

EMERGING ISSUES

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Improving Food System Performance Through Modular Grocery Distribution

Packaging: Barriers, Opportunities, and Research Needs

by

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In a presentation to this Society a dozen years ago, Dr. Gordon F. Bloom, of the Massachusetts Institute of Technology, argued that productivity breakthroughs in the food industry depended on the adoption of a broader management perspective or "systems view." Further, he suggested that in a complex interdependent food system, major technological advances for the industry as a whole are likely to require standardization [2].

Since then, the "systems approach" and standardization have been applied to the food industry to increase its efficiency. Manufacturers and distributors have cooperated to implement a standard symbol (UPC) that facilitated retail checkout automation. Recent inter-industry efforts have produced a uniform communications standard (UCS) to permit electronic data transfer and have developed recommendations for standard coupon formats and sizes to enhance handling efficiency.

Efforts at standardization in the physical distribution system to improve its efficiency have been limited. The objective of this research is to investigate what factors have inhibited standardization of distribution packaging which

has been identified to have great potential for advancing food distribution productivity [2, 3, 8, 16]. The study is nearing completion and a report will be prepared later this fall. This paper overviews: (1) the problem addressed and research objective; (2) the approach and procedures; (3) major findings; (4) key implementation problems; (5) implications of forces driving industry change; and (6) areas needing further study.

Problem Definition and Research Objective

Modular Distribution Packaging: An Unexploited Opportunity For Improving Food Distribution Productivity

Several Western European nations have standardized distribution packaging into modular sizes to maximize the utilization of distribution resources. Modular packaging is defined as a limited series of shipping container sizes which are: (1) related to a basic unit load size (standard pallet); and (2) related to one another by standard fractions of the unit load size.

The impacts of modular packaging have not been extensively studied in the United States. Research conducted in 1974 focused on distributor level effects and found significant potential savings in the areas of warehouse labor, damage, and transportation. Table 1 illustrates the savings in these areas. Savings in 1983 dollars for three major warehouse types are presented in Table 2. The principle reason for variation in the estimates is the use of unitized (pallet) loads. Several additional savings areas noted in Table 1 were identified, but not quantified [1].

Table 1
Potential Savings from Modularisation

<u>Areas Quantified</u>	<u>Estimated Savings</u>	
	<u>Mean</u>	<u>Range</u>
Warehouse labor		
- Order selection	8.0%	3-13%
- Load assembly	32.5%	15-50%
- Truck loading	22.5%	20-25%
Damage reduction		
- Warehouse	25.0%	21-29%
- Store delivery	37.0%	25-50%
Transportation		
- Space utilization	11.5%	3-20%
<u>Areas Identified</u>		
Warehouse		
- Faster training of workers		
- Improved space utilization		
Retail		
- Direct warehouse to store shelf stocking and display on unit loads		

Source: [1]

The figures in Table 2 can be used to calculate a total savings estimate for

the supermarket distribution industry. Given existing warehouse technology and channels of distribution, the potential savings from modular packaging could range from 106 to 248 million dollars annually. Table 3 presents the savings for major existing warehouse types. If modular packaging leads to greater warehouse mechanization and the application of new technology, total savings will be higher. Two limitations of this total savings estimate should be noted. First, it is based on figures for typical firms, but not necessarily industry averages. Second, effects on small but important industry segments are not included [1].

Impacts of modular packaging on the manufacturing sector have not been investigated. Cost to manufacturers of converting to modular shipping containers is related to the adjustment of existing retail packages and the implementation period [1]. Consequently, modular package proposals in the United States and programs in European countries attempt to minimize these costs through gradual conversion in conjunction with package changes for other reasons (new product introduction or metrication) and normal equipment replacement.

Even though representatives of almost every facet of the food industry have pointed to the key role of package standardization in improving distribution productivity, implementation has not occurred in the U.S. grocery distribution system. A 1973 National Commission on Productivity task force, consisting of diverse food industry experts, identified package standardization as a significant opportunity for productivity advancement [8]. A survey of 144 industry executives conducted in 1978 found that standardization of packaging was perceived to have the greatest productivity improvement potential of ten possible joint industry endeavors [3]. The Government Accounting Office surveyed industry participants in 1978 and concluded that modularization would

Table 2
Modularization Savings By Major Warehouse Types

Savings Area	Warehouse Type		
	1983 Dollars per 100 Cases Shipped		
	Manual (Pallets)	Mechanized (Pallets)	Automated (Carts)
Warehouse Labor ¹	1.99 + .82	2.98 + 1.35	.08 + .08
Warehouse Damage ¹	.26 + .04	.26 + .04	.26 + .04
Store Delivery Damage ¹	.50 + .18	.50 + .18	.06 + .06
Transport To Store ²	1.11 + .49	1.11 + .49	.86 + .37
TOTAL	3.86 + 1.54	4.85 + 2.06	1.26 + .55

¹Figures from A. D. Little study converted to 1983 dollar values using an index calculated from wages for workers in the wholesale grocery trade in Employment and Earnings, published by the U.S. Department of Labor, Bureau of Labor Statistics.

²Figures from A. D. Little study converted to 1983 dollar values using the Producer Price Index for refined petroleum products in Producer Prices and Price Indexes, published by the U.S. Department of Labor, Bureau of Labor Statistics.

Table 3
**Estimated Total Savings Potential of Modularization Per Year
With Existing Warehouse Types and Technology**

	Warehouse Types			Total
	Manual	Mechanized	Automated	
Estimated Annual Case Flow (Millions)	4,033.564	410.800 ²	75.636 ²	4,520,000 ¹
Percent	89.24%	9.09%	1.67%	100%
Savings Per Year (Millions)				
Lower bound	93.6	11.5	.5	105.6
Mean	155.7	19.9	1.0	176.6
Upper bound	217.8	28.4	1.4	247.9

¹Calculated by dividing 68,804.3 million dollars in wholesale dry grocery sales in 1984 by an average wholesale case value of 15 dollars. The wholesale sales figure was estimated by accounting for 21.9% and 19.4% markup on total retail sales of 60,901.5 and 25,103.8 million dollars for food and non-food grocery sales, respectively (Progressive Grocer, p. 42, July 1984).

²Estimates calculated from data obtained through personal communication with several major materials handling equipment suppliers to the food industry.

increase productivity, reduce damage, and possibly lower food prices. Despite these potential benefits, little movement toward modular packaging was found to be occurring in the U.S. food industry [6].

Research Objective

The objective of this research is to identify, describe, and analyze organizational and institutional factors which act as barriers to or present opportunities for modular package adoption in the dry grocery segment of the food industry.

Research Approach and Procedures

Research Approach

The conceptual framework developed for this research is not pursued in detail here. Rather, a simplified conceptual model used to frame the problem and suggest important classes of variables for empirical study is presented.

The conceptual model employed is one of exchange between two key participants in the vertical marketing system, manufacturers and distributors. The issue of modular packaging adoption is framed as a general problem of exchange. Suppliers, who hold the right to determine shipping container size, can be visualized as "sellers" of modular packaging. Distributors can be viewed as potential "bidders" for some of those rights in their requests for modular shipping containers. Two broad categories of variables were hypothesized to be significant in determining whether exchange takes place and modular packaging is adopted. First, information about the characteristics of the "good" to be traded is required. This would include the costs and benefits of modularization and their incidence. Second, an institutional mechanism for the transaction, such as a firm, market, or collective arrangement is necessary. Variables in these two categories provided the focus for the empirical part of the study.

Research Procedures

The procedures used to acquire data consisted of a comprehensive literature search and an extensive set of personal interviews with distribution managers and executives in manufacturing, wholesaling, and retailing firms. A generalized "mirror image" interview technique was employed to elicit viewpoints of individuals from both sides of the industry on a common set of themes and questions derived from the literature review. A semi-structured format for the interviews allowed interviewees to describe the problem in their own terms, identify critical factors, and suggest potential solutions. In total, 95 individuals in 54 leading manufacturer and distributor firms were interviewed. Interviews were also conducted with 26 representatives of industry trade associations, research institutions, and food distribution related firms.

An Overview of Interview Findings: Perceived Barriers To Modular Package Adoption

Nine factors were frequently identified in the interviews as major barriers to modularization. Five factors were broadly identified by individuals in manufacturer and distributor organizations. Four additional factors were cited as a major obstacle to modular package adoption, two primarily by manufacturers and the other two primarily by distributors.

Broadly Identified Factors

- The lack of quantitative estimates of the effects of modularization.
- The disparate incidence of the benefits and costs among industries.
- Potential negative impact on manufacturers' marketing flexibility.
- Relatively less importance assigned to distribution productivity than

marketing and merchandising goals in food industry firms and industry organizations.

- Diversity in distributor trade and the resultant lack of agreement on desired package design changes.

Factors Primarily Identified By Manufacturers

- Potential adverse effect of standardization on technological innovation in food products and packaging.
- Inherent diversity of food products in grocery category prevents a significant amount of case standardization from being achieved.

Factors Primarily Identified By Distributors

- The fragmented nature of the food distribution industry diminishes the ability of one firm to effect change.
- The fast pace of industry activity causes firms to focus efforts on short-term problems rather than addressing package standardization which will take time to implement and thus produce longer-term payoffs.

Critical Problems in Communication And Coordination

Differing Perceptions of The Modular Concept and Its Effects

There appear to be two levels at which the views on what constitutes modular packaging differ. First, modularization is often used more broadly than the industry-wide definition outlined earlier. For example, it has been defined as unitizing cases of similar product to form a stable load or has been interpreted even more generally to be products which precisely fit on the standard grocery pallet. Some suppliers use the term

modular to describe pallets of different products mixed by layer. While none of these definitions are technically incorrect, their use increases the difficulty of communication about industry-wide modularization.

Second, differences of opinion exist on how the industry-wide modular concept would be operationalized into specific sizes. For instance, the literature review revealed that distributors envisaged possible modular systems with as many as 300 and as few as 10 case sizes. Obviously, the benefits and costs would vary tremendously over this range. Possibly the reason many suppliers perceive modularization as having negative impacts on marketing is that they interpret modular packaging to mean a system with few sizes, such as the 15 recommended sizes of Project M.U.M. (Modularization-Unitization-Metrication) in the fresh produce industry. Consequently, differing interpretations of modular packaging is a serious obstacle to informed discussion among industry participants.

Organizational Barriers: Problems of Intrafirm and Vertical System Coordination

The root of this coordination problem involves firms' goals and the translation of these goals into an organization's structure and practices. A key question is: Among the many functions performed, where does a firm perceive it makes money and place its emphasis? In the food industry, firms have generally viewed the heart of their business to be sales and, thus, placed relatively higher priority on marketing and merchandising than distribution functions. One industry leader interviewed put it this way: "Operations, such as distribution, are a servant of a sales organization." While a similar organizational relationship exists in both supplier and distributor firms, intrafirm coordination problems will be explored only for the latter.

The goals of a distributor are accomplished by creating an incentive structure for individuals performing various functions. Since management has emphasized the retail store level, procurement and merchandising functions have assumed primary importance. Buyers occupy a pivotal communication role within the firm and between distributor and suppliers. Thus, their practices, which are conditioned by the organization's reward structure, intimately affect intrafirm and vertical system coordination and performance.

Two procurement and merchandising practices have been identified as impediments to package improvements that could lower distributors' handling costs. First, buyers' decision criterion of gross margin ignores the impact of a product upon costs in the firm's distribution operations. Since their performance is judged by gross margin, buyers are reluctant to purchase a product which costs more due to improved packaging, even if these added costs are more than offset by handling cost savings. Given the nature of buyers' decision making, no manufacturer has the incentive to make package changes, such as modularization, that enhance physical distribution efficiency.

A second practice identified as a barrier is the allocation of handling costs on an average basis in the pricing of products. This practice is used because decision makers do not know with any precision the handling costs of one item out of the thousands handled [5]. Products with very high handling costs and those which are handled with ease are assessed the same charge. Consequently, there is little incentive for a manufacturer to make a packaging improvement which lowers distributors' handling cost since it will not be directly rewarded through a reduction in its product's price.

Barriers to Market Incentives: Problems of Coordination Among Competing Firms

Two important characteristics of modular packaging benefits were identified in this research. First, cost savings to a distributor depend upon a significant proportion or "critical mass" of manufacturers adopting modular packaging. The need for a critical mass, or threshold level of adoption, creates difficulties for getting a modular container system off the ground. No supplier making the change alone can produce savings in handling costs for a distributor. Therefore, distributors are unlikely to have interest in or be willing to pay more to obtain a supplier's product in a modular case since no savings accrue until the threshold level is reached. The costs of acting to implement modularization are immediate while the benefits are delayed and, since participation by enough suppliers is not guaranteed, the benefits are also uncertain. For an individual distributor considering the implementation of modularization, the return is likely to be perceived to be insufficient. An executive of a leading national food distributor interviewed put it this way: "Our firm's ability to get a return from efforts on modularization depends upon the action of so many different people. Considering the return on investment, such efforts don't compare favorably with internal innovations from which we know we can obtain a certain amount of benefits since we are autonomous."

A second characteristic of the benefits of modular packaging is that once a system is established, the benefits are available to all firms. This has the effect of weakening the incentive to a firm to take steps either individually or jointly toward implementation. For example, the cost of a distributor's effort to move modular packaging forward are borne individually by that firm while the benefits are shared with its competitors. Moreover,

if firms at either the supplier or distributor level act collectively to implement modular packaging, the result will be a lower general level of industry costs, but offer no advantage to any individual firm over any other [8].

**Forces Changing the Industry:
Potential Opportunities
For Improved System Performance**

Several forces driving change in the U.S. food industry have implications for packaging improvements which can increase the efficiency of the food system. The implications of one development, advances in information systems, for package changes and modular packaging adoption are explored below. Three additional food industry trends with the potential to positively affect the adoption of modular packaging are identified.

Advances in Distributor Information
Systems Permitting Analysis of
Individual Product Handling Costs

The advent of scanning of UPC symbols on retail packages coupled with the availability of low cost computer power have brought about greater sophistication in distribution information management and analysis. Information systems are being developed to precisely monitor individual products' performance. In addition to studying movement data, some firms are now tracking product handling costs. For example, many leading super-market chains scan unsaleable damaged merchandise and are able to determine the incidence of damage among different manufacturers' brands and sizes [11, 14]. A second and perhaps more significant development is direct product cost analysis. A number of major distributors are using computer models which account for cost factors, including handling characteristics of shipping and retail packaging, in addition to purchase price, to get a better picture of an item's true profitability [4, 10, 13]. If analysis of individual product handling costs continues and data generated is used in

distributor decisions, there will be important implications for packaging.

Incentives for package improvements one manufacturer can effect. Distributors' application of information systems advances should create incentives for manufacturers to undertake package changes which, by their action alone, can provide savings to distributors. This development has the potential to overcome the organizational barriers which have impeded the transmittal of economic signals to manufacturers to improve packaging. For example, the use of direct product cost as a criterion in buying and merchandising decisions will reward suppliers making package changes that lower distributors' handling costs. Thus, a manufacturer should have a greater incentive to improve package design, such as strengthening case quality or reducing case size (cube), which have a direct impact on distributors' handling cost. A leading supplier has already redesigned several of its retail and shipping packages to reduce warehouse and retail handling and storage costs [10].

Incentives for adoption of modular packaging. Developments in distributor information systems have the potential to eliminate organizational barriers to modularization, but since other critical communication and coordination problems remain, these changes alone are unlikely to provide sufficient incentives for modular packaging adoption. Availability of individual product cost data to buyers and merchandisers should increase their awareness of package characteristics affecting handling costs in distribution operations. Such improved information flow between these two functional areas of distributor organizations is a necessary step to implementing modular packaging. However, the expanded use of individual product cost analysis will probably not be sufficient for modular packaging to be implemented. At least two additional barriers discussed in the previous section need to be dealt

with for substantial progress to be made on modularization.

The different perceptions of the modular concept and how it should be operationalized is one problem. Intra- and interfirm communications will be greatly enhanced once a common understanding of the concept is reached. Also, the possibility exists that individual distributors could develop different systems of preferred modular sizes. Thus, there is a need for collective agreement on container sizes in order to provide direction for firms in the industry to work towards implementation.

A second problem concerns barriers to horizontal coordination. Several characteristics of the benefits of modularization suggest that even with improved information flow through the vertical marketing system, insufficient incentives will exist for a firm to adopt modular packaging. The problem is primarily one of getting a modular program started. Since a "critical mass" of products in modular sizes is required to produce any effect, no one manufacturer making the change can reduce distributors' handling cost. Direct product cost analysis would find no advantage for a suppliers' product in a modular case until the critical threshold point was reached. Consequently, no incentive exists for any one manufacturer to take the lead in implementing modularization since it cannot capture any benefits from doing so. Also, a supplier's interest in modularization may be further weakened if it realizes that the coordinated efforts necessary to produce savings will reduce handling costs for all firms making the change and not provide any individual competitive advantage.

This discussion has focused on difficulties of "starting up" a modular system. If some way could be devised to achieve sufficient adoption for savings to begin to be realized, direct product costing would reward those undertaking the change and, thus, would provide a

cost differential which would induce the remainder to follow.

The communication and coordination barriers cited above have one thing in common. Both involve the limits of an individual firm to effectuate an inherently system-wide change. Therefore, such barriers need to be addressed on an industry-wide basis either by firms collectively acting through their trade associations or government.

Forces Bringing Greater Attention to Physical Distribution

Several developments have occurred that have increased the visibility of distribution function within firms and across the industry as a whole. First, past increases in fuel and labor costs have increased firms' expenditures on distribution activities. Second, a reduction in government regulation has removed legal constraints preventing companies from efficiently utilizing their distribution resources. For example, through expanded backhaul of suppliers' products, managers and key decision makers in distributor firms are recognizing potential opportunities to enhance profits through the distribution function. Apparently, the somewhat greater visibility of distribution has permeated to the trade association level. Previous supplier-distributor discussions of physical distribution issues have occurred primarily between operations people, but recently greater discussion has been between chief executives of food industry firms [12, 15].

Changing Nature of The Buyer-Seller Relationship

Several important trends over the last decade have altered the traditional buyer-seller relationship in the food industry. A subtle, yet significant, development occurred when distributors began to view themselves as the consumers' buying agent instead of the suppliers' selling agent. The emergence of fewer larger wholesale and retail firms

[7], success of private label and generic items, and informational advantages from access to scanning data are all forces which have enhanced distributors' abilities to pressure suppliers to improve credit terms or distribution methods in order to reduce their costs [6, 17]. Some firms are requesting revisions in product packaging and in some cases are discontinuing or refusing to accept certain package designs and types [11]. Continuation of these trends could further enhance distributors' ability to influence suppliers to make package design changes, such as modularization, which lower handling costs.

Recognition of Value of a Systems Approach To Improving Industry Performance

In the past few years, expanded awareness of the interdependence of suppliers' and distributors' actions has led many to favor inter-industry cooperation to reduce the total cost of food distribution. The value of this "systems approach" was demonstrated in the successful joint study and implementation of the UPC symbol. Many of the largest U.S. grocery manufacturers have endorsed this approach and have expressed a willingness to support projects which reduce total industry costs, even if it means higher costs for themselves [9, 12]. In this cooperative spirit, the major food trade associations, including the Grocery Manufacturers of America, Food Marketing Institute, National Grocers' Association, and National-American Wholesale Grocers' Association, recently sponsored a broad study of possible improvements in shipping container design to facilitate distribution efficiency [11].

Research Needs

Some Questions for Further Study

This exploratory study of the complex process of implementing a major industry-wide innovation has identified a number of questions needing further study. The questions can be categorized

into three broad areas: (1) defining and operationalizing the modular concept; (2) generating information on effects of alternative modular systems; and (3) institutional designs that foster system-wide change.

Defining and operationalizing the modular concept. Given the various interpretations which currently exist, there is a clear need for a precise definition of the modular concept and operationalization of it into specific modular dimensions. The major definitional question that needs addressing is that of distinguishing industry-wide standardization from other package concepts or shipping methods often grouped under the general term modularization. The usefulness of taking modularization from a concept to specific container sizes is that it will allow the more precise identification and measurement of impacts. For example, the degree to which retail packaging will be affected will not be known until the number of standard modular sizes are chosen. A possible approach would be to devise several modular systems, each having a different total number of and specific sizes. Options for study could also include "partial modularization," such as standardizing one dimension, which could be a practical first step toward a full modular packaging program.

Investigating the effects of alternative modular packaging systems. Greater knowledge of the effects of modular packaging is required before implementation can take place. Distributors are unlikely to pursue modularization until they know what benefits they will receive and at what cost. Thus, an important research need is the identification and estimation of modular packaging impacts.

As noted earlier, the type and magnitude of such impacts depend upon the specific modular package system developed. Benefit and costs should be estimated and compared for several alternative modular systems. Thus, the general

question of whether modularization is worthwhile needs to be refined into: (1) which specific alternatives have positive net benefits? And (2) which alternatives provide the most net benefits?

One possible option for study would be a set of standard modular shipping container heights. This "partial modularization" step was identified by materials handling equipment suppliers and several distributors and manufacturers interviewed. The height dimension was pointed out to be critical in increasing mechanization and automation potential and for enhancing container stackability in warehouses of all types. There is also evidence that, for at least some package types, costs of equipment change for adjusting package height are lower than the other dimensions [1].

Impacts of each of the alternatives need to be assessed at three levels. First, manufacturing costs and benefits are largely unknown. The sensitivity of impacts to the implementation period need to be considered. Second, retail effects deserve attention in light of the fact that 76 percent of the costs of handling dry groceries have been found to occur at store level [10]. Third, impacts upon warehousing and transportation need to be updated to account for technological and regulatory changes and expanded knowledge about product damage and losses. Additional effects of modularization that have been identified need to be quantified.

Two remaining research questions concern effects on equity considerations. Modular packaging may increase the technical efficiency of the food distribution system, but produce some consequences that reduce overall system performance. First, information is needed on the impact on future employment in the food industry. Second, the effect of modularization on industry structure and competition is largely unknown and deserves exploration.

Design of institutions which foster system-wide innovations. Information on modular packaging impacts alone will not guarantee that implementation occurs. A specific system of modular sizes could be shown to produce net savings for the overall industry, yet not be adopted if existing institutional mechanisms do not provide the necessary incentives. Several problems of establishing incentives for adoption of system-wide innovations through market exchange were discussed in the last section. A promising area for further research is the design of institutions which can overcome these problems. Efforts might be focused on three questions. First, are there ways to improve the market mechanism's ability to reflect the more widespread, longer-run advantages of system-wide innovations? For instance, after savings to distributors of a specific series of modular sizes are quantified, these cost advantages could be built into individual handling cost analysis systems to create adoption incentives to manufacturers. Second, what arrangements at the collective level could be devised to implement system-wide changes with net benefits to the industry? Third, what catalytic role might government play in this process?

Toward a Better Understanding Of Modular Packaging

The discussion and study of improvements in distribution packaging with an aim to reduce total system costs is in its infancy. At this early stage, the most pressing need appears to be one of definition and clarification of possible shipping container improvements, including modularization, to promote informed discussion. The broad approach taken by the jointly sponsored trade association project on shipping container design should go a long way toward addressing this need. Once the entire spectrum of package improvements is defined, the potential exists for a common understanding of the modular concept. An important next step is operationalizing the concept into specific sizes to permit

the precise identification and measurement of impacts.

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