases per man-hour when a conveyor line was run directly into the truck from the selection area. The production per man-hour of 1 man loading from a conveyor line was 130 cases greater, or almost 23 percent more, than when 2 men worked as a team using the same method. For a balanced work crew with a conveyor system, 2-man loading is seldom necessary.

In most instances 3 order fillers, 1 "repack room" man, 1 checker, and 1 loader constitute a balanced work crew with the conveyor system.

One man using a conveyor to load the delivery truck handled 145 cases per man-hour more than when a 4-wheel selector truck was used. Increased productivity with this system resulted because the truck loader did not have to push the 4-wheel selector truck into and out of the delivery truck. Figure 15 shows a conveyor line that is run directly into a delivery truck from the selection area. When using the conveyor system for receiving and shipping merchandise, only 1 truck can be unloaded or loaded at a time with a single conveyor line.

BN-3142

Figure 15.--Merchandise placed on the conveyor in the selection area is being loaded in the truck from the same conveyor.

Factors Affecting Productivity in the Loading Operation

The amount of space available at the loading dock for holding orders assembled on 4-wheel selector trucks affects the output of warehousemen in the loading operation. A well-planned shipping area with adequate operating space will help truck loaders achieve a higher production level than could be attained with a dock that is frequently congested.

The height of the dock in relation to truck-bed level also is an important factor affecting the efficiency of the loading operation. At 1 of the multistory warehouses studied intensively, the shipping dock was below the warehouse floor level and above truck-bed level. Because of this, 2 men were required to maneuver a loaded 4-wheel truck into the delivery truck for loading. It was recommended to this firm that the dock be removed and the truck parking area be raised so that truck beds would be at shipping floor level. This recommendation was made because there was not sufficient room for easy tractor-trailer parking with the existing dock and orders were loaded directly into trucks without using the dock for holding space. Advantages of the proposed changes included: (1) Additional area for truck maneuvering and parking; (2) order filler trucks could then be easily pushed directly into the trailer for unloading by 1 man instead of a 2-man team. Figure 16 shows 2 truck loaders maneuvering a loaded selector truck into a delivery truck. The effort required to accomplish this job is obvious.

BN-3143

Figure 16.--Two men maneuvering a loaded 4-wheel selector truck down into a delivery truck. (View is from inside the truck.)

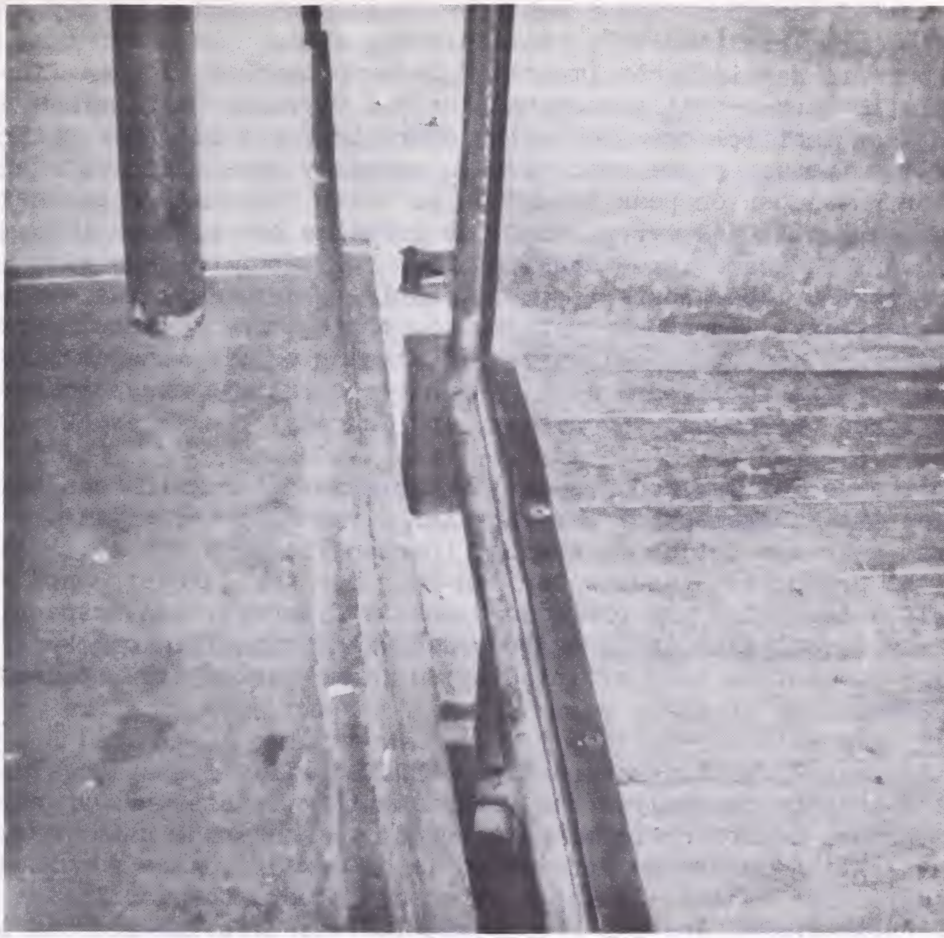
Crew scheduling plays an important part in the efficiency of the truck loading operation. In 1 firm, productivity of truck loaders during a time study averaged 443 cases per man-hour, excluding delays, while on the basis of an 8-hour shift the loaders averaged only 330 cases per man-hour.

The difference in production was primarily attributed to delay caused by lack of work, particularly at the beginning of the shift. When truck loaders reported for duty 1 hour later than order fillers working the same shift, the productivity of loaders was substantially increased through reducing the amount of idle time at the beginning of the shift and, at the same time, reducing overtime in getting trucks loaded after the end of the regular shift.

Figure 17 shows a truck loader carrying cases from a 4-wheel selector truck into the delivery truck. This system of loading trucks was used in 1 firm because they did not have a dock board to span the gap between the loading dock and truck-bed (fig. 18). By installing a dock board between the dock and truck-bed, the truck loader could push the 4-wheel selector truck inside the delivery truck for unloading. The productivity of the truck loader was increased almost 54 percent, from 365 to 562 cases per man-hour.

BN-3144

Figure 17.--A truck loader carrying cases from a handtruck into a delivery truck.



BN-3145

Figure 18.--A dock board can be used to span this gap between the dock and truck-bed to facilitate pushing handtrucks inside the delivery truck.

EVALUATION OF THE EXISTING WAREHOUSING OPERATION

While this report has been primarily concerned with obtaining efficient warehousing operations through use of improved equipment and work methods, previous research on grocery warehousing revealed the importance of such factors as retailer cooperation, employee motivation, warehouse cost control programs and planned warehouse organization on the productivity of warehousemen. 7/ Warehouse management controls in addition to those mentioned in the previous report are: (1) Relationship of overtime labor to regular labor costs; (2) utilization of square and cubic warehouse footage; (3) cost comparison of operations on a 1-, 2-, or 3-shift basis; and (4) the importance of transportation methods used for inbound and outbound merchandise on warehouse layout.

7/ Marketing Research Report No. 94, p. 24-28. (See footnote 2.)

The cost of warehouse labor must be closely controlled if a profitable operation is to be realized by warehouse management. The labor cost of overtime man-hours is particularly important because payment of this labor is usually at the time-and-a-half hourly wage rate. Overtime work, as such, does not indicate an inefficient warehousing operation, but it does require management control. The warehouse operation is normally more efficient when there is some overtime labor on peak volume days. With fluctuating business volume, both inbound and outbound merchandise, no overtime or variance in daily warehouse man-hours indicates an excessive amount of labor on days with low volume. By the same token, labor costs become excessive when a firm has overtime work occurring every day. Thorough analysis of working crew balance, work scheduling, order processing, and order delivery will usually enable management to solve the problem satisfactorily and will do much to eliminate excessive overtime and heavy work loads on Tuesday, Wednesday, and Thursday of each week.

Effective use of warehouse space is another factor which can be evaluated. For example, the management of a particular firm might feel that the warehouse tons per man-hour are not up to average (perhaps records are available which show that the production figures per man-hour for the current month are as much as half a ton below the preceding month's figures). An inspection of the warehouse may reveal that it is overcrowded with much aisle blockage; the warehouse cubage may not be used efficiently; or some factor has impaired the operating system.

The action program and the results achieved will depend largely upon management's ability to analyze the situation that exists through careful study and through use of corrective measures. A measuring unit frequently used for evaluating warehouse congestion is dollars of sales per square foot of usable warehouse space. During 1 warehouse study, the facilities were found to be overcrowded and the recommendation was made and adopted that merchandise turnover be used as a guide in placing orders for replacement stock. Analysis of this type may lead to the removal of some items from stock. Purchases of merchandise in quantities larger than requirements for good turnover and stock rotation result in multimerchandise handling, warehouse aisle congestion, decreased employee morale, increased warehouse breakage, and therefore, increased operating costs. The personnel responsible for buying and scheduling shipments of incoming merchandise were kept informed on item turnover and warehouse space availability so that they were able to place orders for the most economical quantities of warehouse merchandise.

The hours of warehouse operation should be considered by management during its evaluation of the existing operation. Several of the wholesale grocery firms studied handled "will-call" orders and received merchandise during the daytime shift and assembled orders for shipment during a night shift. This arrangement proved to be more efficient than a single-shift operation from both the labor cost and the production per man-hour standpoints.

In 1 warehouse study, it was recommended that the operation be changed from a 2-shift basis to a 3-shift basis by revising work schedules. During the study, 21 men worked an average of 54 hours per week each. This amounted to 1,134 total man-hours per week, and meant that 294 man-hours were paid for at the time-and-a-half hourly wage rate. With improved work methods developed during the study plus the development of three 8-hour shifts in the warehousing operation, the 21 men each worked 40 hours per week, eliminating the 294 hours of weekly overtime. This change was accomplished without having to hire any additional supervisory help. With the 3-shift system of operation, it was possible to develop greater flexibility in the warehouse operation since more men acquired skills for operating forklift trucks and other equipment.

In an evaluation of the existing warehousing operation, the portion of merchandise receipts by motortruck and rail car should be considered and present dock space used for rail receipts compared with present dock space used for truck receipts. Almost every warehouse studied during this research project was built when a larger part of the merchandise receipts were by rail car. The resulting ratio of rail dock space to motortruck dock space had no direct relationship to the ratio of rail traffic to motortruck traffic. The volume of merchandise handled per square foot of dock space was far greater for motortrucks than for rail cars and congested dock space frequently occurred at the motortruck docks while relatively little use was being made of the rail dock space.

EVALUATION OF THE EXISTING WAREHOUSING FACILITY

Many wholesale grocers question the adequacy of their existing warehouse and wonder if they should build a new one. The answer to this question requires a realistic appraisal of the individual firm's present and potential business volume, as well as estimated costs in the present warehouse compared with those estimated for a new facility. The purpose of this section is to outline the type of analysis needed to answer the question.

The basic purposes of the grocery warehouse are: (1) To provide the merchandise stored in it with shelter, and protection from rodents and theft; and (2) to provide adequate facilities for efficient handling of inbound and outbound merchandise. Almost every warehouse will provide shelter and protection without major expenditures. It is the need for efficient handling of merchandise that raises questions in the minds of wholesale grocers concerning their existing warehousing facilities.

The usual definition of warehousing cost includes fixed and variable costs. Fixed costs for warehousing include, among others, taxes, insurance, and facility cost. Facility cost includes either rental of a leased building, or interest and depreciation on an owned building. These costs remain relatively constant in dollar value regardless of how much merchandise passes through the building. Many wholesalers operating out of multistory buildings have owned their warehouses for a long time and the buildings are fully depreciated and unencumbered.

Variable costs constitute the greater proportion of the total warehousing costs and vary with the volume of business done. Of more importance, however, since labor is the biggest item in warehousing, is the fact that labor cost may be greatly reduced through improved work methods, use of various equipment, and warehouse layout - including the construction of new facilities. Many grocery warehouses have been built and paid for on labor savings accomplished through more efficient operations in a new warehouse.

The wholesaler operating a multistory warehouse that is fully depreciated wonders if his total warehousing cost could be lowered in a new warehouse. A wholesaler with this situation has a low facility cost and a high labor cost. By comparison, the facility cost, with a new warehouse, would be relatively high and labor cost low. The problem is to determine whether or not the increased facility cost of a new building will be offset by decreased labor costs.

Three case studies were made of this problem in typical firms with multistory warehouses of different sizes. The studies show the nature of the problem, the type of analysis made, and the actions taken by these firms based on the analysis.

Case A

This wholesaler sponsored a voluntary group of retailers. The warehouse was 25 years old and had approximately 40,000 square feet of warehouse space divided equally between 2 floors. Merchandise, both in receiving and shipping, was handled on 4-wheel handtrucks. A freight elevator was used to move merchandise between the 2 floors. In addition to the grocery warehouse, outside storage was rented at a cost of $6,000 per year to accommodate the grocery inventory. The business volume was approximately $2.5 million in dry groceries annually. Eighteen warehousemen were employed at an annual cost of $4,500 each.

The business volume had shown a steady growth for several years. However, the possibility of continued growth in business volume was limited because of the current high cost of operation and competitive conditions in his market area. This wholesaler believed his existing warehousing cost was too high. Analysis of this problem revealed 2 possible alternatives: (1) Build a new warehouse; and (2) remodel or modernize the existing warehouse.

Estimated costs were obtained for the construction of a new 1-floor 30,000 square foot warehouse, equipped to efficiently handle the existing business volume. Estimated cost of the land, building, including office space, and pallet racks totaled $220,000. Amortizing a loan of $220,000 for a 20-year period at 4.5 percent interest would cost $16,698 per year. Additional equipment needed in the new warehouse would include 2 forklift trucks at an estimated cost of $3,000 each and 5,000 pallets at a cost of $3.00 each. The cost of this equipment would total $21,000 and would be depreciated over a 5-year period at the rate of $4,200 annually. Estimated annual insurance and taxes in the new warehouse would total $4,510. Table 8 shows a comparison of estimated annual warehousing costs in a new warehouse compared with existing costs.

Table 8.--A comparison of annual warehousing cost in a 40,000 square foot multistory warehouse with estimated cost in a new 1-floor warehouse with a business volume of $2.5 million - Case A

Annual expense item	Existing warehouse	New warehouse
	Dollars	Dollars
Facility cost	6,000	16,698
Equipment depreciation	---	4,200
Insurance and taxes	4,550	4,510
Supervision	6,500	6,500
Labor	81,000	40,500
Total expense	98,050	72,408

It was estimated that the new warehouse could be operated with half as much labor, or a crew of 9 men (table 8). Comparing his existing warehouse costs with the projected estimates, the wholesaler's annual saving would total more than $25,600 8/ in a new warehouse.

A study was made by the firm of the possibility of reducing warehousing cost in the existing facilities by modernizing them through the installation of conveyor equipment. This study revealed that with existing warehousing methods, 40 percent of the warehouse floor space was taken up by aisles and shipping dock storage area for the 4-wheel handtrucks. With a conveyor system, only 18 percent of the floor area would be utilized for conveyors, and holding area for 4-wheel handtrucks would not be needed. The added space gained from aisles would adequately take care of merchandise in outside storage that cost $6,000 annually to rent, and an additional 24,000 cases could be placed in the warehouse. Because clear stacking height in the warehouse totaled only 12 feet and the floor load limit was restricted on the second floor, the use of high stacking materials-handling equipment was not justified.

The estimated cost of a complete conveyor system installation was $20,591 and depreciation over a 5-year period would total approximately $4,200 annually. It was estimated that with the conveyor system, a warehouse crew of 12 men would be required compared to 18 men with the existing warehousing methods. A comparison of the cost with the existing methods and with a conveyor system in the existing warehouse is shown in table 9.

8/ This and comparable savings shown in cases B and C would be somewhat larger if allowances were made for the value of the land and buildings at the end of the 20-year amortization period and for the market value of the old facilities, the proceeds of which, if applied to the cost of the new facilities, would reduce the annual amortization payments.

Table 9.--Estimated annual warehousing cost using present methods compared with a conveyor system in a 40,000 square foot multistory warehouse with a business volume of $2.5 million - Case A

Annual expense item	Present methods	Conveyor system
	Dollars	Dollars
Facility cost	6,000	---
Equipment depreciation	---	4,200
Insurance and taxes	4,550	4,550
Supervision	6,500	6,500
Labor	81,000	54,000
Total expense	98,050	69,250

As shown in table 9, estimated annual saving of $28,800 in warehousing cost would be possible with the installation of a conveyor system in the existing warehouse compared with an estimated annual saving of approximately $25,600 in a new 1-floor warehouse. The wholesaler decided to install the conveyor system in the existing warehouse for the following reasons: (1) The immediate potential annual saving would be greater with the conveyor system; (2) less capital investment would be required; (3) more capital would be available to develop additional retail accounts; (4) the existing warehouse was in very good condition and would require little maintenance cost in the near future; and (5) a new 30,000 square foot warehouse would meet the need for efficient handling of the present business volume but would require expansion as business volume increased. He believed an improved warehouse could be built at a later date to more nearly meet the future needs of the company.

A conveyor system was installed at a cost of $19,955 or $636 below the estimated cost. The number of warehousemen, through use of good work methods and the conveyor system, was reduced from 18 to 11 men, hence the annual saving with the conveyor system actually totaled more than $33,000. The company is now in the process of developing new retail accounts for added business volume. The case history illustrates the type of planning and thinking used by 1 firm in evaluating the existing warehousing facility.

Case B

This wholesaler sponsored a voluntary group of retailers operating supermarkets and also a group of smaller store operators. Grocery warehousing space totaled approximately 47,000 square feet. The main warehouse had 32,000 square feet on 3 floor levels. The remaining warehousing space was in 3 separate buildings. All of the buildings are old although they have been well maintained. Annual business volume per 1,000 square feet of warehouse space was greater than for any of the other multistory warehouses studied. The company owned the existing warehouse buildings and business volume had grown to approximately $8 million annually in groceries. In addition to groceries, the company supplied frozen foods to its retail customers.

By operating 24 hours daily, the company had been able to perform the warehousing operation although many inefficiencies existed. Continually bringing merchandise from reserve storage in other buildings, selecting merchandise from different floor levels, limited operating space hampering use of labor saving materials-handling equipment, and frequent rehandling of merchandise made the existing warehousing operation inefficient from a labor-cost viewpoint.

The company's business volume has been showing rapid growth in recent years. Directors of the firm believed considerable business growth was possible in the territory with good management and hard work. The possibilities of building a new warehouse or extending the size of the existing structure were limited because the firm did not own enough land at the present site and additional land would prove costly because the buildings now on it would have to be removed.

An 8-acre tract of land next to a railroad with good highway accessibility was located about 3 miles from the existing warehouse. Estimated costs were obtained for the construction of a new 1-floor 80,000 square foot warehouse, equipped to efficiently handle a business volume potential of $12 million annually. Estimated cost of the land, building, including office space, railroad siding, and pallet racks totaled $525,000. Amortizing a loan of $525,000 for a 20-year period at 4.5 percent interest would cost almost $39,850 per year. Additional equipment needed in the new warehouse would include 1 new forklift truck, in addition to the 2 now owned, at an estimated cost of $3,000; 4,000 pallets at $3.00 each; 3 small tow tractors at approximately $1,200 each; twenty-five 4-wheel trucks at $65 each; and refrigeration equipment for the frozen food area. The total cost of this equipment would be about $35,000 and would be depreciated over a 5-year period at the rate of $7,000 annually. Estimated annual cost of insurance and taxes in the new warehouse would total $4,500. Table 10 shows a comparison of estimated annual warehousing costs in a new warehouse compared with existing costs.

Table 10.--A comparison of annual warehousing cost in a 47,000 square foot multistory warehouse with estimated cost in a new 1-floor warehouse with a business volume of $8 million - Case B

Annual expense item	Existing warehouse	New warehouse
	Dollars	Dollars
Facility cost	8,000	39,850
Equipment depreciation	---	7,000
Insurance and taxes	7,100	4,500
Supervision	6,500	6,500
Labor	88,452	38,329
Total expense	110,052	96,179

In the existing warehouse, a total of 58,968 man-hours were required to handle the inbound and outbound tonnage; an average of 21 warehousemen worked 54 hours per week. Assuming an hourly wage rate of $1.50, annual warehouse labor cost totaled $88,452. In a new warehouse where more materials-handling equipment could be used, a total of 25,553 man-hours would be required. With an hourly wage rate of $1.50, estimated annual warehouse labor cost would total $38,329 - an average of 12 men working 40 hours per week could handle the existing business volume in the new warehouse.

A potential saving of more than $13,000 annually in warehousing cost led this wholesaler to conclude that a new warehouse should be built. His decision was influenced by the following factors: (1) The new warehouse would provide facilities for handling an increased volume of business; (2) it would provide for the consolidation of a smaller branch warehouse with the main warehouse for increased efficiency and control in warehousing and office procedures; (3) with the new building, warehouse labor would become increasingly efficient as the business volume increased. In the existing warehouse, labor efficiency would decrease as volume increased; (4) additional cooler space would be provided for frozen food; (5) land would be available for construction of a produce warehouse when the firm is ready to enter the business; and (6) the new warehouse would provide additional prestige with customers and with the public. Plans for immediate construction of a new warehouse have been made by this wholesaler.

Case C

Six voluntary groups of retailers are sponsored by this company. The groups vary as to store size, location, and amount of cooperation between the wholesaler and each group. The company operates out of 5 buildings in a congested city area. However, the major warehousing functions are conducted in 2 main buildings placed side by side with a rail siding running the full length between them. The buildings are connected by bridge plates that span the siding at 2 separate doors on the first and second floor levels. The older and larger structure was built in 1928, and has approximately 100,000 square feet of warehouse space on 5 floor levels. The newer building is about 7 years old and contains approximately 40,000 square feet of warehouse space divided between 3 floor levels. Incoming merchandise is palletized and handled out of the rail cars and motortrucks with fork trucks. Outgoing merchandise is assembled on 4-wheel handtrucks. Three elevators are used for interior transportation of merchandise between floor levels. The business volume totals approximately $17 million annually in dry groceries.

The business has had a steady growth since its beginning. However, the possibility of continued growth is limited because of crowded warehouse operating conditions. This wholesaler believed the warehousing operations in the multistory buildings could be conducted more efficiently by having all segments of the business under 1 roof in a modern, 1-floor building located in a less congested area.

Estimated costs were obtained for the construction of a 1-floor warehouse building containing approximately 188,000 square feet of operating space, equipped to handle efficiently an annual business volume up to $25 million. Estimated cost of land, building, including office space, and pallet racks totaled $1,250,000. Amortizing a loan of $1,250,000 over a 20-year period at 4.5 percent interest would cost $94,875 per year.

Equipment needed in the new warehouse would include 3 forklift trucks, in addition to the 3 now owned, at an estimated cost of $3,000 each; an additional 15,000 pallets at $3.00 each; 7 order filler tractors costing approximately $1,200 each; and fifty 4-wheel trucks at $65 each. The cost of this equipment would total $65,650 and would be depreciated over a 5-year period at the annual rate of $13,130. Estimated annual insurance and taxes in the new warehouse would total $27,485. Table 11 shows a comparison of estimated annual costs in the new warehouse compared with existing costs.

Table 11.--A comparison of annual warehousing cost in a 140,000 square foot multistory warehouse with estimated cost in a new 1-floor warehouse with a business volume of $17 million in dry groceries - Case C

Annual expense item	Existing warehouse	New warehouse
	Dollars	Dollars
Facility cost	---	94,875
Equipment depreciation	---	13,130
Insurance and taxes	27,600	27,485
Supervision	6,500	6,500
Labor	238,000	80,500
Total expense	272,100	222,490

A total of 68 men at an annual average cost of $3,500 each was used in the present warehouse with the existing work methods and equipment. It was estimated that the number of men required in the new warehouse, handling the present volume of business and operating at peak efficiency, would be 23 men (table 11). A major factor in the reduction from 68 to 23 men in the new building would be the combining of all shipping operations under 1 crew at 1 dock. In the existing operation, 4 shipping docks with separate shipping crews are used to handle city and country, institution, "will-call," and frozen food shipments. Estimated annual savings in warehousing costs would total approximately $49,600 in a new warehouse.

A study was made of the existing warehousing operation for a 2-fold purpose: (1) To determine the potential savings of warehouse man-hours by introducing more efficient work methods, merchandise layout, materials-handling equipment, and work scheduling; and (2) to use the data developed in the study to plan the new warehouse building. This study revealed that with the adoption of more efficient practices, the number of men could be reduced from 68 to 53 for an estimated annual saving of $52,500 in warehouse labor cost. Comparing this with an estimated saving of approximately $49,600 annually if a new warehouse was built, the wholesaler decided to initiate more efficient practices at once in his existing warehouse and also began to formulate plans for the new warehouse.

The wholesaler decided to build the new warehouse for the following reasons: (1) The long-term potential annual savings would be greater in a new warehouse; (2) the existing warehouse buildings would require increased maintenance cost in the future; (3) overcrowded operating conditions in the present warehouse would increase as business volume grew; (4) prospects of acquiring additional space within the immediate area for efficient handling of additional volume would prove expensive because of buildings now on it; (5) adequate facilities would be available to efficiently handle the fresh fruit and vegetable needs of retail customers; and (6) a new facility would build company prestige with the trade and the public.

RESULTS OF APPLYING IMPROVED METHODS AND EQUIPMENT IN 9 GROCERY WAREHOUSES

An average saving of 19 percent in warehouse man-hours resulted after improved work methods and equipment were applied in 9 warehouses. An average projected saving of an additional 36 percent can be expected for a total man-hour saving of 55 percent after the building of a new warehouse and installation of recommended equipment (table 12). Estimates of projected savings from a new warehouse and recommended equipment were made for the 4 firms planning to build a new warehouse and install equipment and for 3 additional firms planning to install recommended equipment.

Table 12.--A comparison of the number of weekly warehouse man-hours required using former methods, with the number of man-hours using improved and projected methods in the receiving, order assembly, checking, and loading operations in 9 grocery warehouses

Method 1/	Weekly man-hours required in grocery operations						
	Receiving	Order assembly	Checking	Loading	Total 4 operations	Savings	
	Man-hrs.	Man-hrs.	Man-hrs.	Man-hrs.	Man-hrs.	Man-hrs.	Pct.
Company A:							
Former	160	240	40	40	480	--	--
Improved	160	200	40	40	440	40	8
Projected	160	200	40	40	440	--	--
Total savings	---	---	--	--	---	40	8
Company B:							
Former	270	648	108	108	1,134	--	--
Improved	160	480	100	100	840	294	26
Projected	140	200	60	80	480	360	32
Total savings	---	---	---	--	---	654	58
Company C:							
Former	900	1,457	611	188	3,156	--	--
Improved	900	1,075	305	141	2,421	735	23
Projected	360	360	80	120	920	1,501	48
Total savings	---	---	---	--	---	2,236	71
Company D:							
Former	360	1,305	225	180	2,070	--	--
Improved	315	1,215	135	135	1,800	270	13
Projected	200	280	80	120	680	1,120	54
Total savings	---	---	---	--	---	1,390	67
Company E:							
Former	175	234	58	58	525	--	--
Improved	140	200	40	58	438	87	17
Projected	140	160	40	40	380	58	11
Total savings	---	---	---	--	---	145	28

Table 12.--A comparison of the number of weekly warehouse man-hours required using former methods, with the number of man-hours using improved and projected methods in the receiving, order assembly checking, and loading operations in 9 grocery warehouses --Continued

Method 1/	Receiving	Order assembly	Checking	Loading	Total 4 operations	Savings	
	Man-hrs.	Man-hrs.	Man-hrs.	Man-hrs.	Man-hrs.	Man-hrs.	Pct.
Company F:							
Former.......	180	135	45	45	405	--	--
Improved.....	180	115	45	45	385	20	5
Projected....	180	115	45	45	385	--	--
Total savings..	---	---	---	--	---	20	5
Company G:							
Former.......	220	135	45	45	445	--	--
Improved.....	220	135	45	45	445	--	--
Projected....	160	135	45	45	385	60	13
Total savings..	---	---	---	--	---	60	13
Company H:							
Former.......	95	188	134	90	507	--	--
Improved.....	80	150	45	45	320	187	37
Projected....	80	115	20	45	260	60	12
Total savings..	---	---	---	--	---	247	49
Company I:							
Former.......	60	98	24	24	206	--	--
Improved.....	60	48	24	24	156	50	24
Projected....	30	48	24	24	126	30	15
Total savings..	---	---	---	--	---	80	39
Total all Companies:							
Former.......	2,420	4,440	1,290	778	8,928	--	--
Improved.....	2,215	3,618	779	633	7,245	1,683	19
Projected....	1,450	1,613	434	559	4,056	3,189	36
Savings......	---	---	---	--	---	4,872	55

1/ The former method shows the number of man-hours required per week before improvements resulting from the study were made. The improved method shows the number of man-hours required when improved methods and equipment were adopted. The projected method shows the estimated number of man-hours required when a new warehouse and recommended equipment is installed and in operation for those firms planning to build a new warehouse or purchase and install new equipment.

The receiving operation, under former work methods, used 2,420 man-hours per week in the 9 firms. This was reduced more than 8 percent to 2,215, a weekly saving of 205 man-hours, through use of improved methods. The savings in the receiving operation were accomplished by separating the forklift storing operation from the palletizing operation and use of 1 man in unloading cars rather than 2-man teams in 4 firms using the pallet system. A projected saving of an additional 765 man-hours, 34 percent, is based on the building or acquisition of a new 1-floor warehouse with adequate space, use of good work methods, and materials-handling equipment.

A total of 4,440 warehouse weekly man-hours was used in the order assembly operation in the 9 firms using former methods. The number of man-hours was reduced nearly 19 percent, to 3,618, by reducing order filler delays, such as: waiting for retailer orders, selector trucks, packing room items, conveyor lines to be cleared, shipping clerk to call items over public address system, hunting for items, improving crew balance, and by using an improved method of order assembly.

Projected savings of an additional 2,005 man-hours weekly, more than 55 percent, were estimated for 3 firms with the building of a new warehouse, use of tow tractors, with orders being printed by automatic tabulating equipment in sequence with warehouse location numbers, improved work methods, with the use of preprinted order forms in order assembly in 1 firm, and with the use of order fillers reading items with a conveyor assembly system in 1 firm, using the truckload reassembled into individual orders system.

In the 9 firms, the total weekly man-hours employed in the former checking operation were reduced nearly 40 percent, from 1,290 to 779, by having a single checker replace 2-man teams, eliminating duplicated order checks, eliminating the stamping of retailer numbers on cases through improved order separation on delivery trucks, improving crew balance, and scheduling of orders, and--in 1 firm--changing from the truckload--reassembled into individual orders system of assembly, to individual retailer order assembly using 4-wheel handtrucks. Projected savings of an additional 345 weekly man-hours were estimated for 3 firms on the basis of the use of sample checking rather than checking all orders by item description and case count.

The number of man-hours in the conventional loading operation was reduced nearly 19 percent, from 778 to 633 man-hours weekly, by the use of 1 man loading delivery trucks instead of a 2-man team in 2 firms, and by improved workload scheduling in 2 additional firms. Projected savings of an additional 74 man-hours were estimated for 3 firms with the use of 1-man loading of delivery trucks in a new warehouse, whereas 1-man loading cannot be used in the present building, and with the use of a dock board in 1 firm to bridge the gap between the shipping dock and truck bed so that 4-wheel handtrucks can be pushed inside delivery trucks for unloading.

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