A COMPARISON OF UNLOADING UNITIZED TRUCK LOADS OF GROCERIES AT FINAL DISTRIBUTION WAREHOUSES -- PALLETS VERSUS SLIPSHEETS --

By

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The author evaluates the efficiency of unitized truck loads utilizing pallets versus slipsheets.

INTRODUCTION

Considerable information has been published concerning the potential savings available to manufacturers and carriers when slipsheets replace pallets for unitizing grocery products in over-the-road trucks. However, little information has been published concerning the impact of unloading slipsheets at the final distribution warehouse.

OBJECTIVE

The objective of this paper is to provide a comparison of unloading unitized truck loads of grocery products at final food distribution warehouses when slipsheets and pallets are the unitizing platforms.

PROCEDURE

In order to assist in fulfilling the objective, the following hypothesis was tested: there was no significant difference at the .01 level in the means of the time requirements for unloading grocery products at final food distribution warehouses among unitized shipping techniques (pallets and slipsheets).

Data for the study were obtained by conducting time studies of truck unloading operations. In order to achieve accuracy in the study (a 95 percent confidence level and $\pm$ 5 percent precision) the following equation was used to determine the number of observations required for each element:

$$N^1 = \left(\frac{40\sqrt{N\Sigma X^2 - (\Sigma X)^2}}{\Sigma X}\right)^2 \quad 1/$$

Where N equals the required number of observations to predict the true time within plus or minus 5 percent precision and the 95 percent confidence level. N equals each stop watch reading or individual observation. As a result, the number of observations ranged from 219 to 481 for the different elements. The data were analyzed on the basis of an average slipsheet truck load and an average pallet truck load of grocery products. The average truck loads were based on weights, number of cases, and number of unit loads in the truck loads studied as follows:

1. The average slipsheet truck load:

   a. Weight: 25,506 pounds (range = 9,600 - 45,549).
   b. Number of cases: 1,738 (range = 600 - 2,775).
   c. Number of slipsheets: 33 units (range = 14 - 74).
   d. Case weight: 14.68 or 15 pounds (range = 6 - 41).

2. The average pallet truck load:

   a. Weight: 28,402 pounds (range = 9,900 - 47,880).
   b. Number of cases: 1,178 (range = 400 - 2,400).
   c. Number of pallets: 23 units (range = 10 - 37).
   d. Case weight: 24.11 or 24 pounds (range = 9 - 52).

Therefore, the average slipsheet truck load studied contained 2,896 less pounds than the average pallet truck load studied (difference is not significant), 560 more cases of produce (difference is significant at the .01 level), 10 more unit loads (difference is significant at the .01 level) and per case weight was 9 pounds less (difference is significant at the .01 level).

PRODUCT UNLOADING

Pallet truck loads studied were unloaded with electric pallet jacks by the truck driver and placed in the staging area on the receiving dock. Slipsheet truck loads were unloaded with forklift trucks equipped with push-pull attachments by an employee of the receiving firm. In addition to the forklift operator, another person (the truck driver in all observations) was required to position empty pallets in the staging area on which to put the slipsheet loads. Thus, unloading slipsheets requires two people and unloading pallets requires one person.

For purposes of the study the unloading operations were divided into common and specific elements. The common elements applied to both slipsheet and pallet loads and were: entering the vehicle, engaging the unit load and removing it from the vehicle, traveling with the unit loading and parking it, and returning to vehicle. During the course of our observations, the common elements occurred 100 percent of the time in both operations. The specific elements occurred less frequently. In slipsheet unloading, breaking down and doublestacking units occurred in 50 percent of the observations and pallet positioning delays in 45 percent. For pallet unloading, placing empty pallets in the truck to replace the ones unloaded occurred in only 5 percent of the observations.

Unloading Time

According to the results of this analysis, the time required to unload slipsheet loads of product amounted to 44.8 forklift operator minutes per truck load, 1.76 minutes per 1,000 pounds, and 25.78 minutes per 1,000 cases (Table 1). In comparison, the time required to unload pallet loads of products amounted to 29.10 minutes per truck load, 1.02 minutes per 1,000 pounds, and 24.70 minutes per 1,000 cases (Table 2). The difference between the total truck load times (44.8 minutes slipsheet - 29.10 minutes pallets = 15.7 minutes more for slipsheets) is significant at the .01 level. The hypothesis that there was no significant difference at the .01 level in the time requirements was consequently rejected.

The difference between the unloading time requirements becomes even more striking when converted to total worker-minutes. As discussed earlier, two people are required for unloading slipsheets but only one is required for unloading pallets. Therefore, 89.6 worker-minutes (about 1.49 worker-hours) is required for unloading a truck load of slipsheeted products, and 29.10 worker-minutes (about .48 worker-hour) is required for unloading a truck load of palletized products -- a difference

TABLE 1. FORKLIFT OPERATOR TIME REQUIRED TO UNLOAD SLIPSHEET UNIT LOADS OF GROCERY PRODUCTS FROM OVER-THE-ROAD TRUCKS, BY ELEMENT, TRUCKLOAD, 1,000 POUNDS, AND 1,000 CASES

Element Description	Basic Elemental Time	Frequency of Occurrence	Weighted Elemental Time
	Worker-minute	Percent	Worker-minute
Travel into truck	.216	100	.216
Engage product and remove	.476	100	.476
Travel and place on pallet	.423	100	.423
Return to truck	.136	100	.136
Let down and/or double stack	.745	50	.377
Delay for pallet	.316	45	.142
Total forklift operator worker-minute per product removal trip			1.770
15 percent personal and fatigue allowance			.266
Standard forklift operator worker-minute per product removal trip			2.036
Standard forklift operator worker-minute per truck load (22 trips per truck load)			44.8
Standard forklift operator worker-minutes per 1,000 pounds (25,508 pounds per truck load)			1.76
Standard forklift operator worker-minutes per 1,000 cases (1,738 cases per truck load)			25.78

of 60.5 worker-minutes (about one worker-hour) in favor of the palletized loads.

Unloading Costs

The costs for unloading slipsheets and pallets also include equipment and labor costs. The equipment costs amounted the $2.21 and $.26 per truckload, respectively, for slipsheets and pallets (Table 3). Labor costs per truck load amounted to $8.74 for the slipsheets and applied to only the forklift operator.[2] No labor costs were charged to the warehouse for pallet unloading nor for positioning of pallets for slipsheets since the truck drivers performed these activities. However the cost of the driver are part of the food distribution system costs which will be discussed later.

The total warehouse labor and equipment costs for unloading slipsheet loads amounted to $10.95 ($2.21 for equipment + $8.74 for labor) per truckload, $.43 per 1,000 pounds, and $6.30 per 1,000 cases. The total labor and equipment costs for unloading pallet loads amounted to $.26 per truckload, $.009 per 1,000 pounds, and $.22 per 1,000 cases. These cost differences amounted to $10.69 per truck load, $.421 per 1,000 pounds, and $6.08 per 1,000 cases in favor of the palletized loads. At the final distribution warehouse, the skepticism expressed by many managers concerning the impact on their unloading operations and costs resulting from adopting slipsheets appears to be justified.

TABLE 2. TIME REQUIRED TO UNLOAD PALLET UNIT LOADS OF GROCERY PRODUCTS FROM OVER-THE-ROAD TRUCKS BY ELEMENT, TRUCKLOAD, 1,000 POUNDS, AND 1,000 CASES

Element Description	Basic Elemental Time	Frequency of Occurrence	Weighted Elemental Time
	Worker-minute	Percent	Worker-minute
Travel into truck	.201	100	.201
Engage produts and remove	.371	100	.371
Travel and park pallet load	.297	100	.297
Return to truck	.152	100	.152
Load empty pallets	2.598	.05	.130
Total worker-minutes per product removal trip			1.151
15 percent personal and fatigue allowance			.172
Standard worker-minutes per product removal trip			1.323
Standard worker-minutes per truck load (22 trips per truck load)			29.10
Standard worker-minutes per 1,000 pounds (28,402 pounds per truck load)			1.02
Standard worker-minutes per 1,000 cases (1,178 cases per truck load)			24.70

In order to establish how the food distribution system is affected, it is assumed shipping on pallets is the norm. Therefore, cost changes should be measured relative to unloading pallets. To develop this comparison the cost for the truck driver's time[3] must be added to the warehouse costs for unloading slipsheets and pallets. The cost for the truck driver's labor for unloading pallets amounted to $6.40 per truck load, and for unloading slipsheets amounted to $9.86 per truck load -- a difference of $3.46 per truck load in favor of unloading palletized loads. Adding the costs of the truck drivers to warehouse costs results in the cost for unloading pallets to be $6.66 per truck load, $.23 per 1,000 pounds, and $5,65 per 1,000 cases. The costs for unloading slipsheets becomes $20.81 per truck load, $.81 per 1,000 pounds, and $11.97 per 1,000 cases. The differences, all in favor of unloading pallets, are $14.15 per truck load, $.58 per 1,000 pounds, and $6.32 per 1,000 cases.

OBSERVATIONS

During the study several hinderances to efficient unloading of slipsheets caused by improper procedures during both the loading and unloading operations were observed.

Loading Operations

Four improper procedures occurred during the loading operations. First, slipsheets were placed in the truck so the lip for grasping the slipsheet was not exposed to the forklift operator. Not having the lip of the slipsheet exposed increased the "engage and out" element up to 3 minutes (compared with the normal time of .476 minute) and caused product damage. Second, products

TABLE 3. EQUIPMENT COSTS FOR UNLOADING UNIT LOADS OF GROCERY PRODUCTS FROM OVER-THE-ROAD TRUCKS, BY TWO UNITIZING METHODS

Unitizing Method	Equipment Description	Initial Cost[a]	Annual Depreciation Cost[b]	Annual Interest Cost[c]	Annual Repair Cost[d]	Total Annual Cost	Hours Used/ Year	Total Cost/ Hour
		$	$	$	$	$	Hours	$
Slipsheet	Forklift truck with push/pull attachment	29,000	3,412	2,300	435	6,147	2080	2.96
Pallet	Electric palletjack	5,200	612	416	78	1,106	2080	.53

[a]Source: Washington, D.C. area distributors. [b]Straight line with no salvage value and 8.5 years useful life. [c]Simple interest at 16 percent of average value. [d]Based on 1.5 percent of initial cost.

were stacked too high on slipsheets for the forklift operator to remove the unit loads through the truck opening causing a delay to remove the top one or two tiers. Third, two or more partial slipsheet units were in the same shrink wrap causing delays while the shrink wrap was removed so the units could be separated and placed on pallets. Finally, the entire unit (including the slipsheet) was enclosed in shrink wrap causing delays because the shrink wrap usually became caught on the forklift truck.

Unloading Operations

Two hindrances to efficient unloading of slipsheets were observed. First, warehouse employees did a poor job policing pallets when they removed them from pallet rack slots to be returned to the receiving dock. Most truck drivers did not pay attention to the condition of the pallet they placed on the floor for the slipsheet. When the forklift operator saw a bad pallet, a delay occurred while the bad pallet was removed and replaced. Second, most forklift operators assumed all truck drivers were familiar with slipsheet unloading and automatically started positioning pallets correctly. Such was not the case, truck drivers should have been asked if they were familiar with slipsheet unloading. If they were not familiar with slipsheet unloading, the forklift operator should have taken a minute or two to explain what was expected from the truck driver.

Each of the observed hinderances mentioned above contribute to unloading problems with products unitized on slipsheets in over-the-road trucks. Eliminating the hindrances falls on all parties involved.

SUMMARY AND CONCLUSION

The objective of this paper is to provide a comparison of unloading unitized truck loads of grocery products at final food distribution warehouses when slipsheets and pallets are the unitizing platforms. In order to assist in fulfilling the objective, the following hypothesis was tested: there was no significant difference at the .01 level in the means of the time requirements for unloading grocery products at final food distribution warehouses among unitized

shipping techniques (pallets and slipsheets).

According to the results of the analysis, unloading grocery products unitized on slipsheets took 15.7 more total minutes per truck load (difference is significant at the .01 level causing rejection of hypothesis), 60.5 more worker-minutes per truck load, had warehouse costs amounting to $10.69 more per truck load, and total unloading costs amounting to $14.15 more per truck load than unloading grocery products unitized on pallets.

The analysis appears to justify the skepticism expressed by many managers of final food distribution warehouses concerning the impact of slipsheets on their receiving operations. The analysis also shows that managers of final food distribution warehouses should insist savings accrued to other members of the food distribution as a result of wide-spread adoption of slipsheets be passed on to them to compensate for the increased unloading cost.

Observations made during the study pointed out improper procedures during loading and unloading greatly hindered efficient unloading of products on slipsheets. Elimination of the observed hinderances falls upon all parties involved.

FOOTNOTES

[1]Ralph M. Barnes. Motion and Time Study, 6th Edition (New York: John Wiley and Sons, Inc., 1968) p. 360.

[2]Based on $11.70 per hour, as reported by firms cooperating in the study.

[3]Based on $13.21 per hour, as reported by motor freight firms in the Washington, DC area.