# PHYSICAL HANDLING OF FOOD PRODUCTS FROM SUPPLIERS TO RETAIL STORES--A HISTORICAL PERSPECTIVE OF SYSTEMS ANALYSIS RESEARCH

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U.S. Department of Agriculture research on grocery distribution efficiency has been typically oriented toward industry segments, manufacturer, transportation, wholesaling, and retailing. By using systems analysis new opportunities for efficiency are provided, particularly with the interdependence existing in the food distribution chain.

What is systems analysis as it relates to food distribution? The technique draws on several fields of academic endeavor. Some of the terms used to describe this kind of activity are: systems, total systems concept, systems engineering, systems analysis, analysis, operations research, logistics, physical distribution, distribution cost analysis, microeconomics, macroeconomics, and innovation processes. Although each describes some aspects of the technique, none satisfactorily describe it all. William C. Crow, former research Director, has stated his concept of "systems" research on several occasions. According to Mr. Crow, "The cost of moving products from farms to consumers can be reduced by (a) improving the efficiency of the individual parts or steps in the marketing systems and (b) improving the way these steps are put together to make a more efficient total system. Marketing is a highly integrated system of many parts, all interdependent, so it is important to make it work as a total system rather than as a collection of disjointed parts."

Research concerning efficiency in food distribution was initiated in the U.S. Department of Agriculture in 1949. The first research project concerned the retail checkout operation, and findings of the study were published in January 1951 [26]. Interestingly, one of the many recommendations resulting from this study was the use of a well for bagging merchandise, a practice that had not been widely adopted until development and use of the automatic checkout. The second study was published in May 1952 and was concerned with retail store dry grocery receiving, price marking, and stocking [27]. Innovations developed in this study included the use of shelf case supports for grocery stocking, and the use of backroom grocery-pricing stations. At the pricing station, cases of products were cut in half to expose the ends of items in each half case, and prices were applied to each item with a stick stamp. Additional research was done in 1959 on the feasibility of using and the design for a tray pack for stocking grocery items. A device was developed for cutting and making a tray pack from conventional cases, and standards were developed for shelf stocking with tray packs [23]. At the same time, research was conducted on improving the stick-stamp pricing method. The prices that were most used were determined so fewer

stamps would be needed, and the stamp holder was improved by placing ink in the bottom of the tray to keep the stamps moist [36].

Research to improve meat department operations was initiated and three reports were issued in 1953 and 1954 [10, 24, 25]. Substantial increases in productivity were achieved with such developments as the breaking of beef carcasses into smaller cuts on the rail by the use of a meat hook stabilizer, a smear remover attached to a power saw to remove the bone and fat smear, an improved cutting table and improved workplace arrangement, the combining of semiautomatic wrapping machines with scales, and overall improved layouts and layout principles for the self-service meat department.

One of the first systems study was conducted in 1954 and 1955. This study, entitled "Improved Handling of Frozen Foods in Retail Food Stores [11], included warehouse order assembly, delivery, retail store receiving, storage, price marking, and displaying. Productivity with three methods of order assembly and truck loading were compared and the influence of methods on retail store operations was highlighted.

From 1955 to 1963, six marketing research reports [12-15, 33, 34] relating to retail produce operations were issued. These studies covered retail produce subjects such as unloading and receiving, trimming, packaging, price marking, display location, customer service and layout principles. Because the subject areas covered were so broad and the details so specific, training aids were needed for the training of store employees. As a result eight marketing bulletins and two AMS series reports were issued to serve as training aids [1-9, 39]. Many innovations were developed in these studies, including collapsible racks for transporting, storing, displaying and selling watermelons on semilive skids and pallets, produce trimming methods, packaging and wrapping stations, and a tray system for preparation, display, and sale of produce. The tray system was perhaps the most innovative. With that system, all produce would be prepared at a specially designed work station in the backroom and then wheeled on a specially designed dolly to the display area. These trays would be lifted onto the produce counter. Productivity in the produce department was improved more than 25 percent and also resulted in improved display appearance; rapid display setup and, at the end of the day, rapid removal; and reduced congestion from stocking in the store aisle.

The first relatively complete analysis of systems for handling dry groceries was conducted in 1959 and 1960. Eight combinations of methods were studied for handling groceries from warehouse slots to retail store shelves [35]. Each phase of handling, from order assembly through delivery and retail store operations, was studied and the costs were measured. Costs ranged from $124.50 to $155.70 per thousand cases when the delivery distance from the warehouse to the retail store was 30 miles. Later research lead to the marking of cases with adhesive lables showing the product identification and retail selling price of each item to assure that products delivered to a store were the ones ordered and to provide better legibility and accuracy of the suggested retail selling price [17].

Another problem deserving more evaluation concerned methods and costs for unitizing grocery shipments from the warehouse to retail stores. The report of a study on use of warehouse pallets and mobile carts was published in 1972 [37]. Cost difference between the two methods was only $4.23 per

1,000 cases. This cost difference favored use of mobile carts; however, the difference in cost would be nullified if trailers could be used for backhauls from suppliers on the return trip to the warehouse.

Research was again conducted in meat department operations from 1961 to 1963. A new concept, centralized processing of fresh meat for retail stores, was tested through development of a new central plant specifically designed for the processing function. The equipment cost with use of the central plant was more than 50 percent less than with conventional methods [40] because it was not necessary to equip each store with a complete meat cutting and packaging operation and, in addition, automatic wrapping machines, scales, and pricing machines were used that were not affordable in retail store operations. Through labor specialization and with better equipment and more volume, productivity was increased nearly 100 percent. This system is only now being adopted by several supermarket chains in this country. Initial problems with inventory control of fresh packaged meat in retail stores and with labor acceptance probably retarded more rapid adoption.

A study of the handling of dairy products in retail food stores was made in 1962 and 1963 [21]. Included in this study was development of a new system for handling and displaying eggs in which a collapsible container was used that could be positioned directly in the display case. This eliminates individual handling of each one dozen carton, as was required with use of 30-dozen cases. Material and labor savings with the system totaled $3.40 per 1,000 dozen cartons of eggs. The system also provided the potential for additional savings through a reduction in breakage during handling at the packing plant and during delivery. As another part of the 1962-63 study, time studies showed that stocking rear-fed display cases with milk required 16 percent less labor than conventional multishelf display cases.

A study that extended over a period of years, from about 1965 to 1970, related to the feasibility of optical scanning at the checkstand in retail food stores. After we found that major cash register manufacturers were not interested in conducting such a study, we developed a computerized checkout. This checkout was demonstrated to trade associations, supermarket operators, and government officials in August 1970. A research report describing the potential and savings with such a system was published in 1971 [32].

The computerized-checkout study as well as many others, demonstrated the catalytic effect of marketing research in the U.S. Department of Agriculture. Industry established an ad hoc committee composed of representatives of grocery manufacturers, wholesalers, and retailers to determine the number of digits needed in the code and to determine the conformation and dimensions of the code. Industry agreement was established by this ad hoc committee, which also established a self-supporting distribution number bank for assignment of code numbers to suppliers of grocery products. We are now seeing rapid adoption of the optical scanner in supermarkets throughout the country.

In the report of a study conducted under contract in 1969, the contractor concluded that the development of a physical distribution model for evaluating improvements in the cattle and fresh beef industry was possible [28]; however, the cost of initial industry surveys and model development would have exceded $500,000 at that time. Unfortunately, funds were not available to build the model. It was pointed out that previous research was concerned with only one or a few specific areas of the industry. The effect on other

areas in the industry is frequently obscured by the extreme segmentation that characterizes the industry.

Some research that relates to total marketing systems for a commodity group has also been done. For example, a study was made of comparative methods of handling produce from warehouse slots to holding areas in retail stores [38]. Data obtained in this study are being used on all produce-systems studies in which the produce items are handled through a warehouse. Other research has been directed toward costs for marketing specific commodities such as potatoes, onions, citrus, tomatoes, and lettuce. These studies have been initiated at the point of harvest and have continued through transportation to the packing house, packing house operations, transportation to wholesale warehouse, warehouse handling, transportation to retail stores, and retail store handling.

Other research has been directed toward specific problems that relate to the total marketing system. Examples of such research include: Marketing eggs by two systems from packing plant to retail store [29], eggshell damage and master container costs with two shell egg marketing systems [30], eggshell damage from the end of the packing line to the supermarket [31], and systems for handling beef subprimals from central fabricating facility to retail stores [22].

In a 1975 survey of 129 food warehouse operators [18], including corporate chain, voluntary group, and cooperative warehouses, the median warehouse received 60 percent of its groceries by common carrier truck, 30 percent by rail, and 10 percent by backhaul on its own delivery trucks. This study lead to an analysis of systems for handling groceries from supplier to distribution warehouse [19]. Labor and cost standards were established for loading and unloading grocery products in railcars and trucks by the following methods: (a) Manually stacking, or handstacking the products, (b) handling products on a standard 48- by 40-inch pallet; (c) handling products on 40- by 54-inch slipsheets transported by a forklift with a push-pull attachment, (d) clamp loading the products with a forklift having an attachment to pick up and transport unit loads with squeeze-type pressure plates, (e) handling shrink-film-wrapped individual cases of product or shroud-film-wrapped unit loads of product on pallets or slipsheets. The study involved five product categories including: (a) products in glass, (b) high density products such as canned goods and cake mixes, (c) products in plastic containers, (d) paper products, and (e) bagged products such as sugar, flour and charcoal.

When slow moving products are received on the standard 48- by 40-inch unit load, the product is frequently repalletized manually onto a 40- by 32-inch pallet to conserve selection-line space in grocery wholesale warehouses. Those warehouses handled an average of 7,550 items in 1977 [16], and, with that many items, they must store items in the least possible space. We, therefore, conducted a study to determine whether it would be economically feasible for suppliers to ship groceries in 40- by 32-inch unit loads instead of in the standard 48- by 40-inch loads [20]. It was found that shipping on the smaller pallet would increase the suppliers' cost 49 percent, or $45.29 per 1,000 casses--a cost which would have to be passed on to the wholesale warehouse. The cost to the warehouse of repalletizing from the larger pallet onto the smaller pallet was only $6.00 per 1,000 casses.

Current studies that have developed as a result of the grocery systems analysis include the feasibility of using slipsheets for common carrier shipments of groceries from suppliers to a distribution warehouse. Since about 60 percent

of the groceries are shipped on common carrier trucks, the use of slipsheets for unitized loading and unloading offers the potential for tremendous savings. Pallet exchange programs have not worked satisfactorily for the majority of common carrier shipments. Deterrents to slipsheet shipments on trailers are as follows: (a) very few grocery warehouses have forklift trucks with "push-pull" attachments for unloading slipsheet loads at the grocery truck docks, (b) the mast on "push-pull" forks used at the rail docks is too high to enter some trailers, (c) "push-pull" forks are too heavy to enter some trailers, and (d) common carrier rates are generally based on unloading by the driver; therefore, receivers have little incentive to unload vehicles.

Small forklift trucks, and even jacks, have been developed that can be used for unitized unloading of products on slipsheets. However, warehouse management is reluctant to purchase equipment until the number of loads on slipsheets increases. In general, suppliers have the equipment for slipsheet loading of carrier trucks. A study of the feasibility of slipsheet loading and unloading of common carrier trucks indicated that the shipping of products on slipsheets can potentially save $26.00 per 1,000 cases over the cost of loading and unloading products manually.

Another study, nearing completion, is concerned with the cost of less-than-trailer-load (LTL) shipments and receipts of grocery products. In general, LTL shipments are loaded and unloaded by hand, and productivity is lower than with unitized loading and unloading. By putting the partial loads from each of two or more suppliers in one city into a trailer for shipment to a warehouse in another city, or by putting two or more orders from one supplier into a trailer for shipment to different warehouses in another city, shippers can substantially reduce the number of LTL shipments. We are presently measuring the potential reduction in LTL shipments, the effect on inventory turnover, and possible reduction in receiving costs in one firm through combining LTL loads.

In 1972 a market operations research group was established in the Department. The main research objective of this group is to rearrange, combine, or otherwise modify agricultural marketing processes to increase efficiency and decrease costs. This assignment could be termed a systems assignment to overall agricultural marketing. An ambitious program of research was undertaken, by a small staff, to try to determine the cost of each phase of the marketing process for several commodities, including both fruits and vegetables.

The phases studied included harvesting the product by various methods, movement of the product to the packing plant; washing, grading, packaging, and storage at the packing plant; movement to distribution warehouses; warehouse storage and assembly; transportation to retail stores, and in-store receiving, storage, and display. Although certain segments of the study on each commodity have been completed, the total costs have been gathered for only potatoes, onions, citrus, and tomatoes. Completion of the studies as originally planned would require a considerably larger staff than we have. Therefore, future work will likely be in the form of a team approach on one specific commodity at a time.

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