

Efficiency in Fruit Marketing

in-plant transportation equipment for fresh fruit packing houses compared for seasonal cost and efficiency

L. L. Sammet

Part VI of a series of reports of studies on the effects of packing-house equipment, plant layout, and work methods on efficiency and costs. These studies have been made co-operatively by the University of California Giannini Foundation of Agricultural Economics, and the Bureau of Agricultural Economics, United States Department of Agriculture, under the authority of the Research and Marketing Act.

Moving fruit and materials from one point to another within a packing house represents much of the work involved in packing fresh fruit. Hand trucks, powered hand trucks, fork-trucks, and various types of gravity and powered conveyors are used for in-plant transportation.

Load capacity varies with the equipment and the material transported. Among the packing houses co-operating in this study the loads of full field lugs, varied from five to six lugs with hand trucks and from 30 to 42 lugs with fork-trucks. The load sizes of empty standard packing boxes ranged from 14 to 21 boxes with hand trucks and from 72 to 96 boxes with fork-trucks.



The use of different types of equipment results in wide differences in costs. This is illustrated in the summary of transportation costs for 15 California pear and apple packing plants given in the table in columns 2 and 3 on page 12. To permit inter-plant comparisons, the costs—transportation labor, and total plant labor—were computed on the basis of an eight-hour work day at rates of output typical for each plant. The labor costs in each plant were adjusted to reflect uniform wage rates that are typical for the industry.

Labor Cost

In the hand truck plants, labor costs for transportation varied from \$0.645 to \$1.140 per 1,000 pounds of fruit received.

In the partially mechanized plants, the range was from \$0.353 to \$0.637 per 1,000 pounds received, and in the fully mechanized plants, the range was from \$0.209 to \$0.338. Comparison of the high- and low-cost plants shows the transportation labor costs to be more than five times higher in Plant L than it is in Plant P.

Compared to total direct labor, the transportation labor cost amounted to 16.1% in Plant L and only 3.7% in Plant P.

The figures in the table indicate that mechanization of the transportation operations can result in large savings in labor cost. This indication can easily be misleading, however, because of the many variations between plants that are not included in the data summarized in the large table on page 12.

Building Designs

An important factor in comparing costs in hand truck and fork-truck plants is the difference in type of building construction required for operation with these two kinds of equipment.



Equipment for transporting fruit and materials in pear and apple packing plants. Left: Hand truck. Above: Fork-truck. Right: Powered hand truck.

The differences in building design may affect construction costs and should be considered in a comparison of transportation costs. However, estimates of building replacement costs indicate that the building costs—for either of the two types of equipment—balance fairly well.

This is particularly true if the comparison is made in terms of estimated annual charges which reflect building expenses such as depreciation, repairs, taxes, and so on. Hence, building costs can be ignored in comparing transportation costs with fork-truck and hand truck equipment.

In addition to differences in building design, there are several other factors affecting transportation costs that are not considered in the table. These include the plant layout, the proportion of the total work time of the transportation workers that is actually spent in productive work, the size of load transported per trip, and the cost of equipment. Equipment costs are particularly important. To purchase a fork-truck, for example, requires roughly 50 times the capital outlay necessary to purchase a hand truck and this difference must be considered in a comparison of costs.

The nature of the variations between plants makes it difficult to judge their effect on actual costs and conclusions drawn from plant cost records may easily be misleading, even when standardized to the extent that they are in the large table on the next page.

Model Plant Estimates

These difficulties in comparing costs with different types of equipment can be overcome, in part, by making cost comparisons in terms of estimates of transportation costs that may be expected when different types of equipment or dif-

Continued on next page



EFFICIENCY

Continued from preceding page

ferent methods are used in a typical, or model, plant. In making such estimates, the major elements affecting costs—other than the factor being compared—are standardized.

The initial step in estimating transportation costs for a standardized operation is to determine the cost per season for each item of equipment or for each category of labor. Such estimates involve two categories of cost—the annual charges for equipment which are to a large extent independent of hours of use per season; and the costs directly associated with use, such as operating labor and fuel.

Fixed Costs

The annual charges—fixed costs—for equipment might be described as the costs-of-ownership, which include taxes, insurance, interest on the investment, repairs, and depreciation.

A precise value for the annual fixed costs is impossible to obtain but estimates based on commonly used cost rates are given in the following table:

Replacement Costs, Approximate Use-life, and Estimated Annual Fixed Costs for In-plant Transportation Equipment.

Type of equipment	Estimated use-life, Years	Annual charge, per cent of replacement cost ^a	Estimated replacement costs, Dollars ^b	Estimated annual charge, Dollars
Conveyor;				
gravity,				
8' sec.	20	13.0	25	3.20
power				
20' sec. ^c	20	15.0	650	98.00
power				
100' sec. ^c	20	15.0	1,200	180.00
Hand-truck,				
each	15	13.0	66	10.00
Fork-truck,				
each	10	18.0	3,300	595.00
Powered hand truck,				
each	10	18.0	1,600	290.00
Pallets	10	18.0	3½	.60

^a Includes allowance for interest, taxes, insurance, repairs; also depreciation, based on estimated use-life.

^b Estimated at 1950 price level.

^c For steel-roll conveyor.

Annual fixed costs can be estimated for each type of equipment by multiplying the estimated replacement cost by the percentage annual charge.

Direct costs for the transportation equipment include the labor cost of the operator and, with powered equipment, operating expenses such as gasoline or electric power. These costs vary with the kind of equipment and the particular plant.

For instance, based on 1950 prices, the direct cost for a power conveyor in a typical plant is approximately \$0.02 per

Selected Costs for Total Direct Labor and for In-plant Transportation Labor in 15 California Apple and Pear Packing Plants^a

Plant	Type of transportation equipment ^a			Labor cost per 1,000 lbs. of fruit run through plant, dollars ^c		Transportation labor relative to direct labor, per cent
	Incoming fruit	Fruit not packed	Packed fruit	Transportation labor	Total plant labor	
HAND TRUCK TRANSPORTATION						
A ^d	HT ^b	HT	HT	.892	6.455	13.8
B ^d	HT	HT	HT	.998	6.619	15.1
F ^d	HT	HT	HT	.645	4.870	13.2
L	HT	HT	HT	1.140	7.089	16.1
N	HT	HT	HT	.848	6.554	12.9
PARTIALLY MECHANIZED TRANSPORTATION						
H ^d	FT	HT	HT	.602	4.488	13.4
M	HT	FT	HT	.637	4.000	15.9
R	HT	FT	HT	.628	4.559	13.8
T	HT	FT	HT	.518	3.593	14.4
Q	FT	HT	FT	.467	6.258	7.5
S	HT	HT	C	.353	5.298	6.7
MECHANIZED TRANSPORTATION						
U	FT ^e	FT	C ^f	.338	5.038	6.7
P	FT	FT	C	.209	5.658	3.7
V	FT	FT	FT	.221	3.880	5.7
W	FT	FT	FT	.330	4.264	7.7

^a Computed on the basis of 8-hour days, with typical hourly rates of output. Labor costs adjusted to reflect uniform wage rates typical for the industry. Costs adjusted to eliminate labor costs in cold storage or precooling operations.

^b Abbreviations: HT = hand truck; FT = fork truck; C = power conveyor.

^c All direct labor, including packing, box making, and labeling; also, direct supervision.

^d Apple packing plants.

^e Part of receiving operations performed by hand truck.

^f Part of packed fruit transported by hand truck.

hour per drive unit. The direct cost per hand truck is typically \$1.25 per hour. For a gas-engine fork-truck of 4,000 pounds capacity the typical labor cost is \$1.30 per hour; the cost of fuel, oil and miscellaneous supplies is \$0.15; and the total direct cost is \$1.45 per hour.

Total transportation costs per season for a given type of equipment are the sum of the annual fixed cost for the equipment and the season direct costs.

Total Season Costs

Using the above data, total season costs may be estimated as follows for hand truck and fork-truck equipment:

Item	Total season cost, dollars per truck			
	Fork-truck		Hand truck	
Hours of operation per season	100	300	100	300
Annual fixed charge (including pallets)	\$675	\$675	\$10	\$10
Direct cost per season	\$145	\$435	\$125	\$375
Total cost per season	\$820	\$1,110	\$135	\$385

For both types of equipment, total season costs are given for operation for 100 and 300 hours per season. These season total costs divided by the hours of opera-

tion per season give the total cost per hour. In the fork-truck plant, the total cost with 100 hours operation per season is \$3.20 per hour; with 300 hours operation per season this cost is only \$3.70 per hour. In the hand truck plant, the hourly costs are respectively \$1.35 and \$1.28. Spreading the fixed costs over a larger number of hours of operation as the season lengthens reduces the total hourly cost and narrows the difference between the costs per hour for fork-trucks and hand trucks.

Obtaining total season costs per equipment unit—as in the above text table—completes the initial step in estimating transportation costs in a standardized plant. The second step is to estimate the quantities of transportation labor and equipment required with a given method. These requirements, when combined with the season cost per equipment unit give an estimate of total transportation cost per season. By comparing such cost estimates for different methods—keeping length of season and total volume of fruit run constant—the relative efficiency of different types of transportation equipment can be determined.

Part VI to be continued

L. L. Sammet is Co-operative Agent of the University of California Agricultural Experiment Station, Berkeley, and the Bureau of Agricultural Economics, U. S. D. A.