THE UNIT-LOAD EXPLOSION in the FOOD INDUSTRY

A study showing the relative importance of several materials-handling systems in shipping food products

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The Opportunities

THE WOODEN PALLET—born in World War II out of the need for moving and storing vast volumes of materials—offers exciting opportunities today not only for the food industry and other user industries, but also for the forest industries. This was revealed by a recent cooperative study of the food industry by the U. S. Forest Service and Better Management Services, Inc.

For the food industry, a unit-load system using wooden pallets, coupled with an efficient pallet-exchange system, offers opportunities for increased efficiency and cost savings in handling the great volumes of products that move daily from manufacturers to distribution centers to retail stores.

For the forest industry, this offers promise of greatly expanded markets for the low-grade timber resource, which can abundantly produce short pieces of good wood that are ideally suited for making pallets. Expanded use of pallets in a national pallet-exchange program by the food industry alone would provide profitable use for a volume of low-grade timber equal to the total volume of hardwood timber cut for all uses in the United States today.

This study, initiated by the Northeastern Forest Experiment

Station's Forest Products Marketing Laboratory at Princeton, West Virginia, is the first of a series of studies designed to evaluate the performance of wooden pallets and develop criteria for operating a national pallet-exchange program. This study was concerned with the systems used in the food industry for handling shipments.

Background

Not too many years ago finished goods were moved with the two-wheel hand truck and then "stair-stepped" to a ceiling height of 10 to 14 feet. Orders were selected onto 4-wheel flat trucks or 2-wheel hand trucks and moved to the shipping area where the product was loaded piece by piece into the carrier's equipment, and was secured for transit with lumber dunnage. Handsaws, nails, and hammers were the tools for moving products between shipper and receiver. At intermediate warehouses, again the goods were handled piece by piece — loading, unloading, storing, selecting, and shipping to the retail outlet where the consumer could see and purchase the goods. It mattered not, in the distribution cycle from manufacturer to consumer, whether the order was for a few cases or several thousand cases — the handling was the same.

The constant search for more efficient and economical ways to handle products led manufacturers and intermediate distributors to begin using wooden pallets and forklift trucks to move and store multiples of a product as single units. The unit-load concept came into its own within the warehouse. After World War II, traffic men realized that if the benefits of unit-load handling within the warehouse could be extended throughout the shipping and receiving cycles, distribution costs could be reduced substantially. In the late 1940's the building-materials industry, oil refineries, the chemical industry, breweries, meat packers, and steel fabricators began shipping their products on wooden pallets. Many companies used expendable pallets; others successfully began pallet-exchange programs.

In 1960 the food industry became a prime prospect for this method of unit-load handling. The problems that resulted from

multiple manual handlings as well as variety in warehouse layouts and operating systems, prompted traffic men to search for a better way to handle products. They concluded that the concept of the unit load, applied in a total concept approach, would produce significant cost reductions badly needed in an industry that operated on a 1-percent profit margin. The successful, though limited, use of this concept in other industries and in Europe provided useful guidelines for the food industry.

Trade associations studied the European pallet-exchange programs. Sweden had initiated such a project in 1947, and by 1960 about 1,000 companies were participating. Thirteen other nations in Western Europe now have exchange programs, and an international pallet-exchange program is operating among Austria, Switzerland, and Western Germany.

In 1962 a major U. S. food manufacturer took a step forward by initiating a pallet-exchange program among 11 of its processing plants and 20 of its sales and distribution center warehouses and more than 600 customers' warehouses. Thirty-one rail carriers invested $19 million in special car equipment for this one company alone. The carriers expected increased revenue per car as a return on their investment due to faster turn-around, reduced claims for loss and damage, and reduced car maintenance because of clean loads and special devices to secure them. A central traffic group was given responsibility for scheduling these cars, and personnel at the food-distribution centers were supposed to expedite loading or unloading and insure release of the car within 48 hours after effective placement at the dock. Following this lead, many other companies began to plan handling programs based on the wooden pallet and the conventional forklift truck.

A second system of handling unit loads was introduced in 1962 when another food manufacturer developed a system of handling loads on fiber slip sheets with special attachments for a forklift truck. This system is commonly referred to in the industry as "push pak."

In 1964 a third food manufacturer introduced another system of handling loads on slip sheets. Known as "pull-pak," this sys-

tem requires a gripper bar on the special forklift attachment developed from the "push-pak" system.

In 1964 and 1965 another manufacturer serving the food industry introduced the clamp-truck system they had been using internally for 9 years, which employed special clamp attachments on a forklift truck.

By January 1966, 39 companies were participating in wooden pallet-exchange programs; 11 companies were using push-pak and/or pull-pak; and several companies continued to experiment with the clamp-truck system.

PROFILE OF THE FOOD INDUSTRY

The food industry is national in scope. Over 500 major manufacturers move their products to over 2,000 chain and wholesale food distribution centers, who in turn ship to 325,000 retail stores. Some 15 billion cases of products are handled annually.

Millions of shipments are involved in the movement of goods. One large distribution center alone will receive 3,000 carloads and 12,000 truckloads a year via common carrier, plus many more thousands of shipments via its private carrier operation.

The industry uses specially designed rail cars for unit-load systems. These cars cost $20,000 compared to the cost of $8,000 for a standard box car. These special cars are commonly assigned for the exclusive use of individual firms. They travel empty for 50 percent of their mileage.

The food industry has been exposed to every conceivable problem inherent in unit-load handling, with its 7,000 unlike items in every type of package or shipping container designed. The industry has professionalized the role of its traffic managers by extending their responsibilities into warehousing, inventory control, order-selecting systems, and many other company interrelated activities.

This industry occupies a central position in the development of unit-load handling. One of the largest industries in the United States, it overlaps many other industries. During the last 5 years the food industry has devoted more effort than any other industry to designing, testing, and installing systems of unit-load handling.

PROFILE OF THE FOOD-DISTRIBUTION CENTER

Because the food-distribution center is responsible for moving products to the retail stores and for maintaining stock levels sufficient to meet their requirements, it necessarily controls the chain of events in product movement from the manufacturers. The product, production schedules, and storage requirements are dictated to a large extent by the quantities and the line-items mix ordered by the distributor. The manufacturer in turn specifies the transportation equipment that the carrier must provide.

The typical warehouse is a modern one-story building not more than 10 years old. Inside it has 20 feet of clear stacking height, which is consistently utilized. The rail receiving dock is either covered or totally enclosed within the building; and more often than not it has a double track that can be bridged through one car to unload the other.

The distribution center normally stocks 5,000 to 7,000 items of dry grocery products. Small slow-moving items that are stocked in less than one pallet load are stored on gravity-flow racks to obtain more facings for the order-selecting operation. If the maximum inventory of an item is two or three pallet loads, the pallets are usually placed on the order-selecting line in either portable or permanent racks. If the maximum inventory of an item exceeds three pallet loads, the excess is usually placed in a designated reserve area. Because space is scarce, it is carefully controlled, and areas are assigned for specific products.

Too often products are stored in the staging areas at both rail and truck docks. This causes congestion and loss of efficiency in loading and unloading.

Food-distribution centers use many different kinds of equipment. In this study, we found that 41 unlike pieces of equipment were used to handle wooden pallets of like size.

The equipment most commonly used includes electric or propane powered straddle-type and counterbalanced forklift trucks, transveyors, electric worksavers, and walking forks. Much of the receiving equipment is in the 5,000-pound class so that two pallet loads of the heavier products can be moved as one load.

Most forklift trucks are designed to handle both conventional and multi-tine attachments to permit handling loads unitized on either pallets or slip sheets. Usually the distribution center has a preference for certain kinds of handling equipment, developed from experience with daily operating problems.

The specially equipped rail cars received at the food-distribution center are often held for 4 to 7 days in the yard, and are handled in the same manner as the standard box cars. This results in inefficient use of these cars, which are designed for rapid loading and unloading. They should be grouped and handled separately so that they can be pulled and returned to service with minimum delay. Delays are most often caused by shortage of manpower, congestion in the dock areas, and poor scheduling.

The Study

SCOPE

In this study, begun in 1965, detailed information was collected on 2,706 shipments moving from 422 manufacturers by rail and truck carriers to 10 major distribution centers. The shipments consisted of:

Item	*Rail*		*Truck*	
	No.	*Percent*	*No.*	*Percent*
Shipments	709	26.0	1,997	74.0
Pieces	1,127,818	35.0	2,032,048	65.0
Pounds	34,652,535	37.9	56,998,344	62.1
Man-hours	4,402	40.5	6,443	59.5

METHODS

The products were classified on the basis of their physical handling characteristics into five product groups:

Group I—paper products.—Bags, meat trays, napkins, toilet tissue, towels, facial tissue.

Group II—low-density items.—Baking soda, cereals, charcoal, crackers, cookies, dried fruit, pet food in bags, toys, games.

Group III — canned goods — Evaporated milk, fish, fruits, juices, pet food, pork and beans, soups, spaghetti, vegetables.

Group IV—products in glass.—Baby food, catsup, jams, jellies, spreads, salad dressing, shortenings, oils, syrups.

Group V — heavy packaged goods. — Baking mixes, flour, powdered milk, rice, salt, soaps and detergents, sugar.

Each shipment was classified by method of unit-loading as defined below:

Floor-loaded (FL).—Cases are loaded in the car or truck piece by piece.

Wooden pallet/floor loaded (WP/FL). — A portion of the shipment is loaded in units on wooden pallets; the remainder of the order is dead-piled in the doorway, or as dunnage alongside the unitized portion, or on top of the unitized portion; or a combination of these methods.

Slip-sheet/floor-loaded (SS/FL).—A portion of the shipment is loaded in units on slip sheets (push-pak or pull-pak); the remainder of the order is dead-piled in the doorway, or as dunnage alongside the unitized portion, or on top of the unitized portion; or a combination of these methods.

Clamp-truck/floor-loaded (CT/FL).—A portion of the shipment is loaded in unit blocks with a clamp truck; the remainder of the order is dead-piled in the doorway, or as dunnage alongside the unitized portion, or on top of the unitized portion; or a combination of these methods.

Wooden pallets (WP).—The entire shipment is unit-loaded on wooden pallets, either single- or double-decked.

Slip sheets (SS).—The entire shipment is unit-loaded on slip sheets (push-pak and pull-pak), either single- or double-decked.

Clamp truck (CT).—The entire shipment is loaded in blocks with clamp-truck equipment.

Information and data were collected at the 10 major food-distribution centers by tallying all incoming shipments for a period of 1 week at a time. A total of 54 weeks of shipments were tallied—a minimum of 3 weeks and a maximum of 6 weeks shipments at each distribution center. Items of information tallied on each shipment included: shipper, carrier, and receiver identification; carrier equipment number, dimensions and nomenclature; purchase-order number; terms of purchase; number of line items, number of pieces, weight, and number of unit loads in each shipment; dates ordered, shipped, scheduled to arrive,

actual arrival, placed at receiving dock, unloaded, and release of equipment; time and man-hours required to unload; and data on overs, shorts, and damages.

The following productivity measures were computed from the basic data for each shipment:

Man-hours.—The number of men used for unloading times the number of hours required. For rail shipments, *start time* began with the start of the workers' assignment to unloading (normally this coincided with the start of the workday). Working time included coffee breaks, setting dock plates, removing dunnage, tallying and marking items, and all other paid time spent by the employees assigned to the car, but did not include lunch periods and those times when employees were assigned to tasks other than unloading the car. *End time* was recorded when the last item was removed from the car and tallied by the employee assigned to the car, and the pallets or dunnage were returned and the car door was closed.

For truck shipments, *start-time* began when the driver shut off the truck motor after having backed into the receiving dock. Working time included coffee breaks, lunch periods, waiting for pallets, for equipment, for receiver's employees, for space on the dock, and all the time when the truck was in the bay before the last item of the shipment was removed.

Tons per man-hour.—Computed as the quotient of the weight of the shipment in tons, divided by the number of man-hours required to unload.

Cases per man-hour.—Computed as the quotient of the total number of cases in the shipment, divided by the number of man-hours required to unload.

Cost of labor.—Direct labor cost for unloading was computed for each shipment. Two adjustments were made so that a comparison could be made when evaluating direct labor receiving costs. At several of the distribution centers, supervisory wages were charged to general administrative expense; and at other centers they were charged to operating expense. In this study, all supervisory wages were charged as direct operating expense for unloading.

Because of differences in geographical location, hourly wage rates ranged from $2.87 to $3.27. An average wage of $3.00 per hour was used in all computations to obtain comparable labor costs per car, per ton, and per case.

Individual companies may also want to consider the wage differentials between forklift operators and warehousemen who unload floor-loaded cars; and between day shifts and night shifts where costs of either unit-load or floor-loaded shipments will be slightly higher. However, these differentials probably are so small relative to the savings obtained from unit-load handling that they may be ignored for all practical purposes.

Results

GENERAL

Motor carrier deliveries accounted for 74 percent of the shipments, 65 percent of the pieces, and 62 percent of the weight. Rail carriers accounted for the rest.

In 1964, 31 percent of the rail shipments were unitized; and in 1965, 38 percent were unitized (fig. 1 and tables 1 and 2). Most of this increase was in fully unitized shipments on wooden pallets.

Rail shipments — whether floor-loaded or unitized — are unloaded entirely by distribution-center personnel. Motor-carrier shipments, when floor-loaded, are unloaded by carrier personnel; unitized shipments may be unloaded by either distribution-center or carrier personnel.

At the close of 1964, about one-fourth of the motor carriers were experimenting with unit-load handling, and about 5 percent of the product movement was unitized on wooden pallets. By the end of 1965, motor carriers were moving 45 percent of their volume in unitized loads; and 93 percent of the unit loads were on wooden pallets.

Motor carriers were able to adopt unitized handling systems relatively fast because 85 percent of their present equipment is adaptable to the 48-inch by 40-inch pallet size.

Tests showed that it is more efficient for distribution-center employees to unload fully unitized shipments from motor car-

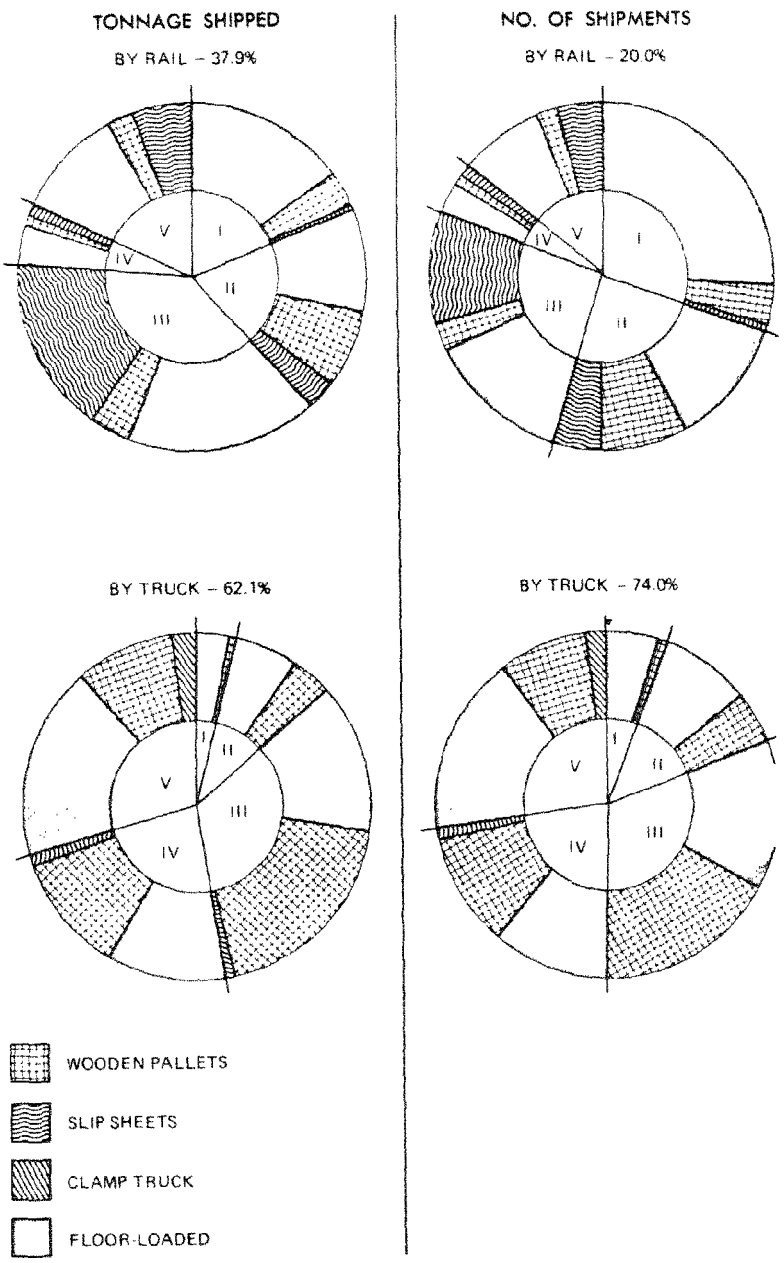

Figure 1.—The pattern of product-handling methods for different product groups and shipping methods.

Table 1.—*Summary of rail and truck shipments for the five product groups*

Product group	Item	Rail		Truck	
		No.	*Percent*	*No.*	*Percent*
I	Shipments	214	30.2	118	5.9
	Pieces	161,115	14.3	58,844	2.8
	Weight in pounds	6,471,307	18.6	2,051,396	3.5
	Man-hours of labor	1,215	27.6	379	5.8
II	Shipments	173	24.4	267	13.2
	Pieces	325,557	28.9	299,578	14.7
	Weight in pounds	6,792,242	19.6	5,043,375	9.4
	Man-hours of labor	1,154	26.3	862	13.3
III	Shipments	185	26.0	622	31.3
	Pieces	383,742	34.0	612,052	30.2
	Weights in pounds	13,166,632	37.9	19,565,490	34.4
	Man-hours of labor	1,110	25.2	1,663	25.8
IV	Shipments	33	4.7	451	22.5
	Pieces	72,555	6.4	562,928	27.8
	Weight in pounds	1,950,246	5.6	13,309,684	23.4
	Man-hours of labor	219	5.0	1,490	23.2
V	Shipments	104	14.7	532	27.0
	Pieces	184,849	16.4	498,646	24.5
	Weights in pounds	6,272,108	18.3	16,668,399	29.3
	Man-hours of labor	704	15.9	2,049	31.9

riers. Distribution-center personnel required only half the time required by motor-carrier personnel. This is because they know their own equipment better, having a better understanding of the part receiving plays in the total concept of the distribution center, and know the methods used by the distribution center to accomplish its purpose.

LOADING SYSTEMS

Competition among the several systems for handling unit loads has forced proponents of each system to work on strengthening the weak points of his system. The following analysis of the unit-load systems now in use throughout the food industry is based on what is actually being done. Three general systems are in use: wooden pallets, slip sheets, and clamp trucks (table 3).

Table 2.—*Summary of rail and truck shipments for the different methods of unitization*

Unitizing Method	Measures	Rail		Truck	
		No.	*Percent*	*No.*	*Percent*
FL	Shipments	438	61.8	1,094	54.6
	Pieces	621,144	55.1	1,069,359	52.6
	Weight in pounds	19,328,109	55.8	29,496,427	51.7
	Man-hours of labor	3,318	75.4	4,582	71.1
WP	Shipments	96	13.5	698	35.5
	Pieces	158,038	14.0	722,423	35.6
	Weight in pounds	4,751,690	13.8	21,513,562	37.8
	Man-hours of labor	294	6.6	1,283	20.0
WP/FL	Shipments	29	4.1	134	6.7
	Pieces	52,665	4.7	162,152	8.0
	Weight in pounds	1,666,640	4.8	4,052,626	7.1
	Man-hours of labor	119	2.8	392	6.0
SS	Shipments	60	8.5	8	.5
	Pieces	118,811	10.5	9,133	.4
	Weight in pounds	3,827,517	11.0	224,982	.4
	Man-hours of labor	182	4.2	23	.3
SS/FL	Shipments	80	11.3	11	.5
	Pieces	171,178	15.2	15,153	.7
	Weight in pounds	4,876,976	14.0	418,956	.7
	Man-hours of labor	446	10.0	59	.9
CT	Shipments	—	—	30	1.5
	Pieces	—	—	22,325	1.1
	Weight in pounds	—	—	778,182	1.4
	Man-hours of labor	—	—	25	.4
CT/FL	Shipments	6	.8	15	.7
	Pieces	5,982	.5	31,503	1.6
	Weight in pounds	201,603	.6	518,609	.9
	Man-hours of labor	43	1.0	79	1.3

Pallet System

The wooden pallet makes possible a system that is simple to operate for both shipping and receiving, is low in cost, and can be used efficiently by producer, distributor, and retailer. The wooden pallet can be handled with all standard types of materials-handling equipment, and no special training of operators is needed.

Table 3.—*Summary of rail and truck shipments for the five product groups, by method of unit-load handling*

Product group	Handling method[1]	RAIL						TRUCK					
		Shipments	Distribution centers	Pieces handled		Weight handled		Shipments	Distribution centers	Pieces handled		Weight handled	
				Average	CV[2]	Average	CV[3]			Average	CV[2]	Average	CV[3]
		No.	*No.*	*No.*	*%*	*1,000 lbs.*	*%*	*No.*	*No.*	*No.*	*%*	*1,000 lbs.*	*%*
I	FL	181	10	739	41	28.5	37	104	8	505	50	16.7	48
	WP	23	6	723	56	37.6	50	13	4	448	28	23.5	51
	WP/FL	5	3	1,181	13	63.5	28	—	—	—	—	—	—
	SS	2	1	768	—	34.3	—	—	—	—	—	—	—
	CT/FL	3	3	808	55	23.0	58	1	1	400	—	12.5	—
II	FL	85	8	1,984	47	38.2	44	169	9	1,011	60	19.0	66
	WP	42	8	2,043	61	44.0	47	80	6	1,228	64	22.4	53
	WP/FL	15	5	1,788	54	46.7	44	15	5	1,718	64	22.4	50
	SS	6	2	1,245	47	27.5	18	—	—	—	—	—	—
	SS/FL	24	7	1,848	62	32.8	30	2	1	1,992	31	40.5	60
	CT/FL	1	1	1,897	—	46.3	—	1	1	1,700	—	26.3	—
III	FL	93	10	1,892	42	61.9	48	269	10	928	44	29.1	38
	WP	13	3	1,879	24	68.8	23	305	10	1,012	40	33.4	32
	WP/FL	6	3	2,346	26	83.0	19	39	7	1,743	28	29.9	40
	SS	42	7	2,067	27	70.8	24	5	4	1,045	38	27.3	33
	SS/FL	31	7	2,546	34	82.1	26	3	1	2,024	48	65.2	2
	CT	—	—	—	—	—	—	1	1	450	—	24.8	—
IV	FL	21	7	2,410	54	60.8	34	222	10	1,188	59	29.0	40
	WP	6	5	1,658	65	46.6	31	163	9	1,185	61	29.6	38
	WP/FL	1	1	2,204	—	60.0	—	50	5	1,537	68	30.2	37
	SS	1	1	1,042	—	46.0	—	2	2	1,610	24	30.4	1
	SS/FL	4	1	2,189	25	71.9	6	4	2	1,249	15	24.8	44
	CT/FL	—	—	—	—	—	—	10	4	2,609	58	37.2	22
V	FL	58	8	1,443	58	37.2	37	330	10	1,002	39	31.1	36
	WP	12	6	1,678	28	72.2	27	137	9	813	36	32.3	37
	WP/FL	2	2	1,830	10	45.1	29	30	5	1,006	39	44.7	26
	SS	9	3	2,457	34	63.6	24	1	1	690	—	27.5	—
	SS/FL	21	6	1,807	46	56.0	21	2	—	551	52	21.6	47
	CT	—	—	—	—	—	—	29	—	754	30	25.8	24
	CT/FL	2	1	830	—	43.2	—	3	—	1,105	32	36.1	27

[1]FL = floor-loaded. WP = entire load on wooden pallets. SS = entire load on slip sheets. CT = entire load in clamp blocks. WP/FL = part of load floor-loaded. SS/FL = part of load floor-loaded. CT/FL = part of load floor-loaded.
[2]Coefficient of variation = standard deviation divided by mean times 100.
[3]Weight of pallets not included.

In using wooden pallets, the weight of the pallet and the space it requires are important considerations in handling product group I (paper products) and product group II (low-density items), especially when a standard 40-foot 6-inch boxcar is used. For products groups III, IV, and V the carrier's equipment (except for some of the 100,000-pound cars for product group III) had space enough to absorb the wooden pallets and still attain minimum weight. In 76 percent of the cars carrying mixed loads of all product groups, space was also sufficient to accommodate the pallets.

Pallet quality is important. The species of wood used, the quality of individual parts, the design of the pallet, and the precision of construction are some of the quality considerations.

The food industry has adopted a standard pallet size and specification. The pallet constructed of class C (high-density) hardwood lumber is not readily available to the industry on the West Coast and in the South. The softwood lumber (Douglas-fir, hemlock, larch, and southern pine) is not accepted as equal to the hardwood lumber pallet for use in the pallet-exchange program.

ADVANTAGES

1. The load can be handled from all four sides. This permits maximum use of the floor area of rail and truck equipment.

2. Two pallet loads may be handled as one load. This permits double-decking in the cars and trailers. Two short loads are preferred to one high load, because the short loads are consistent with rack clearances and with stack heights convenient for order selecting.

3. Less time is consumed in checking. When goods are properly palletized, checking is reduced to counting pallet loads. To realize this saving, distribution centers must order in full layer units, which is entirely feasible.

4. Damage to goods in transit can be reduced by 75 percent. To attain this saving, pallet patterns and package dimensions must be designed so that the cases can be well interlocked on the pallet. Additional savings result from elimination of dunnage materials.

5. Demurrage charges can be reduced because unloading times can be reduced from the 6 to 14 hours required for floor-loaded cars to ½ to 2 hours for palletized cars.

6. Condition of the stock is improved because the individual cases are handled only when loaded on the pallet and when selected for shipment to the retail store.

7. Use of pallets permits 100-percent unitization of the carrier equipment because unit loads on wooden pallets can be placed in the doorway of the rail car.

8. Use of pallets permits the use of all conventional types of hand and powered forklift equipment.

9. Less training is required for personnel. This is an important advantage that results from the simplicity of the conventional forklift truck compared to materials-handling equipment with special attachments that require more skill and judgment on the part of the operator.

10. More personnel can operate conventional forklift equipment. Because of the simplicity of the system, it is relatively easy for the distribution center to assign new operators when the regular operators are absent.

11. Unit loads on wooden pallets can be handled easily on motor-carrier equipment.

12. Palletization is the only system that can be employed in a total concept approach from receipt of raw material by the manufacturer through all steps to the retail store, where merchandise may be sold directly from the pallet.

DISADVANTAGES

1. Pallets take up space in the carrier equipment—6 percent in 60-foot cars and 7 percent in 50-foot cars.

2. Pallets must be replaced or returned.

3. A serious disadvantage at present results from the exchange of pallets of different quality. A system of policing and certification is needed.

4. Pallets must be repaired. It is more economical for a distribution center to make repairs than to send pallets out for repair.

5. The reserve pallets needed for an exchange program take up space in the warehouse.

6. The initial investment cost for pallets is higher than the initial cost for other unit-loading systems. But at the same time the initial investment for handling equipment is less.

Slip-Sheet System

Slip sheet is a general term used for both the pull-pak and push-pak methods of unit-load handling. This is a sound materials-handling system, but difficult to apply in day-to-day operations because it requires specially trained personnel and special equipment.

For example, not enough carload shipments are received daily on slip sheets to warrant keeping a multi-tine attachment permanently on a forklift truck. The changeover time commonly takes ½ hour under normal operating conditions.

The multi-tine attachment, combined with the weight of the product, necessitates use of a 5,000-pound capacity forklift truck. This equipment is more difficult to maneuver in a rail car, and receivers are reluctant to take the responsibility for using it in common carrier motor vehicles because of the weight.

The cost of the slip sheet is borne wholly by the supplier even though the benefits are received by supplier, carrier, and receiver.

The cost of 20 to 30 cents for the bottom slip sheets and 30 to 96 cents for the in-between slip sheets makes it very costly for the supplier to use this method, although it can still be cheaper than piece handling.

More than one-half of the cars double-decked with slip sheets required hand unloading of the second deck. The weight of the second stack depresses the in-between slip sheet so that the multi-tine forks cannot enter without damaging the product. When a distribution center purchases the pull-pak attachment, it must also purchase longer tines for the forklift truck to accommodate the 4-inch width of the gripper bar.

The heavier fiberboard slip sheet, substituted for the lighter sheet that tore when the gripper bar pulled it, has created a new problem. Unless the load is slightly raised before the gripper bar is actuated, the forklift truck will be pulled into the load. This happens especially in product group 3 when the unit load weighs 2,000 pounds or more, even though the brakes are set on the

forklift truck (4,000-pound capacity). Unless this problem is corrected through training or modification of slip-sheet design, a 5,000-pound truck will be needed for handling product group III or V packages with the gripper-bar attachment.

ADVANTAGES

1. There is neglible loss of space and weight. This is important in carload shipments of low-density items.
2. Checking or tallying cost is reduced because a unit load count can be employed instead of a piece count.
3. Damage to product can be reduced by as much as 62 percent.
4. Demurrage charges are reduced by reducing the time required to unload the car. Slip sheets were used most extensively for product group 3, where a time saving of 4 to 8 hours per carload was attained.
5. Stock condition is improved because less handling of pieces is required.
6. There are no problems of accountability, return, exchange, or repair because the slip sheets are used only once.
7. Initial investment cost for slip sheets is less than that for pallets, but the investment for handling equipment is greater.

DISADVANTAGES

1. The load can be handled from only one side.
2. Handling two unit loads at the same time is not possible. Twice as many lifts are required to unload double-decked loads as with pallets.
3. Unit loads utilize less of the rail car capacity because the multi-tine equipment, with its longer tines, needs more maneuvering space.
4. Checking time is increased for shipments of mixed lots of products because the products are not normally separated with slip sheets.
5. Slip-sheet systems do not permit efficient use of the forklift equipment because the conventional 2-tine attachments must be removed and replaced with special 6-tine attachments. This requires about $\frac{1}{2}$ hour for each changeover.

6. Personnel require more training to operate the equipment efficiently.

7. When trained personnel are absent, it is more difficult to assign replacement personnel because the equipment is more complex.

8. The equipment needed for handling slip sheets is too heavy for some motor-carrier equipment.

9. Slip sheets are not adaptable to a total concept approach. This is one of the most critical disadvantages. The push-pak and pull-pak systems are more successful when operated between a manufacturers' plant and his own distribution center. There are too many daily operating problems at food distribution centers to permit these systems to operate efficiently on a consistent day-to-day basis. The manufacturer has the problem of making a system efficient only within his own operation. The food-distribution center has the problem of operating a system that will handle a variety of products from over 500 manufacturers.

Clamp-Truck System

ADVANTAGES

Clamp-truck handling has one outstanding advantage: it eliminates both wooden pallets and slip sheets for a variety of products.

DISADVANTAGES

There are a number of disadvantages that must be overcome before this system can begin to provide savings like those already being provided by the wooden-pallet and slip-sheet systems.

1. The product must be center-loaded in the motor carriers' equipment to provide clamping space on both sides. The greatest danger in center loading is damage to the product from shifting loads. Experiments are now being conducted to eliminate this problem.

2. The unit load must be square (each layer to one another), otherwise cases are dropped when the load is picked up.

3. Many products require cooling in storage. Use of the clamp system does not permit any voids in the unit block.

4. The carton walls must be strengthened to avoid collapse while in storage. When the products are stacked 16 to 18 feet high, the carton must have the ability to withstand such loads under adverse humidity conditions. The collapse of stacked merchandise was noted at three different times because of this problem.

5. The drivers of forklift trucks with clamp attachments must be trained to regulate pressure controls. The modern machine has three settings, but the drivers seldom change these settings as they should and when they should.

6. There is a reluctance to use the clamp truck on motor carrier equipment because of its weight.

RAIL SHIPMENTS

Product Group I

Paper products shipped by rail represented the largest movement of shipments to a distribution center (30.2 percent), yet represented only 14 percent of the pieces and 19 percent of the

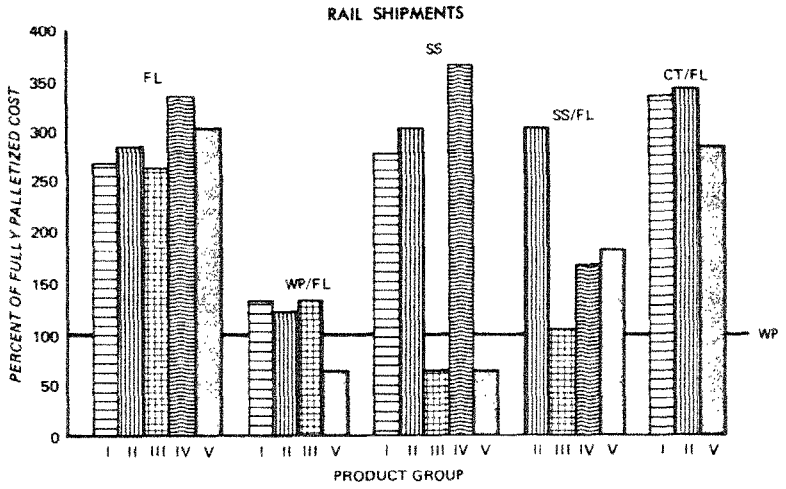

Figure 2.—A comparison of direct labor costs for unloading rail shipments, by product group and handling method. Cost for fully palletized loads is used as a basis (100 percent) for comparison. WP = wooden pallet, FL = floor-loaded, SS = slip sheet, CT = clamp truck.

Table 4.—*Rail shipments of paper products (product group I), by handling method*

Item	FL	WP	WP/FL	SS	SS/FL	CT	CT/FL	Total
				PERCENT OF PRODUCT GROUP				
Shipments	84.7	10.7	2.3	0.9	—	—	1.4	100.0
Pieces	83.5	10.4	3.7	.9	—	—	1.5	100.0
Weight	79.5	13.4	4.9	1.1	—	—	1.1	100.0
Man-hours	90.7	4.3	2.0	1.1	—	—	1.9	100.0
				PERCENT OF TOTAL RAIL SHIPMENTS				
Shipments	25.5	3.2	.7	—	—	—	—	30.?
Pieces	11.9	1.5	.5	—	—	—	—	14.3
Weight	14.9	2.5	.9	—	—	—	—	18.7
Man-hours	25.0	1.9	.5	—	—	—	—	27.6
				AVERAGES				
Cases/car	743.0	723.0	1,180.0	768.0	—	—	808.0	—
Pounds/case	38.2	52.0	53.7	44.6	—	—	28.4	—
Tons/car	14.1	18.7	31.6	17.1	—	—	11.4	—
				PRODUCTIVITY				
Man-hours/car	6.0	2.3	4.8	6.5	—	—	8.0	—
Tons/man-hour	2.3	8.2	6.5	2.6	—	—	1.6	—
Cases/man-hour	122.0	319.0	245.0	118.0	—	—	101.0	—
				LABOR COST				
Dollars/car	18.0	6.9	14.4	19.5	—	—	24.0	—
Dollars/ton	1.3	.4	.5	1.1	—	—	2.1	—
Cents/case	2.4	.9	1.2	2.5	—	—	3.0	—

total weight received. However, 28 percent of the total labor cost was used to handle this product at the receiving end, because 85 percent of the shipments are still floor-loaded.

Of the 214 carloads audited, the least cost per case handled was for shipments fully unitized on wooden pallets (fig. 2 and table 4). For 23 carloads from 8 paper products manufacturers to 6 distribution centers receiving unit loads via this method, unloading time ranged from 35 minutes per car to 2 hours 40 minutes per car. Compared to piece handling, this unitized handling yielded a saving of $11.10 per car. Unit-load handling systems other than pallets employed in this product group required more man-hours per car than floor-loaded shipments.

The average weight per case in this product group was 40.2 pounds. The range was from 28 to 54 pounds per case.

Product Group II

About half the shipments of low-density products were unitized loads, of which about 75 percent were on wooden pallets (table 5). The average cost of $10.50 per car was equal for handling both partially and fully palletized loads because relatively few cases were floor-loaded in the doorway. The cost per ton was slightly higher and cost per case was slightly less for the fully palletized cars.

In this low-density product group, net weight per carload was less than 30,000 pounds for 40 percent of the floor-loaded cars, for 20 percent of the palletized cars, and for 50 percent of the cars unit-loaded on slip sheets.

The average cost of unloading the 85 floor-loaded cars was $25.80. The saving per car was $15.30 for both the 42 fully

Table 5.—Rail shipments of low density products (product group II) by handling method

Item	FL	WP	WP/FL	SS	SS/FL	CT	CT/FL	Total
				PERCENT OF PRODUCT GROUP				
Shipments	49.1	24.3	8.7	3.5	13.8	—	0.6	100.0
Pieces	48.9	26.4	8.3	2.3	13.6	—	.5	100.0
Weight	47.8	27.2	10.3	2.4	11.6	—	.7	100.0
Man-hours	63.3	12.8	4.5	3.2	15.2	—	1.0	100.0
				PERCENT OF TOTAL RAIL SHIPMENTS				
Shipments	11.9	5.9	2.1	.8	3.4	—	—	24.4
Pieces	14.1	7.6	2.4	.7	4.0	—	—	28.8
Weight	9.4	5.3	2.0	.5	2.3	—	—	19.6
Man-hours	16.6	3.4	1.9	.8	4.0	—	—	26.2
				AVERAGES				
Cases/car	1,873.0	2,043.0	1,788.0	1,234.0	1,847.0	—	1,897.0	—
Pounds/case	20.4	21.5	26.1	22.1	17.7	—	24.4	—
Tons/car	19.1	21.9	23.3	13.6	16.3	—	23.1	—
				PRODUCTIVITY				
Man-hours/car	8.6	3.5	3.5	6.3	7.2	—	10.7	—
Tons/man-hour	2.2	6.2	6.7	2.2	2.3	—	2.1	—
Cases/man-hour	218.0	579.0	506.0	201.0	254.0	—	172.0	—
				LABOR COST				
Dollars/car	25.8	10.5	10.5	18.9	21.6	—	32.1	—
Dollars/ton	1.4	.5	.4	1.4	1.3	—	1.4	—
Cents/case	1.4	.5	.6	1.5	1.5	—	1.7	—

palletized and the 15 partially palletized cars. The saving per car was $6.90 for the 6 cars fully unitized on slip sheets and $4.20 for the 24 cars partially unitized on slip sheets.

Product Group III

Unit-load shipments of canned goods increased substantially in 1965 over 1964. In this product group 23 percent of the shipments were fully unitized on slip sheets compared to 7 percent on wooden pallets, and 17 percent were partially unitized on slip sheets compared to 3 percent on wooden pallets (table 6).

Direct labor cost per case handled on slip sheets was 40 percent less than the cost per case handled on wooden pallets. This reflects the experience that has been gained both at shipping and receiving levels in handling single-decked slip-sheet unit

Table 6.—*Rail shipments of canned goods (product group III), by handling method*

Item	FL	WP	WP/FL	SS	SS/FL	CT	CT/FL	Total
				PERCENT OF PRODUCT GROUP				
Shipments	50.3	7.0	3.2	22.7	16.8	—	—	100.0
Pieces	45.9	6.6	3.7	22.6	21.2	—	—	100.0
Weight	46.9	6.8	3.9	22.5	19.9	—	—	100.0
Man-hours	70.8	4.1	3.2	9.4	12.5	—	—	100.0
				PERCENT OF TOTAL RAIL SHIPMENTS				
Shipments	13.1	1.8	.9	5.9	4.4	—	—	26.
Pieces	15.6	2.3	1.3	7.7	7.2	—	—	34.0
Weight	17.8	2.6	1.4	8.6	7.6	—	—	38.0
Man-hours	17.9	1.0	.8	2.4	3.2	—	—	25.
				AVERAGES				
Cases/car	1,892.0	1,963.0	2,346.0	2,301.0	2,628.0	—	—	—
Pounds/case	35.0	35.0	35.3	34.3	32.2	—	—	—
Tons/car	33.1	34.3	41.4	39.4	42.3	—	—	—
				PRODUCTIVITY				
Man-hours/car	8.4	3.5	6.0	2.6	4.5	—	—	—
Tons/man-hour	3.9	9.7	6.9	14.8	9.4	—	—	—
Cases/man-hour	223.0	555.0	391.0	833.0	590.0	—	—	—
				LABOR COST				
Dollars/car	25.2	10.5	18.0	7.8	13.5	—	—	—
Dollars/ton	.8	.3	.4	.2	.3	—	—	—
Cents/case	1.3	.5	.7	.3	.5	—	—	—

loads. Fewer new shippers were using slip sheets in 1965 than were using the wooden pallet-exchange program.

Because shippers in this product group have more experience in using the several methods of unit-load handling, the canned-goods group reflected the least handling cost per case of all five product groups. The cost per case of 1.3 cents for floor-loaded shipments — compared to the costs of 0.6 cent for partially unitized shipments and 0.4 cent for fully unitized shipments — shows that part of the long-sought savings in unit-load handling are beginning to materialize.

For the 185 carloads audited in this group, average weight per car for all unitized shipments exceeded that for floor-loaded cars. This confirms the belief that unit loads do not require more space than floor-loaded shipments. Efficient use of the carrier's equipment depends upon the size of the order rather than on the capacity of the equipment.

Product Group IV

Products in glass comprised only about 5 percent of the total rail shipments; so only 33 cars were audited. Two of the methods of handling—fully unitized on slip sheets and partially unitized on pallets—were represented by only one shipment each. Only 34 percent of the shipments were unitized, of which 60 percent were fully palletized and 30 percent were partially unitized on slip sheets (table 7). Most products of this group can be handled more efficiently on pallets because the products are dense and the containers are fragile.

The average labor cost for handling floor-loaded cars was $26.40. Savings per car of $20.40 were attained for fully palletized cars and $14.40 for cars partially unitized on slip sheets.

The number of unitized shipments of heavy packaged goods increased substantially. At the end of 1965, 44 percent of the shipments were unitized. Most of this increase was in cars partially unitized on slip sheets.

Table 7.—*Rail shipments of products in glass (product group IV), by handling method*

Item	FL	WP	WP/FL	SS	SS/FL	CT	CT/FL	Total
				PERCENT OF PRODUCT GROUP				
Shipments	63.6	18.2	3.0	3.0	12.1	—	—	100.0
Pieces	69.8	13.7	3.0	1.4	12.1	—	—	100.0
Weight	65.5	14.3	3.1	2.4	14.7	—	—	100.0
Man-hours	84.6	5.6	.5	2.1	7.2	—	—	100.0
				PERCENT OF TOTAL RAIL SHIPMENTS				
Shipments	3.1	.8	—	—	.6	—	—	4.6
Pieces	4.5	.9	—	—	.8	—	—	6.5
Weight	3.7	.8	—	—	.8	—	—	5.6
Man-hours	4.2	.2	—	—	.4	—	—	5.0
				AVERAGES				
Cases/car	2,409.0	1,658.0	2,204.0	1,042.0	2,188.0	—	—	—
Pounds/case	25.2	28.1	27.2	44.0	32.8	—	—	—
Tons/car	30.3	23.2	30.0	22.9	35.8	—	—	—
				PRODUCTIVITY				
Man-hours/car	8.8	2.0	1.2	4.6	4.0	—	—	—
Tons/man-hour	6.4	11.6	25.7	4.7	8.9	—	—	—
Cases/man-hour	273.0	828.0	1,889.0	226.0	547.0	—	—	—
				LABOR COST				
Dollars/car	26.4	6.0	3.5	13.8	12.0	—	—	—
Dollars/ton	.9	.2	.1	.6	.3	—	—	—
Cents/case	1.0	.3	.2	1.1	.5	—	—	—

Product Group V

Many of the unit loads on slip sheets were moved in the standard 40-foot 6-inch box cars, and little or no damage to product occurred because of the destiny of the items (flour and sugar mostly) and the interlocking of the packages (bags) permitted very little shifting in transit. The average weight of the cars fully unitized exceeded the weight carried in the floor-loaded cars, providing further evidence that the size of the order and not the capacity of the equipment dictates the efficiency in use of space (table 8).

Only two cars partially unitized in clamp blocks were audited. Because these were both experimental shipments, no conclusions can be drawn.

Table 8.—*Rail shipments of heavy packaged goods (product group V), by handling method*

Item	FL	WP	WP/FL	SS	SS/FL	CT	CT/FL	Total
				PERCENT OF PRODUCT GROUP				
Shipments	56.0	11.5	1.9	8.6	20.1	—	1.9	100.0
Pieces	54.5	10.9	1.9	12.0	19.8	—	.9	100.0
Weight	55.6	13.8	1.4	9.1	18.7	—	1.4	100.0
Man-hours	73.2	5.0	.7	3.4	16.6	—	1.1	100.0
				PERCENT OF TOTAL RAIL SHIPMENTS				
Shipments	8.2	1.7	—	1.3	3.0	—	—	14.7
Pieces	9.0	1.9	—	2.0	3.3	—	—	16.4
Weight	10.0	2.5	—	1.7	3.7	—	—	18.1
Man-hours	11.7	.8	—	.6	2.7	—	—	16.0
				AVERAGES				
Cases/car	1,736.0	1,677.0	1,830.0	2,457.0	1,742.0	—	830.0	—
Pounds/case	34.5	42.9	24.6	25.8	32.1	—	52.0	—
Tons/car	29.9	35.9	22.5	31.6	27.9	—	21.5	—
				PRODUCTIVITY				
Man-hours/car	8.9	2.9	2.4	2.7	5.6	—	4.0	—
Tons/man-hour	3.3	2.3	9.0	11.9	5.0	—	5.3	—
Cases/man-hour	195.0	575.0	752.0	923.0	312.0	—	201.0	—
				LABOR COST				
Dollars/car	26.7	8.7	7.2	8.1	16.8	—	12.0	—
Dollars/ton	.9	.2	.3	.2	.6	—	.6	—
Cents/case	1.5	.5	.3	.3	.9	—	1.4	—

The labor cost for handling floor-loaded cars was $26.70. Savings of about $18 per car were found for fully unitized shipments on both pallets and slip sheets. However, savings of $19.50 per car on shipments partially unitized on wooden pallets were nearly double the saving for loads partially unitized on slip sheets because a larger number of cases were placed in the doorway of slip-sheet cars. A forklift equipped with slip-sheet attachments needs more space for maneuvering.

MOTOR-CARRIER SHIPMENTS

Product Group I

Paper products shipped by truck represented only 6 percent of total truck shipments. Of the 118 truckloads audited, 88 percent were floor-loaded and 11 percent were fully palletized. In view

of the preponderance of floor-loaded shipments, by both rail and truck, this group offers a greater savings potential than any of the other product groups. Also, the cost per case handled was found to be from 33 percent to 100 percent greater for floor-loaded shipments of this group (2.0 cents) than for the other product groups (1.0 to 1.5 cents). Per-case handling cost was 0.8 percent case for palletized shipments (fig. 3 and table 9).

It is frequently stated that paper products cannot be unitized economically because of the low density of the products, which requires that the total space in the carrier equipment be utilized. It was found that nearly 75 percent of the floor-loaded shipments did not utilize 90 percent of the available space anyhow.

One manufacturer of paper products who kept records of 8 palletized shipments via motor carrier found that the average weight was 12.3 tons, the average unloading time was 55 minutes

Figure 3.—A comparison of direct labor costs for unloading truck shipments, by product group and handling method. Cost for fully palletized loads is used as basis (100 percent) for comparison.

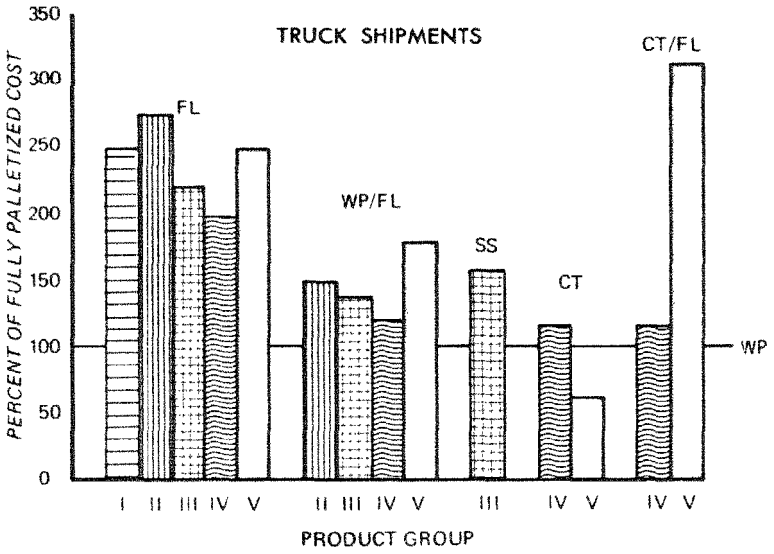

Table 9.—Truck shipments of paper products (product group I), by handling method

Item	FL	WP	WP/FL	SS	SS/FL	CT	CT/FL	Total
				PERCENT OF PRODUCT GROUP				
Shipments	88.1	11.1	—	—	—	—	0.8	100.0
Pieces	89.4	9.9	—	—	—	—	.7	100.0
Weight	84.5	14.9	—	—	—	—	.6	100.0
Man-hours	94.7	4.4	—	—	—	—	.9	100.0
				PERCENT OF TOTAL TRUCK SHIPMENTS				
Shipments	5.2	.7	—	—	—	—	—	5.9
Pieces	2.6	.2	—	—	—	—	—	2.9
Weight	3.0	.3	—	—	—	—	—	3.6
Man-hours	5.6	.3	—	—	—	—	—	5.9
				AVERAGES				
Cases/truck	505.0	448.0	—	—	—	—	—	—
Pounds/case	32.9	52.4	—	—	—	—	—	—
Tons/truck	8.3	11.7	—	—	—	—	—	—
				PRODUCTIVITY				
Man-hours/truck	3.4	1.2	—	—	—	—	—	—
Tons/man-hour	2.4	1.7	—	—	—	—	—	—
Cases/man-hour	146.0	342.0	—	—	—	—	—	—
				LABOR COST				
Dollars/truck	10.2	3.6	—	—	—	—	—	—
Dollars/ton	1.2	.3	—	—	—	—	—	—
Cents/case	2.0	.8	—	—	—	—	—	—

(45 to 61 minutes), and average unloading cost was $2.70 as compared to $10.20 for the average floor-loaded truck.

A recent survey by the Truck Trailer Manufacturers Association showed that 85 percent of the motor carrier equipment being manufactured is at least 40 feet long and has height and width sufficient to double-deck 48-inch by 40-inch pallet loads.

Product Group II

Thirty-seven percent of the 267 shipments of low-density items were in unit loads, of which 97 percent were on wooden pallets. The 80 truckloads fully palletized averaged 0.4 cent labor cost per case handled, compared to the cost of 1.1 cents for handling floor-loaded shipments (table 10).

Table 10.—*Truck shipments of low-density items (product group II), by handling method*

Item	FL	WP	WP/FL	SS	SS/FL	CT	CT/FL	Total
				PERCENT OF PRODUCT GROUP				
Shipments	63.1	30.1	5.7	—	0.7	—	0.4	100.0
Pieces	56.9	32.8	8.7	—	1.0	—	.6	100.0
Weight	59.5	32.3	6.2	—	1.5	—	.5	100.0
Man-hours	75.4	16.5	6.4	—	.9	—	.8	100.0
				PERCENT OF TOTAL TRUCK SHIPMENTS				
Shipments	8.4	4.1	.8	—	—	—	—	13.3
Pieces	8.4	4.8	1.2	—	—	—	—	14.7
Weight	5.7	3.0	.6	—	—	—	—	9.5
Man-hours	10.1	2.2	.9	—	—	—	—	13.4
				AVERAGES				
Cases/truck	1,023.0	1,228.0	1,717.0	—	—	—	—	—
Pounds/case	18.8	17.7	13.0	—	—	—	—	—
Tons/truck	9.6	10.8	11.1	—	—	—	—	—
				PRODUCTIVITY				
Man-hours/truck	3.9	1.7	3.6	—	—	—	—	—
Tons/man-hour	2.4	6.1	3.0	—	—	—	—	—
Cases/man-hour	262.0	692.0	468.0	—	—	—	—	—
				LABOR COST				
Dollars/truck	11.7	5.1	10.8	—	—	—	—	—
Dollars/ton	1.2	.5	1.0	—	—	—	—	—
Cents/case	1.1	.4	.6	—	—	—	—	—

Product Group III

Canned goods represented the largest movement via motor carrier to distribution centers—31.3 percent of the total products delivered by truck. Approximately 60 percent of the shipments were unitized, of which almost 98 percent were palletized. The cost per case for handling palletized loads was less than half the cost for handling floor-loaded shipments. Per-case handling costs for direct labor were 0.5 cent for palletized loads, 0.8 cent for slip sheets, and 1.1 cents for floor-loaded shipments (table 11).

Table 11.—*Truck shipments of canned goods (product group III), by handling method*

Item	FL	WP	WP/FL	SS	SS/FL	CT	CT/FL	Total
				PERCENT OF PRODUCT GROUP				
Shipments	42.6	49.8	6.0	0.9	.5	.2	—	100.0
Pieces	40.7	50.8	6.2	.8	.9	.6	—	100.0
Weight	40.0	52.2	6.0	.7	1.0	.1	—	100.0
Man-hours	58.7	32.8	5.8	.9	1.7	.1	—	100.0
				PERCENT OF TOTAL TRUCK SHIPMENTS				
Shipments	13.6	15.7	2.0	—	—	—	—	31.3
Pieces	12.2	15.4	1.9	—	—	—	—	30.1
Weight	13.7	17.9	2.0	—	—	—	—	34.3
Man-hours	15.2	8.5	1.5	—	—	—	—	25.8
				AVERAGES				
Cases/truck	931.0	1,007.0	983.0	1,044.0	—	—	—	—
Pounds/case	31.0	32.7	30.4	26.1	—	—	—	—
Tons/truck	14.6	16.4	14.9	13.6	—	—	—	—
				PRODUCTIVITY				
Man-hours/truck	3.6	1.7	2.5	2.8	—	—	—	—
Tons/man-hour	4.0	9.4	6.0	5.2	—	—	—	—
Cases/man-hour	255.0	573.0	395.0	373.0	—	—	—	—
				LABOR COST				
Dollars/truck	10.8	5.1	7.5	8.4	—	—	—	—
Dollars/ton	.7	.3	.5	.6	—	—	—	—
Cents/case	1.1	.5	.7	.8	—	—	—	—

Product Group IV

Slightly more than 50 percent of the products in glass moved in unit loads. Of the 228 unitized shipments, 60 percent were fully palletized and 22 percent were partially palletized (table 12).

Though this group as a whole accounted for only 5 percent of the total movement audited in the study, the 451 truckloads accounted for 22.5 percent of the total truck shipments. Handling cost for palletized shipments were 0.5 cent per case compared to 1.0 cent for floor-loaded shipments.

This product group was the most susceptible to damage because of the fragile nature of the containers. However, use of proper pallet patterns and loading practices by the manufacturer was the key to reduced damage to goods.

Manufacturers in this group tend to stack their product too

Table 12.—*Truck shipments of products in glass (product group IV) by handling method*

Item	FL	WP	WP/FL	SS	SS/FL	CT	CT/FL	Total
				PERCENT OF PRODUCT GROUP				
Shipments	49.4	36.2	11.1	0.4	0.9	—	2.0	100.0
Pieces	47.4	34.5	12.0	.6	.8	—	4.7	100.0
Weight	48.4	36.3	11.3	.5	.7	—	2.8	100.0
Man-hours	63.2	22.8	8.7	.4	1.2	—	3.7	100.0
				PERCENT OF TOTAL RAIL SHIPMENTS				
Shipments	11.1	8.2	2.5	—	—	—	—	22.6
Pieces	13.2	9.6	3.4	—	—	—	—	27.8
Weight	11.2	8.5	2.6	—	—	—	—	23.4
Man-hours	14.6	5.3	2.0	—	—	—	—	23.1
				AVERAGES				
Cases/truck	1,201.0	1,190.0	1,357.0	1,610.0	1,249.0	—	2,609.0	—
Pounds/case	24.1	24.9	22.2	18.8	19.8	—	14.2	—
Tons/truck	14.4	14.8	15.0	15.2	12.4	—	18.6	—
				PRODUCTIVITY				
Man-hours/truck	4.2	2.1	2.5	3.2	4.4	—	5.5	—
Tons/man-hour	3.4	7.1	5.8	4.7	2.8	—	3.7	—
Cases/man-hour	283.0	572.0	522.0	501.0	286.0	—	499.0	—
				LABOR COST				
Dollars/truck	12.6	6.3	7.5	9.6	13.2	—	16.5	—
Dollars/ton	.9	.4	.5	.6	1.0	—	.8	—
Cents/case	1.0	.5	.6	.6	1.0	—	.6	—

high on a pallet, and this creates leaning loads that seemed to open up in transit and fall to the trailer floor. Even where bracing was supplied, it did not contain the load properly and permitted cases to fall. None of the restraining devices now in use prevent this type of damage; and manufacturers of this kind of equipment could perform a good service by developing effective restraining devices.

Product Group V

Heavy packaged goods provided data on the clamp-truck method of handling unit loads. The 29 shipments in clamp blocks were all from one manufacturer to one distribution center. The labor cost for clamp-truck handling was 0.4 cent per case compared to 0.6 cent for fully palletized shipments. Analysis of

39 fully palletized truckloads shipped by the same manufacturer to 8 distribution centers showed an almost identical relationship (table 13).

The apparent efficiency of the clamp trucks in unloading was due mainly to the fact that there were 20 palletized units single-decked in each truck and only 10 clamp blocks stacked down the center of the truck; so the palletized truckloads required twice as many lifts as the clamp-truck loads. The clamp loads contained 17 percent less weight per truckload.

Damage to products was higher in the trucks loaded in clamp blocks because approximately 2 feet of space was left on each side of the unit blocks. The requirements for a minimum space of 4 to 6 inches between blocks is one of the problems limiting the use of this system. Compatibility with handling requirements,

Table 13.—*Truck shipments of heavy packaged goods (product group V), by handling method*

Item	FL	WP	WP/FL	SS	SS/FL	CT	CT/FL	Total
				PERCENT OF PRODUCT GROUP				
Shipments	61.6	26.6	5.4	.2	.3	5.4	.5	100.0
Pieces	66.1	22.4	6.1	.1	.2	4.4	.7	100.0
Weight	61.6	26.6	6.2	.2	.3	4.5	.6	100.0
Man-hours	80.6	11.7	5.4	.1	.3	1.2	.7	100.0
				PERCENT OF TOTAL TRUCK SHIPMENTS				
Shipments	16.5	7.2	1.5	—	—	1.5	—	26.9
Pieces	16.2	5.5	1.5	—	—	1.1	—	24.5
Weight	18.0	7.8	1.8	—	—	.1	—	29.2
Man-hours	25.7	3.7	1.7	—	—	.3	—	31.8
				AVERAGES				
Cases/truck	998.0	782.0	1,003.0	690.0	551.0	744.0	754.0	—
Pounds/case	31.1	39.5	34.5	40.0	39.2	34.6	32.6	—
Tons/truck	15.5	15.4	17.3	13.8	10.8	12.8	12.2	—
				PRODUCTIVITY				
Man-hours/truck	5.0	1.7	3.6	2.5	3.2	.9	4.8	—
Tons/man-hour	3.1	9.2	4.7	5.5	3.4	15.8	3.6	—
Cases/man-hour	199.0	466.0	274.0	276.0	174.0	926.0	220.0	—
				LABOR COST				
Dollars/truck	15.0	5.1	10.8	7.5	9.6	2.7	14.4	—
Dollars/ton	1.0	.3	.6	.5	.9	.2	1.2	—
Cents/case	1.5	.6	1.1	1.1	1.7	.4	1.9	—

strength of the containers, stacking patterns, weight of equipment, cost of equipment, and attachment changeover time also influence the economics of the system.

The use of the wooden pallet as the major medium for unit-load handling on motor carriers reflects the restriction on the weight of equipment that can be placed in truck trailers. Hand and electric pallet jacks were used in many places, and 3,000- to 4,000-pound forklift trucks with two tines were used for many of the double-decked loads. The multi-tine and clamp attachments weigh considerably more than other pieces of equipment, and may seriously damage the carriers' trailers.

THE VALUE OF A WOODEN-PALLET SYSTEM

Of the systems now in use, the wooden pallet, used in a national pallet-exchange program, has the best chance to provide consistent savings in unit-load handling. In addition to handling products with available conventional equipment, it is the only system that can be used in a total concept approach to:

Carry raw material into a plant.
Move finished goods from production to storage.
Provide the base for order selecting.
Carry the completed order to a shipping area.
Support the load during transportation.
Carry the product to receiving dock at destination.
Hold the product in a reserve or forward storage area.
Form the base for order selecting to retail stores.
Again carry the product to a shipping area.
Support the load through transportation cycle.
Carry the product to its final destination—the retail store.

The analysis of case histories in the application of unit-load handling in a total concept approach showed that savings of 20 cents per case resulted when piece handling systems were converted to palletized systems.

Current statistics provided by the food industry show that 15 billion cases of goods pass through the total food-distribution system annually. At a savings of 20 cents per case, this indicates

a saving of $3 billion per year. This is equivalent to three times the current net profit of the total industry.

Sixty percent of the savings occur in product flow activities, beginning with receipt of raw materials by the manufacturer through to receipt of the finished goods by the retail food store. Forty percent of the savings occur in paper flow activities, beginning with creation of purchase orders by the buyers through to payment of the final invoice. The savings are distributed as shown in the following tabulation:

	Saving *Cents per case*
Manufacturer	
Raw material:	
Receiving	0.6
Moving to storage	.8
Storing	.2
Finished goods:	
Moving to storage	.1
Storing	.0
Selecting	1.0
Shipping	1.1
	3.8
Carrier	
Pickup	.7
Delivering	.7
	1.4
Distribution Center	
Receiving	1.1
Storing	.2
Selecting	1.0
Shipping	1.1
Other	.4
Backhauling	1.4
	5.2
Retail Store	
Receiving	.5
Storing	.4
Pricing	.9
Shelving	.0
	1.8
Total, product flow	12.2
Total, paper flow	7.8
Total saved per case	20.0

It is relatively easy to establish cents per case saved at each cost center in product flow because the pattern of product flow through different companies is consistent.

It is relatively difficult to establish cents per case saved at each cost center in paper flow because of the variety of forms used both within and between companies. However, in any individual company this saving can be determined accurately.

Discussion

THE VARIABLES IN UNIT-LOAD SYSTEMS

A unit-load handling system has impacts at every cost center all along the line from manufacturer to retailer. To get the full benefit from a unit-load program, one must consider all the many variables.

Few shippers, carriers, and receivers plan and schedule their entry into unit-load handling in enough detail to account for all the variables. As a result, the savings they expect often do not materialize. Many companies concentrate their interest on the loading and unloading, and ignore the impacts that a unit-load system has on other cost centers. The effects of inadequate planning can be seen when the costs for the same type of shipment, handled by different receivers, range widely.

Unit-load handling is affected by:

1. The company policy, methods, personnel practices, physical facilities, equipment, and supervision ratio.
2. Product characteristics and the manner in which the product is loaded at the shipper's plant.
3. The type and condition of the carrier's equipment.

The following list details the various factors that affect any system of unit-load handling in each of the activity locations. The four requirements that have the greatest effect in coordinating or minimizing these variables are:

1. A better understanding of each others' problems.
2. A sincere desire among shipper, carrier, and receiver to cooperate.
3. More supervision by men trained to supervise rather than oversee.

4. A standard, for the entire industry, to measure performance in many of the activity areas.

The variables can be grouped by classes as follows:

Administrative Variables

Major areas in which profits and pitfalls can occur are often overlooked. They should be carefully controlled. To be successful, any program of unitized handling must be tempered with the many variables in real-life operation. Some of the factors most frequently overlooked in the process of installing unitized handling systems are listed below. Too often these functions are still geared to piece handling while the unloading and loading functions are unitized.

Accounting treatment
Assignment of personnel
Buyer cooperation
Coffee breaks
Control reports
Customs
Employee attitudes
Employee rating procedures
Freight allowances
Housekeeping
Packaging
Paperwork flow
Physical facilities
Smoking rules
Split shifts
Supervision
Traffic operations
Training
Type of equipment
Unions
Use of private carrier
Weather

Paperwork at the manufacturer's plant and the distribution centers has grown far too complicated and is a major cause of delay in shipping and receiving unit loads. By realigning the flow from the point at which the purchase order is created, the order can be transmitted, processed, filled, shipped, received, and paid for with 60 percent less paperwork than is now being used.

Rail-Dock Variables

Variables relate directly to the receiving system of the distribution center in terms of personnel, equipment, physical properties, and company policy.

	Distribution center							
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Physical properties:								
Number of rail tracks used	1	2	1	1	1	1	1	2
Dock area covered	Yes	No	Yes	Part	Part	Yes	No	Yes
Company policy:								
Cards spotted on tracks used	15	17	15	10	10	12	15	15
All cars unloaded same day	No	Yes	Yes	No	No	No	No	Yes
Doors opened before shift start	No	Yes	Yes	No	No	No	No	Yes
Unloaders get own pallets	Yes	No	No	No	No	No	No	No
Smoking allowed in dock area	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Receive during day/night	D/N	D	N	N	D	D	D	D
Day shift starts	7am	6am	—	4pm	7:30am	8am	7am	7am
Two-shift operation (rail)	Yes	No	Yes	No	No	No	No	No
Equipment used: EWS = Electrical work saver; F/L = Conventional fork lift; W/F = Walkie fork.								
Floor-loaded product	EWS	EWS	EWS	EWS	F/L	EWS	EWS	EWS
Unitized on wooden pallets	W/F	F/L	F/L	F/L	F/L	—	F/L	F/L
Slip sheets, pull pak	Yes	Yes	Yes	No	No	No	No	Yes
Slip sheets, push pak	Yes	Yes	Yes	No	No	No	Yes	Yes
Personnel practice:								
Number men per car — F/L	2	1	1	2	2	1	1	1
W/P	2	1	1	3	1	1	1	1
S/S	3	1	1	—	—	—	—	2
Additional checks & tally	—	1-2	—	1	1	—	1	—

Truck-Dock Variables

Variables directly related to the receiving system of the distribution center in terms of personnel, equipment, physical properties, and company policy.

	Distribution Center 1	2	3	4	5*	6	7	8
Physical properties:								
Number of receiving dock areas	1	3	1	2	1	1	1	3
Number of receiving bays used	18	25	25	12	12	18	24	30
Covered dock area	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Company policy:								
Unit loads unloaded by carrier/distribution center	DC	C	C	DC	DC	DC	C	DC
Checked/at dock/on truck/in staging area	T	D	SA	D	SA	D	SA	SA
Receiving starts—a.m.	7	6	6	7	7:30	8	7	8:30
Receiving finishes—p.m.	3:30	2:30	2:30	3:30	4:00	4:30	3:30	5:00
Day shift/night shift	D	D	D	D/N	D	D	D	D/N
Equipment used: EWS = Electric work saver; F/L = Conventional fork lift: W/F = Walkie fork.								
Floor-loaded product	F/L	Dolly	EWS	W/F	F/L	EWS	EWS	F/L
Unitized on wooden pallet	F/L	EWS	EWS	W/F	F/L	EWS	EWS	F/L
Slip sheets, multi-tine	X	—	—	—	—	—	—	—
Clamp truck	—	—	X	—	—	—	—	—
Size pallets: 48x40 — 4-way	X	X	X	X	X	X		X
32x40 — 2-way	—	—	—	—	—	—	X	—
48x40 — wing	—	—	—	—	—	—	X	—
40x36	—	—	—	—	—	X	—	—
Personnel practice:								
Number of receiving clerks	3	2	4	4	1	3	3	3
Number of take off men	3	3	0	2	1	2	0	3
Number of put away men	2	3	4	2-3	1-2	2	*	6

*Different type put-away system used.

Physical and Information Flow

AT THE MANUFACTURER

Physical Flow Variables

A B C velocity ratings of products.
Unit package dimensions, capacities, and position in cases.
Pallet load heights and layer patterns.
Case loading, pallet loading, and reloading of pallets for shipment.
Finished goods storage layout.
Order-picking equipment and methods.
Building restrictions evaluation.
Order accumulation for shipment.
Pallet-repair and replacement policies.
Empty pallet removal from rail cars and trailers.
Spotting of rail cars and trailers.
Loading equipment and methods for rail cars and trailers.

Information Flow Variables

Market research.
Market forecasting.
Sales policies and practices.
Order processing procedures.
Production control and planning.
Inventory-control methods and equipment.
Quality-control methods and policies.
Central data-processing systems.
Carrier equipment specification.
Traffic control, rates, and schedules.
Billing methods and procedures.
Damage claim processing.

AT THE CARRIER

Physical Flow Variables

Pool car assignment.
Assignment of specially equipped cars.
Specification of rail car and trailer dimensions.

Planning for carload, less than carload, truckload, and less than truckload shipments.
Private cartage.

Information Flow Variables

Freight allowances.
Demurrage and detention.
Damage-claim processing.
Fleet scheduling.

AT THE WHOLESALER-DISTRIBUTOR

Physical Flow Variables

Spotting of rail cars and trailers.
Preparing for unloading.
Unloading equipment and methods for rail cars and trailers.
Empty pallet replacement in rail cars and trailers.
Clean-up of cars and trailers.
Reloading pallet loads to fit storage racks.
Movement to storage and segregation of items.
Empty pallet storage.
Pallet repair and replacement.
Housekeeping.
Order-picking.
Order assembly and staging.
Truck loading for delivery to retail store.

Information Flow Variables

Data processing.
Inventory control and re-order points.
Order processing.
Received order entry.
Billing and paying.
Delivery scheduling.
Damage-claim processing.

AT THE STORE DELIVERY CARRIER

Physical Flow Variables

Private cartage.
Motor freight carrier.
Cargo space specification.

Information Flow Variables

Route scheduling.

AT THE RETAILER

Physical Flow Variables

Truck and trailer unloading equipment and methods.
Empty pallet return.
Segregation of product for stock or storage.
Replenishment.
Pricing and price marking.

Information Flow Variables

Order preparation.
Receiving order checking.
Price checking.
Shelf-space analysis.

Handling Variables

FLOOR-LOADED SHIPMENTS

Including floor-loaded portions of partially unitized shipments

1. Shifting of cases in transit often requires the use of a crowbar to unload.

2. Removal of cases from the doorway in shipments of product groups I and II often requires either that the top cases be pried under the doorway and dropped, or pulled with some type of hook device, or with the assistance of a second man. Product groups I, II, IV, and V necessitate either building a platform of pallets raised by an electric work saver for the unloader to stand on, or the assistance of a fork truck operator to raise the unloader to the top of the load.

3. Color coding of items facilitates the locating of items and thus avoids mistakes in building a load, and then the need to tear it down and rebuild it.

4. Vertical alignment of items, as opposed to horizontal alignment, facilitates unloading by making it easier for the unloaders to reach cases of an item.

5. Locating the entire quantity of an item in the same place in the car or truck eliminates the need to build a partial load,

remove it until other items are unloaded, and return again to complete the load.

6. Block-loading hinders unloading, especially when the block is high. Items in product groups I and II, when loaded on slip sheets or in clamp blocks to the roof of the carriers' equipment, present a hazard because the block may fall when the pallet pattern is broken in manual unloading. Workmen are hesitant when unloading such shipments and consequently the process is delayed. Items in product groups III, IV, and V are usually smaller and it is difficult to remove them from the far side of a block; and because they are heavy, it is difficult to remove them when they are interlocked with cases on the layer above.

7. Product damage causes lost time in cleaning up, checking wet or creased cases for the presence of additional damage, avoiding odors (vinegar, bleach, ammonia, decay), avoiding slick spots on the floor, and removing cases stuck to each other.

8. Gluing cases together hinders unloading when cases must be handled individually.

9. The use of reefer cars with small doorways and high, rotted rack floors impedes movement of equipment in and out of the car.

10. The use of removable retaining devices increases unloading time because the devices must be removed and stored on the busy receiving dock, and then later must be put back into the car.

11. Loading cases up against the doors, besides damaging products because of the opening and closing of doors, hinders securing the dockplate to the car.

SHIPMENTS ON WOODEN PALLETS

1. Underhang on pallets permits shifting of the load during transit.

2. Not allowing for overhang causes poor alignment at the doorway and allows shifting behind the bulkheads.

3. Not allowing for differences in unit-load heights permits shifting of top layers.

4. Improper use of bulkheads, not closed in proper slots, or side fillers not used to full capacity, will allow shifting.

5. Double-decking unlike items results in double handling

because each pallet must be handled individually instead of two pallets at one time.

6. Double-decking high loads impedes or prevents removal of two pallets at a time.

7. Shipping on broken pallets often requires the transfer of merchandise to another pallet; and in addition the receiver must incur the costs of repair or replacement of the damaged pallet.

SHIPMENTS ON SLIP SHEETS

Slip sheets single-decked or with separators between decks

1. Slip sheet lips often do not show at the front of the load.

2. Cardboard placed on the floor beneath the slip sheets makes it difficult to insert the multi-tines under the load or to pull the slip sheet onto the tines. The chances of damaging the product are increased; and in some refrigerated cars circulation of the cold air is restricted.

3. The cases on the second deck often sag between the separator strips that are often placed between the loads, so that mechanical unloading is virtually impossible.

4. All the conditions necessary to obtain a well-interlocked load on pallets also apply to loads on slip sheets to prevent shifting in transit.

5. The practice of using products as dunnage hinders unloading and requires the use of additional personnel to remove the floor-loaded cases. This practice increases the cost and usurps most of the potential savings. Such loading cannot truly be classed as unitized.

Slip sheets without separators

1. Shippers frequently use lightweight slip sheets, which tear in the process of pulling the load onto the tines of the truck.

2. Loads are often so heavy that the fork truck is pulled into the load instead of the load being pulled onto the fork truck tines.

3. An additional sheet should be placed on top of the first unit load if pull-pak equipment is used to remove the second deck.

4. Cardboard side fillers and center separators that are not properly designed often collapse when cases shift in transit.

Pallet-Pattern Variables

Pallet patterns affect every phase of the system for both the manufacturer and the distributor, because the pattern determines the size, composition, and stability of the unit load. Choice of the right pallet pattern is the most important factor in setting up a pallet-exchange program because distributors and manufacturers must select a pattern that is compatible for both of them; and they must coordinate work methods to speed flow of merchandise between them.

Distributors must write the orders and specify quantities in unit load or full layers of the unit block so that the manufacturer can process the order without reverting to piece handling. Order-picking at both locations can be easy and fast if pallet patterns are designed to be consistent with order quantities and physical facilities. Packages must be sized and shaped to fit the pallet and provide good interlock.

The height of the unit block must be consistent with ceiling heights to utilize the space of the buildings efficiently.

Storage of both raw materials and finished goods at the manufacturer's plant as well as reserve storage and picking-area storage at the distributor is affected by the pallet pattern. Close coordination and compromise is required.

Capital investments by both parties must be carefully analyzed to insure that existing facilities are not rendered obsolete and that new investments are necessary.

Handling equipment at both locations must be considered to insure that the equipment can handle the unit load. Shipping and receiving practices must be coordinated and adjusted to provide minimal cost and maximum efficiency to both parties.

At the manufacturer's plant, pallet patterns affect production planning, scheduling, storing, cooling, production facilities, and warehouse capacity. In assigning pallet patterns to each item in the product line, planning must be detailed and thorough enough to insure compatibility with unitized handling. Paper flow is very often geared to the rate of product flow for piece-handling systems and thus causes delays and increases costs when unitized systems are installed. Freight allowances, demurrage, and deten-

tion charges are affected by the accelerated movement of unit loads. Faster turn-around of carrier's equipment justifies reduced tariff rates and eliminates the costs of holding carrier's equipment at the docks.

At the distributor's plant, stock rotation, inventory systems, and storage facilities are affected by the pallet pattern.

The impacts of these factors on unit-load systems are often underestimated.

OVERS, SHORTS, AND DAMAGE

One of the major benefits expected from unit-load systems of handling food products is a significant reduction in claims for overs, shorts, and damages (OS&D). Records maintained over a period of 27 months on shipments moving in unit loads via the

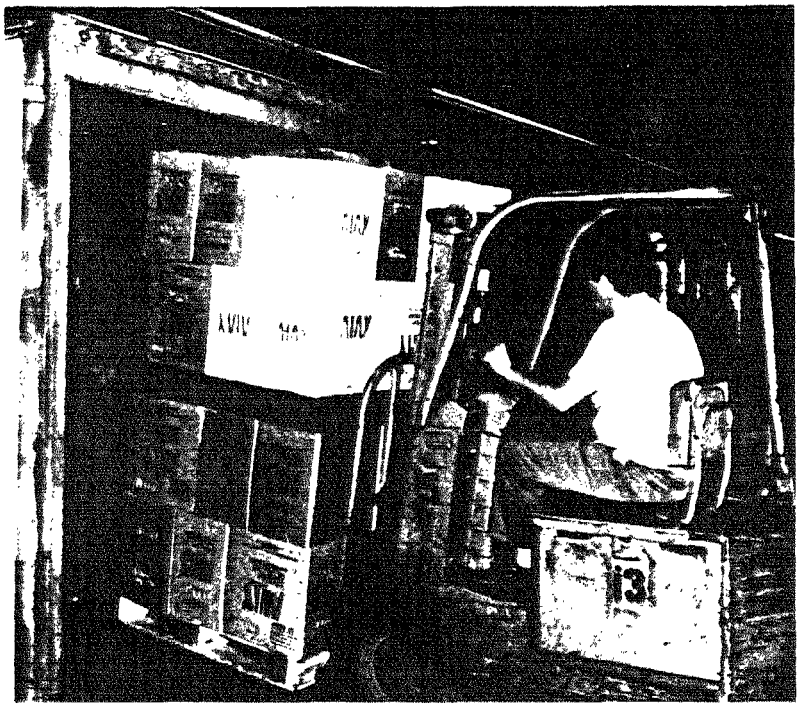

Figure 4.—Minimal handling costs result from the right carton size, right pallet pattern, correct loading, and correct materials-handling equipment operated properly.

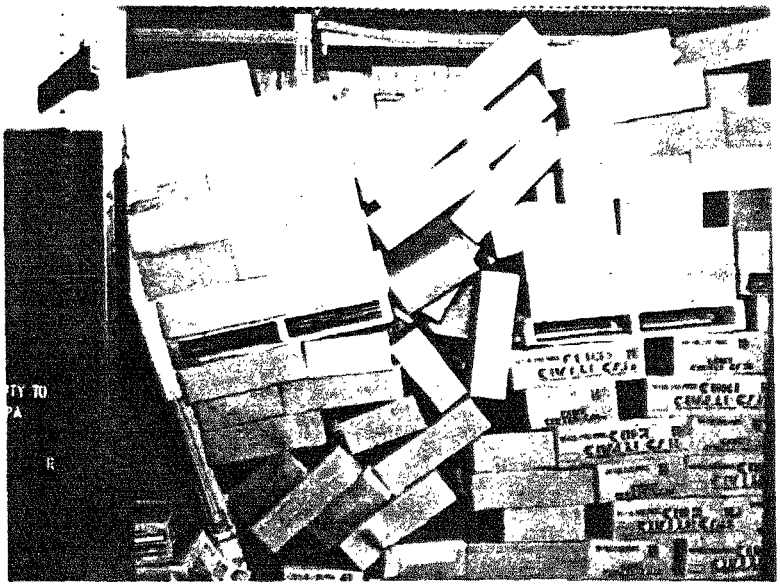

Figure 5.—The load in the doorway of this boxcar has fallen apart, causing damage to the goods. Poor loading methods cause much damage to goods.

several systems used showed that a dramatic reduction in overs, shorts, and damage to product can be attained. For example, claims against the rail carrier have been reduced $132,000 a year at one distribution center.

However, the records also showed that unit-load systems installed without adequate planning and operated by inexperienced personnel resulted more often than not in a dramatic increase in OS&D claims. Three significant findings of this study showed that:

1. Properly planned and executed unit loads in a wooden-pallet-exchange program reduced product claims by 73 percent.
2. Properly planned and executed unit loads in a slip-sheet program reduced product claims by 62 percent (fig. 4).
3. Improperly planned or executed unit loads, in these programs, increased claims 23 to 58 percent beyond that experienced when the same product was floor-loaded (fig. 5).

The specific causes of overs, shorts, and damage were found to be due to poor practices on the part of shippers, carriers, and receivers as noted below.

Poor Practices by Shippers

1. Cases are loaded loose on pallets in car doorways.
2. Bulkhead doors are not latched, are partially latched, or are improperly latched.
3. Incorrect pallet patterns provide poor interlock of cases.
4. Pallets are used as dunnage.
5. Products are used as dunnage.
6. Gluing cases together keeps the goods stacked during transit, but causes considerable damage at subsequent handling stages.
7. Poorly designed packages result in rupture, tearing, and crushing.
8. Paperwork practices designed for piece handling cause errors and delays because the checker cannot keep pace with the rapid flow of products.
9. Poor-quality pallets result in product damage as a result of puncture, tearing, and crushing.
10. Pallet-repair practices materially affect damage, especially where hay-wire practices result in failure during transit.
11. Side fillers are often not extended to provide support to the entire cargo.
12. Slip sheets are often too small, too light, or too heavy, so that the product is damaged in attempting to unload it.
13. Double-decked slip-sheet loads without proper spacers are subject to damage because the handling requires very precise maneuvering of materials-handling equipment.
14. The product is often stacked too high in one unit block so that cases fall off the top or the load falls apart.
15. Overhang of products on the pallet results in crushing, puncturing, and binding of the load so that it cannot be unloaded in units.
16. Underhang of products allows the load to shift on the pallet, resulting in jamming of the load and resultant damage.

17. Placing products, especially product groups III, on slip sheets in trucks requires piece handling to avoid damaging the carrier's equipment.

18. Placing products in clamp blocks in motor carrier equipment may damage the trailer when materials-handling equipment exceeds the structural capacity of the equipment.

19. Attitudes of personnel handling products affect damage directly.

Poor Practices by Carriers

1. The sliding sill on cushion cars is frequently not serviced regularly, resulting in excessive shock.

2. Trailers and cars are not always cleaned properly, resulting in damages to products.

3. The old refrigerator cars with wooden slat floors often have decayed slats so that materials-handling equipment cannot operate.

4. In motor carrier shipments, products improperly stacked will fall in transit and may be seriously damaged.

5. Damage to products often results during switching operations by rail carriers and when trailers are coupled and uncoupled.

6. Doors that do not fit properly result in weather damage to products.

7. Claims for damage are often exaggerated because they are based on inspection by the receiver instead of by the carrier.

8. Switching of partially unloaded cars frequently results in damage to products.

Poor Practices by Receivers

1. The practice of using unloaders to check products at the receiving dock often results in errors.

2. Operators of materials-handling equipment are often inadequately trained.

3. Damage to carrier's equipment at the receiver's dock is caused by careless practices, inadequate training, and improper facilities.

4. The practice of not breaking down loads before switching results in product damage.

5. Poor-quality pallets used in exchange programs cause damage to products.

6. Permitting truck drivers to operate materials-handling equipment frequently results in damage to materials-handling equipment, to products, and to carriers' equipment.

7. Damage claims initiated by unqualified personnel are often erroneous.

8. Attitudes of personnel handling products affect damage directly.

9. Double-decked slip-sheet loads are subject to damage because the handling requires very precise maneuvering of equipment. Proper care is not exercised by drivers in handling these loads.

10. Poor repairs to pallets result in damage to products.

PALLET REPAIRS

Analysis of pallet-repair methods and procedures indicates that both the manufacturers and the distribution centers should repair their own pallets rather than contract for repair or discard the damaged pallets. The initial investment required is about $500. The following equipment is needed:

1. An air-driven power gun to drive screw-type nails. The ability of the power tool to drive the nail in completely with one stroke negates the need for predrilled deckboards and thus reduces the cost of replacement parts.

2. A reel on a balancer arm will be helpful in keeping the air hose off the floor and out of the way of the employee doing the repairs.

3. An oiler to lubricate the equipment will prolong its life and reduce down time. The repairs to the power gun are usually provided at no cost by the supplier, as long as nails are purchased from the same suppliers.

4. Air hoses will normally be about 25 feet long—depending on the physical setup of the repair location.

5. Air compressors are normally available in a maintenance shop. It is strongly recommended that the maintenance group be charged with repairing all pallets at one location. This will cen-

tralize the operation and obviate the need for any accounting allocation—as it can be treated as a maintenance chore in budget and company policy. The practice of having one department repair pallets for another and keep records to charge labor and material costs to other departments is false economy.

6. Space for repairs will usually take 150 to 225 square feet, depending on the volume of pallets repaired. Approximately 200 square feet is adequate space for equipment, materials, and working area for one man to repair 75 pallets daily.

Variable costs will be for nails, labor, and deckboards. For cost-accounting, light and other fixed utility costs can be charged; but the lights will probably burn anyway, regardless of whether pallets are repaired in a location or not. The same applies to heat and other fixed utility costs, which will not change whether pallets are repaired or not.

The following standards for repairing pallets were developed in this study:

1. Productivity: one pallet repaired every 7 minutes.
2. Material: up to three deckboards—18 nails.
3. Cost of nails: about $2.75 per 1,000.
4. Cost of deckboards: $0.08 to $0.26 each, depending on quality, dimensions, champfering, etc.
5. Decision to repair: should be supervised by one person.
6. Location: centralized at one repair station — recommend maintenance department.
7. Flexibility: do not create new job classification.
8. Cost of repair: for labor, deckboards, and nails—up to $0.88 per pallet.
9. Contract cost for repair: $1.25 to $1.75, depending on geographical location.

As a guide to management for measuring the labor costs of handling a case of goods by the various handling methods, the following standards were developed. In working out these standards, we first established the variables that most effect the efficiency of unit loading.

PHILOSOPHY OF STANDARDS

After the variables were documented, the criteria that form the basis of present methods for measuring productivity were examined. These methods reflected the use of controls that were established before the advent of unit-load systems, and that were designed for piece handling. It was concluded that measuring productivity in tons per man-hour is of limited value when pieces are handled individually. However, even in piece handling other actions are performed by the employee besides handling products, and the time to accomplish these actions is included in the measure of tons or pieces handled per man-hour. While it is an accepted fact that the cubic volume and weight of the package also causes variations in productivity in piece handling, they are predictable, and therefore controllable.

In unit-load handling, tons or pieces handled per man-hour do not provide a meangingful measure of productivity of an employee. He performs the same task (driving a forklift truck) regardless of the size, shape, or weight or the unit load. Therefore a different measure of employee productivity is needed in unit-load handling. The most simple, predictable method of measuring unit-load handling is the number of unit loads that can be moved between two given points in a unit of time. Both weight and pieces per man-hour become irrelevant as factors influencing productivity.

The common denominator with which management can measure labor productivity and compare the efficiency of the different systems must be direct labor cost in cents per case handled or cents per unit of product handled. It is essential that the buyer know the profit per item sold in terms of cents per unit of product; and it is equally essential to know the labor cost of handling a case of the product.

Based on this reasoning, and evaluated in terms of the variables found to influence productivity, the following standards are proposed as a guide to management for measuring the labor cost of handling a case of goods, in a product group, for either floor-loaded or unitized systems of handling.

Standard industrial engineering techniques were used in the development of these standards. Each employee was identified with the shipment he unloaded — for the 2,706 shipments received. After this identification of each employee with each shipment, a performance range was established, based on productivity within groups where all conditions were similar—except the employees unloading.

OPERATING STANDARDS

In the majority of the food-distribution centers, the measurements of tons handled per man-hour and pieces handled per man-hour include extraneous actions necessary to complete the major task of unloading. Neither measurement is precise when related to actual productivity of handling the product. However, because the common practice is to employ these measurements within the food industry, they have been included in the standards provided. These extraneous actions, with average times to complete, are shown below and they should not be ignored in using the standards.

Floor-Loaded Rail Shipments

The average times required to complete these actions for a standard box car were found to be 33 minutes. The actions included:

Before unloading.—Break seal, open door, set dock plate, and remove dunnage.

After unloading.—Remove dock plate, close and lock door, put on seal, and gather up and dispose of dunnage.

For a standard box car with interior bars these actions required 61 minutes. The same before- and after-unloading actions are required as for a standard box car, but an additional 28 minutes are required for removing and replacing the bars.

The performance ratings established, based on number of pieces handled per man-hour, are:

Product group	*Performance Rating*			
	Poor	*Fair*	*Good*	*Excellent*
1	—110	111-135	136-150	150+
2	—195	196-240	241-260	260+
3	—200	201-246	247-265	265+
4	—245	246-300	301-325	325+
5	—175	176-215	216-235	235+

This range of performance reflects the curve of better methods used.

Example of use.—Paper products (group I). There are 750 cases in a standard box car. Company policy provides for an unpaid lunch hour and two paid coffee breaks of 15 minutes each. Starting time 7:30 a.m.; quitting time 3:00 p.m.; total work time 6 hours 30 minutes. Actual time required to unload car was 6 hours (chargeable 6 hours 30 minutes) for one man. Seven hundred and fifty cases divided by 6.5 hours equals 116 cases per man-hour (fair performance). The direct labor rates of $3 per hour divided by 116 cases per hour equals 2.5 cents direct labor cost per case handled.

Unitized Rail Shipments

Standards for unit-load handling by wooden pallets and slip sheets reflect the characteristics of the systems themselves. To illustrate this relationship, following is a comparison of the operation of the two systems:

Wooden pallets	*Slip sheets*
Approach, enter, transport.	Approach, pause, line up, enter or pull, transport, place on pallet.
System employed in receiving, storage, selecting, shipping.	System employed in receiving only.
Two unit loads may be handled as one load.	Each unit load is handled individually.
Load may be handled from four sides.	Load can be handled from one side only.
All types of hand or motorized trucks may be used.	Only motorized trucks with special attachment may be used.

The actions before and after the unloading of the product require less time in cars specially equipped for unit-load handling than in a standard box car.

For a DFB (damage-free bulkhead) car, these actions require 18 minutes. They include:

Before unloading.—Break seal, open door, set dock plate, unlatch pivot-type bulkhead door, and recess side fillers.

After unloading.—Pull out and set side fillers, replace exchange pallets or cardboard side fillers or other type unit-load equipment used with slip sheets, latch bulkhead door and remove dock plate, close door and put on seal, and dispose of dunnage if used.

It is more efficient tc have different employees unload the floor-loaded portions of unitized cars than to have the employee handling the unit loads do it.

Standards for unitized rail shipments are:

	Minutes per unit load	
	Single-deck	*Double-deck*
Wooden pallets	1.0	1.5*
Slip sheets	2.0	4.0**

*Top and bottom handled as one unit load.

**Top and bottom handled as separate loads—(2 minutes each).

Properly unitized shipments on slip sheets require only one man in the car (the equipment operator). However, an additional man is often needed to assist the operator. The above standards for unitized shipments on slip sheets do not provide for this additional man.

Example of use.—With wooden pallets (WP)—1,850 cases in car on 32 pallets—double-decked equals 16 lifts. With slip sheets (SS)—1,850 cases in car on 32 slip sheets—double-decked equals 32 lifts.

	Minutes to handle unit loads per car	+	*Minutes to handle other action*	=	*Total minutes to unload car*	×	*Labor rate per man-hour*	=	*Total labor cost*	÷	*Number cases in car*	=	*Cents per case labor cost*
WP	24		18		42		$3.00		$2.10		1,850		0.13
SS	64		18		82		$3.00		$4.10		1,850		0.22

If this were a floor-loaded car and the standard for this product were 300 cases per hour, it would be expressed as follows:

1,850 ÷ 300 = 6.2 hours

6.2 × $3.00 = $18.60 ÷ 1,850 = 1.00 cent per case

Most cars containing unit loads on wooden pallets will have 44, 56, or 64 pallet loads in the car. This 32-pallet example was used for comparison purposes with the slip-sheet cars.

Floor-Loaded Truck Shipments

The performance ratings established, based on number of pieces handled per man-hour, are:

Product group	*Performance rating*			
	Poor	*Fair*	*Good*	*Excellent*
1	—130	131-160	161-175	175+
2	—200	201-250	251-280	280+
3	—230	231-280	281-305	305+
4	—255	256-300	301-340	340+
5	—180	181-220	221-240	240+

Unitized Truck Shipments

Wooden pallet	*Minutes per unit load*	
	Single-decked	*Double-decked*
Hand pallet jack	1.50	—
Electric pallet jack	1.25	—
Forklift truck	1.00	1.25

EFFICIENCY RATING OF SHIPPERS

While the different systems of receiving and handling products at food-distribution centers cause fluctuations in labor costs, poor loading practices of shippers will also have a substantial effect on these costs. By using the employee-productivity standards provided in this report, it is possible to rate the shippers and isolate those practices that adversely affect the handling efficiency of the distribution center. Figure 6 is an example of one shipper rated at 10 different distribution centers. Though fluctuations are caused by variations in handling practices between distribution centers, the consistent pattern of poor performance indicates a need for improvement by this shipper in his loading practices (fig. 6).

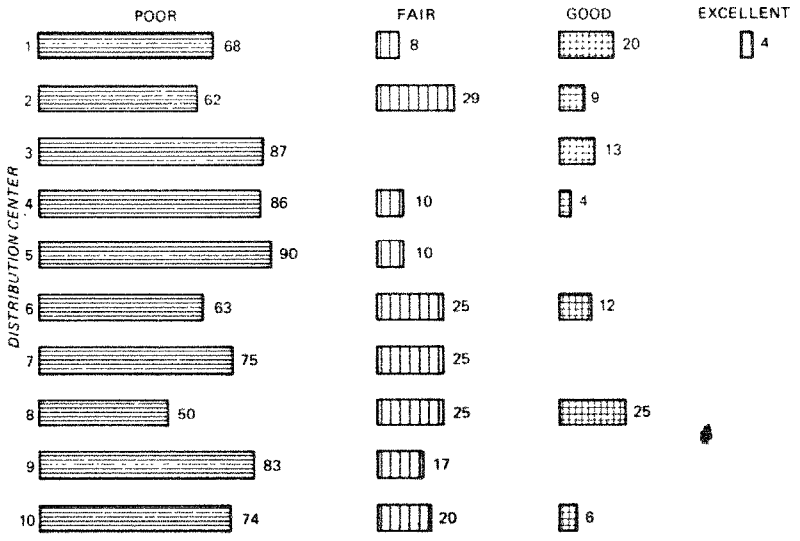

Figure 6.—How efficiently has the shipper prepared the shipment? These ratings of shipments from one shipper were based on productivity performance at 10 distribution centers. Values shown are percentages of total shipments to distribution center.

Summary & Conclusions

The concept of unit-load handling is applicable to the food industry. It can provide substantial benefits if companies entering such a program plan and schedule their entry carefully. In the planning, a company must recognize the limitations of the system and provide a framework that can be used under normal operating conditions by present personnel.

These conclusions are the result of (1) continuous work with manufacturers, carriers, receivers, and trade associations during the last 5 years in developing cost-reduction programs for the handling and physical distribution of food products; and (2) a detailed analysis of 2,706 shipments moving from 422 manufacturers to 10 major food-distribution centers.

Present methods used by most manufacturers and food-distribution centers in their shipping and receiving operations are

geared to piece handling. These systems and methods are not suited to the accelerated pace of modern materials handling.

The general impression in the industry that a compromise system of unitization is better than no system at all is erroneous. Many companies involved in unit-load programs profess to be employing the total concept approach, when in reality they concentrate only on the loading and unloading of products and ignore the full benefits that are possible at every cost center from the receiving dock of the manufacturer to the receiving dock of the retail store. The full benefits cannot be obtained unless the program follows the total concept approach.

Unit loading can produce substantial savings. They will vary between $14 and $19 per car under daily operating conditions depending upon the nature of the product, the ability of personnel, size and weight of cases, personality of the company, supervision ratio, and use of workaday standards to measure productivity. Savings as high as $50 per car have been attained in isolated instances—a measure of the gap between the best and the worst handling practices. The potential economies for the supplier, the carrier, and the receiver are sufficient to justify the investment each must make to weld together the parts of a unit-load program.

The wooden-pallet system is the only system that can be applied in a total concept from the handling of raw materials, through manufacture and distribution, to the retail store. Though some of the other handling systems can be shown to be more efficient within a given plant or in a given situation, none can be applied in a total concept throughout the entire system.

The wooden pallet-exchange program still faces substantial problems in uniformity of pallet quality and in instituting procedures to foster confidence in the program. One of the most difficult problems is policing the quality of the exchange pallets.

The greatest single value of a successful pallet-exchange program is the simplicity with which it can operate. The wooden pallet can be handled with conventional equipment that most companies of all sizes already have, such as hand pallet jacks,

electric pallet jacks, or forklift trucks. It requires no additional capital investment in special equipment.

Slip sheets were used most extensively in shipment of canned goods. The introduction of pull-pak has created several additional problems that must be corrected to gain the promised savings. It is a sound materials-handling principle but is difficult to apply in day-to-day operations.

The clamp truck system is used to a limited extent at distribution centers. Several problems connected with this system must be solved before it can be widely accepted. Experimental programs are continuing with this system for motor carrier transportation.

Paperwork at the manufacturer's plant and the distribution center has grown far too complicated and is a major cause of delay in shipping and receiving unit loads. By realigning the flow from the point at which the purchase order is created, the order can be transmitted, processed, filled, shipped, received, and paid for with 60 percent less paperwork than is now being used.

Pallet patterns also affect handling efficiency at the manufacturer's level, during shipment, and at the distribution center. The size of the cases and the arrangement of them to provide a stable pallet load requires considerable thought and detailed planning.

A new era in overs, shorts, and damage has evolved since the birth of the unit-load concept. Properly planned unit loads reduce damage to products by 62 to 73 percent: improperly planned unit loads increase the damage to products 23 to 58 percent beyond that experienced with the same product floor-loaded. It is a paradox that the same system, which provides the means of reducing claims, will also increase claims when improperly applied.

A National Pallet-Exchange Program

Since the idea of a national wooden pallet-exchange program was first proposed about 7 years ago, positive progress has been made in spite of a multitude of problems. Some of the more significant accomplishments to date are:

- A specification for a standard size and quality of pallet has been accepted by leading associations of the food industry.
- Thirty-nine companies have initiated and are operating exchange programs with their customers.
- Carriers, both rail and motor, have provided incentives in their tariffs for unit loads on wooden pallets.
- Rail carriers have invested millions of dollars in special equipment designed specifically for unit-load systems in the food industry.
- Trade associations have held hundreds of committee meetings and seminars on the subject of unit-load handling.
- Government personnel have spent thousands of man-hours developing information on the subject.

Such accomplishments demonstrate real progress, and bring the goals of a national program closer to reality. Industry has brought this program to the point where full-time personnel ought to be devoted to organizing and operating a national program to realize its full potential.

A master working plan is needed to analyze the wealth of information available and to prepare a national program acceptable to, and for the benefit of, all participants. This master working plan should provide for:

- Operating rules, systems, and procedures for all participants, in clear language.
- Establishment of the responsibilities of participants in the program.

- Inspection service on the quality of pallets being exchanged in the program.
- Research studies and test programs on new methods, for the benefit of all participants.
- Training programs to reduce damage both to product and to carrier equipment.
- Accumulation and analysis of statistics that will provide trends as to costs and savings in all types of unit-load programs.
- Guidance and assistance to companies when installing an exchange program.
- Preparation of a monthly or bi-monthly bulletin for all members that would include: latest news on unit-load handling, and results of research and test programs; a "Question Box" and "Gripe" section which would not identify the writers, but which would bring into focus the problems of the industry; and articles on meetings, events, etc., that discuss the subject of unit-load handling.

In addition to laying the groundwork for an orderly implementation of a national wooden pallet-exchange program, the master working plan should also provide practical answers to questions that have plagued the members of industry for the last 7 years every time the concept of such a program has been discussed. Some of these questions are:

Why must an exchange program start with the customer and work back?

Are administrative, bookkeeping and record-keeping costs necessary?

Should there be a legal and binding contract between the partipants?

Who should be responsible for the actions of the manufacturer, the carrier, and the customer in the program?

Why must the program operate with common ownership of pallets rather than individual ownership?

Which activities of the manufacturer, the carrier, and the receiver benefit from unit-load handling? How can they benefit?

Why do they benefit?

What are the limitations in a pallet-exchange program?

Why is agreement needed in a step-by-step approach as the program grows?

Why are the numbers of layers important for some products and unimportant for others?

Why are productivity standards needed for specific product groups rather than an average for all product groups?

Who benefits most in unit-load handling—the manufacturer, the carrier, or the customer?

What should be done to the shipper or customer who cheats on pallet quality?

What conditions now existing at manufacturer, carrier, and receiver levels cause the most damage to product?

How much money does a rail carrier invest in the specially equipped 50-foot 6-inch DFB car?—the 60-foot car?

What is the weight of a conventional forklift truck — with two tines? With special attachments for push-pak? For pull-pak? For clamp truck?

How much does each of the above attachments cost? What is their total use?

Why is the 48 x 40-inch, 4-way, non-reversible, notched-stringer, flush-type pallet best for the exchange program?

What quality wooden pallet is best in an exchange program? What is the break-even point in quality?

Does the success of a national program depend on more than one type of pallet because of geographical differences?

Why must specifications for a pallet that will be used in an exchange program also cover specifications for materials used in repairing these pallets?

How can introduction of inferior pallets into the exchange program be avoided?

Who should provide the pallets for the program?

Who should repair the pallets in the program?

How many pallets are necessary for each participant in an exchange program?