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SPECIFYING VARIABLES FOR GROCERY DISTRIBUTION CENTER PRODUCTIVITY ANALYSIS

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INTRODUCTION AND PURPOSE

The food distribution center and specifically the dry grocery warehouse, which constitutes the focus of this study, are central to the entire U.S. food distribution system. The food warehouse serves as a break bulk operation for approximately 50% of the \$180 billion in 1978 retail food sales (Progressive Grocer). Centrally located, warehouses receive relatively few, large shipments from processors and provide timely delivery of widely assorted shipments (truck-load or less) to geographically dispersed retail stores.

The large volume of materials handled by food warehouses indicates the need for efficient operation and effective cost control. Central to cost control is the efficient use of labor, the major cost area in conventional warehouses (Crawford and Grinnell).^{1/} As a consequence of minimal productivity increases in the relatively labor intensive conventional grocery warehouse operations, wage escalation (up 22% from 1976 to 1978) has exerted an upward pressure on retail food prices. For 1972-74 alone the USDA farm-retail food margin index rose 31 percent, nearly three times faster than the non-food Consumer Price Index (Parker).

Unit labor costs in conventional food distribution centers can be reduced through capital substitution or improved management. This study addresses improving management. Involved are, first, the identification of problem areas, followed

^{1/}The dry grocery warehouse is typically a one-story building with the floor at the level of truck and rail siding docks. By industry standards a warehouse with floor area of under 100,000 square feet (2.3 acres) would be classified as 'small' while a 500,000 square foot plant (11.5 acres) is considered 'large.'

A conventional warehouse is equipped with pallet jacks, high lifts, tuggers, carts, etc. in contrast with more sophisticated equipment used in automated warehouses. About 98 percent of U.S. food distribution warehouses operated by wholesale and retail firms are classified as conventional (Progressive Grocer).

by the institution of corrective action. For identifying problem areas food distribution executives have traditionally evaluated their warehouses' level of productivity relative to those of similar warehouses. These evaluations are facilitated by three continuing comparative warehouse productivity studies^{2/} which report the level of productivity of individual warehouses and attempt to relate these to causal factors. Thus one report may list the productivity of participating warehouses in one column and such characteristics as number of items handled, single or multiple shipping/receiving docks, average order size, etc. in adjacent columns. Management's responsibility is to identify warehouses with characteristics similar to their's and compare the reported performance to their own. The key to the usefulness of these reports is then (1) the identification of a limited number of factors which significantly impact productivity, (2) collecting accurate measures of these variables, and (3) reporting the variables in the way easiest for management to interpret.

This publication relates to one such productivity report, the Cornell Report on Grocery Distribution Center Productivity (hereafter referred to as the Cornell Report). For 1979 both the Questionnaire and the Report format are completely revised. These revisions were undertaken to include productivity-related factors previously missing from the Cornell Report and the other reports. Special attention was given to more accurate measurement of managerial variables and including operations which had been inadequately addressed. Most notable among these are storage and replenishment. Neglect of these two operations has been especially unfortunate since they were identified by Pierson (pp. 114-20) as the principal cost component in dry grocery warehouses.

^{2/}Three periodic comparative efficiency reports are available for food warehouse operators. They are: (1) "Warehouse Productivity Analysis System" prepared by National-American Wholesale Grocers Association (NAWGA), New York; (2) "Warehouse Productivity Improvement Program" by Bartz, Postl and Associates, Milwaukee; (3) "Grocery Distribution Center Efficiency Report," prepared by Cornell University, Ithaca, New York.

The purpose of this bulletin is to explain the rationale for selecting each variable included in the revised Questionnaire and to set forth a priori expectation of the effect of each variable on warehouse productivity. This information may be used to better understand the revised Cornell Report and enhance its usefulness. In this role it is useful to warehouse management as well as those who are relatively unknowledgeable about warehouse operations and wish to gain an understanding of the relevant factors. This bulletin may also be used as the basis for more formal hypotheses about food warehouse operations which could be tested with statistical methods.

Since the questionnaires for the Cornell and other reports are typically completed by and for warehouse personnel they contain data only on physical operations (characteristics, labor productivity, throughput, etc.). It is important to note that analysis based entirely on labor productivity, its wide acceptance notwithstanding, is incomplete since maximizing labor productivity does not necessarily maximize overall warehouse or firm objectives (e.g., profits, growth, market share, product assortment, service level, delivery response time) in either the short or the long run. However, with labor constituting the major cost component of conventional warehouse operations, maximizing labor productivity is a good first approximation to achieving cost efficiency.

This bulletin is structured as follows: The next section contains a discussion of alternative labor productivity measures and the rationale for selecting those included in the Cornell Report; the third section offers a brief explanation of the variables included in the Questionnaire and their expected effect on productivity; finally, in the fourth section further comments are made about improving the operations of food warehouses. The 1979 Questionnaire is included in the Appendix.

PRODUCTIVITY MEASURES

Productivity ratios (e.g., cases per man-hour, tons per man-hour) are used to measure efficiency of a warehouse as a whole as well as in each of the production activities which occur in a conventional grocery warehouse. These activities can be classified as: (1) receiving (truck and rail); (2) storage and replenishment; (3) order selection; and, (4) loading for shipment. These four functions, although intricately related, provide useful modules for comparison and analysis.

Receiving includes coordinating incoming shipment schedules, unloading trucks and rail cars and preparing stock for storage. Commonly used inbound transportation modes are regulated common carriers, backhaul (i.e., hauling products from suppliers' depots on empty returning delivery trucks owned or leased by the warehouse) and railroads. If incoming merchandise is not unitized (i.e., organized in multiple case unit loads on standard pallets) the individual cases must be placed on pallets by carrier or warehouse personnel. Unitization makes possible the use of mechanized equipment (e.g., forklift trucks, unit load handlers, pallet jacks) to speed unloading. As soon as inbound stock has been unloaded, verified, checked for sanitation and marked with a storage location it is ready for storage.

Storage and replenishment entail the handling of stock from time of receipt until it is selected and assembled for shipment. Stock is moved from the receiving docks to temporary storage locations by forklifts, highlift trucks and pallet transporters. Storage locations consist of floor space and positions in racks which facilitate greater storage density. Movement of stock from a storage location to a location (slot) from which it can be selected for shipment completes the stock handling activity.

Order selection slots are located either in the lower levels of pallet rack structures or in floor stock areas. From these slots warehousemen assemble shipping orders according to selection documents (e.g., invoice copies, adhesive case labels). The specified cases of products are placed on pallets or carts for delivery to the shipping dock by battery operated pallet transporters or cart pulling tractors.

The various parts of each order selected from different areas within the warehouse are consolidated and checked for accuracy on the shipping dock. Warehousemen complete the shipping preparation activity by placing the completed orders into delivery vans in either unitized (i.e., loading pallets or carts directly into the truck) or nonunitized form (i.e., stacking one case at a time in the truck).

When constructing productivity ratios for each productive area within the warehouse one must carefully define the unit of labor input. In the case of storage, replenishment and order selection, the primary job tasks consist of direct or physical handling labor as opposed to shipping and receiving where a large component of labor input may be of the indirect or clerical type. Therefore, productivity is most appropriately measured in the former functions in terms of product units (i.e., cases or tons) per man-hour of direct labor. In shipping and receiving environmental and policy factors influence the proportions of direct and indirect labor employed. For example, physical dock limitations or a firm's relative lack of leverage vis a vis local trucking concerns will result in the warehouse incurring a relatively high proportion of direct labor if it assumes all or part of the unloading task in addition to the traditional checking function. Also, the thoroughness of checking of products entering and leaving a warehouse directly influences the amount of indirect labor utilized in shipping and receiving. The resulting variation in proportions of direct and indirect labor indicates

that the amount of total labor hours (i.e., direct plus indirect) is a more appropriate denominator for the ratios measuring productivity in these peripheral areas.

Traditional productivity ratios and warehouse subdivisions were retained not only because they still fit today's warehouse operations but because their retention avoids potential transition problems for industry readers. The authors' industry experience indicates that case count data are still considerably more reliable than the tonnage data currently available. For this reason the productivity ratios upon which report ranking and statistical analysis are expressed in units of cases per man-hour rather than tons per man-hour. Industry experience is also used to identify operating characteristics which may affect labor productivity levels in conventional grocery warehouses.

FACTORS AFFECTING PRODUCTIVITY

Data included in the Cornell Report are collected from participating warehouses by means of an annual questionnaire (see Appendix). The revised Questionnaire is divided into three sections. The first requires general responses about the organizational structure of the firm while the second includes questions about the year-round operation of the reporting warehouse. The third section requires that records be kept on certain operating data during a four-week reporting period (see Appendix). Work sheets are provided to assist in collecting data on functions for which detailed records are not typically kept (i.e., storage, replenishment and general allocation of labor hours to tasks).

The Questionnaire provides explicit instructions for collecting and recording nonroutine data. Included with the instructions is a glossary of common terminology, provided as an aid to minimizing interpretation problems.

The following is a brief explanation of and rationale for each question included.

I. GENERAL INFORMATION

1. Warehouse ownership: This question assesses the effect of vertical integration in the food distribution system on productivity. There is a feeling in the food industry that the level of productivity in retailer owned warehouses may be significantly lower than that in wholesaler or cooperative owned warehouses. The lower productivity of integrated firms, if present, may be due to coordination problems within large firms or to less managerial control exercised in firms which emphasize the retailing function.

2. Number of warehouses operated by a firm: This question is directed to measuring the effect of organization size and geographic dispersion on productivity. The operation of multiple warehouses may improve productivity by making possible specialized management, technical staff support and better training programs. On the other hand, large firms may be operating beyond the efficient level of dispersion which with inadequate managerial control can result in coordination problems and lower productivity.

II. GENERAL WAREHOUSE OPERATIONAL CHARACTERISTICS

1. Commodity group reported: The questionnaire is limited to a single product class (e.g., dry grocery) in order to simplify data collection and improve the accuracy of data.

2. Total number of items stocked: The warehouse stocking relatively more items is expected to have lower productivity for two reasons. First, a large number of items suggests the presence of many slow moving ones which do not lend themselves to productivity improvement schemes such as unitization. Second, the increased need for coordination and clerical support associated with more items may also detract from productivity in receiving and shipping operations as well as storage and replenishment.

3. Number of items sold in less than case quantity: This question measures the number of items requiring special handling with the removal of sale units from

master cases and possibly placement in repack containers for shipment. Thus a relatively large number of repack items is expected to reduce replenishment and selection productivity.

4. Total number of warehouse employees: Used to compute turnover (see question 5 below).

5. Number of warehouse employees who have quit or who have been terminated: The number of employees no longer employed by the warehouse and the total number of employees are used to compute an annual turnover ratio. A relatively high turnover ratio may indicate such things as low pay, poor working conditions, low morale or attractive outside employment opportunities in the local labor market, but high employee turnover, whether voluntary or forced, is frequently associated with lower productivity.

6. Total number of first line supervisors: Used to compute turnover (see question 7 below).

7. Number of first line supervisors who have quit or who have been terminated: As in questions 4 and 5 above the responses to questions 6 and 7 are used to compute an annual turnover ratio. A relatively high turnover ratio for first line supervisors may have an even greater adverse effect on productivity than a high rate for hourly employees. In addition to the possible causes listed for hourly employees supervisors sometimes voluntarily terminate because of a lack of management training, higher level support and opportunities for advancement.

8. Are outside warehouse facilities used to handle inventory surges?: The use of outside warehouse facilities may indicate operations which are at or near capacity levels. Capacity utilization is considered to be an important variable in determining the reasons for productivity variances, particularly for warehouses which are experiencing crowding as they approach or exceed estimated capacity. Use of outside warehouses may also indicate inadequate control of the buying function which can reduce efficiency.

9. Number of hours of operation per day and days per week: The number of hours of operation reflect management policies which may be based on capacity utilization and service objectives. Facilities (e.g., docks, aisles) and equipment may be inadequate to perform all warehouse functions during one or even two shifts. The needs of the retail outlets serviced may also dictate the number of hours of operation. Hours of operation can affect employee morale (e.g., day time hours vs. night time hours) and thus influence efficiency. Long hours of operation can adversely affect support operations (e.g., three shifts of order selection precludes adequate sanitation procedures in the selection area).

10. Dock sizes: The size and physical characteristics of shipping and receiving docks are crucial to the economic production process in a grocery warehouse. Inadequate dock space can result in congestion and loss of efficiency. Equally important is the buffer area between warehouse functions (e.g., receiving and storage, order selection and shipping). Adequate staging and surge areas adjacent to docks provide insurance against a surge in one function adversely affecting another. Efficient 'cross dock' moves can be made only with sufficient dock space.

11. Do shipping and truck receiving use the same dock?: Congestion problems may arise when the same dock is used simultaneously for both shipping and receiving. Scheduling shipping and receiving at different times may alleviate these problems.

12. Are docks used for permanent storage?: The use of docks for permanent storage is interpreted as a symptom of inadequate or improperly managed storage space. Crowding in a warehouse contributes to lower productivity in storage replenishment and order selection. Permanent dock storage may also reduce receiving and shipping efficiencies by increasing dock congestion.

RECEIVING

13. How often does your receiving operation run short of empty pallets?: Shortages of empty pallets for incoming cases can result in lost time in storage and receiving operations as inventory is rehandled to free pallets for receiving. Pallet shortages are often a result of receiving surges.

14. Receiving: Principal checking method by carrier type: The thoroughness of checking done in receiving directly affects the amount of indirect labor spent on that function and thus the productivity of that operation. More careful checking can, however, improve security and the accuracy of inventory records and may improve productivity in other warehouse operations.

15. Do you require that carriers make truck receiving appointments?: Truck receiving appointments can reduce receiving surges resulting from seasonality, promotions, carrier labor disputes, weather, etc. Requests for appointments also give warehouse management prior notification of the need for short run adjustments in manpower and equipment. A well administered appointment system can result in higher levels of truck receiving efficiency.

STORAGE AND REPLENISHMENT

16. Method of movement from receiving to storage or selection slots: The method used to move stock from receiving to storage or selection slots is central to warehouse productivity. Automated storage systems achieve high rates of productivity but require a relatively large capital outlay. These systems are usually justifiable only in high volume warehouses. In conventional warehouses several alternatives exist but most common among these are the direct 'highlift hauls and stores' and 'forklift or pallet jack from dock-highlift stores' systems. The direct system permits pallet movement in the order best suited for efficient stowage at the expense of increased use of this relatively expensive equipment. The second system is used if the dock is small and must be kept clear. In many cases the latter alternative requires more manpower.

17. Reserve storage location selection for inbound merchandise: The use of an on-line computerized inventory system is taken as indicative of good storage control compared to the expected lower efficiency of using operators' judgments. The major effect of on-line stock control is, however, likely to be the reduction in search time in order selection and replenishment operations.

18. Method used to replenish conventional selection slots: A computer generated replenishment schedule which incorporates selection slot inventory, reserve stock on hand and pending orders provides better information and control than depending on historical or even expected movement data alone. Relying solely on operator judgement can result in lower overall efficiency if, for example, the operator's objective is to replenish the maximum number of slots during his shift and not to minimize stock-out conditions in slots during order selection.

SELECTION

19. Are conventional selection slots fixed or floating?: Fixed slots may enhance order selection productivity in warehouses using less sophisticated stock location control systems by reducing selector search. Floating slots incorporated with a sophisticated control system may provide a greater level of efficiency in storage and replenishment. Without such a control system productivity may drop in order selection as well as in storage and replenishment.

20. Is the selection document printed in slot sequence?: A selection document (i.e., invoice or case labels) which is printed in slot sequence should reduce search and thus increase productivity in order selection when compared to documents printed in some other order.

21. Are case labels used for order selection?: The time required for the order selector to remove adhesive case labels from a paper strip and apply them to each case selected is expected to reduce selection productivity. Part of this time loss may be made up by increased selection accuracy and faster, more accurate

checking at the loading dock and delivery point. Additionally case labels can greatly increase price marking productivity at store level.

22. Please rank slotting criteria in order of importance: The purpose of this question is to attempt to correlate warehouse management's perceived slotting priorities with the degree of efficiency found in the order selection, storage and replenishment functions. Because of the range of possible criteria no expectations about the effect on productivity have been formulated. Slotting criteria also interacts with the use of fixed or floating slots since fixed slots may be used to maintain family groupings. Finally, an attempt shall be made to relate management's priority for damage minimization to the actual amount of damaged product created.

23. Do you segregate items by movement (i.e., fast or slow moving items)? Segregating items by sales volume may increase order selection productivity by increasing the hit frequency for both fast and slow moving items. Fast moving items are placed together away from slower moving items in order to reduce the travel time required to select a large proportion of the outbound cases (tonnage). Slow moving items are usually condensed into a relatively small area, sometimes by the use of hand-stacking, or multi-level selection. These arrangements may increase the hit frequency and thus selection efficiency for slow movers. Segregation of fast or slow movers may adversely affect storage operations due to increased travel time from receiving to storage locations. Replenishment operations may be negatively impacted if labor intensive hand-stacking is employed in handling slow moving items.

24. Are multiples selected by a bulk selector?: Selection of large quantities of an item for one or more stores by one individual (possibly equipped with a highlift) may result in higher productivity as orders calling for pallet or near pallet loads may be delivered directly from storage to the loading dock.

This procedure avoids depleting the selection slot which must then be replenished (possibly as order selectors wait).

25. If a bulk selector is used enter the minimum quantity to be selected by same: The intent of this question is to determine an ideal minimum quantity cut-off point for bulk selection.

SHIPPING

26. How often does your loading operation run short of trailers?: Adequate availability of trailers for shipping may be important to loading efficiency either directly by causing idle time or causing backup on the loading dock and staging area. Both trailers and dock space can act as buffer zones between order selection and ultimate timely delivery; insufficient buffers may cause serious delivery schedule disruptions.

27. Principal checking method: The degree of checking performed before and during the loading process directly affects the amount of indirect labor spent on that process. Relatively more checking on the dock can effect direct labor productivity by causing slower loading if the checking function is inadequately staffed. Inadequate checking can, however, result in delivered order inaccuracies and security problems.

28. Who physically places product into trailers for shipment?: This question is included partially as an internal check for identifying labor hours misallocated elsewhere in the questionnaire as well as detecting any overlap between order selection and shipping functions. For systems in which order selectors load (and in some cases check) their own orders, allocation of labor hours between order selection and shipping is difficult. If this allocation is done improperly shipping productivity measures tend to be biased upward and order selection measures downward.

In reference to productivity, order selectors loading their self-selected orders reduce idle time and raise productivity in an imperfectly coordinated selection/checking/loading system. However, these systems may lack the checks needed for adequate security.

WAGES, INCENTIVES, LABOR AGREEMENTS

29. What is the wage rate for a conventional order selector?: The intent of this question is to collect information on the warehousemen's wage level relative to prevailing regional wages. The higher the wage the more incentive management has to improve productivity.

30. Do you use productivity incentives?: This question asks for data which will be used to test for the existence of relationships between various types of incentives and productivity levels in the functional areas of food warehousing.

31. Do you have individual minimum performance standards?: The responses to this question will be used to determine the relationship between minimum job performance standards and the degree of efficiency in food warehouses. Standards are expected to enhance performance by providing a goal and incentive for workers and management.

32. Are performance standards based on industrial engineering standards?: The intent of this question is to determine if performance standards based on engineering analysis have a greater effect on productivity, possibly because they prescribe more accurately what productivity levels can and should be achieved.

33. Please list any progressive disciplinary steps taken when an employee fails to meet minimum performance standards: The number of progressive disciplinary steps and their severity may have an impact on employee performance levels relative to specified minimums. A few relatively severe steps which are strictly followed may result in close adherence to production standards. Numerous loosely administered steps may result in irregular adherence to standards and thus lower efficiency.

34. Is short internal scheduling used?: When an employee is told the time in which he will be expected to complete a unit of work and is subsequently evaluated on the basis of that expectation, individual productivity may improve. Individual productivity improvements should result in increased efficiency in each warehouse function.

35. Are your warehouse employees unionized?: The responses to this question may indicate whether or not unionization in grocery warehouses affects the level of productivity. Unionization can be expected to have several effects on productivity - both positive and negative.

On the positive side unionized warehouses may experience a lower rate of employee turnover as a result of the higher wages and better fringe benefits typically provided unionized workers. A seniority ranking system can provide for better informal on-the-job training by reducing the rivalry among employees who may otherwise compete counter productively for pay raises, promotions, etc. when evaluated only on the basis of merit. From a managerial perspective one might expect stricter adherence to production standards when management tightens control to compensate for union gains in wages and benefits.

Unionization reduces productivity when rigid inefficient work rules are imposed by the collective bargaining process. The same seniority system which enhances informal training may interfere with efforts to promote or transfer the best qualified employees. Conversely, seniority may make the elimination or demotion of poor performers impossible. Finally, and perhaps most importantly, an organized work force may effectively block or delay technological changes which increase productivity.

36. Union name and local number: The effect of unionization may vary from union to union and region to region. The intent here is to measure any variation of this nature.

37. Are minimum performance levels specified in writing in your union contract?: To have production standards explicitly spelled out in a labor agreement usually means that they have become a negotiable item. Negotiating standards may not always be conducive to increasing productivity.

38. Are progressive disciplinary steps specified in writing in your union contract?: Disciplinary steps written into a contract may be applied more consistently and therefore upheld more frequently in the grievance procedure than informal steps. This consistency could lead to better employee morale and thus a higher degree of efficiency.

39. Is job assignment in the warehouse based on seniority?: Job assignment by strict seniority may hinder management's efforts to match the right individual to the appropriate task. However, failure to recognize seniority may result in a competitive work environment which does not foster informal job training among employees. No seniority rights in the realm of job selection could result in disharmony and a less cohesive work team, depressing warehouse productivity. The intent of this question is to provide information necessary to measure the magnitude and direction of any effect of competitive seniority for job assignment on efficiency.

40. Does your contract call for a guaranteed minimum of hours to be paid?: Guaranteed minimums may detract from management's ability to adjust manpower to short run business fluctuations. Failure to match manpower with warehouse volume can result in lower productivity. It can also be argued that a lack of minimum daily or weekly guarantees may result in lower employee morale due to a feeling of insecurity. Such attitudes in the work force may lead to higher turnover rates and lower productivity. The responses to this question may indicate which argument is more valid in the grocery warehousing industry.

41. Are first line supervisors union members?: First line supervisors who are union members may experience some difficulty in executing managerial duties

because of lack of authority, a low level of respect for their position by employees and divided loyalty on the part of the union member supervisors themselves. It can also be argued that the first live supervisor being a union member would result in better teamwork between the foremen and his employees and thus improved efficiency. Using the responses to this question an attempt will be made to identify the relationship between union membership for first line supervision and warehouse productivity.

EQUIPMENT INVESTMENT

42. What was the original cost of all of the moving and standing equipment in regular use in this warehouse?: The original cost of equipment will be used as a measure of the capital goods input to the warehouse production process. In warehouse operations capital may be substituted for labor so that a relatively capital intensive warehouse would be expected to have higher labor productivity.

WAREHOUSE CAPACITY

43. Total area utilized: The total floor space utilized in conjunction with the usable stocking height (question 45) provides a crude measure of warehouse cubic capacity. These data will facilitate size comparisons among warehouse plants.

44. What is your predominant aisle width?: Aisle width is a limiting factor on type of warehousing systems and equipment that may be employed. For example, double length pallet jacks require more aisle space than single length jacks or tuggers with carts. One must purchase more expensive highlifts to work in relatively narrow aisles than in wider aisles where simple counterbalance trucks usually suffice. Narrow aisle warehouses may require less land and plant input but more capital equipment. Wide aisle warehouses may require less capital equipment but more land and plant. This information will allow for homogeneous comparisons among warehouses with comparable aisle widths.

45. Predominant height from floor to top of pallets in storage: The effective storage height in conjunction with the total floor space utilized provides a crude measure of warehouse cubic capacity. These data will facilitate size comparisons among warehouse plants.

46. Storage capacity: This question asks for effective warehouse capacity (for the reported commodity group) in cases, pallets or sale units. From effective capacity and average inventory it is possible to estimate capacity utilization. Higher levels of capacity utilization may result in a greater return to plant input. However, extremely high capacity utilization or overcapacity operation may result in lower warehouse efficiency due to overcrowding.

III. WAREHOUSE DATA FOR THE REPORTING PERIOD

1. Inventory at the beginning and at the end of the reporting period: The beginning and ending inventory data are used to compute the average inventory and capacity utilization (see 46 above for the importance of this factor).

2. Percent of cases received from outside carrier trucks which were unloaded by employees and carrier personnel: This question attempts to determine who physically unloads carrier trucks: Carrier personnel, warehouse personnel, or a combination. Who unloads varies across the industry according to management philosophies, warehouse/carrier, warehouse/union and carrier/union relationships. The degree to which incoming merchandise is unloaded by nonwarehouse employees could have a significant effect on receiving dock manpower requirements and thus on productivity.

3. Customer profile for the reporting period: The customer profile provides data which are used to test for the effects of customer group makeup on warehouse productivity. The number of stores in each classification (e.g., corporate supermarkets, independents, etc.) provides a qualitative measure of customer profile. The customer makeup in turn influences the average order size and

the number of emergency orders. The expected effect of these two factors on warehouse productivity is discussed above.

4. Order selection system used: Five principal order selection systems are included -- conventional with pallet jacks or tuggers pulling carts or wagons, tow-line or chaintow, multi-level with high lift device, conveyor system, vending. The more automated systems (e.g., vending, conveyor) substitute capital for labor, raising labor productivity, but they are practical for only a portion of the tonnage handled in grocery warehouses. Because automated selection equipment can be acquired only in large increments the initial capital expenditure has been justifiable in relatively few high volume operations.

Batch selection can improve productivity and increase throughput in any order selection environment. In a relatively labor intensive selection environment (e.g., conventional, multi-level highlift, conveyor) the picking of more than one order at a time when the hit frequency is low (e.g., small orders, slow moving item area) can significantly reduce selector travel time thus improving productivity. In automated vending systems the acquisition of more capital (i.e., additional modules) directly increases system throughput.

5. Number of cases printed on a selection document that were not shipped during the reporting period: The number of warehouse order cut-offs (scratches) may indicate the adequacy of the warehouse stock control, storage access and replenishment systems. Inability to locate items in the warehouse may cause productivity losses as well as customer service disruptions.

6. Number of cases and repacks shipped to stores by mode: The principal modes considered, listed in order of increasing unit labor requirements, are pallets, carts and dead pile. The answer to this question will indicate the degree of unitization of shipments with more unitization expected to correspond to increased productivity. There are a number of factors such as trailer cubic

space utilization, unloading productivity and in transit damage which may make non-unitized shipments more economical overall despite the higher in-warehouse labor requirements.

7. Number of loads that contained various numbers of orders: The number of orders placed on each load influences the degree of coordination required on the shipping dock. Assembly and loading of multiple order loads may require more checking and loading labor thus negatively affecting shipping productivity.

8. Operating data forms for the reporting period: FORM I: This form is used to record data on warehouse volume and direct labor hours. Volume is measured in cases and tons or in pallets. From the volume and hours data (indirect labor data is collected on FORM II) are constructed productivity measures for each functional area of the warehouse for the commodity group reported (e.g., cases per man-hour, tons per man-hour).

In addition to the productivity measures the data from FORM I are used to derive unitization percentages for truck and rail receiving as well as shipping. Percentage of unitization may be a significant predictor of efficiency level in these areas as it indicates the degree of labor intensive manual operation required in unloading and loading.

The mix of truck and rail receiving as determined from the data entered on FORM I may indicate a level of overall receiving productivity based on the relative efficiencies found within those functions.

The percentage of truck freight received by backhaul may be an important predictor of truck receiving efficiency. Because backhaul is typically unloaded entirely by warehouse employees and not even partially by carrier personnel a large backhaul percentage could mean lower receiving dock productivity. Of course, the additional labor expense may be more than offset by backhaul allowances.

FORM I asks for the number of pallet loads moved from receiving to storage and selection slots as well as pallet loads moved from storage to selection slots. As most stock which is moved within the warehouse is in unitized pallet form, the number of unit loads moved may be more useful for analysis than cases or tons. Two ratios associated with pallet movement within the warehouse may prove interesting in the study of storage and replenishment productivity. The number of cases (or weight) per pallet moved may influence storage and replenishment efficiency. Theoretically, more cases per pallet should result in fewer trips and fewer storage/replenishment operations for a given quantity of stock moved. Of course, the number of cases per pallet is subject to both handling equipment, pallet size and space availability limitations.

Total cases (or tons) of stock handled by the recouping department may indicate the severity of product damage problems in a warehouse. A relatively large amount of damaged product suggests problems with storage practices, equipment or employee attitudes.

Overtime hours recorded on FORMS I and II are used to calculate overtime/regular time ratios for each participating warehouse. Efficiency may begin to decrease after a certain number of hours on the job. The intent is to test for a relationship between overtime hours worked and warehouse productivity in all phases of operation including support activities. The establishment of the point at which returns to overtime begin decreasing could be useful to management for manpower planning.

FORM II: The data recorded on FORM II pertain to indirect labor hours and absenteeism. Indirect labor may influence productivity in several ways. In shipping and receiving indirect labor in the form of checking may represent the largest portion of total labor hours. In these instances the productivity of checkers and clerical personnel may have a greater impact on efficiency than

direct handling of stock. For this reason indirect labor hours are included in the calculation of efficiency measures.

Supervision, another form of indirect labor, may play an important role in achieving higher productivity by improving coordination while too much supervision can lead to contradictory direction. The ratio of employees per first line supervisor thus may influence warehouse efficiency.

Data on warehouse support functions (i.e., recouping, inventory control, maintenance, housekeeping and security) are recorded primarily for comparative reporting purposes. Although they may be indirectly related to productivity (e.g., the role of maintenance in keeping equipment running or inventory control in insuring fast accurate stock retrieval) their effect is difficult to measure quantitatively.

The amount of absenteeism in a grocery warehouse may have an effect on efficiency. Unscheduled absences may result in more overtime than might otherwise be necessary. It might be necessary to assign some warehouse personnel to unfamiliar jobs and to jobs for which they are inadequately trained. Absence in one warehouse area may result in schedule disruptions not only in the immediate area but in the warehouse in general.

CONCLUDING COMMENTS

The responsibility for reversing the trend toward lower productivity in the U.S. food industry must be assumed by it's member firms and unions as well as by academic institutions, industry associations, consulting firms, equipment suppliers and the several levels of government. As a first step in meeting this responsibility the breadth and quality of data on warehouse operations must be improved. In 1966 the National Commission on Food Marketing noted that, "Detailed statistical information is not available for different sizes of warehouse operations" (p. 150). Data availability has not improved markedly since that time.

Recent analysis of warehouse operations have, therefore, relied on engineering economic analysis. Although this form of analysis is appropriate for answering some research questions such as size economies of operation, it excludes the rich variety of management practices and consequently offers limited insights into measures for enhancing physical productivity. More complete data on warehouse operations is clearly needed and must be generated at the warehouse level.

The accuracy and timeliness of warehouse data depend heavily on the individual within each warehouse responsible for the questionnaire's completion. Ideally that person should possess enough knowledge of day-to-day operations to allow collection of requisite data accurately and efficiently. On the other hand, in the interest of objectivity, the responsible individual should hold a position within the organization which would insulate him/her from possible management criticism based on the firm's ranking in the subsequent comparative report.

The collection of data for the Cornell warehouse productivity study and the resultant Report on grocery distribution center productivity along with its companion comparative efficiency publications are only small contributions to the total research effort required. Also urgently needed is more systematic statistical analysis which can isolate and quantify the effect of individual factors on warehouse productivity in a way which is free of the judgment required for comparative analysis. It is hoped that by detailing the need and uses of an enlarged data base this bulletin will contribute to the accumulation of data for research on food distribution.

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APPENDIX

Operating Data for Grocery
Distribution Centers

1979 Questionnaire

INTRODUCTION

Food distribution costs have been rising persistently in recent years. Wages, the major component of conventional warehousing costs, rose 22% from 1976 to 1978 (Progressive Grocer). Without significant increases in productivity these cost increases must be passed along as higher retail food prices. The way for the manager to help keep food prices down and protect and increase profits is to increase efficiency. This questionnaire and the summarized results published in the Cornell Grocery Distribution Center Efficiency Reports are directed to assisting management with improving productivity in dry goods warehousing.

The Reports provide annual performance measures of warehouses compared with similar warehouses operated by other participant firms. This information may be used to identify inefficiencies in a warehouse operation as well as to determine those areas of operation which are likely to provide the greatest responses to increased management. The Report will be changed and streamlined in several ways this year, including a presentation of data in rank order form rather than the quartile format used in recent reports. Furthermore, statistical techniques will be used to identify critical managerial and organizational factors influencing efficiency. These techniques solve one of the long-standing limitations of comparative reports: how to compare the productivity of warehouses when many of the characteristics, like size and selection method, are different. The results of the statistical analysis can be interpreted as measuring the effect of one factor net of differences in the others. As in past years the Report is restricted to physical operating characteristics. Plans are underway for adding cost data in future years.

This manual introduces the efficiency reporting system and contains

the questionnaire used to collect warehouse performance data. The following two sections include instructions for completing the questionnaire along with definitions of terms to reduce uncertainty. Participants are urged to take the necessary time to provide complete and accurate answers. The validity of the Report depends on getting complete and accurate information. The returned questionnaires are held in strict confidentiality and characteristics of individual warehouses cannot be deciphered from the Report. One complimentary copy of the Report is provided for each completed questionnaire.

Respondents need not be restricted to those operating conventional warehouses. Mechanized warehouses (e.g., those with Rapistan conveyORIZED systems) and automated warehouses (e.g., those with computer controlled SI ordermatic machine selection) may be included if data from only the conventional portion is submitted. Only dry groceries are to be included in this year's survey. In future Reports provision will be made for including other commodity groups such as frozen foods and produce.

GENERAL INSTRUCTIONS

The questionnaire is divided into three sections. The first requires general responses about the activities of the firm in total while the second includes questions about the year-round operations of the reporting warehouse. The respondent will be able to complete these two sections without data collection or use of warehouse records. Completing the third section will entail keeping records of specific operating data over the four-week reporting period indicated on the cover and at the front of the questionnaire. Several work sheets are included to assist in completing this third section.

Although common terminology is used throughout the questionnaire there may be some differences in interpretation from firm to firm and area to area.

Respondents are urged to refer to this manual whenever in doubt about a question or term. The questions explained in depth in this manual may be identified by the bold-faced type while terms included in the glossary are underscored. The use of this material will help to insure the comparability of data among warehouses.

If you have any remaining questions please call Professor William Lesser (607-256-4595), or Vaughn Roller (607-256-7685). Comments on and suggestions for the Manual and Report are also appreciated.

DETAILED EXPLANATIONS

Section I: General Information

- 1a. A coop warehouse is owned by a cooperative of retail store owners to whom the warehouse provides service.
- 1b. A corporate-retailer warehouse is owned by a retail organization. Its primary role is to service the retail stores owned by the corporation.

Section II: General Warehouse Operational Characteristics

1. The answers to all the following questions must refer only to the commodity group specified here. Throughput totals (tons, cases, pallets, etc.) should include only products from the specified group. For example, if you have specified dry grocery, report only grocery cases received, grocery cases and repacks selected, grocery cases and repacks shipped, etc. Do not report totals from other commodity groups (e.g., frozen food, non-foods, etc.). Labor totals (direct labor hours, supervision hours, absentee hours, etc.) should include only those hours that can be attributed to handling products from the specified commodity group. For example, if you have specified dry grocery, report only the shipping hours (labor, supervision and support) used to complete the loading of dry grocery items. Do not include hours attributable to loading product from other commodity groups.
3. Items may be shipped in full manufacturer's case lots or in partial manufacturer's case lots or in both full and partial case lots. Report also all items that are ever sold in less than manufacturer's case lot.
4. Include in the total number of employees: warehouse production personnel employed in receiving, storage and replenishment; order selection and shipping; employees performing checking and inventory control duties; maintenance, housekeeping, recovering and security personnel. Exclude all management, supervisory and clerical personnel.
5. Include those employees referred to in question 4 who are no longer actively employed by this warehouse for any reason, including voluntary quits, discharges, transfers, retirement, death or disability.
6. Include members of management or the work force who are directly responsible for the supervision of warehouse employees. Exclude any higher level management or staff personnel who do not directly supervise the work force.
7. Include those supervisors referred to in question 6 who are no longer actively employed by this warehouse for any reason, including voluntary quits, discharges, transfers, retirement, death or disability.
43. The best source of information about the original cost of warehouse equipment is the accounting department. Depreciation schedules should

provide adequate original cost information. No attempt is being made at this time to determine the depreciated value of equipment because of the variation in depreciation methods from firm to firm.

Examples of equipment to be reported:

Operational Area	Equipment	
	Rolling	Standing
Receiving	Lift trucks Electric pallet jacks Manual pallet jacks Slip-sheet trucks Other equipment	
Storage and replenishment	Highlifts Pallet jacks Towlines Other equipment	Storage racks Conveyor systems Automated storage and retrieval systems Other equipment
Order selection	Pallet jacks Tuggers Towlines Carts, wagons and pallet cages High-lift selection trucks Other equipment	Storage/selection racks Conveyor systems Automated selection equipment Other equipment
Shipping	Trailers Lift trucks Electric pallet jacks Manual pallet jacks Slip-sheet trucks Clamp trucks Other equipment	Automated loading equipment Other equipment

47. A good source of storage capacity information is warehouse design documentation. Most modern warehouses were designed to store a specified number of cases, pallets, etc. based on projected sales and inventory turnover. If this information is not available, warehouse layout drawings and a tour through the facility should provide an adequate estimate. The same unit of inventory (e.g., cases, pallets or sale units) must be specified for both active and inactive storage. The unit of inventory must be the same as that specified for the inventories reported in response to the first question in Section III.

Section III: Warehouse Data for the Reporting Period

1. The same unit for inventory (e.g. cases, pallets or sale units) must be specified for both active and inactive storage. This unit of inventory must be the same as that specified for the warehouse capacity reported in response to question 47 in Section II.
5. Report the number of sale units that appeared on selection documents e.g., case labels, invoices) but were not shipped by the warehouse (i.e., warehouse cuts or scratches), not total out-of-stocks.
8. Four worksheets are provided to facilitate the collection and recording of warehouse operating data. On FORMS I and II you will find space to enter throughput and hours data for each of the stages of warehouse production (e.g., receiving, moving stock, order selection, shipping, support) for the reporting period. The stages of warehouse production are listed across the top of FORMS I and II. Throughput and direct labor hours are listed down the left side of FORM I. Indirect labor hours and absences are listed down the left side of FORM II.

Some companies may be able to assemble the necessary data from existing in-house information systems. Others may find that some data are not available in company records. For these cases FORM III and FORM IV are provided to aid in data collection.

FORM III may be used to obtain an accurate distribution of labor hours during the reporting period. If FORM III is used, a blank copy of the form is given to each employee at the beginning of each shift. The employee records time spent in various work activities in the appropriate places on FORM III. Both total hours and overtime hours are recorded as on the DAILY WORK RECORD (FORM III). At the end of the shift FORM III is returned to the employee's first-line supervisor who checks it and forwards it to the individual responsible for data collection. The codes found next to the spaces for hours on FORM III refer to the boxes on FORMS I and II into which those hours should be added (e.g., 1D, 1E, 13F, etc.). The original compiled copies of FORM III should be forwarded to Cornell with the completed questionnaires.

FORM IV provides a means by which the movement of pallets and cases during storage and replenishment may be recorded. Instructions for the use of FORM IV are included with the detailed instructions for collecting and recording storage and replenishment data (FORM I, item 7B).

Certain elements of FORMS I and II are explained below to insure comparable data from all participating warehouses. Please remember that only the throughput and hours attributable to the commodity group specified in the first question of section I (e.g., dry grocery, frozen food, non-food etc.) should be recorded on the worksheets.

FORM I
RECEIVING

1. RECEIVED FROM COMMON CARRIER UNITIZED. (Includes freight delivered by common carriers, contract carriers and manufacturers' fleets.)
 - C. Total cases and repacks - enter the number of whole cases received in unitized form during the reporting period.
 - D. total direct labor hours - direct labor hours used in unloading unitized carrier or manufacturer delivered stock. Include labor to move product to the receiving dock and prepare it to be moved to storage. Does not include labor to move product from dock to storage or selection slots. Includes all regular straight-time hours and all overtime hours. Does not include checking hours.
 - E. Direct labor overtime hours - hours used to perform the work described in D above for which an overtime premium rate was paid.
2. RECEIVED FROM COMMON CARRIER NONUNITIZED. (Same as 1 above except product received arrived in trailers deadpiled or in a form requiring repalletization.)
3. RECEIVED FROM BACKHAUL UNITIZED. (Same as 1 above except product received arrived in trailers belonging to the warehouse after being delivered by drivers employed by the company operating the warehouse.)
4. RECEIVED FROM BACKHAUL NONUNITIZED. (Same as 3 above except product received arrived in trailers deadpiled or in a form requiring repalletization.)
5. RECEIVED FROM RAIL UNITIZED.
 - D. Total direct labor hours - direct labor hours used in unloading unitized rail delivered stock. Includes labor to move product to the receiving dock and prepare it to be moved to storage. Does not include labor to move product from dock to storage or selection slots. Includes all regular straight time hours and all overtime hours. Does not include checking hours.
6. RECEIVED FROM RAIL NONUNITIZED. (Same as 5 above except product received arrives in cars deadpiled or in a form requiring repalletization.)

STORAGE AND REPLENISHMENT

7. MOVEMENT - TRUCK AND RAIL RECEIVING TO STORAGE OR SELECTION SLOTS.
 - B. Total pallets - all pallet loads that were moved from the receiving docks (truck and rail) into storage or directly into selection slots during the reporting period. Also includes 'cross dock' movement

to shipping. FORM IV maybe used to develop this information if it is not available from warehouse records. To complete FORM IV each employee responsible for moving stock makes entries for pallets moved from the receiving docks. It is necessary for the employee to enter only the number of pallets moved and the pallet configuration (tie or case pattern and high or layers). Cases should be entered only when a pallet is not organized in pattern. The number of pallets and cases (tie x high) are totaled at the bottom. Completed original copies of FORM IV should be forwarded to Cornell with the completed questionnaire.

- C. Total cases and repacks - total cases moved from truck and rail receiving is derived from FORM IV as described in B above.
- D. Total direct labor hours - direct labor hours used in moving in-bound stock from receiving docks (truck and rail) into storage locations and order selection slots. Also includes hours used to make 'cross dock' moves to shipping. Includes all regular straight time hours and all overtime hours. Does not include hours used to move stock from storage into selection slots.

8. MOVEMENT FROM STORAGE TO SELECTION SLOTS.

- B. Total pallets - all pallet loads that were moved from storage locations into selection slots. Also pallet loads that were moved from one storage location to another. FORM IV may be used to capture this information in the manner described in 7B above.
- C. Total cases and repacks - total cases moved from storage to order selection slots. Also, total cases moved from one storage location to another. This information is derived from FORM IV as described in 7B above.
- D. Total direct labor hours - direct labor hours used in moving stock from storage locations into order selection slots and other storage locations. Includes all regular straight time hours and all overtime hours. Does not include hours used to move stock from receiving docks (truck and rail) into storage or order selection slots.

ORDER SELECTION

9. ORDER SELECTION

- C. Total cases and repacks (pieces) - enter the number of pieces selected by order selectors. Each sale unit (e.g., cases, dozens, threes, sixes, etc.) counts as a piece selected. In repack areas count the sale units that go into the repack container, not the repack container.

- D. Total direct labor hours - direct labor hours used in selecting orders. Does not include loading and dock checking time spent by selectors (these hours should be allocated to shipping: items 10D, E; 11D, E; 17H, I). Does not include slot replenishment operations performed simultaneously with selection (allocate these hours to moving stock from storage to selection: items 8D, 8E).

SHIPPING

10. SHIPPING UNITIZED.

- C. Total cases and repacks - enter the number of cases and repacks loaded in unitized form (pallets, carts, cages, etc.) during the reporting period. Do not count sale units within repacks.
- D. Total direct labor hours - hours used in loading stock in unitized form (pallets, carts, cages, ect.). Includes all regular straight time hours and all overtime hours. Does not include checking hours.

11. SHIPPING NONUNITIZED. (same as 10 above except product shipped was loaded in nonunitized or deadpiled form).

SUPPORT

12. RECOOPERING.

- A. Total tons - total weight of stock damaged in your operation during the reporting period. Include all damaged merchandise handled in the warehouse within the commodity group reported (e.g., rail damage, concealed truck receiving damage, warehouse damage and stock damaged in transit to stores and returned).
- C. Total cases and repacks (pieces) - number of cases (pieces or sale packs in repack areas) of the damaged stock described in A above.

FORM II

RECEIVING

13. TOTAL TRUCK RECEIVING.

- F. First-line supervision hours - total supervisory hours used in directing truck receiving operations (carrier and backhaul). Includes all regular straight time hours and all overtime hours.

- G. Total indirect labor hours - all hours used to check inbound truck receiving (carrier and backhaul). Includes all regular straight time hours and all overtime hours. Does not include unloading hours.
 - H. Indirect labor overtime hours - hours used to perform the work described in G above for which an overtime premium rate was paid.
 - I. Total record handling hours - all hours used to perform the clerical tasks that support truck receiving operations (carrier and backhaul). Includes all regular straight time hours and all overtime hours.
 - J. Record handling overtime hours - hours used to perform the work described in I above for which an overtime premium rate was paid.
 - K. Total absentee hours - those hours of truck receiving work (direct labor, checking, supervision and clerical) that were missed by employees that were not due to scheduled absences. Include sick time, unexcused absences, etc. Exclude vacations, personal leave, holidays, etc.
14. TOTAL RAIL RECEIVING. (same as total truck receiving except explanations refer to rail receiving operations).

STORAGE AND REPLENISHMENT

15. TOTAL STORAGE AND REPLENISHMENT.
- F. First-line supervision hours - total supervisory hours used in directing the movement of stock from a) receiving docks (truck and rail) into storage and order selection slots, and b) storage locations into order selection slots and other storage locations. Includes all regular straight time hours and all overtime hours.

SHIPPING

17. TOTAL SHIPPING.
- G. Total indirect labor hours - all hours used to check the loading of orders and the accuracy of order selection. Includes all regular straight time hours and all overtime hours. Does not include loading hours.

SUPPORT

18. RECOOPERING.

G. Total indirect labor hours - all hours used to recycle or dispose of the damaged stock described in 12A above. Includes all regular straight time hours and all overtime hours.

19. INVENTORY CONTROL.

G. Total indirect labor hours - all hours used to maintain an accurate inventory status (e.g., cycle counting, low stock level checking, inventory verification counts, etc.) on the items in the reported commodity area (e.g., dry grocery, frozen food, etc.). If a complete physical inventory count was taken during the reporting period do not report the hours used to complete that count. Includes all regular straight time hours and all overtime hours.

20. MAINTENANCE.

G. Total indirect labor hours - all hours used to maintain the warehouse equipment (rolling and standing) used in the commodity area (e.g., dry grocery, frozen food, nonfoods, etc.) during the reporting period. Exclude physical plant maintenance. Includes all regular straight time hours and all overtime hours.

21. HOUSEKEEPING.

G. Total indirect labor hours - all hours used to maintain an acceptable level of sanitation within the reported commodity area (e.g., dry grocery, frozen food, nonfoods, etc.) during the reporting period. Includes all regular straight time hours and all overtime hours.

22. SECURITY.

G. Total indirect labor hours - all hours used for property protection and loss prevention. Includes all regular straight time hours and all overtime hours.

23. TOTAL SUPPORT.

F. First-line supervision hours - total supervisory hours used to direct support activities related to the reported commodity group (e.g., dry grocery, frozen food, nonfood, etc.). Includes all regular straight time hours and all overtime hours.

GLOSSARY

Automated storage: Automated stacker crane arrangement that stores product in computer assigned locations.

Automatic dragger or conveyor: A device that moves pallets automatically from receiving to the storage area.

Batch pick: To select cases (sale units) for more than one order on a single pass through a selection aisle.

Bulk selector: A selector assigned to pick multiples of full case line items when the multiple exceeds some specified number (e.g., 15 or more).

Backhaul: The hauling of product from a vendor's warehouse to one's own warehouse (usually with one's own vehicles) on the return from delivery trip.

Carts: Four-wheeled vehicles made of metal on which the product selected at the warehouse, is wheeled onto trailers, off-loaded at stores and wheeled into the stores' aisles for stocking. Empty carts are returned to the warehouse. For example, Techno and Cumberland carts.

Cases: The containers in which the product is received from the vendor.

Conventional distribution center: A distribution center (or warehouse) using "conventional" equipment in the receiving, storage, selection, and shipping operations. Conventional equipment includes pallet jacks (transporters), forklifts, tuggers, carts, 4-wheelers and towlines (overhead and in floor). Nonconventional equipment includes conveyORIZED selection (e.g., Rapistan), automatic machine selection (e.g., SI Ordermatic) and stacker crane storage.

Conveyor selection system: System in which selection is done at various levels from conventional or gravity fed racks to a conveyor. The conveyor moves merchandise to a staging area where sorting may be required before loading.

Cooperative stores: Stores (of any size), belonging to a cooperative buying and warehousing group, who own stock in the group and who share in the corporation's profits.

Corporate store: A store (of any size) owned by a company having eleven or more stores. The company may or may not also own and/or operate your warehouse.

Cost of goods sold: Inbound f.o.b. cost of goods delivered to the warehouse. Normally equals invoice cost plus inbound transportation cost.

Direct labor: Labor used in the dry grocery operation to actually handle or move product. Exclude sick leave and vacation time. Include all other paid time used to handle products, for break item, for overtime, or for idle time.

Emergency order: An order which requires special handling with respect to selection, shipment or store delivery. Orders termed "add on" or "supplementary" are not necessarily emergency orders. Not all "add on" orders will require special handling in the warehouse and are therefore not always emergency orders.

Fixed slot: A selection slot identified with a particular product; the same item is selected from the slot until reassigned.

Floating slot: The slot is assigned to an item on receipt. Items do not have permanent selection location assignments. Selection is usually done on a first-in, first-out basis moving to another full slot when a location is depleted.

Hit frequency: Number of units selected in a given distance of travel (e.g., number of cases selected on one order while traveling one aisle).

HRI establishment: Hotels, restaurants, schools and other institutional customers.

Inactive storage: Areas where no individual case selection occurs. These areas are used primarily to store quantity purchases ("buy-ins") and to hold excess product which cannot be placed into overhead rack or floor stack storage (reserve storage) near the selection slot.

Independent store: A store (of any size) owned by a company having fewer than eleven stores. The same company may or may not also own and/or operate your warehouse.

Indirect labor: Labor used in the warehouse to perform inbound and outbound checking, record handling, inventory control, and other support work not included in supervision or direct product handling.

Industrial engineering standards: Production standards derived from engineering analysis using time and motion studies.

Inventory turnover: Equals the cost of goods sold divided by the average inventory, specified on an annual equivalent basis.

Job Assignment: The process by which individual employees are assigned to specific tasks (e.g., order selection, checking, etc.) in the warehouse.

Line item: An item on an invoice that is received in full case quantities.

Master containers: Containers or cases used to ship pieces from the repack operation to the store. They include reusable plastic tote bins or nonreusable corrugated boxes.

Minimum performance standards: The lowest acceptable rate at which an employee or group of employees are retained. Usually measured in cases or pieces per hour.

Multi-level selection with a high lift picking device: Selection from conventional or gravity fed racks at levels above the warehouse floor. Selector and cart or pallet are raised by a high lift mobile platform (e.g., 'cherry picker') that may or may not be guided by a floor track.

Pieces: The individual unit that is selected in repack (i.e., the sale unit). Its distinguishing characteristic is that it requires separate handling. Use pieces when reporting order selection data in repack departments.

Rail load: Partial or full railroad car unloaded at warehouse raildock constitutes one load. For this questionnaire a partial railroad car load is counted as a load.

Receiving: The unloading and checking of inbound product received from outside vendors or from own manufacturing. Does not include moving product from the dock to its storage position.

Recovering: The salvage of damaged product.

Regular order: A regular order is a regularly scheduled delivery to a store. A regular order and an emergency order may be shipped together, either at the scheduled time or at a later time. In either case, report both orders.

Repack: The operation in a warehouse where pieces are selected from full vendor cases and packed into shipping containers for shipment to the store. Repack items therefore move in less than full case quantities. This operation commonly includes health and beauty aids, tobacco, candy and housewares.

Replenishment: The movement of product from one storage location to another. Generally the movement is from reserve storage to a selection slot but all movement between remote storage, reserve storage, and selection slots should be included (including "rewarehousing").

Reserve storage: All floor stack and rack storage nearby the selection slots. This storage is generally used for selection slot replenishment.

Sale unit: The individual unit that is selected and invoiced to the customer (e.g., full cases, partial cases, inner packs, 3 cans from a case of a dozen, etc.).

Security: All theft protection activities in and around the warehouse.

Selection: The picking of product from the selection area, generally in individual case lots, to make up store orders and the movement to the shipping dock. Pallet quantities of high volume items, especially of promotional items, are also included.

Shipping: The loading onto trucks of store orders of selected product previously placed on the shipping dock.

Short interval scheduling: The process by which employees are told the time in which they will be expected to complete a small unit of work. The employees are evaluated on their performance relative to this scheduled objective time.

Slot: A position in the warehouse only one pallet in width assigned to only one type of product. A slot may contain only one pallet position, as is the case for selection slots in selection rack; or a slot may contain several pallet positions, as is the case for floor slots. The height and depth of the slot varies, depending on the type.

Storage (activity): The movement of product from the receiving dock to the first storage location.

Supermarket store: A self-service food store that has annual gross sales of \$1 million or more. It may be a corporate chain store, an independent (unaffiliated) store or an affiliated store in a cooperative or voluntary group.

Supervision: All personnel involved in the supervision of dry grocery operations. This should include all personnel not considered direct, indirect, or support labor.

Support labor: All nonsupervisory personnel involved in recoop, maintenance, security, janitorial, and other work not considered direct or indirect labor. All property conservation work including fire, theft and contamination prevention is support labor.

Towline or chaintow: A powered cable or chain (overhead or imbedded in the floor) designed to tow carts from dock to selection/storage area, from one selection/storage area to another and from selection/storage area to dock.

Truck load: TL and LTL orders received from outside vendor or own manufacturing operations.

Unitized: Any type of device that permits handling many cases as a unit (e.g., carts, pallets and slip sheets).

Vending type selection system: An automated system in which cases are electronically released from gravity fed lanes under computer control. Cases are delivered sorted to the shipping dock via conveyors.

Voluntary store: A store (of any size) belonging to a voluntary group which uses a common trade name and is sponsored by and/or adheres to your warehouse's supply and service program.

CONFIDENTIAL QUESTIONNAIRE

CORNELL UNIVERSITY

Company _____ Dates for four weeks ending November 9, 1979

Warehouse Address _____

Correspondence To:
Name and Title _____

Address _____ Telephone _____

Person Directly Responsible
for Supplying Information:
Name and Title _____

Address _____

PLEASE READ THE INTRODUCTION AND GENERAL INSTRUCTIONS SECTIONS OF THE INSTRUCTION MANUAL BEFORE COMPLETING THIS QUESTIONNAIRE. QUESTIONS IN BOLD FACED TYPE HAVE MORE COMPLETE EXPLANATIONS IN THE MANUAL. UNDERLINED TERMS ARE DEFINED IN THE GLOSSARY.

I. GENERAL INFORMATION

1. WAREHOUSE OWNERSHIP (check one):

- a. Coop _____
- b. Corporate-retailer _____
- c. Wholesaler _____
- d. Other (please describe) _____

2. Number of warehouses operated by your firm _____.

II. GENERAL WAREHOUSE OPERATIONAL CHARACTERISTICS

These questions relate to operations throughout the year.

- 1. COMMODITY GROUP REPORTED IN THIS QUESTIONNAIRE _____
Examples: Dry grocery, frozen food, nonfood, etc.
- 2. Total number of items stocked in commodity group in question 1 (one) above _____.
- 3. TOTAL NUMBER OF ITEMS IN QUESTION 2 ABOVE THAT ARE SOLD IN LESS THAN MANUFACTURER'S CASE QUANTITY _____.
- 4. TOTAL NUMBER OF WAREHOUSE EMPLOYEES _____.

5. HOW MANY WAREHOUSE EMPLOYEES HAVE TERMINATED OR HAD THEIR EMPLOYMENT TERMINATED DURING THE PAST 12 MONTHS _____?
6. TOTAL NUMBER OF FIRST-LINE SUPERVISORS _____.
7. HOW MANY FIRST-LINE SUPERVISORS HAVE TERMINATED OR HAD THEIR EMPLOYMENT TERMINATED DURING THE PAST 12 MONTHS _____?
8. Are outside warehouse facilities used to handle inventory surges resulting from promotions, seasons, speculative buying, or overstock conditions?
yes _____ no _____
9. Number of hours of operation per day and days per week:

a. Truck receiving	_____	hours	_____	days per week
b. Rail receiving	_____	hours	_____	days per week
c. Movement of product from truck receiving to reserve storage and selection slots	_____	hours	_____	days per week
d. Movement of product from rail receiving to reserve storage and selection slots	_____	hours	_____	days per week
e. Movement of product from reserve to selection slots	_____	hours	_____	days per week
f. Order selection	_____	hours	_____	days per week
g. Shipping	_____	hours	_____	days per week
10. Dock Sizes:

	Truck receiving	Rail receiving	Shipping
Length (ft.)	a. _____	d. _____	g. _____
Depth (ft.)	b. _____	e. _____	h. _____
Number of doors (cars for rail)	c. _____	f. _____	i. _____
11. Do shipping and truck receiving use the same dock (check one)?
 - a. No _____
 - b. Yes, but at different times _____
 - c. Yes, at the same time _____
12. Are docks used for permanent storage (more than one week)?

a. Truck receiving (check one)	yes _____	no _____
b. Rail receiving (check one)	yes _____	no _____
c. Shipping (check one)	yes _____	no _____

RECEIVING

13. How often does your receiving operation run short of empty pallets to be used for palletizing inbound shipments (check one)?

continued on next page

- a. Never _____
- b. Less than once a month _____
- c. Less than once a week _____
- d. Once a week or more frequently _____

14. Principal checking method by carrier type

	Common Carrier (check one)	Backhaul (check one)	Rail (check one)
a. Spot check (check selected shipments)	_____	_____	_____
b. Case count all inbound shipments	_____	_____	_____
c. Total item check all inbound shipments	_____	_____	_____
d. No checking	_____	_____	_____

15. Do you require that carriers make truck receiving appointments?
yes _____ no _____

STORAGE AND REPLENISHMENT

16. Method of movement from receiving to storage or selection slots:

Truck (check one)	Rail (check one)	
_____	_____	a. Forklift from dock to aisle and store.
_____	_____	b. Forklift or pallet jack from dock - highlift stores aisle.
_____	_____	c. <u>Automatic dragger</u> or conveyor to aisle - highlift stores in aisle.
_____	_____	d. <u>Automatic dragger</u> or conveyor to aisle - <u>automated storage</u> .
_____	_____	e. Other (please describe) _____

17. Reserve storage location for inbound merchandise (check one):

- _____ a. Location selected by on-line computer.
- _____ b. Fill selection slot first then store in nearby reserve.
- _____ c. Other (please describe): _____

18. Method used to replenish conventional selection slots (check one):

- _____ a. Computer generated replenishment schedule.
- _____ b. Lift operator replenishes using only visual inspection.
- _____ c. Lift operator replenishes using historical movement data and visual inspection.
- _____ d. Lift operator replenishes using expected movement data and/or visual inspection.
- _____ e. Other (please describe) _____

SELECTION

Questions 19 through 25 refer to that portion of order selection done conventionally.

19. Conventional selection slots are (check one):

- _____ a. Fixed
- _____ b. Floating
- _____ c. Both

20. Is the selection document printed in slot sequence? yes _____ no _____

21. Are case labels used for order selection? yes _____ no _____

22. Please rank in order of importance (1 = most important, 5 = least important) the following slotting criteria as they apply to your conventional selection operation.

- | | Rank |
|---|-------|
| a. Maintaining family groupings | _____ |
| b. Minimizing damage | _____ |
| c. Maximize cube utilization
on carts or pallets | _____ |
| d. Maximize <u>hit frequency</u> in
selection | _____ |
| e. Minimize replenishment handling | |

Please briefly describe other slotting criteria used in your operation.

23. Do you segregate items by movement in the conventional selection areas?

- a. Slow moving items yes _____ no _____
- b. Fast moving items yes _____ no _____

24. Are multiples selected by a bulk selector? yes _____ no _____

25. If the answer to question 24 above is yes enter the minimum quantity selected by a bulk selector _____.

SHIPPING

26. How often does your shipping operation run short of trailers into which to load shipments (check one)?

- _____ a. Never.
- _____ b. Less than once a month.
- _____ c. Less than once a week.
- _____ d. Once a week or more frequently.

27. Principal checking method (check one):

- a. Spot check (check selected orders) when loading.
- b. Case count all orders when loading.
- c. No checking at the loading dock.
- d. Other (please explain): _____

28. Who physically places product into trailers for shipment (check those applicable)?

	Carts	Pallets	Deadpile
a. Order selectors	_____	_____	_____
b. Shipping personnel	_____	_____	_____
c. Others (please describe)	_____	_____	_____

WAGES, INCENTIVES, LABOR AGREEMENTS

29. What is the wage rate (excluding fringes) for a conventional order selector in your warehouse? \$ _____ per hour.

30. Do you use productivity incentives (check where applicable)?

Functional area	Circle one	Monetary	Merchandise	Time Off	No Incentives
a. Truck receiving	group/individual	_____	_____	_____	_____
b. Rail receiving	group/individual	_____	_____	_____	_____
c. Storage and replenishment	group/individual	_____	_____	_____	_____
d. Order selection	group/individual	_____	_____	_____	_____
e. Shipping	group/individual	_____	_____	_____	_____

Please briefly describe other incentive plans used in your operation.

31. Do you have individual minimum performance standards for specific jobs?

- a. Truck receiving yes _____ no _____
- b. Rail receiving yes _____ no _____
- c. Storage and replenishment yes _____ no _____
- d. Order selection yes _____ no _____
- e. Shipping yes _____ no _____

32. Are the standards in question 31 above based on industrial engineering standards?

continued on next page

- a. Truck receiving yes _____ no _____
- b. Rail receiving yes _____ no _____
- c. Storage and replenishment yes _____ no _____
- d. Order selection yes _____ no _____
- e. Shipping yes _____ no _____

33. Please list any progressive disciplinary steps taken when an employee fails to meet the minimum performance standards referred to in question 31 above:

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____
- 6. _____

34. Is short interval scheduling used?

- a. Truck receiving yes _____ no _____
- b. Rail receiving yes _____ no _____
- c. Storage and replenishment yes _____ no _____
- d. Order selection yes _____ no _____
- e. Shipping yes _____ no _____

35. Are your warehouse employees unionized? yes _____ no _____

36. If the answer to question 35 above is no please skip to question 43.

37. Union name: _____ Local number _____

38. Are the minimum performance levels mentioned in question 31 above specified in writing in your union contract? yes _____ no _____

39. Are the progressive disciplinary steps referred to in question 33 above specified in writing in your union contract? yes _____ no _____

40. Is job assignment in the warehouse based on seniority? yes _____ no _____

41. Does your contract call for a guaranteed minimum number of hours to be paid?

- a. Daily yes _____ hours _____ no _____
- b. Weekly yes _____ hours _____ no _____

42. First-line supervisors are:

- a. Union members yes _____ no _____
- b. Nonunion yes _____ no _____
- c. Both yes _____ no _____

EQUIPMENT INVESTMENT

43. WHAT WAS THE ORIGINAL COST OF ALL OF THE MOVING AND STANDING EQUIPMENT IN REGULAR USE IN THIS WAREHOUSE? Please include the kinds of equipment listed in the instruction manual as well as other types used. Include only equipment that is used to handle products belonging to the commodity group specified in question 1 (one) above.

	Total Cost	Description of other equipment
a. Truck receiving	\$ _____	
b. Rail receiving	\$ _____	
c. Storage and replenishment	\$ _____	
d. Order selection	\$ _____	
e. Shipping	\$ _____	

WAREHOUSE CAPACITY (for the commodity group specified in question 1 above)

44. Total area in square feet utilized (please exclude dock areas, rail sidings, truck wells, maintenance and support areas, equipment parking/charging areas, lunch rooms, offices) _____ square feet.

45. What is your predominant aisle width?

- a. Active storage area _____ feet
- b. Conventional selection area _____ feet

46. Predominant height from floor to top of pallets in storage:

- a. Active storage area _____ feet
- b. Conventional selection area _____ feet

47. STORAGE CAPACITY:

- a. Active storage area _____
 - (cases)
 - (pallets) circle one
 - (sale units)
- b. Inactive storage area _____

III. WAREHOUSE DATA FOR THE REPORTING PERIOD

These questions relate to the four-week reporting period identified above.

1. INVENTORY AT THE BEGINNING AND AT THE END OF THE REPORTING PERIOD (for the commodity group specified in question 1):

continued on next page

beginning ending

a. Active storage area _____ _____

(cases)
(pallets) circle one
(sale units)

b. Inactive storage area _____ _____

2. Percent of cases received from outside carrier trucks that were:

- _____ % a. Placed on the dock palletized by the carrier driver.
- _____ % b. Palletized by the carrier driver and unloaded by warehouse employees.
- _____ % c. Palletized by the carrier with help from warehouse employees then unloaded by warehouse employees.
- _____ % d. Palletized and unloaded entirely by warehouse employees.
- _____ % e. Other (please describe): _____

3. Customer profile for the reporting period:

	Supermarkets				Nonsupermarkets
	Corporate	Coop	Voluntary	Independent	Small stores, convenience stores and HRI establishments
a. Number of stores	_____	_____	_____	_____	_____
b. Number of regular orders	_____	_____	_____	_____	_____
c. Number of emergency orders	_____	_____	_____	_____	_____
d. Number of cases shipped	_____	_____	_____	_____	_____

4. Selection system used:

System	Number of cases selected	Batch pick (circle one)	Maximum orders in a batch
a. Conventional with pallet jacks or tuggers pulling carts or wagons	_____	yes/no	_____
b. <u>Towline or chaintow</u>	_____	yes/no	_____
c. <u>Multi-level selection with a high lift picking device</u>	_____	yes/no	_____
d. <u>Conveyor system (Rapistan type)</u>	_____	yes/no	_____

continued on next page

System	Number of cases selected	Batch Pick (circle one)	Maximum orders is a batch
e. <u>Vending type system</u> (SI ordermatic type)	_____	yes/no	_____
f. Other (please describe)	_____		

5. NUMBER OF CASES (SALE UNITS) PRINTED ON A SELECTION DOCUMENT THAT WERE NOT SHIPPED DURING THE REPORTING PERIOD, _____.

6. Number of cases and repacks shipped to stores on:

- a. Pallets _____
- b. Carts _____
- c. Deadpile _____
- d. Other (please describe): _____

7. Number of loads that contained:

- a. One order per load _____
- b. Two orders per load _____
- c. Three orders per load _____
- d. More than three orders per load _____

8. PLEASE ENTER YOUR OPERATING DATA FOR THE REPORTING PERIOD ON THE FORMS PROVIDED.

Operating data, if available, may be recorded directly on FORMS I and II. For those firms which do not routinely collect all the requested information, FORMS III and IV can be used for directly recording the data. These completed forms should be totaled and sums transcribed to FORMS I and II. Please return all used copies of FORMS III and IV with the questionnaire. Complete instructions for the use of these forms is included in the DETAILED EXPLANATIONS sections. Please review these instructions before beginning data collection.

WAREHOUSE DATA

Four week totals for the reporting period:

Total truck receiving	13	Total rail receiving	14	Total Storage and Replenishment	15	Order selection	16	Total shipping	17	Recoopering	18	Inventory Control	19	Maintenance	20	Housekeeping	21	Security	22	Total support	23
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INDIRECT LABOR AND ABSENCES

F. First line supervision hours

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G. Total indirect labor hours

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H. Indirect labor overtime hours

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--	--	--	--	--	--	--	--	--	--

I. Total record handling hours

--	--	--	--	--	--	--	--	--	--

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J. Record handling overtime hours

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K. Total absentee hours

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K.

RECEIVING

	I & II ID	Total Hours	I & II 1E	O/T Hours
Truck unloading - unitized	1D		1E	
Truck unloading - deadpile	2D		2E	
Backhaul unloading - unitized	3D		3E	
Backhaul unloading - deadpile	4D		4E	
Checking - truck receiving	13G		13H	
Supervision - truck receiving	13F		13F	
Record handling - truck receiving	13I		13J	
Rail unloading - unitized	5D		5E	
Rail unloading - deadpile	6D		6E	
Checking - rail	14G		14H	
Supervision - rail receiving	14F		14F	
Record handling - rail receiving	14I		14J	

MOVING STOCK

Moving stock - truck and rail receiving to storage, selection slots or shipping	7D		7E	
Moving stock - storage to selection slots or other storage locations	8D		8E	
Supervision - movement storage to selection slots	15F		15F	
Record handling - movement storage to selection slots	15I		15J	

SELECTION

Order Selection	9D		9E	
Supervision - order selection	16F		16F	
Record handling - order selection	16I		16J	

SHIPPING

Loading - unitized	10D		10E	
Loading - deadpile	11D		11E	
Checking - shipping	17G		17H	
Supervision - shipping	17F		17F	
Record handling - shipping	17I		17J	

SUPPORT

Recoopering	18G		18H	
Inventory control	19G		19H	
Maintenance	20G		20H	
Housekeeping	21G		21H	
Security	22G		22H	
Supervision - support	23F		23F	
Record handling - support	23I		23J	

Daily Totals

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