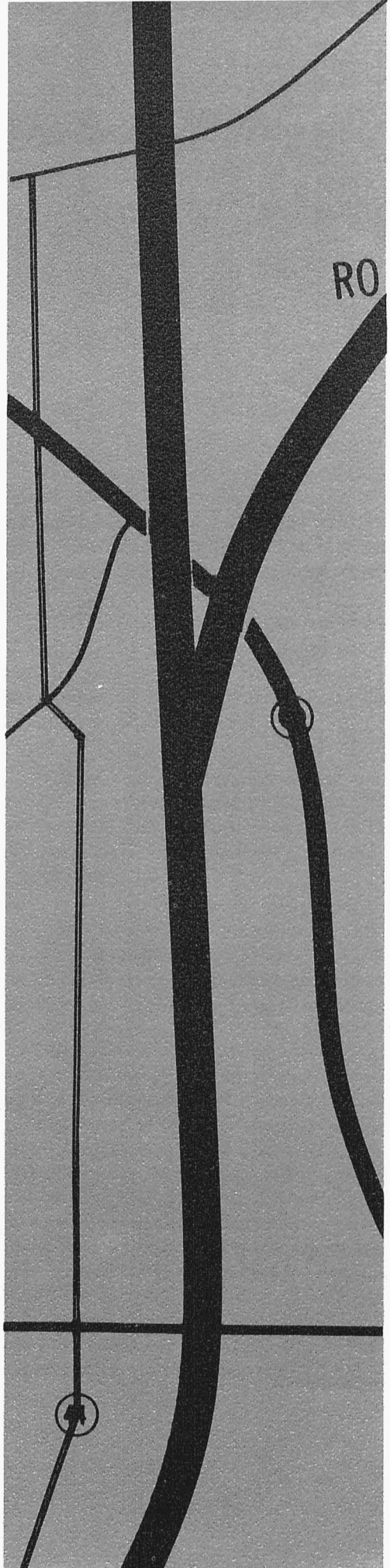

FACTORS AFFECTING COSTS FOR ALTERNATIVE MEAT DISTRIBUTION SYSTEMS

B 866
University of Missouri
Agricultural Experiment Station
1/68/1.5M

Contents

Introduction 3

Assumptions Underlying the Study 5
- General Assumptions 5
- Retail Store Assumptions 6
- Meat Warehousing Assumptions 6

Procedure 7
- Models 7
- Data 7

Results 7

Exhibit A 12

Exhibit B
- Models of Meat Distribution Systems 16

Glossary 19

Appendix A
- Source of Basic Data and Derivation of Specific Data 20

Appendix B
- Applications of Data to Model Components 26

Literature Cited 28

ACKNOWLEDGEMENTS

Appreciation is expressed to Dr. V. James Rhodes, Department of Agricultural Economics, University of Missouri; to Dr. Ross V. Baumann and Mr. Dale L. Anderson, Agricultural Research Service, U.S. Department of Agriculture, for guidance and assistance in preparation of this manuscript. The research was financed under contract with the U.S. Department of Agriculture-Agricultural Research Service.

Factors affecting

Costs for Alternative Meat Distribution Systems

HUGH V. LEACH

Introduction

The basic pattern of marketing fresh meats has remained essentially unchanged since the advent of large scale meat packing and refrigerated transport in the late 1800's. This basic marketing pattern is structured around three aspects of livestock and meat production:

1. Livestock production is concentrated in geographical areas that have favorable technical and economic climates for such enterprises. Frequently, the areas of livestock production are located at significant distances from the major population centers.

2. Meat animals are slaughtered at central locations near the area of live animal production. Then carcasses and wholesale cuts are transported in bulk lots to wholesalers for storage and subsequent distribution to retailers in small lots.

3. It is at the retail store that the last major function of the meat production process takes place. Carcasses and wholesale cuts of fresh meats are fabricated into retail cuts which are displayed and sold to individual consumers.

This structure of interspersed marketing and production functions was developed to accommodate restrictions imposed by economic and technical factors associated with production of livestock and meat products. One important limitation that has restricted the fabrication of retail cuts before delivery to retail stores is the fact that retail cuts of fresh meats handled under conditions generally prevalent in the industry have a shelf life of three days or less; whereas, high quality fresh meat attributes can be maintained in carcass beef for a much longer time period. The shelf life limitation of retail cuts can be explained partially by the fact that retail cuts have relatively large surface area per pound of meat and the fabrication process tends to distribute bacteria over the entire surface area.

From an economic viewpoint the fabrication of retail cuts at most retail stores has inherent characteristics of inefficient utilization of productive resources with the resulting tendency toward higher cost operation. The trend toward higher cost operations at the retail level becomes particularly important as wage rates increase, equipment costs increase, and space in the store becomes more valuable. Inefficiency in the utilization of productive resources in the retail store occurs because productive capacity for the fabrication process cannot be made directly variable with sales volume. Since sales volume will fluctuate widely between hours of a day and between days of a week, the retail store must maintain sufficient productive capacity to meet the requirements of the peak periods. Thus, excess capacity exists because of peak period requirements and because of the inherent capacity in certain pieces of equipment.

During recent years upward pressure on marketing costs has provided considerable incentive for marketers of fresh meats to search for cost-reducing innovations. One area of research has been to look for more efficient methods of distribution. Advances in refrigeration, meat processing equipment, packaging materials and equipment, managerial techniques, and data processing have prompted questioning the continued use of the basic process of meat distribution.

An innovation that has the potential of reducing fresh-meat distribution costs is that of centralizing the fabrication process so that one specialized plant could fabricate retail cuts for several retail stores in the local area. Duplication of equipment in retail stores would be reduced. Retail store backroom areas would be smaller since there would not be need of space to station bulky power equipment. Labor would be more efficiently used in the jobs, appropriate to the skills of individual workers.

This study was designed to specify and evaluate factors affecting distribution costs for four methods of marketing fresh meat. The conventional method of carcass

and wholesale cut distribution (Model 1) was used as a base or standard for comparison with the alternative distribution systems. Alternative distribution methods were: central processing of retail cuts for rapid distribution to stores located within a 100-mile radius of the central processing plant (Model 2), central processing of retail cuts for short term inventory storage at central plant and distribution from inventory to retail stores located within a 100-mile radius of the central plant (Model 2a), and fabricating retail meat cuts at a meat packing plant and transporting the cuts 1,000 miles to the consuming area (Model 3).

More detailed consideration of the alternative meat distribution methods point out distinctive characteristics that are important to each system. The alternative distribution system specified in Model 2 was designed to exhibit the functional characteristics of minimum time lapse between fabrication of the fresh retail cuts and ultimate sale to the consumer. Consideration of the distribution functions involved and the high degree of control needed to insure that all the retail cuts are distributed within the minimum time limitation makes it necessary to assume that the system consists of a business firm that is vertically integrated from central plant through the retail outlets. The single management of this vertically integrated firm would have authority over all the operating units and could make sure that the necessary records were maintained and the necessary information relayed to the central plant which would make this system operable.

A centralized fabrication distributing system where the firms were not vertically integrated but had separate management for the central plant and various retail stores is specified in Model 2a. A basis for this system could be the situation where several retail firms might be interested in a centralized prepackaging operation, but no one firm had a sufficient number of retail stores or sufficient sales volume to justify a central plant type operation. It was assumed that several individual firms could not generate sufficient managerial discipline to maintain records and transmit the necessary information to make a distribution system operate under conditions specified for Model 2. However, it appeared feasible to assume that extension of retail cut shelf life sufficient to permit inventory storage of retail cuts would facilitate independent operations of central prepackaging plants. This type of prepackaging plant would be able to operate with many of the characteristics of dry grocer wholesalers. Stocks of retail cuts would be maintained in inventory at the central plant for sale and delivery to independent retail firms. Introduction of the selling and buying functions between the central plant and retail stores would permit small independently managed retail stores to obtain the services of a central processing operation.

Distribution system three was designed to evaluate those factors affecting the operation of a system where retail cuts were fabricated at a packing plant located approximately 1,000 miles from the retail distribution area. Important characteristics of this system include large volume production, significant time lapse between fabrication and consumption of retail cuts, and multiple changes of retail cut ownership.

Four alternative marketing systems for meat distribution are specified. The costs of performing each function or group of functions are represented symbolically with the cost of each distribution method being the total of its components. Comparisons of total costs among alternative distribution systems can be made. Six sets of comparisons are made among the four marketing systems.

Conventional Distribution—Centralized Prepackaging
(Model 1) (Model 2)

Conventional Distribution—Centralized Prepackaging
(Model 1) (Model 2a)

Conventional Distribution—Packer Prepackaging
(Model 1) (Model 3)

Centralized Prepackaging—Centralized Prepackaging
(Model 2) (Model 2a)

Centralizing Prepackaging—Packer Prepackaging
(Model 2) (Model 3)

Centralized Prepackaging—Packer Prepackaging
(Model 2a) (Model 3)

The fundamental objective of each distribution system is to provide retail packaged meat cuts at the point of sale to consumers. The systems are not unique in themselves, but there are characteristic differences in the sequence, frequency, and scale with which marketing and production functions are performed.

Assumptions Underlying the Study

General Assumptions:

Marketing is a dynamic force in our economic system and is constantly changing to meet new competitive and economic situations. Any attempt to describe normal or typical channels for specific commodities beyond a few broad generalities involves many assumptions of heroic proportions. This study was designed to compare costs of alternative meat marketing systems based upon available secondary information.

Three of the alternative marketing systems (Models 2, 2a, and 3) are not currently in use to any appreciable extent. Nevertheless, the procedure can be justified because marketing of meats is composed of a series of steps or functions which can be rearranged to create the new systems. The functions transferred from one system to another will not be precisely identical in costs or content in all cases, but adjustments can be made in costing to conform to the new position in the marketing process.

Consumer reactions to the different systems will be largely ignored on the assumption that each system of distribution will deliver comparable meat cuts to the point of sale. Thus eliminated is consideration of new forms or package configurations of meats and the consumer's willingness to pay a price differential between various product and package combinations.

The following assumptions will be made about the meat products entering distribution channels. These assumptions apply to meat as it leaves the normal packing plant operation and enters specific marketing systems. Beef quarters weigh 150 pounds per quarter with an equal number of fore and hind quarters. Lamb and veal are in carcass form. Fresh pork is in wholesale cuts; cured pork is mostly processed and packaged in consumer units. Poultry is assumed to be dressed but uncut and in bulk containers. Meat in carcass form refers to beef quarters and lamb and veal carcasses. Prepackaged meat refers to meat packages that are cut and wrapped for normal retail sale from self-service display cases in retail stores. Thus, each of the prepackaging systems refers to the point where the carcasses and wholesale cuts are fabricated into retail cuts.

Proportions of total meat handled that consist of beef quarters and lamb and veal carcasses are derived from data from Ott[26] and by a major chain (Table 1). Carcass form meat is 40 percent of total meat with beef quarters 36 percent, veal 2 and lamb 2 percent of total meats. Beef in non-carcass form is frozen shanks for use in making ground beef and consists of 4 percent of total meat.

TABLE 1--PROPORTIONS OF MEAT HANDLED BY SPECIE

Specie	Volume of Meat
	Percent
Fresh Beef	40
Fresh Pork	14
Lamb	2
Veal	2
Poultry	12
Store packaged delicatessen	10
Packer packaged delicatessen	20
TOTAL	100

It is realized that new technologies and management concepts must be developed in order to permit generalized adaptation of either of the alternative distribution methods included in this study. The magnitudes of some related problems appear to be a direct function of the scale of operation. Increases in the scale of operation of a centralized plant in relevant ranges should offer economies and savings in production of retail cuts.

The basic function of the centralized operation is to produce retail meat packages for more than one retail store. Since each retail store must merchandise meat to fulfill the particular demands of its clientele and the stores differ in sales volume, special orders must be assembled at the central plant for each store. Logical consideration of the factors involved leads to the conclusion that correct production, order assembly, and delivery to the retail store becomes a major problem even for a moderate scale of plant operation and limited number of stores. Some of the important factors affecting this problem are limited shelf life of retail meat packages, effect of repeated handling on quality of meat package and product, a large variety of cuts and considerable variation in sales volumes of specific cuts from store to store. The three-day maximum shelf life generally attributed to fresh retail meat packages dictates rigid control and coordination of production with sales. The perishability of the product under current industry practices prohibits any practical medium term storage of excess production. Wrapping films used on the packages are subject to damage and the meat subject to deterioration due to repeated handling. A large variety of cuts are distributed under conditions of most cuts going to each store in widely fluctuating volume. The effects of these factors on the profitability of operation requires that production, order assembly, and delivery be closely coordinated with sales.

The relatively limited shelf life of fresh retail meat packages prohibits long distance movement of such packages under current industry practices. Also, problems of package damage and meat deterioration due to handling and proper distribution to retail stores are associated with the packer prepackaged distribution method.

Thus, consideration of the factors of limited shelf life for fresh retail meat packages, package and product deterioration from repeated handling, a large variety of cuts and wide variations in retail store sales volume indicates that moving the meat fabricating function away from the retail store raises problems of major technological and economic significance. Moving the meat fabricating function a sufficient distance from the retail area to require a separate warehouse function increases the scope of these problems. Although the problems of extending shelf life for fresh retail meat packages, reducing package and product deterioration from handling, and building a fast, efficient distribution procedure are of major magnitude, history suggests that technological innovations can provide solutions. The relevant question becomes: Is there economic justification for solving these problems? In order to make economic comparisons among the various distribution systems, certain assumptions must apply to each system.

Each system is assumed to have a weekly sales volume of $250,000. All equipment is depreciated over a 10-year life span. Six percent interest is charged on all invested capital. The 40 retail stores in each distribution system are located within delivery distance of the warehouse or central plant.

Retail Store Assumptions:

Retail outlets for meats in this study are assumed to have the following characteristics: Meat sales account for 25 percent of total store sales and are made from conventional self-service display cases with provision made for customer service and special orders. Weekly meat sales average $6,250 per store for the 40 stores in each distribution system. Prevailing methods of advertising, sales promotion, and pricing are used at the retail level under each meat distribution system. The assumption of $6,250 as the average weekly meat sales was an attempt to conform, within data limitations, to the average weekly sales of $6,715 for 26,008 supermarkets as derived from *Super Market Merchandising.*[38] Application of this assumption to the restriction of $250,000 weekly sales for the entire system requires use of 40 retail stores for each distribution system.

Retail stores are assumed to be of two types. One type is the conventional retail store that fabricates retail cuts from carcasses and wholesale cuts, and it is used exclusively in the conventional distribution system. The other type of retail store is serviced by a centralized or packer prepackaging plant for the major part of the meat sold. The retail store provides only the processing service needed to fulfill special customer orders. Labor used in this type retail store is assumed to be that of qualified meat cutters because of the need to provide special customer service.

Meat Warehousing Assumptions:

The meat warehouse used in this study is assumed to be located in the local area of the retail stores that it services. In each system the warehouses are of sufficient capacity to handle the quantity and variety of meats required in an efficient manner. Each warehouse is the sole source of meats for all retail stores serviced, and deliveries are made in a manner to achieve lowest costs consistent with maintenance of meat quality, and the needs and preferences of retailers for deliveries. In the two centralized prepackaging systems the central plant is assumed to perform the necessary functions of warehousing as well as the functions of fabricating retail cuts. In the packer prepackaging system a separate warehouse facility is used to provide necessary distribution functions of retail packaged meats between the packing plant and the retail store. Major functions performed at the warehouse include receiving, storage, order assembly, and billing.

Procedure

Models: Factors affecting distribution costs vary in magnitude among the alternative marketing systems due to effects attributed to changes in functions performed and variations in efficiency of performance among the alternative distribution systems. Exhibit A identifies the cost factors associated with five major distribution functions for each distribution system: packing, plant operation, transportation for 1,000 miles, warehouse operation, delivery to retail stores and retail store operation. The variables shown in Exhibit A are expressed in symbolic form so that models of the functional relationship between cost factors and distribution function could be constructed (Exhibit B). Each model was constructed to show the relationships among the distribution functions for general reference. The components of each model show specific variables applicable to estimation of cost or revenue for the distribution functions. It is obvious that the specific components which have relevance to cost or revenue estimation would vary as the type of data which becomes available would change. Thus, other investigators would need to change the components to conform to the data which they wish to use.

Data: Many diverse data components are needed to make cost and revenue estimates. Many data for specific components tend to perish rapidly due to changing economic and technical factors. Attempts to obtain data components of which the statistical precision could be computed would involve many research projects of major magnitude and the precision might become diluted by a technical development or an economic change.

The source of basic data and the procedure used to generate data for particular model components are shown in Computations I through XX of the Appendix. However, resources available for this study limited efforts to estimate cost and revenue components, primarily to available secondary data. Thus, the cost and revenue estimates must be viewed as first estimates and demonstrations of model use rather than estimates of known statistical precision.

Results

There are two stages to the results which have a bearing on the findings of this study. The first stage consists of the data components which are applied to the models. As pointed out in the procedure, the data applied to particular components of the model are generated in the Appendix. Those data are summarized in Table 2 so that other investigators may evaluate the data components used to derive the final results for this study with other data available to them. By substituting different data which they have available, other investigators could generate cost and revenue estimates more appropriate to their use. Data tend to change over time due to changes in technology and economic conditions. Thus, more recent data would likely generate more accurate cost and revenue estimates.

The final results were derived by applying the data components to each of the models. Applications of data components to the models are shown in Appendix B. The results generated by the derived data components are presented for each distribution system by marketing function (Table 3). The cost of operating the conventional meat distribution system was estimated to be $2,378,330.39, which is larger than the estimated cost of operating any other system. The centralized prepackaging system, where the central plant and the retail stores are owned and operated by one management group (Model 2), was estimated to have an operating cost of $1,729,829.43, which is smaller than the estimated cost of operating any other distribution system. It should be realized that the limited retail cut shelf life places the centralized prepackaging system (Model 2) at an operational disadvantage which may not be entirely reflected in the estimate of operating cost. In order for the centralized prepackaging system (as specified in Model 2) to be economically feasible there must be close coordination between sales at the retail store and prepackaging operations at the central plant. Lack of coordination between retail sales and retail cut prepackaging could result in undesirable out-of-stock situations or deterioration of unsold meat.

Estimated costs of operating the centralized prepackaging system, where the central plant and the retail stores are owned and operated by different management teams (Model 2a), and the packer prepackaging system (Model 3), were intermediate between the estimated costs of op-

erating the other distribution systems. The operating cost for the centralized prepackaging system (Model 2a) was estimated to be $1,993,925.58 and for the packer prepackaging system (Model 3) was estimated to be $1,931,642.46. The increase in estimated operating costs for these systems (Models 2a and 3) over the estimated operating costs for the centralized prepackaging system with one management team can be explained largely by the inclusion of retail cut inventory storage functions prior to distribution of retail cuts to the stores. The purpose of the retail cut inventory storage function is to facilitate distribution of prepackaged retail cuts where the lack of close coordination between retail cut fabrication and sales is lacking. In order that the retail cut inventory storage function be possible, the shelf life of retail cuts must be extended appreciably. It should be recognized that the cost of shelf life extension for retail cuts must be added to the operating cost for the centralized prepackaging system (Model 2a) and the packer prepackaging system (Model 3).

TABLE 2--SUMMARY OF MODEL COMPONENTS

Model Component	Symbol	Data[a/] Source	Our Estimate	Your Estimate	Unit of Measure
Carcasses and Wholesale Cuts:					
Transportation rate-1,000 miles	r	I	$ .017120	_____	per lb.
Loading cost - at packing plant	j	X	.000862	_____	per lb.
Warehousing cost	s	XII	.007919	_____	per lb.
Delivery cost	h	XIII	.006200	_____	per lb.
Conventional Retail Store:					
Annual labor cost	w	VII	26,307.22	_____	per store
Annual overhead cost	o	XIV	.013400	_____	per lb.
Investment in equipment	k	XV	15,103.00	_____	per store
Annual rent	m	XVII	3,154.13	_____	per store
Annual depreciation	v	XVI	1,510.30	_____	per store
Central Prepackaging Plant:					
Annual labor cost	w'	VIII	382,247.84	_____	
Annual overhead cost	o'	XIV	.010000	_____	per lb.
Investment in equipment	k'	XV	218,181.00	_____	
Annual rent	m'	XVII	59,402.70	_____	
Annual depreciation	v'	XVI	21,818.10	_____	
Loading costs	j'	XI	.001315	_____	per lb.
Delivery costs	h'	XIII	.009015	_____	per lb.

Table 2 (continued)

Model Component	Symbol	Data[a/] Source	Our Estimate	Your Estimate	Unit of Measure
Retail Store Served by Central Plant:					
Annual labor cost	w"	VI	$ 7,146.28	_____	per store
Annual overhead cost	o"	XIV	.002100	_____	per store
Investment in equipment	k"	XV	4,180.00	_____	per store
Annual rent	m"	XVII	1,261.65	_____	per store
Annual depreciation	v"	XVI	418.00	_____	per store
Estimated increase in value of tallow	u		.015000	_____	per lb.
Estimated increase in value of bone	u'		.008500	_____	per lb.
Additional cost due to shrinkage losses of retail packaged meat stored 10 days	x		.014013	_____	per lb.
Quantity of Meat Entire System, Annually:					
Carcasses, wholesale cuts and packer prepackaged meat	p	III	24,245,998.40	_____	lbs.
Prepackaged retail meat	p'''	IV	21,336,478.59	_____	lbs.
Conventional Retail Store:					
Carcasses, wholesale cuts and packer prepackaged meat	p'	III	606,150.00	_____	lbs.
Retail store served by central plant	p"	IV	533,411.96	_____	lbs.

a/ Data source refers to the detailed computation of specific data estimates in Appendix A.

TABLE 3--MODEL 1--CONVENTIONAL MEAT DISTRIBUTION METHOD

$$Y_1 = a + b + c + d$$

Cost Factor	Symbol	Our Estimate	Your Estimate
Transportation cost (1,000 miles)	a	$435,991.54	_____
Warehouse cost	b	$192,004.06	_____
Cost of delivery to retail store	c	$150,325.19	_____
Display and service cost in retail store	d	$1,600,009.60	_____
TOTAL	Y_1	$2,378,330.39	_____

MODEL 2--CENTRALIZED PREPACKAGING METHOD (One Management Team)

$$Y_2 = a+e+c'+d'-f-g$$

Cost Factor	Symbol	Our Estimate	Your Estimate
Transportation cost (1,000 miles)	a	$435,991.54	_____
Operating cost at central plant	e	$719,019.48	_____
Cost of delivery to retail stores	c'	$192,348.35	_____
Operating cost at retail stores	d'	$407,876.00	_____
Revenue due to higher value tallow sales	f	$18,184.50	_____
Revenue due to higher value bone sales	g	$7,221.43	_____
TOTAL	Y_2	$1,729,829.43	_____

MODEL 2a--CENTRALIZED PREPACKAGING METHOD (Multiple Management Teams)

$$Y_{2a} = a+e+b'+c'+d'-f-g+x$$

Cost Factor	Symbol	Our Estimate	Your Estimate
Transportation cost (1,000 miles)	a	$435,991.54	_____
Operating cost central plant	e	$719,019.48	_____
Cost of warehousing retail packaged meat	b'	$168,963.57	_____
Cost of delivery to retail stores	c'	$192,348.35	_____
Operating cost at retail stores	d'	$407,876.00	_____
Revenue due to higher value tallow sales	f	$18,184.50	_____
Revenue due to higher value bone sales	g	$7,221.43	_____
Shrinkage losses for longer storage of retail packaged meat	x	$95,132.57	_____
TOTAL	Y_{2a}	$1,993,925.58	_____

MODEL 3--PACKER PREPACKING METHOD

$$Y_3 = t+a'+b'+c'+d'-f-g+x$$

Cost Factor	Symbol	Our Estimate	Your Estimate
Cost of central plant type operation at packing plant	t=e	$719,019.48	_____
Transportation cost (1,000 miles)	a'	$373,708.42	_____
Cost of warehousing retail packaged meat	b'	$168,963.57	_____
Cost of delivery to retail stores	c'	$192,348.35	_____
Operating cost at retail stores	d'	$407,876.00	_____
Revenue due to higher value tallow sales	f	$18,184.50	_____
Revenue due to higher value bone sales	g	$7,221.43	_____
Shrinkage losses for longer store of retail packaged meat	x	$95,132.57	_____
TOTAL		$1,931,642.46	_____

Exhibit A

MODEL 1--COST FACTORS ALLOCATED TO SPECIFIC FUNCTIONS IN THE CONVENTIONAL DISTRIBUTION SYSTEM

Function	Cost Factors
Packing plant operation	
Transportation for 1, 000 miles	Loading trucks Freight charges
Warehouse operation	Unloading trucks Storage Office overhead and management Rent or depreciation of building Depreciation of equipment Interest on investment Loading delivery trucks
Delivery to retail store	Fixed & variable costs of operating delivery trucks Drivers' wages
Retail store operation	Receiving and storage All necessary handling, breaking, cutting, trimming, grinding Wrapping and price marking Office overhead, management and supplies Rent or depreciation of building Depreciation of equipment Interest on investment Stocking and display costs Customer service

MODEL 2--COST FACTORS ALLOCATED TO SPECIFIC FUNCTIONS IN THE CENTRALIZED PREPACKAGING SYSTEM

Function	Cost Factors
Packing plant operation	
Transportation for 1,000 miles	Loading trucks Freight charges
Central plant operation	Unloading trucks Storage All necessary handling, breaking, cutting, trimming, grinding, wrapping and price marking Office overhead, management and supplies Rent or depreciation of building Depreciation of equipment Interest on investment Order assembly and loading delivery trucks
Delivery to retail store	Fixed and variable costs of operating delivery trucks Drivers' wages
Retail store operation	Receiving and storage Office overhead, management and supplies Rent or depreciation of building Depreciation of equipment Interest on investment Stocking and display costs Customer service

MODEL 2a--COST FACTORS ALLOCATED TO SPECIFIC FUNCTIONS IN THE CENTRALIZED PREPACKAGING SYSTEM (Multiple Management Teams)

Function	Cost Factors
Packing plant operation	
Transportation for 1,000 miles	Loading trucks Freight charges
Warehouse and central plant operation	Unloading trucks Storage for wholesale cuts & carcasses, all necessary handling, breaking, cutting, trimming, grinding, wrapping and price marking Office overhead, management and supplies Rent or depreciation of building Depreciation of equipment Interest on investment Storage for prepackaged retail cuts Order assembly and loading delivery trucks
Delivery to retail store	Fixed and variable costs of operating delivery trucks Drivers' wages
Retail store operation	Receiving and storage Office overhead, management and supplies Rent or depreciation of building Depreciation of equipment Interest on investment Order assembly and loading delivery trucks

MODEL 3--COST FACTORS ALLOCATED TO SPECIFIC FUNCTIONS IN THE PACKER PREPACKAGING OPERATION

Function	Cost Factors
Packing plant operation	All necessary handling, breaking, cutting, trimming, grinding, wrapping and price marking Office overhead, management and supplies Rent or depreciation of building Depreciation of equipment Interest on investment Storage
Transportation for 1,000 miles	Loading trucks Freight charges
Warehouse distribution operation	Unloading trucks Storage Office overhead, management and supplies Rent or depreciation of building Depreciation of equipment Interest on investment Order assembly and loading delivery trucks
Delivery to retail store	Fixed and variable costs of operating delivery trucks Drivers' wages
Retail store operation	Receiving and storage Office overhead, management and supplies Rent or depreciation of building Depreciation of equipment Interest on investment Order assembly and loading delivery trucks

Exhibit B

Models of Meat Distribution Systems

Model 1: Conventional Prepackaging Method

Y_1 = Total cost of conventional prepackaging method for one year.

$Y_1 = a+b+c+d$ where:

a= Annual cost for 1,000 miles truck transportation of sufficient carcasses and wholesale meat cuts to service *n* retail stores with a weekly meat sales volume of *i* dollars.

b= Annual warehousing cost of sufficient carcasses and wholesale meat cuts to service *n* retail stores with a weekly meat sales volume of *i* dollars.

c= Annual cost of delivering carcasses and wholesale meat cuts to *n* retail stores with a weekly meat sales volume of *i* dollars.

d= Annual proceessing, packaging and display costs in *n* retail stores with a weekly meat sales volume of *i* dollars.

Model 2: Centralized Prepackaging Method (One Management Team)

Y_2 = Total cost of centralized prepackaging method for one year.

$Y_2 = a+e+c'+d'-f-g$ where:

a= Annual cost for 1,000 miles truck transportation of sufficient carcasses and wholesale meat cuts to service *n* retail stores with a weekly meat sales volume of *i* dollars.

e= Annual cost of processing and packaging retail meat packages in a centralized plant sufficient to supply *n* retail stores with a weekly meat sales volume of *i* dollars.

c'= Annual cost of delivering retail packaged meat to *n* retail stores with a weekly meat sales volume of *i* dollars.

d'=Annual display and service costs in *n* retail stores with a weekly meat sales volume of *i* dollars.

f= Additional annual revenue due to sale, by a centralized or packer prepackaging plant, of higher value tallow from carcasses and wholesale cuts sufficient to serve *n* retail stores with weekly meat sales volume of *i* dollars.

g= Additional annual revenue due to sale, by a centralized or packer prepackaging plant, of higher value bone from carcasses and wholesale weekly meat sales volume of *i* dollars.

Model 2a: Centralized Prepackaging Method (Multiple Management Teams)

Y_{2a}= Total cost of centralized prepackaging method for one year.

$Y_{2a}= a+e+b'+c'+d'-f-g+x$ where:

a= Annual cost for 1,000 miles truck transportation of sufficient carcasses and wholesale meat cuts to service *n* retail stores with a weekly meat sales volume of *i* dollars.

e= Annual cost of processing and packaging retail meat packages in a centralized plant sufficient to supply *n* retail stores with a weekly meat sales volume of *i* dollars.

b'=Annual warehousing cost of sufficient retail packaged meats to service *n* retail stores with a weekly meat sales volume of *i* dollars.

c'= Annual cost of delivering retail packaged meat to *n* retail stores with a weekly meat sales volume of *i* dollars.

d'=Annual display and service costs in *n* retail stores with a weekly meat sales volume of *i* dollars.

f= Additional annual revenue due to sale, by a centralized or packer prepackaging plant, of higher value tallow from carcasses and wholesale cuts sufficient to serve *n* retail stores with a weekly meat sales volume of *i* dollars.

g= Additional annual revenue due to sale, by a centralized or packer prepackaging plant, of higher value bone from carcasses and wholesale cuts sufficient to serve *n* retail stores with a weekly meat sales volume of *i* dollars.

x= Additional annual cost due to shrinkage losses for those meat packages stored 10 days of *i* dollars weekly meat sales for *n* retail stores.

Model 3: Packer Prepackaging Method

Y_3 = Total cost of packer prepackaging method for one year.

$Y_3 = t+a'+b'+c'+d'-f-g+x$ where:

t= Annual cost of processing and packaging retail meat packages in a centralized plant sufficient to service *n* retail stores with a weekly meat sales volume of *i* dollars.

a'= Annual cost for 1,000 miles truck transportation of sufficient retail meat cuts to service *n*

retail stores with a weekly meat sales volume of *i* dollars.

b'= Annual warehousing cost of sufficient retail packaged meats to service *n* retail stores with a weekly meat sales volume of *i* dollars.

c'= Annual cost of delivering retail packaged meat to *n* retail stores with a weekly meat sales volume of *i* dollars.

d'= Annual display and service costs in *n* retail stores with a weekly meat sales volume of *i* dollars.

f= Additional annual revenue due to sale, by a centralized or packer prepackaging plant, of higher value tallow from carcasses and wholesale cuts sufficient to serve *n* retail stores with a weekly meat sales volume of *i* dollars.

g= Additional annual revenue due to sale, by a centralized or packer prepackaging plant, of higher value bone from carcasses and wholesale cuts sufficient to serve *n* retail stores with a weekly meat sales volume of *i* dollars.

x= Additional annual cost due to shrinkage losses for those meat packages stored 10 days of *i* dollars weekly meat sales for *n* retail stores.

Components of Model 1: Conventional Prepackaging Method

Y_1 = a+b+c+d where:

a= Annual cost for 1,000 miles truck transportation of sufficient carcasses and wholesale meat cuts to service *n* retail stores with a weekly meat sales volume of *i* dollars.

a= p(r + j) where:

p= pounds of carcasses, wholesale cuts and packer prepackaged meat to be transported.

r= transportation rate per pound for carcasses, wholesale cuts, and packer prepackaged meats.

j= loading costs per pound for carcasses, wholesale cuts and packer prepackaged meats.

b= Annual warehousing cost of sufficient carcasses and wholesale cuts to service *n* retail stores with a weekly meat sales volume of *i* dollars.

b= ps where:

p= pounds of carcass meat, wholesale cuts, and packer prepackaged meats to be warehoused.

s= warehousing costs per pound for carcasses, wholesale cuts and packer prepackaged meats.

c= Annual costs of delivering carcasses and wholesale meat cuts to *n* retail stores with a weekly meat sales volume of *i* dollars.

c= p(j + h) where:

p= pounds of carcasses, wholesale cuts, and packer prepackaged meats to be delivered.

j= loading costs per pound for carcasses, wholesale cuts, and packer prepackaged meats.

h= delivery cost per pound of carcasses, wholesale cuts and packer prepackaged meats.

d= Annual processing, packaging, and display costs in *n* retail stores with a weekly meat sales volume of *i* dollars.

d= n(w+p'o+.06k+m+v) where:

n= 40 stores

w= annual labor cost in conventional meat department with *i* dollars sales.

p'= pounds of carcasses, wholesale cuts, and packer prepackaged meat received per store.

o= overhead costs per pound of carcasses, wholesale cuts and packer prepackaged meats for supplies, utilities and general management.

k= investment in equipment and facilities used in retailing meat.

m= annual rent of building used in retailing meats.

v= depreciation of equipment.

Components of Model 2: Centralized Prepackaging Method (One Management Team)

Y_2 = a+e+c'+d'-f-g where:

a= Annual cost for 1,000 miles truck transportation of sufficient carcasses and wholesale meat cuts to service *n* retail stores with a weekly meat sales volume of *i* dollars.

e= Annual cost of processing and packaging retail meat packages in a centralized plant sufficient to supply *n* retail stores with a weekly meat sales volume of *i* dollars.

e= w'+po'+.06k'+m'+v' where:

w'= annual labor cost in centralized meat prepackaging plant.

p= pounds of carcasses, wholesale cuts, and packer prepackaged meat to be handled.

o'= overhead costs per pound of carcasses,

wholesale cuts and packer prepackaged meats for supplies, utilities, and general management.

k'= total investment in equipment and facilities in central plant.

m'= annual rent of building used in centralized prepackaging plant.

v'= depreciation of equipment.

c'= Annual cost of delivering retail packaged meat to *n* retail stores with a weekly meat sales volume of *i* dollars.

c'= np" (j'+h') where:

n= 40 stores

p"= pounds of prepackaged retail meat cuts per store.

j'= loading costs per pound of prepackaged retail cuts.

h'= delivery costs per pound of prepackaged retail cuts.

d'= Annual display and service costs in *n* retail stores with a weekly meat sales volume of *i* dollars.

d'= n (w"+p"o"+.06k"+m"+v") where:

n= 40 stores

w"= annual labor costs in stores having *i* dollars meat sales and receiving prepackaged meats from centralized warehouse.

p"= pounds of prepackaged retail meat cuts per store.

o"= overhead cost per pound of supplies, utilities, and general management.

k"= total investment in equipment and facilities for handling meats in retail stores.

m"= annual rent of building used in retailing meats.

v"= depreciation of equipment.

f= Additional annual revenue due to sale, by a centralized or packer prepackaging plant, of higher value tallow from carcasses and wholesale cuts sufficient to serve *n* retail stores with a weekly meat sales volume of *i* dollars.

f= $p^{iv}u$ where:

p^{iv}= pounds of tallow sold by central plant.

u= most probable increase in the value of tallow per pound.

g= Additional annual revenue due to sale, by a centralized or packer prepackaging plant, of higher value bone from carcasses and wholesale cuts sufficient to serve *n* retail stores with a weekly meat sales volume of *i* dollars.

g= $p^{v}u'$ where

p^{v}= pounds of bone sold by central plant.

u'= most probable increase in the value of bone per pound.

Components of Model 2a: Centralized Prepackaging Method (Multiple Management Teams)

Y_{2a}= a+e+b'+c +d -f-g+x where:

a= Annual cost for 1,000 miles truck transportation of sufficient carcasses and wholesale meat cuts to service *n* retail stores with a weekly meat sales volume of *i* dollars.

e= Annual cost of processing and packaging retail meat packages in a centralized plant sufficient to supply *n* retail stores with a weekly meat sales volume of *i* dollars.

b'= Annual warehousing cost of sufficient retail packaged meats to service *n* retail stores with a weekly meat sales volume of *i* dollars.

b'= p'''s where:

p'''= retail pounds of meat to be warehoused.

s= warehousing costs per pound.

c'= Annual cost of delivering retail packaged meat to *n* retail stores with a weekly meat sales volume of *i* dollars.

d'= Annual display and service costs in *n* retail stores with a weekly meat sales volume of *i* dollars.

f= Additional annual revenue due to sale, by a centralized or packer prepackaging plant, of higher value tallow from carcasses and wholesale cuts sufficient to serve *n* retail stores with a weekly meat sales volume of *i* dollars.

g= Additional annual revenue due to sale, by a centralized or packer prepackaging plant, of higher value bone from carcasses and wholesale cuts sufficient to serve *n* retail stores with a weekly meat sales volume of *i* dollars.

x= Additional annual cost due to shrinkage losses for those meat packages stored 10 days of *i* dollars weekly meat sales for *n* retail stores.

x= p^{vii}.0173u" where:

p^{vii}= pounds of retail packaged beef needed to supply *n* retail stores with *i* dollars weekly meat sales.

u"= average price per pound for beef at the retail level during 1963.

Components of Model 3: Packer Prepackaging and Distribution of Retail Meat Cuts

$Y_3 = t+a'+b'+c'+d'-f-g+x$ where:

$t=$ Annual cost of processing and packaging retail meat packages in a centralized plant sufficient to service *n* retail stores with a weekly meat sales volume of *i* dollars.

$t= w'''+po'''+.06k'''+m'''$ where:

$w'''=$ annual labor cost for fabrication and packaging retail cuts in packing plant.

$p=$ pounds of carcasses, wholesale cuts and packer prepackaged meat to be handled.

$o'''=$ overhead cost per pound of carcasses, wholesale cuts, and packer prepackaged meats for supplies, utilities and general management.

$k'''=$ total investment in equipment and facilities for fabricating retail meat cuts.

$m'''=$ annual rent of building used in fabricating meats.

$a'=$ Annual cost for 1,000 miles truck transportation of sufficient retail meat cuts to service *n* retail stores with a weekly meat sales volume of *i* dollars.

$a'= p'''(r'+j')$ where:

$p'''=$ retail pounds of meat to be transported.

$r'=$ rate per pound of retail meat cuts.

$j'=$ loading costs per pound of retail meats.

$b'=$ Annual warehousing cost of sufficient retail packaged meats to service *n* retail stores with a weekly meat sales volume of *i* dollars.

$c'=$ Annual cost of delivering retail packaged meat to *n* retail stores with a weekly meat sales volume of *i* dollars.

$d'=$ Annual display and service costs in *n* retail stores with a weekly meat sales volume of *i* dollars.

$f=$ Additional annual revenue due to sale, by a centralized or packer prepackaging plant, of higher value tallow from carcasses and wholesale cuts sufficient to serve *n* retail stores with a weekly meat sales volume of *i* dollars.

$g=$ Additional annual revenue due to sale, by a centralized or packer prepackaging plant, of higher value bone from carcasses and wholesale cuts sufficient to serve *n* retail stores with a weekly meat sales volume of *i* dollars.

$x=$ Additional annual cost due to shrinkage losses for those meat packages stored 10 days of *i* dollars weekly meat sales for *n* retail stores.

Glossary

1. **Carcass meat**—beef or mutton carcasses, beef sides or beef quarters.

2. **Centralized prepackaging system, single management team**—A distribution system where the fresh meat is fabricated into retail cuts at a central plant for display and sale at retail stores. The central plant and all retail stores in this system are under one company management and authority.

3. **Centralized prepackaging system, multiple management team**—A distribution system where the fresh meat is fabricated into retail cuts at a central plant for display and sale at retail stores. Some or all of the retail stores in the system will be owned and managed by a different company or corporation than that which owns and manages the central plant.

4. **Conventional prepackaging system**—A distribution system where the fresh meat is fabricated into retail cuts in the backroom of each retail store.

5. **Delivery**—Transporting the meat from the wholesale warehouse or central plant to the retail store.

6. **Fabrication**—Cutting retail cuts from wholesale cuts or carcasses. Trimming, wrapping, and labeling are considered part of the fabrication process.

7. **Inventory**—Stock of retail cuts available for sale and immediate delivery.

8. **Packer prepackaging system**—A distribution system where the fresh meat is fabricated into retail cuts at the packing plant.

9. **Processing**—Same as fabrication.

10. **Revenue**—Money received from sale of bone or tallow.

11. **Shelf life**—The number of days that retail cuts remain good for human consumption after they are fabricated from carcasses or wholesale cuts.

12. **Transportation**—Transporting the meat from the packing plant to the warehouse or central plant.

Appendix A

Source of Basic Data and Derivation of Specific Data

The nature of this study includes a large segment of the meat marketing industry. Many functions are performed and many facilities used within this segment. Cost estimates for this segment of the industry are made by use of available sources of secondary data and data from cooperating firms. Sources of basic data are identified and derivations of specific data are detailed as much as possible consistent with requests for confidential treatment of data from cooperating firms. Source of data is identified by a number referring to specific literature cited or by a footnote.

Computation I

Derivation of transportation rates for 1,000 miles.

Truck rates: Tariff Authority[32]

Carcasses shipped on rail—$.0185 per pound. Meat shipped in bulk containers—$.0162 per pound. Carcasses are assumed to constitute 40 per cent and bulk containers account for 60 per cent of total meat shipments.

.0185 (.40) = $.007400

.0162 (.60) = $.009720

Composite rate = $.017120 per pound carcasses and bulk meat.

Computation II

Derivation of wage rates.

Job Classification	Hourly[9] Wage	Fringe[9] Benefits	Social Security & Unempl. Tax	Total
Cutters & bonners	$2.9375	$.1047	$.1200	$3.1622
Luggers	2.6750	.1047	.1100	2.8897
Truck drivers	2.9250	.1047	.1200	3.1497
Scalers	2.7500	.1047	.1100	2.9647
Unskilled males	2.0000	.1047	.1000	2.2047
Female production employees	1.8750	.1047	.1000	2.0797

Employer's contributions to social security and unemployment taxes were estimated on the basis of expected employee salaries.

Computation III

Meat tonnage sold was derived using data collected from six stores in a major chain, four stores from a regional chain and from Ott[26] on one store. The object is to derive an estimate of pounds sold per dollar retail sales.

Derivation of tonnage sold (wholesale weight basis).

Average meat sales in eleven stores = $7,931.09 per week.

Pounds of meat sold in eleven stores = 14,792.09 per week.

7,931.09x = 14,792.09 (6,250)

x = 11,656.73 pounds sold for $6,250 weekly sales.

11,656.73(52) = 606,150.0 lbs. sold annually by one store.

11,656.73(40) = 466,269.2 lbs. sold weekly by forty stores.

466,269.2(52) = 24,245,998.4 lbs. sold annually by forty stores.

Computation IV

Derivation of meat tonnage sold (retail weight basis).

It is assumed that wholesale cuts, poultry and packer prepackaged meats have no weight loss due to processing. For the purposes of this report it is assumed that lamb and veal carcasses have the same yield as beef. Knapp reported the bone-in retail yield of six-hundred-pound beef carcasses to be seventy percent.

Wholesale weight—24,245,998.4 pounds

Proportion of total in carcass form = .40

24,245,998.4 (.40) = 9,698,399.36 pounds in carcass form.

9,698,399.36 (.70) = 6,788,879.55 pounds of retail yield from carcass form meat.

24,245,998.40 pounds wholesale weight
9,698.399.36 pounds carcass form wholesale basis
14,547,599.04
6,788,879.59 pounds retail yield from carcass meat
21,336,478.59 pounds of retail meat sold annually

21,336,478.59/40 = 533,411.96 pounds of retail meat sold per store annually.

Computation V

Derivation of man-hours used in conventional retail stores.

Average meat sales in six stores was reported to be $33.49 per man hour[26, 27]

6,250/33.49 = 186.62 man-hours used for $6,250 sales.

186.62(52) = 9,704.24 man-hours used annually by one store.

7,464.80(40) = 388,169.60 man-hours used annually by forty stores.

Computation VI

Derivation of labor cost for retail store served by central plant.

Estimates of man-hours labor used were made on the basis of functions remaining in the store when processing is moved to a central plant. Estimates of percentages were made as a proportion of total time required to operate a conventional retail store and are strictly a judgment estimate by the author using Ott[26] as reference.

Function	Percent of total man-hours	Man-hours in store served by central plant
Receiving	1.0	1.87
Stocking	12.7	23.70
Customer service	6.8	12.69
Administration	1.0	1.87
Organization	.5	.93
Clean-up	.3	.56
Idle	1.0	1.87
Conventional store man-hours	186.62	43.49

43.49 (52) = 2, 261.48 man-hours used annually by one store.

43.49 (40) = 1,739.60 man-hours used weekly by forty stores.

1,739.60 (52) = 90,459.2 man-hours used annually by forty stores.

90,459.2 (3.16) = $285,851.07 annual wage

$285,851.07/40 = $7,146.28 annual wage for one store.

The $3.16 hourly wage is used because of the assumption of having a qualified meat cutter in the store to give customer service.

Computation VII

Derivation of annual labor cost for conventional retail store.

Category of Workers	Proportion of Total Time[26]	Man-hours	Wage[9, 37]	Labor Cost
Manager	.17	65,988.93	$3.25	$ 214,463.70
Cutter	.40	155,267.84	3.16	490,646.37
Wrapper	.43	166,912.93	2.08	347,178.89
TOTAL	1.00	388,169.60		$1,052,288.96

$1,052,288.96 = annual wage--forty stores.
1,052,288.96/40 = $26,307.22 annual wage--one store

Computation VIII

Derivation of labor cost in central plant.

Job Function	Wage[9, 37]	Man-hours[a/] Per Week	Weekly Labor Cost
Break	3.16	112	353.92
Cut, trim, tray	3.16	448	1,415.68
Bone	3.16	112	353.92
Grind	3.16	160	505.60
Operate scale	2.96	300	888.00
Utility	2.20	560	1,232.00
Order & billout	2.80	374	1,047.20
Auto-wrap	2.20	120	264.00
Hand wrap	2.08	320	665.60
Manager	225.00 (weekly)	40	225.00
Assistant Manager	175.00 (weekly)	40	175.00
Clerical	75.00 (weekly)	120	225.00
		2,706	$7,350.92

$7,350.92 (52) = $382,247.84 annual labor cost

a/ Man-hours are estimated on the basis of data derived from a major chain and reference (26).

Computation IX

Derivation of cost per pound of loading out carcass meat at packing plant.

These data are derived by using labor requirement and equipment costs from Hammons[14] and wage rates for common labor derived in this report.

The functions include transporting carcass sides on the overhead rail from the holding cooler to the track scale, weighing each carcass, putting grade on carcass side and loading carcass on truck using overhead rail. Loading ninety carcasses required 2.61 man-hours and equipment cost of 70 cents.

Number of Carcasses	Average Carcass Weight in Pounds,	Total Pounds
9	750	6,750
36	475	17,100
45	250	11,250
		35,100 lbs. carcass wt.

2.61 (2.20) = $5.74 labor cost
.70 equipment cost
$6.44 Total of loading 35,080 lbs. of carcass meat.

6.44/35,100 = $.000183

Computation X

Derivation of composite cost per pound of loading forty percent carcass and sixty percent non-carcass meat.

.000183 (.40) = $.000073

.001315 (.60) = .000789

$.000862 Composite loading cost per pound

Computation XI

Derivation of cost per pound of loading out non-carcass meat at packing plant.

These data are derived by using labor requirements and equipment costs from Hammons[14], estimates of boneless beef yields from Kropf[21] and wage rates for common labor derived in this report (Computation II).

The functions performed are packing meat into 100 pound boxes, weighing, strapping and stenciling boxes, loading boxes onto a semilive skid, transporting them to the load-out dock and loading them onto trucks. Handling the boneless meat from ten carcasses required 1.27 man-hours and equipment cost of 49 cents. Yield of boneless beef from 560 pound carcasses was 63.98 percent. The derived wage rate of common labor is $2.20 per hour.

Number of Carcasses	Average Carcass Weight in Pounds,	Total Pounds
1	750	750
4	475	1,900
5	250	1,250
		3,900 lbs. carcass wt.

3,900 (.6398) = 2,495.22 pounds boneless meat handled

1.27 (2.20) = $2.79 labor cost

.49 equipment cost

$3.28 Total cost of loading 2,495.22 pounds of meat.

3.28/2,495.22 = $.001315 loading costs per pound for retail cuts.

Computation XII

Derivation of warehousing cost.

Cost of wholesale operations are derived by use of data taken from Blackmore[3] and Taylor[33]. These data contain estimates of wholesaling costs for meats in Detroit and New Bedford. Cost estimates are made for each city based on data collected from use of current facilities of a proposed new wholesaling center for each city. There appears to be little logical basis for weighing the data because the main differences in cost estimates appear to be a function of the old versus new facility rather than a function of tonnage handled. For this reason a simple average of the data was taken.

	Handling Cost/Lb.	Waste and Deterioration Cost/Lb.	Rental Cost/Lb.	Total Cost/Lb.
a/	$.00400	$	$.002100	$.006500
b/	.004700		.006800	.011500
c/	.002620	.001075	.001617	.005312
d/	.001950	.000900	.005513	.008363
Total	.013670	.001975	.016030	.031675
Average	.003417	.000987	.004008	.007919

a/ Data Source: Blackmore (3), Table 36.

b/ Data Source: Blackmore (3), Table 37.

c/ Data Source: Taylor (33), Tables 16, 18, 19.

d/ Data Source: Taylor (33), Tables 16, 18, 19.

Computation XIII

Derivation of delivery costs.

Delivery of carcasses and wholesale cuts for the conventional system:

Blackmore[3] estimated the cost of transporting meat and meat products to retail in Detroit to be $.0062 per pound.

Delivery of retail packaged meat to retail stores for the centralized and packer prepackaging systems:

This cost is estimated by consolidating the operational data collected on a localized central prepackaging operation and converting to a per pound value. The operation handled 1,144,000 pounds annually.

Item	Annual Cost
Depreciation, repairs, maintenance, license, taxes, insurance	$2,067.20
Gasoline and oil (average round trip 50 miles)	3,436.16
Wages ($2.50 per hour for 1924 hours)	5,483.40
	$10,986.76

$10,986.76/1,144,000 = $.009015 per pound

Computation XIV

Derivation of overhead costs.

Overhead costs are derived from data in the Progressive Grocer Colonial Study.[27] Included in the data are direct costs of wrapping supplies, utilities, laundry, insurance, telephone, outside service, bad checks, licenses, and taxes. These costs amounted to 2.5 percent of retail store sales. Previous derivation in this report determines that weekly retail meat sales per store amount to 11,656.73 wholesale pounds for $6,250.

Conventional retail store:

6,250 (.025) = $156.25
156.25/11,656.73 = $.0134 per pound

Central packaging operation:

Overhead costs for the central packaging operation are derived for the central plant and for the retail stores served by the central plant. Primary data for these two functions are not currently available and the following data are a judgment estimate by the author using the Progressive Grocer Colonial Study[27] as a reference. Consideration of each item included in overhead costs led to the conclusion that overhead costs should be less for the centralized operation, including the central plant and the retail stores served by the central plant, than for the conventional operation because concentration of the processing function permits more rigid control over use of supplies, more efficient use of refrigeration equipment and better maintenance of equipment. It was estimated that the centralized packaging system will yield a ten percent savings in overhead costs.

.0134 (90) = $.0121 per pound

One cent per pound is allocated to the central plant and .21 cents per pound are allocated to the retail store on a judgment basis.

Computation XV

Investment in equipment.

Conventional retail store

Equipment:[37]

Cooler	$ 2,640	
Freezer	1,043	
Other	11,420	
	$15,103	equipment cost, one store

Retail store served by central processor

Equipment:[37]

Cooler	$1,056	
Freezer	1,043	
Other	2,081	
	$4,180	equipment cost, one store

Central processing plant

Equipment:[37]

Cooler	$ 28,151	
Refrigerator for processing and billing areas	48,486	
Freezer	23,423	
Other	118,121	
	$218,181	equipment cost

Computation XVI

Depreciation of equipment.

Conventional retail store
$15,103/10 = $1,510.30
Retail store served by central processor
$4,180/10 = $418.
Central processing plant
$218,181/10 = $21,818.10

Computation XVII

Derivation of rent.

Rent for the retail stores is based on meat department rent shown in the Progressive Grocer Colonial Study.[27] The rent reported in that study was .9705 percent of sales. Average weekly sales are assumed to be $6,250 per store for this study.

Conventional retail store rent:
$6,250 (52) (.009705) = $3,154.13 annually

Rent on retail store served by central plant:
The major chain estimated that meat department area would be forty percent of conventional meat department area. Rent for this type store was made proportional.
.40 (.009705) = .003882 percent of sales
325,000 (.003882) = $1,261.65 annual rent

Rent on central processing plant:
Rent for the central processing plant is based on rents reported for meat warehousing facilities by Blackmore[3] and Taylor.[33] This procedure is justified because the rent purchases the same items in each case: refrigerated storage area and space for handling of product. The rents reported were .21 and .28 cents per pound or an average of .245 per pound.

24,245,998.4 (.00245) = $59,402.70 annual rent

Computation XVIII

Derivation of revenue due to an increase in tallow value attributed to centralized and packer prepackaging type operations.

It was estimated by managers of three retail marketing firms that 12.5 percent of the beef carcass weights handled in their stores was disposed of as rendering tallow. In many conventional retail store operations all tallow is disposed as non-edible tallow.

The author estimated that 50 percent of the tallow could be sold as higher priced edible tallow by the central prepackaging plant.

The *National Provisioner* reported price differentials between edible and non-edible lard to be approximately three cents per pound during January and May of 1964.

The tonnage of wholesale meat handled per year by one marketing system was derived in Computation III to = 24,245,998.4 pounds.

Beef was estimated to be 40 percent of total meat handled (Table 1).

24,245,998.40 (.40) = 9,698,399.36 pounds wholesale beef handled annually by one marketing system.

9,698,399.36 (.125) = 1,212,299.92 pounds tallow disposed annually by one marketing system.

1,212,299.92 (.50) = 606,149.96 pounds of edible tallow sold by the central plant.

606,149.96 (.03) = $18,184.50 increase in value of tallow sold by the central plant.

Computation XIX

Derivation of revenue resulting from bone sales by the centralized and packer prepackaging type operations.

The tonnage of wholesale beef handled annually by one marketing system was derived in Computation XVIII to = 9,698,399.36 pounds.

Knapp reported bone as equal to 8.76 percent of carcass weight.[20] In many retail store operations, bones are given to the rendering firms in return for regular pickup.

Thompson reported the price of bone to range from .2 to 1.5 cents per pound.[35] The author took the midpoint plus the minimum of the range as the most representative price.

$.0065 + .0020 = $.0085
9,698,399.36 (.0876) (.0085) = $7,221.43

Computation XX

Derivation of value loss due to shrinkage of retail beef packages stored for a ten day period.

Upper and Lower Estimates of Retail Package Shrink[22]

Wrapping Film	Temperature	*Shelf Life* 3-days	10-days
MSAD-80	38°F	1.87%	5.20%
X-L	30°F	0%	.13%

The tonnage of wholesale beef handled by one marketing system was derived in Computation XVIII to be 9,698,399.36 pounds. Percent retail yield from carcass beef = 70 percent.[20] Average price of retail beef for 1963 = $.81 per pound.[36] 9,698,399.36 (.70) = 6,788,879.55 pounds retail beef handled annually by one marketing system.

Estimated average value of shrink per pound:

.81(.0520) - .81(.0187) + .81(.0013) - .81(0)/2 = .014013

Estimated value loss due to retail package shrink:

6,788,879.55 (.014013) = $95,132.57

Appendix B

Applications of Data to Model Components

Data applied to components of Model 1.

Y_1 = a+b+c+d where:

a= p(r+j) where:

p= 24,245,998.4 pounds

r= $.017120 per pound

j= $.000862 per pound

a= 24,245,998.4 (.017120 + .000862)

a= 24,245,998.4 (.017982)

a= $435,991.54

b= ps where

p= 24,245,998.4 pounds

s= $.007919 per pound

b= 24,245.998.4 (.007919)

b= $192,004.06

c= p(j+h) where:

p= 24,245,998.4 pounds

j= 0 (included in b for current data)

h= $.0062 per pound

c=24,245,998.4 (0 + .0062)

c= $150,325.19

d= n(w+p'o+.06k+m+v) where:

n= 40 stores

w= $26,307.22 per year

p'= 606,150.0 pounds per store

o= $.0134 per pound

k= $15,103.00 investment in equipment

m= $3,154.13 annual rent of building

v= $1510.30 annual depreciation of equipment

d= 40 [26,307.22 + 606,150 (.0134) + .06 (15,103) + 3,154.13 + 1,510.30]

d= 40 (26,307.22 + 8,122.31 + 906.18 + 3,154.13 + 1,510.30)

d= 40 (40,000.24)

d= $1,600,009.60

Y_1 = 435,991.54 + 192,004.06 + 150,325.19 + 1,600,009.60

Y_1 = $2,378,330.39

Data applied to components of Model 2:

Y_2 = a+e+c'+d'-f-g

a= $435,991.54

e= w'+po'+.06k'+m'+v' where:

w'= $382,247.84 labor cost

p= 24,245,998.4 pounds

o'= $.01 per pound

k'= $218,181.00 investment in equipment

m'= $59,402.70 rent on building

v'= $21,818.10 depreciation of equipment

e= $382,247.84 + 24,245,998.4 (.01) + 218,181 (.06) + 59,402.70 + 21,818.10

e= 382,247.84 + 242,459.98 + 13,090.86 + 59,402.70 + 21,818.10

e= $719,019.48

c'= np"(j'+h') where:

n= 40 stores

p"= 533,411.96 pounds

j'= 0 (included in central plant costs)

h'= $.009015 per pound

c'= 533,411.96 (.009015) 40 = $192,348.35

d'=n(w" + p"o" + .06k" + m" + v") where:

n= 40 stores

w"= $7,146.28

p"= 533,411.96 pounds

o"= $.0021

k"= $4,180 investment in equipment

m"= $1,261.65 rent of building

v"= $418.00 depreciation of equipment

d'=40[7,146.28 + 533,411.96 (.0021) + .06 (4,180) + 1,261.65 + 418.00]

d'=40 (7,146.28 + 1,120.17 + 250.80 + 1,261.65 + 418.00)

d'=40 (10,196.90)

d'=$407,876.00

f= $p^{iv}u$ where:

p^{iv}= 1,212,299.92 pounds

u= $.015 per pound

f= 1,212,299.95 (.015)

f= $18,184.50

g= $p^{v}u'$ where:

p^{v}= 849,579.78 pounds

u'= $.0085 per pound

g= 849,579.78 (.0085)

g= $7,221.43

Y_2 = 435,991.54 + 719,019.48 + 192,348.35 + 407,876.00 - 18,184.50 - 7,221.43

Y_2 = $1,729,829.44

Data applied to components of Model 2a:

Y_{2a}= a+e+b'+c'+d'-f-g+x where:

a= $435,991.54

e= $719,019.48

b'=p'''s where:

p'''= 21,336,478.59 pounds

s= $.007919 per pound

b'=21,336,478.59 (.007919)

b'=$168,963.57

c'= $192,348.35

d'=$407,876.00

f= $18,184.50

g= $7,221.43

x= p^{vii}.0173u''' where:

p^{vii}= 6,788,879.55 pounds

u'''= $.81

x= 6,788,879.55 (.0173) .81

x= $95,132.57

Y_{2a}= 435,991.54 + 719,019.48 + 168,963.57 + 192,348.35 + 407,876.00 - 18,184.50 - 7,221.43 + 95,132.57

Y_{2a}= $1,993,925.58

Data applied to components of Model 3:

Y_3 = t+a'+b'+c'+d'-f-g+x where:

t=e= $719,019.48

a= p'''(r'+j') where:

p'''= 21,336,478.59 pounds

r'= $.016200 per pound

j'= $.001315 per pound

a'= 21,336,478.59 (.016200 + .001315)

a'= $373,708.42

b'=$168,963.57

c'= $192,348.35

d'=$407,876.00

f= $18,184.50

g= $7,221.43

x= $95,132.57

Y_3 = 719,019.48 + 373,708.42 + 168,963.57 + 192,348.35 + 407,876.00 - 18,184.50 - 7,221.43 + 95,132.57

Y_3 = $1,931,642.46

Literature Cited

1. Anderson, Dale L. and Shaffer, Paul F., "Principles of Layout for Self-Service Meat Departments," U.S. Department of Agriculture, Marketing Res. Rpt. 77, 37 pp., illus., 1954.

2. "ASRE Data Book, Refrigeration Applications, Volume 1," Chapter 1, C.D. Macy, American Society of Refrigeration Engineers, 1958.

3. Blackmore, W. Edward and Clowes, Harry G., "Detroit Wholesale Food-Distribution Facilities," U.S. Department of Agriculture, Marketing Res. Rpt. 607, 159 pp., illus., 1963.

4. Branson, Robert E., "The Consumer Market for Beef," Texas Agricultural Experiment Station, Bulletin 856. April, 1957.

5. Brinser, Ayers, Allison, Harry, and Zwich, Charles, "Using Panel Data in Analyzing Consumer Demand for Meat," U.S. Department of Agriculture, 97 pp., December, 1963.

6. Buback, Donald Clarence, "Consumer Acceptability of Boneless Carcass Beef," Unpublished Masters Thesis, the University of Missouri, Columbia, 1958.

7. Clar, Faith, Murray, Janet, Weiss, Gertrude S., Grossman, Evelyn, "Food Consumption of Urban Families in the United States with an Appraisal of Methods of Analysis," U.S. Department of Agriculture, Agri. Info., Bul. 132, 203 pp., 1954.

8. Cole, J. W., Ramsey, C. B., and Cavender, A. R., "Effect of Weight, Grade and Sex of Beef Carcasses on Yield of Packaged Beef for the Freezer," Agricultural Experiment Station, the University of Tennessee, Bulletin 345, July, 1962.

9. Contract Wholesale Meat, 1961-63. Butchers' Union of Greater New York and New Jersey—Local No. 174, 121 East 18th Street, New York 3, N.Y. New York Council of Wholesale Meat Dealers, Inc., 1 Hanson Place, Brooklyn 17, N.Y.

10. Eickhoff, William Dean, "Consumer Preferences for Beef Rounds," Unpublished Masters Thesis, the University of Missouri, Columbia, 1960.

11. Farnworth, Virginia, "The Inedible Tallow and Grease Industry: Changes in Markets, Practices, and Costs." U.S. Department of Agriculture, Mktg. Res. Rpt. 342, 56 pp., illus., 1959.

12. Gerrity, Martin V., and Johnson, Harold D., "Motortruck Transportation of Freshly Killed Beef," U.S. Department of Agriculture, Mktg. Res. Rpt. 119, 40 pp., illus., 1956.

13. Graham, Harold, "Delivery Costs: More Important Than Ever," *Meat—The Monthly Operating and Management Magazine for Meat Packers,* March 1963, pp. 22-25 and April 1963, pp. 26, 27, 66, 68.

14. Hammons, Donald R. and Miller, Jarvis W., "Improving Methods and Facilities for Cattle Slaughtering Plants in the Southwest," U.S. Department of Agriculture, Mktg Res. Rpt. 436, 52 pp., illus., 1961.

15. Harwell, E. M., Anderson, Dale L., Shaffer, Paul F., and Knowles, R. H., "Receiving, Blocking, and Cutting Meats in Retail Food Stores," U.S. Department of Agriculture, Mktg. Res. Rpt. 41, 55 pp., illus., 1953.

16. Harwell, E. M., Anderson, Dale L., Shaffer, Paul F., and Knowles, R. H., "Packaging and Displaying Meats in Self-Service Meat Markets," U.S. Department of Agriculture, Mktg. Res. Rpt. 44, 86 pp., illus., 1953.

17. Hendrickson, Taylor, "Consumer Acceptance of Boneless Beef," Unpublished Masters Thesis, the University of Missouri, Columbia, 1960.

18. Household Food Consumption Survey, "Food Consumption of Households in the Northeast, Report 2," U.S. Department of Agriculture, 195 pp., illus., December, 1956.

19. Jensen, Lloyd Bryan, "Meat and Meat Foods," The Ronald Press Company, N.Y., 1949.

20. Knapp, Paul A., "Relationship of Beef Yield and Merchandising Techniques," Unpublished Masters Thesis, the University of Missouri, Columbia, 1964.

21. Kropf, Donald H., "Estimation of Boneless Beef Yield from Carcass Beef," Quartermaster Food and Container Institute for the Armed Forces Quartermaster Research and Engineering Command U.S. Army, Chicago, Illinois, 1958.

22. Marriott, Norman G., "The Stability of Prepackaged Fresh Beef Steaks as Influenced by Pre-display Environments," Unpublished Masters Thesis, University of Missouri, Columbia, 1964.

23. "Meat Consumption Trends and Patterns," U.S. Department of Agriculture, Agri. Handbook 187, 67 pp., illus., 1960.

24. Murphey, C. E., Hallett, D. K., Tyler, W. E. and Pierce, J. C., "Estimating Yields of Retail Cuts from Beef Carcasses," Livestock Division, AMS, U.S. Department of Agriculture, Presented at the Sixty-second Meeting of the American Society of Animal Production, Chicago, Illinois, Nov. 26, 1960.

25. *National Provisioner,* Vol. 150, No. 3, January 18, 1964, and Vol. 150, No. 20, May 16, 1964.

26. Ott, Leland E. and Marion, Bruce W., "Using Commodity Labor Data to Improve Managerial Effectiveness in Retail Meat Departments," A speech presented at the Fourth Annual Food Distribution Conference, Michigan State University, East Lansing, Michigan, October 23, 1963.

27. Progressive Grocer Colonial Study

28. "Readings in Packing House Practice. Part II—Beef, Mutton, and Veal Operations," Institute of American Meat Packers, University of Chicago, 151 pp., illus., 1926.

29. "Readings in Packing House Practice. Part IV—Plant Operating Service and Control," Institute of American Meat Packers, University of Chicago, 140 pp., illus., 1926.

30. Sleeth, Rhule Baily, "The Effect of Various Environmental Conditions During Aging on Shrinkage and Organoleptic Characteristics of Beef and the Efficacy of Oxytetracycline for Aging Beef," Unpublished Ph.D. Dissertation, the University of Missouri, August, 1959.

31. Snitzler, James R., "Improving the Truck Delivery Operations of a Wholesale Grocer—A Case Study," U.S. Department of Agriculture, Mktg. Res. Rpt. 127, 51 pp., illus., 1956.

32. Tariff Authority: Motor—The Eastern Central Motor Carriers Association, Inc., Agent, MF-Icc A-228, Tariff 38-D: East-Central Edible Goods Tariff. Issued May 17, 1963—Effective June 17, 1963. Rates apply on straight or mixed shipments.

33. Taylor, Earl G., Overheim, Richard K., and Lowstuter, A.B., "New Bedford Wholesale Food-Distribution Facilities," U.S. Department of Agriculture, Mktg. Res. Rpt. 613, 64 pp., illus., 1963.

34. The Super Market Industry Speaks, 1963.

35. Thompson, John W., "Rendering Inedible Animal Fats," U.S. Department of Agriculture, Mktg. Res. Rpt. 283, 62 pp., illus., 1958.

36. U.S. Department of Agriculture, *Livestock and Meat Situation,* Vol. 136, March, 1964.

37. Volz, Marvin D. and Marsden, James A., Centralized Processing of Fresh Meat for Retail Stores, U.S. Department of Agriculture, Mktg. Res. Rpt. 628, 76 pp., illus., 1963.

38. ——————————"The True Look of the Super Market Industry—1961," *Super-Market Merchandising,* April, 1962.