Efficiency in Fruit Marketing

building and equipment replacement costs for pear and apple packing houses using hand trucks or fork-lifts

L. L. Sammet and I. F. Davis

Part V of a series of reports of studies on the effects of packing house equipment and work methods on efficiency and costs. The studies were 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 authority of the Research and Marketing Act.

Fixed costs are an important factor in the costs of packing and shipping California fruit.

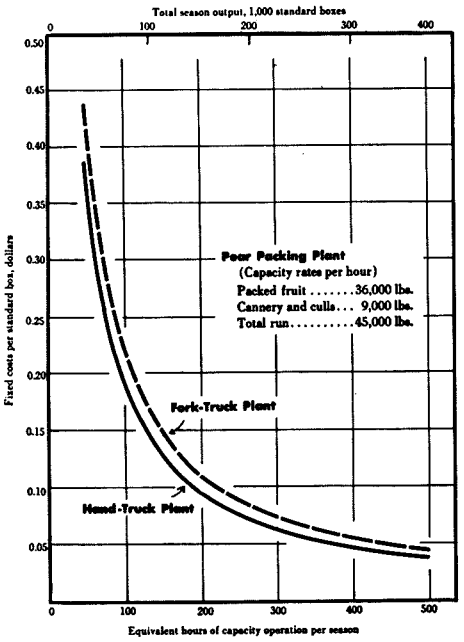
Many California pear and apple packing plants operate only about one month a year; other plants may run about three months a year. This means fixed costs for buildings and equipment are high in relation to annual output.

Annual accounting charges for buildings and equipment vary widely from one plant to another. Aside from the size of plant they are affected by the local tax rate, the type of equipment used, local insurance costs, and—perhaps most important—by the price level at the time of purchase.

For particular plants there are additional factors which contribute to variations in cost, such as the type of building construction used, local prices for construction materials and labor, differences in the type of packing house equipment used, and differences in the proportions of packed fruit and cannery fruit.

The replacement cost for a typical pear packing plant with capacity to ship two cars per eight-hour day—at the 1950 price level—would have been approximately $40,000. For a plant with capacity to ship eight cars per day, the replacement cost in 1950 would have been about $130,000 if the plant were equipped for operation with hand trucks or about $160,000 if equipped for operation with fork-trucks.

Estimates of replacement costs are based on the use of tub-type packing equipment in two kinds of plants—a hand truck and a fork-truck plant. The hand truck plant is of woodframe construction, with a wood floor at truckbed height. Except for the use of wood in the roof the fork-truck plant is of concrete construction, with concrete floor laid directly on the ground.



The effect of annual output on average fixed costs per standard box in a typical pear packing plant. (California, 1950 price level.)

Replacement costs at the 1950 level for the buildings and equipment required for a typical packing house are given in the diagram on page 11. The diagram is based on a plant in which 80% of the total fruit run is packed in standard boxes and the remainder consists of cannery fruit and culls.

Replacement costs are given on the vertical scale of the diagram in relation to the Capacity Rate of plant output, which is shown on the horizontal scale. The Capacity Rate is the sum of the quantities of packed, cannery, and cull fruit run per hour when the plant is at full-scale operation. This quantity must be distinguished from other measures of output—total season output or season average rate of output—as the Capacity Rate per hour is the factor that governs the size of plant and determines the plant investment.

In a fork-truck plant with a Capacity Rate of 45,000 pounds total fruit run per hour, the replacement cost for transportation equipment is read from the vertical scale as about $17,700. In the same manner, the cost of packing equipment is given as $61,800 and the cost of the building as $75,000. The total cost is approximately $154,000.

The replacement cost of a hand truck plant of the same capacity rate is shown by the diagram to be about $126,000. In the same way, the diagrams may be used to estimate replacement costs for plants of different capacities, but handling approximately the proportions of packed and cannery fruit specified in the diagrams.

For ordinary accounting purposes and for use in studies of efficiency, estimated costs of constructing buildings and purchasing and installing new equipment usually are expressed as annual charges. Annual charges include taxes, insurance, repairs, interest on the investment, and depreciation—a provision for replacement of the buildings and equipment when they are worn out.

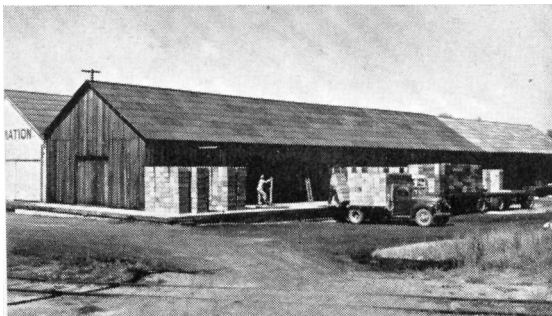
Exact determinations of annual charges are impossible, largely because of uncertainty regarding the correct depreciation rate. The rate that is suitable will depend on how long the building or equipment can be used before it is worn out or becomes obsolete, and on its final salvage value.

Estimates of use-life for several classes of packing house equipment and buildings are given in the lower table on page 11. This table also gives the corresponding percentage of value—the depreciation rate—written off each year and the estimated percentage of the replacement cost required each year to cover repairs, insurance, interest, and taxes.

The total percentage annual charge ranges from 8.9% for a reinforced concrete building to 18.0% for fork equip-

Hand truck plant—wood-frame construction, with wood floor at truck-bed height.

Fork-truck plant—concrete sidewall construction, wood-frame roof, concrete floor at ground level.



ment and pallets. In the case of packing machinery, the percentage charge is 14.3% or 15.2%, depending on whether the equipment is housed in a wood-frame or a concrete building. The total percentage charge, when applied to the estimated replacement cost gives an estimate of annual fixed cost.

The application of the annual fixed cost percentages is illustrated in the upper table on this page in which estimated annual fixed costs are given for the pear packing plant of 45,000 pounds-per-hour capacity referred to in the diagrams on the right.

Replacement costs for the packing equipment are the same in both the hand truck and fork-truck plants, but annual costs for the packing house equipment are lower in the fork-truck plant because the insurance cost for the equipment is at the lower rate applicable to the concrete building used for the fork-truck plant.

Annual fixed costs for transportation equipment are given in the table as $3,200 in the fork-truck plant and only $300 in the hand truck plant. This difference reflects both the higher replacement cost and the higher percentage annual charge for the fork-truck equipment.

Replacement cost for the wood-frame hand truck plant is considerably lower than that for the concrete fork-truck plant. But owing to a longer estimated use-life and a lower fire risk in the concrete fork-truck plant, the annual costs for the two types of buildings are about the same.

Total annual fixed costs are estimated as $16,300 for the hand truck plant and $18,700 in the fork-truck plant. As an offset to the higher fixed costs in the fork-truck plant, the labor cost of inplant transportation is considerably less with fork-trucks. Inplant transportation costs with different types of equipment will be considered in a later report.

The fixed cost per unit of output varies with the size of plant and type of equipment, but the most important factor is the total output per season. The general level of unit fixed costs is illustrated by estimates for the pear packing plants on which the preceding examples are based. Average unit costs per packed standard box are shown in the graph on page 10.

By allocating total annual fixed costs to cannery and packed fruit, average fixed costs per unit of output can be estimated by dividing the allocated costs by the annual output of packed fruit or of cannery fruit as appropriate. The annual output is calculated on the assumption that the plant operates at the capacity rate for a given length of season, or that it runs for a longer period at a reduced rate to produce the specified annual output.

As shown in the graph on page 10 the fixed costs per packed box decrease sharply as the length of the season and the season volume increase. With 100 hours operation at capacity rate, the fixed costs in the hand truck are $0.195 per standard box; with 500 hours operation per season, the fixed costs are only $0.039 per packed standard box.

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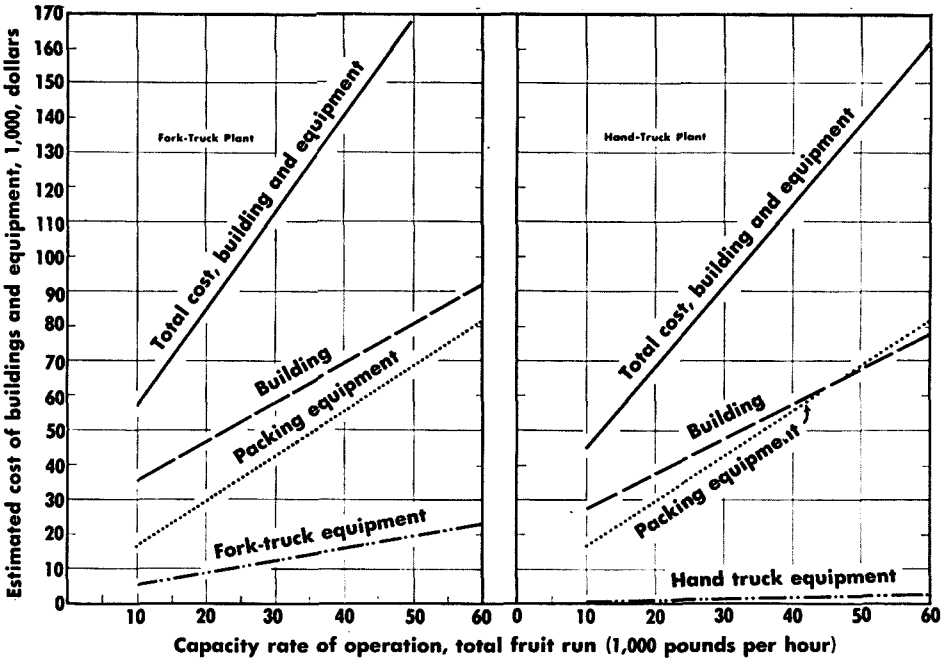
Effect of Capacity Rate of operation on the cost of buildings and equipment in typical California pear and apple packing plants (1950 price level).



Effect of Type of Transportation Equipment on Estimated Replacement Costs and Annual Fixed Costs in a Typical Pear Packing Plant of 45,000 Pounds per Hour Capacity.

Item	Fork-truck			Hand truck		
	Replacement cost	Percentage annual charge	Annual cost	Replacement cost	Percentage annual charge	Annual cost
Packing equipment	$61,800	14.3	$8,800	$61,800	15.2	$9,400
Transportation equipment	17,700	18.0	3,200	1,900	14.7	300
Buildings	75,000	8.9[a]	6,700	62,500	10.5[b]	6,600
Total	$154,500		$18,700	$125,200		$16,300

[a] For reinforced concrete construction.
[b] For wood-frame construction.

Annual Fixed Cost of Buildings and Equipment as a Percentage of Replacement Cost.

Item	Estimated use-life, years	Annual charge, percentage of replacement cost				
		Depreciation	Repairs	Insurance[a]	Interest and taxes[b]	Total
Buildings:						
Concrete, reinforced	40	2.5	1.8	0.6	4.0	8.9
Steel frame	40	2.5	1.8	0.6	4.0	8.9
Wood frame	33	3.0	2.0	1.5	4.0	10.5
Equipment:						
Fork-trucks	10	10.0	3.0	1.0	4.0	18.0
Hand trucks	15	6.7	3.0	1.0	4.0	14.7
Pallets	10	10.0	3.0	1.0	4.0	18.0
Packing machinery	15	6.7	3.0	0.6 to 1.5[c]	4.0	14.3 to 15.2

[a] Typical base rates for fire insurance in small communities.
[b] Taxes 1.0%; interest 3.0% (interest at 3% equal to approximately 5% on undepreciated balance).
[c] Use same rate as for building in which equipment is housed.

EFFICIENCY

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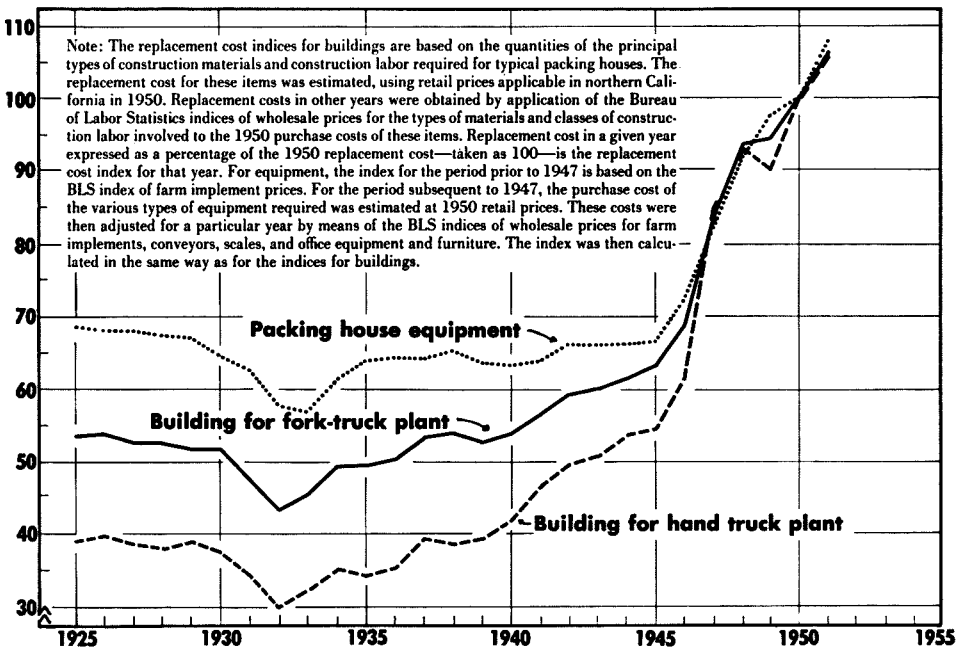
From data similar to the above, the fixed costs for cannery fruit are estimated as $3.78 per ton with 100 hours operation per season, and only $0.76 per ton with 500 hours operation per season.

The graph indicates that fixed costs per unit of output are higher in the fork truck plant than in the hand truck plant, although the differences are relatively small when the length of season extends beyond 400 to 500 hours.

Replacement costs for apple packing houses are calculated to be roughly 5% higher than in the pear packing plants. The smaller weight per apple box—42 pounds net per standard apple box in comparison with 48 pounds net per standard pear box—results in a slightly lower fixed cost per standard box in the apple packing houses than in the pear packing houses.

Over a period of time, large variations in the price level result in corresponding variation in the costs of buildings and equipment. This is indicated in the index of costs for packing house equipment and for hand truck and fork-truck buildings for the period 1925 to 1951 on this page.

For each index, the replacement cost at the 1950 price level is taken as 100 and the relative costs in other years is shown as a percentage of the 1950 cost. For example, the building for the fork-truck plant used in the preceding examples was estimated to have a replacement cost in 1950 of $75,000. The 1940 replacement cost index for this type of construction is given by the diagram as 54. This indicates that the replacement cost in 1940 would have been 54% of the 1950 cost, or approximately $40,500. Similarly, the construction cost index for the fork-truck plant in 1951 is 107, and the replacement cost in 1951 is 107% of the 1950 cost, or about $80,000.



Indices of equipment and building costs for pear and apple packing houses in California (1950 = 100).

L. L. Sammet is a Co-operative Agent of the California Agricultural Experiment Station and the Bureau of Agricultural Economics, United States Department of Agriculture.

I. F. Davis is a Research Assistant in Agricultural Economics, University of California College of Agriculture, Berkeley.

A more detailed report on this topic is available, which provides data for estimating replacement costs for plants having different types of packing equipment, different proportions of cannery and packed fruit, and involving the use of different construction methods for the building. Agricultural Publications, 22 Giannini Hall, University of California, Berkeley 4, California.

CAPACITY

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commercially built airplanes designed for agricultural use must take their place. In 1950, some 750 planes were in use; the estimate for 1955 is 1,250.

A more abundant supply of irrigation facilities is required to realize the projected acreage increase of 400,000 acres of cropland between 1950 and 1955. In 1955 the number of pumps will have to rise from 88,000 to 120,000, sprinkler systems from 3,500 to 8,000, gated-pipe systems from 150 to 300, wells from 72,000 to 100,000, and well-drilling rigs from 600 to 1,000.

The high level of technology makes California agriculture extremely vulnerable to shortages of machines and repair parts. Seedbed preparation, seeding, cultivation, and pest control are almost completely mechanized, and tremendous strides have been made in mechanizing the harvest. Harvest mechanization is within sight for practically all field crops, many of the vegetables, and nuts. Such technological developments are vital under the conditions of short labor supplies assumed for 1955.

Because California agriculture is already largely mechanized, no general drastic reduction in labor required per acre and per unit can be expected by 1955.

Cotton is an outstanding exception in which 37 hours per acre—of which 33 are in harvest—are expected to be cut from 1950 average labor requirements. Sugar beets is another crop with an important percentage reduction—11 hours from the present 80 hours per acre. Most of the other reductions are small, though important in total. Among the vegetable crops, carrots, celery, and tomatoes—processing and for fresh marketing—are expected to show reductions in labor requirements. As these crops require considerable hand labor a reduction is highly important. Almonds, apricots, peaches, and walnuts among the deciduous fruits, and lemons and oranges, among the citrus, also are expected to show reductions in labor requirements per acre.

Reductions in labor requirements per beef breeding cow, dairy cow, lamb on feed, laying hen and broiler are expected. Reductions assumed in hours required per head are 5% for dairy cows, 7% for beef cows, 2% for sows, and 10% for laying hens and broilers.

Although the labor requirements are expected to be lower per unit in 1955, the number of animal units will increase so that the total labor required in California's 1955 agriculture will be above that of 1950.

Field crops, vegetables and flowers totaled 9,390,000 acres in 1950, and are projected at 10,475,000 acres in 1955. While the labor-per-acre requirement is expected to drop from 53 to 49 hours, acreage increases will boost total labor requirements from 494 million man-hours in 1950 to 511 million man-hours in 1955.

Similarly, livestock—including poultry—production is expected to increase from 3,592,000 animal units in 1950 to 4,009,000 animal units in 1955. While labor requirements are estimated to drop from 42 to 39 hours per animal unit, increased production will require a total