Economies of Size in Southwestern Beef Slaughter Plants

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Table of Contents

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SUMMARY

This study was made to provide estimates of the investment and operating cost requirements for models of six sizes of on-the-rail beef slaughtering and dressing plants operated at six alternative percentages of rated capacity.

Results indicated that a plant designed to slaughter 20 head per hour would require an investment in land, buildings and equipment of $304,000. The investment required for larger sized plants increased in a generally linear manner up to $1,262,000 for a plant designed to slaughter 120 head per hour. The annual depreciation on the total investment ranged from $6,900 for the 20 head per hour plant to $32,900 for the 120 head per hour plant.

Labor costs accounted for most of the operating costs. Total annual labor costs for the 20 head per hour plant, at rated line speed, were $175,000 and increased to $993,000 for the 120 head per hour plant.

Total annual costs for utilities increased from $15,428 for the 20 head per hour plant to $137,775 for the 120 head per hour plant.

The overall average killing cost per head decreased for each size of plant as the output of the plant was increased from 90 to 115 percent of rated capacity. The average reduction in per head costs resulting from more efficient use of plant, equipment and other fixed factors of production amounted to $0.457.

The average killing cost per head decreased as the plant size increased up to the 60 head per hour level. From the 60 to 120 head per hour levels, however, the average killing cost per head increased slightly due to limitation on cooler capacity, distribution of workers by pay scale and limitations on utilities data.

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Cattle slaughter has trended upward in recent years due to increased consumption and subsequent increased production on farms and feedlots. Total cattle slaughter in federally inspected plants has increased from 19 million head in 1955 to 20.3 million head in 1962. Total cattle slaughter in non-federally inspected commercial plants decreased from 6.7 million head in 1955 to 5.7 million head in 1962 (1).

Between 1955 and 1963, the number of federally inspected slaughtering plants increased from 455 to 565; the number of large non-federally inspected plants decreased from 952 to 902; and medium sized non-federally inspected plants decreased from 1,810 to 1,712 (2).

Plant efficiency kill levels have increased from one head to around two head per man per hour with the development of the "on-the-rail" kill floor and associated equipment such as hydraulically operated lift platforms, dehorners, hock cutters, hide pullers, air powered knives, moving top viscera tables and electrically operated splitting saws and hoists (3).

This study was made to determine construction and operating costs of different sized "on-the-rail" beef slaughtering plants designed to operate at several alternative output levels in the Southern Plains region.

General Specifications of the Model Plants

For this analysis the input-output relationships of six selected sizes of plants with designed maximum kill rates of 20, 40, 60, 75, 90, and 120 head per hour were synthesized. Although other plant sizes are possible, these represent the sizes commonly constructed by the industry. Each plant was designed to comply with the regulations set forth by the Meat Inspection Division of the United States Department of Agriculture. Construction details, where necessary in the analysis, are specified in the appropriate cost section.

Each plant consists of corral facilities, a kill and dressing area, chill and holding coolers, an offal workup area, an equipment cleaning area,

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an employee dressing area, a rendering department, office space, and sufficient parking space for employees and visitors.

The plants were presumed to operate with a single labor shift of eight hours duration for 255 operating days per year—a common practice in southwestern plants. Cost estimates were made for each plant when operating at output levels equivalent to 90, 95, 100, 105, 110, and 115 percent of the designed line speed.[1] To allow for output levels equivalent to up to 15 percent greater than the designed line speed, the capacity of the chill and holding coolers were altered accordingly.

Data Sources

The data requirements can be classified into the three broad categories of investment, operating, and other costs. Investment can be classified further into real estate, building, and equipment requirements. Operating costs include labor, water, electricity, gas, telephone, laundry, repair and maintenance, and miscellaneous supplies. Other costs include taxes, insurance, and interest.

Building Investment

The cost of constructing a beef slaughtering plant depends upon many factors, not all of which were considered in detail in this study. In this analysis it was assumed that the plants would be constructed on level ground in industrial areas suitable for slaughterhouse operations and that the plants would meet all the requirements for Federal inspection (4). Cost estimates are based, insofar as possible, on the costs of construction in the Oklahoma City area.

Corrals

To provide flexibility in purchasing cattle and to maintain an adequate supply of animals for plant operations, many slaughtering plants in the Southwest commonly maintain holding pens large enough for 1.5 to 3.0 days' kill. For the model plants, corral space sufficient to handle 2.5 times one day's kill at rated line speed was specified.

One-fifth of the pen area was covered in compliance with the requirement of federal inspection that a reasonable portion of the holding pens be covered with a weather-tight roof to facilitate the ante mortem inspection of animals in inclement weather.

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[1] The output level was adjusted by varying the length of the kill day rather than the line speed. Although slaughtering plants do vary line speed to alter the level of plant output, such a practice requires rebalancing of the kill floor crew. No attempt was made to determine the adjustments in labor requirements necessary to achieve a balanced kill floor crew for a series of line speeds. For output levels less than equivalent to rated line speed a reduced length of workday was assumed; for output levels greater than equivalent to rated line speed, overtime was assumed.

The corral fencing, designed with five rails, was constructed of 2-inch steel pipe. Supporting posts were seven feet long, set 24 inches deep in concrete, and spaced on 10 foot centers. Pen floors and alleys were constructed of 4-inch concrete with 12-inch curbs, except at gateways.

The cost of galvanized metal roofing using pole type support was estimated at $1.00 per square foot. The structural steel pipe was priced at $.21 per linear foot and the cost of the concrete paving was estimated on the basis of $.45 per square foot. Total costs of corrals and other building construction for each of the model plants are presented in Table 1.

Kill Floor

The kill floor is the heart of the beef slaughtering plant. Kill floors must be of such size and arrangement "to facilitate the conduct of sanitary operations and the efficient performance of the inspection (4).

The kill floor specifications used to estimate the cost of construction were taken from architectural drawings of on-the-rail kill floor lay-outs approved by the USDA Meat Inspection Division[2]. A rate of $18.00 per square foot was used to estimate the construction costs.

Chill and Holding Coolers

Chill and holding coolers are built in a great variety of sizes and shapes, usually designed to meet the particular needs of the individual plant. Several important factors involved in the design of coolers are: (1) the type and amount of construction materials used, (2) the amount and type of product to be handled, (3) the cooler room temperature to be maintained, (4) the outdoor temperature, (5) the amount and size of electrical equipment in the cooler, (6) the number of individuals working in the coolers, (7) the frequency of air changes, and (8) the orientation of the coolers to the compass.

Several assumptions regarding the construction detail of the chill and holding coolers were made as an aid in estimating the needs for refrigeration equipment.

To estimate the chill cooler size, the following specifications were employed: (1) the rails were spaced on three foot centers with an allowance of 30 inches of rail space per carcass, (2) an allowance of two feet was made on each rail for space used by switches, and (3) all rails were

[2] Architectural drawings from which the kill floor area requirements were taken were provided through the courtesy of the Allbright-Nell Co.

Table 1. Synthesized Building Requirements and Construction Costs for the Six Model Plants.

Item	Cost Per Sq. Ft.	Plant Size, Head Per Hour: 20 Floor Area[6]	20 Total Cost[7]	40 Floor Area[6]	40 Total Cost[7]	60 Floor Area[6]	60 Total Cost[7]
	(Dollars)	(Sq. Ft.)	(Dollars)	(Sq. Ft.)	(Dollars)	(Sq. Ft.)	(Dollars)
Kill Floor	18.00[1]	1,750	31,500.00	2,990	53,820.00	3,280	59,040.00
Chill Cooler	[2]	1,710	23,138 00	3,132	39,282.00	4,692	56,103.00
Holding Cooler	[3]	2,247	30,168 00	3,782	40,852.00	5,472	66,060.00
Rendering	15.00[1]	1,500	22,500.00	1,800	27,000.00	2,825	42,375.00
Corrals	[4]	8,800	8,460 20	17,800	16,889.80	27,800	26,534.90
Employee Dressing	6.00[1]	391	2,346.00	765	4 590.00	1,054	6,324.00
Equipment clean-up	6.00[1]	224	1,344.00	224	1,344 00	224	1,344.00
Dock	15.00[1]	420	6,300.00	620	9,300.00	720	10,800.00
Dock Apron	0.50[5]	840	420.00	1,240	620.00	1,440	720.00
Dry Storage	6.00[1]	100	600 00	150	900.00	344	2,064.00
Office	10.00[5]	1,320	13,200 00	2,160	21,600.00	2,880	28,800.00
Parking lots	0.56[5]	9,486	5,312.16	18,414	10,311.84	25,389	14,217 84
Total		28,788	145,288 36	53,077	226,509.64	76,120	314,382.74

Item	Cost Per Sq. Ft.	Plant Size, Head Per Hour: 75 Floor Area[6]	75 Total Cost[7]	90 Floor Area[6]	90 Total Cost[7]	120 Floor Area[6]	120 Total Cost[7]
	(Dollars)	(Sq. Ft.)	(Dollars)	(Sq. Ft.)	(Dollars)	(Sq. Ft.)	(Dollars)
Kill Floor	18.00[1]	4,260	76,680.00	5,247	94,446.00	8,970	161,460.00
Chill Cooler	[2]	5,712	67,481.00	7,490	85,934.00	8,964	102,936.00
Holding Cooler	[3]	6,912	78,238.00	7,917	92,604.00	10,527	122,832.00
Rendering	15.00[1]	3,425	51,375.00	4,040	60,600.00	5,000	75,000.00
Corrals	[4]	33,400	31,033.35	39,800	37,188 95	52,300	49,232.60
Employee Dressing	6.00[1]	1,343	8,058.00	1,683	10,098.00	2,346	14,076.00
Equipment clean-up	6.00[1]	224	1,344.00	224	1,344 00	224	1,344.00
Dock	15.00[1]	720	10,800.00	870	13,050.00	870	13,050.00
Dock Apron	0.50[5]	1,440	720 00	1,740	870.00	1,740	870.00
Dry Storage	6.00[1]	429	2,574.00	514	3,084.00	639	3,834.00
Office	10.00[5]	3,240	32,400 00	3,600	36,000.00	4,800	48,000.00
Parking lots	0.56[5]	31,527	17,655.12	38,502	21,561.12	52,110	29,181.60
Total		92,632	378,358.47	111,627	456,780.07	148,490	621,816 20

[1] H. L. Rothra, Editor, *Meat Industry Trends, 1961*, Chicago, 1961 were verified for the Oklahoma City area in an interview with Lipperd Brothers, General Industrial Contractors, Oklahoma City, Oklahoma.

[2] Taken from Appendix B, Table II.

[3] Taken from Appendix B, Table III.

[4] Taken from Appendix A, Table I.

[5] Figures were obtained from local contractors and verified in an interview with Lipperd Brothers, General Industrial Contractors, Oklahoma City, Oklahoma.

[6] See text for methods of estimating area requirements for the various departments within the plant.

[7] Column 2, 4, 6, 8, 10, and 12 times the cost figure in column 1, except for the coolers and corrals.

spaced three feet from any obstructions. Sufficient rail space was provided to allow for a kill equivalent to that which would result from operating at 115 percent of the designed line speed. The total area required for the chill coolers was determined on the basis of the foregoing specification. A rate of $4.00 per square foot of exterior wall was used to

estimate the construction costs not including the costs of doors, floor drains, and railing.

The procedure employed to estimate the area requirements for the holding coolers was the same as for the chill coolers. However, in the holding coolers railing was spaced on two and one-half foot centers with an allowance of 24 inches of rail space per carcass.

Dock and Apron

A loading dock 10 feet wide, used for transferring carcasses and edible by-products from the refrigerated areas of the plant into trucks or railroad cars, was provided along the length of the narrow side of the holding cooler. To comply with the requirements of federal inspection, a dock apron 20 feet wide and extending the length of the loading dock was also provided.

A rate of $15.00 per square foot was used to estimate the construction cost of the dock and a rate of $.50 per square foot was used to estimate the construction cost of the dock apron.

Rendering

Slaughtering plants have a wide range of alternatives facing them with respect to the method of handling by-products. At one extreme, all the by-products may be sold to commercial rendering firms. At the other extreme, plants may engage in extensive by-product processing.

For the purposes of this study, it was assumed that each of the model plants sold their hides daily on a green basis and that only inedible rendering operations would be conducted.

Equipment Clean-up and Dry Storage

Each of the model plants was provided with an equipment cleaning area equal to 224 square feet. A cost rate of $6.00 per square foot was used to estimate the cost of the equipment clean-up area.

Stocks of items such as boxes, strapping, extra trolleys, aprons, shrouds, and general supplies require a dry storage area in each plant. The amount of space allocated to this function varies widely. The area specifications used in this study were obtained from selected plants in the Southwest.

A rate of $6.00 per square foot was used to estimate the cost of construction, the equipment clean-up, and dry storage areas.

Employee Dressing

Employee dressing rooms meeting the requirements for Federal inspection were specified for each of the model plants. The area of the dressing room was estimated on the basis of 17 square feet per production employee. A rate of $6.00 per square root was used to estimate the cost of the dressing rooms.

Offices & Parking Space

Three types of offices are found in a packing plant. These consist of a general office, a manager's office, and the Federal inspector's office. The size of these offices varies widely among plants except that the inspector's office must be at least seven feet by nine feet in size. The size of the manager's office and the general office often reflects the personal preference of the manager more than any other factor.

The office space for the model plants was estimated on the basis of 360 square feet for lobbies and hallways plus 120 square feet for each office employee.

For the model plants, a parking area of nine by 30 feet (including the drive area between lines of cars) was allocated for each employee. An area equal to 10 percent of the total employee parking area was provided for visitor parking.

A rate of $0.56 per square foot of asphaltic concrete was used to estimate the cost of parking lot construction.

Real Estate Investment

Values of land suitable for slaughtering plant sites in the Oklahoma City area ranged from $1,500 per acre to $10,000 per acre.[3] In the absence of any good criteria for assigning values in this range to particular scales of plant, a cost of $4,356 per acre was arbitrarily selected as the basis for estimating the magnitude of the real estate investment for the model plants. These costs are presented in Table 2.

Equipment Investment

The equipment needs of the slaughtering plants considered in this study may be placed in four general categories: (1) kill floor and supporting operations, (2) inedible rendering, (3) refrigeration, and (4) of-

[3] Land values were obtained through correspondence with Mr. John Connor, Manager, Agriculture and Livestock Division, Oklahoma City, Chamber of Commerce, Oklahoma City, Oklahoma.

Table 2. Land Requirements and Costs for the Six Model Plants.

Plant Size Head Per Hour	Plant Area[1]	Future Expansion Area[2]	Total Area[3]	Total Land Cost[4]	Annual Cost of Interest[5]
	(sq. ft.)	(sq. ft.)	(sq. ft.)	(Dollars)	(Dollars)
20	28,788	1,710	30,498	3,049.00	182.99
40	53,077	3,132	56,209	5,620.09	337.20
60	76,120	4,692	80,812	8,081.20	484.87
75	92,632	5,712	98,344	9,834.40	590.06
90	111,627	7,490	119,117	11,911.70	714.70
100	148,490	8,964	157,454	15,745.40	944 72

[1] Taken from Table 1.
[2] Since the chill cooler limits the capacity of the plant, an area equal to the size of the present chill cooler is allowed for future expansion.
[3] Sum of Columns 2 and 3.
[4] Column 4 times $0.10 per square foot.
[5] An interest rate of six percent was applied to Column 5.

fice. The specification of equipment for the kill floor and inedible rendering operations was provided by the Allbright-Nell Company.

No attempt was made to estimate the specific items of refrigeration equipment required for each scale of plant. The capacity of the equipment was estimated in terms of tons of refrigeration required to remove the total heat load. The procedures used in obtaining these estimates were taken from Gunther (5).

Estimates of the cost of refrigeration equipment varied considerably among the manufacturers contacted. The cost rates used for the model plants were taken from those published in the ASHRAE Guide and Data Book, 1962 (6). The estimated cost of the refrigeration equipment is reported in Table 3.

Office equipment requirements were synthesized on the basis of the functional operations of the office and the number and type of personnel. Cost rates for the various items of office equipment were taken from prices supplied by the purchasing office, Oklahoma State University.[4] Total costs of the office equipment are presented in Table 3.

Annual Cost of Investment

The annual depreciation cost for buildings was estimated by dividing the total cost of the building, including estimated architectural costs, by the estimated useful life of the buildings. For all equipment, an estimate of the salvage value was subtracted from the total cost before dividing by the estimated useful life.[5] The annual depreciation cost

[4] The cost rates used do *not* include discounts arising from purchase by a state agency.
[5] The salvage value of all equipment was assumed to be equal to 10 percent of the initial cost. Buildings were assumed to be fully depreciated in 25 years.

for buildings is presented in Table 4, and the annual depreciation cost for equipment is presented in Table 3.

In addition to depreciation costs, the firm must face the cost of the interest on the total funds invested. An interest rate of six percent was applied to the real estate investment and to the nondepreciating salvage value of the equipment. A three percent rate was applied to the depreciable balance of the buildings, equipment, and parking lots. The interest charges for the model plants are presented in Table 4.

For the purposes of this study, personal property taxes were computed by the procedures and with the rates presently used in Oklahoma County.[6]

Since tax rates vary to some extent among tax districts, an average rate of $7.69 per $100 of assessed valuation, typical of the industrial areas of Oklahoma City, was used. The assessment value of the plant, usually some percentage of actual market value, was determined by assessing the model plants at the following rates: 25 percent of the market value of land, buildings, and parking lots; and 35 percent of the value of the equipment.

The full tax rate was applied to the assessed value of the land, buildings, and parking lots (for personal property tax purposes no depreciation is allowed on these). Since the value of the equipment is decreasing over time, application of the full tax rate to the assessed valuation would be overestimating the taxes of the plant. For this reason, the salvage value of the equipment was subtracted and a tax rate of $3.845 per $100 (equal to one-half of the full rate) was applied to the depreciable balance. The salvage value, which does not depreciate, was taxed at the full rate.

Personal property taxes also must be paid on the average number of animals and carcasses owned by the plant. The current practice in Oklahoma County is to average the number of head on hand January 1 and December 31 of each year and assesses each head at $20. The tax rate of $7.69 per $100 of assessed valuation is then applied to determine the taxes. The tax costs for the model plants are listed in Table 5.

Because of additional fire protection provided and the lower insurance rates involved, the model plants were specified to be protected by sprinkler systems. In computing the insurance, a cost rate of $0.14 per $100 was applied to 80 percent of the cost of the buildings and

[6] Procedures used and tax rates applied were obtained from the County Assessor's Office, Oklahoma County Court House, Oklahoma City, Oklahoma.

Table 3. Total Investment in Equipment and Annual Equipment Depreciation Costs for the Six Model Plants.

Plant Size Head Per Hour	Tons of Refrigeration Equipment Required[1]			Refrigeration Equipment Cost		Kill Floor Equipment Cost[4]	Rendering Equipment Cost[4]	Office Equipment Cost[5]	Total Equipment Cost[6]	Equipment Salvage Value[7]	Balance For Depreciation[8]	Annual Depreciation Cost[9]
	Chill Cooler	Holding Cooler	Total	Per Ton[2]	Total[3]							
						Dollars						
20	43	12	55	772	42,460	33,000	65,000	6,481.44	146,941.44	14,694.14	132,247.30	6,904.03
40	84	22	106	744	78,864	62,000	114,000	10,343.28	265,207.28	26,520.73	238,686.55	12,399.78
60	125	30	155	715	110,825	75,000	126,000	14,302.94	326,127.94	32,612 79	293,515.15	15,319.40
75	157	41	198	701	138,798	120,000	150,000	17,871.05	426,669.05	42,666.90	384,002.15	20,004.31
90	210	50	260	677	176,020	130,000	150,000	21,312.71	477,332.71	47,733.27	429,599.44	22,439.04
120	248	66	314	658	206,612	140,000	258,000	28,506.32	633.118.32	63,311.83	569,806.49	32,905.00

[1] See Appendix B and Appendix B Tables I, II, and III for assumption and specifications used in estimating equipment requirements.
[2] Cost figures taken from the *ASHRAE Guide and Data Book 1962, Application for Heating Refrigerating Ventilating and Air Conditioning,* American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc., New York, page 860.
[3] Column 4 times column 5.
[4] Equipment costs supplied by the Allbright-Nell Company, Chicago.
[5] Cost figures secured from Office Supply Companies and applied to equipment lists in Appendix C, Table 1.
[6] Sum of colums 6, 7, 8, and 9.
[7] Assumed to be 10 percent of original cost.
[8] Column 10 less column 11.
[9] Sum of columns 6, 7, and 8, less 10 percent salvage value divided by 20 years, plus column 9 less 10 percent salvage value divided by 10 years.

Table 4. Annual Depreciation, Insurance, and Interest Costs for Buildings and Equipment.

Plant Size Head Per Hour	Building Costs[1]	Architectural Costs[2]	Total Building Costs[3]	Building Depreciation Cost[4]	Total Cost of Buildings and Equipment[5]	Insured Value of Building and Equipment[6]	Annual Insurance Cost[7]	Annual Interest Cost[8]	Equipment Depreciation Cost[9]	Total Annual Cost[10]
				Dollars						
20	145,288.36	8,717.30	154,005.66	6,160.23	300,947.10	240,757.68	337.06	9,028.41	6,904.03	22,429.73
40	226,509.64	13,590.57	240,100.21	9,604.00	505,307.49	404,245.99	565.94	15,159.22	12,399.78	37,728.94
60	314,382.74	18,862.96	333,245.70	13,329.83	659,373.64	527,498.91	738.49	19,781.21	15,319.40	49,168.93
75	378,358.47	22,701.50	401,059.97	16,042.40	827,729.02	662,183.22	927.06	24,831.87	20,004.31	61,805.64
90	456,780.07	27,406 80	484,186.87	19,367.47	961,519.58	769,215.66	1,076.90	28,845.59	22,439.04	71,729.00
120	578,615.00	34,716.90	613,331.90	24,553.27	1,246,450 22	997.160.17	1,396.02	37,393.50	32,905.00	96,227.79

[1] Taken from Table 1.
[2] A figure of 6 percent of total building costs was used.
[3] Column 2 plus column 3.
[4] Column 3 divided by 25 years.
[5] Column 3 plus total equipment cost taken from Table 3.
[6] The Oklahoma Inspection Bureau recommended practice is to insure buildings and equipment for 80 percent of their original cost.
[7] An estimated fire and business interruption insurance rate of $0.14 per $.00.00 was obtained from the Oklahoma Inspection Bureau, 2000 Classen Building, Oklahoma City, Oklahoma and was applied to column 6.
[8] An interest rate of 6 percent was applied to one-half of column 6.
[9] Taken from Table 3.
[10] Sum of columns 5, 8, 9, and 10.

Table 5. Annual Personal Property Tax Costs for the Six Model Plants.

Plant Size Head Per Hr.	Assessed Real Estate Value[1]	Taxes on Real Estate[2]	Assessed Equipment Value[3]	Taxes on Equipment[4]	Assessed Salvage Value[5]	Taxes on Equipment Salvage Value[6]	Assessed Value of Cattle Inventory[7]	Taxes on Cattle[8]	Total Taxes[9]
20	39,263.86	3,019.39	46,286.55	1.779.72	5,142.95	395.49	6,000.00	461 40	5,656.00
40	61,430.28	4,723.99	83,540.29	3,212.12	9,282.25	713.80	12.000 00	922.80	9,572.71
60	80,615.98	6,199.89	102,730.30	3,949.98	11,414.48	877.77	18 000.00	1,384.20	12,411.84
75	97,048.22	7.463.00	134,400 75	5,167.71	14.933.41	1,148.38	22,520.00	1,731.79	15,510.88
90	124,024.64	9,537.49	150,359.80	5.781.33	16,706.64	1,284.74	27,000.00	2,076.30	18,679.86
120	157,269.32	12,094 01	199,432.27	7,668.17	22,159.14	1,704.04	36,000.00	2,768.40	24,234.62

[1] Twenty-five percent of actual market value of land, buildings, and improvements.
[2] A tax rate of $7.69 per $100 of assessed valuation in Column 2 was used.
[3] Thirty-five percent of actual market value, less the salvage value of the equipment.
[4] Since value of the equipment is being depreciated out over time, a tax rate equal to one-half the tax rate (0.5 times 7.69 = 3.845) per $100 was applied to Column 4.
[5] Thirty-five percent of the salvage value of the equipment.
[6] A tax rate of 7.69 per $100 was applied to the assessed salvage value in Column 6 since salvage value assumed not to depreciate over the life of the equipment.
[7] Personal property tax on cattle is based on an average of the cattle on hand January 1 and December 31 of the tax year, including both live and dressed animals. For the purpose of this study, two days normal kill is assumed to be the average. These cattle are assessed at $20 per head.
[8] A tax of 7.69 per $100 was applied to assessed value of cattle.
[9] Sum of Columns 3, 5, 7, and 9.

Source: The procedures used for assessment and tax rates applied to assessments were obtained from the County Assessor's Office, Oklahoma County Court House, Oklahoma City, Oklahoma.

equipment[7]. The $0.14 rate was selected from the lower end of the range because the model plants were assumed to approximate "ideal" risks. The insurance most on the buildings and equipment are listed in Table 4.

Variable Costs

Six operating levels were considered in the beef slaughtering plants in this study. The lowest output level was equivalent to 90 percent of the attainable output at the rated line speed.[8] The highest output level was equivalent to 115 percent of the attainable output at the rated line speed. The other levels investigated were at 95, 100, 105, and 110 percent of the attainable output at the rated line speed.

Labor Costs

Apart from the cost of the livestock input, wages and salaries constitute the largest expense item in the meat packing industry (7). Changes in the cost of the labor input may arise from changes in the size of the work force or from changes in the length of the work week. In this study only changes in the length of the work week were considered.[9]

Labor specifications for the kill floor, coolers, and supporting operations were developed by Mr. Donald R. Hammons from time study analysis supplied by the Allbright-Nell Company, The Koch Co. and selected slaughtering plants. Labor requirements for the rendering operations were developed from data published in **Meat Industry Trends, 1961.** Requirements for office personnel, were synthesized on the basis of the functions to be performed and discussions with several packing plant managers.

The wages of the production workers were based on an agreement between the Texas Meat Packers, Inc. and the Amalgamated Meat Cutters and Butcher Workmen of North America, AFL-CIO, Local No. 540. The wages of salaried workers were developed on the basis of conversations with packing plant managers. Total wage costs are shown on Table 6.

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[7] Present practice is to insure buildings for 80 percent of their value. One hundred percent coverage is offered only at a much higher rate.

[8] The attainable output at the rated line speed is defined as 7.5 hours (eight hours less two 15 minute breaks) times the rated line speed for the particular scale of plant, i.e., 20, 40, 60, 75, 90 or 120 head per hour for the plants considered in this study.

[9] Changes in the size of the labor force entail rebalancing of the kill floor crew for each kill level. Time study data for such an analysis was not available for use in this study. Data pertaining to the changes in cost associated with changes in the size of the work force would also be needed. This type of data also was not available.

Two additional variable costs directly associated with the number of employees and their wages are Social Security tax and insurance. Social Security taxes were computed at the present rate of 3.625 percent to a maximum of $4,800 per employee. The Social Security tax costs for the six levels of production are listed in Table 6.

Both general liability and workman's compensation were included in this analysis. Rates for these types of coverages are the same for all slaughter plants in the state and were obtained from the Millard Insurance Agency at Stillwater. A general liability coverage of $25,000 Bodily Injury and $100,000 Property Damage was specified for all

Table 6. Estimated Total Costs of Labor.[1]

Plant Size Head/Hour	Percent Rated Line Speed	Kill Floor	Supporting Operations	Salaried Personnel	Social Security Tax	Insurance Cost	Total
				Dollars			
	90	47,387	51,128	52,100	4,752	8,244	163,621
	95	49,842	53,786	52,100	4,924	8,553	169,205
20	100	52,296	56,434	52,100	5,054	8,863	174,747
	105	55,970	60,408	52,100	5,192	9,327	182,997
	110	59,663	64,383	52,100	5,280	9,792	191,218
	115	63,347	68,358	52,100	5,285	10,256	199,346
	90	80,340	106,478	106,600	9,010	16,031	318,459
	95	84,499	111,985	106,600	9,348	16,617	329,059
40	100	88,658	117,492	106,600	9,632	17,203	339,585
	105	94,892	125,762	106,600	9,977	18,083	355,314
	110	101,145	134,032	106,600	10,247	18,963	370,987
	115	107,388	142,202	106,600	10,266	19,824	386,280
	90	128,023	126,540	150,500	12,411	22,429	439,903
	95	134,646	133,084	150,500	12,876	23,227	454,333
60	100	141,269	139,627	150,500	13,274	24,032	468,702
	105	151,189	149,455	150,500	13,779	25,230	490,153
	110	161,149	159,283	150,500	14,190	26,424	511,546
	115	171,090	169,111	150,500	14,245	27,623	532,569
	90	156,875	166,175	196,900	15,341	28,767	564,058
	95	164,990	174,766	196,900	15,933	29,781	582,370
75	100	173,105	183,358	196,900	16,455	30,794	600,612
	105	185,265	196,262	196,900	17,128	32,314	627,869
	110	197,466	209,166	196,900	17,668	33,837	655,037
	115	209,646	222,071	196,900	17,725	35,358	681,700
	90	194,379	209,795	226,000	18,676	35,093	683,943
	95	204,496	220,640	226,000	19,418	36,364	706,918
90	100	214,555	231,485	226,000	20,083	37,632	729,755
	105	229,623	247,775	226,000	20,935	39,534	763,867
	110	244,751	264,066	226,000	21,613	41,440	797,870
	115	259,848	280,356	226,000	21,683	43,343	831,230
	90	271,381	288,693	295,600	25,805	48,414	929,893
	95	285,418	303,614	295,600	26,846	50,170	961,649
120	100	299,455	318,525	295,600	27,763	51,927	993,280
	105	320,494	340,949	295,600	28,989	54,403	1,040,434
	110	341,592	363,363	295,600	29,992	57,042	1,087,589
	115	362,660	385,777	295,600	30,121	59,679	1,133,838

[1] All cost items rounded to nearest dollar.

plants. The rate for the workman's compensation insurance for all employees other than clerical was $5.92 per $100 of payroll. For the clerical employees it was $0.12 per $100 of payroll. Also there was a charge of $25 per policy for all plants purchasing workman's compensation insurance.

The insurance costs for both general liability and workman's compensation are listed in Table 6.

Utilities

The availability of an adequate supply of each utility is important to the operation of a slaughtering plant. Large amounts of electricity are required for the operation of the electrical equipment used including the large motors associated with the rendering and refrigerating functions. Substantial quantities of water are consumed in washing carcasses and edible offal, in plant cleanup operations, and in the rendering operations. Natural gas is used primarily for heating the nonrefrigerated work areas in the winter season, and for the heating of boilers.

Electricity

Data obtained from the accounting records of selected slaughtering plants were used to estimate, by linear multiple regression, the relationship between the number of kilowatts consumed per month; and, (1) the number of head slaughtered per month, (2) the designed slaughter rate of the plant, and (3) the square of the designed slaughter rate of the plant. The following regression equation resulted:

$$\underset{}{Q_E} = \underset{}{-99{,}047.79} + \underset{(2.24)}{11.35Q_S} + \underset{(1701.38)}{4758.08R} - \underset{(1.53)}{1.71R^2}$$

where Q_E represents the KWH of electricity consumed per month, Q_S represents the number of cattle slaughtered per month and R represents the designed slaughter rate of the plant in head per hour. The coefficient of multiple determination was estimated as 0.98 and the standard errors are displayed beneath the appropriate coefficient. The cost of the electricity consumed by each plant at each operating level was estimated by applying the electrical rates for the Oklahoma City area to the estimates of consumption. The rates used were as follows:
Rate:

Primary Charge

First	100 kw of billing demand $1.90 per kw per month
Next	400 kw of billing demand $1.45 per kw per month
Next	500 kw of billing demand $1.25 per kw per month
Excess	kw of milling demand $1.15 per kw per month

Secondary Charge

First	200,000	kwh per month at .76¢ per kwh
Next	800,000	kwh per month at .60¢ per kwh
Excess		kwh per month at .44¢ per kwh

The billing demand was estimated as .228 percent of the total electrical consumption. The factor of .228 percent of the total electrical consumption was derived from the records of the 75 and 90 head per hour plants. The validity of this estimating factor for the smaller scale plants was verified through consultation with utility company engineers. Electricity requirements and costs are listed in Table 7.

The estimates of electrical costs tend to support a conclusion that beef slaughtering plants are subject to diseconomies of size with respect to the use of electrical energy. However, the results obtained *may* be a consequence of an inherent bias in the data. Although an attempt was made to select plants which closely approximate the specifications of the model plants, deviations undoubtedly occurred. The amount of cooler capacity, for example, and therefore the tonnage of refrigeration required were, perhaps, more similar between the model and actual plant for the smaller sizes of plant, but became more divergent as the size of plant increased. The result must be used with this limitation in mind.

Water

Data obtained from the accounting records of selected slaughtering plants were used to estimate, by linear multiple regression, the relationship between the consumption of water; and (1) the number of head slaughtered per month, and () the designed slaughter rate of the plant. The following regression equation resulted:

$$\underset{}{Q_w} = \underset{}{-4063.48} + \underset{(0.18)}{0.62Q_s} + \underset{(138.34)}{141.54R}$$

where Q_w represents the quantity of water consumed in thousands of gallons per month and the other variables have been defined previously. The coefficient of multiple determination was estimated as 0.99 and the standard errors are displayed beneath the appropriate coefficient.

The cost of the water consumed by each plant at each operating level was estimated by applying the water rate schedule for the Oklahoma City area to the estimates of consumption. The rate schedule used was as follows:

			Per 1,000 Gallons		
			Gross	Discount	Net
(A)	First	1,000 Gallons	Included	in Minimum	Bill
	Next	4,000 Gallons	.62	.02	.60
	Next	10,000 Gallons	.54	.02	.52
	Next	135,000 Gallons	.39	.02	.37
	Next	350,000 Gallons	.29	.02	.27
	Next	4,000,000 Gallons	.22	.02	.20
	All Over	5,000,000 Gallons	.18	.02	.16

Table 7. Estimated Consumption and Cost of Utilities

Plant Size Head Hour	Percent Rated Line Speed	Electricity Monthly Consumption[5]	Electricity Yearly Cost[6]	Gas Monthly Consumption	Gas Yearly Cost	Water and Sewer Monthly Consumption[6]	Water and Sewer Yearly Cost[6]	Total Cost[7]
		(K.W.H.)	(Dol.)	(M.C.F.)	(Dol.)	(1,000 Gal.)	(Dol.)	(Dol.)
	90	29,352	4,391	1,083.8	3,280	1,359.27	6,457	14,128
	95	31,140	4,554	1,140.0	3,436	1,451.05	6,754	14,744
20	100	32,970	4,721	1,204.2	3,613	1,555.94	7.094	15.428
	105	34,899	4,897	1,268.4	3,790	1,660.83	7.434	16,121
	110	36,587	5,051	1,324.6	3,945	1,725.61	7,731	16,727
	115	38,478	5,223	1,388.8	4,123	1,855.44	8,064	17,410
	90	159,119	21,651	2,167.6	6,192	4,072 88	14,605	42,448
	95	162,736	21,981	2,288.0	6,466	4,269.55	15,124	43,571
40	100	166,354	22,311	2,408.4	6,741	4,466.21	15,643	44,695
	105	169,971	22,641	2,528.9	7,016	4,662.88	16.163	45,820
	110	173,588	22,971	2,649.3	7,290	4,859.55	16,682	46,943
	115	177,205	23,301	1,769.7	7,565	5,056.22	17,147	48,040
	90	290,252	36,776	3,251.4	8,663	6,786.48	20,817	66,256
	95	295,557	37,158	3,428.0	9,066	7,074.93	21,405	67,629
60	100	301,104	37,558	3,612.7	9,487	7,376.49	22,021	69,066
	105	306,650	37,965	3,797.3	9,907	7,678.05	22,636	70,499
	110	311,956	38,338	3,974.0	10,310	7,966.50	23,244	71,872
	115	317,502	38,738	4,158.6	10,712	8,268.05	23,839	73,289
	90	389,679	47,426	4,070.3	10,521	8,831.52	24,989	82,936
	95	396,432	47,912	4,295.1	11,007	9,198.64	25,738	84,657
75	100	403,194	48,399	4,515.9	11,493	9,566.32	26,488	86,380
	105	409,936	48.885	4,744.7	11,978	9,932.87	27,236	88,099
	110	416,688	49,371	4,969.4	12,464	10,299.98	27,985	89,820
	115	423,440	49,859	5,194.2	12,949	10,667.10	28,733	91,539
	90	489,393	57,930	4,873.1	12,255	10,850.34	29,107	99,292
	95	497,592	58,521	5,146.1	12,845	11,296.12	30,017	101,383
90	100	505,791	59,111	5,419.0	12,787	11,741.90	30,926	102,824
	105	513,990	59,701	5,692.0	14,024	12,187.68	31,836	105,561
	110	522,190	60,292	5,694.9	14,614	12,633.47	32,745	107,651
	115	530,208	60,869	6,231.9	15,191	13,069.43	33,634	109,694
	90	691,849	79,044	6,503.0	15,776	14,927.30	37,424	132,244
	95	702,701	79,826	6,863.8	16,555	15,517.31	38,628	135,009
	100	713,553	80,607	7,225.4	17,337	16,107.31	39,831	137,775
	105	724,405	81,388	7,586.6	18,117	16,697.32	41,035	140,540
	110	735,257	82,170	7,947.8	18,897	17,287.32	42,239	143,306
	115	746,109	82,951	8,309.8	19,678	17,877.33	43,442	146,071

[1] Developed from regression equation on page xx.
[2] Developed from regression equation on page xxx.
[3] Sum of Columns 3, 5, and 7.

The 20 and 40 per hour plants had a minimum fixed charge of $73 per month, and the four larger plants had a minimum fixed charge of $200 per month. The water requirements and costs are listed in Table 7.

The estimating procedure used assumes a linear relationship to exist between water consumption and size of plant and may contain a bias in the data resulting from differences between the selected plants and the model plants. That is, the model plants did not specify extensive by-product processing at any level of operation, whereas the larger, actual plants probably find it profitable to do rather extensive processing of beef by-products which would result in relatively larger increases in water consumption per head for such plants.

Natural Gas

Several attempts were made to relate the consumption of natural gas to the output of beef. An analysis of the accounting record data indicated that no satisfactory relationship could be detected between these variables. For this reason, an average conumption of 3.778 hundreds of cubic feet per head, estimated from the plant records, was used to estimate the natural gas consumption of the model plants. The gas rate was applied to the consumption estimates to determine the cost of the gas.

Rate:

First	1 M c.f.	or fraction thereof $1.60
Next	99 M c.f.	per month at 46¢ per M c.f.
Next	1,900 M c.f.	per month at 23¢ per M c.f.
Next	2,000 M c.f.	per month at 19¢ per M c.f.
Next	6,000 M c.f.	per month at 18¢ per M c.f.
Next	20,000 M c.f.	per month at 17.5¢ per M c.f.
All Over	30,000 M c.f.	per month at 17¢ per M c.f.

Using the above procedure, the average cost of natural gas per head slaughtered decreased slightly over the range of plant sizes studied.

Sewer Services

The cost of the sewer services depends directly on the amount of water consumed by the model plant. Sewer charges are based on the amount of water metered to the plant and are calculated by multiplying the rate by the number of gallons of water consumed.

First 200,000 gallons of water used at 10¢ per 1,000 gallons per month.

Next 300,000 gallons of water used at 9¢ per 1,000 gallons per month.

Next 500,000 gallons of water used at 8¢ per 1,000 gallons per month.
Next 1,000,000 gallons of water used at 7¢ per 1,000 gallons per month.
Next 1,000,000 gallons of water used at 5¢ per 1,000 gallons per month.
Next 1,000,000 gallons of water used at 4¢ per 1,000 gallons per month.
Next 2,000,000 gallons of water used at 2¢ per 1,000 gallons per month.
All over 6,000,000 gallons of water used at 1¢ per 1,000 gallons per month.

The sewer service also includes a minimum fixed charge of $29 per month. The sewer costs are listed in Table 7.

Miscellaneous Supplies and Services

Four other minor cost items were considered. These were repair and maintenance, telephone, laundry, and miscellaneous supplies. Insufficient data were available from the selected plants to estimate repair and maintenance costs. Therefore, an average cost of $.339 per head per year (8) was assumed to be valid in the Oklahoma City area. Average costs, taken from the accounting records, were used to reflect the costs of telephone, laundry, and miscellaneous supplies. The rates used to estimate the costs for the model plants were: $.2662 per head per year for telephone expenses, $.2232 per head per year for laundry expenses, and $.3833 per head per year for miscellaneous supplies expenses. These costs are listed in Table 8.

Interest on Operating Capital

For the purposes of this study it was assumed that the operating capital requirements were supplied by both internal and external sources in such proportions that the effective average interest rate was five percent per annum. Costs of interest on operating capital for each of the model plants are presented in Table 8.

Total Costs

The total annual costs for the five model plants, estimated at rated line speeds, ranged from over three-quarters of a million dollars for the 20 head per hour plant to over one and one-half million dollars for the 120 head per hour plant. Total costs increased nonlinearly for each

Table 8. Estimated Cost of Other Supplies and Services.[1]

Plant Size Head Killed Per Hour	Percent Rated Line Speed	Telephone	Laundry	Miscellaneous Supplies	Repair and Maintenance	Interest on Operating Capital	Total
				Dollars			
	90	9,164	7,684	13,195	11,670	11,062	41,713
	95	9,639	8,082	13,879	12,273	11,472	41,875
20	100	10,182	8,537	14,661	12,967	11,879	46,347
	105	10,725	8,993	15,443	13,658	12,459	48,819
	110	11,200	9,391	16,128	14,263	12,999	50,982
	115	11,743	9,846	16,909	14,955	13,555	53,453
	90	18,328	15,367	26,390	23,340	22,276	83,425
	95	19,346	16,221	27,856	24,637	23,081	88,060
40	100	20,364	17,075	29,322	25,934	23,880	92,695
	105	21,383	17,929	30,789	27,230	24,938	97,331
	110	22,401	18,782	32,255	28,527	25,993	101,965
	115	23,419	19,636	33,721	29,824	27,029	106,600
	90	27,492	23,051	39,585	35,010	31,956	125,138
	95	28,985	24,303	41,736	36,912	33,076	131,936
60	100	30,546	25,612	43,984	38,900	34,212	139,042
	105	32,108	26,921	46,232	40,888	35,701	146,149
	110	33,601	28,173	48,382	42,790	37,169	152,946
	115	35,162	29,482	50,630	44,779	38,636	160,053
	90	34,856	28,856	49,555	43,828	40,986	156,655
	95	36,316	30,450	52,292	46,248	42,412	165,306
75	100	38,217	32,044	55,028	48,669	43,835	173,958
	105	40,118	33,637	57,765	51,089	45,708	182,609
	110	42,018	35,231	60,502	53,509	47,577	191,260
	115	43,919	36,825	63,239	55,930	49,421	199,913
	90	41,204	34,548	59,329	52,472	49,768	187,553
	95	43,512	36,484	62,652	55,411	51,543	198,058
90	100	45,820	38,418	65,976	58,350	53,275	208,564
	105	48,128	40,353	69,299	61,290	55,641	219,070
	110	50,436	42,289	72,622	64,229	57,967	229,576
	115	52,693	44,181	75,872	67,103	60,197	239,849
	90	54,984	46,102	79,171	70,020	68,323	252,939
	95	58,038	48,663	83,569	73,910	70,620	264,180
120	100	61,093	51,093	87,967	77,800	73,044	278,084
	105	64,148	53,786	92,366	81,691	76,250	291,991
	110	67,202	56,347	96,764	85,581	79,451	305,394
	115	70,257	58,908	101,624	89,471	82,629	320,260

[1] Figures are rounded to nearest dollar.

scale of plant as the output level was increased from 90 to 115 percent of rated line speed.

The annual cost of ownership, or the total annual investment cost comprised a relatively small part of the total annual cost. Annual investment costs were estimated at $28,269, $47,639, $62,066, $77,707 $91,123 and $121,407 for the 20, 40, 60, 75, 90, and 120 head per hour plants, respectively. In relative terms these investment costs are 10.2, 8.7, 8.0, 7.9, 7.7, and 7.6 percent of the total annual costs, respectively (Table 9).

Table 9. Cost Components as a Percentage of Total Annual Cost at Rated Line Speeds, Six Model Plants.

Cost Items	Plant Size, Head Killed Per Hour					
	20	40	60	75	90	120
	Annual Costs (Percent)					
Annual Investment	10 22	8.69	8 03	7.93	7.69	7.57
Depreciation	4.72	4 01	3.71	3.67	3.53	3.58
Interest	3.33	2.83	2.62	2.59	2.49	2.39
Taxes and Insurance	2.17	1.85	1.70	1.67	1 67	1.60
Labor	63 16	61.91	60.62	61.12	61.55	61.94
Kill Floor	18.90	16.16	18.27	17.62	18.10	18.67
Supporting Operations	20.40	21.42	18.06	18.66	19.53	19.86
Salaried Personnel	18.83	19.44	19 47	20.04	19.06	18.43
Tax and Welfare	5.03	4 89	4.83	4.81	4.87	4.97
Utilities	5 58	8.15	8 93	8.79	8.67	8.59
Other Supplies	16.75	16.90	17.99	17.70	17.59	17.34
Interest on Operating Capital	4.29	4.35	4.43	4.46	4.49	4.56
Total	100.00	100.00	100.00	100.00	100.00	100.00

Depreciation comprised the largest component of the annual fixed investment cost and ranged from $13,064 or 4.7 percent of total cost for the smallest plant to $57,438 or 3.6 percent of total cost for the largest. Interest on the investment ranked second in importance and amounted to almost one-third of the annual fixed investment cost. Taxes and insurance on the investment formed the balance of the fixed investment costs and increased from $5,993 for the 20 head per hour plant to $25,630 for the 120 head per hour plant. The various components of the annual investment costs are presented in Table 10.

The annual operating costs, consisting of the costs of labor, utilities, other supplies and the interest on operating capital, constitute the major part of the total annual costs. Labor costs, the largest component of total operating costs, were estimated in excess of 60 percent of total annual cost for each of the plants at rated line speed.

For each plant, labor costs increased uniformly as the level of output was increased from 90 to 100 percent of rated line speed. When output levels were increased from 100 to 115 percent of rated line speed, the total labor cost increased at a greater rate, causing a kink to occur in the total cost function at an input level equivalent to 100 percent of rated line speed. The change in rate of increase in total labor costs at the larger output levels was a result of the payment of overtime wages. Average costs per head for each cost component for each plant is presented in Table 11.

An examination of the total annual costs in relation to the size of plant provides information concerning the existence, or nonexistence,

Table 10. Annual Fixed Investment Costs.

Cost Items	Plant Size, Head Killed Per Hour					
	20	40	60	75	90	120
			Dollars			
Depreciation[1]	13,064.26	22,003.78	28,649.23	36,046.71	41,806.51	57,438.27
Interest						
Building and Equipment[2]	9,028.41	15,159.22	19,781.21	24,831.87	28,845.59	37,393.50
Land[3]	182.99	337.20	484.87	390.06	714.70	944.72
Insurance[4]	337.06	565.94	738.49	927.06	1,076.90	1,396.02
Taxes[5]	5,656.00	9,572.71	12,411.84	15,510.88	18,679.86	24,234.60
Total	28,268.72	47,638.85	62,065.64	77,706.58	91,123.56	121,407.11

[1] Column 13, Table 3, and Column 5, Table 4.
[2] Column 9, Table 4.
[3] Column 6, Table 2.
[4] Column 8, Table 4.
[5] Column 10, Table 5.

Table 11. Cost Components for Six Model Plants, Average Cost Per Head at Rated Line Speed.

Cost Items	Plant Size, Head Killed Per Hour					
	20	40	60	75	90	120
			Cost Per Head (Dollars)			
Annual Investment	.74	.62	.54	.54	.53	.52
Depreciation	.34	.29	.24	.25	.25	.25
Interest	.24	.20	.18	.17	.17	.16
Taxes and Insurance	.16	.13	.12	.12	.11	.11
Labor	4.57	4.44	4.09	4.18	4.24	4.33
Kill Floor	1.37	1.16	1.23	1.21	1.24	1.31
Supporting Operations	1.48	1.54	1.22	1.28	1.34	1.38
Salaried Personnel	1.36	1.39	1.31	1.37	1.32	1.29
Tax and Welfare	.36	.35	.33	.32	.34	.35
Utilities	.40	.58	.60	.60	.60	.60
Other Supplies	1.21	1.21	1.21	1.21	1.21	1.21
Interest on Operating Capital	.31	.31	.30	.31	.31	.32
Total	7.23	7.16	6.74	6.84	6.89	6.98

of size economies. If the 20 head per hour plant is used as a basis for comparison, it can be noted that as the size of plant is increased by multiples of 2.00, 3.00, 3.75, 4.50 and 6.00, total costs are increased by multiples of 1.98, 2.79, 3.55, 4.29, and 5.80, respectively. These results imply the existence of some economies of size over the range of plants studied.

Short-Run Average Costs

The size economies implied by the total cost relationships may be investigated more closely and in more conventional form by an examination of the short-run average cost relationships. Estimates of the average cost per head for each size of plant at each of six operating levels is presented in Table 12 and plotted in Figure 1.

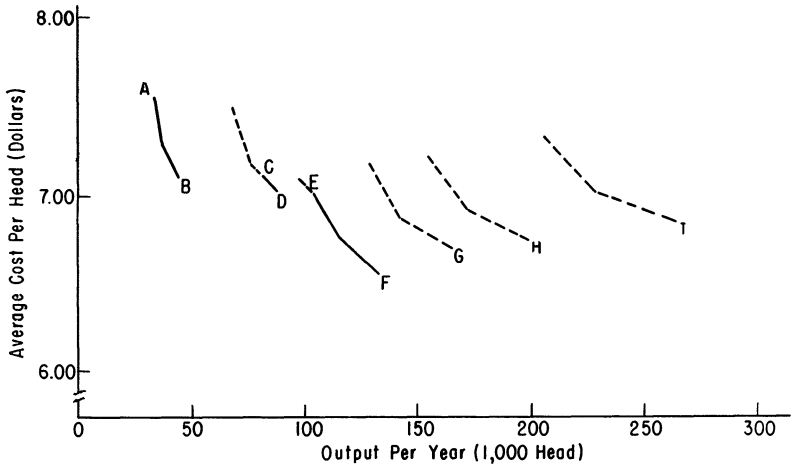

Figure 1. Short-Run and Long-Run Average Cost Curves, Six Model On-The-Rail Beef Slaughtering Plants.

The average cost estimates obtained for the model plants, operating at their respective rated line speeds, ranged from $7.23 per head for the 20 head per hour plant to $6.74 per head for the 60 head per hour plant.

Average short-run costs decreased for each size of plant as the output increased from 90 to 115 percent of rated line speed. Over the range of plants studied, the average cost decreased an average of $.457 as plant output increased from 90 to 115 percent of rated line speed. The reduction in average cost resulting from increased utilization of the fixed factors of production was least for the 20 head per hour plant.

Each of the model plants attained a position of minimum average cost at 115 percent of rated line speed, or at maximum designed cooler capacity. These results are summarized in Table 12.

Table 12. Per Head Costs of Slaughtering Beef Cattle, Six Sizes of Model Plant, Six Levels of Operation.

Percent of Rated Capacity	Size of Plant (number killed per hour)					
	20	40	60	75	90	120
			Dollars Per Head			
90	7.52	7.47	7.02	7.14	7.18	7.29
95	7.39	7.31	6.88	6.98	7.03	7.12
100	7.23	7.16	6.74	6.84	6.89	6.98
105	7.16	7.11	6.67	6.78	6.83	6.93
110	7.13	7.05	6.62	6.73	6.78	6.88
115	7.08	7.00	6.56	6.67	6.73	6.84

Long-Run Average Costs

Theoretically, the long-run average cost curve lies tangent to an infinite number of short-run average cost curves. When less than an infinite number of short-run average cost curves are possible, then only segments of the short-run average cost curves describe the long-run average cost curve.

In the case of the model plants, the long-run average cost curve is described by the line segments AB, CD, EF, and points G, H and I in Figure 1. Thus, when faced with a choice among alternative sizes of plant, a saving of $0.52 per head or over $68,000 per year can be realized on a 60 head per hour plant operated at 115 percent of capacity as opposed to obtaining the same kill with three 20 hour plants operated at 115 percent of capacity.

When the size of plant is increased beyond 60 head per hour, and cooler facilities are limited to the kill from a single shift, some diseconomics appear to exist. Average cost per head for the 120 head per hour plant, operated at 115 percent of rated capacity, was $0.28 per head greater than for the 60 head per hour plant operated at an equivalent level. This implies an annual saving of almost $74,000 per year with two 60 head per hour plants in lieu of a single 120 head per hour facility.

The economies accruing to sizes of plant up to 60 head per hour can be attributed primarily to the net effect of greater efficiencies in the use of labor (Table 11). Increases in output are attained primarily by an increased number of employees in the lower wage skills. As plant size increases beyond 60 head per hour, the number of workers in the lower paid skills increases less than proportionately, whereas the number of workers in the higher paid skills increases more than proportionately. Thus, although the technical efficiency remains nearly constant at two head per man per hour, economic efficiency declines.

Some of the diseconomies evident over the range of plant sizes from 60 head per hour to 120 head per hour may only be apparent diseconomies. These diseconomies may be the result of the procedures used to estimate electrical and water consumption, to differences in the operations specified for the model plants and the operation conducted in actual plants, or to a bias in the utilities costs resulting from the procedures used to collect data on utilities consumption. Additional information is needed to determine the degree bias, if any, in the cost estimate for plants of 60 head per hour and greater. Economies in the use of plant and equipment for the larger plants were not sufficient to offset or exceed the estimated increases in labor costs.

The fact that per head costs of slaughtering beef cattle were minimal for the 60 head per hour plant should not be used to infer that this is the optimum size of abattoir to construct and operate. The plants considered in this analysis did not include sufficient cooler space for multiple shift operations. Therefore, if additional cooler space, labor, and utilities were provided to permit multi-shift operations, the average cost per head for the larger plants, at or in the neighborhood of the physical limits of the plant and equipment, may approach or even be slightly below the cost per head for the 60 head per hour plant.

In addition to the foregoing, a choice among alternative sizes of plant includes many other considerations. Paramount among such considerations, perhaps, are the costs per head of procurement and distribution activities and the size and nature of the market areas which can be expected to generate the plant's revenues. None of these factors were considered in this study. Given the foregoing qualifications, investors and managers should realize that the important size economies are achieved with plants up to 60 head per hour.

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APPENDIX A, Table I
Cost of Corral Flooring, and Roofing

Plant Size Head Per Hour	Pens Needed[1] 10′ x 20′	Area in Pens[2]	Area in Alleys[3]	Total Area[4]	Cost of Pen and Alley Floor[5]	Gates[6]	Length of Fencing[7]	Cost of Gates and Fencing[8]	Area Cover by Weathertight Roof[9]	Cost of Weathertight Roof[10]	Total Cost[11]
	(Number)		(Square Feet)		(Dollars)	(Number)	(Feet)	(Dollars)	(Square Feet)	(Dollars)	(Dollars)
20	32	6,400	2,400	8,800	4,501.80	36	1,120	2,198.40	1,760	1,760.00	8,460.20
40	66	13,200	4,600	17,800	9,045.00	73	2,140	4,284.80	3,560	3,560.00	16,889.80
60	104	20,800	7,000	27,800	14,174.10	113	3,440	6,800.80	5,560	5,560.00	26,534.90
75	128	25,600	7,800	33,400	16,795.35	137	3,650	7,558 00	6,680	6,680.00	31,033.35
90	152	30,400	9,400	39,800	20,082.15	161	4,490	9,146.80	7,960	7,960.00	37,188.95
120	200	40,000	12,300	52,300	26,350.20	212	5,820	11,922.40	10,460	10,960.00	49,232.60

[1] Based on 11 head per pen with total capacity of approximately 2½ days kill.
[2] Number of pens in Column 2, multiplied by 200 square feet.
[3] Alleys are specified to be 10 feet wide.
[4] Columns 3 plus Column 4.
[5] Total area plus the linear length of fence to allow for the 12 inch curbs which separate all pens, plus ¾ square foot per post, multiplied by $.45 per square foot.
[6] One gate is allowed for each pen, plus a number of extra ones for the alleys.
[7] Derived from pen requirements.
[8] Fencing cost estimated at $1.32 per linear foot, gates (10 foot wide) estimated at $20.00 each.
[9] One-fifth of total pen area to be covered by weathertight roof.
[10] Square feet of roof multiplied by $1.00 per square foot.
[11] Sum of Columns 6, 9, and 11.

APPENDIX B, Table I
General Cooler Specifications for the Six Model Plants

Plant Size Head Per Hour	Size		Maximum Daily Heat Load			Estimated Tons of Refrigeration Required[6]
	Dimensions[1]	Cu. Ft.	Carcasses[2]	Electric Motors[3]	Electric Lights[4]	
Chill Coolers			Number	Horse-power	Watts Per Hour	
20	45x38x13	22,230	173	15	3,840	43
40	54x58x13	40,716	345	30	6,480	84
60	69x68x13	60,996	518	45	9,120	125
75	84x68x13	74,256	647	60	11,120	157
90	90x83x13	97,110	876	75	14,480	210
120	108x83x13	116,522	1,035	105	17,440	248
Holding Coolers						
20	53.5x42x13	29,211	300	5	5,040	12
40	61x62x13	49,166	600	7.5	7,760	22
60	76x72x13	71,136	900	10	10,640	30
75	96x72x13	89,856	1,126	15	14,080	41
90	91x87x13	102,210	1,350	20	15,360	50
120	121x87x13	136,851	1,800	30	20,480	66

[1] The number of linear feet of rail space was estimated (see Appendix B, Tables II and III) and the coolers were arbitrarily shaped to allow enough area for required spacing of the rails.
[2] Maximum number of carcasses to be in cooler at any one time.
[3] Estimated from the equipment necessary to provide proper circulation under the peak loads.
[4] For procedure used in estimating electric light requirements, see Brown, R. H., E. E., A. E., Farm Electrification (New York, 1956), pp. 139-152.
[6] For the procedure used in estimating tons of refrigeration required see Raymond C. Gunther, *Refrigeration Air Conditioning and Cold Storage* (Philadelphia, 1957), pp. 1125-1130. An alternative procedure may be found in *ASHRAE Guide and Data Book 1962, Application for Heating Refrigerating Ventilating and Air Conditioning*, American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc., New York, pp. 341-343.

APPENDIX B, Table II
Cost of Chill Coolers

Plant Size Head/ Hour	Area[1]	Exterior Wall[2]	Construction Cost of Exterior Wall[3]	Number of Floor Drains[4]	Cost of Floor Drains[5]	Number of Doors[6]	Cost of Doors[7]	Feet of Rail[8]	Cost of Rail Installed[9]	Total Cost[10]
	(Square Feet)		(Dollars)		(Dollars)		(Dollars)		(Dollars)	
20	1,710	5,081	20,336	4	96	1	546	432	2,160	23,138
40	3,132	8,422	33,688	8	192	2	1,092	862	4,310	39,282
60	4,692	12,062	48,248	12	288	2	1,092	1,295	6,475	56,103
75	5,712	14,492	57,968	14	336	2	1,092	1,617	8,085	67,481
90	7,470	18,359	73,436	19	456	2	1,092	2,190	10,950	85,934
120	8,964	21,815	87,260	23	552	4	2,184	2,588	12,940	102,936

[1] Rail space required for one day's kill plus 15 percent excess capacity was estimated and enough area was allowed to space rails on three feet centers.
[2] Does not include wall between coolers.
[3] Column 3 times $4.00 per square foot.
[4] Approximately one floor drain per 400 square feet. Agriculture Handbook No. 191, *U. S. Inspected Meat Packing Plants*, Agricultural Research Service, USDA, p. 4.
[5] Column 5 times $24.00 each (manufacturer's price).
[6] Number of doors assumed.
[7] Column 7 times $546.00 each (manufacturer's price).
[8] Thirty inches rail space per carcass, plus one foot for each switch.
[9] Column 9 times $5.00. (Estimate of rail cost installed made by contractors).
[10] Sum of Columns 4, 6, 8, and 10.

APPENDIX B, Table III
Cost of Holding Coolers

Plant Size Head/ Hour	Area[1]	Exterior Wall[2]	Construction Cost of Exterior Wall[3]	Number of Floor Drains[4]	Cost of Floor Drains[5]	Number of Doors[6]	Cost of Doors[7]	Feet of Rail[8]	Cost of Rail Installed[9]	Total Cost[10]
	(Square Feet)		(Dollars)		(Dollars)		(Dollars)		(Dollars)	
20	2,247	6,483	25,932	6	144	2	1,092	600	3,000	30,168
40	3,782	9,886	39,544	9	216	2	1,092	1,200	6,000	46,852
60	5,472	13,908	55,632	14	336	2	1,092	1,800	9,000	66,060
75	6,912	16,372	65,488	17	408	2	1,092	2,250	11,250	78,238
90	7,917	19,383	77,532	20	480	2	1,092	2,700	13,500	92,604
120	10,527	25,500	102,000	27	648	4	2,184	3,600	18,000	122,832

[1] Rail space required for two days' kill was estimated and enough area was allowed to space rails on two and one-half foot centers with three feet of clearance from all walls. An alley seven feed wide for pushing offal down one side of the cooler was also included.
[2] Does not include wall between coolers.
[3] Column 3 times $4.00 per square foot.
[4] Approximately one floor drain per 400 square feet.
[5] Column 5 times $24.00 each.
[6] Number of doors assumed
[7] Column 7 times $546.00 each.
[8] Twenty-four inches rail space per carcass.
[9] Column 9 times $5.00 per linear foot.
[10] Sum of Columns 4, 6, 8, and 10.

APPENDIX C, Table I
Annual Wage Schedule of Hourly Employees[1]

Hourly Wage Rate[2]	Vacation Pay[3]	Health Welfare[4]	90 Percent Rated LineSpeed or Below: Annual Minimum[5]	90 Percent Rated LineSpeed or Below: Minimum Total Annual Wage[6]	95 Percent Rated Line Speed: Annual Wage[7]	95 Percent Rated Line Speed: Total Annual Wage[8]	Rated Line Speed: Annual Wage[9]	Rated Line Speed: Total Annual Wage[10]
				(Dollars)				
1.82	145.60	120.00	3,407.04	3,672.64	3,596.32	3,861.92	3,785.60	4,051.20
1.85	148.00	120.00	3,463.20	3,731.20	3,655.60	3,923.60	3,848.00	4,116.00
1.91	152.80	120.00	3,575.52	3,848.32	3,774.16	4,046.96	3,972.80	4,245.60
1.92	153.60	120.00	3,594.24	3,867.84	3,793.92	4,067.52	3,993.60	4,267.20
1.95	156.00	120.00	3,650.40	3,926.40	3,853.20	4,129.20	4,056.00	4,332.00
1.96	156.80	120.00	3,669.12	3,945.92	3,872.96	4,149.76	4,076.80	4,353.60
1.98	158.40	120.00	3,706.56	3,984.96	3,912.48	4,190.88	4,118.40	4,396.80
2.01	160.80	120.00	3,762.72	4,043.32	3,971.76	4,252.56	4,180.80	4,461.60
2.09	167.20	120.00	3,912.48	4,199.68	4,129.84	4,417.04	4,347.20	4,634.40
2.12	169.60	120.00	3,968.64	4,258.24	4,189.12	4,478.72	4,409.60	4,699.20
2.17	173.60	120.00	4,062.24	4,355.84	4,287.92	4,581.52	4,513.60	4,807.20
2.20	176.00	120.00	4,118.40	4,414.40	4,347.20	4,643.20	4,576.00	4,872.00
2.28	182.40	120.00	4,268.16	4,570.56	4,505.28	4,807.68	4,742.40	5,044.80
2.36	188.80	120.00	4,417.92	4,726.72	4,663.36	4,972.16	4,908.80	5,217.60
2.50	200.00	120.00	4,680.00	5,000.00	4,940.00	5,260.00	5,200.00	5,520.00

[1] Wage practices (vacation pay, holidays, health and welfare, and overtime) based on an agreement between Texas Meat Packers, Inc., an Amalgamated Meat Cutters and Butcher Workers of North America, AFL-CIO, Local No. 540.

[2] Wage rates vary considerably from location to location. These rates were selected after comparing the wage rates of several plants with up-dated wage rates taken from *Wage Structure Series II*, No. 59.

[3] Based on two weeks' vacation with full pay (full pay based on 40-hour week).

[4] A sum of $10.00 a month or $120.00 a year per employee is paid into a trust by the employer for the purpose of providing Health and Welfare benefits to the employees.

[5] Hourly wage times 1,872 hours.

[6] Sum of Columns 2, 3, and 4.

[7] Hourly wage times 1,976 hours.

[8] Sum of Columns 2, 3, and 6.

[9] Hourly wage times 2,080 hours.

[10] Sum of Columns 2, 3, and 8.

APPENDIX C, Table II
Annual Wage Schedule of Hourly Employees

Hourly Wage Rate	Total Annual Wage[1]	Over-time Wage Rate[2]	105% Rated Line Speed		110% Rated Line Speed		115% Rated Line Speed	
			Annual Overtime[3]	Annual Wage Plus Over-time[4]	Annual Over-time[5]	Annual Wage Plus Over-time[6]	Annual Over-time[7]	Annual Wage Plus Over-time[8]
			(Dollars)					
1.82	4,051.20	2.73	283.92	4,335.12	567.84	4,619.04	851.76	4,902.96
1.85	4,116.00	2.78	289.12	4,405.12	578.24	4,694.24	867.36	4,983.36
1.91	4,245.60	2.87	298.48	4,544.08	596.96	4,842.56	895.44	5.141.04
1.92	4,267.20	2.88	299.52	4,566.72	599.04	4,866.24	898.56	5,165.76
1.95	4,332.00	2.93	304.72	4,636.72	609.44	4,941.44	914.16	5,246.16
1.96	4,353.60	2.94	305.76	4,659.36	611.52	4,965.12	917.28	5,270.88
1.98	4,396.80	2.97	308.88	4,705.68	617.76	5,014.56	926.64	5,323.44
2.01	4,461.60	3.02	314.08	4,765.68	628.16	5,089.76	942.24	5,403.84
2.09	4,634.40	3.14	326.56	4,960.96	653.12	5,287.52	979.68	5.614.08
2.12	4,699.20	3.18	330.72	5,029.92	661.44	5,360.64	992.16	5,691.36
2.17	4,807.20	3.26	339.04	5,146.24	678.08	5,485.28	1,017.12	5,824.32
2.20	4,872.00	3.30	343.20	5,215.20	686.40	5,558.40	1,029.60	5,901.60
2.28	5,044.80	3.42	355.68	5,400.48	711.36	5,756.16	1,067.04	6,111.84
2.36	5.217.60	3.54	368.16	5,585.76	736.32	5,953.92	1,104 48	6,322.08
2.50	5,520.00	3.75	390.00	5,910.00	780 00	6,300.00	1,170.00	6,690.00

[1] Column 9, Appendix D, Table I.
[2] Based on one and one-half times the employee's basic straight time wage. Paid for all hours over 40 hours in any one work week.
[3] Overtime hourly wage times 104 hours.
[4] Sum of Columns 2 and 4.
[5] Overtime hourly wage times 208 hours.
[6] Sum of Columns 2 and 6.
[7] Overtime hourly wage times 312 hours.
[8] Sum of Columns 2 and 8.

APPENDIX D, Table I
Synthesized Salaried Personnel Requirements and Annual Personnel Costs of the Six Model Plants

Position	Item	Output Per Hour					
		20	40	60	75	90	120
		(Number of Head)					
General Manager	Wage	9,500	11,500	14,500	17,500	25,000	25,000
	Number	(1)	(1)	(1)	(1)	(1)	(1)
Senior Buyer	Wage	---	9,000	9,000	11,500	11,500	11,500
	Number	---	(1)	(1)	(1)	(1)	(1)
Sales Manager	Wage	---	9,000	9,000	11,500	11,500	11,500
	Number	---	(1)	(1)	(1)	(1)	(1)
Plant Superintendent	Wage	---	7,500	9,000	11,500	11,500	11,500
	Number	---	(1)	(1)	(1)	(1)	(1)
Asst. Plant Supt.	Wage	---	---	5,200	5,600	6,000	6,000
	Number	---	---	(1)	(1)	(1)	(1)
Buyers	Wage	7,500	7,500	7,500	8,500	8,500	8,500
	Number	(2)	(3)	(5)	(6)	(7)	(10)
Sellers	Wage	7,500	7,500	7,500	8,500	8,500	8,500
	Number	(2)	(3)	(5)	(6)	(7)	(10)
Office Manager	Wage	---	9,000	9,000	11,500	11,500	11,500
	Number	---	(1)	(1)	(1)	(1)	(1)
Switch Board	Wage	---	3,000	3,000	3,000	3,000	3,000
	Number	---	(1)	(1)	(1)	(1)	(1)
Secretary	Wage	3,000	3,000	3,600	3,600	3,600	3,600
	Number	(1)	(1)	(2)	(2)	(3)	(5)
Bookkeeper	Wage	6,000	6,000	6,000	6,000	6,000	6,000
	Number	(1)	(1)	(1)	(2)	(2)	(4)
Payroll & Billing Clerk	Wage	3,600	3,600	3,600	3,600	3,600	3,600
	Number	(1)	(1)	(1)	(1)	(1)	(1)
Total	Wage	52,100	106,600	150,500	196,900	226,000	295,600
	Number	(8)	(15)	(21)	(24)	(27)	(37)

APPENDIX D, Table II
Synthesized Kill Floor Crews and Annual Labor Costs for the Six Model Plants

Operation	Wages Hourly	20 Output Per Hour, in Number of Head: No. of Workers[1]	20: Annual Cost Per Worker[2]	40: No. of Workers[1]	40: Annual Cost Per Worker[2]	60: No. of Workers[1]	60: Annual Cost Per Worker[2]	75: No. of Workers[1]	75: Annual Cost Per Worker[2]	90: Workers[1] No. of	90: Per Worker[2] Annual Cost	120: No. of Workers[1]	120: Annual Cost Per Worker[2]
	(Dollars)		(Dollars)		(Dollars)		(Dollars)		(Dollars)				(Dollars)
Kill Floor Labor													
Drive	1.85			1	4,116.00	1	4,116.00	1	4,116.00	1	4,116.00		
Pen	1.85					1	4,353.60	1	4,353.60	1	4,353.60	3	4,353.60
Knock	1.96	1	4,634.40										
Shackle & Hoist	1.95			1	4,634.40	1	4,332.00	2	4,332.00	2	4,332.00	2	4,332.00
Sticking	2.09					2	4,634.40	3	4,634.40	4	4,634.40	1	4,634.40
Scalping	2.09	1 (1)	4,634.40	2 (1)	4,634.40							4	4,634.40
Remove Right Hind Leg	1.98					1	4,396.80	1	4,396.80	2	4,396.80	2	4,396.80
Open Right Butt	1.98					1	4,396.80	1	4,396.80	1	4,396.80	1	4,396.80
Transfer	1.98	2 (2)		2	4.396.80			1	4,396.80	1	4,396.80	4	4.396.80
Remove Left Hind Leg	1.98					1	4,396.80	1	4,396.80	1	4,396.80		
Open Left Butt	1.98					1	4,396.80	1	4,396.80	1	4,396.80	1	4,396.80
Remove Front Legs	1.98	1 (1)		2 (1)		1	4,396.80	2	4,396.80	2	4,396.80	2	4,396.80
Rim Over	2.20			1 (2)	4,872.00	2	4.872.00			3	4,872.00	3	4,872.00
Open Shanks, Clear Out	2.20	1 (3)	4,872.00					3	4,872.00			2	4,872.00
Skin Pit of Shanks	2.20			2 (3)		1	4.872.00			3	4,872.00		
Clear Rosette	2.12							1	4,699.20			1	4,699.20
Clear Flanks	2.12	2 (2)	4,699.20	1	4,699.20	1	4,699.20	1	4,699.20	1	4,699.20	2	4,699.20
Open Aitch Bone	2.12									1	4,699.20		
Rump	2.28			1 (4)	5,044.80			1	5.044.80	1	5,044.80	2	5,044.80
Drop Bungs	2.12			1 (5)	4,872.00	2	5,044.80	1	4.872.00	1	4,699.20	1	4,699.20
Open & Pull Tails	2.20	1	5,044.80	1 (4)						1	4,872.00	1	5,044.80
Pull Hide	2.20			1	4,872.00	1 (1)	4,872.00					2	4,872.00
Pull Fells	2.20			1 (5)		1 (2)		1	4,872.00	2 (1)	5,217.60		
Saw Brisket	1.92	1 (3)		1 (2)		1 (1)						1	4,267.20
Back	2.36	1 (4)	5,217.60	2 (3)	5,217.60	1 (2)	5,217.60	2	5,217.60	2(1)1)2)	5,217.60		
Drop Hides	2.17									1 (2)		4	5,217.60
Evisecrate	2.01	1 (5)	4,461.60	1 (6)	4,461.60	2	4,461.60	2	4,461.60	3	4,461.60	3	4,461.60
Saw or Split Carcass	2.50	1	5,520.00	1	5,520.00	2	5,520.00	2	5,520.00	2	5,520.00	3	5,520.00
Kill Floor Labor													
Trim Bruises	1.95	1 (4)		1(6)1(7)		2	4,332.00	3	4,332.00	3	4.332.00		
Scribe & Trim Neck	1.92	1 (5)		1 (7)	4,332.00							3	4,332.00
Scale	1.92	1 (6)	4,267.20			1	4,267.20	1	4,267.20	1	4,267.20	2	4,267.20
High Wash	1.82					1	4,051.20	1	4,051.20	2	4,051.20	2	4,051.20
Low Wash	1.82	1	4.245.60			1	4,051.20	1	4,051.20	1	4,051.20	2	4,051.20
High Shroud	1.91			3	4,245.60	1	4,245.60	1	4,245.60	1	4,245.60	2	4,245.60
Low Shroud	1.91	1 (6)				1	4,245.60	1	4,245.60	2	4,245.60	2	4,245.60
Push into Cooler	1.85					2	4,116.00	2	4,116.00	2	4,116.00	2	4,116.00
TOTAL		11	52,296.00	19	88,658.40	31	141,266.80	38	173,104.80	47	214,555.20	60	299,455.20

[1] Similar figures in parentheses indicate that the operations are being performed by the same man or men.

[2] The worker will always be paid the wage rate of the highest skill he is performing.

Source Labor requirements were taken from specifications supplied by Allbright-Nell Co., Chicago, and selected slaughter plants in the Southwest. These were used to synthesize the skill floor crews with the help of Donald R. Hammons, Industrial Research Engineer, of the Handling and Facilities Research Branch, Transportation and Facilities Research Division, Agricultural Marketing Service, U. S. Department of Agriculture.

APPENDIX D, Table III
Synthesized Crews and Annual Labor Costs for the Supporting Operations in the Six Model Plants

Operation	Hourly Wages	Output Per Hour, in Number of Head: 20 No. of Workers[1]	20 Annual Cost Per Worker[2]	40 No. of Workers[1]	40 Annual Cost Per Worker[2]	60 No. of Workers[1]	60 Annual Cost Per Worker[2]	75 No. of Workers[1]	75 Annual Cost Per Worker[2]	90 No. of Workers[1]	90 Annual Cost Per Worker[2]	120 No. of Workers[1]	120 Annual Cost Per Worker[2]
	(Dollars)		(Dollars)		(Dollars)		(Dollars)		(Dollars)		(Dollars)		(Dollars)
Hot Offal Labor													
Foreman[3]	2.28			1	5,044.80	1	5,044.80	1	5,044.80	2	5,044.80	1	5,044.80
Separate, Open & Flush Paunches	1.95	1	5,044.80								4,332.00	3	4,332.00
Bone Heads, Save Brains	1.95			1	4,332.00	3	4,332.00	3	4,332.00	3	4,332.00	6	4,332.00
Trim Plucks, Hang Offal	1.95	1	4,332.00	1	4,332.00			2	4,332.00	3	4,332.00	4	4,332.00
Wash Hang, Brand Edible Offal, Inedible Trucks	1.95			1	4,332.00	1	4,332.00	1	4,332.00	1	4,332.00	2	4,332.00
Cold Offal Labor													
Foreman[3]	2.28		5,044.80	1 (1)	5,044.80	1	5,044.80	1	5,044.80	2	5,044.80	1	5,044.80
Truck Edible Offal, Trim Tongues, Spread Offal to Chill, Assist Inedible Trucker	1.95	2 (1)	4,332.00								4,332.00	3	4,332.00
Pack Offal	1.95			2	4,332.00	3	4,332.00	5	4,332.00	6	4,332.00	6	4,332.00
Assemble Local Orders, Load Trucks	1.95	1	4,332.00	2	4,332.00	3	4,332.00	4	4,332.00	4	4,332.00	9	4,332.00
Wash Barrels, Hook Trucks, Tub Trucks, Shelf Trucks & Buckets	1.95	2 (1)		1 (1)		1	4,332.00	1	4,332.00	1	4,332.00	5	4,332.00
Cooler Labor													
Foreman[3]	2.28	1	5,044.80	1	5,044.80	1	5,044.80	1	5,044.80	1	5,044.80	1	5,044.80
Remove Shrouds, Push Carcasses	1.95			3	4,332.00	3	4,332.00	4	4,332.00	6	4,332.00	12	4,332.00
Dock Labor													
Foreman[3]	2.28			1	5,044.80	1	5,044.80	1	5,044.80	2	5,044.80	1	5,044.80
Roll Beef, Hook Cars and Trucks	1.95	1	5,044.80								4,332.00	1	4,332.00
Push to Scale	1.95			1	4,332.00	1	4,332.00	1	4,332.00	2	4,332.00	1	4,332.00
Scale	1.95			1	4,332.00	1	4,332.00	1	4,332.00	1	4,332.00	1	4,332.00
Dock Pusher	1.95											5	4,332.00
Luggers	1.95	3	4,332.00	6	4,332.00	6	4,332.00	8	4,332.00	10	4,332.00	5	4,332.00
Rendering Labor													
Foreman[3]	2.28	1	5,044.80	1	5,044.80	1	5,044.80	1	5,044.80	1	5,044.80	1	5,044.80
Helper	1.92			1	4,267.20	1	4,267.20	2	4,267.20	2	4,267.20	3	4,267.20
Maintenance Labor													
Foreman[3]	2.36	1	5,217.60	1	5,217.60	1	5,217.60	1	5,217.60	1	5,217.60	1	5,217.20
Helper	2.17			1	4,807.20	2	4,807.20	3	4,807.20	4	4,807.20	5	4,807.60
TOTAL		12	56,433.60	26	117,492.00	31	139,627.20	41	183,357.60	52	231,484.80	72	318,535.20

[1] Similar figures in parentheses indicate that the operations are being performed by the same man or men.
[2] The worker will always be paid the wage rate of the highest skill he is performing.
[3] The operations performed by the foreman were arbitrarily designated, since they would vary greatly in actual plants.

Source: Labor requirements were taken from specifications supplied by Allbright-Nell Co., Chicago, and selected slaughter plants in the Southwest. These were used to synthesize the kill floor crews with the help of Donald R. Hammons, Industrial Research Engineer, of the Handling and Facilities Research Branch, Transportation and Facilities Research Division, Agricultural Marketing Service, U. S. Department of Agriculture.