Chapter V

DISTRIBUTION TECHNOLOGIES FOR ASSESSMENT

DISTRIBUTION TECHNOLOGIES FOR ASSESSMENT

Consumers have become accustomed to having most foods they desire available any time of the year and throughout the United States. To provide this availability requires specialized production areas and elaborate transportation, storage, and distribution facilities. [1] Trucks, trains, barges, and in some instances airplanes for highly perishable fresh produce move food products from producer to processor, wholesaler, retailer, and in some instances on to the consumer. Those food distribution technologies the Office of Technology Assessment (OTA) considers of highest priority are listed in table 5. The list emphasizes those with a probability of early occurrence and significant expected impacts.

Table 5.—Distribution Technologies With High Priority for Assessment

Technologies with high probability of adoption and high impact
1) Technologies to improve food sanitation in transportation (p. 54)
2) Electronic checkouts in retail stores (p. 57)
3) Computer systems that improve retail store management (p. 59)
4) Technologies to reduce food loss (p. 61)
5) Electronic food shopping systems (p. 59)

Technologies with high probability of adoption and moderate impact
1) Improvement in trailer design and use (p. **56)**

Technologies **with low probability of adoption and moderate impact**
1) Development of railroad cars or containers for better quality preservation (p. 55)
2) Technologies to enhance warehouse automation (p. **52)**
3) Technologies for delivery of complete meals to home (p. 60)

As in the previous chapter, those technologies where the probability of adoption is considered high and expected to have considerable impact if adopted are rated the highest; technologies where the probability of occurrence by 1985 is considered high with moderate impacts and technologies whose impacts are expected to be high but probability of adoption is considered low are rated lower.

Other technologies discussed in this section are considered of lower priority because of insufficient data on economic feasibility or impacts. These priorities may change in the future as conditions arise that may influence their development or adoption.

The technologies discussed in this chapter are divided into: 1) wholesaling, 2) transportation, 3) retailing and food service, and 4) those technologies applicable to two or more of the above.

[1] The 1972 census reported 39,137 wholesale grocery establishments. 194,346 grocery stores, and 73,006 food stores not classified as grocery stores. In addition, there were 253,136 eating places for away from-home food consumption.

WHOLESALING

Wholesalers receive food products from producers or processors/manufacturers, temporarily store them, and then distribute them to retail stores or other food outlets. Food retailers have integrated extensively into wholesaling and to some extent wholesalers into retailing, but regardless of ownership arrangements, the basic functions must be performed.[2]

General line wholesalers, those who carry a full line of groceries, and specialty whol~ salers, those who carry a special line of items such as frozen food and meat products, share the market. Specialty wholesalers represent about 90 percent of all wholesalers and account for about 60 percent of wholesale grocery sales.[3]

According to a survey by the Food Marketing Institute (FMI), in 1976 the typical wholesaler in their survey serviced 273 retail stores and operated a single distribution center. In addition to food distribution, the wholesaler provided such services as engineering, store design, product movement data, and accounting. Almost 87 percent of the wholesalers surveyed depended on manual selection and picking operations, 3 percent operated fully computerized centers, and the remaining 10 percent used belts and conveyors in a manual operation.[4]

Technologies To Enhance Warehouse Automation

Automating warehouse operations allows for faster handling of larger volumes of merchandise with less labor. Productivity in wholesaling could be improved by standardization in shipping containers, which would allow greater modularization and would make technology easier to apply to the sorting, assembling, and shipping of orders. Mechanical systems exist whose handling capability starts at 300,000 cases per week, a tremendous volume that in many instances would be feasible only through the consolidation of volume from several firms or as a public warehouse.

This concept has a low probability of adoption, but if adopted, it would cause negative impacts. The major issues would probably arise from the impact of consolidation on industry structure and conduct. Consolidation of physical operations could result in consolidation of other management functions. Consolidation of this type suggests a lessening of competition at the wholesale level. In addition, the possibility of consolidated warehouses building and operating stores might act to the detriment of small, independently owned stores without access to the financing of the consolidated groups; and the competitive relationship between smaller suppliers and the larger consolidated warehouses may be affected.

Other issues are the effect on geographic distribution and possible legal problems with State laws and regulations.

Warehouse Consolidation of Items Normally Supplied by Vendors

Vendors supply such items as beverages, bread, snacks, tobacco, and candy directly to stores. In many instances, the quantity delivered at each stop is small and the cost very high.

It would be possible to lower delivery costs if these vendor products were consolidated and delivered along with other grocery items. Other advantages could include better control of shelf space by store managers and elimination of the commission charge on many items, Continued increases in the cost of gasoline could push delivery costs higher, increasing even more the importance of delivery cost-reduction benefits.

[2] 1ntegrated wholesale facilities (owned by the retailer) offer the possibility of better utilization of certain technologies between wholesaling and other distribution functions.

[3] U.S. Department of Agriculture, Economic Research Service, The Food and Fiber System—How *It* Works, Agriculture Information Bulletin *383,* Washington, D, C., March 1975.

[4] Timothy Hammonds, "Food Marketing Industry Speaks 1977, " speech at Food Marketing Institute Convention, 1977.

One deterrent to consolidation might come from labor, as many labor contracts include a commission on deliveries. Many store operators feel that the drivers perform services beyond actual delivery of products by maintaining the displays in an attractive manner. Store operators may not be willing to forego this kind of service.

This technology could work to the disadvantage of the smaller stores, who may not have daily deliveries from the warehouse, so that products that have to be delivered fresh almost every day (such as bakery items) could not be included in regular grocery deliveries.

Computer-Controlled Automation in Warehouses

Experience to date has shown that slower moving items are the first to be automated in warehouses; the fast moving items are handled in bulk with a forklift. Order picking, about 30 percent of the warehouse function, is currently automated; and some inbound functions that account for approximately 20 percent of the system are being automated. Since only the slower moving items are being automated, it has been estimated that "the most sophisticated system we have today is probably less than 15 percent of the warehouse operation. But it's growing . . . it's coming.

To date, many of the "automated" warehouse systems have not been cost-effective. However, the development of computers, scanning capability, and other supporting mechanization would probably result in the development of "industrial robotism," enabling robot units to do many of the warehousing tasks. (Industrial robots are already widely used in the automobile industry for welding and other relatively complicated operations.)

Computer-controlled automation is part of the large concept of warehouse automation, raises the same basic policy issues, and should be assessed in concert with other automation systems. Labor would likely be displaced; firms with available capital would be the first to automate, possibly to the disadvantage of smaller firms. Competition in the warehousing industry could become a policy issue; however, such automation is expected to evolve gradually.

Electronic Interface Between the Retail Store and Warehouse

This technology would result from computer-aided store management and computerization by warehouses or other suppliers. One such technology permits a retail terminal to place orders directly to a warehouse computer. Eventually the ordering could be accomplished by a store computer, which keeps track of inventories without human intervention. An extension of this technology would permit communication between the warehouse and the manufacturer-processor computers.

Electronic interface should improve efficiency in ordering by reducing store inventories and minimizing the risk of running short of supplies. The effect on competitive relationships among firms in warehousing and distribution would have to be assessed. One issue would be possible discriminatory pricing against firms that could not use the electronic-ordering system.

[5]Gerald Peck, OTA workshop, Nov. 12, 1977.

TRANSPORTATION

The food transportation system has served us reasonably' well in the past. Intercity rail and truck transportation was 8 percent of the marketing bill for domestically produced agricultural products in l977, an increase from 7 percent in 1974. The figures do not include air and water transportation or intracity distribution, which would significantly increase the transportation component of the marketing bill.

The system, however, is currently being criticized for not being as efficient as it should be. Critics charge that it is overburdened by regulations that discourage the adoption of technologies which would promote efficiency and save energy. These regulations are administered by a number of Federal and State agencies; they regulate routes, rates, and equipment size and weight.

Other factors also contribute to railroad and motor carrier inefficiencies. For example, an estimated 20 percent of railcars are idle much of the time. Concurrently there have been spot shortages of railcars for hauling agricultural products. Inferior record systems that cannot locate idle cars in time and/or lack of priorities in freight car assignments are cited as reasons for this problem,

Trucks travel the highways empty because of poor scheduling and/or regulations that prevent them from picking up loads on backhauls (return trips). Another part of the transportation problem is one that also hampers other sectors of the distribution system—lack of standardization in containers and associated equipment.

In addition to the issue of efficiency, sanitation is a major factor in our food transportation system. Inadequate cleaning of railcars and trucks has led to food spoilage and waste that could be eliminated by the introduction of certain technologies or the use of existing ones.

Technologies To Improve Food Sanitation in Transportation

The subject of maintaining adequate levels of sanitation in food as it moves through the food marketing system emerges from this study as one of the top priority areas for assessment. Adulteration and spoilage of food, as has been pointed out, occurs at all steps; however, the problem is of particular concern from the point of view of transportation, specifically of the rail system. Applicable technologies exist to correct this problem, although additional development of technologies may be needed.

The basic problem is that much of the Nation's food, which moves by rail, is held in unsanitary conditions during transportation. Boxcars may be infested with rodents and insects and may contain microbiological and chemical contamination. There are documented cases of pets dying from pet foods whose ingredients were contaminated with toxic substances during shipment. Food ingredients are frequently rejected by the processor because they have become contaminated during shipment. Users frequently reject railcars or must decontaminate them before use.

Several factors contribute to the problem. The railroads do not have the technology for a. national commodity tracking system capable of identifying toxic substances or other contaminants that are transported in boxcars, nor of tracking contaminated boxcars to prevent their selection and use for the transportation of edible food products. Currently railroad boxcar classification procedures do not assure the selection of "food quality" boxcars for food transportation. Railroad inspectors determining classifications almost never, if ever, have academic training in food science and are generally not qualified to determine the suitability of a freight car for the transportation of food or food ingredients destined for human consumption.

Beyond the boxcar classification problems, a technological breakthrough in freight car cleaning techniques is needed. The principal boxcar cleaning technology of most railroads continues to be basically unsophisticated; unfortunately, it is best described as still in the "garden hose and straw boom era. " If the railroad industry is to have quality assurance in its freight car fleet, it must develop industry-wide techniques to clean freight cars that have been used for the transportation of bulk commodities, corrosives, or toxins or to detect insects, vermin, or other contaminants having a deleterious effect on freight quality.

An overriding problem is that railroads do not have sufficient capital to refurbish or renew the freight car fleet. Part of the problem may have been that neither public offi. cials, the railroads, shippers, nor the public

have shown sufficient concern. The fact that no loss of human life has been traced to contamination by toxic substances in railcars does not minimize the problem.

One solution to this problem would be to have a fleet of "dedicated cars. " The best cars in the fleet would be designated to handle food only; a fine would be levied if a dedicated car were not returned to the assigned pool. A repair fee could be assessed against a railroad that allowed a car to be misloaded, which would permanently downgrade it to a non-food use. This system, when tried, has not worked very well because the railroads do not enforce the assessment penalties.

Examples of possible technologies are suggested for three specific areas:

1. Freight cars, designed specifically for food products, that will be more resistant to contamination and infestation.
2. Equipment and procedures for decontaminating freight cars. This would include inspectors trained and operating with specific guidelines.
3. Freight cars specifically designated for food use, with a system that will keep track of the cars and schedule them in an efficient manner. There should be an effective enforcing system to maintain the integrity of the system.

Technologies that improve sanitation in food distribution should lessen the chance of food contamination and reduce the concern over possible illness from this contamination.

The cost resulting from lack of sanitation in railroad cars is considerable. In addition to the chance the food will become contaminated, there is an economic cost of preventing it under the present system, When a full car is rejected, it must be returned to the shipper and the load reconditioned, restricted to an inferior use, or perhaps completely destroyed. There is the cost of the return as well as extra handling of cars. If the shipper finds a car unsatisfactory, time is lost in securing additional cars, or the shipper bears the cost of decontaminating and preparing the car. New technologies should reduce this economic loss.

A major policy issue will be the funding of these technologies. The railroads appear unable to secure the needed capital to initiate and maintain the system needed. Serious attention should be given to the desirability of policies that will be needed to help railroads finance these needed improvements.

Cooperation will be needed among the railroads and between railroads and ingredient suppliers and users. There is a need to determine whether this should be through regulation, voluntary cooperation, or some type of incentive arrangement.

Development of Containers or Railroad Cars for Better Quality Preservation

Technologies are needed to develop railroad cars for quality preservation of foods in the marketing system, Certain technologies may be applicable to trucks as well. Developments might include special controlled-atmosphere containers, specially designed cars using ambient air for cooling perishable products, solar-powered car~, or a central refrigeration unit for several cars that draws power from the train axle. These technologies will upgrade equipment primarily for cooling fruits and vegetables in railcars and trucks.

Besides improving the quality of both long- and short-haul shipments, these technologies are viewed as a means of moving food products through marketing channels with greater labor productivity and lower costs. The food service industry is interested in the container concept for deliveries to units, which would allow for better scheduling of delivery vehicles to keep them off the road during peak traffic hours. (These containers would probably be smaller than truck-size.)

The various technologies mentioned above should be assessed to determine economic feasibility, energy consumption, and the effect on food quality or safety. The only major policy issue expected to result from the potential adoption of these technologies will likely come from labor. Containerized shipments could affect the entire marketing system as different delivery methods, equipment, and labor requirements would likely surface.

Improvements in Trailer Design and Use

Adoption of technologies to improve truck trailer design and use should result in improved efficiency and lower transportation costs. Specific improvements include greater truck widths, increased capacity, and multiple trailers hauled by a single cab.

Increasing the normal truck width by a few inches would allow standard 48-inch pallets to be positioned side by side. This standard pallet size is already compatible with freight car loading but is impossible in nearly all existing trucks. These loading problems contribute to much space being wasted. The possibility also exists of reducing the size of the pallets instead of enlarging the trucks. The empty space left in freight cars would be more than compensated for by the increased efficiency in truck loads.

The adoption of these technologies depends in large part on changes in the regulations that control most aspects of the transportation industry. These regulations are currently not uniform among States; varying bridge and axle loads pose the major hurdles, and many States have restrictions limiting loads to single trailers.

If policies are set to encourage the development of more uniform standards and regulations, certain adverse impacts may be expected, such as an increase in the number and severity of accidents as truck weight and size increase. The cost of maintaining roads capable of handling increased tonnage would increase, and the distribution of these costs among Federal, State, and local agencies would have to be decided.

Adoption of these technologies would reduce the number of truckdrivers needed, and labor can be expected to oppose this change. This would probably affect only drivers; loading and unloading rates should not be affected. However, further information would be needed to pinpoint these technologies' justification relative to savings in fuel, increased labor efficiency, the negative impacts on highway safety and increased maintenance cost, alternative funding methods, and the expected impact on and opposition of labor organizations representing truckdrivers.

Intermodal Terminals Constructed in Main Food Distribution Centers

The intermodal terminal would be a large facility designed to receive unit trains of produce or manufactured goods, truck lots, and shipments by water. To be successful, the operation would require some type of standardized or containerized shipments allowing for easy intermodal transfer. The purpose would be to handle large quantities in an efficient manner, eliminating much of the delay of intracity or area delivery.

This concept would probably be a replacement for rather than an addition to our present delivery system, and adoption is much further in the future than many of the other distribution technologies. (The Agricultural Research Service has some preliminary work on a similar concept for a site in New Jersey.)

Terminals would impact on all facets of commercial food distribution and possibly even on international trade. The expected use of containers on ships, trains, and trucks would impact on the number of workers needed. In the absence of specific technologies and because the concept is unlikely to be adopted for some time, this technology is not highly ranked.

RETAILING AND FOOD SERVICE

Grocery stores account for more than 90 percent of all retail food sales for at-home consumption. The remaining 10 percent ineludes other foodstores such as meat markets, retail bakeries, and produce and dairy product stores. Recent trends are toward fewer and larger stores and more convenience foodstores. Although the size, type, and vocation of stores have changed, until very recently there were few technological changes in retail operation.

Adoption of the self-service concept substituted customer labor for that of the store employee. Shelves are still loaded by hand, and the price of each item is marked individually, although in some instances dairy, cured meats, poultry, and other products may be individually price-marked at central processing plants. In meat stores, cashiers still ring up each item, but automated checkout systems using the Universal Product Code (UPC) have been introduced on a limited scale. Although the UPC system eliminates the need for price marking, most items are still individually priced to overcome consumer objections.

According to the FMI, a survey of their members in 1976 showed average weekly sales of $72,425 and an average of over 9,000 items per store. FMI also reported that for the first time in 5 years, there was a general increase in real sales per square foot, per transaction, and per man-hour. Profit margins remain low, however, and if retail stores are to increase their productivity and profits to any extent, new technologies will have to be adopted,

The most recent publicized technology is electronic seaming at checkout and its possible use in conjunction with electronic funds transfer. Technologies for improving productivity in stocking shelves are being developed, but their success depends in part on standardization of containers and packages throughout the distribution system. Until there is more industry standardization on such items as packaging shape and size, improvements in retail store productivity will be somewhat limited.

Food service comprises both public and institutional feeding. Public organizations include commercial cafeterias, catering, and all other eating places serving the general public. Institutions include schools of all types, airlines and other transportation systems, penal institutions, and other non-public eating places.

The Economics, Statistics, and Cooperatives Service of U.S. Department of Agriculture (USDA) reports that in 1977, of the $180 billion spent by consumers on domestically produced foods, $55.8 billion was spent on food consumed outside the home. Of that about $44.1 billion (79 percent) was spent in commercial eating places and $11.7 billion (21 percent) was-accounted for by institutions.

Fast-food service is expected to be the fastest growing segment of the food service industry over the next 5 years, with an annual growth rate averaging 15 percent. Since most of these outlets are of the drive-in type, however, any restriction of gasoline supplies could dampen this prediction.

The fast-food service industry has readily adopted new technologies such as centralized controlled onsite cooking. This has allowed the use of relatively unskilled labor instead of trained chefs and yet has maintained acceptable food service. Preparing food in central plants and limiting menus have minimized the space and labor needed onsite and contributed to the labor productivity increases of these operations.

Electronic Checkout in Retail Stores

The electronic checkout system is a technology currently in use. Although approximately 300 U.S. stores presently have electronic checkouts with the capability of reading the UPC, there will be continued expansion of this new technology in retail grocery stores.

There are two basic checkout systems with many variations. The system using the UPC and seamers has received the most publicity and generated the most opposition. A scanner reads the product identification, weight, etc. from the UPC printed on the product and transmits this information to a central computer where prices are stored. The computer does all computations and relays this information back to the checkout unit in the store, which usually displays the price on a screen and prints it on the customer's receipt tape. Advantages claimed for the system are speedier checkout, no necessity to price-mark individual items, readily available information on inventory, and sale information on all items.

The other system is an electronic cash register which may be self-contained or tied in with a central computer. Items would be in-

dividually marked and entered manually into the system. If connected to a central computer, this system would have the same capability of inventory control and price and quantity transactions as the system with scanners.

The UPC scanner system theoretically would allow greater savings than the electronic cash register because it would eliminate individual pricing and increase productivity of checkers. Both systems have potential for improved merchandising decisions resulting from better inventory control, improved labor scheduling, less need for storage, more thorough analysis of sales, increased product movement, and better use of shelf space.

Most public opposition to the UPC scanner system has centered on the elimination of individually priced products. Opponents claim that elimination of prices deprives customers of information they need to make rational purchase decisions. Bills have been introduced in more than 30 State legislatures to require the price to be marked on every item, while allowing for exceptions regarding size and type of store. However, the passage of bills requiring price-marking could prevent a test to a system just being introduced. Also, not all consumers react the same to these systems. Some might prefer the UPC scanner system even without price marking, and these laws would restrict the choices available to them.

Underlying much of this consumer opposition is doubt about the benefits of the UPC scanner system over other systems and just where the positive and negative impacts would fall. Part of the problem is that consumer groups felt left out of the planning and introduction of the systems and felt instead that a system was being pushed on them. Also, industry disagreements and uncertainty over benefits and costs may have contributed to consumer unrest. However, consumer confidence may grow if the system reduces checkout errors and stems the increase in food prices.

There are a number of issues to be considered:

The first is determining what the economic impacts are, what particular components of the system generate savings, how much of the savings are cash savings resulting from increased productivity of labor versus the secondary savings from better management of inventory, pricing policies, etc. How much additional savings result from using the UPC scanners versus the electronic cash register system.

Second, the effect on consumer purchase decisions from the elimination of individual prices versus having a printed tape identifying 'prices and products needs assessing.[6] There may be other alternatives to solving the pricing problem, such as providing consumers with the means for price-marking or better shelf price-marking. Eliminating the need for individual pricing opens up possibilities for automated or semiautomated stocking of supermarket shelves.

A third is the effect on industry structure and performance. The cost of installing a UPC scanner system now may run as high as $2O O,OOO per store. This will probably decrease with volume production but still requires a tremendous amount of capital. It could become more difficult for smaller firms to compete, especially in the short run when larger firms have the capital to experiment and are the first to adopt the innovation. The electronic checkout system could accelerate the trend toward fewer and larger stores and fewer companies. This raises the issue of increased concentration in retailing and the impacts on competition and consumer prices. There may be a sociological impact as we move toward larger units that could become more impersonal and further alienate consumers. Also, if the adoption of the electronic checkout involves laws requiring individual price-marking, the growth of high-volume, low-price discount or warehouse-type foodstores could be adversely affected.

Adoption of the UPC scanner system could impact on small suppliers who might have difficulty meeting a requirement that all products have a UPC marking.

[6]For a study on the effect of removing individual prices, see Gilbert D. Harrell, Michael D. Hutt, and John W. Allen, Universal Product Code: Price *Removal* and Consumer Behavior in Supermarkets, Michigan State University Business Studies, **1976.**

Fourth, labor would be adversely affected if there were increased productivity as expected. The latest census data show more than 1.7 million employees in foodstores, and many of these positions could be affected by widespread use of the electronic checkout. Checkers and stockers would lose positions, and the magnitude of these job losses needs to be determined. It may be possible to alleviate the impacts during a transition period by eliminating positions only through attrition or retraining these persons for other jobs.

Finally, electronic checkout suggests the possibility of increased use of electronic funds transfer, which raises the associated issues of invasion of privacy and liability for losses and errors in the system.

Computer Systems To Improve Retail Store Management

A retail storewide computer system that uses data derived from an automated checkout system and controls physical facilities for heating, lighting, refrigeration, scheduling of labor, and interfaces electronically with suppliers will likely be adopted by 1985 and can be expected to have implications throughout the marketing system. (Electronic interface between wholesalers and retail stores is discussed as a separate technology in the wholesaling section of this chapter. Seep. 53.)

Adoption of such a computer system would be expected to greatly increase the efficiency of retail stores, including managing inventory to decrease retail storage needs, minimizing transportation, more efficiently utilizing shelf space, and improving labor scheduling and management. Labor would be affected in that it may involve more night shifts, split shifts, relocation, or job loss.

Would the savings generated by this efficiency be passed on to consumers, or would the computer technology be used by stores to increase their profit margin?

What would be the consequences of reduced energy consumption in retail stores? Energy is becoming an increasingly larger share of the retail operation. Computer-controlled lighting, refrigeration, and other power savers should reduce costs. Scheduling of power use during offpeak hours has implications for the generating capacity of power companies. The impacts should be positive, but if consumption were to be reduced below the long-range planning demand curves, the power companies could have excess generating capacity and would have to increase rates.

Electronic Food Shopping Systems

Three electronic food shopping technologies are considered: warehouse-to-door systems involving ordering by telephone; automated minimarkets; and mobile aut~ mated markets. These technologies are applicable primarily to large metropolitan areas and to meet special distribution needs in rural areas. They are not as likely to be adopted by 1985 as the electronic checkout system, but their gradual evolution would have very significant impacts on the marketing system.

Increased recognition of the cost of driving to stores and the increase in high-density metropolitan living might contribute to the increase in these retailing innovations,

A number of warehouse-to-home ordering systems have been tried, with both successes and failures. Possible advantages include savings in time to the consumer, savings in transportation costs, and a possible increase in safety to the elderly and others. Whether this system would provide these services at less cost than conventional supermarkets is not known. The warehouse operators must do the picking that supermarket customers do for themselves, but there is the possibility that labor-saving innovations would lower costs.

The automated minimarket is basically a convenience store with most, if not all, of the items dispensed automatically. The warehouse-to-home and minimarket systems imply a system of payment based on some type of credit, probably related to electronic funds transfer (EFT), which in the case of the automated minimarket could be card-activated. The minimarket concept, therefore, is dependent on the development and use of EFT technology.

Mobile automated markets would move products into certain areas on a scheduled basis. Tests of this system have indicated high-cost operations, but cost would probably decrease if the operation were large-scale.

The principal advantage of all three systems is that food would be made available in areas where services are at a minimum. In some metropolitan areas, for instance, supermarkets have closed, restricting food outlets to small chains or individually owned stores.

One disadvantage is a restriction in the choices available to consumers and in their ability to examine produce before purchase. The question is whether consumers would be better off with limited choices under these automated systems than with a gradual decline in the present system.

All three systems should be judged against other possibilities, such as industry-cooperative stores in the inner city or direct marketing by farmers in the rural areas. Growth in types and size of retail foodstores has in the past depended on population density, income, and specific preferences and tastes.

Technologies for Delivery of Complete Meals to the Home

The delivery of complete meals to the home is a possible extension of electronic food shopping and could be the result of changing lifestyles already under way. Special groups, such as the elderly or handicapped, may look toward the benefits of home delivery of complete meals rather than the purchase of separate ingredients or commodities.

The concept has been tried with several variations for feeding elderly or incapacitated persons and children in special programs. The School Lunch Program in many instances is a special application of meal delivery. Much of the institutional feeding is catering on a meals concept.

The meals concept could result in poorer or better nutrition depending on the type of program or the meals themselves. Nutrition would be poor if the meals contained less fresh fruits and vegetables, consisted of highly processed or fabricated foods, and lost nutrients in storage and preparation. This concept, however, affords the opportunity to provide highly nutritious meals that could be tailored to supply the special nutritional needs of targeted groups. Specific programs would have to be assessed to determine the effect on nutrition and health.

Meals delivered to homes could have an adverse effect on the social life of the aged and handicapped, especially if going out for meals were a major social activity. This would be especially important if the delivery concept were the only practicable alternative. Conversely, there should be an evaluation of the benefits to recipients and to society of letting these people remain in their homes rather than being cared for in an institution.

Home delivery of meals could impact on the traditional marketing channels if a significant amount of food were delivered in this manner. The growth of the fast-food industry has affected the traditional way in which foods are distributed. These technologies do not have a high probability of occurrence by 1985, but the impact of such a shift would be substantial, and developments in this technology should be closely monitored.

Ordering Systems and Equipment To Minimize Intermediate Order Breakdown Before Shipping to Retail Stores

Intermediate breakdown involves subdividing bulk shipments received from a manufacturer or processor into smaller lots for delivery to individual retail stores. Adoption of new ordering systems and equipment technologies would allow the processor-manufacturer to package items and move them on pallets directly to the retail store. This system is currently being used in Europe for very large "warehouse" retail stores, and a reasonable assumption is that use in the United States would also depend on the development of such large, limited-item stores.

Widespread adoption of this marketing concept will be slow because of the historic development of our food distribution system.

The major advantages could not be realized within the major part of our existing system.

If the development of large retail stores is assumed, the impact of adopting such a system would be considerable because a major shift to larger and more concentrated marketing units would be required. Such units might be Government-controlled or a private system of units large enough to obtain the economic benefits of the special packaging systems. Government-controlled stores should be examined from the standpoint of available services and product choices and of responsiveness to consumer wants and needs. A system of privately owned stores should be assessed with regard to a possible increase in industry competition.

TECHNOLOGIES INVOLVING THE TOTAL DISTRIBUTION SYSTEM

The two technologies discussed in this section—technologies to reduce food loss and standardization in retail packages and wholesale containers—are both extremely important to the marketing system. The concepts underlying both of these technologies, however, by their nature do not fall neatly into the three other distribution categories; rather, they impact with equal emphasis in all three. For this reason, we have separated them from the other categories.

Technologies To Reduce Food Loss

These technologies include those that reduce waste in packaging and transportation throughout the system and reduce losses that occur from pilferage and general lack of security control. Loss-prevention technologies will become increasingly important as worldwide pressure increases for more food.

Loss occurs in field waste from mechanical harvesting, at the processing dock, in shipment to grocery stores, and in the retail stores. Another type of loss is the waste from not utilizing undersized or misshapen products that are nutritionally equivalent to produce graded higher. Consumers should have the choice of a nutritious product at a lower cost or perhaps of a food processed from waste.

There are divergent views on how waste reduction could be accomplished. In California some produce has been harvested, packed in wooden bins, and transported directly to the store for display. This eliminates intermediate order breakdown and the damage and waste that inevitably results, and customers are given an attractive product at a lower price. This marketing method might not be adaptable to long-haul shipment, where the emphasis needs to be on shipping containers and transportation methods that reduce damage in transit and storage. Much of the loss in retail stores is a result of internal bruising that starts with picking and transportation and continues to the retail shelf.

Technologies are needed to harvest and move more produce through the food system with less waste. However, in marketing certain fruits and vegetables the extent of loss and where the loss occurs must be determined first.

Alternative methods of harvesting and transporting should be assessed under differing production, storage, transportation, and retailing conditions. For example, field packing, transporting, and retail display of produce in bulk bins may be feasible under certain conditions but would impact the entire marketing system. The bins would have to be returned, salvaged for other uses, or destroyed. Displaying loose produce would cause changes in retailing methods, including pricing and packaging.

Gleaning produce left in the field by mechanical harvesters is one way of reducing field waste. However, securing dependable labor at a price that makes this technology economical may not be possible.

Another concern is utilizing produce that does not meet grade standards because of size or minor blemishes. Although this pro-

duce may be equally nutritious, consumers may not readily accept "second-best" produce or produce not in familiar packages. Since the cost of transporting lower grade produce may equal that of moving higher grade produce, the sale of lower grades might be discouraged.

Waste in food preparation and on the plate, both in the home and in food service operations, should be assessed. An assessment of the value of open dating on food packaging to help prevent waste would be a starting point in reducing waste in the home through using the date in inventory control on home shelves.

Pilferage loss occurs primarily in retail outlets and to some extent in truck and rail shipments. Supermarkets have claimed losses from pilferage as the reason they have closed stores in inner city areas. The different marketing alternatives discussed under electronic food shopping systems could possibly be an answer to the problem. Better designed railcars and trucks with more reliable locking systems would be a deterrent to theft in food shipments. Technologies that would reduce pilferage losses in stores and other segments of the marketing system are needed.

Standardization in Retail Packages, Cases and Pallets

The concept of standardized packages has been advocated as a means for improving efficiency in handling products moving through the food marketing system by reducing the number of different sizes and shapes, improving modularity, and making palletizing more efficient.

A determination of the extent of the benefits that would accrue from this system is needed. Standardization would result incest savings in packaging due to the need for less inventory and a possible saving in materials. However, standardization of retail packages might restrict the choice of available merchandise by presenting problems for manufacturers whose products might not conveniently fit those sizes. New technologies in handling food products might also negate some of the benefits.

The problem is complex, involving many segments of the food marketing industry. Unless new incentives or initiatives are forthcoming, technologies for standardization do not have a high probability of adoption by 1985, and the issue is likely to remain dormant.