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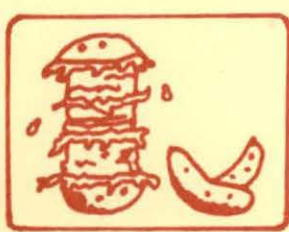
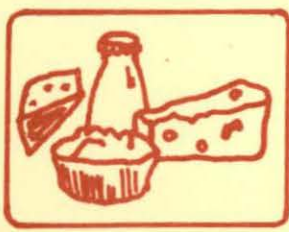
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LOSSES IN U.S. FOOD DISTRIBUTION SYSTEM



DRY GROCERY LOSSES

Thomas R. Pierson
John W. Allen
Edward W. McLaughlin

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U.S. FOOD DISTRIBUTION SYSTEM

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Department of Agricultural Economics
Michigan State University
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PREFACE

This is one of eight reports resulting from a study of losses and waste in food distribution. The National Science Foundation-Research Applied to National Needs (NSF-RANN) commissioned and provided primary funding for the analysis of the general magnitudes and locations of food losses occurring in the U.S. food distribution system. Additional resources were provided by Michigan State University's Agricultural Experiment Station and Cooperative Extension Service. Seven food product categories have been analyzed: fresh beef, produce, dairy products, dry grocery, frozen foods, bakery goods and foods sold through delicatessen departments. Foods within these categories constitute about 92 percent of supermarket dollar food sales. Dry grocery is the largest category, accounting for about 36 percent of supermarket food sales. It is followed by dairy products at about 15 percent, fresh beef at about 13 percent, and produce at about 9.8 percent of food sales. Frozen foods, "deli" department foods, and bakery goods accounted for 8.1, 5.2, and 4.7 percent respectively. It should be noted that with the exception of fresh beef, the categories are designated according to conventional food store departments. In the case of beef, it is the dominant product in the meat department.

This particular report contains: an introduction and orientation to dry grocery distribution through supermarkets; a discussion of the general nature of dry grocery losses; and findings of the magnitudes, causes and suggested remedies for dry grocery losses. The following companion reports also derived from the NSF-RANN study complement this report.

- Losses in the U.S. Food Distribution System
- Produce Losses in the U.S. Food Distribution System
- Dairy Product Losses in the U.S. Food Distribution System
- Delicatessen Food Losses in the U.S. Food Distribution System
- Fresh Beef Losses in the U.S. Food Distribution System
- Frozen Food Losses in the U.S. Food Distribution System
- Bakery Losses in the U.S. Food Distribution System.

DRY GROCERY LOSSES IN THE
U.S. FOOD DISTRIBUTION SYSTEM*

CONTENTS

	<u>Page</u>
Introduction	1
The Nature of the Research	1
Dry Grocery Distribution	3
The General Nature and Causes of Dry Grocery Losses and Damage	3
Losses During Transportation Operations --	
Manufacturer to Distribution Center	8
Truck Transport	8
Rail Transport	9
Losses During Wholesaling Operations	12
Causes of Losses and Suggestions for Prevention	12
Warehouse Damage by Primary Container Types	15
Delivery Losses -- Distribution Center to Supermarket	18
Economic Losses Associated with the Wholesaling Operations	20
Losses During Supermarketing Operations	21
Causes of Losses and Suggestions for Prevention	22
Summary and Conclusions	24
Appendices	33
Selected Bibliography	43

*In addition to the principal authors, major contributions to this report were made by Cynthia M. Seik, Graduate Assistant, Department of Marketing and Transportation Administration, Michigan State University.

INTRODUCTION

The reality of serious resource shortages coupled with stagnant productivity over the past decade has led to a renewed search for ways to improve efficiency in the U.S. economy. The productivity problem and resource shortages have been important factors in creating the nation's most serious economic problem -- inflation. Among the most visible symptoms of inflation are rising gasoline and heating fuel costs as well as food price increases. Rapid food price increases and the hardships they pose for society highlight the necessity to improve productivity and resource utilization in the food distribution system. Among the many resources used in the distribution foods -- labor, energy and capital, to name just a few -- food itself must be included as a vital resource. Thus, food firms need to develop and implement more "food efficient" distribution methods within an overall context of cost efficiency.

At the present time, however, the nature of food losses in the distribution system is often not well understood. Neither the magnitudes nor the locations of food losses have been adequately documented. Even definitions of the terms differ greatly. Nonetheless, until the magnitudes and locations of the losses are established, opportunities to take action to reduce them are severely limited. This report presents preliminary estimates of dry grocery losses in the U.S. food distribution system.

The Nature of the Research

"Dry grocery losses" is a term subject to many interpretations. The purposes and nature of this study dictated the use of a number of different "dry grocery losses" terms and concepts: (1) economic value of physical losses, (2) total

economic costs associated with losses; (3) shrinkage, and (4) losses resulting in reductions of either the quantity or quality of dry grocery products available for human consumption. Although different "dry grocery loss" concepts with disparate data were used, the study tended toward a single focus: an effort to develop estimates or proxies for the quantities of dry grocery products lost for human consumption. The project covered dry grocery distribution beginning at the processor's or manufacturer's shipping dock, extending through transportation and wholesaling activities, and ending with supermarket retailing operations.

The specific objectives of the study were:

- To identify the general magnitudes and locations of major dry grocery losses during distribution activities based upon a thorough inventory of available information.
- To determine the approaches currently used to control dry grocery losses, and to assess the strengths and weaknesses of these approaches.
- To identify dry grocery loss issues which may need additional research in order to reduce losses.

Research procedures employed to achieve these objectives involved a four-step process:

- An initial, broad-based survey of published information was conducted. Sources of information included: (a) university, United States Department of Agriculture and private industry-sponsored symposia on food losses and related topics; and (c) trade publications.
- A select panel composed of representatives from industry, trade associations, and government met at Michigan State University to review and comment upon the preliminary findings. They also contributed to the identification of comprehensive resource materials.

- The analysis and synthesis of selected published data was conducted in order to develop a comprehensive picture of dry grocery losses.
- A limited number of in-depth interviews were carried out with selected industry authorities to provide additional information, and to ascertain the reasonableness of findings.

Dry Grocery Distribution

In 1977 Americans spent about \$35.1 billion on dry grocery items in supermarkets. This accounted for over 36 percent of all food purchased through supermarkets (7). The dry grocery category generally includes food items not requiring refrigeration and having a shelf life of over two weeks. Items such as canned fruits and vegetables, breakfast cereals, soft drinks, coffee, beer and wine, snacks, desserts, garnishes, condiments, candy and gums, are among the foods included in this category.

The predominant mode of distribution for dry groceries is shipment via rail or truck from manufacturers to wholesalers' distribution centers, truck shipment to retail stores, and consumer purchase. However, some grocery items are delivered by truck to supermarkets from vendors and by direct shipment from manufacturers.

The dry grocery distribution channels also involve some variation in warehousing operations. Manufacturers may own regional warehouses or lease space in public warehouses in order to provide efficient delivery services to wholesalers' distribution centers. This report focuses on that portion of the distribution system, beginning when goods leave the manufacturer's final shipping dock and ending when consumers remove goods from retail supermarket premises.

THE GENERAL NATURE AND CAUSES OF DRY GROCERY LOSSES AND DAMAGE

Losses in dry groceries are caused primarily by mishandling and/or packaging failure which results in broken, dented, ripped, crushed, or cut packaging.

Incidents of spoilage of dry grocery items in the distribution channels are relatively infrequent.

These damage losses could be prevented, to some degree, by improved packaging; however, at times the packaging quality issue is a source of controversy between manufacturers and retailers. Retailers sometimes view product losses as a direct result of packaging failure; whereas, manufacturers may see the problem as being one of mishandling. The basic issue concerns the kind of secondary or shipping container used. Some common secondary containers are: paper bales, kraft cardboard boxes, corrugated boxes, and shrink (polyethelene) wrap.

In some instances society would clearly be better served by improved packaging. In these cases the extra costs initially paid by manufacturers would be exceeded by the benefits of reduced food losses, less labor for recouping damaged goods, and reductions in numerous other indirect costs associated with damaged grocery products. However, manufacturers frequently view improved packaging as significantly raising costs which they may not be able to recover. Many times they alternatively propose that wholesalers and retailers revise handling methods to reduce losses (24).

In recent years the packaging issue has been aggravated by inflation that has been pushing packaging costs upward at rapid rates. These cost increases have accompanied increases in many other food marketing costs. In efforts to reduce overall costs, or at least stem the tide of rising costs, some manufacturers have been using secondary containers that possess less structural support and protection for the contents. At the same time many wholesalers are attempting to increase efficiency and reduce costs by stacking palletized products higher in the distribution center. Thus, the independent quest for cost savings by both manufacturers and wholesalers may be resulting in increased losses within the system. Clearly, awareness of the problem from a systems perspective is necessary. With

this need in mind, a number of retailers and manufacturers are working together to remedy packaging and handling issues, but broad based solutions to the overall problem are far from being achieved.

A number of other packaging and handling problems have caused controversy among manufacturers, shippers, wholesalers, and retailers. For example, innovations in packaging and packaging materials used in new ways frequently present problems -- at least in the beginning. The replacement of glass juice bottles by plastic bottles is a case in point. Some plastic bottles do not possess the structural capacity to support the same load weights as their glass counterparts. Thus, when put in the same secondary container as glass and subjected to the same stacking weights, substantial losses due to leaking product have resulted.

Another set of packaging concerns involves package weights, size dimensions, and the primary container count inside. Package sizes and weights impact dramatically upon handling efficiency during distribution to the retail level; whereas, container counts influence efficiency in retail stocking and ordering procedures. Several additional issues regarding packaging include: (1) defective packaging, such as flaps on secondary cardboard containers that come unglued, and polybags that are improperly sealed; (2) the multiplicity of shipping container sizes which makes stable, palletized loading of trucks for retail delivery difficult to achieve; (3) inadequate labeling on secondary containers which results in selection and delivery errors, i.e., the wrong product is delivered to the supermarket which increases potential for loss and damage; (4) excess air space in secondary containers making them more susceptible to crushing and subsequent product damage; (5) shipping container sizes that do not conform to the standard 48" x 40" pallet. This latter problems leads to product overhang and pallet loads that are far more vulnerable to damage.

A sampling of wholesaler and retailer discontent with current packaging as excerpted from Supermarketing magazine is presented below (24).

One wholesaler billing manufacturers for damage expenses is Red Owl (Minneapolis). Vice-president Neal Jansen has already billed three companies for extra expenses caused by poorly packaged merchandise.

Red Owl discussed possible packaging changes with all three companies before charging damage expenses. All three agreed to consider certain packaging changes. Until these changes are made, Red Owl reserved the right to bill for damage expenses.

Companies have always paid us for damages incurred during shipping, but they never took the responsibility for products damaged in our warehouse. If a product is too large, it may fall off pallets and damage other products. Who is going to pay us for cleaning up? Who is going to pay us for all the other products damaged during the fall?

We believe poor packaging is the number one damage-producer. If manufacturers refuse to change packaging, we feel that they should pay for their decision. We've been deducting about 10 percent on each bill. This policy will be continued until packaging is changed.

Gerald Blumenau, Vice-president, Bay City Milling & Grocer Co. (Bay City, Michigan) decided to drop one dog food item until its manufacturer agreed to review the packaging. The product was too large and was overhanging on our pallets. It would constantly fall down and bring other products down with it. We're paying someone \$6 an hour to clean up damaged products when he really could be doing something productive.

According to Joel Leavitt, Vice-president, Springfield Sugar & Products Co. (Windsor Locks, Connecticut), his firm loses \$250,000 every year in damaged products. The situation is getting out of hand. Many manufacturers don't have any real understanding of our economic losses suffered by damage. Package designers know that we use 48" x 40" pallets. Why do they still design products that overhang?

In the future, as mechanized materials handling systems become more prevalent, increased attention should be focused on the packaging issues. Mechanized systems may reduce human error, but they also reduce opportunities for human judgment. For instance, a mechanized system cannot see improperly glued case flaps, nor can it handle fragile paper-baled packages without excessive damage.

Mishandling by human beings is, of course, the proximate cause of much damage in the distribution sector. To some degree damage is inevitable. Harried warehouse or supermarket workers will seek the easiest way to perform their jobs

creating opportunities for mistakes and accidents; others may often be careless. Pressures exerted by the organization to increase productivity may also contribute to damages. On occasion, lack of knowledge and inadequate methods and/or equipment also may be causal factors. But, damage due to improper handling and stacking is often a symptom of personnel who lack the interest to perform tasks at acceptable standards.

Gary Droz, General Manager, King Distributors (Wyandotte, Michigan), believes that employees contribute much to product damage.

I had a delivery from a wholesaler I work with just last week. We were about fifth on this guy's route. When he came to our warehouse, the truck driver stopped short. Of course that was not very intelligent. Equally unintelligent was the fact that the driver had not rearranged his load after each delivery. Instead of equalizing his product, he just left everything in tall columns. As a result of not breaking down the load, all the soda pop in the truck fell off the large piles and broke all over the cigarettes. Another large damage claim had to be filed.

I definitely feel that wholesalers have to share the damage blame. Poorly trained employees can cause just as much damage as poorly-packaged merchandise (24).

Human nature is difficult to change, but many wholesalers and retailers have conducted successful programs to heighten employee awareness of damage control (23). Management awareness is also needed. Often employees are furnished equipment that tends to increase damage such as unadjustable case cutters, handtrucks with no stocking tray, lift trucks that are too small for the job, and so forth. In other instances the materials handling systems are set up poorly with conveyors or towlines at sharp angles, narrow slots in warehouses that fail to account for pallet overhang, and improper heights on shipping and receiving docks. Frequently, management is not fully aware of the losses problem. This is especially true when recordkeeping is not sufficiently detailed to permit the identification of problem areas.

LOSSES DURING TRANSPORTATION OPERATIONS --
MANUFACTURER TO DISTRIBUTION CENTER

Many dry grocery items are shipped at least part of the way through the distribution channels via rail. In some instances, however, truck transport may be used exclusively when the manufacturer is located near the wholesaler (usually within a 300-400 mile radius), when full rail carlots are impractical, or when the wholesaler has no rail spur and must receive by truck. As a rule, however, because of cost considerations most large wholesalers have rail access.

Truck Transport

Interstate Commerce Commission (ICC) data was used to derive figures for the average claim awarded per truckload. Even though ICC data did not contain information on private and contract trucking fleets, data from common carriers was assumed to be representative of overall dollar damages per truckload.

Analysis of 1973 to 1975 ICC data indicates that the average truckload sustained \$10.53 of claims. This is described in terms of major causes in Table 1.

Table 1. Truck Transport Claims -- Per Truckload

Claim	Total Claims	Claims
	(percent)	(dollars)
Visible Damage	46.8	4.93
Shortage	37.1	3.91
Delay, Heat, Cold, Water, Other	8.0	.84
Wreck and Catastrophe	4.2	.44
Concealed Damage	1.5	.16
Hijacking	1.4	.15
Theft and Pilferage	1.0	.10
Total	100.0	10.53

Source: See Appendix I and (9).

Of the \$10.53 average claim per truckload, \$6.37 or 60 percent was product damage. Shortage, hijacking, and theft claims of \$4.16 was an economic loss to the carrier and/or shipper, but not necessarily a loss in the available food supply. The food loss component of motor carrier claims represented approximately .5 cent per case shipped or about .065 percent of the product's wholesale value based on an average load of 1300 cases and wholesale value of \$7.65 per case.

Approximately 65 to 70 percent of all cases received at grocery warehouses arrived by truck. The "share of market" for motor carriers has increased steadily during the last twenty years, and may continue to do so. While claims figures do not appear to be excessively high, this may be misleading. Despite the vigilance of receiving inspectors, a great deal of the concealed damage is discovered later in the warehouse or at retail may have occurred in materials handling and transit operations earlier in the distribution channels.

The most important cause of losses in motor carrier shipment was improper loading and bracing. This included:

- Heavy letdown of product in both lift-truck and hand loading.
- Failure to evenly distribute weight.
- Lack of bracing.
- Failure to redistribute product on multiple-stop loads.

The problems of training and motivating loading dock workers and truck drivers are substantial. Yet, most controllable damage in truck transit apparently could be prevented by appropriate actions in these areas.

Rail Transport

In 1975, railroad losses and damage of dry grocery products was about \$47.2 million. The loss and damage categories are tabulated in Table 2 below. In some instances the rail losses figures commingled food products destined for reprocessing with products in final form -- for example, sugar and "grain mill

products". These categories were included since most of the products ultimately are destined for supermarket shelves.

Table 2. Rail Transport Losses and Damages, 1975

Item	Loss & Damage	Total
	(\$000)	(percent)
Canned or cured seafood	800.7	1.70
Canned specialties	251.1	.53
Canned fruits & vegetables	2,459.8	5.21
Pickled fruits & vegetables	408.6	.87
Mixed shipments canned goods	<u>1,793.9</u>	<u>3.80</u>
Subtotal:	5,714.1	12.10
Beer	2,993.1 ¹	6.34
Soft drinks	<u>75.7¹</u>	<u>.16</u>
Subtotal:	3,068.8	6.50
Grain mill products	20,829.5	44.13
Sugar, refined	<u>4,510.4</u>	<u>9.55</u>
Subtotal:	25,339.9	53.68
Miscellaneous food preparations	13,082.4	27.71
Total	47,205.2	100.00

Source: See Appendix II, (10) and (3).

¹This is a 1974 figure; 1975 data were not available.

Grain mill products and refined sugar accounted for over 53 percent of the total damage. Miscellaneous food preparations, which included such items as catsup, mayonnaise, mustard, salad dressing, spices, and other unclassified dry grocery items was the second most heavily damaged group with nearly 28 percent of the dollar damage. Canned fruits and vegetables, and mixed shipments of canned goods accounted for about 9 percent of damage.

Unfortunately, a large portion of dry grocery rail damage was officially classified as "improper handling -- all damage not otherwise provided for". However, the basic causes of rail losses and damages were: inferior packaging, poor loading, insufficient bracing and blocking, faulty equipment, water damage from improperly sealed cars, broken pins on bulkhead doors which permitted doors to swing into product, broken or poorly spaced side spacers, overheating from steel floors in hot weather, and improper car handling which covers situations where employees coupled loaded cars in excess of 4 mph. In addition, the Association of American Railroads (AAR) estimated that 21 percent of loss and damage claims were due to train accidents.

Some suggestions made by Hamilton for damage prevention during rail transportation include:

- Build more cars with cushioned underframes and end-of-car cushioning devices.
- Apply improved rise controllers.
- Place more cars in service with interior stowing devices.
- Supply specially equipped cars for specific loadings.
- Make greater use of impact recorders to determine problem areas.
- Use inflatable dunnage materials.
- Conduct studies of items susceptible to damage; and study loading activities (8).

In summary, losses during loading, transportation and unloading were frequently attributed to poor handling, which, as indicated, has many root causes. Generally, the more times goods are handled in the distribution channels, the greater is the possibility for loss and damage. Another important characteristic of damage losses incurred during the initial transportation phases is that it frequently goes undetected until later in the distribution processes. This is the

case because much of the damage is within secondary containers and is not visible until products are removed for display in supermarkets.

LOSSES DURING WHOLESALING OPERATIONS

Although physical layouts, equipment, and work procedures vary, all distribution centers share common functions: receiving of merchandise from truck and rail, transport to storage area, selection of retail orders, replenishment of picking slots, and shipment to retail stores.

Causes of Losses and Suggestions for Prevention

Two comprehensive studies of warehouse damage appear in recent literature. A 1964 USDA study (27) collected information from employees in three warehouses for periods ranging from two to four months. The study attempted to measure causes of damage -- by container type and extent of damage. The second study, a 1975 National American Wholesale Grocers Association (NAWGA) research report (14) collected data from seven distribution centers over a period of four months. The NAWGA study had a case movement sample equal to about four times that of the USDA study. However, the NAWGA breakdown of causes for damage was not as detailed as in the USDA study. A complete, weighted average ranking of damage causes is given in Appendix III. A summary of this data is presented below in Table 3. Due to the larger sample size and because it is more recent, the NAWGA results were weighted 70 percent and those of USDA 30 percent.

The term "Other" appearing in Table 3 includes damage from unidentified sources, damage peculiar to unique operations, miscellaneous, wet cases, opened cases, and damage in transit. Additional causes of damage in order of importance were: Pallet overhang when putting into storage, fell off moving equipment, stacking collapsed, fell off load entering shipping truck, fell off selection vehicle, dropped by loader in shipping truck, fell on receiving dock, and hit while on moving equipment.

Table 3. Causes of Product Damage: Percentages of Total Damage

Cause	NAWGA ¹	USDA ¹	Weighted ¹ Average
Fell or bumped from slot	20.5	20.3	20.4
Dropped by selector	11.0	11.3	11.1
Hit in slot by equipment (tines on lift truck)	10.3	10.1	10.2
Fell during letdown	11.0	5.8	9.4
Fell in slot filling	7.5	2.5	6.0
Nails and splinters in pallets	2.4	11.0	5.0
Hit in aisle by equipment	5.9	2.5	4.9
Unglued case	6.7	--	4.7
Crushed by weight above	2.4	1.2	2.0
"Other"	21.5	33.3	25.1

Source: See Appendix III, (14) and (27).

¹Column totals do not equal 100% due to rounding.

Descriptions of some major "cause" categories are as follows.

Fell or Bumped from Slot. Two factors that are related to packaging damage are containers with slick surfaces and those with no fixed shape, such as dog food packages. In these latter types of packages, normal settling of package contents can cause them to fall. Also, failure to provide enough space between rack uprights and pallets makes it difficult for the lift truck driver to avoid accidents. Falling and bumped merchandise often sets off mini-chain reactions, causing further damage. Some operators have installed drive-in racks, solid rack linings, and stack covers to help prevent this kind of damage.

If a selection line consists of two picking levels, employees are tempted to "nudge" second-level merchandise as an alternative to climbing into the slot. On occasion an employee will fail to catch a case once it falls. Two preventive measures are: (1) assign glass-packed items to floor-level slots, and (2) provide small steps on uprights so that order selectors can more easily reach into upper slots.

Cases Dropped by Selector. Cases tend to be dropped as a result of selecting cases from the sides of pallet cubes, rather than from the top. Such a practice causes a "honey-combing" effect for interlocking pallet patterns when support for higher cases is removed. Cases dropped into selection vehicles is a similar cause of damage.

Cases Hit in Slot by Equipment (damaged by tines of lift trucks). Lift operators may incorrectly perceive depth between truck forks and pallets on upper racks. Lift truck masts should be marked in correspondence with rack levels so that operators can see when the forks are at the correct heights. Also, eye examinations for lift truck operators may be a valuable pre-employment screening device.

Fell During Letdown. Cases fall during letdown when lift truck operators commit errors, when slots are too narrow to accommodate pallet overhang, and when merchandise is improperly stacked on pallets. The top tiers of a pallet of light weight cases may shift during transportation, overhang pallet cube, collide with other merchandise, and subsequently fall. Pallet cubes built without an interlocking pattern also are likely to fall during letdown. The USDA study recommended:

Allow for proper clearance between pallets in floor slot areas. Four inches between pallets is advised. Painted or taped yellow guidelines should be placed to indicate clearly where palletized merchandise should be letdown.

Stack cases in square stacks on pallets if the dimensions of the cases prevent interlocking without excessive overhang. The top tiers should be taped if cases have a tendency to slide (27).

Fell in Slot Filling. Merchandise may fall while being maneuvered into storage due to inadequate stacking, or by a careless swing with the lift truck. Preventive measures are basically the same as those for "fell during letdown".

Nails and Splinters. The older and more worn the pallet, the greater is the likelihood of damage done to products packaged in paper bags and paper boxes. A

solution is to use a pallet covering material such as plywood under merchandise susceptible to such damage. A regular program of pallet maintenance also should be instituted.

Hit in Aisle by Equipment. Damage can be caused by lift trucks backing into merchandise, errant selection carts, and merchandise erroneously left stacked in aisles. Damage can be reduced by exercising greater care in equipment handling, and by prohibiting the stacking of merchandise beyond lane markings.

Unglued Cases. In conventional warehouses damage may occur when selectors or loaders place merchandise "wrong side up," or for other reasons cases become unglued. However, this problem is far more severe in mechanized warehouses that use vacuum suction depalletizers to lift entire tiers from pallet cubes.

A number of the preceding causes for damage in the distribution center often are related to congested warehouse conditions. Constricted space creates increased opportunities for damage resulting from hitting, tearing, dropping, and similar types of physical abuse. Crowded conditions, themselves, are frequently a result of the need to fully utilize space, and to operate facilities at high levels of capacity. Unfortunately, the tradeoff is often increased damage.

Warehouse Damage by Primary Container Types

In addition to the NAWGA and USDA studies, O'Connor and Leed at the University of Massachusetts also analyzed damage related to specific classes of commodities and package types, such as paperboard boxes, paper bales, cans, glasspack, bottles, and other (16).

Although the University of Massachusetts and USDA studies concurred on the relative ranking of damage among different package types, the measurement of damage frequency varied greatly between the two studies. These differences were attributed to the research methodology; each study examined only one warehouse in terms

of damage by commodity and package types. Thus, substantial variation in the frequency of damage might be anticipated.

Items packaged in paper bales are the most damage-prone. In the NAWGA study, paper bales accounted for 33 percent of all damage even though baled items are a small percentage of total warehouse movement. O'Connor and Leed found that damage to paper and cellophane bags was twice the average damage incurred by all package types.

Additionally, in both the O'Connor and Leed, and USDA studies, bagged items such as flour, salt, charcoal, sugar and dog food were the most heavily damaged items per thousand cases shipped. Bagged items accounted for 35 percent of total warehouse damage. NAWGA data, contained in Table 4, also shows that disproportionate losses are incurred by bagged merchandise in comparison to all other types of packaging. For example, in all instances of products damaged by being "hit in slot by equipment," 43 percent of the products were bagged items, whereas 57 percent were in other types of packaging.

Table 4. Causes of Damage to Bagged Items

Cause	Damage to Bagged Items	Damage to All Other Items
	(percent)	(percent)
Hit in slot by equipment	43	57
Fell in slot filling	42	58
Hit in aisle by equipment	39	61
Pallet overhand	40	60
Dropped by selector to floor	53	47
Pallet nails, splinters	91	9
Hit by load entering truck	77	23
Hit on dock by equipment	37	63

Source: See (14).

O'Connor and Leed found plastic containers to be the next most damage-prone form of primary packaging. The major sources of damage to these items were: crushed by weight above, stack collapsed, and case unglued. Secondary containers for plastic items are often susceptible to moisture retention from condensation which contributes to the reduction of structural integrity. Loose caps also are a problem, particularly with respect to vinegar and flavored beverage products.

Glass-packed items such as pickles, mayonnaise, and condiments sustain disproportionately large damage from the damage causes shown in Table 5.

Table 5. Causes of Damage to Glass-Packed Items

Cause	Damage to Glass-Packed Items	Damage to Other Items
	(percent)	(percent)
Fell off moving equipment	38	62
Fell on receiving dock	40	60
Hit while on moving equipment	49	51
Fell off load entering truck	49	51
Fell off selection vehicle	48	52
Dropped by selector	52	48
Dropped by loader	63	37
Case unglued	55	45

Source: See (14).

Improved secondary containers and more careful handling would help to reduce these damages. However, it is not known what additional packaging cost to protect glass-packed items could be justified by attendant loss reduction. Economic analysis is necessary to provide an answer to this question.

Items packaged in primary paper box containers account for 18 percent of all warehouse damage. Major causes of damage are: crushed by weight from above, and hit in aisle by equipment.

Cans are the most resistant to warehouse damage, but because they comprise such a large proportion of warehouse movement, they account for 26 percent of total

damage. The major causes of damage to canned food are: fell off load entering truck, fell during letdown, case unglued, hit while on moving equipment and fell or bumped from slot.

Delivery Losses -- Distribution Center Supermarket

Throughout the grocery distribution system reduced handling generally results in less product damage and loss. The move from individual case handling to palletization, use of slipsheets and other forms of unitization are indicative of this fundamental fact. Many wholesalers are attempting to make even greater use of standard pallets of product -- in some instances mixed product pallet loads -- for shipment to supermarkets. In so doing, reduced handling and/or handling in a more controlled environment has reduced damage. A number of Midwestern retailers are expanding their delivery of palletized and unitized product to supermarkets through the consolidation and unitization of items previously delivered to stores by many individual vendors in smaller, more damage-prone quantities. In some instances, a relatively large vendor may perform the consolidation, unitization and store delivery functions. In other instances, vendors make large shipments to a wholesaler's distribution center where the wholesaler in turn assembles and palletizes products from many vendors for a single delivery to the store.

Research reported by NAWGA and USDA concerning damage occurring during delivery to supermarkets differ sharply. USDA reported only .083 cases damaged per thousand shipped; whereas NAWGA reported 1.03. This large difference in research findings may be explained by sample size. The USDA study covered only those shipments made from a single distribution center; while the NAWGA study included the damage experience of shipments made from seven distribution centers.

The USDA study identified a number of products that were damaged during delivery. The major products are shown in Table 6.

Table 6. Products Damaged in Transit -- Distribution Centers to Supermarkets (proportion of all delivery damage)

Product	Damage (percent)
Bagged flour	35.5
Bagged salt	20.7
Bottled items	12.4
Items in jars	10.1
Canned items	8.3
Other items	13.0

Source: See (27).

In the NAWGA study, bagged and glass-packed items each accounted for 31 percent of delivery damage, and paper boxes and canned items each accounted for 17 percent of delivery damage.

The causes of transit damage as identified by NAWGA are shown in Table 7.

Table 7. Causes of Damage in Transit -- Distribution Centers to Supermarkets (proportion of all delivery damage)

Cause	Damage (percent)
Damaged in transit	55.0
Fell off unloading equipment	20.0
Dropped while unloading	8.3
Other	16.7

Source: See (14).

Also, damage of .69 cases per thousand was discovered in the store after delivery. Causes for this damage, and the origin of the damage, is not known because it is not until cases are opened that such losses are encountered. Intensive research of these "hidden" or "phantom" losses is needed. Retail store managers accepted responsibility for about 78 percent of such damaged merchandise with credit given by the organization for the remaining 22 percent. This

experience would vary, depending on individual company policies and the nature of the relationship between the wholesaling functions and the supermarket; i.e., chain, voluntary, co-op, and unaffiliated independent organizations.

Economic Losses Associated with the Wholesaling Operations

The previous two sections concentrated on the sources, causes, and nature of damage in warehousing activities and delivery. Here, the concern is focused on the relative frequency of damage, dollar amounts of inventory loss, costs of recouping damaged goods, and various indirect costs.

The NAWGA and USDA studies agreed on the overall frequency of warehouse damage per 1,000 cases shipped. The USDA damage rate was reported as 1.51 cases per thousand; and the NAWGA rate was 1.53. Given the large sample size of each study, this similarity of findings would seem to be reassuring. However, in terms of wholesale value lost due to damage during wholesaling activities, the two studies differed. In a sample of 226 cases damaged in the warehouse, the USDA study estimated a 25 percent loss of wholesale value per case. On the other hand, the NAWGA study estimated value lost at about 34 percent. However, the NAWGA study covered all wholesaling functions -- receiving, storage, selection, shipping, and delivery; whereas the USDA study did not include the delivery function.

Both USDA and NAWGA researched the costs of operating salvage rooms. About 40 percent of all damaged merchandise dealt with by wholesalers in the two studies was processed in recoup rooms. The USDA study used a time-and-motion technique, which when 1977 wage costs of \$7.80 per hour were applied led to an estimated recoup labor cost of \$0.85 per case. NAWGA's estimate for recoup labor costs was \$1.30 per case. The difference may be due to the USDA study's assumption of constant production by employees at work stations, while the NAWGA study made allowances for slack time. Using the NAWGA data, it is concluded that labor costs of the recoup

room were equivalent to a 17 percent loss of the overall wholesale value of the total number of damaged cases.

In addition to wholesale inventory value losses and recoup room labor costs, indirect costs added significantly to the total cost of damage. Some of the more important indirect costs were: checking for damage during receiving, damage clean up, on-the-spot recoup, credit memos, supervisory time, and lost time for employees either causing or finding damage and accounting for damage. NAWGA's figures indicated that indirect costs may be equivalent to a 9 percent loss in wholesale value per damaged case. Total costs of damage occurring during wholesaling operations was about \$9.04 per 1,000 cases shipped.

Using NAWGA damage rate figures and an estimated movement of 3.6 billion cases per year, annual inventory losses in the wholesaling functions were about 2.0 million cases; equal to about .055 percent of U.S. case movement which entered the distribution system. Similar calculations using USDA damage rates led to annual case losses of 1.4 million cases, or about 0.04 percent of U.S. case movement.

LOSSES DURING SUPERMARKETING OPERATIONS

The 1964 USDA study estimated damage losses from dry grocery goods scrapped or sold at less than regular retail prices at .089 percent of grocery sales. Spoilage loss was estimated at 0.17 percent of sales. Spoilage consisted of swollen cans, discolored glass-packed items, deteriorated candy, and customer returns of already opened products. Store-level recoup labor was estimated at .014 percent of dry grocery sales. This estimate included time required to sweep, mop up, and otherwise handle damaged items; however, it did not include employee time to move from the normal work station to the maintenance closet, to the site of damage and so forth.

Combining the estimates of food losses in supermarkets led to a retail physical losses calculation of approximately .106 percent of retail volume. When

applied to estimated 1977 retail dry grocery movement of 3.6 billion cases, damages were about 3.82 million cases or \$37.05 million per year.* An estimate of the direct costs of retail dollar damage requires the addition of recoup labor costs and total approximately .12 percent of retail dry grocery sales.

Causes of Losses and Suggestions for Prevention

The USDA study identified ten causes for damage common to all five supermarkets included in its study. These causes and their relative importance are indicated in Table 8. Several important causes of retail damage and associated preventive measures are discussed next.

Table 8. Causes for Damage in Supermarkets¹
(proportion of all damage)

Causes	Damage (percent)
Carton damaged by cutter blade during cutting of case	19.3
Dropped by customer	10.2
Fell off shelf when disturbed by customer	9.4
Unit dropped during stocking of shelf	6.4
Stack fell over in backroom	4.1
Merchandise crushed in stack	3.0
Broken or crushed in shopping cart	2.9
Dropped by customer unloading shopping cart	2.8
Units fell out of open or torn shipping container	2.1
Dropped case while taking it from stock	1.8
Other causes not common to all surveyed stores	33.0

Source: See (27).

¹Exclusive of spoilage, missing labels, and concealed damage.

Dropped by Customers. Items dropped by customers and items falling off shelves when disturbed by customers may be related to several factors: (1) customer carelessness, (2) poor display building and stocking techniques which

*Based upon \$35.1 billion in sales (7), and \$9.75 per case.

contribute to customer damage, and (3) lack of store and equipment planning designed to reduce damage. Common sense stocking procedures include: (1) not allowing glass-packed merchandise to overhang the shelf; (2) using cardboard dividers between layers of double-stacked glass-packed items. This is especially important on lower shelves where merchandise may be struck by shopping carts, or disturbed by children; and (3) not storing leftover jars on their sides or top of tiers since the jars may shift position and fall when the upright supporting jars are removed by customers.

Dropped During the Stocking of Shelves. This cause of damage can be reduced by providing employees with a convenient case support to be used while stocking shelves from the case. Also when the prescribed number of facings is not maintained, employees may drop items as they make room for newly arrived merchandise.

Backroom Storage. Inadequate case stacking practices (e.g., bottom case of marshmallows supporting eight cases of 46-ounce juice drink -- "leaning towers") can be prevented through a combination of training and the motivation to apply common sense. In an industry characterized by high-employee turnover and about 50 percent part-time personnel, the teaching of basic "acceptable operating practices" is a continuous need. Moreover, backrooms should be arranged with designated places for storing different commodities, and maintained in an orderly fashion.

Broken in Shopping Cart. Customer carelessness is difficult to prevent, but it can be mitigated by placing fragile items near the end of the shopping pattern.

Torn or Open Shipping Containers. The tearing of baled merchandise on gravity feed conveyor systems can be prevented by placing the bale on some other sturdy case. Also, baled merchandise is often susceptible to moisture and water damage if it is stored directly on backroom floors.

Missing Labels. Poorly glued labels is another cause for economic loss, but not a loss in food volume. If the contents of the item are known, it may be possible to "cannibalize" half of the label from another unit. Otherwise, the item must be marked down drastically for sale, or given to charity.

Much of the damage to dry groceries in supermarkets appears symptomatic of a serious industry problem -- lack of management's developing and retaining employees who are motivated and sufficiently trained. Damage savings is but one of many benefits from an effective employee training and relations program (23).

Damage-Prone Items. Appendices IV-IX list the causes and amounts of damage to grocery items by primary container type in five supermarkets studied by USDA. Note that this compilation suffers from a volume bias, in that larger selling products reflect the most damage. Concealed damage is the largest category. Certainly, some of this damage happens in the supermarket, but much of it probably occurs in handling during distribution center and transportation activities.

SUMMARY AND CONCLUSIONS

The process used for estimating total dry grocery damage involved the summation of losses in the following activities:

- Losses in truck transportation and handling -- manufacturers to food distribution centers.
- Losses in rail transportation and handling -- manufacturers to food distribution centers.
- Losses in the wholesaling functions -- receiving, storage, selection, shipping, and delivery.
- Losses in supermarket operations.

This summation provided broad estimates of total dry grocery dollar and physical volume losses encountered in the "sold through supermarkets" segment of the food distribution system.

In Table 9, "concealed or hidden damage" has been attributed to the point where it was encountered rather than attempting to allocate the damage back to its source of origin.

Table 9. Estimated 1977 Dry Grocery Losses in the Distribution System¹

Distribution Activity	Losses ² (percent)	Losses in Case Equivalents (millions)	Value of Losses ³ (millions of dollars)
Transportation ⁴	.221	8.0	61.20
Truck	.044	1.6	12.24
Rail	.177	6.4	48.96
Wholesaling	.055	2.0	15.30
Retailing	.105	3.8	37.05
Systems Losses	.382	13.8	113.55

¹Losses cited are estimated values of physical quantities of food lost for human consumption. Costs of recoup, salvage operations and numerous indirect costs associated with losses and damage are not included.

²Percentages based upon 3613.8 million cases entering the distribution system and the case losses incurred in each distribution phase.

³Based upon values of \$7.65 per case in transportation and wholesaling activities, and \$9.75 per case at retail.

⁴Transportation from the manufacturer to wholesaler was assumed to be 33 percent by rail, and 67 percent by truck. Loss rates based upon 1973 to 1975 data.

Post-packaging losses of dry groceries as a percent of total sales do not appear to be as significant as losses measured in the perishable products categories, especially fresh beef and produce. As a percentage of items handled it does not appear that losses are exceptionally high. Indeed, when viewed as a percentage, it might be said that losses are relatively small. However, because the total dry grocery category is so large, in absolute physical volume, the

economic importance of minimizing losses should not be underestimated. This is especially so in light of the fact that the achievement of loss reduction is within the capability of many organizations.

It is important to realize the limitations of the estimates set forth in this report. First, it should be noted that the loss estimates are presented as average figures; in fact, there is substantial variation in losses from firm to firm. Second, though aggregate U.S. dollar losses are large, it must be noted that by comparison individual incidents of losses in dry groceries are small. Whereas the aggregate systems-wide losses are estimated to be approximately \$114 million, the majority of individual loss situations would probably be measured in cents! In part, because individual losses tend to be small, and also because they occur in hundreds of thousands of trucks, distribution centers, and supermarkets across the nation, it is unlikely that losses can be significantly reduced by single or simplistic actions.

The causes of damage and traditional solutions generally are well known. This study revealed that human error, equipment inadequacy, and poor packaging were frequently the major sources of problems. In terms of solving these problems, materials handling equipment is continually being redesigned for improved efficiency. With regard to reducing human error, successful programs have been conducted and lend credence to the belief that such problems can be resolved through the combined attention of manufacturers, transporters, wholesalers, retailers, and organized labor.

Inadequate packaging as a cause of damage, however, poses a different kind of issue. In general, products are priced to reflect costs incurred. This system should provide manufacturers with the economic incentive to reduce damage to their products. But since allowances and cash refunds granted sometimes cover only 15 to 20 percent of the total cost of damage borne by retailers (24), manufacturers may

lack incentive to improve packaging to the extent warranted. In some instances the economic signals being transmitted through the system back to manufacturers appear to be providing incomplete information, and in this situation there is a lack of pressure to resolve the issue of sizeable losses.

It should be noted that manufacturers' awareness of packaging problems is increasing, but apparently not as rapidly as many shippers, wholesalers, and retailers would like. Examples of positive action that has been taken by some companies are as follows:

- The Carnation Company has instituted a three-phase program to reduce food losses by means of improved packaging and shipping designs. The first phase involved the analysis of internal data and communications with warehouse managers to identify problem areas. Second, causes for major problems were determined; and the third phase focused on the implementation of remedies.
- In order to help reduce damages in shipping to distribution centers, General Mills has begun using a clear stretch film which is wrapped around the sides of flour before the cube is loaded on a pallet or slipsheet.
- Pillsbury employed a polypropelene shrink net to surround loaded pallets thus enabling bales of flour to remain intact during shipment. Pillsbury estimated that damage claims have been reduced by as much as 80 percent as a direct result of this improvement.
- Ralston Purina currently is testing a redesign of its 50 pound pet food bags into a more rectangular shape. The objective is to prevent the package from sliding off the pallet, and to create a stacking pattern which more nearly conforms to the 48" x 40" standard size (21).

Other packaging development needs include secondary container designs of modular sizes suitable for the 48" x 40" pallet so as to eliminate pallet overhang.

Pallet overhang has been cited as a major problem by several distribution center managers. Although a complex and ambitious task, modularization of secondary shipping containers would facilitate stable mixed product stacking, a giant step toward the reduction of losses and overall efficiency improvement. One Midwestern retailer stated that dry grocery losses would be halved if secondary containers were modularized.

The difficulty of assembling stable loads of palletized product as a major cause of damage appears to have its origin where carts and pallets are loaded for delivery to stores. Damage occurs during loading, continues in transportation to the supermarket, and during unloading -- all due to instability of the loaded pallets and carts. Modularization of secondary cartons also would facilitate the use of more standard mixed product pallet loads for store delivery. Such shipments would reduce handling costs and losses. Also, in the long run it seems clear that mechanized materials handling equipment cannot achieve its full potential without modularization of secondary containers.

Finally, there is the need for performance rated packaging. At the present time many handling and storage procedures are developed on a product-by-product, trial-and-error basis. Packaging should be rated for weight loads under specified conditions of temperature, humidity, stacking patterns, and other important criteria.

In terms of achieving major breakthroughs such as modularization of secondary containers and the performance rating of packaging, industry-wide efforts will be essential. These are not the kinds of changes that single firms or small groups of firms can accomplish alone. The tasks will be long and difficult, but results seem certain to be worth the effort. Organizations such as the Food Marketing Institute, National American Wholesale Grocers Association, Grocery Manufacturers Association, and U. S. Department of Agriculture or other governmental agencies may

need to collaborate. Major universities and consulting organizations also may find a helpful role in this coordinated effort, as was the case in developing the Universal Product Code project.

If it were decided that a program of performance ratings for packaging was needed, an independent institute might be established to set guidelines and to conduct performance appraisals. Resolving packaging problems on the present ad hoc basis seems wasteful and inefficient. Human error has been cited as the "first line" cause for damage in dry grocery distribution. It is probable that if companies achieved higher levels of training and generally improved management that losses will be significantly reduced. Moreover, if the latest available knowledge of sound handling practices and technology were implemented, losses might be further reduced. Thus, both improvement in management and technology adoption are important factors. It is likely that, not only would losses be reduced, but necessary changes in attitudes and practices would, in turn, result in still other seemingly unassociated benefits. Such secondary benefits are those that accrue to organizations which reflect improved motivation, self-discipline, and a continuing attitude of searching for better ways. Of course, the development of such benefits and their ultimate impacts on total organization performance are difficult to forecast with precision. However, it seems reasonable they would be extremely useful to any firm that could achieve them.

The final portion of this report presents three separate summaries. The first summary lists major causal factors for dry grocery losses occurring during distribution. This list identifies and generalizes the causes for losses at a basic level. The letters in parentheses to the right of each factor in the summary provide a coding system. The codes are used along with the specific causes for losses which are listed next.

The second summary identifies specific causes for losses in the contexts of the phases and functions of the distribution system. The major causal factor codes indicate the related, underlying causes.

The third summary provides a preliminary list of potential remedies for product loss reductions. It is not intended to indicate that such remedies are either technologically or economically feasible, but only that there are numerous opportunities which warrant careful consideration and analysis, and indeed, this is the initial requisite step in reducing losses and improving the effectiveness of the food distribution system.

Major Causal Factors for Dry Grocery Losses

- Handling (H)
- Packaging materials and processes (P)

Specific Causes for Dry Grocery Losses

- During transportation -- manufacturer to wholesaler
 - * Product damaged during loading and unloading (H)
 - * Failure to redistribute merchandise during multiple stop truck transit (H)
 - * Inadequate rail equipment and dunnage materials (H)
 - * In transit shifting of load due to inadequate stacking or lack of bracing (H)
- During Wholesale operations
 - * Product damaged in handling (H)
 - Receiving and shipping dock
 - Movement to storage area
 - Storage area
 - Selection, assembly and loading for shipment to supermarkets

- * Inadequate designs for materials handling systems in distribution centers (H)
- * Packaging materials and processes do not provide reasonable protection under normal handling and storage conditions (P)
 - Excessive air space in secondary containers
 - Unglued flaps
 - Lack of integral strength
 - Size does not conform with 48" x 40" pallet base
 - Bagged items
- * Inadequately labeled packages increase potential for losses (P)
- * Failure to redistribute loads on multiple stop deliveries (H)
- During supermarket operations
 - * Product damaged during handling (H)
 - Unloading of delivery trucks
 - Temporary storage in backroom
 - Stacking on stocking carts
 - Movement to selling area
 - Opening of secondary containers
 - Stocking shelves
 - * Product damaged during consumer purchase activities (H)
 - Dropped by customer
 - Fell off shelf when disturbed by customer
 - Crushed in shopping cart

Remedies for Losses of Dry Groceries

- Improved handling
 - * Improved professional management
 - * Management awareness of losses issues

- * Upgrade employee training
- * Improve materials handling systems
- * Upgrade rail equipment
- * Use of inflatable dunnage materials
- * Impact recorders to identify problem areas in transportation -- especially rail
- * Increase in use of unitization of product in shipping and handling -- including standard mixed loads to supermarkets
- * Consolidation of direct store deliveries
- Improved packaging
 - * Performance rated packaging materials and processes to accommodate reasonable handling practices and conditions
 - * Development of a program for modular secondary containers

Appendix I

ICC Motor Carrier Damage Claims by Quarters
Line 203 - Food: Canned, Dried, Preserved, Pickled

Causes of Damage	1st 1975	4th 1974	3rd 1974	2nd 1974	1st 1974	4th 1973	3rd 1973	Average Claims Per Quarter	Damage per Truckload
Total Dollar Claims	1,229,732	1,328,239	1,133,259	1,478,073	1,045,965	1,133,833	919,255	1,181,194	\$10.53
Shortage % of Total	452,407 36.8%	531,612 44.6%	433,014 38.2%	507,916 34.4%	400,283 38.3%	420,780 37.1%	322,802 35.1%	438,402 37.1%	3.91
Theft & Pilferage % of Total	13,918 1.1%	10,935 .92%	6,005 .53%	33,460 2.3%	7,735 .74%	5,409 .48%	2,086 .23%	11,364 .96%	.10
Hijacking % of Total	81,927 6.7%	475 .04%	360 .032%	0 --	63 --	57 --	35,022 3.8%	16,843 1.4%	.15
Concealed Damage % of Total	22,753 1.9%	15,576 1.3%	16,446 1.5%	12,638 .86%	13,110 1.3%	22,106 1.9%	20,007 2.2%	17,520 1.5%	.16
Visible Damage % of Total	502,815 40.1%	528,625 44.4%	561,627 50.0%	776,667 52.5%	481,610 46.0%	562,057 49.6%	459,356 50.0%	553,301 46.8%	4.93
Wreck & Catastrophe % of Total	99,255 8.1%	24,078 2.0%	32,521 2.9%	50,642 3.4%	67,843 6.5%	44,411 3.9%	28,793 3.1%	49,649 4.2%	.44
Delay, Heat, Cold Water % of Total	56,655 4.6%	216,938 18.2%	83,285 7.3%	96,750 6.7%	75,321 7.2%	78,213 6.9%	51,189 5.6%	94,179 8.0%	.84

Source: See (9).

Appendix II

Loss and Damage (L & D) to Dry Grocery Products Shipped by Rail (000) omitted except for per car figures

Code ICC	Item Description	1975		1974		1973		1972		1971		1970		1969		1968		1967		1977 ¹ (projected)		Percent of Total
		Total L & D	L & D per car ²	Total L & D	L & D per car	Total L & D	L & D per car	Total L & D	L & D per car	Total L & D	L & D per car	Total L & D	L & D per car	Total L & D	L & D per car	Total L & D	L & D per car	Total L & D	L & D per car	Total L & D	L & D per car	
2031	Canned or Cured Seafood	800.7		736.3	124.69	663.7	103.30	765.5	100.69	550.4	374.06	520.5	72.37	536.1	67.59	468.6	54.38	393.6	47.47	897.1	149.14	1.95
2032	Canned Specialties	251.1		198.7	26.80	158.2	22.10	132.0	15.70	289.5	32.11	281.9	30.10	256.2	22.41	200.7	14.17	189.0	12.42	207.1	31.43	0.45
2033	Canned Fruits and Vegetables	2459.8		2110.7	27.26	1905.0	24.09	2191.6	25.78	2146.5	23.74	2139.1	22.17	2445.6	25.18	1869.5	19.47	1850.5	19.71	2337.5	29.56	5.07
2035	Pickled Fruits and Vegetables	408.6		330.9	29.32	378.0	32.50	367.4	25.62	368.5	24.10	283.3	16.90	372.8	23.35	313.3	19.43	270.4	18.19	413.7	35.85	0.90
2039	Mixed Shipments Canned Goods Subtotal ³	1793.9 5714.1		1565.6 4942.2	36.10 33.99	1480.3 4585.2	30.96 30.74	1811.0 5267.5	37.62 32.22	1591.7 4948.6	33.99 29.28	1084.0 4308.8	36.05 23.98	1915.9 5526.8	46.64 31.85	1937.4 4789.5	17.74 19.62	1166.7 3970.2	12.05 18.90	1719.0 5574.4	35.78 39.94	3.73 12.10
2082	Beer	2993.1		2446.5	15.45	1807.4	12.14	1851.6	13.67	2447.2	18.65	2408.5	17.52	2281.9	15.85	2087.7	14.55	2212.1	15.84	2551.2	13.89	5.54
2086	Soft Drinks	N.A.		75.7	26.18	86.6	32.48	62.5	21.79	56.5	19.15	52.1	16.65	52.9	13.31	16.1	5.48	23.2	5.27	63.7	41.47	0.13
	Subtotal ³	2993.1		2522.2	15.64	1894.0	12.50	1914.1	13.84	2503.7	18.66	2460.6	17.51	2334.8	15.78	2103.8	14.37	2335.3	15.51	2614.9	14.46	5.67
2040	Grain Mill Products ⁴	20829.5		20913.4	20.92	14299.4	14.07	13286.7	13.15	14812.8	14.60	13656.3	12.88	13866.5	12.69	12020.4	11.10	11799.5	10.69	21383.4	20.69	46.41
2062	Sugar, Refined Subtotal ³	4510.4 25339.9		2833.3 23746.7	35.84 22.01	1795.1 16094.5	22.10 14.67	1875.3 15162.0	22.08 13.84	2531.9 17344.7	30.39 15.80	2264.9 15921.2	25.29 13.85	3125.7 16992.2	31.62 14.37	2491.0 14511.4	24.62 12.26	2515.0 14314.5	25.81 11.91	3256.0 24639.4	29.85 21.27	7.07 53.48
2090	Misc. Food Preparations	13082.4		12818.3	24.39	9287.6	17.29	9552.6	17.61	10331.1	18.87	10496.6	18.80	9343.7	16.82	8062.0	16.33	8741.4	17.20	13248.3	22.86	28.75
	TOTAL ³	47129.5		44029.4	22.65	31861.3	16.43	31896.2	16.44	35076.1	18.03	33187.2	16.36	34197.3	16.82	29470.7	14.25	29161.4	14.90	46070.7	24.44	100.00

Source: See (3) and (10).

¹Calculated by linear regression. Based upon 1967 to 1975 data.

²Not available

³Subtotals and totals for L & D per car were estimated in order to account for variable product weightings.

⁴About 45 percent of the damage is to "flour" and "prepared flour."

Appendix III

Summary of NAWGA (1975) and USDA (1964) Warehouse Damage Studies
(Causes of Product Damage as a Percent of Product Damage)¹

CAUSE	NAWGA	USDA	Weighted ² Average
FELL OR BUMPED FROM SLOT	20.5	20.3	20.4
fell off pallet-slick surface on case		0.6	
damaged during removal from second rack slot		6.0	
fell off rack		0.1	
hit rack-putting into storage		1.6	
hit by pallet being lowered from rack above		3.0	
damaged in rack (done in filling)		9.0	
FELL DURING LETDOWN	11.0	5.8	9.4
bad letdown-narrow slot		4.3	
bad letdown-poorly stacked merchandise		1.5	
HIT IN SLOT BY EQUIPMENT	10.3	10.1	10.2
damaged by lines of lift truck		10.1	
FELL IN SLOT FILLING	7.5	2.5	6.0
fell while being maneuvered into storage		2.0	
bad swing into slot-putting into storage		0.5	
CASE UNGLUED	6.7	--	4.7
HIT IN AISLE BY EQUIPMENT	5.9	2.5	4.9
fork lift backed into merchandise		1.7	
rammed into by hitch or lift truck		0.2	
rammed into by tractor or lift truck		0.6	
CRUSHED BY WEIGHT ABOVE	2.4	1.2	2.0
merchandise stacked too high		1.1	
stacked too high-crushed		0.1	
PALLET OVERHANG	1.6	3.1	2.1
narrow slot-putting into storage		1.5	
cases overhanging pallet edge-putting in storage		1.6	
FELL OFF MOVING EQUIPMENT	1.6	2.5	1.9
fell off pallet when engaged by lift truck		0.6	
fell off pallet-jerky clutch in lift truck		0.4	
fell off pallet in aisle from dock to storage		1.0	
fell off pallet cornering from dock to storage		0.5	
STACK COLLAPSED	1.2	3.4	1.9
damaged during palletizing-poor shipping container		0.8	
stack fell over-weak container		1.5	
leaning stack		1.0	
stack fell over		0.1	

Appendix III (Continued)

CAUSE	NAWGA	USDA	Weighted Average ²
FELL ON RECEIVING DOCK fell off pallet from car to dock	.8	<u>1.2</u> 1.2	.9
HIT WHILE ON MOVING EQUIPMENT	.8	--	.6
DROPPED BY SELECTOR TO FLOOR dropped in aisle	11.0	<u>11.3</u> 11.3	11.1
PALLET NAILS, SPLINTERS nails in pallet	2.4	<u>11.0</u> 11.0	5.0
HIT BY LOAD ENTERING TRUCK stack fell over in trailer during loading	1.2	<u>1.0</u> 1.0	1.1
FELL OFF LOAD ENTERING TRUCK fell off while selector truck pushed into trailer hit top of trailer-stacked too high	1.2	<u>2.9</u> 2.5 0.4	1.7
FELL OFF SELECTION VEHICLE fell off selector truck-towline removal fell off selector truck on shipping dock fell off train rounding corner fell off selector truck fell off towline-bad wheels on selector truck fell off truck while being hooked to towline fell off train after towline collision	1.2	<u>2.2</u> 0.2 0.4 0.2 0.1 -- 1.2 0.1	1.5
DROPPED BY SELECTOR TO CART set down too hard on selector truck	.8	<u>2.2</u> 2.2	1.2
DROPPED BY LOADER dropped case in trailer	.8	<u>1.4</u> 1.4	1.0
*OTHER & MISCELLANEOUS ³ other reasons damaged by bars in back of rack damaged by pallet wing rammed into on corner rammed by handtruck on towline jammed against column miscellaneous (short, broken pallet, manufacturer)	10.3	<u>13.4</u> 0.3 4.9 2.8 1.0 1.0 0.2 3.2	11.2

Sources: see (14) and (27).

¹Column totals do not total 100% due to rounding

²Weighted average calculated as: .7 (NAWGA) + .3 (USDA).

³NAWGA defines "Other" as:

- 32% - hit by equipment
- 8% - opened
- 23% - wet
- 14% - in transit
- 23% - miscellaneous

Appendix IV

Causes and Amount of Damage to Grocery Items Packaged
in Paperboard Containers in Five Supermarkets

Cause	Units damaged	Percent of group damage	Cumulative
	No.	Percent	Percent
Carton damaged by cutter blade when cutting case	251	34.90	34.90
Concealed damage	91	12.66	47.56
Fell off conveyor or pallet from trailer	39	5.42	52.98
Miscellaneous and unknown	30	4.17	57.15
Miscellaneous customer damage	32	4.45	61.60
Fell off or crushed by jam-up on conveyor	26	3.62	65.22
Stack fell over in backroom	23	3.20	68.42
Fell off shelf when disturbed by customer	23	3.20	71.62
Merchandise crushed in stack	21	2.92	74.54
Damaged during building of end display	21	2.92	77.46
Spoiled by water	21	2.92	80.38
Spoiled	20	2.78	83.16
Dropped by customer	13	1.81	84.97
Broken or crushed in shopping cart	13	1.81	86.78
Unit dropped during stocking	12	1.67	88.45
Dropped while being put away during receiving	10	1.39	89.84
Fell off conveyor going to basement	7	.97	90.81
Case dropped while being taken from stock	7	.97	91.78
Fell off shelf--knocked off by falling merchandise	7	.97	92.75
Units fell out of open or torn shipping container	6	.83	93.58
Missing label	6	.83	94.41
Glue from shipping container damaged contents	6	.83	95.24
Broken by children--fell off shelf	5	.70	95.94
Crushed or torn when piled on checking counter	5	.70	96.64
Damaged during consolidating of loose units in case	3	.42	97.06
Spoiled by heat	3	.42	97.48
Dropped during price changing	2	.28	97.76
Damaged during filling of dump display	2	.28	98.04
Damaged by children throwing it from cart	2	.28	98.32
Dropped by customer unloading shopping cart	2	.28	98.60
Pilfered	2	.28	98.88
Fell off conveyor at turn	1	.14	99.02
Units fell out of case during price marking	1	.14	99.16
Damaged during building of end display	1	.14	99.30
Whole case dropped during shelving of units	1	.14	99.44
End display rammed by handtruck	1	.14	99.58
Fell off bottom of shopping cart	1	.14	99.72
Broken when bag burst	1	.14	99.86
Broken during carry-out	1	.14	100.00
Total	719	100.00	

Source: See (27).

Appendix V

Causes and Amount of Damage to Grocery Items Packaged
in Glass Jars in Five Supermarkets

Cause	Units damaged	Percent group damage	Cumulative
	No.	Percent	Percent
Concealed damage	62	21.55	21.55
Spoiled	44	15.28	36.83
Fell off shelf when disturbed by customer	28	9.72	46.55
Dropped by customer	25	9.68	55.23
Fell off conveyor or pallet from trailer	19	6.60	61.83
Fell off conveyor going to basement	16	5.56	67.39
Miscellaneous other causes and unknown	13	4.51	71.90
Unit dropped while being placed on shelf	11	3.82	75.72
Stack fell over in backroom	10	3.47	79.19
Missing label	8	2.78	81.97
Whole case dropped during shelving of units	6	2.08	84.05
Case dropped while being taken from stock	4	1.39	85.44
Dropped by customer unloading shopping cart	4	1.39	86.83
Broken during filling of dump display	3	1.04	87.87
Broken by children--fell off shelf	3	1.04	88.91
Fell off counter when merchandise was being pulled toward checker	3	1.04	89.95
Fell off counter--reached for by checker	3	1.04	90.99
Dropped while being put away during receiving	2	.69	91.68
Units fell out of open or torn shipping container	2	.69	92.37
Units fell out while being taken from stock	2	.69	93.06
Units fell out of case during price marking	2	.69	93.75
Fell off handtruck while being taken to sales area	2	.69	94.44
Broken while display merchandise was being put into backroom	2	.69	95.13
Unit fell off shelf--should have had divider.	2	.69	95.82
Broken or crushed in shopping cart		.69	96.51
Broken when bag burst	2	.69	97.20
Fell off or crushed by jam-up on conveyor	1	.35	97.55
Unit dropped during rearranging of shelf	1	.35	97.90
Damaged during building of end display	1	.35	98.25
Fell off shelf--knocked off by falling end display	1	.35	98.60
Fell off bottom of shopping cart	1	.35	98.95
Broken by children throwing it from cart		.35	99.30
Dropped while bagging	1	.35	99.65
Broken during carry-out	.1	.35	100.00
Total	288	100.00	

Source: See (27).

Appendix VI

Causes and Amount of Damage to Grocery Items Packaged
in Paper Bags in Five Supermarkets

Cause	Units damaged	Percent of group damage	Cumulative
	No.	Percent	Percent
Concealed damage	111	37.23	--
Miscellaneous and unknown	32	10.74	47.97
Fell off conveyor or pallet from trailer	23	7.72	55.69
Unit dropped during stocking of shelf	22	7.38	63.07
Fell off or crushed by jam-up on conveyor	10	3.36	66.43
Broken or crushed in shopping cart	10	3.36	69.79
Units fell out of open or torn shipping container	8	2.68	72.47
Broken during carry-out	8	2.68	75.15
Damaged by case cutter	8	2.68	77.83
Fell off conveyor going to basement	6	2.01	79.84
Dropped by customer unloading shopping cart	6	2.01	81.85
Broken when shopping bag burst	6	2.01	83.86
Dropped while being put away during receiving	5	1.68	85.54
Dropped by customer	5	1.68	87.22
Fell off shelf when disturbed by customer	5	1.68	88.90
Spoiled	5	1.68	90.58
Miscellaneous customer damage	4	1.34	91.92
Fell off two-wheel handtruck taking it to sales area	3	1.01	92.93
Crushed or torn when piled on checkout counter	3	1.01	93.94
Damaged by pallet	3	1.01	94.95
Merchandise crushed in stack	2	.67	95.62
Units fell out of case while being taken from stock	2	.67	96.29
Units fell out of case during price marking	2	.67	96.96
Damaged while display was being taken down	2	.67	97.63
Dropped during bagging	2	.67	98.30
Fell off conveyor at turn	1	.34	98.64
Damaged while display merchandise was being put in the backroom	1	.34	98.98
Whole case dropped during shelving of units	1	.34	99.32
Fell off bottom of shopping cart	1	.34	99.66
Dropped by bagboy unloading shopping carts	1	.34	100.00
Total	298	100.00	

Source: See (27).

Appendix VII

Causes and Amount of Damage to Bottled Grocery
Items in Five Supermarkets

Cause	Units damaged	Percent of group damage	Cumulative
	No.	Percent	Percent
Concealed damage	51	17.43	--
Fell off shelf when disturbed by customer	39	13.31	30.74
Fell off conveyor or pallet from trailer	34	11.60	42.34
Miscellaneous other reasons and unknown	38	9.56	51.90
Dropped by customer	25	8.53	60.43
Stack fell over in backroom	24	8.19	68.62
Unit dropped during stocking	20	6.83	75.45
Dropped by customer unloading shopping cart	10	3.41	78.76
Spoiled	9	3.07	81.93
No label	9	3.07	85.00
Fell off conveyor going to basement	6	2.05	87.05
Damaged while display merchandise was being put into backroom	5	1.71	88.76
Fell or crushed by jam-up on conveyor	5	1.71	90.47
Case dropped while being taken from stock	4	1.37	91.84
Case dropped while being put away during receiving	3	1.02	92.86
Units fell out of case while being taken from stock	3	1.02	93.88
Broken or crushed in shopping cart	3	1.02	94.90
Broken by children--fell off shelf	2	.68	95.58
Fell off shelf--knocked off by falling merchandise	2	.68	96.26
End display rammed by handtruck	2	.68	96.94
Fell off handtruck taking it to sales area	2	.68	97.62
Broken during carry-out	1	.34	97.96
Unit dropped during rearranging of shelf	1	.34	98.30
Units fell out of case while being taken from stock	1	.34	98.64
Dropped during bagging	1	.34	98.98
Fell off counter while merchandise was being pulled toward checker	1	.34	99.32
Fell off counter - merchandise backed up on counter	1	.34	99.66
Units fell out of open or torn shipping container	1	.34	100.00
Total	293	100.00	

Source: See (27).

Appendix VIII

Causes and Amount of Damage to Canned Grocery Items
in Five Supermarkets

Cause	Units damaged		Cumulative
	No.	Percent of group damage	
Concealed	829	41.22	--
Spoiled	523	26.03	67.25
Missing labels	355	17.67	84.92
Fell off conveyor from trailer	44	2.19	87.11
Misc. other reasons and unknown	44	2.19	89.30
Out of date	26	1.29	90.59
Fell off conveyor going to basement	20	1.00	91.59
Dropped by customer	19	.95	92.54
Units fell out of torn shipping container	13	.66	93.20
Unit dropped during stocking of shelf	12	.60	93.80
Leaker	11	.55	94.35
Fell off or crushed by jam-up on conveyor	11	.55	94.90
Damaged while display was being taken down	11	.55	95.45
Fell off shelf when disturbed by customer	11	.55	96.00
Glue from shipping container damaged contents	9	.45	96.45
Case dropped while being taken from stock	8	.40	96.85
Merchandise crushed in stack	7	.35	97.20
Whole case dropped during shelving of units	6	.30	97.50
Stack fell over in backroom	5	.25	97.75
Units fell out of case during price marking	5	.25	98.00
Dropped during price changing	4	.20	98.20
Fell off two-wheel handtruck	4	.20	98.40
Damaged when bag burst	3	.15	98.55
Damaged in shopping cart	3	.15	98.70
Fell off conveyor at turn	3	.15	98.85
Dropped while being put away during receiving	3	.15	99.00
Fell off shelf--knocked off by falling end display	3	.15	99.15
Dropped during bagging	2	.10	99.25
Damaged by children - fell off shelf	2	.10	99.35
Dropped by customer unloading shopping cart	2	.10	99.45
Spoiled by heat	2	.10	99.55
Damaged during building of end display	2	.10	99.65
Fell off four-wheeler taking it to sales area	1	.05	99.70
Fell off shelf - knocked off by falling merchandise	1	.05	99.75
Dropped during consolidating of loose units in case	1	.05	99.80
Damaged by children throwing it from cart	1	.05	99.85
Fell off counter while merchandise was being pulled toward checker	1	.05	99.90
Crushed or torn when piled high on checking counter	1	.05	99.95
Fell off shelf - should have had divider	1	.05	100.00
Total	2,009	100.00	

Source: See (27).

Appendix IX

Causes and Amount of Damage to Grocery Items Packaged
in Plastic Bags in Five Supermarkets

Cause	Units damaged	Percent of group damage	Cumulative
	No.	Percent	Percent
Concealed damage	25	20.64	--
Spoiled	21	17.36	38.00
Damaged by case cutting	20	16.53	54.53
Misc. other causes and unknown	11	9.09	63.62
Mdse. crushed in stack	10	8.26	71.88
Dropped by customer unloading shopping cart	9	7.44	79.32
Fell off shelf when distrubed by customer	5	4.13	83.45
Broken or crushed in shopping cart	4	3.31	86.76
Damaged while display was being taken down	3	2.48	89.24
Fell off conveyor going to base- ment	2	1.65	90.89
Crushed or torn when piled on checkout counter	2	1.65	92.54
Misc. customer damage	2	1.65	94.19
Units fell out of open or torn shipping container	1	.83	95.02
Missing labels	1	.83	95.85
Unit dropped during stocking of shelf	1	.83	96.68
Dropped by customer	1	.83	97.51
Fell off bottom of shopping cart	1	.83	98.34
Dropped during bagging	1	.83	99.17
Broken when shopping bag burst	1	.83	100.00
Total	121	100.00	

Source: See (27).

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