FUNCTIONAL ANALYSIS OF FOOD DISTRIBUTION

PART III

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Jerome Louis Thole

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"The Food Distribution Program at Michigan State University is under the sponsorship of the National Association of Food Chains."

FUNCTIONAL ANALYSIS OF FOOD DISTRIBUTION

PART III

By

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No thesis is the product of any one person. The concepts and beliefs expressed here as the author's own are in reality the results of an incorporation of ideas of many other individuals. Thus, the author can only acknowledge his sincere appreciation to the many persons who have knowingly or unknowingly contributed to this work.

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INTRODUCTION

Purpose of the Study

The most valuable approach through which the workings of organizations engaged in marketing may be grasped is the functional approach. Briefly defined, "a marketing function is an act, operation, or service performed in the process of distributing goods and services. The study of functions breaks the process down into smaller parts so that each portion of the whole may be studied critically."[1]

Various scholars have divided the work of marketing into eight functions. Two of these major activities, known as the functions of physical supply, are those of storage and transportation, both having to do with the actual physical handling of the goods incident to their movement from places of plenty to places of relative scarcity or to their storage from times of plenty to times of scarcity. The purpose of this study is to dissect critically these two functions as they relate to the food distribution industry.

Need for the Study

"Warehousing never seems to attract the full scrutiny of the 'scientific' managers. Indeed, it hasn't even been regarded as a field. It is not taught in

1. David J. Luck and Hugh G. Wales, Marketing Research (New York: Prentice-Hall, Inc., 1952), pp. 3-4.

business schools as a subject, it doesn't have a single trade journal of its own - and it is one of the few economic activities in the United States that isn't represented by an over-all national association."[2] In spite of the fact that this quotation refers to the warehousing industry in general, it adequately explains the need for the study of warehousing in the food industry.

Over the years, however, the importance of the warehousing function has always been evident. The consumer is reluctant to anticipate his needs for goods and cannot, or will not, provide storage for goods in quantity. He demands that supplies of goods be made accessible for satisfying his current wants. To meet these requirements, retailers must, in some way, provide for storage.

The most important conditions which bring about a need for storage may be summarized as follows.[3]

1. Seasonal production and more or less uniform consumption.
2. Uniform production and seasonal consumption.
3. Roundabout methods of production and inability to maintain perfect balance between supply and demand.
4. Surplus production of a commodity in one locality and consumption of the surplus in another or many other localities.
5. Irregularity of consumer demand.
6. For transportation reasons.
7. For conditioning.
8. The need for financing between time of production and time of consumption.
9. Speculation.
10. Quantity purchasing.

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2. Editors, Fortune Magazine, "The Push Button Warehouse", Vol. LIV, No. 6, (December 1956), p. 140.

3. H. B. Killough, The Economics of Marketing (New York: Harper and Brothers, 1933), pp. 108-109.

In addition, a high proportion of a concern's capital is usually represented by merchandise inventories - inventory is their largest single item of investment, frequently exceeding even the investment in owned buildings. This investment outlay becomes unprofitable unless the goods are properly cared for and are sold within a relatively short period of time.

Scope of the Study

A basic consideration that was previously used in this work must be mentioned in respect to the term "storage". Webster defines storage as "the safekeeping of goods in a warehouse; a place in which things are stored". As used in this sense, the term is highly inadequate for purposes of this study. The term warehousing is not synonymous with the term storage for it embraces more than that. It encompases all the activities having to do with the handling of goods, their storage, order filling and shipping activities. Perhaps a better definition of warehousing, as it relates to the food industry, would be a distribution center. Distribution connotes movement, illustrating the principle of turnover on which the food industry is so dependent in modern merchandising activities. Food distribution centers, therefore, are not primarily places of storage but rather centers at which merchandise is gathered and/or processed incident to its delivery to retail stores.

The present study will be limited to an analysis of the organization, layout, equipment and operations of the various departments within a food distribution center. This study further assumes that the operations described handle a sufficient tonnage of merchandise to warrant the use of materials handling equipment.

Since many food distribution centers handle produce, meat and other items, in addition to groceries, this discussion will cover each department and its particular operations and problems. As a result, depth and detail in certain phases of the operation are often omitted in order to cover the subject as adequately as possible. Should the reader become interested in detailed operations of this nature, the bibliography at the conclusion of the paper lists excellent sources for reference.

Many food distribution centers serve as manufacturing plants for certain items: however, these operations will be excluded from this work.

Certain areas of the center, such as training, maintenance and repair, operating efficiencies and costs, plant construction and specifications, will be discussed only very briefly or not at all. Much of this information is very detailed and beyond the scope of this paper.

It has been the purpose of the author to cover the field as comprehensively as possible and to present it in a manner that has not been previously employed.

Historical Background

Although the warehousing industry is of relatively modern origin, the storage function is as old as man. Prehistoric man probably had some system of storing goods for future use. Evidences are plentiful that supplies were preserved for periods of greater need as proved by many studies in archaeology. Thus, through the years, a greater need of warehousing has been realized.

It was not until the advent of World War II that the newer concept of warehousing came into being. Prior to that time, the traditional concept had been primarily one of providing storage for goods carried in stock. Physical operations were, in a large measure, neglected and as long as expenses did not increase, operators could continue the traditional practices.

During the war years, concerns were faced with the burden of handling an expanded volume of business and at the same time were losing experienced warehouse employees to the armed forces or to the more remunerative war industries. Consequently, profit margins were reduced due to inexperienced labor and higher wage rates since government regulations prevented the obtaining of equalizing price increases. These factors probably contributed to the trend of movement of goods rather than storage. Also, about this time, methods of increasing operating efficiency were brought to the forefront.

In the food industry, stores were fairly small units and could not handle large quantities of merchandise. As a result, the food distribution center came into existence primarily as a place where goods would be "broken down" into quantities suitable for store handling.

Today, as in yesteryear, the purpose of the food distribution center is still to serve the store. In addition, as well be discussed in the latter part of this paper, food distribution centers are now intergrating not only groceries, but produce, meat and processing operations as well. Formerly food chains operating distribution centers thought of them as necessary evils - today, however, the thinking has changed in that the distribution center is not an expense, but rather a means through which overall food distribution cost may be minimized.

Sources of Data

Few books have been written on the subject of food warehousing and transportation. However, the food distribution warehouse is primarily a distribution center, not a storage operation. Moreover, little formalized writing has been given to the subject of food distribution centers as a field in itself. From various books have evolved certain principles and objectives which can be applied in any warehousing situation, and these sources have been valuable sources of information.

Much of the information contained in this work has been obtained from government, trade and individual company publications.

The most valuable source of information has been personal visits to several food distribution centers. A special debt of gratitude is extended to Mr. Frank Seaman, Warehouse Superintendent, The Kroger Company, Cincinnati Division, Cincinnati, Ohio, and his organization for their efforts and time in aiding the author during his extensive tour of that plant.

CHAPTER II

FOOD DISTRIBUTION CENTER ORGANIZATION

What is Food Distribution Center Organization

The food distribution center, like the super market it serves, but on a much larger scale, is a vast complex array of heterogeneous activities, functions, departments and personnel. Distribution center organization is the relationship which exists among these activities, functions, departments and personnel. It may be defined as "the arranging or putting together of mutually connected and dependent parts into a systematic whole so that they will work together with the least possible friction and the greatest harmony."[1]

The organization plan of the food distribution center should facilitate the assignment of responsibility, and the delegation of authority to the personnel. Every person in the center should be aware of his responsibility and to whom he is subordinate. "In its simplest form organization may be said to be the fixing of responsibility for performing or accomplishing particular jobs or functions."[2]

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1. Norris Brisco, Retailing (New York: Prentice-Hall, Inc., 1947), p. 59.

2. Ibid., p. 51.

Economic conditions, competition, size, services rendered and complexities of food distribution centers hold many implications for distribution center organization. Present economic conditions call for larger, more expensive centers. The size and complexity of the modern food distribution center has produced an organization which is far more complicated than the organizational structure of its predecessor. Present day food distribution centers are organized in many different patterns. The only conclusion that can be drawn is that there is no standard type of organization and "as each business enterprise has conditions peculiar to itself a set of rules cannot be laid down that would be applicable to the organization of all enterprises."[3]

Type of Food Distribution Center Organization

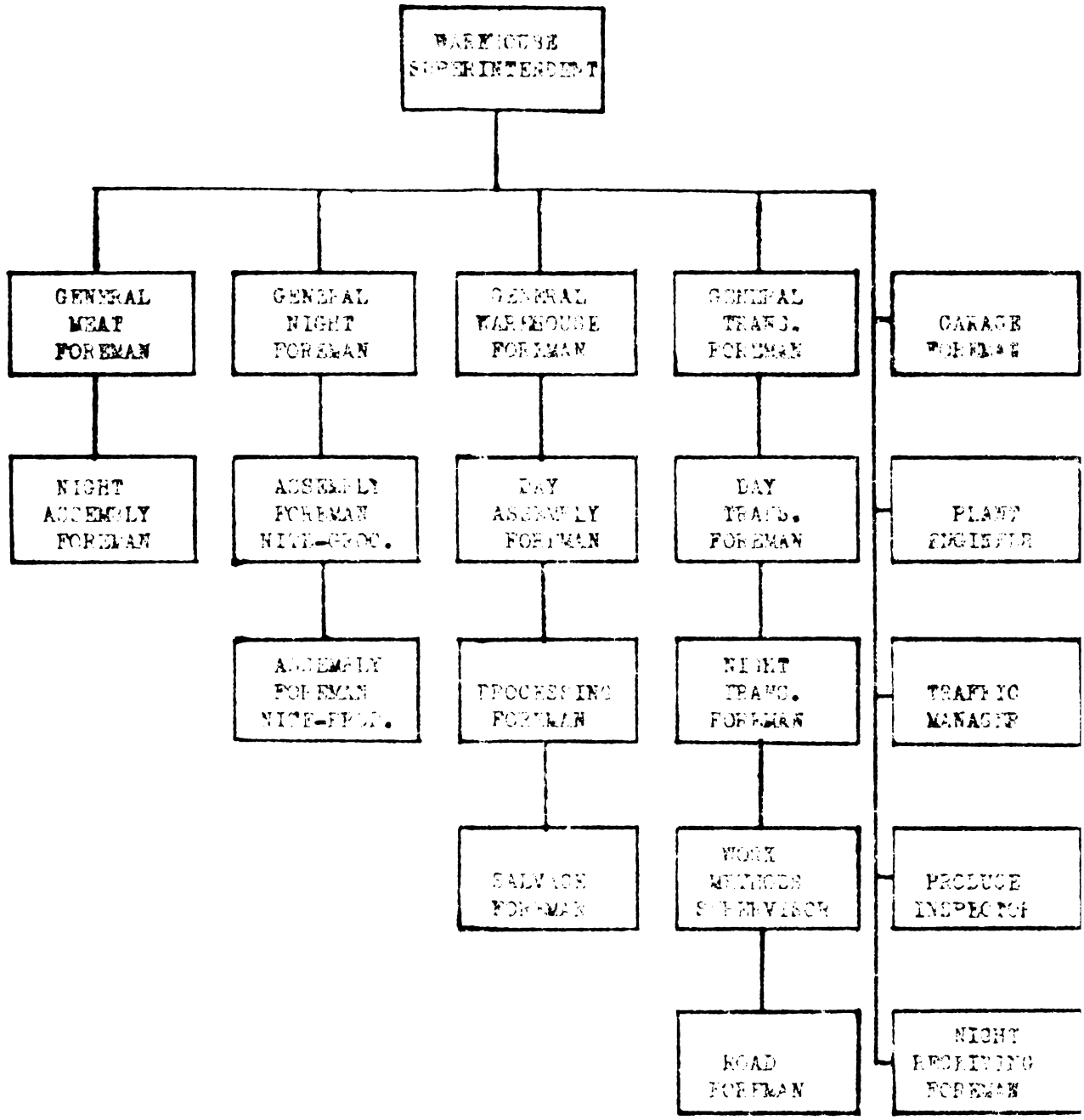
With the foregoing discussion in mind, it would serve no useful purpose to attempt to present, in this paper, the many types and variations of distribution center organization being presently used in the food industry. Job titles may and often do change within various companies, but basically their tasks remain the same. Figure I illustrates a typical organizational structure of a large corporate food chain distribution center moving approximately six million (6, 000, 000) pounds of merchandise per week.

As can be readily seen from Figure I (page 9), the organization is the single line type - one person is responsible for the operation. The organization is sub-divided into many departments. The heads of these departments are

3. W. B. Cornell, Organization and Management in Industry and Business (New York: The Ronald Press Company, 1936), p. 35.

FIGURE I

Illustration of a Typical Organization Chart for a Large Food Distribution Center Operation



responsible for the internal department operations and they are subordinate to the distribution center superintendent in a direct line of command.

The majority of food distribution centers have this single line plan. The purpose is to segregate the various departments according to the type of work, tending toward decentralization, each department forming a self-governing unit, subject only to the general supervision of management, and assuming responsibility for functioning in line with the major policies of the company.

Functions of Food Distribution Center Personnel

The first step in food distribution center organization is to outline the major classes or types of activities that are essential to the conduct of the business and to designate the person responsible for each such class or type of activity. Next, all the specific jobs or activities within each major division and the personnel handling them are listed.

Food Distribution Center Superintendent

The food distribution center superintendent is responsible to the branch manager or divisional manager for the performance of the following functions at the lowest cost consistent with sound service.

1. Develop and maintain a competent organization.
    a. See that key jobs are filled with competent men.
    b. Provide for the proper selection and training of all other employees.
    c. Establish and enforce clear, written and posted shop rules.
    d. Periodic meetings with foreman and supervisors.
    e. Hold group meetings of all employees periodically by departments.
    f. Give credit where credit is due.

g. Review the control records which show performance of subordinates and take whatever remedial measures may be necessary.
h. Give subordinates constructive aid in correcting their difficulties.

2. Coordinate warehouse and transportation functions.
   a. Get a clear understanding of relationship with each of the other departments.
   b. Actively participate in merchandise and operational meetings.

3. Supervise the warehousing and transportation of all merchandise.
   a. Receiving all merchandise.
   b. Storing all merchandise.
   c. Routing all merchandise.
   d. Assembling of all merchandise.
   e. Loading.
   f. Transporting.
   g. Selection and assignment of drivers.
   h. See that federal and state laws and regulations governing motor vehicles are observed.

4. Supervise traffic department.
   a. Control movement of all inbound and outbound merchandise moved by public carrier.
   b. Process claims for loss, storage, or damage resulting from the shipment of merchandise by public carrier.
   c. Procure needed public storage.

5. Supervise garage operation.
   a. Maintain automotive equipment at the lowest cost consistent with sound maintenance and satisfactory deliveries.
   b. Maintain warehouse mobile power units at lowest cost consistent with sound maintenance.

6. Supervise building and equipment maintenance.
   a. Keep buildings, equipment, and premises under jurisdiction clean and in good repair at the lowest cost consistent with sound maintenance and service.

7. Supervise processing operation.
   a. Provide for the economical processing of items in accordance with quantity standards established by the meat, grocery and produce departments.

8. Supervise salvage operations.
    a. Provide for the maximum collection of salvage at the lowest cost.

9. Supervise safety, accident and fire prevention program.
    a. Delegate specific responsibility to each department head on each program and supply the necessary equipment.
    b. Establish and effectively maintain the company's safety, accident and fire prevention programs.

The foregoing sums up the principle duties and functions of the food distribution center superintendent who is responsible for the overall efficiency of his operation.

Traffic Manager

There are two kinds of merchandise movement or traffic in a food distribution center operation. The internal movement of goods, which is part of the work of the food distribution center personnel and the external movement of goods which centers around the functions of receiving and shipping, and represents the core of activity of the traffic department. The term traffic management is restricted in this chapter to the external transportation movement and activities of the food distribution center.

Because of the nature of its duties, the traffic department is normally considered a staff function and reports directly to the distribution center superintendent.

The traffic manager needs formal training in transportation and traffic management plus practical experience that will enable him to speak the traffic language and readily develop and maintain favorable contacts with freight agents, carriers and others. He should be familiar with all available transportation facilities for the movement of goods.

The fact that more and more merchandise is being transported over increasing distances and is being purchased from all parts of the nation, has increased the importance of the position and the activities of the traffic manager. It is imperative, therefore, that a close working arrangement be effective between the traffic manager and the buying department in order that the lowest possible transportation cost and the most expeditious service be provided.

Railroads, express companies, motor carriers, common and contract, are subject to regulation by the Interstate Commerce Commission (I. C. C.) and state commissions. Their rates and rules and regulations governing shipping are filed with these commissions. Shipments are subject to rates filed for the service rendered. Once the shipment is moved, the charge is established. There are substantial differences in the rates of different carriers and in the rates charged by individual carriers in large versus small quantities. Changes are constantly being made in the rates of all carriers in the competitive struggle for business which necessitates constant checking by the traffic manager if a company is to take advantage of the lowest transportation costs.

The traffic manager to be effective must work closely with the buyers at the time of purchase and at the time orders are placed for shipment.

In addition to the foregoing, the traffic manager also performs the following activities.

1. Routing incoming shipments in order to effect economies in transportation and to expedite receipt of goods.

2. Tracing undue delays in transportation or lost shipments.

3. It is the function of the traffic department to handle the claims resulting from discrepancies in incoming shipments.

4. He must exercise good judgment regarding the handling and reconditioning of damaged merchandise or perishables subjected to improper temperatures.

5. He should be helpful in avoiding, or at least controlling, payment of demurrage charges.

6. Auditing of freight bills, embracing an examination of the classifications assigned to each item on the bill and a verification of extensions should be handled by a traffic expert.

7. The ordering of both full and empty freight cars, trucks or trailers to be spotted for loading and unloading falls in the province of the traffic manager.

8. In various companies, the trafffic manager makes all Pullman and airplane reservations for personnel requiring such transportation.

9. He should advise the buyers of perishable merchandise of any cars due over weekends or holidays so that inspection may be arranged and protection afforded while awaiting unloading.

10. The traffic manager should furnish buyers, early each day, a list of cars on track, unloading that day, cars awaiting placement for unloading, cars in transit, and expected arrival date.

11. Finally, in a few of the larger food chains of national or regional scope, the traffic manager plays an important part in the movement of products on company owned trucks, commonly termed inter-branch or inter-division hauling.

One such system, that is unique due to the economies realized in transportation costs, the Kroger Company utilizes to good advantage. The following example illustrates the system. Suppose, for example, the Cincinnati Division is shipping coffee, processed in the Cincinnati Division, to the Grand Rapids Division via its own trucks. Assume also that a shipment of apples was purchased in the Grand Rapids area by the Cincinnati Division buyer. In this

example, the traffic manager of the Cincinnati Division, fully informed of the coffee shipment and apple purchase, would make arrangements with the Grand Rapids traffic manager and then proceed to dispatch a truck from Cincinnati to Grand Rapids with the coffee. The Cincinnati produce buyer would instruct the apple grower to ship to Grand Rapids Division on a specific date. Then, upon arrival of the coffee shipment in the Grand Rapids Division warehouse, the driver would simple exchange trailers with Grand Rapids and return to Cincinnati.

A system of this nature effects savings in several ways. First, the cost of shipping apples to Grand Rapids and then transported to Cincinnati by its own trucks is lower because it is performed by the more efficient use of its own fleet rather than by an outside carrier. Secondly, Grand Rapids is billed by Cincinnati with the transportation charges of the coffee, hence an additional revenue for Cincinnati. Grand Rapids, on the other hand, charges Cincinnati with the cost of moving the apples from common carrier to its truck and thus effects a savings in the transportation cost of the coffee due to the aforesaid savings in drayage by company owned vehicles. A move such as this also utilizes, to the utmost degree, company owned equipment by reducing the number of "rolling" empty trailers.

From the foregoing discussion, it can be seen that the role of the traffic manager is vital and much too important to be treated lightly in any discussion of the food distribution center. His department cannot realize a profit and is, in actuality, a liability. However, this department can and does perform valuable

service that will substantially reduce the liability of the distribution center operation as a whole.

Plant Engineer

With the vast array of complicated machinery and large buildings, the job of the plant engineer becomes even more momentous than before. It is for this reason that more and more food distribution centers have created a department in the organizational structure for a plant engineer. **This is especially true of food distribution centers due to the influx of hugh refrigeration units for the preservation of perishable foodstuffs.**

An attempt to enumerate all the specific duties of this department is a large task indeed, as they are of a complex nature and not within the scope of this paper. However, it is important to note that basically his duties are those of preventive maintenance, such as:

1. He should make a complete inspection of buildings from roof to basement at least twice a year. Building preservation and needed maintenance should be noted.

2. Elevators, refrigeration and boiler rooms should be inspected at least once a month. Cooler rooms should be inspected daily for the condition of the cooling unit.

3. Inspection of materials handling equipment should be provided. A definite greasing program should be established and carried out according to schedule.

4. All employees should be instructed to report immediately any equipment which needs repair or servicing. Provide for such service to be done immediately to encourage employee's reporting these conditions.

5. Provide promptly for any repairs, maintenance or replacements required. In this respect the plant engineer should

keep himself abreast of the times concerning new or improved equipment and prices relating to this equipment.

6. He should make a thorough check for cleanliness when making daily rounds of the warehouse. Cleanliness is important and has direct influence on morale.

7. Take immediate steps to correct any unsatisfactory conditions that may exist.

In many food distribution center organizations, the plant engineer is also delegated the responsibility of the fire prevention and safety programs. These subjects should not be taken lightly in any case, no matter to whom the responsibility is assigned, and, for this reason, they are treated under a special chapter heading in the latter part of this paper.

CHAPTER III

SITE SELECTION, LAYOUT AND EQUIPMENT

Site Selection

In the wake of the expansion programs of the food industry, acute problems in regard to distribution center site selection have developed. For a particular site to be considered a suitable location, special attention must be given to a number of factors, the most important of which are discussed briefly below. Not all factors, however, are applicable in every case, as the importance of each factor varies with the size of the company, the lines of merchandise handled, the proposed method of operation, and the plans for occupancy, i.e., whether to own or lease an existing building or whether a new structure is to be erected.

1. Highways - Easy access to highways, (present and planned), is important from a truck movement standpoint.

2. Availability of railway track service - Whenever possible, sities should be located along side railroad spurs from which cars may be loaded and unloaded with a minimum of labor, time and expense.

3. Finding the "ton-mile" center - The geographic center of store operations is not always the important factor, many times the tonnage delivered to stores must be considered as the operational center. Future store openings must also be considered in this factor.

4. Proximity to freight terminals - Such a location facilitates the handling of less than carlot (LCL) shipments.

5. Traffic conditions - Warehouses located in outlying or surrounding districts seem to have an advantage of ease of traffic movement over warehouses located in congested areas. However, this may involve more ton miles than the traffic center.

6. Availability of public storage facilities - In some cases, it is relatively important to locate near cold and other storage facilities.

7. Sufficient expansion possibilities - This involves the feasibility of adding one or more floors to a vertical warehouse and of acquiring sufficient ground space to expand a one-story warehouse.

8. Labor supply - Consideration must be made of the accessibility of transportation for personnel.

9. Availability, cost of land and property taxes are important factors to also be considered.

Often other factors enter into the site selection picture as evidenced by the recent National Association of Food Chains Management Clinic.

"One member voiced the opinion that out-of-town warehouses can result in less distribution than those in the heart of cities". Another suggested: "Find places available before wasting time deciding where to put the warehouse".[1]

Building Design and Size

The design of the food distribution center, until recently, was not given much consideration. However, distribution center design is an important factor in deciding whether to locate in a city or in some outlying or surburban area.

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1. "Warehousing-Delivery-Automation", National Association of Food Chains Management Clinic (Washington, D. C., April 30, 1956), p. 5.

"Basically there are two types of warehouses in use. These consist of (1) the older and more familiar multi-story warehouse designed for vertical storage, and (2) the newer one-story buildings that involve horizontal storage of merchandise."[2]

"There is no categorical answer to the question as to whether the new firm should build a single-story or multi-story building. The decision in each particular case must be based upon a thorough analysis of all the location factors and of the operating requirements of the firm."[3] The trend of modern food distribution center construction, however, is toward one-story buildings.[4]

One of the most baffling problems confronting executives of the food industry is that of food distribution center size. As in distribution center design there is no categorical answer. At the 1956 National Association of Food Chains Management Clinic of Warehousing, Delivery and Automation, food chain executives attempted to reduce food distribution center size to a basic formula. Some of the formulas presented by various executives are summarized in the following paragraphs:

"A number of members pointed out that buyers as well as food distribution

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2. Theodore N. Beckman and Nathanael H. Engle, Wholesaling (New York: The Ronald Press Co., 1951), p. 357.

3. Ibid.

4. For a detailed discussion of the considerations, see C. C. Wright and J. P. Perry, "The Trend of One-Storied Warehouses", Distribution Age, (April 1948) pp. 34ff. and J. R. Bromell, "Modernizing and Operating Grocery Warehouses", United States Department of Commerce, 1951, p. 2.

center operators must be considered in food distribution center planning. For example, they noted there are buying advantages to be obtained by receiving in carload instead of LCL where the rate may be very much higher.

Another formula for determining size was suggested by a member who said his company used '5 weeks' supply as their basis.

One executive said: 'Some experts say sixty thousand (60,000) square feet is proper for maximum efficiency.'

Other comments were : Our system calls for ninety thousand (90,000) square feet to handle $40,000,000.

Another: We figure twenty (20) square feet per ton of inventory. The best turnover we get is 17 times a year with an average of 13.

One member cautioned that buyers will fill up space faster than it can be built and that if the space is doubled they will want eighty (80) thousand tons in the warehouse.

On the question, how wide should a warehouse be, one member said it should be 1 to 3, i.e., 1 wide - 3 deep.

A few members evidenced some interest in multiple story food distribution centers. However, when polled, no company indicated plans for building a multi-story food distribution center.

Different distribution center aisle widths were used by different companies - 6 feet, 6 1/2 feet, 9 feet, 11 1/2 feet. Aisle width is in part determined by size of pallet used and type of fork lift."[5]

5. NAFC, op. cit., p. 6.

Food Distribution Center Layout

One of the principle methods of attaining maximum efficiency in a food distribution center organization is through the use of scientific layout. This calls for adequate provision for the placing of merchandise in such a manner that all items can be located without delay, orders can be assembled and filled rapidly and at a low cost, work in the warehouse can be handled by a minimum amount of labor and inventories can be taken with little effort. If the food distribution center is properly laid out, kept clean and a strict policy of rotation followed, operating costs will tend to be lower, losses resulting from deterioration minimized, and a favorable impression will be conveyed to suppliers, fire inspectors and others who visit the concern as well as to the employees of the firm.

To determine how much space, on what floor, and in what particular position on a given floor the merchandise of a department is to be placed, is a study far too detailed and complex to be discussed in this thesis. Various companies utilize different layout procedures with various degrees of success. For purposes of clarity, however, certain general similarities are presented here.[6]

In multi-story buildings, space is set aside for an order assembly area and another part of the building space for reserve stocks. Usually the ground floor is devoted to receiving, checking and shipping operations.

6. For a more detailed discussion see Nelson Friz, "How to Estimate Warehouse Requirements", Modern Materials Handling, vol. VI, no. 6, (June 1951), pp. 23-26.

One or more of the lower floors above the ground level constitutes the order assembly line, and the upper floors are used for reserve stocks stored on skids or pallets. Some companies do not use reserve stocks; all merchandise is maintained in the open stock in the order assembly area. Distribution centers of the multi-story style utilize a roller conveyor, monorail conveyor, a moving tow line or manual hand trucks in the order assembly area.

One story food distribution centers usually follow the same basic pattern but on one floor. A large portion of the floor area is set aside for reserve stocks and the remainder, except for the receiving - shipping and office operations, is utilized for the order assembly area. A plan of this general type is illustrated in Figure II. Many companies prefer not to set aside a reserve stock area, instead they use the entire floor, except for receiving - shipping and offices, for the order assembly area. In this case, all merchandise is maintained in bays, the front or lower level stock is used by the order picker and the rear or upper level for reserve stocks.

Many companies determine their layout based on the materials handling equipment desired, e.g., is a conveyor system, a fork lift pallet type system, or a tow line system to be used?

Various merchandise layout systems are utilized by different companies. These are of two types; the commodity grouping or the slot system. Others use a combination of the two and still others lay out their warehouse according to the sequence of order forms.

The food distribution center union contract often determines layout considerations. For example, some contracts specify that an order picker must

make a complete tour of the assembly area (Figure II, page 25) before he may begin his next order even though he may finish the first order in the first aisle. Consequently, concerns experiencing this condition would not want to use a layout as illustrated in Figure II, but possibly one in which the order assembly is broken into sections, each section a complete tour or "run" in itself.

Distribution Center Lighting and Color

The trend toward greater efficiency and employee morale has greatly increased the need for adequate lighting and color in the food distribution center. Losses due to improper checking, water damages and accidents can be minimized with satisfactory illumination and the use of colors.

In the newer, one-story food distribution centers, illuminating engineers have relied on natural light to a great degree. This is accomplished by a skylight system across the roof area, thus making the use of artificial light unnecessary during daylight operations. A common characteristic of many multi-story food distribution centers has been inadequate lighting. Fluorescent installations are in vogue today due to the fact that they are capable of providing "daylight" over the floor area. By installing these lights in a "cross merchandise" manner, as opposed to horizontal installation, greater illumination can be accomplished as shadows are eliminated.

The proper use of color in the food distribution center may at first seem a wasteful expense. However, it must be recognized that some colors reflect light, while others absorb it. For this reason, engineers suggest that ceilings, walls and pillars be painted white. Some colors create a restful atmosphere

FIGURE II

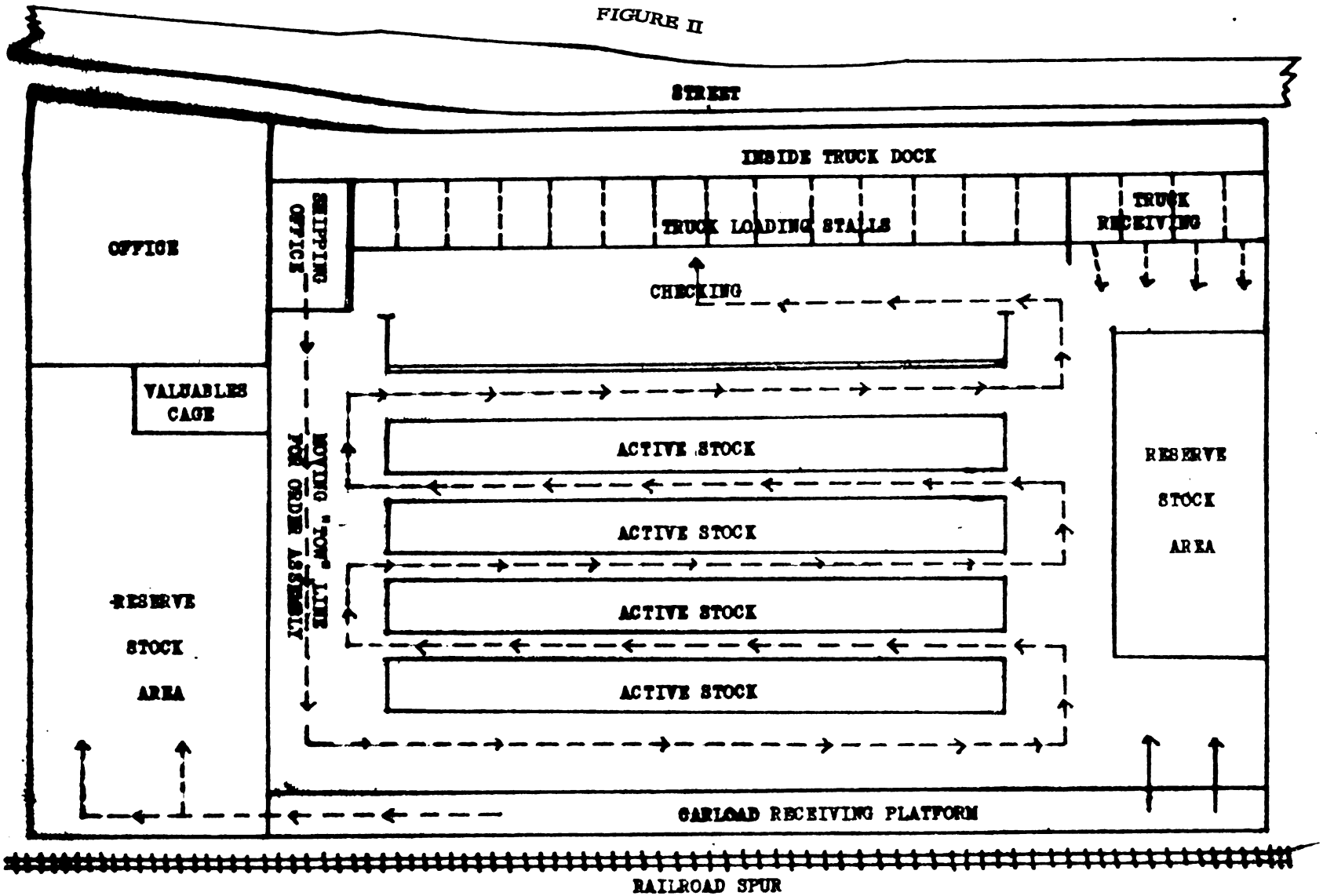

Illustration of a Complete Assembly Line Type of Plan for a One-Story Warehouse

and for this reason bins and shelves are painted gray to prevent glare. Danger spots, such as corners and fire equipment, are painted red for easy identification.

Materials Handling Equipment

The tremendous increase in the volume of merchandise which a company must handle through a single food distribution center, compared with that of the pre-World War II period, has made it imperative to develop low cost, high speed distribution methods. The demand for this operating efficiency places a premium upon methods of moving goods and consequently a greater need for efficient materials handling equipment.

Materials handling is as old as history itself. Traditionally, merchandise has been on a case-by-case handling method, i.e., with the worker carrying one or more cases from the unloading to the storage area. With the influx of the two and four wheel handtruck the movement of merchandise was made easier. The use of these trucks, however, still necessitated the case-by-case handling at both ends of the operation.

High labor cost and the speed required in the manual handling of merchandise has induced food distribution center operators and manufacturers to coordinate their efforts in order to develop equipment which would reduce these costs and speed up operations. Thus, began the evolution of materials handling equipment as we know it today.

Just what is materials handling? Many definitions could probably be developed, but perhaps the most logical is one given by Curtis H. Barker, Jr., Sales Manager, Pallet Loader Division, Lamson Corporation, New York.

"Materials handling is the picking up and putting down, moving of materials or products in any plane or combination of planes, by any means, which includes storage and all movements except processing operations and consumption or end use of this material."[7]

Certain objectives are sought of materials handling. The primary objective is to reduce labor cost and increase efficiency. However, there are many more as evidenced by the following statement.

"Materials handling should promote good building utilization, make men more productive, speed and smooth production and distribution, reduce packaging problems, materials and costs, increase efficiency in the use of boxcar and other transportation equipment space, speed loading and unloading, reduce demurrage, keep transportation equipment on the road, make safer working conditions, decrease damage, breakage and pilferage, decrease dunnage, and bracing, and improve cost and inventory control."[8]

In addition to materials handling objectives, there are basic principles which have evolved over the years. These principles are important in that they act as guide posts in establishing a materials handling system, and also because they help in evaluating a given handling system and enable one to point out certain

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7. C. H. Barker, Jr., I. M. Footlek, C. F. Yarham and F. J. Carle, Industrial Materials Handling (Cleveland, Ohio: The Lincoln Extension Institute, Inc., 1950), p. 6.

8. Materials Handling (New York: General Electric Company, 1948), p. 6.

areas of improvement. However, due to the scope of this study, a more detailed analysis will not be undertaken.[9]

By far the most important contribution in the accomplishment of the materials handling objectives has been the adoption of the "unit load principle". By definition, this principle states that "the more pieces or pounds of merchandise it is possible to combine in a single unit that can be moved in a single handling operation, the lower the cost of moving each piece or pound and the shorter the time required to move a given physical volume of goods."[10]

Pallets and Skids

There are two methods of handling unit loads in general use today. One utilizes platform skids and the other consists of the use of pallets.

Skids are usually of wood construction and resemble sledges in appearance. They usually have two runners, of the same length as the skids that elevate the platform 10 to 12 inches off the floor. Some improved skids are maintained on four metal legs and add to flexibility. The platforms vary in size - a common size being 48 by 72 inches. The open space under the platform allows the insertion of a hand jack or a power lift truck. In addition to having runners

9. For a detailed study of these principles and their application see: David M. Park, Warehouse Materials Handling in the Food Chain Industry, unpublished Master's degree thesis, Michigan State University, East Lansing, 1951.

10. Beckman, Engle, op. cit., p. 424.

or legs, skids many times are mounted on wheels or coasters. The latter are commonly referred to as "live" skids and the former (without wheels) "dead" skids.

The pallet is a flat wooden platform, usually about six inches thick, consisting of planks fastened to both sides or cross timbers. There are also various sizes; 32 by 36 inches, 36 by 36 inches, 40 by 48 inches and 48 by 48 inches. The forks of a lift truck are inserted into the space between the planking and the load is lifted, carried to the allotted space and lowered into position.

While skids usually accommodate larger loads than do pallets, the pallet is more flexible than the skid in that its lower height permits higher tiering wherever high ceilings are used.

Hand Trucks

The most universal type of equipment is the hand truck, and it is often the most economical equipment for a particular operation. Basically there are two types of hand trucks; a two wheel, stevedore type, or the four wheel, platform model.

The two wheel stevedore truck hardly needs much explanation here as they are similiar to those used in the retail store. They usually consist of a pair of handles, separated by stretchers, at an angle to the lower end of which is attached a blade, normally of metal, which supports the load. The apparatus is carried on a pair of wheels of either iron, steel or rubber. The two wheel truck is used mainly for transporting small quantities of merchandise short distances.

"The four wheel hand truck is one of the oldest used methods today."[11] It consists of a platform supported by four wheels and may or may not be equipped with end racks. These trucks come in a great variety of forms, although in essence they are all the same. One type has four wheels of the wagon type, two of which swing around a center pin or fixed handle, serving both for steering and the manpower to move the vehicle. Others include three swivel wheels, "H" style with tongue, four flanged wheels, fifth wheel on front or both axles, etc. Various upper structures, in addition to the end racks, include one end closed, two sides closed, rack in center, etc.

Trailers

When there is a flow of material between two points, hauls are performed more economically with trailers powered by a mechanical prime mover.

These trailers are essentially the same as the four wheel hand truck. It is usually a wooden, metal bound platform vehicle mounted on four wheels or coasters. The coaster type is in widespread use because of its simplicity of construction, its excellent trailing qualities, and the ease with which it can be moved by hand. They are usually six feet long and three feet wide. The fifth wheel or wagon type is used for handling heavy loads and for long load hauls. Both types may or may not be equipped with end racks. The platform usually will accommodate two pallets placed lengthwise. The truck may either be towed

11. R. W. Hoecker, Methods of Handling and Delivering Orders Used by Some Leading Wholesale Grocers, United States Department of Agriculture, Marketing Research Report Number 13, (Washington, D. C.: United States Printing Office, 1952), p. 2.

manually, by tractor or tow line and normally has a coupling device on both ends of the vehicle by which it may be coupled with others to form a "train", or coupled to the prime mover. If an overhead tow line is used, the top of the end rack usually has a chain attached by which it is coupled to the overhead chain conveyor or tow line as it is sometimes called.

Another variation is the "banded ribbon" type. These stock assembly carts have a metal base with eight slats to accommodate the "finger" attachment of a fork lift truck. These fork lifts have corresponding eight-tined forks. The pusher attachment lifts the load from the truck, moves it into a trailer body, onto the floor, without the use of pallets.[12] Needless to say, this innovation will materially reduce operating expenses due to the elimination of pallets and the cost of maintaining them.

Fork Trucks

Fork trucks are divided into three basis types: (1) gas, electric, or gas-electric powered truck on which the operator is seated; (2) electric powered truck operated by a walking driver who controls steering and movement by means of a handle equipped with levers or push buttons, in some cases the driver rides the truck, holding the handle in an upright position; and (3) manually operated truck controlled by a walking operator by means of a handle.[13]

12. "Warehousing and Transportation", Chain Store Age (November 1955), vol. 31, no. 11, p. 289.

13. H. E. Stocker, Materials Handling (New York: Prentice-Hall, Inc., 1951), pp. 75-76.

The first type is basically a vehicle powered by either regular gasoline, propane gas, or a storage battery. This fork lift is driven in much the same way as an automobile, having various levers with which to control the power lift system and direction of the truck. The power lift, chain or hydraulic, is capable of lifting many tons of merchandise depending on its size and may stock loaded pallets to a height of from twelve to sixteen feet. Goods may be moved either on a horizontal or vertical plane. Many firms prefer not to use the gasoline type for inside work, fearing that carbon monoxide fumes given off by the motor may be hazardous to employees. Although the electric truck is initially more expensive, it is reported that it is 60 per cent easier to maintain and has no exhaust fumes.

Depending on where fork lift trucks are to be used, they may be either of the high lift or low lift type. Although both can lift pallets or skids off the floor, the low lift is capable of working in areas where the high lift cannot, e.g., a trailer body, whereas the high lift can reach greater heights than can the low lift truck.

The versatility of the fork lift truck is increased by the use of various attachments, e.g., detachable clamps for handling cartons, boxes, etc., without the use of pallets. These attachments vary and each is suited to some particular operation. The square-nose and rounded-nose forks are those chiefly used in the grocery distribution center. The forks are at approximately a 30 degree angle to the lift system, thereby tilting the loaded pallets slightly to the rear as they are raised.

Another variation of the fork lift is the straddle type fork lift truck. This machine performs the functions of a fork lift truck and differs in that the fork lift is counter-balanced, whereas the straddle is not. This truck has been designed to work in confined areas, usually in six foot aisles and using winged pallets.

The walking type truck is essentially the same as the type on which the operator is seated and can be either high lift or low lift. The essential difference lies in the ability of the larger truck to move more rapidly over long distances, whereas the smaller truck usually operates in a rather limited work area. The smaller truck has the additional advantage of working in areas where the larger truck cannot, e.g., narrow aisles and areas where the floor-load limit is low, such as an elevator.

The third type, manually operated truck, is similar to the type used by many filling stations and auto mechanics, the difference being the two forks. Basically the pallet hand truck, or "pallet jack", is a low lift machine which can raise the loaded pallet a few inches from the floor and transport it to a new location.

Essentially the fork truck is a tiering machine for placing and removing unit loads in and from storage. Using the truck as a horizontal carrier for distances in excess of 150 to 200 feet generally results in an increase in both the time consumed and the cost. However, there is no general rule about length of haul as it depends upon the speed of the truck.

Tractors

Experience has shown that, in some operations, hauls over 200 feet are performed more economically with the tractor-trailer system than with a fleet of fork lift trucks using pallets.

Though tractors must be powerful enough for the work to be performed, they should also be as compact as possible to facilitate maneuvering in restricted places. These tractors are powered either by storage batteries or gasoline. There are of three distinct types: (1) the twin three wheel, short radius type, (2) the four wheel type with larger turning radius and (3) the small, three wheel type which can be operated by the worker as he walks along in front of it. In some operations the operator rides the tractor. Newer types operate without a driver, the operator has a control box which hangs over his shoulder or attaches to his belt, and he operates the machine by remote control.

The small, three wheel tractor is used where loads are light and in congested areas. The first type is also used in congested areas, but can handle heavier loads. It is often used for pushing or pulling merchandise or heavy machinery mounted on skids where larger trucks cannot operate. The four wheel type, due to its larger size and lacking the short turning radius of the other two, cannot be operated in congested areas. However, they can be operated at greater speeds and on rougher surfaces, due to their larger wheel diameters and pneumatic tires. The other two can operate only on very smooth, hard surfaced floors.

Conveyors

Although many operators agree that conveyors are obsolete, conveyors often provide the most economical method of handling materials under many conditions.

Basically they are divided into five basic types as used in food distribution centers: (1) roller, (2) belt conveyor, (3) chain conveyors, (4) monorail conveyors and, (5) twin screw conveyors.

The simplest type of conveyor is the roller conveyor. A modification of the roller conveyor is the skate wheel conveyor as is often used in the retail store. They can be used in a horizontal position or an inclined position in which the merchandise moves by gravity. Usually these conveyors are built of steel, aluminum or magnesium. Some variations of the roller conveyor include flexible and telescopic roller conveyors, gravity roller spiral conveyors and line roller conveyors. The use of each depends upon the operation and layout of the food distribution center.

The second type of conveyor is the belt conveyor. They consist of a carrying belt, idler rollers or steel sheet for supporting the belt, a supporting structure, a head pully at the drive end, and a tail pully equipped with take-up on the opposite end. The belt is made of canvas, rubber, rubber fabrics, wire mesh, or flat steel bands and may range in width from three inches to three feet. Many times this conveyor is used in conjunction with roller conveyors, a booster belt conveyor is power driven and raises loads to higher levels in connection with the gravity roller conveyor. The booster belt conveyor is

either fixed or portable. The portable power conveyor is easily maneuvered over distribution center floors to either remove or stock merchandise and the supporting frames provide for adjustment to various inclines.

Monorail conveyors consist of an overhead track on which move traveling units supported by trolleys. The traveling units can either be moved manually or by electric motors.

Chain conveyors are power driver and consist of one or more strands of endless chain operating on suitable tracks or guide rails. Loads are placed on the top of the chains and are conveyed toward their destination. This type of conveyor is usually found in multi-story buildings due to its ability to save floor space because they can travel overhead.

A variation of the chain conveyor is the overhead trolley chain conveyor. Some companies use this type, instead of tractors, for hauling trailers. This conveyor is often referred to as a "tow line". Essentially it is a chain which pulls trailers along an overhead monorail or may be installed in the warehouse floor, and consists of an endless chain-on-edge to which the trailer is attached. Any number of trailer trucks can be connected and travel at a speed of so many feet per minute.

Twin screw conveyors are usually used for unloading bagged materials from rail cars. "Each section consists of two pieces of steel tubing around which are welded spiral pieces of steel. The tubing is revolved by an electric motor.

The spiral action on the bags causes them to move forward. Each section is connected to the other by a universal joint."[14]

Dollies

The dolly usually has a rectangular frame, supported on wheels or rollers. If wheels are used, they are often of the coaster type, each swiveling on a vertical axis, permitting the vehicle to move in any direction.

Lift Trucks

A hand powered device used in conjunction with skid platforms is the lift truck. These trucks usually have four wheels, two of which are turned by means of an attached handle for steering. These lift trucks consist of a frame to which wheels are attached, and a deck which can be raised or lowered vertically to lift or deposit the skid. The elevating device can be either a mechanical or a hydraulic system, and is raised or lowered by movement of the handle. Since the development of the fork lift pallet method, the lift truck, skid method has been largely abandoned.

Elevators

"Freight elevators form a vital part of the materials handling system in multi-floor warehouses"[15], and as such are important to economical operations. It is essential that such things as building characteristics, units to be

14. Stocker, op. cit., p. 172.

15. Ibid., p. 246.

carried on the elevator, number of units to be handled per hour, etc., be considered in their use.

Chutes

A chute is a trough or tube used as a guide and conveyor for sliding objects from a higher to a lower level. In grocery warehouses chutes almost always are permanent installations and are usually either circular (spiral) or a straight slide. "A spiral chute is wound in a helical form around a central vertical axis so that the material slides downward, using the principles of gravity and centrifugal force."[16] The circular type is generally of metal construction whereas the straight slide is usually of polished wood.

Chutes are limited in that they play no part in the input function, except when the place of storage is lower than the receiving station, as in the basement.

Storage Racks

Although storage racks are not ordinarily considered as handling equipment, it is essential that they be considered here in order to bring about a more clear understanding of chapters to follow.

There are various types of racks available, such as those for storage of small items, slow moving merchandise and a variety of other items. Normally, the types of merchandise mentioned are placed on pallets and are stowed

16. Barker, op. cit., p. 89.

in these racks. The advantage of using them lies in the ability of removing lower pallets without disturbing upper pallets. This equipment provides for a better utilization of space - three or four items can be stored one on top of the other on different shelves. Storage racks are so constructed that they are easily dismantled for erection in another location.

Summary

The author has presented a fairly complete listing of the various types of equipment in common use by the food industry today. Much information about this and other types of equipment can be obtained through trade magazines and catalogues of the manufacturers.

The food distribution center uses only a few of the available types of equipment. The use of certain types of equipment at the present time does not mean that other types of equipment are unavailable. A later chapter in this thesis will deal with some of the new developments in food distribution automation, and as will be shown, materials handling is a dynamic field.

The selection of equipment is a problem often faced by operators. The question as to which handling system is best, is of primary concern. A quick glance at the industry today will show that the different companies use various systems, some use a combination of two or more systems and obtain satisfactory results.

In the following chapters, the specific types of equipment used and their applications will be discussed as they apply to handling systems within the warehouse.

CHAPTER IV

FOOD DISTRIBUTION CENTER OPERATIONS

In the previous discussion, the writer attempted to point out some basic fundamentals of food distribution center operation in addition to information that is pertinent to the following study. The purpose was to supply the reader with fundamental knowledge with which to understand the 'heart' of the operation. This chapter, therefore, will deal with the internal functions of the grocery, produce and meat departments of the food distribution center. In addition, the distribution center safety program, maintenance department and various new developments in the food distribution center will be briefly discussed.

Because the grocery distribution center comprises the greatest part of the business, much of the discussion relates to it. Since many of the basic functions, systems and procedures of the grocery center apply equally well to the meat and produce operations, they will be omitted in the discussion of those departments. Only the fundamental differences and special problems relating to their operation will be considered for that reason.

The operation of the food distribution center is commonly divided into the following basic functions; receiving, storing, order assembly, shipping and inventory control. These functions vary greatly from center to center and for every combination there is just one system that fits. Each company strives

for an efficient distribution center operation, one which saves payroll dollars in relation to the volume of goods that flow through the plant. It is common knowledge that more than half of the center cost is paid to labor and for this reason, concerns are continually attempting to reduce the amount of labor required. The following discussion is directed toward a study of the present methods of grocery distributing used by independent and chain grocers.

GROCERY DISTRIBUTING

Organization

As was previously illustrated in Figure I of Chapter II, the overall operation of the grocery distribution center is the responsibility of the general foreman. Subordinate to him are the receiving and assembly foremen who are responsible for the in-put and out-put of the center. In-put includes the function of receiving and storing, out-put includes the order assembly and shipping functions. The processing and salvage foremen are also responsible to the general foreman.

Receiving

The grocery distribution center receiving functions normally begin when merchandise is spotted at the receiving platform by the common carrier. Approximately 70 per cent of the grocery merchandise is received by rail, with the remainder by motor truck,[1] although this varies depending upon the size of

1. From a class address by William H. Meserole, Warehousing Consultant, The Ballinger-Meserole Co., January 31, 1957.

the organization. Receiving must be integrated with the flow of activity in the center and, like the other functions, its efficiency is dependent upon avoiding conditions which tend to retard progress.

The control of the flow of receiving starts with buying. However, goods must be purchased when they are needed and where they are available. Many times it becomes necessary to receive shipments which arrive at inconvenient times, that is, from the point of view of availability of facilities. Adequate receiving platform space is vital and enough equipment must be on hand to meet these demands.

Building design varies within the industry. The one-floor distribution center enjoys several advantages over the multi-story units in regard to efficient receiving of merchandise, as fewer man hours are needed to move the merchandise to the storage point. In a recent survey conducted by the United States Department of Agriculture in six scattered warehouses, it was estimated that 31 per cent of all warehouse man hours were consumed in the receiving operations.[2] Plant layouts also have a direct bearing on efficiency. The one-floor center usually has more dock space for receiving, as well as shipping. Some older and/or poorly designed centers receive and ship from the same dock; an inefficient operation at best.

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2. John C. Bouma, Methods of Increasing Producivity in Modern Grocery Warehouses, Agricultural Marketing Service, United States Department of Agriculture, Marketing Research Report No. 94, (Washington: United States Government Printing Office, 1955), p. 2.

Operators generally agree that the work load will be more flexible if congestion around the dock is held to a minimum.

Unless loads are palletized previous to their arrival at the distribution center, receipts must be unloaded case-by-case in the rail car or motor vehicle on hand trucks, pallets, conveyors or skids. This case-by-case handling cost is unavoidable, except when merchandise is received by motor truck. One of the advantages of receiving by motor truck is that drivers are usually required to unload their own vehicle and usually will palletize the merchandise. In addition, merchandise damaged in transit can usually be sent back to the shipper on the same truck.

With the foregoing considerations in mind, various methods of receiving can now be explored. The wide range of methods discussed are not applicable for all companies, however, they should give the reader a verbal picture of their application and/or modification.

Methods of Receiving

Basically there are three methods of receiving groceries in the food distribution center: (1) by the pallet system, (2) the conveyor system, and (3) the hand truck system. Combinations of these are often used.

The predominant method, in modern food centers, is the pallet system. The first step is to palletize all merchandise in the railroad car or motor truck. Then, from this point of palletization the merchandise is moved into storage as a unit load. These pallet loads are removed from the car or truck with either a hand-operated fork truck (commonly termed a pallet jack),

electrically-operated pallet jacks, fork lift trucks; or with live or semi-live skids, or four wheel hand trucks from which pallet loads are removed later with fork lift trucks. The loaded pallets are then moved into storage or are left on the dock for subsequent movement.

Presently the pallet method of receiving is the most efficient and productive. Receiving with pallets enables larger loads to be moved to the storage area in a shorter time. Fatigue on the part of the men is also greatly reduced. There is, however, an important element that requires special attention if the method is to be performed efficiently. The study made by the United States Department of Agriculture showed that when one man was used in palletizing the efficiency considerably increased than when two men were used.[3]

Moving the loaded pallets to the storage area is a subject of much discussion by operators, consequently many methods are used. Direct flow, mechanization, and the separation of the unloading and moving tasks into two separate operations, are the keys to efficient handling of merchandise. One rather common method is using the fork lift pallet. Pallet loads are double tiered by auxiliary hand operated trucks on the receiving dock. The larger, more mobile fork lifts move the merchandise to the storage area. The same operation is used for skids. Another procedure is the tractor trailer train system. Fork lifts place the loaded pallets on trailers and, when the train is fully loaded, electrically operated tractors move the train to the storage area where the pallets are removed by another fork lift. A similar procedure is the

3. Ibid., p. 5.

tow or drag line method, the difference is that the trailer is coupled to a chain conveyor which acts as the prime mover. Tow lines can handle a hundred or more trailers at one time depending upon their length.

Many multi-story centers use the pallet system to advantage. This is usually accomplished by using freight elevators. Palletized loads may be placed on the elevator by fork truck on one floor and removed on another by the same method. Moving fork trucks with their loads from one floor to another, however, is generally considered poor practice because of higher costs. Many times, trailers or four wheel hand trucks, loaded with palletized loads, are used. Using this method does not bottle-up the elevator as merchandise is put on and off in minutes.

Another method of receiving is the conveyor system. This method is widely used in multi-story distribution centers, oftentimes in conjunction with floor to floor chutes. In plants having a complete conveyor system, a portable extension is put into the car or truck. The cases are placed on the conveyor and shipped directly to storage. Disadvantages of this procedures are case-by-case handling and often conveyors must be used for shipping as well as receiving, making it necessary to confine each function to specific hours. A comparison of some apparent advantages and disadvantages of the pallet vs. conveyor system can be seen in the following table.[4]

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4. John R. Bromell, Modernizing and Operating Grocery Warehouses, United States Department of Commerce, Domestic Series, No. 26, (Washington, D.C.: United States Government Printing Office, 1951), p. 40.

TABLE I

CONVEYOR VS. PALLETS IN A SIMPLE OPERATION

When we - - -	If we use - - -	
	Conveyors	Pallets
1. Receive merchandise . .	We must handle all of the food piece by piece and place them on the conveyor or the pallet.	
2. Store the merchandise . .	When the goods have been conveyed to the place of storage:	
	The cases must again be handled piece by piece (sometimes twice) to stack them.	The entire load is set down in one quick operation by machine.
3. Select orders	Whichever the system, we must handle most of the goods on a piece-by-piece basis:	
	But all goods have to be so handled if we use conveyors.	Whereas large orders calling for all or substantial parts of a pallet load will be included in the order as a unit, without piece handling.
4. Load delivery truck . . .	This involves a piece-by-piece handling of all the goods.	
5. Rewarehouse	When it is necessary to shift remainders to make room for new goods:	
	The old goods must be handled twice more, piece by piece.	The old goods are moved as pallet loads.

Concerns using chutes in conjunction with conveyors, use gravity chutes to carry incoming merchandise to under-floor conveyor belts which carry the goods to the storage area. To move merchandise to upper floors, power belt conveyors are used. Conveyors, used in this manner, help to create continuity of operation in multi-story warehouses.

Another quick, efficient way of unloading carriers and getting unpalletized merchandise stacked on pallets is through the use of dollies and conveyors. The worker places a pallet on a dolly, loads the pallet in the car and then rolls the dolly to the car door. He pushes the unit load off the dolly onto a roller conveyor. At the dock, the pallet is then picked off the conveyor by fork lift. Using this system, the worker need not wait for the fork truck to remove the load; he can roll several loads on the conveyor before a fork lift has to pick them up.

In the modern food center today, four wheel hand trucks are seldom used exclusively to receive goods. Under this system, goods are loaded case by case onto the hand truck. Congestion and confusion often occur on the receiving platform. The inefficiencies of this method result from the case by case loading and unloading at the receiving and storage points, from the frequent trips to storage, and from the greater worker fatigue encountered. Costs are even higher when one considers the reverse procedure of shipping.

An important consideration of the receiving function is the dock itself. Dock doors must be wide and the floor of the dock should be level with the

with the floor of the truck for ease of loading and unloading. This fact alone often determines methods of handling. Often, box cars are unloaded in the center, that is, a one or two track well for cars runs into the plant. With the building floor level at the car door, steel transfer plates make it easy to move merchandise from the car to the dock. Hydraulically controlled lift bridges are used to provide direct routes between sides of the receiving area.

Before terminating the discussion of receiving, mention must be made of the receiving clerk, as he is the king-pin of the whole operation. It is his duty to see that the incoming goods agree with the shippers invoice (or bill of lading) both in description and amount. In addition, the clerk usually marks each unit load, or part thereof, in some manner indicating the item code number and the date received. This facilitates quick identification and rotation of the stock so a first-in-first-out(FIFO) inventory procedure can be practiced. Inspection of the merchandise is also his responsibility, both for physical condition and damage. His job is further complicated by less-than carlot receiving as the truck drivers usually do the unloading, therefore, he must check merchandise as it is placed on the dock. Rail merchandise presents less of a problem, as a whole car can be checked at once and since the goods are usually unloaded by company personnel. Then, too, there are normally only one, two, or three items in the car, whereas the less than carlot might have many more. Standardization of pallet pattern is also his responsibility, this enables the clerk or warehouse auditors to make a fast, accurate tally of all goods.

Finally, it is of utmost importance that the receiving record and accompanying documents be forwarded to the tabulating department as soon as possible in order to prevent misleading out of stock records.

Storing

The storing function is the final step of the input operation of the food distribution center. Closely related to this function is the layout of the center, so that the two become almost the same. The modern food distribution center can be considered as a parking lot for merchandise, that is, its function is to move merchandise in and out as efficiently and quickly as possible. The idea behind the storage function is principally aimed at saving space - consistent with keeping merchandise accessible and in good order. Mechanical stacking of the unit load takes advantage of cubic space.

Types of Storage Systems

Basically there are two systems of storage used in the industry today; commodity grouping and the slot system. Both are widely used and each company adapts its center to one of these two directly or with modification.

Commodity grouping, as the name implies, is a system by which merchandise is stored in the warehouse by family groups, for example, all the pickles in one place, all the soups in one place, etc. It is the most difficult one to use from a handling and distribution standpoint due to the fact that each

item in the center has a fixed location. Thus, new incoming merchandise must often be placed in reserve storage space until older stock is depleted. Since some merchandise, therefore, must be placed in reserve storage, a strict policy of rotation is difficult to follow because stock must be handled twice - from receiving to storage and from storage to the assembly line. Furthermore, commodity grouping does not fully utilize distribution center space because slots must be held open if new merchandise has not arrived. However, the system is advantageous from the store ordering viewpoint as the order is normally set up according to the store layout and similarily the selection line is laid out according to the order. Thus, if the order picker is assemblying a canned vegetable order, he would find all the items located in one area. Many companies carry this method so far that if the first item on the order is canned fruits and the last is soap powders, then the first section along the order assembly line is canned fruits and the last is soap powders. As can readily be seen, this system is simple in nature. Merchandise may either be placed entirely on the assembly line or may be placed partly in storage and partly on the assembly line depending on daily needs.

In the recent 1956 National Association of Food Chains Management Clinic on warehousing, delivery and automation, the majority of members stated that they used a slot system: generally members said they used a mixture of slot systems. This system is more complex than commodity grouping, and generally is divided into two types: the open slot and the controlled slot.

Actually the controlled slot is a modification of the open slot system and for that reason the permanent or fixed slot, as it is sometimes called, will be discussed later.

With this system, merchandise, as it comes into the distribution center, is placed in an open area that best accommodates that merchandise. It is not located in a specific area, as in the commodity group system, but rather is placed where the merchandise will best utilize space. This space is termed a slot and as such is given a slot number. Slot numbered spaces remain constant. For example, five pound sugar bales may be in number 1025 for a period of time and the next time sugar is received it may be located in another slot, numbered 3043. In other words, goods may occupy one or more slots in the warehouse at the same time, and each with a different slot number. With the use of automatic tabulating equipment, the oldest stock's location is indicated on the order sheet and it is pulled first.

The slot system utilizes center space more fully than commodity grouping since space is not held open until merchandise arrives. Under commodity grouping, the old stock must be moved out before new merchandise can be stored which may mean using reserve storage space until the assigned space is available. In using the open slot system, therefore, the entire distribution center becomes the order assembly area.

"The flexibility of the slot system makes it possible to meet every condition from the selection of an entire truck load by one man to the division of one large order among a number of selectors. The slot numbers are usually

divided into groups of 1000 or more in groups, and each group will designate a specific section of a warehouse. By breaking up an order into these groups, it can be assigned to a number of selectors if speed is essential."[5]

The really new idea in food distribution centers is what engineers like to call the "systems approach" to storage. This is termed, by William H. Meserole who developed it, the controlled slot system. Permanent or fixed slots are sometimes used as synonymous with controlled slots. This method of storage layout is probably the most efficient and logical of them all. As Mr. Meserole puts it: "Commodity grouping in food distribution warehouses may not be extinct - but it is archaic. Commodity-likeness groups have no place in most of the wholesale warehouses we engineer because we are interested in whittling costs and time down to the thinnest sliver."[6]

Mr. Meserole, in designing distribution centers, bases his system on a rule of thumb that is almost as reliable in distribution as the law of gravity is

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5. David Gardenier, A Summary of the Slot System of Grocery Warehouse Operation, I. B. M. Department of Education, Customer Administration Program. An article reprinted from The Voluntary and Cooperative Groups Magazine, courtesy of Cook Publications.

6. William H. Meserole, "Slot Number Please!", I. B. M. Department of Education, Customer Administration Program. An article reprinted through the courtesy of Wholesale Grocer News.

in physics. This rule of thumb states that whenever a variety of merchandise is selling, 20 per cent of the variety will account for approximately 80 per cent of movement. With this rule, Meserole established his "ton-mile" principle which minimizes the ton-mile of handling in the warehouse. "The result was a crazy quilt arrangement that no warehouseman could be expected to memorize."[7]

The ton-mile is applied by "locating goods on order pick lines in relation to their cost making characteristics of weight, bulk and demand. At the beginning of the line, farthest from the tail gates, are placed the light, small and slow-moving items. At the end of the line nearest the shipping dock are put the heavy, bulky, and fast moving items. About 80 per cent of tonnage shipped comes from the fast mover area, where some 20 per cent of the items are arrayed."[8] Figure III graphically illustrates this principle.. The square represents the warehouse, V = velocity (sales movement), X = spread (how many varieties of items), W = weight (of merchandise), B = bulk (how bulky are the goods), and the arrow represents the theoretical flow of goods through the warehouse. The dotted line illustrates where an item, for example sugar, should be located on the assembly line. In this example the bulk, point sales velocity, weight and spread factors are fairly high, and the point on the arrow where they intersect, indicates where the sugar is to be located.

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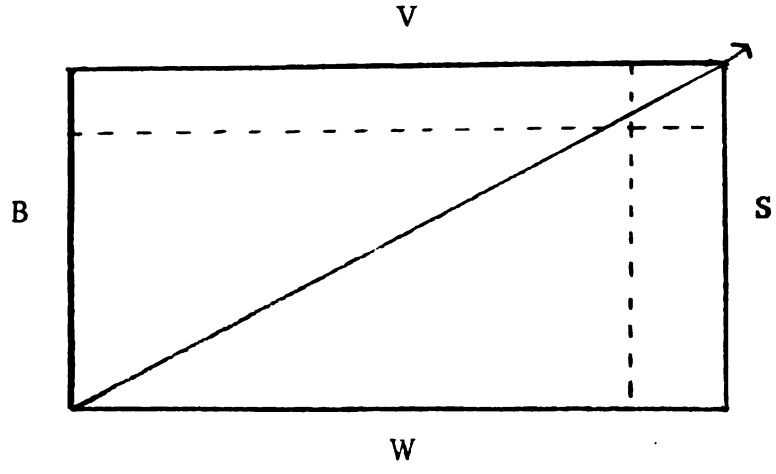
7. Fortune, op. cit., p. 141.

8. Meserole, loc. cit.

FIGURE III



The next problem was the arrangement of the warehouse on a controlled slot basis, utilizing his rule of thumb and ton-mileage theory. Each slot was given a number and as merchandise was placed in that slot it received that particular slot number. If, for example, an item was of seasonal nature, it would be located in a slot close to the tailgate during the on-season and then moved to another slot, at the beginning of the order pick line, during the off-season, each time having different slot numbers.

"Favorable ton-mileage depends on placing goods in logical sequence in the right general areas and places so the daily task of moving a given tonnage involves the fewest footsteps and least time."[9] The kinds of storage place used are as follows: (1) shelving - each shelf section carries 10 or more small lot items, not palletized, (2) two-level racks - each side of each section carries four items in full pallet quantities for order pick, with six pallets in storage on

9. Meserole, op. cit.

top, (3) seven pallet stock - each front carries two active pallets of an item and five storage pallets, (4) three-level racks - each side of each section carries six items in one-half pallet quantity accessible to order pickers and six full pallet lots in storage on top, (5) one-level racks - each side of each section carries two items, each in two pallet quantities for order pick and six pallets in storage on top, and (6) twelve-pallet stock - each front carries two active pallets of an item and five storage pallets.

Another storage system, used by some food distribution centers, is that advocated by Mr. George A. Ramlose, an industrial engineer of Boston, Massachusetts. Mr. Ramlose's system is, in many respects, directly opposed to Mr. Meserole's theory. Whereas Meserole's theory of ton-mileage depends on placing goods in areas so the daily tasks of moving merchandise involves a minimum of ton movement and the least time, Ramlose's theory emphasises use of distribution center cubage, that is, better utilization of floor space along with increasing labor handling efficiency. Mr. Ramlose alleges that placing goods according to such factors as weight, bulk and demand are less important because of the efficiency that can be obtained by modern materials handling equipment. In other words, he sacrifices savings in ton movement for ease of handling. Mr. Ramlose advocates placing palletized goods at an angle in the distribution center. By placing pallets at an angle, fork lift trucks can manuever more easily and in less space than the conventional 90 degree method of placing goods in a distribution center. Fork lift trucks, therefore, are able to approach pallets from an angle thus requiring a shorter turning radius. The resultant

decrease in aisle space increases usable storage space. Furthermore, according to Ramlose, angled pallets makes it easier for order pickers to select merchandise because they can select from two sides of the pallet, whereas in 90 degree stacking, they can only select from the front. Thus labor efficiency can be increased, the time required to place goods in the center is shortened, and ease of order selection is increased.

Mr. Ramlose's distribution centers use a combination of the commodity grouping and the controlled slot system. Part of the merchandise is placed on the order assembly line and part in reserve stock. Goods are brought from the receiving dock to storage by fork lift trucks; tractor trailers and tow lines are not used in these operations because they cannot be manuevered in the narrow storage aisles used in Ramlose's centers. His selection line is a combination of the perimeter and regular tow line systems. The tow line travels through the main aisles of the selection area; order pickers place goods on four wheel trucks which are then coupled to the tow line when full or when the order is completed.

To say which of these systems is best is a subject of much discussion in warehouse circles, and probably will be for years to come. Certainly many considerations must be taken into account in any discussion of the storage function; not the least of which are the following: the improper "tying" of full case merchandise on pallets can result in damaged merchandise as well as in waste of space. Layers should be alternated in different directions to provide neat and compact stacks. High ceilings permit high stacking of goods and makes

the maximum use of cubage. Angled stacking makes maximum use of floor space and also facilitates the action of fork trucks, this method also permits a narrower aisle. Pallets, constructed with verticle members which divide merchandise into conveniently handled stocks can be used to advantage with hard-to-stock items.[10]

Order Filling

The order filling function is the first link in the out-put operation. Briefly defined, order filling includes picking up the invoice and selecting the listed merchandise from distribution center stocks, placing the selected merchandise on a hand truck, trailer, conveyor or skid, and moving it to the loading dock.

An accurate, fast, low cost order filling system is a must for efficient, smooth distribution center operations, and must be well-coordinated with the shipping function. As one source stated: "The weak link in the armour of the poorly operated warehouse seems invariably to be a poor stock-selection system."[11] In addition, nearly 40 per cent of distribution center man hours are employed in the order filling function.[12]

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10. For a further discussion of storing see: S.O.Kaylin, "Storage . . . 26 Ways to Save Space", Chain Store Age (September 1951), vol. 27, no. 9, pp. 254-261.

11. S. O. Kaylin, "Order Filling . . . 29 Ways to Speed Stock Selection", Chain Store Age, (October 1951), vol. 27, no. 10, p. 70.

12. Bouma, op. cit., p. 6.

In the following discussion, the author shall attempt to point out some of the various systems used. Many factors enter into their consideration, not the least of which are the systems of distribution center storage layout, and the type, frequency, and quantity of store orders. Smooth distribution center operations should not be achieved at the expense of the stores they serve. Schedules of order filling should be distributed equally through the work week, therefore, rigid store ordering should be established. Furthermore, the criterion of materials handling efficiency - handle goods as little as possible - applies equally as well to the stock selection system.

The first step in the order assembly process is the obtaining of store orders or invoices by the order picker. Perhaps, it would be advantageous, however, to pause at this point and trace the store order as it travels from store to distribution center in order to obtain a more complete understanding of the steps that have gone before order selection.

After the merchandise order is written by the retail unit, it is normally forwarded to the firm's branch or divisional tabulating department. Orders may be sent to the office on a variety of forms; some of these forms include: the preprinted order form; the adding machine tape on which is printed the item line number and numbers of units needed; the IBM marked sensing card which is used in conjunction with an electrographic pencil; the direct teletyped order, which is currently being tested by Safeway Stores; and modular or standing orders. Firms using modular orders automatically send the merchandise called for on the order to retail units unless changes are made by the individual retail outlets.

There are several types of equipment available to a firm's tabulating department in transposing store orders to invoice billings. The most common include: the International Business Machine's system of batch billing, tub billing or the new Random Access Accounting Machine (RAMAC). Remington-Rand has available similar systems in addition to the new Univac File Computer.

The tub billing system is the oldest of the three methods available today. With this system, every shipping unit of merchandise in the distribution center is represented by a punched card. These cards are maintained in a unit control file and are used with electric accounting machines. This file of punched cards is usually called a "tub file".

Upon receiving the store order, tabulating department personnel pull one card from the tub file for each shipping unit ordered. If, for example, 25 units of a particular commodity were ordered, 25 pre-punched cards, each punched with information such as name of the item, price, weight, etc., would be pulled from the tub file. These cards then go to the accounting machine, or so-called printers, for listing, creating a store invoice, as well as one copy for warehouse selection media, and one for accounting purposes. Invoices may contain any or all of the following information depending on company needs: store number, item weight, unit price, item price, slot number, unit line number, quantity ordered, size and description, pack per unit, retail extension, unit cost, total number of pieces ordered, total weight, total retail and cost of the merchandise called for on the invoice.

A more recent billing system is that of batch billing or the electronic calculator method of billing as it is sometimes called. The term batch billing is used because a batch of store orders are processed together rather than one at a time. Others call it "line billing" because there is one card for each line or item in the warehouse of the order rather than a card for each shipping unit as in tub billing.

Basically the batch billing system requires the use of two cards - a "master inventory card" and a "store address card". Master inventory cards are maintained for each item stocked in the distribution center. Each card contains the following information pre-punched into the cards: line number, description, pack and size, warehouse location, sales tax code, unit weight, unit cost, inventory balance, unit retails, and billing profit per cent. Store address cards contain the store number and the department (grocery, produce, etc.). As store orders are received by the tabulating department, blank cards are punched by a reproducing unit with the line number and quantity ordered - one card for each line of the order. After the complete order has been punched, the store address card is placed in front of the cards. These billing cards are then collated against the proper "warehouse inventory master file" by the use of a collator. From the collator, punch cards are put into an electronic calculating punch which punches into the order cards, from the master inventory card, the description, pack and size, warehouse location, sales tax code, retail selling price and extension, and per cent of gross billing profit. A sorter

then removes the master inventory card from store billing cards. Finally, billing cards along with store address cards, are fed into accounting machines for listing and creation of an invoice.

Mr. J. W. Rowe, Accounting Machine Department Manager of Colonial Stores, Inc., Columbia, South Carolina, had this to say when comparing the two systems:[13]

> It is my opinion, based on personal experience, over the past year, that the calculator method of billing and inventory control in our type of business is superior to the tub file method . . ."

His reasons are as follows:

1. key punching substituted for card pulling, so girls do not have a fatiguing job requiring them to be on their feet all day.

2. price changes require the destroying and creation of only one card per commodity, so we do not waste many cards on these changes as we did previously.

3. release of valuable space previously occupied by the tub files.

4. more information available as a by-product of the billing and inventory control, and on accelerated deadlines.

5. a net lower cost of operation.

In relation to the distribution center, one of the greatest disadvantages of batch billing lies in the fact that batch billing cannot handle a "floating slot" system of distribution center sequence, since multiple inventory cards would

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13. J. W. Rowe, "Warehouse Inventory Control for Chain Grocery Companies", IBM Department of Education, Customer Administrative Program, p. 7.

be required for items stored in more than one location. Tub billing, however, can be adapted to virtually any warehousing scheme.[14]

The final important billing method is that which is performed by random access memory machines, RAMAC or the Univac File Computer. The introduction of random access memory machines open new horizons. All of the advantages of the previous systems are incorporated. "In-line" processing of transactions, made possible by disk memory in RAMAC or magnetic drums in the Univac File Computer, results in new possibilities in scheduling a new level of inventory control, and a new degree of prompt, informed, management decisions. "This new concept applies not only to merchandise accounting, but to all processing functions."[15] Most important to the chain or wholesale distributor - random access memory machines offer the possibilities of the distributor's data processing system becoming an "operations tool" instead of merely a bookkeeping tool.

Memory access accounting machines are in rather limited use at the present time. Basically, however, store billing and inventory control systems work in the following manner:

All item records are stored either in disk or magnetic drum memory units. Item records provide for descriptive data, pricing data, warehouse

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14. "An Analysis of Batch Billing vs. Tub File Billing in the Grocery Distribution Industry", IBM Department of Education, Customer Administrative Program, p. 4.

15. "RAMAC for the Chain and Wholesale Industry Featuring In-Line Data Processing", IBM Department of Education, Customer Administrative Program, p. 3.

location, and sales and inventory information. The item catalog code is the items memory record address. One store order is completely processed at a time. In-put card contain code numbers and quantities of items ordered, several items being spread across each in-put card.

"As an ordered item is processed, the item master record is automatically refered to, pricing and extending is performed, sales and inventory balances are immediately updated, and a computed billing card is punched. Billing lines are punched out to permit resorting of cards to warehouse location sequence prior to invoice listing on a conventional high speed accounting machine."[16]

"Special stock conditions, such as 'out of stock' or below minimum', are automatically signaled by the machine. These signals may be printed by typewriter, by the printer, punched in cards, or a combination of the above."[17]

"Inquiries concerning the current stock position of an item, etc., may be entered at the console, with all desired information typed out."[18]

Operators of food distribution centers observe the elementary rule that the assembly line be such as to permit the order picker to assembly any order in the sequence in which merchandise is spotted along the line of selection. This, then, necessitates that the invoice be arranged in a manner by which the

16. Ibid., p. 4.

17. Ibid.

18. Ibid.

sequence of goods on the assembly line be the same as that in which the goods are called for on the order. Punch cards are, therefore, fed into the tabulating machine in such a way so that the invoice will be printed according to selection line layout.

Store orders or invoice billings are generally forwarded from the tabulating department to the distribution center by the use of a pneumatic tube system. Upon arrival, the assembly foreman either sorts the invoices into specific merchandise or slot sections and distributes these sections to the man responsible, or gives him the entire invoice depending on the type order filling system used. Many times, a basket or a stand is located at the head of each stock selection section. Order pickers may then take the invoices from the basket or stand, clip them to a board, and fill them without further instructions.

Upon receipt of invoices, the order picker proceeds to fill the order. Information describing the merchandise to be selected can be obtained in one of two principal ways - by reading the complete merchandise description, or by reading the slot number from the invoice.

In using the first method, the complete merchandise description, the order picker must know the description and size of the merchandise, quantity ordered, and pack per unit in order to assemble the order. This method is mainly used by firms utilizing the commodity grouping of merchandise. Those firms using the slot system, may have the same type invoice, the difference being that the order picker only needs to know the slot number and the quantity ordered. Each slot number is marked on the floor, bin, shelf or other

convenient place. Order pickers simply select so many units from the slot number punched on the invoice and moves on to the next number. He does not need to know what is inside the cases. As is evident, this latter system can greatly reduce the number of errors in reading and selection of order picking since the required information is reduced to a minimum.

The assembly line is the next step. Basically, "the assembly line is a arrangement of the active stock so that the order picker can assemble individual orders conveniently, rapidly and at the least expense."[19] This is the job of pulling down, case-by-case, goods which have a destination likeness. No matter how the order picking is done, the goods have to be handled case-by-case. The stock arrangement for order assembly follows two basic plans - the short assembly line and open slot system.

The short assembly line is generally used by those concerns employing either the commodity grouping or the controlled slot systems of storage. With this system, a supply of each item carried in the warehouse is arranged in an area for convenient order selection. As the assembly line becomes depleted, it is replenished from reserve stock. This system has the advantage of having a shorter distance traveled by the order picker, but also has the disadvantage of requiring an additional handling of merchandise from reserve to active stock.

With the open slot system, merchandise is stored and orders are selected over the entire warehouse. Goods are placed where it will best utilize space.

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19. William H. Meserole, Streamlined Wholesale Grocery Warehouses, United States Department of Commerce, Industrial Series, no. 18,(Washington, D. C.: United States Printing Office, 1945), p. 36.

The chief advantage of this system, in addition to only one handling of merchandise, is automatic stock rotation.

Both systems are in use today, the most efficient being determined by the type and size of the orders assembled, the type of materials handling used, and individual company preference.

Finally, the selected merchandise order is sent on to the shipping or loading dock by the order picker. There are many ways in which merchandise is brought to the loading platform ; tow line, tractor trailer, manual powered hand truck and conveyor. In addition to these, many multi-story distribution centers utilize the chute conveyor which moves goods from the upper floors to the loading dock. Normally these chutes terminate in a skate or roller conveyor. Hand trucks and elevators are used for bulky merchandise and also as an auxiliary means of moving goods to and from stock rooms. More detailed information on the shipping function is contained in a subsequent chapter.

Materials Handling Equipment Used in Order Assembly

"The four wheel hand truck is probably the simplest and most extensively used piece of materials handling equipment in grocery warehouses today."[20] The procedure is for the order filler to push the truck through his section and place the merchandise ordered on it. After the order has been selected, the order filler moves it to the shipping platform. Many times a pallet is placed on the truck prior to loading merchandise providing the distribution center is

20. Bouma, op. cit., p. 6.

is equipped to remove the palletized load and place it on the trailer. This eliminates additional case-by-case handling. The principal disadvantage of this method is that it requires a considerable amount of labor because of the travel distance and the number of times the picker must walk from the assembly line to the loading area and back again.

The tractor - trailer method is widely used in modern warehouses today. Small gasoline or electric tractors tow four wheel trailers during the order assembly process and to the shipping dock. Tractor-trailer systems reduce the amount of travel time for the order filler and are less fatiguing than the four wheel hand truck method. The order assembly procedure is for the picker to move his train (two or more trucks coupled together) to the first selection point, select the merchandise ordered from that area, place it on one of the trailers, mount or walk the tractor to the next selection point and perform the same activities over again. The use of the train in the selection of large orders has its limitations, because the train becomes longer, it increases the walk to and from the prime mover. It is for this reason that many companies split up the assembly process into sections in order to hold train length to a minimum.

A comparatively recent development is the electronic tow truck which is operated by remote control and is started, stopped and turned in either direction by a control device worn on the belt of the order filler. This truck was devised to eliminate the time required for walking to the tow tractor and returning to the stocks thus cancelling the disadvantage of the long train in larger order filling. The machine can be controlled from any point within

fifty feet. One disadvantage of this truck is the danger of outside interference with respect to the portable transmitter.

Table II shows a comparison of time required to assemble a thirty case order requiring 1500 feet of travel using various types of materials-handling equipment.[21]

Another major type of materials handling equipment is the tow line. Basically there are two types of tow lines, the regular tow line and the perimeter tow line.

Regular tow lines are used by many companies to overcome the disadvantage of hauling loads from the assembly area to the shipping dock and back again. These tow lines act as the prime mover for the trailers or trucks and usually travel at the rate of 100 to 120 feet per minute. Basically, they are of two types, the overhead chain conveyor and the in-floor conveyor or tow-veyor as they are sometimes called. Another commonly used term for the in-floor conveyor is the drag line. Regular tow lines follow an appointed route of the total distribution center, i.e., they travel through each and every stock selection area.

"The chief disadvantages of the regular tow line when used to tow four wheel trucks while orders are being assembled are: (1) it moves either too fast or too slow for many order fillers, and its speed is often geared to the slow workers; and (2) it is a rather permanent installation resulting in a

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21. Bouma, op. cit., p. 7.

TABLE II

Elements of order assembly	Materials - Handling Equipment		
	four wheel hand trucks	small gasoline or electric tow tractors	remote-controlled tow tractors
	man-minutes	man-minutes	man-minutes
Travel time	9.22	5.37	4.26
Selection time	3.24	3.24	3.24
Other production time	1.09	1.09	1.09
Total time	13.55	9.70	8.59
Personnel and fatigue allowance	2.03	1.46	1.29
Standard time	15.58	11.16	9.88
Cases per man-hour	116	161	182

comparatively inflexible assembly area layout."[22] The speed of the regular tow line is controlled by a variable switch. Many companies prefer in-floor - veyors due to the fact that trucks will not snake in operations as with an overhead tow.

The perimeter tow line is actually a modification of the regular tow line. This system differs from the regular tow line in that it does not follow the appointed round of the assembly area, but rather travels around the perimeter of the stock selection area. Four wheel trailers or hand trucks are manually moved along racks, bins, and stock, and are loaded in the conventional manner.

22. Bouma, op. cit., p. 8.

The full trolleys are then attached to the perimeter tow line by means of a connection unit on the chain conveyor and are automatically moved to the shipping dock. Tapered shoes can automatically disconnect order assembly trucks from in-floor conveyor chains at pre-determined locations on the return run. Trucks can then be moved manually to the active stock areas. The perimeter tow line has the principle advantage over a regular tow line, in that order filler production is not geared to the speed of a perimeter tow line.

"The advantages of both the perimeter tow line and regular tow line include: (1) they eliminate order filler travel time to the shipping dock; (2) they reduce delay and confusion on the shipping dock due to order fillers continually bringing in assembled orders; and (3) under a properly managed system they permit order fillers to remain in the order assembly area at all times."[23] Tow lines will carry any number of trucks depending on tow line length, and therefore all distribution center personnel engaged in moving merchandise can use the system at the same time. Loaded assembly carts are identified as to their destination by the use of either (1) a blackboard mounted on the front of the cart on which is written the store number, order number, or tail board number; (2) by marking the merchandise itself with this information. Usually the total piece count is also included. Stock placed on the selection line conforms to the order blank or invoice, giving continuity to the selection process.

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23. Bouma, op. cit., p. 8.

The final important type of materials handling equipment used for order selection is the conveyor system. Distribution centers using a conveyor line for assembly must usually employ power boosters at intervals to re-elevate the merchandise in order to provide the necessary downgrade for gravity conveyors to operate from assembly area to delivery truck. In addition, they must be installed in such a way so as to permit the movement of fork trucks from one aisle to another. This is accomplished by using removable hinged sections or raised gates. In assemblying orders with this method, the picker typically loads the merchandise on the conveyor, and it is then moved directly to the loading area. Many times portable extensions are used; this facilitates the movement of merchandise directly into the truck. The principle advantages of this system are: the greater use of floor space due to narrower aisles; reduced order picker travel time; and use of conveyor line in multi-story buildings that have floors too weak for fork lift operations. On the other hand, however, only one operation can be carried on at a time; i.e., conveyors must be used for order filling as well as receiving and shipping, making it necessary to confine these functions to specific hours. Furthermore, a conveyor line is limited in the amount of merchandise that can be shipped on it in one day and many items such as sugar, brooms and fragile goods are not adaptable to conveyor handling.

Before concluding the order assembly function, mention must be made of order assembly checking. Companies use either the total piece count; individual item count or the no check method. These methods are subjects of

much discussion by operators. The question usually resolves itself as to whether the time consumed in the individual item count method is worth the cost in locating errors of shortages and/or overages. The rule-of-thumb used by controllers - that controls should cease at the point where the cost of controlling exceeds losses, applies equally as well to distribution centers. Many operators feel that checking each order, item for item, is completely impractical and futile. They hold that it defeats the purpose of modern warehousing and good materials handling methods, and that it is equivalent of registering a customer's order at the checkout twice instead of once, since the order is checked in the store. Other companies feel that neither the individual item count or the total piece count is worthwhile, and thus either periodically spot check or do not check orders at all.

"One way of deciding whether a particular kind of check is worthwhile is to determine how much it costs to find an error by this method and weight this cost against the need to eliminate such errors from a customer's order."[24]

Shipping

The shipping function is the final step in the output operation of the grocery distribution center. Ordinarily shipping is the responsibility of the assembly foreman. Shipping begins when the goods making up the order reach the shipping area and ends when the goods are placed on the truck for delivery. The shipping operation is one in which the use of time savers, short

24. R. W. Hoecker, op. cit., p. 23.

cuts and all around ingenuity pays important dividends. This step obviously must be smoothly integrated with those that have gone before.

Food distribution centers normally have shipping docks wide enough to accommodate many delivery trucks thus making possible the loading of several trucks at the same time. Shipping docks are generally built at delivery truck body level to permit easy entrance of four wheel trucks, low lift fork trucks, etc. Adjustable hydraulic sections can be installed in the truck court to correct any differences between truck floor heights and the dock. Metal plates jump the gap between the truck and the dock.

After merchandise reaches the loading dock and is checked, it is either placed piece by piece on the floor of the truck or else in palletized loads. The predominant method used is for a two man team to push a four wheel selector truck into a delivery truck for unloading. It is then unloaded onto the bed of the truck case by case. However, studies have shown that production per man hour is increased by 33 per cent when one man works alone.[25]

Another method is to place portable conveyors into the truck. Further efficiency is obtained if the conveyor is connected to the assembly line conveyor providing firms use this type assembly operation.

Some firms have built roller conveyors in the floor of their delivery trailers in an effort to reduce loading and unloading costs. Using this method, the fork lift places the pallet on the rollers two high and two wide. Loading is completed by pushing the pallets over the roller conveyors into the trailer.

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25. Bouma, op. cit., p. 20.

To attain maximum efficiency, this method requires the use of a hydraulic tail gate and a small pallet pack at the retail outlet in order to unload in full pallets. Few stores today, however, have enough back room storage space to handle and store palletized merchandise.

Some companies load full pallets on delivery trucks in order to reduce piece handling. Trailers are loaded by low lift fork trucks, or the small electric powered fork trucks controlled by a walking driver. Generally, those companies shipping to stores by pallets must still unload at the store piece by piece although a few companies have lift equipment at the retail unit.

Possibly the most efficient palletless loading plan is achieved by the use of a lift truck that has been equipped with eight metal fingers instead of the usual forks. The lift truck raises the load from a banded ribbon truck*, moves it into the trailer, and lowers the load to the floor. A pusher attachment on the lift truck shoves the load forward, freeing the "fingers" of the truck. Thus, loads are placed on the trailer without the use of pallets.

Of utmost importance in the shipping operation is the attainment of a solid load; i.e., slip and side sway must be reduced to a minimum in order to prevent unnecessary damage to merchandise. The load pattern must be such that merchandise of various sizes and shapes is packed solidly, tier by tier, sides, front and back. This objective is one of the disadvantages of transporting by pallet loads. Unit loading results in loss of truck capacity unless light

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* See page 31 for a complete description of the banded ribbon truck.

merchandise is hand packed on top of the loaded pallets which increases the load but also greatly lessen efficiency.

Inventory Control

Inventory of stock control has an important bearing on the efficiency with which a warehouse is operated. The objectives of inventory control are: (1) it must provide a means of preventing an out of stock condition and (2) it must provide guards against overstocking. If these objectives are realized, it will increase turnover which will ease space problems and promote a smooth operation.

One of the best indicators of efficiency is the rate of stock turn. If stock turn rate is too high, it can be more harmful than overstocking. A new high rate of stock turn inevitably leads to an out of stock condition. Obtaining a satisfactory stock turn can be computed on the basis of cost price, retail price or physical unit of sales providing all are computed on the same basis. Computations for annual rate of stock turn are as follows:

$$\frac{\text{Sales at cost}}{\text{Average inventory at cost}} = \text{Annual rate of stock turn}$$

$$\frac{\text{Sales at retail price}}{\text{Average inventory at selling price}} = \text{Annual rate of stock turn}$$

$$\frac{\text{Sales in physical units}}{\text{Average inventory in physical units}} = \text{Annual rate of stock turn}$$

$$\text{Average inventory} = \frac{\text{Opening inventory and closing inventory}}{2}$$

If semiannual physical inventories are taken, the computation is as follows:

$$\text{Average inventory} = \frac{\text{Opening inventory} + \text{mid year inventory} + \text{closing inventory}}{3}$$

If the quartly inventory rate is desired, it may be computed in the following manner and then adjusted to the annual rate.

$$\frac{\text{Sales at cost, last three month}}{\text{Average inventory at cost, last three months}} = \text{stock turn rate for quarter of year}$$

One-quarter year stock turn rate x four = annual rate of stock turn.

There are many modifications and variations of inventories found in actual distribution center practice, but generally they are classified into the following types.

The actual physical inventory is the most accurate of all systems and is the only means of checking up on the accuracy of other stock control methods. This method requires the actual physical count and recount of each and every item, thereby necessitating the orderly arrangement of all merchandise. This is usually accomplished by using an inventory sheet on which the dollar value is listed, or it can be taken with the use of a mechanical calculator.

The physical inspection method is the most economical and easiest method of keeping track of stock movements, but it is also the least scientific and most haphazard. This system places the responsibility on some person of reporting the items on which the center is running low and also may call for reports on slow moving items.

Continuous "stock taking" or count of stock control as it is sometimes called, resembles the physical inventory but differs in that only whole goods are counted, i.e., the merchandise in original containers, rechecking is

eliminated, and no monetary values are used since it is a unit control method. This method is used primarily for controlling purchases with the view of reducing out of stock conditions, slow moving items, and securing maximum turnover.

The tickler method of inventory includes some characteristics of the real perpetual inventory. It deals with physical units rather than values and includes a count of every item, however, the count is not taken too frequently. This method of inventory is based on the assumption that different items move at different rates of speed. To inventory all items would be wasteful and uneconomical. The items are ticklered and inventoried according to the rate of turnover. The system must be flexible since some items change their rate of turnover. It has the advantage in that inventory work can be distributed evenly and made a matter of routine.

The real perpetual inventory is a continuous record of every item in stock, showing receipts, withdrawals, and balance on hand. This running balance shows the number of items on hand at all times of each item in stock. The principle is: goods on hand or beginning inventory by units, plus merchandise purchased, less merchandise sold equals stock on hand. An essential feature of the system is that each item in stock should have a separate record showing, in addition to the previously mentioned information, quantity ordered, balance on hand, order point for replenishment, cost price and a monthly recapitulation of sales. Many companies used the visible index filing equipment (Kardex) to file this information.

The punched card system of inventory control by machine tabulation is widely used by many food distribution centers. This system of stock control integrates the inventory in terms of values and units. The newer random access memory machines are still another means by which inventories can be controlled. These tabulating machines are usually used for printing distribution center order copies and store orders as well as aiding in inventory control. Equipment and supplies are sold and/or leased by the International Business Machines Corporation and by Remington Rand, Inc., etc. The installations are specially designed to meet the requirements of the individual firm.

Food Distribution Center Operating Efficiency.

Because warehousing is such an important part of the food industry's operating costs, systems of measuring and controlling warehouse costs are necessary. Adequate expense records showing comparative operating figures are also necessary (see Figure IV). Since labor accounts for more than 50 per cent of these costs, warehouse cost control programs are primarily designed to measure operating efficiency and cost of labor. Measures used include tons per man hour, cases per man hour or dollar volume handled per man hour (see Figure V). In addition to these cost measures of control, the accident frequency rate, which is the number of disabling injuries per one million man hours worked, and on which insurance rates are based, must also be exercised. Absenteeism, labor turnover and warehouse damage are other factors to be considered.

FIGURE IV

TYPICAL TRANSPORTATION AND WAREHOUSING EXPENSE RECORD

Budget %	Actual %	Basis	Transportation Expense	This year %	Last year %
.80	.86	GP	wages drivers & helper	.85	.87
.17	.17	GP	general wages	.17	.18
.14	.16	GP	supplies (gas & oil)	.16	.16
.13	.14	GP	repairs to auto equipment	.15	.24
				.02	
.03	.03	GP	tires and tubes	.02	.04
.02	.03	GP	hired store hauling	.02	.02
.30	.31	GP	rent, insurance, taxes and depreciation	.32	.32
.05	.05	GP	sundry (all others)	.06	.05
.45	.50	GP	hauling CREDITS	.50	.50
1.19	1.25	GP	TOTAL trans. expense	1.25	1.38
			Warehousing Expense		
.64	.75		warehouse direct wages	.70	.72
.18	.19		general salaries & wages	.19	.18
.04	.03		supplies	.03	.03
.01	.01		decay and spoilage	.01	.02
.04	.05		repairs	.05	.06
.05	.04		freight, express & drayage	.06	.05
			outside storage	.01	.01
.09	.08		heat, light, power, water	.07	.07
.30	.31		rent, insurance, taxes and depreciation	.31	.37
.03	.03		sundry (all others)	.03	.03
			charged to other dept. (credit)		.02
1.38	1.43		TOTAL warehouse expense	1.46	1.52

Company Hauling	Outside Transportation	Store merchandise Hauling statistics	Total this: Month	Year to date
65,000	1,411	hauling cost	67,000	700,000
23,000,000	767,000	poundage	24,000,000	290,000,000
.2856	.1838	hauling cost per cwt.	.2823	.2696
		mileage- own equip.	170,000	1,950,000
		mileage-rented equip.		

Warehousing Statistics: Merchandise delivered to stores handled by warehouse
Weight 23,000,000
Warehousing cost per cwt. .3507

FIGURE V

FOOD CHAIN GROCERY WAREHOUSE OPERATING EFFICIENCY * February 1956

Company	tons into whse.	tons out of whse.	total direct labor hours*	tons handled per man hour	man hrs. spent checking mdse.	total inventory tonnage	no. of items	sq.ft. space used	no. of floors	no. of stores
1	7,892	7,892	4,432	3.56	675	-	2,500	130,000	1	51
2	7,070	7,070	4,251	3.33	675	-	2,500	140,000	1	50
3	7,058	7,058	5,377	2.63	675	-	2,500	140,000	1	73
4	2,227	2,304	1,859	2.44	530	-	2,600	97,000	1	32
5	2,228	2,228	1,833	2.43	270	-	2,500	60,000	1	32
6	2,376	2,146	1,876	2.41	-	2,274	4,300	63,000	1	8
7	3,478	3,622	3,008	2.36	360	3,600	5,150	92,000	1	28
8	1,873	1,873	1,619	2.31	270	-	2,500	50,000	4	25
9	3,445	3,399	3,009	2.27	1,326	3,709	3,600	120,000	1	59
10	3,319	3,360	2,956	2.26	560	4,146	3,141	101,000	1	57
11	3,567	3,567	3,305	2.16	367	2,678	2,796	84,604	1	63
12	7,565	6,463	6,602	2.12	734	4,000	2,400	257,742	6	99
13	8,100	6,295	6,955	2.07	-	15,500	3,154	138,000	1	91
14	8,337	7,159	7,506	2.06	2,049	8,216	3,900	160,000	1	98
15	4,312	4,370	4,210	2.06	150	3,780	3,000	100,000	1	30
16	7,626	7,748	7,523	2.04	-	6,741	3,285	125,000	1	31
17	15,825	13,303	14,408	2.02	2,236	-	2,200	330,500	5	268
18	4,126	3,607	3,899	1.99	-	-	2,200	90,000	1	38
19	7,614	6,578	7,266	1.95	1,285	7,336	4,051	159,399	3	82
20	9,106	6,299	8,445	1.85	960	5,900	3,450	120,000	1	250
21	3,402	4,271	4,140	1.85	-	2,929	3,000	65,000	1	24
22	4,838	5,042	5,638	1.75	1,552	4,856	3,519	110,000	1	78
23	2,880	5,270	4,688	1.74	-	3,871	2,657	86,000	1	33
24	1,740	1,824	2,066	1.73	456	1,881	2,600	35,000	1	28
25	13,343	13,366	15,442	1.72	1,312	-	2,000	236,000	1	169
26	4,840	5,001	6,131	1.61	1,111	2,654	3,154	116,000	1	78
27	2,857	2,857	3,712	1.54	-	-	2,200	66,000	1	86
28	15,217	13,718	19,819	1.46	3,555	6,218	3,659	178,268	1	150
29	2,039	1,998	3,103	1.30	500	-	3,500	85,000	1	19
30	1,270	906	1,837	1.18	176	-	2,900	50,000	1	48
31	1,928	1,745	3,872	.95	528	1,879	3,500	100,000	1	27
Total or Average										
	171,498	162,339	170,778	1.95	22,312	92,168	3,046	3,685,813		2,205

Source: National Association of Food Chains Summary Report, Warehousing Delivery, Automation, 1956.

FIGURE V (cont)

Warehouses reporting groceries and produce combined (**) or groceries, produce and meat combined (***).

***	7,230	7,135	4,441	3.23	936	-	1,900	150,500	1	124
**	5,704	5,704	4,200	2.72	24	6,000	2,300	60,000	1	29
**	8,430	8,693	6,801	2.52	332	-	2,700	198,000	1	106
***	20,624	18,762	17,638	2.23	2,550	8,000	3,500	181,000	1	46
**	5,748	5,597	5,999	1.89	540	6,445	2,400	85,000	3	39
***	3,968	3,968	4,680	1.70	538	2,122	2,939	137,145	5	41
***	4,600	4,320	5,600	1.59	480	3,000	3,450	90,000	1	37
***	4,414	4,407	5,772	1.53	603	-	2,800	61,000	1	27
***	4,121	4,123	6,411	1.29	-	3,895	3,890	86,000	1	54
***	2,853	2,801	4.402	1.28	352	-	2,100	100,000	1	34

* Includes only physical labor hours spent in receiving, stowing, selecting, loading and replenishing selection line. Includes company or outside employee performing such work. Excludes janitor, maintenance, clerical and supervisory hours.

The adoption of modular ordering (standing orders), if practical and flexible can also greatly reduce operating costs. The modular order is based on the theory that 80 per cent of tonnage comes from 20 per cent of the variety. With this method, a retail store has a standing order of fast moving merchandise, the idea being to establish the order so that the store can inform the warehouse what to delete from the standing order (which might be ten or twenty items) instead of what it wants in the absence of the modular order (which might be 2100 items). Modular orders are usually adjusted at fixed intervals by the retail units. The advantages of this system include: time saved in preparing the order, billing time, and it permits better scheduling of distribution center operations.

Problems of Non Food Distributing

Non food distributing is an ever-increasing problem to operators. Many companies, desiring to obtain the increased profit potential that non foods offer distribute them through their distribution centers often eliminating the rack jobber service cost.

Generally non food items are stored in a special area of the distribution center along with other small, high unit value food items, in addition to items which are ordered infrequently, such as canned anchoivies, etc. This is often referred to as the broken package room or small goods room and may be enclosed by wire mesh or screening. Normally this is a separate operation out of the main flow of traffic. Removing items of this kind from the main line speeds selection of volume merchandise. The enclosure reduces the danger of theft or pilferage of valuable units.

The small goods room operation is one in which full case merchandise is broken into small units and repackaged according to store orders. Adjustable steel shelves are usually used to store the merchandise. Returnable shipping containers are used for order assembly of small units like toiletries, drugs, razor blades, etc. These containers are then sent to the loading dock for shipping.

A small goods operation is needed due to the low turnover rate of some merchandise. Retail units, therefore, desiring to hold reserve stocks on these items to an absolute minimum, require very small orders usually less than full case lots.

Another operation usually carried on in the small goods room is the stamping of tax on cigarette packages. Many states, such as Ohio, require that state tobacco taxes be prepaid by retail companies before they are offered for sale. Other states do not have such a law, tax is collected by the firm at the time of actual retail sale to the customer and is then forwarded to the state tax department.

Concerns in states requiring the stamping of tax on cigarettes, utilize automatic stamping machines for this operation, such as the Pitney-Bowes stamping machine. The operator on the in-put end pushes individual cartons along a metal slide which lays open the narrow side so that the top of the cigarette packages can be automatically stamped. (The automatic stamper will imprint a maximum of 999,999 impressions and when empty is sent to the state tax department for refilling. Each time the stamper is refilled, the company

must pay the amount required for 999,999 impressions before it can be put into use again.) Cigarette cartons are then automatically closed at the output end where another operator repacks them into cases.

Another problem confronting distribution center operators is whether or not the pricing of non food items in the center represents a savings over the labor cost of pricing at the retail unit. Almost one-fourth of companies represented at the 1956 National Association of Food Chains Management Clinic, however, do some non food pricing at distribution center level.[26] Some only price health and beauty aids. Many companies use rack jobbers, who assume the responsibility of ordering, stocking and pricing non food items in their retail stores instead of handling these goods through the distribution center. One company, represented in the clinic, operates as its own rack jobber, i.e., a separate unit is set up within the company which operates in much the same way as an outside rack jobber firm.

The size, shape and fragility of non food products creates problems in their economical distribution. Non food handling "generally leads to numerous special facilities, special receiving points, specially trained people, special racks in special rooms, special pricing equipment, special checking and control measures, etc."[27]

Problems of Frozen Food Distributing

The amazing growth of the frozen food segment of the food industry is

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26. NAFC, op. cit., p.,37.

27. Ibid.

nothing short of phenomenal. Frozen food sales have more than quadrupled in the last ten years. In light of today's trends and forecasts of the future, frozen food warehousing seems of greater importance than ever before.

There are three types ofperations currently used in obtaining, assembling, and delivering frozen food orders:[28]

1. Obtain the order from the customer in advance of delivery. Assemble it in the warehouse and deliver the assembled order.

2. Obtain the order from the customer in advance of delivery, figure the total number of cases of each item needed for all orders, load cases on truck, and assemble the order on arrival at the market.

3. Load a full assortment of merchandise on a truck, contact the customers as you go, and assemble the orders directly from the truck.

The first type, which is widely used, required special warehousing and holding facilities for assembling the individual orders.

The principle components comprising a frozen food distribution plant usually include: storage space, an order assembly room and order holding space.[29]

Storage and order holding rooms in frozen food distribution plants, in which part of the cycle of order assembly operations is performed, are held at or near zero degrees Fahrenheit. Order holding space is needed for holding assembled orders before they are loaded onto delivery trucks. Space for this purpose may be provided in the storage room, or in a separate zero room used

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28. James A. Mixon, J. S. Larson, "Planning a Wholesale Frozen Food Distribution Plant", United States Department of Agriculture, Marketing Research Report No. 18, (Washington, D. C., 1952), p. 16.

29. Ibid., p. 3.

specifically for holding orders. Space in the plant for holding orders is unnecessary if orders are loaded from the order assembly line directly onto a refrigerated delivery truck.

Order assembly rooms are required with the frozen food distribution plant because a large number of frozen food items are ordered by customers in less than case lots which necessitates the opening of full cases and the handling of the loose packages.[30] "Order assembly rooms, in which the major portion of this cycle of operation is usually performed, may be held either at or near 0^{o} F (zero), or between 30^{o} and 40^{o} F. In the industry, the latter are usually referred to as warm rooms. In choosing between zero and warm rooms, the principle factors to be considered are: (1) effect on product temperature; (2) productivity of labor; and (3) possible utilization of storage and working space."[31]

When individual orders are assembled in the distribution plant, cycle of the operation is described as follows: (1) removing full case from storage area, (2) transporting to order assembly room, (3) stocking on racks or filling storage chutes order assembly room, (4) selecting and placing on conveyor the item and quantity desired for individual order, (5) checking and stocking for transportation to holding room, (6) transporting to holding room, (7) positioning of loaded pallet with assembled orders to holding room.[32]

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30. Ibid.

31. Ibid., p. 20.

32. Ibid., p. 37.

Many concerns rent freezer storage space from public refrigeration distribution plants, others feel that there are cost advantages to handling frozen foods in company owned distribution centers instead of contracting for its distribution. Various cost factors of the two options are typified below.[33] "We operate near three per cent for frozen food warehousing and delivery." "We have outside distribution at a cost of 4 to 4 1/2 per cent." "We handle frozen food through the warehouse at 10 to 12 cents per case as against distributors charge of 32 cents per case."

One of the major difficulties connected with a company owned frozen food distribution center is the problem of working conditions in rooms where temperatures usually pass below zero degrees Fahrenheit. To overcome this difficulty, employees working under cold room conditions are generally provided with special clothing. Many operators prefer the new lightweight nylon and kapok garments which were developed by the Army Quartermaster Corps - shoes lined with sponge rubber, sheepskin, etc., are provided. Hot coffee is often made available to employees, frequently ten minute breaks are also provided.

Produce Distribution Problems

The deterioration and fragility factors of produce pose many distribution center problems. Normally the produce inspector, who is also responsible

33. NAFC, op. cit., pp. 30-31.

for receiving merchandise, and the produce assembly foreman are directly responsible for this department within the distribution center. The produce processing foreman is also considered a part of the produce distribution center.

The receiving function of the produce distribution center is a two-fold operation - inspection and checking. Receiving is usually performed during the morning or early afternoon hours. Merchandise can be delivered to the distribution center by rail or less than carlot loads. Generally, seasonal or staple items, such as potatoes, bananas, lettuce, citrus, etc., are shipped by rail, non-seasonal merchandise and slow movers such as bib lettuce, artichokes, etc., are transported by truck from a local broker or commission house. Highly perishable items can be received and stored easily by using modern materials handling equipment. Removable-end frames, placed in sockets on skid legs, enable produce to be double-decked. Frames built around and on pallets provide a means of storing and transporting hard-to-handle items such as watermelons. Many cartoned or boxed product items can be palletized. Conveyors are also used to unload clumsy-to-handle merchandise as it comes off box cars and trucks. Probably the most difficult single item to handle is bananas. One method is the use of an overhead track or rail conveyor. This enables workers to move bananas from the receiving dock to the ripening room. The Kroger distribution center in Cincinnati, Ohio uses a fork truck equipped with a special attachment to haul six banana stalks at a time. The car gang simply hangs each stalk, by means of rope, to a horizontal bar

mounted on a frame. There are two bars on each frame, each holding three stalks. Fork trucks pick the two bars off the rack and place them on overhead rails in ripening rooms.

The thorough inspection of produce is an important task of the produce inspector. If a company is to protect its investment and give customers the highest possible quality, every effort must be made to inspect produce for deterioration. Probably the most important factors contributing to the deterioration of fruits and vegetables are respiration and decay. Fruits and vegetables are composed of thousands of living cells - they thus take on the characteristic of respiration. In respiration, oxygen is taken up, it combines with sugar, and gives off heat. This is a continuing process, the higher the outside temperature, the greater the respiration rate. For every 18 degrees Fahrenheit rise in temperature between 32 degrees Fahrenheit and 80 degrees Fahrenheat, the respiration is doubled or tripled. Proper refrigeration or icing is the best known method of slowing down respiration. Thus, the produce inspector must always check for proper refrigeration, especially in the summer months. A thermometer is often used, especially with citrus products. The pulp temperature should normally read between 40 and 50 degrees. In warm weather the produce inspector checks rail cars for the amount of ice in the bunker upon delivery. Very cold weather often necessitates the use of heaters in the car. The produce inspector must also check for the presence of decay. All fruits and vegetables are covered with bacteria and mold spores - when exposed to normal room temperatures infection usually increases, while refrigeration

slows decay. This is done by selecting random samples and thoroughly inspecting every item in the case or carton. Normally maximum decay percentages are established and anything over that must reported to United States Department of Agriculture inspectors before merchandise can be returned. Three per cent decay on citrus and one per cent on potatoes are two examples of maximum decay percentages used by one company. Finally, produce inspector should inspect the food with respect to carload shift and possible damage.

An air conditioned distribution center is important to the order assembly, storage and shipping functions of the product operation. Very few produce distribution centers are air conditioned at the present time, although many are on planning boards. Temperature and the relative humidity to be maintained are two important considerations, generally 55 degrees Fahrenheit and 55 per cent humidity are considered optimum. Some companies select produce in cold boxes, others assemble on the distribution center floor. In the latter case, maximum time for very perishable produce on the selection line is two hours. Some companies make distribution of bulky staple items such as potatoes, citrus and onions early in the week in order to spread the distribution of work. Orders are generally assembled manually, however, tractor trains and tow lines are sometimes used. Order assembly is normally a 3:00 to 11:00 p.m. operation.

Finally, the processing operation is of prime importance. Included in this operation are the banana and tomato ripening rooms and pre-packaging.

As a general rule, growers pick bananas while in a green, unripened state in order that they do not spoil during shipment to the distribution center. Usually, bananas arrive at the distribution center in this unripened state, therefore, retail food firms must provide some means of ripening the fruit before offering it for resale. This is accomplished by the use of so-called banana ripening rooms.

Banana ripening rooms are fully enclosed structures that are, for the most part, air tight. Doors of the rooms are approximately nine feet high and six feet wide to provide easy access. Inside the rooms, moisture and temperature are controlled; these elements ripen the bananas. The processing period is from five to ten days depending on the condition of the fruit before it is placed in the ripening room and according to the time needed. A normal ripening period is usually five days, at 62 to 68 degrees Fahrenheit at 80 per cent humidity. While ripening, the fruit gives off carbon dioxide gas, this gas also aids in ripening. The more heat and the higher the relative humidity, the faster and more evenly the fruit will ripen. If fruit is needed in a hurry, ethylene gas is introduced into the room to speed the process. Ripening can be excelerated as much as desired. Lowering the temperature and humidity can retard the process but will not stop it. Gas heaters in each room provide heat and overhead water sprayer systems induce moisture. The following table shows the temperature needed to ripen the fruit:

68 - 70° - fast ripening
62 - 68° - normal ripening
58 - 62° - slow ripening
56° - holding ripes

Once a banana has been processed, it must be moved and for this reason it often becomes necessary to send stores more than had been ordered. Tomatoes, honey-dew melons and pears can be similarly processed in banana ripening rooms. Since the ripeness of pears and melons cannot be visually seen, a pressure tester is used. The tip of the device, which is similar to a large hypodermic needle, is inserted into the fruit. When manual force is applied to the plunger, the resultant pressure is recorded on a calibrated scale. The lower the pressure the more ripe the fruit and vice versa.

Items such as potatoes, onions, apples and oranges are often packaged in the distribution center on a bagging machine. One man places the items on a conveyor belt which passes an inspector who removes spoiled merchandise. The merchandise then travels to several baggers who fill and weight the bags. Another conveyor belt transports them to a sewing machine operator where the top of the bag is sewed together and the label is attached. Certain types of bags are heat sealed instead of sewed. The packaged goods are then moved to a location where they are packed into containers for storage until they are needed.

Meat Distribution Problems

Meat distribution plant order assembly operations are, in many respects, similar to the produce operation. In addition to the factors of air conditioning, inspection and fast turnover, cleanliness and sanitary conditions are the prime prerequisites. Department of Agriculture inspectors are many times situated on the premises to enforce freshness and sanitation in states where this is

required by law or when companies are engaged in inter-state shipping of meat products.

In the four plants visited by the writer, the assembly line was broken into three departments, frozen goods, smoked meat and fresh meats. The order pickers checked the order, then filled it by first choosing the item, weighing it, and finally placing the merchandise in a hygenically clean metal container. Beef and other bulky items were wrapped in paper or cheese cloth, loaded on a cart and wheeled to the loading dock.

Very few companies do their own slaughtering or processing of smoked meats: some only cure beef, assemble and deliver orders. Many companies depend on outside packers for the whole process.

Beef processing is often a major operation in some distribution centers. Beef that is well finished (that is, has considerable fat) is much more tender and has a better flavor after several weeks in a refrigerator at a temperature just above freezing then when it is freshly slaughtered. Temperatures normally range from 34 to 38 degrees Fahrenheit in these refrigerators at a relative humidity of from 90 to 93 per cent. Most beef in retail markets is sold for consumption within one or two weeks after slaughter. During the "hanging" period, the small amounts of muscle sugar change to lactic acid, which attacks the connective tissue, partially breaking it down go gelatin, and consequently making the meat more tender. The process is known as "ripening" or "aging".[34]

34. Sleeter Bull, Meat for the Table, (New York: McGraw-Hill Book Company, Inc., 1951), p. 60.

This long aging period, however, usually results in the following disadvantages: (1) weight loss (4.5 per cent in seven days for a 160 pound hindquarter at 40 degrees Fahrenheit and 80 per cent humidity), (2) flavor change and, (3) loss of natural juices. In addition, the long aging period is expensive due to the tie-up of capitol invested in the beef. To overcome these disadvantages, Westinghouse Electric has developed a method of speeding the aging process known as the "Tenderay Process".

The Tenderay Process is essentially a process of accelerating the rate of tenderization while attaining the natural tenderness as produced in beef by "hanging". "Heavy trim and shrink losses accompany long hanging methods. These objectionable features are practically eliminated in the Tenderay Process by holding the beef for a comparatively short time in an atmosphere of moderately high relative humidity and temperature under bactericidal ultraviolet irradiations. Thus, natural juices and flavors are retained and there is a gain in edibility."[35]

After beef is received, it is put into a Tenderay room where a temperature of 68 degrees and a relative humidity of 90 to 95 per cent are maintained. Hindquarters of beef require 48 hours in this room and forequarters 24 hours. The beef is then removed to a re-chill room where it is hung for a 24 hour period at 36 to 40 degrees Fahrenheit. It is then ready for delivery to the retail outlets.

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35. The Tenderay Process Operating Manual, Westinghouse Electric Company, Bloomfield, New Jersey, 1948, p. 2.

Food Distribution Center Safety Programs

Modern management recognizes that a well organized accident prevention program not only saves dollars and cents in insurance payments, but also saves by making handling operations more efficient. Without a constantly vigilant safety program, damage to property and personnel can cancel out the efficiency gains that mechanization has made possible. It is believed that approximately 80 per cent of all accidents can be eliminated by education of the personnel through supervisors, posters and meetings. Physical layout, lighting, heating, ventilation, rest rooms, and safe handling methods must all be determined from the standpoint of safety. If a bad accident occurs, the entire distribution center force can be demoralized. Some of the most common safety measures are as follows:

1. Periodic physical examination of all employees.

2. Aisles should be kept clear to eliminate hazards caused by crowded conditions.

3. Pedistrians should not be permitted in busy aisles. Warning signs and mirrows should be installed at corners or elsewhere as needed.

4. Orderliness of the working and storage area are of prime consideration.

5. Cleanliness of floors and other areas should not be overlooked. Many companies utilize mechanical sweepers for this purpose.

6. Window ventilation must be adequate, especially where men work in a pocket between piles of materials. Sometimes blowers must be used where fork lifts are gasoline powered, although a degassing attachment has recently been developed to reduce obnoxious fumes.

7. Operations by unauthorized, untrained personnel should be forbidden. Vehicle operators should report immediately any mechanical defects and have them corrected. Periodic inspections should be integrated.

8. Traffic rules must be observed at all times. Truck operators should stay to the right and slow down at intersections and crowded areas. When the front view is obstructed, trucks should be operated backwards. Hoists should be kept low when traveling.

9. Special care must be taken when either tiering or stacking loads. Loads should be checked to make certain they are safely balanced.

10. Accidents should be reported immediately.

11. Smoking should be confined to certain areas, containers should be provided for cigarette extinguishing.

In any case, however, the first step in reducing accidents should be the recognition that the liability of any accident is primarily a problem of the individual and his mental outlook on this job, and every effort should be made to correct it.

A fire fighting plan is also advantageous. In one plant, the general warehouse foreman was designated a fire chief and was impowered to set up fire drills and establish a fire fighting system. The warehouse was a large, one-story operation and to make his daily inspections, the company equipped him with an electric powered motor scooter. Another company uses a Willy's jeep for its fire engine. This jeep is completely equipped, with a half inch hose and

other fire fighting equipment. Many companies have installed automatic relay signal equipment directly to fire houses or automatic sprinkler systems. The sprinkler systems are required by law in most distribution centers.

Maintenance and Repair of Equipment

The productivity of equipment is increased if a program of preventative maintenance is practiced within the distribution center. Most plants have a special department and trained mechanics to carry out this function. The greatest economy in an adequate maintenance and repair program is not in the lower expenses which result, but in keeping the equipment in use. When equipment is not maintained properly, the capital investment must be higher than necessary because some of the equipment is in the repair shop and, thus requires additional equipment to replace those that are out of order.

The object of preventative maintenance is the elimination of breakdowns. If the program is followed, it will result in longer equipment life, less congestion in the repair shop and reduction in major overhaul jobs. Periodic inspections and prompt replacement of parts can only result in lower maintenance costs. "The main objective of inspectors is to anticipate repairs before a breakdown makes them necessary. The repairs can then be scheduled for such times as the equipment can be spared from service and interruption of operations obviated."[36]

36. T. A. Ramp, "How to Keep Cranes in Service", Milland Factory (July 1940), p. 75.

New Developments in the Food Distribution Center

Automation is one of the most discussed subjects among distribution center operators today. And yet there is little if any agreement as to just what automation is. Certainly mechanization should not be confused with automation. The fully automatic food warehouse has yet to be built.

In spite of this fact, automation is on the way. A few materials handling firms have already made strides to this end. The remote control tow truck is one example. The electronic tow line is still another. An electric truck will follow a charged wire in the floor on any route desired. It can be dispatched from starting point to follow one of several alternate routes through electrical switches and requires no attendant. Another example of the strides being made toward distribution center automation is the adoption of Remington Rand's Univac File Computer by Super Valu Stores, Inc. At the present writing little information is available concerning its use, however, it is reported that the system will operate in the following manner. A tape or printed card, made simultaneously with the invoice, will produce on a lighted screen on the tow truck the quantity and location of the next item on the invoice. The tow truck will be automatically moved to the next location of the next item on the invoice. A signalling device will then show the location of the next item as a check.[37] For the present, however, the large number of items carried in a food

37. NAFC, op. cit., p. 9.

distribution center make the project both technically and economically difficult.

Some manufacturers having a limited variety and a standard size package have experimented with partial automation. The H. J. Heinz Company has built a warehouse in Pittsburgh, Pennsylvania, that handles up to 6,000 cases an hour in a continuous flow. A conveyor network sorts the cases as they come from production and takes them to stocking machines that pile them on double-decked wooden pallets. Automatic elevators then lower the pallets to fork lift trucks for transportation to the shipping dock.[38]

Mr. Irving M. Fodrik, a Chicago industrial engineer, has this to say: "Within two years, you will see completely automatic warehouses on a large scale." His concept is a computer-controlled warehouse. "You take an order from the customer, place it on an IBM punch card or something similar, put it in a machine and by means of electrical impulses release the material from a rack and carry it directly into a waiting vehicle. It is placed in a rack in the vehicle without any human hand touching it."[39]

38. Fortune, op. cit., p. 142.

39. Fortune, op. cit.

CHAPTER V

TRANSPORTATION

To a very great degree, the marketing system in the United States "is built upon and presupposes an economical effective transportation system."[1] Transportation is the second major function of physical supply. Even in the case of the simplest marketing mechanism, where the consumer buys directly from a local producer, transportation is involved and must be performed by either buyer or seller. The total cost of distribution is well over $500 per family with transportation one of the major expenses.[2] Thus, it can be seen that transportation is a vitally important segment of food distribution or any distribution system for that matter.

Due to the scope of the transportation industry, the writer will confine the discussion in this chapter to that having to do with the movement of merchandise from distribution center to store, namely motor transportation. In addition, the first part of the study will assume the question of a company owned and operated transportation department. The question of whether to own or lease will be discussed under a separate heading.

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1. Harold H. Maynard and Theodore N. Beckman, Principles of Marketing (New York: The Ronald Press Company, 1952), p. 453.

2. Cost of Distribution Services, (Washington, D.C.: Domestic Distribution Department, Chamber of Commerce of the United States, 1950), p. 121.

Definition of Common Terms

Before embarking on the discussion of transportation, it would be well to define certain terms that will prevail throughout this discussion.

1. Common carrier is a transportation line engaged in the business of transporting freight from place to place for compensation and for all persons impartially.

2. Contract carrier is a motor transportation line engaged in the transportation of freight for compensation on a contract basis with the shipper.

3. Private carrier is a truck operator not engaged in transporting for hire.

4. Semi-trailer is a trailer designed to have one end supported by a tractor while in motion.

5. Tractor is a short steel base truck, equipped with a fifth wheel designed to pull trailers.

6. Bill of lading - the basic document governing the purchase of commodity transportation service from common carriers is the bill of lading. The significance of the bill of lading in dealings between shippers and carriers is seen in the wide range of its functions: (1) It constitutes a receipt to the shipper for property tendered for transportation. (2) When properly executed, it provides all necessary shipping instructions for the carriers. (3) It serves as the contract for affreightment, setting forth the obligations of both parties. (4) One variety, the "order" bill of lading, has important commercial uses and is a negotiable document. The "straight" bill of lading is non-negotiable.

7. F.O.B. (Free On Board) means the commodities quoted or sold are to be placed free on board the car or at shipside at point of shipment and that the buyer assumes all risks in transit not caused by the shipper and pays the freight and other changes. Unless otherwise specified, F.O.B. sales are understood to meat sales at the shipping point at an agreed price to apply as of date of sales, usually with inspection privileges at destination, the buyer assuming all costs and risks of transportation.

8. Free Time - on truckload or carload freight, free time is the time allowed to consignor to load freight and to consignee to unload freight before demurrage charges are assessed. On less-than-carload freight, it is the time allowed consignee before storage charges are assessed.

9. Dead weight is the weight of a freight carrying vehicle without its load.

10. Gross weight is the weight of freight carrying vehicles without its load.

11. Payload is the income producing part of a shipment.

12. Pool car - this term refers to a car containing commodities intended for two or more receivers. This plan is used for shipment of articles that would otherwise have to be forwarded under less-than-carload rates which are always higher than rates applying to carlot shipments.

13. Back haul means to haul a shipment back over a part of the route over which it has been hauled.

14. Demurrage is a penalty assessed on railroad cars, motor trucks, on freight held by or for consignor or consignee, for loading or unloading, for forwarding directions or for any other purpose.

Organization

Owing to the great variety of operating conditions in various sections of the country, it is obviously impossible to set up a typical organization which would meet the test of practical operation insofar as all companies are concerned. There is little uniformity in the organization of transportation, even in the same section of the country, because they vary in size from one truck to several hundred. However, the functions performed are substantially the same. The principal requirements of merchandise transportation are speed of service,

regular and dependable schedules, merchandise protection, safety, and effective handling services.

Figure I, page 9, of Chapter II, illustrated a typical structure for a large transportation organization. This includes: the general transportation foreman, day transportation foreman, night transportation foreman, road foreman (training), and work methods supervisor. In addition, the dispatcher is normally part of the organization. The responsibilities of each will become rather obvious in the subsequent discussion and for this reason they shall not be discussed in this section of the study.

The Importance of Merchandise Deliveries

The retail food industry owes its success to volume selling and high turnover. No profit is made in the company until the merchandise reaches the consumer. "It is the function of the warehouse and delivery system to furnish ammunition to the front line stores."[3]

In all food companies, deliveries of merchandise are thought of as grocery, produce and meat merchandise. Since some concerns handle a complete variety of perishables in their distribution centers, the retail units may, quite often, receive as high as twenty-five deliveries per week via their own trucks. (See Figure VI). This is necessary since the perishables department of the stores normally operate on a day to day basis in order to keep inventories at a minimum and thus reduce spoilage costs.

3. National Association of Food Chains Summary Report on the Warehouse and Delivery Clinic, Washington, D. C., January, 1950, p. 30.

In contrast to the independent operator, the retail food chain is virtually dependent upon one source of supply. Should a source of supply fail to deliver, the independent operator can send his order to another, readily available source. The chain manager, on the other hand, must wait for the company warehouse to deliver. Thus, an integrated, well organized transportation department is vital to the successful operation of the store.

Orders are normally assembled and dispatched according to required delivery schedules for delivery to stores from the central distribution center. Usually the distribution plant pools a load of different products for one store to keep distribution center and delivery expense at a minimum. Thus, in addition to reducing delivery expense, "a modern warehousing system increases the time available to store personnel for their primary activities".[4]

Many companies utilize a program of night selection and delivery of merchandise, especially of perishables, and more particularly produce. "This program permits a more effective utilization of trucking equipment, lowers fixed costs per ton moved, and gets perishables into the stores fresh and ready for the day's business."[5] The drop trailer method of delivery is also used. At the present writing, it is generally used only for dry groceries. By this plan, loaded trailers are dropped at the stores and picked up at a later time on the next trip after the store has unloaded it. Of course, this plan presupposes no

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4. Paul Sayres, Food Marketing (New York: McGraw-Hill Book Co., Inc., 1950), p. 25.

5. National Association of Food Chains Management Clinic Summary Report (Washington, D. C., A pril, 1956), p. 40.

interference from the International Brotherhood of Teamsters or other similar drivers union. No matter which system is used, every effort is usually made to obtain the maximum legal payload and some companies use back hauls on deliveries; that is, returning crates, cardboard, etc. and claim profit for bailing cardboard. As one executive put it, "Even if waste paper is lower priced, it's good clean up".[6] Some companies, which utilize cardboard for resale, do not offer empty cartons to customers for carryout.

Supervision and Training of Drivers

Training. The efficient delivery of merchandise depends primarily on those employees entrusted with its movement, that is, the truck drivers. The use of systematic training procedure for new men, therefore, becomes of increasing importance. In fact, the amount of information which a driver must acquire regarding operating rules, routes, schedules, store locations, etc., makes some form of systematic instruction imperative.

The procedure usually followed is for the applicant, after satisfying the personnel manager as to his general qualifications, to be sent directly to an instructor for a road test. An instructor with long practical experience and good judgment is able to pick out the men capable of correctly handling the various types of vehicles operated by the company. Upon successful completion of this test, the applicant usually takes a physical examination and obtains a city commercial license and state driver's license if these are not already in

6. Ibid., p. 46.

FIGURE VI

FREQUENCY OF DELIVERY *

PERCENTAGE OF COMPANIES HAVING FROM 1 TO 5 STORE DELIVERIES PER WEEK - by store volume and by distance from warehouse -

Stores under $30,000				Stores over $30,000				All volume			
Distance from Warehouse				Distance from Warehouse				Distance from Warehouse			
Del. per wk.	under 50 miles	over 50 miles	all mileage	Del. per wk.	under 50 miles	over 50 miles	all mileage	Del. per wk.	under 50 miles	over 50 miles	all mileage
1	36%	33%	34%	1	7%	8%	7%	1	20%	20%	20%
2	48	42	47	2	28	38	32	2	39	40	39
3	12	17	13	3	36	23	32	3	24	20	23
4	4	8	6	4	18	23	19	4	11	16	13
5	0	0	0	5	11	8	10	5	6	4	5
	100%	100%	100%		100%	100%	100%		100%	100%	100%

PERCENTAGE OF COMPANIES PERMITTING SPECIAL STORE DELIVERIES - By store volume and by distance from warehouse -

Stores under $30,000				Stores over $30,000				All volume			
Distance from Warehouse				Distance from Warehouse				Distance from Warehouse			
	under 50 miles	over 50 miles	all mileage		under 50 miles	over 50 miles	all mileage		under 50 miles	over 50 miles	all mileage
yes	67%	50%	63%		73%	67%	71%		70%	59%	66%
no	33	50	38		27	33	29		30	41	34
	100%	100%	100%		100%	100%	100%		100%	100%	100%

PERCENTAGE OF COMPANIES HAVING NIGHT SHELF STOCKING - By store volume -

Stores under $30,000		Stores over $30,000		All volume	
yes	40%	yes	78%	yes	58%
no	60%	no	22%	no	42%
	100%		100%		100%

PERCENTAGE OF COMPANIES THAT DROP TRAILERS AT STORES

yes	33%*
no	67
	100%

*includes one company that reported spotting for night deliveries only

PERCENTAGE OF COMPANIES HAVING DELIVERIES TO DIFFERENT STORE DEPARTMENTS HANDLED ON DIFFERENT DAYS

yes	36%
no	41
no answer	23
	100%

*Chart shown above is reporduced from NAFC Bulletin (May 12, 1956) and represents the experience of 22 medium size member companies.

his possession. In addition, most companies include a period of apprenticeship in the distribution center to learn company products and policies, additional training on how to operate a truck, and a period of service as a driver's helper. Usually, driver training includes learning about truck mechanics so that forewarning of truck trouble can be recognized and reported and minor road adjustments or repairs can be made without calling for road service.

As Mr. Les Herman of Safeway Stores, Inc. states, "We feel this program (training) has contributed greatly to the lessening of truck accidents and excessive trucking costs; also, it has done much to assure arrival of merchandise on time, in top quality condition, and without damage."[7]

Accident Prevention. A great deal has been accomplished in the direction of accident prevention and safety of operation, and most companies now are actively engaged in the education and training of drivers to this end. Where intensive training programs have been consistently followed, accidents have been reduced as indicated by the following company: "Transportation equipment operated by the Roanoke, Virginia branch of the Kroger Company last year (1950) traveled 1,600,000 miles without a chargeable accident against its drivers."[8]

Six factors combined to explain this company's notable safety record.

1. Selection of high type men.

2. Constant supervised training.

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7. National Association of Food Chains Summary Report, 1956, op. cit., p. 42.

8. Harry E. Martin, "Maintaining Truck Safety", Chain Store Age vol. 25, no. 9 (September 1951), p. 290.

3. Pride of the men and the Kroger Company in maintaining safety records.

4. Kroger drivers' respect for state, county and city traffic laws and cooperation with state, county and city police.

5. Safety courts in which every accident, however small, is studied and jury decisions are reached by fellow drivers. This practice proved educational not only for the driver who has been in the accident but for the others who hear the case. All drivers are required to attend these court sessions.

6. Constant inspection and maintenance of equipment to assure maximum safety and efficiency on the road.

A well-integrated program which includes a careful analysis of drivers, intensive training and apprenticeship, accident analysis, safe driver incentives, and a preventive maintenance program will not only reduce insurance rates, but is basic in making possible high safety records. Figure VII illustrates a form used by the Kroger Company for administering truck driver safety and ability tests.

Drivers' Meetings. Drivers' meetings are of value in providing additional instruction to the men and in building up their morale and interest in the company. While bulletined instructions are always necessary, they do not arouse the interest or enthusiasm obtainable from personal explanations. Topics discussed at such meetings commonly include innovations about to be adopted, safety and accident prevention, letters of commendation or criticism received, truck and department operation, and the announcement or introduction of men who are being promoted.

FIGURE VII

THE KROGER COMPANY

Kroger Truck Driver Safety and Ability Test

Driver _____ Branch _____ Date _____ Weight _____

Tractor No. _____ Route _____ Total Miles _____ Total Hours _____

DOES HE:	YES	NO	DOES HE:	YES	NO
Know how to start the truck?			Watch instrument board closely?		
Check gear shift lever for neutral position?			Come to full stop at all intersections?		
Allow engine to warm up?			Properly signal on turn or stop?		
Try brakes?			Judge distance properly?		
Check horn? air indicator? lights?			Look both ways before crossing intersections?		
Know the gear shifts?			Drive on right side of highway or street?		
Clash gears?			Look for clearance before backing?		
Double clutch?			Check tires at intervals?		
Slip clutch unnecessarily?			Watch for pedestrians?		
Release clutch before applying brakes?			Watch the road ahead?		
Ride clutch or brakes?			Practice courtesy?		
Release clutch on rounding corners?			Have his mind on his driving?		
Use clutch or brake roughly?			Show signs of over confidence?		
Shift down and up at proper time?			Show signs of being nervous and hesitant?		
Coast down hills?			Does he travel too fast for conditions?		
Drift motor beyond governed speed?			Show any signs of recklessness?		
Whip motor by bobbing foot accelerator?			Explain: _____		
Travel too close to vehicle in front?			Explain: _____		
Check keys before leaving?			Make night deliveries quietly?		
Make sure he has the right load?			Pick up salvage?		
Set down load between stops?			Graps instructions?		
Handle merchandise carefully?			Need further training?		

SIGNATURE OF CHECKER _____

Control over the delivery operation. Although driver selection, training, safety programs and the like are essential parts of any program, companies recognize that these alone do not assure an efficient delivery operation. Since direct supervision is not possible and, in its absence, some means are needed for control, almost every company uses some method of "Keeping tab" on drivers' performance.

Basically, there are two methods of collecting information on how the driver spends his day. There are the driver logs and the mechanical recorder of the trucks movement.

Drivers' logs, although required by the I.C.C., are inadequate to control delivery or to evaluate driver performance. Since many drivers prepare their logs after the day's run and estimate the time intervals at that time, the data are of dubious accuracy. These logs usually cover only the time of delivery and unloading factors.

The mechanical recorders of truck movement are of several makes and models and all contain similar data. (See Figure VII) The mechanical unit is usually housed in an 8 x 6 x 3 inch case and mounted on the dashboard so it can be seen by the driver. It is connected to the cable of the speedometer it replaces. Readings cannot be altered without detection because erasures or other tampering makes the red paper under the wax visible. A mark along the outer edge shows when the record is inserted and removed.

According to one source, these recorders "enable evaluation of individual driver's efficiency and conduct with exactness and to detect and halt bad driving

habits that produce undue wear, excessive fuel consumption and breakdowns."[9] The accuracy of these reports are recognized by law and therefore protect drivers and the company against false charges of speeding, reckless driving, and blame in case of accidents.

Neither of the latter two methods described furnish direct measures of how efficient one driver is as compared with another, or whether a driver shows improvement over a period of time. In addition, they cannot be used to compare the efficiency of one warehouse's operation with that of another. Therefore, a procedure is needed which does take these and other factors into account. The United States Department of Agriculture has recently devised such a scheme.[10] Basically, "a normal time" for covering a given route is computed and actual time taken by the driver can then be compared with the standard. Information to develop the tables for estimating normal time is not dependent on driver logs or mechanical recorders on truck movement.[11]

Supplying the Incentive. Performance standards for delivery truck drivers give management a means of rewarding good workers and rebuking those who do poor work. Such rewards are inefficient as compared with an enthusiastic desire on the part of the worker to perform allotted tasks. Although supervision cannot be removed entirely, it can be exercised in an advisory fashion by an incentive program.

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9. Paul Kuenzle, "Controlling Truck Operations", Chain Store Age, vol. 27, no. 11, (November 1951), p. 250.

10. For a detailed discussion of the procedures see R. W. Hoecker, op. cit., pp. 45-60.

11. Ibid., p. 43.

Briefly, these incentives are usually provided by:

1. Bonus systems or profit sharing.
2. Promotion, which necessarily involves a larger salary or wage.
3. Merit and demerit systems.
4. Other forms of recognition.

Each system has many variations, advantages, and disadvantages. However, regardless of which system is used, the employee must understand just what purpose it serves and he must want to work to earn his share.

Assignment of Runs. The assignment of drivers to runs, other things being equal, is usually based on seniority, although the application of this rule is often at the discretion of management. This is necessary as the requirements for handling various runs vary widely. Runs may be placed for bid either directly as vacancies occur, or at stated intervals. At the "shake-up" period, runs are placed up for bid, and the superintendent makes the practice of posting these runs every six months. When vacancies occur, drivers having seniority cannot "bump" or displace others below them until the next shake-up period. They must accept temporary appointments to new runs or work from the board.

Methods of Allocating Delivery Expense

At the end of each accounting period, the retail units are normally provided a store operating statement which informs operators of the distribution of the gross profit realized by the store for the period. Usually near the bottom of this statement is found the caption, "Transportation and Warehousing", expressed as a per cent and/or dollars of total sales. This is an allocated amount and is probably the best method of allocating delivery cost among the retail outlets.

Food companies have several different methods of allocating delivery expense among the individual store units. The three most common methods are described as follows: (1) a percentage to sales basis; (2) a mileage basis by hundredweight; and (3) as an overall operating expense in which the companies do not attempt to break down the delivery costs on a store or departmental basis.[12]

The per cent to sales method is one of the most commonly employed by retail food chains. Basically it is the pro-rating of distribution center and transportation expense to each store in the branch or division, operating out of the center and to the department in each store. Initially the total sales for a division are taken for an accounting period as determined by company policy. This total is categorized into total grocery, meat, and produce sales. The total departmental store sales are then divided by the total departmental division sales. The resulting percentages are then multiplied by division departmental distribution center and transportation expense and this amount represents the charge made to each department in the store, the sum of which is the total amount charged to each unit.

This method of allocation is simple and particularly applicable to a situation wherein the distances from the distribution center to the stores is relatively uniform. A close correlation exists between the amount of merchandise

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12. For a more detailed discussion of this and other factors affecting the delivery of merchandise see: Robert F. DeWeese, Factors Affecting the Delivery of Merchandise in the Food Chain Industry, unpublished thesis for Master's degree, Michigan State College, 1952.

delivered to each retail outlet and the actual sales and, therefore, the per cent-to-total sales method does afford management a picture of operations.

The second method of allocating delivery expense, the "ton-mile" method, consists of two basis types; straight ton-mile, and ton-mile by zone.

Under the straight ton-mile method, the transportation cost applied to each store is based upon the distance from the point of shipment to the receiving retail outlet. In general, this cost includes either the fixed rate of the contract carrier, or if delivery is made by a company owned truck, an amount sufficient to cover the driver's salary, trucking operating expenses, depreciation, taxes, insurance, etc. Each of these factors is taken into consideration and a rate set which is sufficiently high to cover all of them without resulting in a profit being made from the stores on the service. In practice, a charge is determined per hundredweight between a company and the contract carrier, enough to cover all elements of the delivery expense. This rate per hundredweight is then multiplied by the number of miles hauled and the resulting figure is the amount charged to the store. Where special equipment is required, e.g., refrigerated vehicles, the rate is usually higher.

When the straight ton-mile method is used, it is of primary importance that accurate records of the weights of shipments to each outlet be maintained. In this manner, each outlet is charged with only that portion of the total delivery expense from which it has benefited. In calculating the weight of each shipment, the loaded truck is weighed and the weight of the truck (dead weight) is subtracted from this gross weight. The rate per hundredweight and the distance

involved is then applied to arrive at the actual cost of each delivery. At the end of each accounting period these charges are totaled and are debited to the store's operation for that period.

A variation is the ton-mile by zone. Under this system, the individual outlets are placed in zones which are determined by the air miles from the shipping point to the individual outlet and a rate charged according to the zone in which the outlets fall. For example, zone one might include any outlets situated from one to five miles from the warehouse; zone two, six to ten miles; etc., up to thirty miles at which point the graduation in miles is in units of ten rather than five miles. Thus, all stores within zone one are charged the same rate per hundredweight for merchandise delivered. The farther a unit is from its source of supply, the higher the rate. For example, stores in zone one may have a delivery expense of one and one-half per cent of sales and stores in zone ten, four and one-half per cent. Probably the biggest advantage of this system is the savings in time realized by the elimination of mileage calculations.

The last method of allocating distribution center and transportation expense is the non-allocation system. In general this type is used by the so-called smaller food companies who are not required to publish operating figures such as those large corporations listed on the stock exchange. Therefore, it is not necessary to allocate operating expenses to individual stores. Delivery expense is incorporated into an overall operating expense and no attempt is made to break down the costs on an individual store basis; they are treated much the

same as advertising and administrative costs. It should not be inferred that this is true of all store expenses. Generally the primary interest in the store's operation lies in the operating gain, that is, the amount remaining after wages, variable expenses, and fixed expenses have been subtracted from total store gross profit. Usually these latter expenses can be attributed directly to, and are controlled by store management. Since transportation and distribution center expenses cannot be regulated by the store manager, company executives do not concern themselves with the amount charged to individual stores.

In conclusion, the ton-mile method of applying transportation and distribution center cost is used more often by companies in which the distance from the center to the stores varies greatly. Some companies using this system are: The Kroger Company, The Grand Union Company, First National Stores and Colonial Stores, Inc. Distance is not considered an important factor in the per cent-to-sales method, since it relies only on sales volume. Jewel Tea Company utilizes this method. Since the difference in distance between the central distribution center and the retail unit is not great enough to warrant the allocation of delivery expense to individual units, and the size of the company are important factors, the non-allocation system seems to be justified in these cases. The Daniel Grocery Company, Wrigley Stores, Inc., and Albers Super Markets all handle delivery expense in this manner. It should be pointed out that no one system is best, rather it depends upon distance, company thinking, and various other factors.

Delivery Equipment - Own or Lease

Basically, there are four types of trucking systems in use today. Merchandise deliveries may be made to retail units from company warehouses via either company owned vehicles, leased trucks, contract carriers, or common carriers. For the most part, common carriers are too expensive to be a significant factor in food distribution, they are only used in dire emergencies by most concerns, and therefore will be omitted from this discussion.

Under the leasing system, companies lease the equipment from a leasing company for a fixed daily, weekly, or monthly cost plus a mileage charge based on running cost. The truck leasing company assumes all responsibility and expense. The super market operator furnishes his own personnel and pays their wages. The equipment is painted and lettered according to the specifications of the operator and is operated as a private carrier or company owned vehicle. Truck leasing was first introduced about twenty years ago and actually came into its own during World War II when maintenance and replacement were major problems.[13]

Under the contract carrier method, a contract is made between the trucker and the company acquiring his services covering a definite period of time, the type and amount of equipment used and cost per ton. The terms remain the same throughout the duration of the contract. Rates are based on the distance travelled and volume carried. The contract carrier supplies the driver.

13. "How Truck Leasing Serves Industry", Truck Leasing News, vol. 8, no. 6 (1953), p. 4.

Actually there is no agreement as to which is the best method. However, in order to gain a better understanding of the various methods, the following advantages are listed.

Truck leasing:

1. Saves executives' time
2. Operating costs are known in advance
3. There are no maintenance worries
4. The capital investment in equipment is released
5. Equipment is well maintained
6. Assures uninterrupted service
7. Eliminates surplus trucks
8. Provides a high class advertising medium
9. Eliminates records and bookkeeping
10. Operators may use their own drivers.[14]

In addition to those mentioned above, the contract carrier has the following advantages:

1. Take care of personnel and labor problems
2. Closer supervision over operations is maintained so as to insure the carrier's profit.[15]

There are, on the other hand, definite advantages in operating company owned trucks. If operated with equal efficiency, operators can secure the truckers profit. This is evidenced by the following:

In January, 1951, Alpha Beta Stores of Los Angeles, California completed a survey with a large national trucking company in regard to leasing its trucks and auto fleet from them. All factors were considered in the cost of

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14. "Choosing Your Trucking System", Super Market Merchandising, vol. 13, no. 2, (February 1948), p. 43.

15. Ibid.

each method. The result showed that while the lease contract would cost the company $135,694 annually, the company was operating its fleet for $34,692 less than the trucking company's bid on an annual basis.[16]

Another cited advantage is that "trucks need not be loaded on a deadline basis, often involving expensive overtime to keep them moving our merchandise on a contracted schedule. We can load up to normal closing time and, if necessary, leave trucks partially filled in our enclosed warehouse where the goods are safe until morning. Trucks are always on hand to do whatever needs to be done."[17]

In addition, one food chain company executive recommended fleet ownership and listed his company's experience as follows: "Despite a new operation with a high depreciation rate, etc., we operated our fleet in 1955 at less than what we paid for contract carrier delivery in 1953".[18]

From the foregoing, it would seem that company owned trucking is cheaper than leasing or contracting. Operators agree that it provides for a more personalized service and merchandise gets better care.[19] However, the final determination depends upon the structure of a company's operation, the problem it involves, local conditions, labor relations, and availability of leasing firms or contract carriers. All methods of trucking must be carefully examined before any conclusion is possible.

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16. DeWeese, op. cit., p. 21.

17. Sol Handleman, "Making Truck Ownership Pay", Chain Store Age, vol. 28, no. 2, (February 1952), p. 160.

18. NAFC Summary Report (1956), op. cit., p. 47.

19. "Choosing Your Trucking System", op. cit., p. 43.

Maintenance and Repair

Contrary to popular belief of some concerns, ownership of trucks does not insure an economical and efficient operation. Successful operators of motor vehicles have learned the lesson that it pays to take care of equipment before it shows signs of failure. The maintenance and repair shops of such concerns are as much for the purpose of preventing repairs as of making them.

The maintenance department is responsible for maintaining automotive equipment at the lowest cost consistent with sound maintenance and satisfactory delivery. To accomplish this purpose the following departmental activities are necessary:

1. Service, cleaning and storage.
2. Periodical inspections
3. Repairs and overhauls
4. Operation of stockroom
5. Salvage and reclamation
6. Maintenance of comparative records and history files (in cooperation with cost accounting department)
    a. history file on equipment
    b. car performance - fuel, oil, mileage costs
    c. breakdown reports
    d. shop costs
7. Analysis of shop records and accounts.[20]

The type of organization necessary to accomplish these functions varies with the needs of each individual concern.

Many of the indirect costs of delivery could be reduced by an effective program of preventative maintenance. This program usually includes the

20. Ford K. Edwards, Principles of Motor Transportation, (New York: McGraw-Hill Book Company, Inc., 1953), p. 174.

following: (1) a careful selection of truck engine and capacity in terms of route and load requirements; (2) a systematative procedure for checking truck use and wear; (3) adequate records covering truck operations and maintenance; (4) careful driver selection and training, and continuous supervision; (5) management support and cooperation."[21] Perhaps the most important part of the program is the systematic inspection of trucks and the immediate attention to repairs and adjustments. Some companies use daily check sheets filled out by drivers, and which are followed up carefully by the garage foreman. (See Figure VIII, page 124).

Not all companies maintain their own repair shops - some have their work contracted out. In general, this decision rests on the number of trucks used and availability to hire competent mechanics. However, a company can usually save money, providing it has a sufficient number of vehicles, to efficiently operate a maintenance shop.

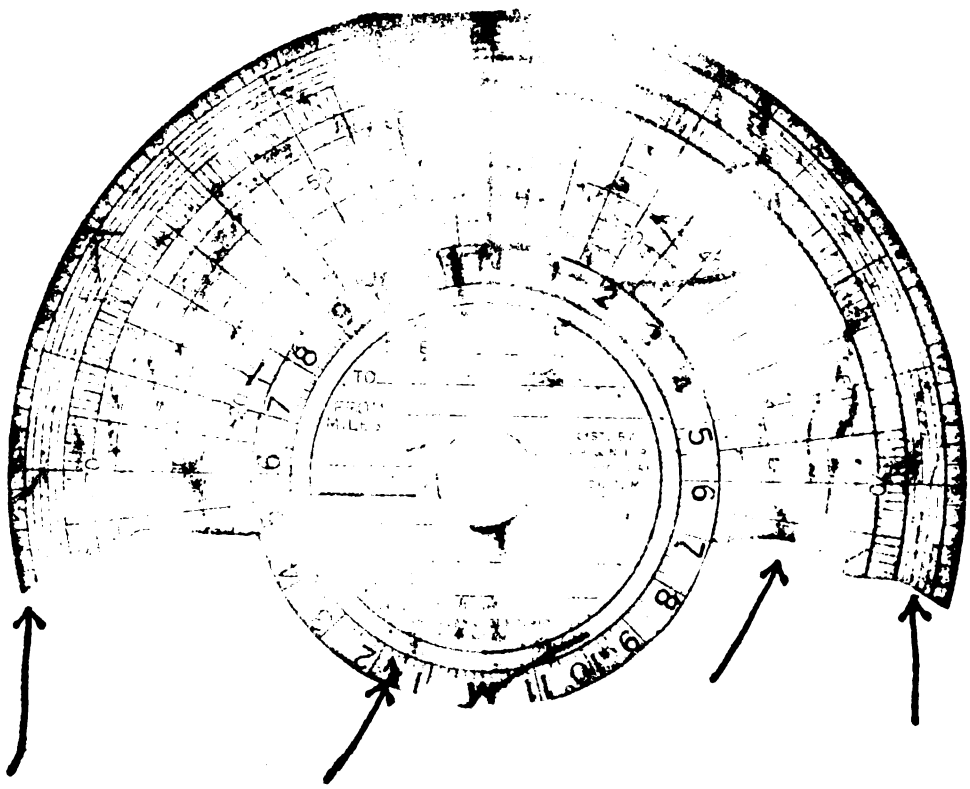
Transportation and the Government

Motor carriers are regulated by the federal government and by the states. Federal authority has come to play the dominant role in control because much transportation cuts across states' lines; but the states were the first to regulate, and they still exercise important powers. For a long time, the states occuppied the field of regulation alone, and not until 1887, with the enactment of the Interstate Commerce Act, did the federal government take a hand.

21. Hoecker, op. cit., p. 35.

FIGURE VIII

TYPICAL RECORD USED IN A MECHANICAL RECORDER



Time Record: Number and divisions show time of day at which recorded data occured.

Operation Record: Shows when engine is stopped, idling in motion.

Speed Record: Graph traces exact speed at all times.

Mileage Record: Distances between lines in saw tooth graph equ[redacted]ne mile, each saw tooth equals ten miles.

FIGURE IX

TRUCK DRIVERS DAILY MECHANICAL REPORT

THE KROGER CO.

Speedometer reading . . . . . Date . . . . . .
Truck No. . . . . Tractor No. . . . . .
Trailer No. . . . . Form 352-D

Mark (X) after items needing repairs.

Motor	Universal joints
Knocks	Rear axle
Missing	Grinds
No power	Controls
Heats up	gas throttle
Noisy tappets	spark throttle
Does not idle	steering gear
Ignition	accelerator
Carburetor spits	Brakes
Magneto loose	grab
Fan belt loose	chatter
Oil leak - motor	adj. - foot - front
Oil leak - lines	adj. - foot - rear
Gas leaks	adj emergency
Water leaks - motor	Miscellaneous
Water leaks - hoses	spring broken - front
Water leaks - pump	spring broken - rear
Clutch	Body - roof - door - gates
slipping	Cab - door - curtain
grabbing	Hood
noisy	Fenders - front - rear
Starter	Head or tail lights
Transmission	Dash or body lights
grinds	Generator
does not stay in gear	Battery
hard to shift	Ammeter
Front axle	Speedometer
out of line	Horn
shimmies	
Drive shaft	
drive shaft center bearing	

FIGURE IX (cont)

Answer "Yes" or "No" to each of the following questions.
Has your truck the following tools: Crank . . . . . Pliers . . . . . .
Rim wrench . . . . . Jack and handle . . . . . Spare light kit . . . . . .
Spare spark plug . . . . . Spark plug wrench . . . . . .
Is your spare tire in good condition? . . . . . Is it properly fastened? . . . . .
Do you carry proper pressure in all tires? . . . . . Does the governor on your truck work properly? . . . . . Does your windshield wiper work properly? . . . . . .
Special remarks . . . . . .
Trailer remarks . . . . . .
Drivers name . . . . . Mechanic's Initial . . . .
Superintendents O,K, ...

The provisions of the state laws differ widely and change often, and in view of the fact that the federal government has assumed the dominant role in transportation legislation, it is unnecessary to describe the state statutes to any great length. In a general way they resemble the federal acts.

State regulation of motor vehicle transportation is of two basic types: police and business.

Police regulation deals with the weights and dimensions of vehicles, speed, safety features, etc. Rules requiring motor operators to carry insurance for protection against injuries and damage are also included. Thus, the objective of police regulations is to protect the highways and promote safety.

However, "some states have prescribed limitations upon the weight and length of motor vehicles which appear to be more stringent than required for purposes of safety and protection, at least along the main arteries of commerce. In some cases specifications have evidently been sodrawn as to favor railroads, or a particular type of highway carrier. As a result, the large trucking concerns have experienced unduly increased costs and unnecessarily impaired service."[22]

Opposed to the non-economic factors of police regulation is the control of rates and service exerted by transportation industries. At present this regulation is in the hands of public service commissions (e.g., Ohio Public

22. C. O. Ruggles, Aspects of the Organization, Functions and Financing of State Public Utilities Commissions, publication of Harvard University Graduate School of Business Administration, vol. 24, no. 2 (April 1937), p. 51.

Utilities Commission, PUCO) or similar bodies in all states except Delaware.[23] It would be impractical to discuss all of the laws pertaining to the regulation of rates and service due to their similarity to the federal laws. However, a rather recent development, worthy of mention is the mileage tax law. For example, the state of Michigan requires a mileage report which must show the gross weight of each vehicle. All vehicles whose gross weight does not exceed 11,000 pounds pay at the rate of one mill per mile of operation for each vehicle. Vehicles between 11,000 and 15,000 pounds gross, pay one and one-half mills per mile for each vehicle, and those over 15,000 pounds must pay two mills. Each truck, tractor, trailer and semi-trailer are all considered a separate vehicle.

In many states the Public Service Commission has no authority over private carriers and others have limited authority. However, in all states, police regulation is extended to private as well as common and contract carriers.

"All means of intercity transportation in the United States, except airlines, are now regulated by the Interstate Commerce Commission."[24] The Commission was established in 1887, and was extended to include motor carriers in 1935.

The provisions of the Motor Carrier Act of 1935 included the following headings: declared policy, administration, scope, types of carriers, safety,

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23. Truman C. Bigham, Merill Roberts, Transportation Principles and Problems (New York: McGraw-Hill Book Company, Inc., 1952), p. 199.

24. Ibid.

service rates, accounts, combination and securities. To cite the act in its entirety is beyond the scope of this paper, for this reason only the "tops off" the act will be presented.

The following exerpt from the Motor Carrier Act gives the premise upon which Congress approached the regulation of motor trucks: "It is hereby declared to be the national transportation policy of the Congress to provide for fair and impartial regulation of all modes of transportation subject to the provisions of this act, so administered as to recognize and preserve the inherent advantages of each; to promote safe, adequate, economical, and efficient services and foster sound economic conditions in transportation . . . . . ."

The administration of the Act was given to the Interstate Commerce Commission. The Commission was given general jurisdiction over motor vehicle carriers engaged in interstate commerce. The act deal with: common carriers, those engaged in transportation for public service; contract carriers, those who operate for hire under special arrangement; private carriers, those who own the carriers; and brokers who sell transportation but who do not perform the service.

The safety feature included: surety bonds or insurance of common and contract carriers, maximum hours of service and qualification of employees, safety of operation, and standards of equipment of all types of carriers. Before a driver may operate a commercial motor vehicle, he must be at least 21 years old, and be examined by a licensed physician and that the employer file a copy of the doctor's certified statement that the driver qualifies under

the law. Effective January 1, 1954, each driver must have in his possession, while driving, a doctor's certificate. The law required re-examination at least once every 36 months. In addition a driver must have at least eight hours rest after ten hours of driving and may not be permitted to remain on duty more than sixty hours during any period of 168 consecutive hours. Drivers must maintain a daily driver's log showing their entire activities during each 24 hour period.

Before extending operations to additional routes, common carriers are required to obtain certificates of public convenience and necessity, and contract carriers were forced to secure permits. "Rates were to be reasonable and non-discriminatory, were to be filed and published, and might not be changed without due notice. The Commission could prescribe the form of accounts and reports, require special reports, and have access to the books and records of common carriers, contract carriers and brokers. It also had limited authority over private carrier accounts."[25]

The foregoing discussion shows the importance that government regulations play in the transportation function. Certainly these laws have a direct bearing on the efficient operation of the department and, therefore, no study of the subject could be complete without their inclusion.

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25. Ibid., pp. 270-271.

Summary

It goes without saying that the transportation department is an important link in the process of profitable food distribution. As a chain is only as strong as its weakest link, so it is with the delivery of merchandise in the food industry. Some retailers view food retailing as a store, distribution center and the buying departments. However, without an adequate knowledge and understanding of the delivery function, no real harmony of operation can be acquired.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Without a doubt, the warehousing and transportation functions of physical supply are a vital link in the efficient, economical distribution of food. Storing and transporting groceries are not only necessary, but are costly operations. How economically these functions are accomplished and controlled is a big factor in determining the price the consumer must pay for his groceries and whether the enterprise's operation will show a profit or a loss and how much of either. As one source states, "Warehousing and transportation represent about 35 per cent of all costs of grocery wholesaling. Hence, warehouse construction and operation, the determination of economical order routines, and the process of assembling and delivering orders must be major considerations in the management deliberations of all wholesalers who are on their toes."[1]

The food distribution center affords a company many economies. Probably the greatest advantage is that of carload quantity purchasing. It also

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1. Nathan Cummings, "Wholesalers Modernize and Merchandise", Food Marketing (New York: Mc Graw-Hill Book Company, Inc., 1950), p. 116.

provides a central point for the gathering and assembly of merchandise, enabling full load deliveries to the retail outlet thereby reducing the final cost of food. By pooling a load of different products for one store, delivery expense is reduced and a modern food distribution system increases the time available to store personnel for their primary activities.

This method of distribution reduces the usual transportation cost and minimizes the old method of rehandling and reshipment of goods, both of which are unnecessary costs. Not only have basic costs been reduced, but food distribution centers have made more active competition in the manufacturing and processing of food. These factors have contributed greatly to the reduction of marketing costs.

The food distribution center and transportation function of any food concern is basically one of service. As evidenced by discussions in the recent National Association of Food Chains Management Clinic on Warehousing, Delivery and Automation, operators often disagree on just how far these services should be extended to the retail units. A typical comment expressed by some operators is: "If the store cannot order their requirements at the proper time, then why should we worry about it. Special and short orders are expensive and result in inefficiency." However, the whole question boils down to one basic premise; that is, retail outlets must have merchandise in order to achieve the company's objectives of maximum sales and profits. If the food distribution center and transportation functions cannot supply this merchandise, at the right time, and the right place, no matter how small or large the delivery, the

enterprise cannot hope to successfully compete with competition and thus is doomed to eventual failure. As one source puts it: "It (deliveries) may be expensive, but it gives good service to the stores."[2] Another NAFC member states, "The most important function of the warehouse is to give service to the stores and cost is secondary."[3]

The "tops off" the study seem to add up to the following major points:

1. A one story warehouse can usually operate at a lower operating cost than multi-story buildings.

2. Every effort of modernizing will generally result in some benefits to the enterprise.

3. "Handling cost will be less with a good crew using poor methods in a poor warehouse than it will be with a poor crew using good methods in a perfect warehouse. Therefore personnel should be carefully selected and trained."[4]

4. The unit load principle based on skids has been largely replaced by pallets.

5. Generally, the pallet system is thought to be more efficient where ceilings are high, elevators and floors are strong enough to carry heavy loads, and there is sufficient space to establish a selection line.

6. If used properly, a conveyor system can be very efficient in multi-story warehouses with weak floors, weak elevators and low ceilings.

7. Chutes are gradually fading from the newer warehouses, but in some cases still have value in the output function.

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2. NAFC, op. cit., p. 21.

3. Ibid.

4. Bromeil, op. cit.

8. The use of the commodity grouping and slot system methods of storage are totally dependent on the operator's opinion as to which method is the best. No one method was found to be ideal for all situations.

9. Stock should be placed on the selection line as to require the minimum of ton-feet haulage in order picking.

10. "The relative advantages of the 'long' and the 'short' selection lines are highly controversial. It is believed that the long line is best for full case stock that is stored on shelves or racks by hand."[5]

11. Every warehouse should have a simple, inexpensive and adequate stock control system. If properly used such a system can lessen the work of buyers, reduce the cost of accounting for stock, decrease insurance costs, decrease the amount of capital invested, practically eliminate an out-of-stock condition, reduce back orders, and promote a better warehouse operation by decreasing the amount of stock to be carried.[6]

12. A program of maintenance and safety in the warehouse will tend to decrease cost, increase productivity and promote efficiency.

13. Complete automation in the warehouse is a long way off, but it is coming.

14. Loading delivery trucks will pallet loads saves labor, but results in loss of truck capacity and considerable breakage unless hand packed.

15. The "ton-mile" method of allocating delivery expense seems to be the most equitable type for most companies.

16. Finally, the question of whether to own or lease delivery equipment is a subject of much debate by warehouse operators. It is generally agreed that the larger organization's prefer to own their equipment during periods of world peace and prosperity. However, there is no categorical answer on the subject.

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5. Ibid.

6. Bromeil, op. cit.

No discussion of food distribution centers would be complete without at least mention being made of the warehouse acts. However, space limitations prevented an extensive study in this thesis.

The United States Warehouse Act of 1916 provides for the licensing and bonding of warehousemen and subjects them to inspection and supervision designed to establish the integrity of the warehouse receipts issued. The law applies only to warehouses engaged in the storing of agricultural products entering inter-state or foreign commerce. A similar law, known as the Uniform Warehouse Receipts Act not only defines the warehouseman's liability and the nature and extent of his lien on goods, but also makes possible a complete identification of the document with the goods it represents. Laws of this type have been enacted in all but four states. A number of states have enacted Cold Storage Laws. Their principle provisions relate to the temperature which must be maintained for different foods and the maximum time for storing each.

The student, interested in further discussion of these Acts, is referred to the many texts and government articles on the subject.[7]

7. See Theodore N. Beckman and Nathaniel H. Engle, Wholesaling (New York: The Ronald Press Company, 1951), chapter 35.

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