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The relative costs of returnable versus disposable milk containers to the retailer

Joe T. Davis

To the Graduate Council:

I am submitting herewith a thesis written by Joe T. Davis entitled "The relative costs of returnable versus disposable milk containers to the retailer." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

Irving Dubov, Major Professor

We have read this thesis and recommend its acceptance:

Jim Snell, Merton Badenhop

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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December 1972

To the Graduate Council:

I am submitting herewith a thesis written by Joe T. Davis entitled "The Relative Costs of Returnable Versus Disposable Milk Containers to the Retailer." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

Irving Dubow
Major Professor

We have read this thesis
and recommend its acceptance:

W. B. Badenhop

James L. Bull

Accepted for the Council:

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Vice Chancellor for
Graduate Studies and Research

THE RELATIVE COSTS OF RETURNABLE VERSUS DISPOSABLE MILK CONTAINERS TO THE RETAILER

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

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by

Joe T. Davis

December 1972

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ABSTRACT

The objective of this study was to determine the alternative costs to the retailer of handling milk in disposable versus returnable plastic containers. Also considered were the costs of three alternative retailer systems of handling returned plastic milk containers.

The procedure involved application of synthetic cost analysis. Three size stores--small, medium, and large--were designed on the basis of total sales. Costs of handling milk in disposable and returnable plastic containers were estimated for each of the three size model stores. The costs associated with an honor system, a checkout system, and a service desk system of handling returnable plastic containers were also estimated.

Costs of handling milk in disposable containers were $.01229, $.01185, and $.01152 per quart equivalent for the small, medium, and large size stores, respectively. The honor system of handling returned plastic milk containers had the lowest cost per quart equivalent. The checkout system had the next lowest cost per quart equivalent, and the service desk the highest.

The costs of handling milk in returnable plastic containers for the three size stores, when each of the three retailer systems of handling empty returnable containers were employed, are given in the following table:

System	Size of Store		
	Small	Medium	Large
Honor	.02177	.02387	.02719
Checkout	.02287	.02555	.02824
Service Desk	.02829	.02833	.03048

The added costs of handling milk in returnable plastic containers, as opposed to disposable containers, were $.00948, $.01202, and $.01567 per quart equivalent for the small, medium, and large size stores, when the honor system was employed. The added costs were $.01058, $.01370, and $.01672 for the three size stores when the checkout system was employed and $.01600, $.01648, and $.01896 when the service desk was used.

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CHAPTER I

INTRODUCTION

Until 1950 glass was the basic package for almost all milk. The reduction in sales of home delivered milk and the increase in supermarket sale of milk reduced the use of glass. While glass was desired for home delivery, the housewife wanted a lighter package to carry milk from the supermarket.[1]

In the late 1940's consumers were introduced to a disposable wax-coated paperboard container. However, wax particles were often found in the milk and the outside of the container had a cloudy and unappealing appearance. These problems prompted the development of the polyethylene coated paperboard container. Since its introduction in the early 1960's, this container has captured a large portion of the milk packaging market.[2]

The trend in milk sales has been from small to large size containers. The quart, once the most important container for fluid milk, has largely been replaced by the half-gallon and gallon containers.[3] The larger size paperboard containers have a tendency to leak and are oftentimes cumbersome to handle. These problems and the shift to larger size containers have accelerated the use of plastics for fluid milk containers.

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[1]Stanley Sacharow and Roger C. Griffin, Jr., Food Packaging (Westport, Conn.: AVI Publishing Company, Inc., 1970), p. 145.

[2]Ibid.

[3]Herbert Saal (ed.), "Trends in Fluid Milk Packaging," American Dairy Review, XXXIII, No. 7 (July, 1971), 12.

The one-way plastic container is lightweight and tougher than other packaging materials. Plastic containers also create high impulse appeal and allow the milk to be seen. Sales in one-way plastic containers have shown noticeable increase during the past few years. In 1969 total sales in plastics more than tripled the 1964 figure when plastic containers were first introduced on the market. In 1969 about 11 percent of the total fluid milk sales were in plastic bottles.[4]

Another new entry into the packaging field has been the returnable plastic container. Experimentation and research into the use of this container started in the early 1960's. It was not until 1965 that permission was granted by the United States Public Health Service to market milk in returnable plastic.[5]

The returnable plastic container has several advantages over other packaging materials, advantages which are desirable for processor, wholesaler, retailer, and consumer. For the processor, the plastic container will not break causing expensive delays and problems on the filling line of bottling plants. In addition there are no problems of broken glass and spills in the cold room and trucks. A case of gallon plastic containers of milk weighs 26 pounds less[6] than a case of glass containers which provides the advantage to the wholesaler of permitting trucks to increase their loads without exceeding weight limits. As a rule supermarket managers do not like returnable containers, but one that

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[4] Ibid.

[5] Robert E. Rutherford, "Returnable Plastic Bottles in an American Dairy," Dairy Industries, XXXII (May, 1967), 371.

[6] Ibid.

will not break at the checkout area causing an expensive mess and the loss of deposit as well as the embarrassment and delay would be a market improvement over other containers. Consumers like the returnable container because it takes less space in the refrigerator, it is lighter to carry, a child cannot break it, and it pours better than glass.

The recent concern over the related problem of pollution and solid waste disposal has prompted the development of new packaging techniques and materials. Public pressure has caused several changes in packaging practices and more are expected. It may be that returnable containers will replace the convenience type containers in an attempt to reduce the amount of solid waste generated by our society. The glass, paper, and disposable plastic half-gallon containers use 23 cu. in., 4.57 cu. in., and 3.23 cu. in., respectively, of land fill space while the gallon containers use 36 cu. in., 8.78 cu. in., and 5.81 cu. in., respectively.[7] Returnable containers would reduce the amount of solid waste and thus the cost to society of disposing of these containers.

Advantages such as unbreakability, lighter weight, general durability, and ease of handling indicate that the returnable plastic container would be the likely choice of both processor and consumer if public pressure increases to the point where disposable containers are banned from use.

The returnable plastic containers are now being used on both the east and west coasts of the United States and in Canada. The containers

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[7]Gerald E. Smolen, "The Costs Associated with Milk Packaging, Delivery, and Container Disposal for Four Container Types and the Policy Implications for the Knoxville, Tennessee, Area" (unpublished Ph.D. dissertation, University of Tennessee, 1971).

have captured between 25 and 40 percent of the display space in supermarkets offering the containers.[8]

I. THE PROBLEM

Studies have been undertaken to determine the increased cost to the milk processor of new equipment, new rates of filling, and new packaging materials associated with the plastic returnable containers. The cost of distribution from the processor to the retailer and of home delivered milk has been analyzed. Little has been done in determining the cost to the retailer of handling milk in these newer returnable containers.

In 1971, 86 percent of the total fluid milk sales in the United States were through other than home-delivery, principally food stores.[9] This large percentage of fluid milk handled by food retailers indicates a need to investigate the cost incurred by this sector of the marketing system in order to determine the full cost of the returnable plastic containers.

In general the food retailer is forced to accept the packaging techniques of the processor. However, if use of returnable plastic containers resulted in higher cost of handling milk in the store to a point where prices of milk had to be increased, then consumer influence might discourage the use of the container.

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[8]Clark Cordill, "The Returnable Plastic Milk Bottle--A Dimensional View," The Milk Dealer, LVIII (June, 1968), 47.

[9]Herbert Saal (ed.), "Trends in Fluid Milk Packaging," American Dairy Review, XXXIV, No. 7 (July, 1972), 49.

II. OBJECTIVES OF THE STUDY

This study was designed to estimate the relative cost at the retail level of using disposable versus returnable plastic containers. The specific objectives were:

1. To estimate the cost per unit of handling fluid milk in disposable paperboard containers by retail food chains.

2. To outline and compare three retailer systems of handling returnable plastic milk containers.

3. To estimate the per unit cost of handling the same milk in returnable plastic containers.

III. SCOPE AND METHOD

A purposive sample[10] was selected from retail food stores in Knoxville, Tennessee, that are members of national or regional food chains. Interviews were conducted with store managers to determine operational procedures and sales. Data on the physical characteristics were obtained by measuring floor space, size of dairy case, space allocated to fluid milk, and other physical characteristics of the stores.

The stores included small, medium, and large size operations based on total sales. Different size stores allowed for variation in operational procedure and amount of fluid milk sold. Variation in size of stores also permitted an application of the results to a wide range

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[10] Frederick E. Croxton, Dudley J. Cowden, and Sidney Klein, Applied General Statistics (Englewood Cliffs: Prentice-Hall, Inc., 1967), p. 28. A purposive sample is one that is chosen to agree with the population in regard to certain characteristics.

of individual stores in the Knoxville area.

The stores selected were from different geographical locations. This allowed further for variation in store operation, clientele, and amount of fluid milk sold.

The general procedure used in the analysis was the "synthetic" or "building block" procedure.[11] It was assumed that a store in a given size group would require the same type of dairy case and checkout equipment regardless of the type of container used for fluid milk. Since all characteristics of the store did not change because of the container used, the partial budgeting procedure was used to estimate the cost of handling milk in the returnable plastic and disposable paperboard containers. The partial budgeting analysis focused specifically on related costs associated with alternative container types used in the store.

Using the synthetic model technique, model stores were "constructed" to comply with given standards determined from results of actual store operations and from specifications published by equipment manufacturers. Costs were then estimated for store operations with all limiting factors removed.

The results obtained apply only to the model stores constructed. However, the results from the synthetic model analysis can be modified so that the cost estimates can be applied to similar situations.

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[11] B. C. French, L. L. Sammet, and R. G. Bressler, "Economic Efficiency in Plant Operations with Special Reference to the Marketing of California Pears," Hilgardia, XXIV, No. 19 (July, 1956).

IV. MODEL STORES

Three size stores--small, medium, and large--were constructed. The size criterion was total sales of each store.[12] These sales approximate the volume ranges of regional and national chains operating in Knoxville. The physical characteristics, dairy operation, operational procedures, and other characteristics of the three size stores were representative of the 12 stores surveyed. The specifications and characteristics of the three size stores are given in the Appendix, Tables 7, 8, and 9.

V. REVIEW OF LITERATURE

No study was found that analyzed the cost of retailing milk in returnable plastic containers, primarily because of the recent development of this new packaging technique.

In 1943 Stitts[13] used accounting data for 291 stores in the Alameda County and San Francisco marketing area to determine the cost of handling milk. This study allocated a portion of all cost involved in the store to fluid milk in proportion to amount of time spent working with fluid milk, space occupied by fluid milk, and percent of sales. Results of the study showed an average cost per unit of $.02214 for glass half-gallons, $.015728 for glass quarts, $.012618 for quart fiber,

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[12] Floor space is sometimes used as the criterion for classification of stores into size groups. Examination of the data indicated that size classifications based on total sales and on floor space would be almost the same.

[13] Tom G. Stitts, "Cost of Handling Fluid Milk by Retail Food Stores in the Alameda County and San Francisco Marketing Area," The Association Bulletin, International Association of Milk Dealers, No. 27, 1943.

$.010850 for glass pints, and $.010751 for fiber pints in stores of the Alameda County area. Slightly higher costs were observed in the San Francisco area for all size containers.

In 1951 Korzan and Pfanner[14] conducted a study in Oregon using a sample of 31 stores to determine the per unit cost of handling milk. In this study, milk included all fresh and fluid milk items handled by the retail grocery store. The sample included small, medium, and large stores from different geographical locations in the study area. The weighted average unit cost of handling milk items among all 31 stores was $.020 based on the total number of all size containers of milk sold by each store. The small stores averaged $.0361 for each unit handled. The average unit cost of the medium size stores was found to be $.0238. A cost of $.0171 was found for the large size stores.

A study by Kirkwood and Blackstone[15] conducted in Alabama in 1955 was designed to determine the relationship of the merchandising of dairy products, with emphasis on fluid milk, to the entire business of retail food stores. This study included 147 stores in the Birmingham, Gadsden, Mobile, and Montgomery area. Percentage of sales was used as the basis for allocating cost to handling milk in the stores. This study yielded an average per unit cost for all stores of $.0354. The average cost per unit decreased as the store size and volume increased. The per unit cost ranged from $.0465 for the small store to $.0318 for the larger stores.

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[14] Gerald E. Korzan and John A. Pfanner, Jr., "Costs of Retailing Milk Among a Group of Grocery Stores in Portland, Oregon," Oregon State College Agricultural Experiment Station Bulletin 504, Corvallis, October, 1951.

[15] E. K. Kirkwood and J. H. Blackstone, "Merchandising Dairy Products in Alabama Retail Food Stores," Alabama Polytechnic Institute Agricultural Experiment Station Bulletin No. 294, Auburn, May, 1955.

CHAPTER II

COST OF HANDLING MILK IN DISPOSABLE PAPERBOARD CONTAINERS

This part of the analysis dealt with the cost of handling milk in disposable paperboard containers in supermarkets. The purpose was to obtain cost estimates that would be appropriate if all milk were packaged in paperboard containers.

I. DESCRIPTION OF MODEL STORE OPERATIONS

Hours of operation of supermarkets in the Knoxville area differed according to size and location. The hours of operation for the three size stores reflected the actual hours of operation of stores that were included in this study. The wage rates for full-time and part-time employees also varied among stores. Wage rates for the different size stores were set at levels approximating those obtained from the survey data.

Equipment used in the different size stores was selected to reflect differences in style, quality, and other characteristics of equipment used in retail food stores. Differences were based on personal observation and equipment manufacturers' literature. These differences reflected cost differentials and such costs were included when equipment was specified for the different size stores.

The different size stores synthesized were all full-service stores with respect to fluid milk. This means that the milk wholesalers delivered the milk to the stores and stocked the milk in the dairy case. Full-service also included pricing of the milk as well as

displaying and rotation of the stock. The deliverymen also put milk in the reserve cooler if that particular store had such reserve milk storage. The deliverymen usually made more than one trip to the store during the day to restock and display milk. This service was usually more prevalent in the larger stores and during the busier days of the week.

II. EQUIPMENT COSTS

Equipment requirements used in this study were obtained from equipment dealers, store managers, and personal observation. Equipment specifications were obtained from manufacturers' literature. The equipment included in the analysis reflects the current trends and methods of food retailing in modern supermarkets.

Equipment dealers[16] provided data on the expected life and the initial cost associated with each component. Freight and installation costs were important items for equipment such as dairy cases and checkout counters. Shipping charges of $100 per section of dairy case and installation charges of $70 per foot of dairy case were added to the initial cost of dairy case equipment.[17] A 10 percent increase in the f.o.b. price of the checkout equipment was used to reflect average freight and installation charges.

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[16]Butcher's Supply Company, Inc., Knoxville, Tennessee; National Cash Register Company, Inc., Knoxville, Tennessee; Burroughs Division of Lear Siegler, Inc., Kalamazoo, Michigan.

[17]Butcher's Supply Company, Inc., Knoxville, Tennessee.

The principal overhead costs associated with the equipment investment were depreciation, interest, repairs and maintenance, insurance and taxes. A list of equipment items for each size store is given in Tables 10, 11, and 12 in the Appendix.

Depreciation was assumed to be an allowance to cover the cost of durable capital used up in the retailing process per unit of time. Equipment depreciation was computed on an annual basis. No attempt was made to separate total depreciation into depreciation due to obsolescence and to use. A salvage value of 10 percent of initial investment was assumed because the old equipment generally had some usefulness for its designated purpose remaining in addition to its junk value. Annual depreciation was calculated for the equipment based on an estimated life of 10 years. The straight line method was used to compute depreciation. Annual depreciation cost was 10 percent of the initial investment minus the salvage value.

Interest was defined as the cost of using capital and was included in the equipment cost analysis. An interest rate of 6 percent was used in this study.[18] The 10 percent salvage value was added to the initial equipment cost and the interest was calculated for half the estimated useful life.

The fire insurance costs were estimated for each of the model stores. Different stores may carry different kinds of insurance but all stores carried fire insurance. A fire insurance rate of $.30 per

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[18]Anyone using the results of this study would need to adjust the findings to reflect local prevailing interest rates.

$100 was used for each size store in this study.[19]

Repair and maintenance costs for equipment and building were included as a fixed proportion of the initial investment. A repair and maintenance factor of 2 percent of the original investment per year was used in this study. This factor has been used in other studies[20] and seemed reasonable from discussions with store managers.

Property taxes were computed based on a 40 percent assessment and a tax rate of $3.49 per $100 assessed value.[21]

III. INVESTMENT IN LAND AND BUILDING

Building costs of $22.12, $19.62, and $19.23 per square foot were used for the small, medium, and large size stores, respectively. These figures were based on construction costs of retail food facilities in Washington, D.C.[22] The construction costs in Washington, D.C., were adjusted with the aid of a location factor in order to reflect conditions prevailing in the Tennessee area.[23] These costs seemed reasonable after checking with building contractors in the Knoxville area.

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[19] Powell Insurors, Knoxville, Tennessee.

[20] Gerald E. Smolen, "The Cost Associated with Milk Packaging, Delivery, and Container Disposal for Four Container Types and the Policy Implications for the Knoxville, Tennessee Area" (unpublished Ph.D. dissertation, University of Tennessee, 1971); J. R. Strain and S. K. Christensen, "Relationship Between Plant Size and Cost of Processing Fluid Milk in Oregon," Oregon State College Agricultural Experiment Station Technical Bulletin 55, Corvallis, November, 1960.

[21] Knox County Property Assessor, Knoxville, Tennessee.

[22] Gary Moselle (ed.), National Construction Estimator (Los Angeles: Craftsman Book Company, 1971), p. 174.

[23] Ibid., p. 177.

The cost of land was assumed to be $.57 per square foot.[24] This relatively high cost was justified by the fact that most supermarkets are located in shopping centers or in other high land value areas.

The principal costs associated with the building investment were depreciation, interest, repair and maintenance, insurance, and taxes.

Depreciation was calculated for the building based on an estimated useful life of 33.3 years. The straight line method was used to compute depreciation which amounted to an annual depreciation cost of 3 percent of the total building investment. No attempt was made to separate depreciation due to obsolescence and depreciation due to physical wear on the building. An interest rate of 6 percent was used for the investment in land and building. Because it was assumed that the value of the building would be zero at the end of its life, the interest rate was applied to one-half of the initial investment. The insurance rate used was the same as that for the equipment costs. Building requirements for each model store are given in the Appendix Table 13.

IV. LABOR COSTS

Supermarkets have a staff of regular or full-time employees which perform specific duties such as checking and ordering. There is also a large amount of part-time labor used to perform duties such as sacking, working returnable bottles, and clean up. These two groups of employees, together with the manager, comprise the labor force needed to operate a supermarket.

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[24] Crossroads Realty Company, Knoxville, Tennessee.

The amount of labor needed in each store will depend on floor space and volume of business that each has. The labor inputs required by each size store in this study were obtained from personal observation and survey interviews conducted with the store managers.

The hourly wage rates also varied by store size. Employees in the smaller stores were paid less per hour of labor than in the larger stores. Wage rates for full-time and part-time employees were set at levels that reflected the conditions prevailing in stores of different size. The wage rates for the different size stores are stated in the specifications and characteristics of the three size stores in the Appendix.

V. UTILITY COSTS

Utility rates were obtained from the Knoxville Utility Board which provides the electric service to customers in the Knoxville area. The B rate for commercial establishments was used for all stores in this study.[25]

Electricity was priced on a demand charge and an energy charge. The demand charge is based on the maximum estimated quantity of energy that will be used per month. The energy charge is based on the rate at which energy will be used per month. The energy charge was established on a quantity discount step rate schedule. The more energy a customer uses the cheaper the rate he will pay for the last increment.

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[25] Knoxville Utilities Board, Rate Schedule of the Electric Division, General Power Rate-Schedule C-2, Knoxville, Tennessee, 1972.

The demand requirements can be computed by reading the electrical specifications from manufacturers' literature or from the plate attached to each piece of equipment. The motor horsepower rating can be converted to kilowatt-hours (KWH) on the basis of a "rule of thumb" that one installed horsepower uses 1 KWH of electrical energy per hour of use.[26] The energy demanded was determined for equipment used in handling fluid milk. The requirements were then aggregated for all equipment and an electrical bill was computed. Motors that powered the compressors for the dairy case were assumed to run 18 hours per day.

A summary of the related costs and the per unit cost associated with handling milk in disposable paperboard containers is given in Table 1.

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[26] Aaron C. Johnson, Olan D. Forker, and D. A. Clarke, "Operations and Costs of Manufacturing Dairy Products in California," California Agricultural Experiment Station, Giannini Foundation Research Report No. 272, January, 1964.

Table 1. A Summary of the Related Costs Associated with Handling Milk in Disposable Paperboard Containers for the Three Size Stores

	Size of Store[a]		
	Small	Medium	Large
	---------- Dollars ----------		
Investment Outlays			
Building	581.10	998.46	1096.69
Land	14.97	29.01	32.51
Equipment	2742.93	4266.82	4571.43
Total	3359.64	5171.28	5680.67
Annual Operating Costs			
Wages and salaries			
Full-time	1048.80	1284.66	1316.92
Part-time	547.80	390.04	445.12
Sub-total	1596.60	1674.70	1762.04
Annual overhead allowances			
Depreciation--equipment[b]	246.83	384.01	411.43
Depreciation--building[c]	17.43	28.87	32.90
Insurance--equipment[d]	8.23	12.80	13.71
Insurance--building[e]	1.74	2.89	3.29
Repairs and maint.--equipment[f]	54.86	85.34	91.43
Repairs and maint.--building[g]	11.62	19.25	21.93
Interest--equipment[h]	90.52	140.81	150.86
Interest--building[i]	17.88	29.74	33.88
Taxes--equipment[j]	38.29	59.56	63.82
Taxes--building[k]	8.32	13.84	15.76
Sub-total	495.72	777.11	839.01
Utilities			
Electricity	116.73	128.14	140.32
Total--Annual Operating Costs	2209.05	2579.95	2741.47
Per Unit Cost[1]	.01229	.01185	.01152

[a]The size criterion was total sales.

[b]Equipment cost allocated to fluid milk minus the salvage value x 10 percent.

[c]Building and land costs allocated to fluid milk x 3 percent.

Table 1 (continued)

[d]Equipment cost allocated to fluid milk divided by 100 x $.30.

[e]Building costs allocated to fluid milk divided by 100 x $.30.

[f]Equipment costs allocated to fluid milk x 2 percent.

[g]Building and land costs allocated to fluid milk x 2 percent.

[h]Equipment costs allocated to fluid milk + salvage value divided by 2 x 6 percent.

[i]Building and land costs allocated to fluid milk divided by 2 x 6 percent.

[j]Equipment costs allocated to fluid milk x .40 divided by 100 then x $3.49.

[k]Building costs allocated to fluid milk x .40 divided by 100 then x $3.49.

[l]Per unit costs based on quart equivalents of 179,723, 217,538, and 237,915 for the small, medium, and large size stores, respectively.

CHAPTER III

COSTS ASSOCIATED WITH THREE SYSTEMS OF HANDLING RETURNED PLASTIC MILK CONTAINERS

A retail store must have a system for handling all types of returnable containers that are used in packaging food or beverage. The system employed must provide an efficient way to facilitate the return and handling of all returnable containers. There are three major systems presently in use: (1) the honor system, (2) the check-out system, and (3) the service desk. Store managers indicated they would handle returnable plastic milk containers in the same general way they presently handle returnable soft drink bottles which in general follows one of these systems.

I. THE HONOR SYSTEM

The honor system assumes that people are honest and will tell the truth about returning empty milk containers. Containers are returned by the customer to the store and placed in a designated area. This area is generally outside the entrance to the store or inside the door near the entrance. There is no supervision of the returning of containers and no questions are asked when customers state they have returned the containers.

The customer picks up full containers of milk and if he has returned the same number of empty containers, there is an even exchange. If the customer had more empty containers than full ones purchased, he receives a refund of the deposit on the extra containers. If the

customer did not have containers, he is charged a deposit for the containers.

The empty containers are taken from the designated area at regular intervals or when the bins are filled. This is the responsibility of the sack boy or some other part-time employee.

Milk containers that are not placed in the designated area upon arrival at the supermarket are placed in the bins by the checker or sack boy when the customer checks out.

The honor system requires additional building space for a temporary storage area in which the customer places the empty plastic containers. Additional space is required for storage in the back room of the supermarket for the containers until they are picked up by the wholesalers. The cost per square foot of this area is the same as that charged per square foot of building space for disposable paperboard containers discussed in the previous chapter. The building requirements for the honor system in the three different size stores are given in Appendix Table 15. Depreciation, interest, and other costs associated with building expense were calculated in the same way as in the cost analysis for the disposable paperboard containers.

The additional labor inputs required for the honor system include part-time labor to move the containers from the temporary storage area to the back room where they are sorted, cased, and stacked. Additional checker time is also required for making deposits and refunds on containers. The same wage rates for full-time and part-time employees were used as those used in calculations for using disposable paperboard containers.

No additional equipment is needed when the honor system is used. Electricity requirements associated with use of the honor system were determined using the same procedure as for disposable paperboard containers. The utility costs were determined by applying the electrical rates used for the disposable paperboard containers to the electricity requirements of the honor system.

A summary of the related costs associated with use of the honor system is given in Table 2.

II. THE CHECKOUT SYSTEM

The checkout system is similar to the honor system except the customers keep empty containers in their shopping carts until they are ready to check out. The checker charges customers for container deposits if they do not have empties to exchange for the full ones purchased. The cashier returns the deposit the customer has coming for containers that he has over the amount of full ones purchased.

The sack boy or the checker places the empty containers in a bin or area that is located near the checkout area. This area should be emptied at regular intervals or whenever it becomes filled. This is the responsibility of the sack boy or some other part-time employee. The containers are taken to the back room where they are sorted, cased, and stacked.

Under this system all bottles are handled through the checkout area. This method tends to eliminate loss of deposit through dishonesty that may occur under the honor system.

The checkout system uses a temporary storage area for returnable containers located near the checkout area and a storage area in the back

Table 2. A Summary of the Costs Associated with the Honor System of Handling Returned Plastic Milk Containers for the Three Size Stores

	Size of Store[a]		
	Small	Medium	Large
	---------- Dollars ----------		
Investment Outlays			
Building	603.40	647.70	690.42
Land	15.96	19.38	21.09
Total	619.36	667.08	711.51
Annual Operating Costs			
Wages and salaries			
Full-time	395.20	730.08	1518.40
Part-time	1115.40	1655.68	1946.88
Sub-total	1510.60	2385.76	3465.28
Annual overhead allowances			
Depreciation--building[b]	18.58	20.01	21.35
Insurance--building[c]	1.86	2.00	2.13
Repairs and maint.--building[d]	12.39	13.34	14.23
Interest--building[e]	18.58	20.01	21.35
Taxes--building[f]	8.65	9.31	9.93
Sub-total	60.06	64.67	68.99
Utilities			
Electricity	16.50	28.02	33.36
Total--Annual Operating Costs	1587.16	2478.45	3567.63
Per Unit Cost[g]	.00883	.01139	.01499

[a]The size criterion was total sales.

[b]Building and land costs allocated to fluid milk x 3 percent.

[c]Building and land costs allocated to fluid milk divided by 100 x $.30.

[d]Building and land costs allocated to fluid milk x 2 percent.

[e]Building and land costs allocated to fluid milk divided by 2 x 6 percent.

Table 2 (continued)

[f]Building costs allocated to fluid milk x .40 divided by 100 then x $3.49.

[g]Per unit costs based on quart equivalents of 179,723, 217,538, and 237,915 for the small, medium, and large size stores, respectively.

room. Since the same volume of milk is handled in this study under the honor and the checkout system, building costs are the same.

Additional labor is required to carry containers from the storage area near the checkout stands to the back room where they are sorted, cased, and stacked. Additional checker time is required to handle deposits and refunds to customers. The labor requirements for the checkout system are given in Appendix Table 17. The utility costs associated with the checkout system are the same as the utility costs for the honor system.

A summary of the related costs associated with use of the checkout system is given in Table 3.

III. THE SERVICE DESK SYSTEM

The service desk method consists of an area or counter at which customers take empty milk containers and soft drink bottles to receive deposit refunds. The customers receive the refund of the deposit for the containers returned for which he was previously charged.

The service desk is located near the front of the store. All returnable containers are processed through this center; no containers are handled at the checkout area. If containers are brought to the checkout area, they are carried to the service desk by the checker or sack boy where the deposit is returned to the customer.

The customer is charged a deposit for every returnable container of full milk that he purchases. It is the responsibility of the individual customer to return the container and secure the deposit at the service desk.

Table 3. A Summary of the Costs Associated with the Checkout System of Handling Returned Plastic Milk Containers for the Three Size Stores

	Size of Store[a]		
	Small	Medium	Large
	---------- Dollars ----------		
Investment Outlays			
Building	603.40	647.70	690.42
Land	15.96	19.38	21.09
Total	619.36	667.08	711.51
Annual Operating Costs			
Wages and salaries			
Full-time	592.80	1095.12	1670.24
Part-time	1115.40	1655.68	1946.88
Sub-total	1708.20	2750.80	3617.12
Annual overhead allowances			
Depreciation--building[b]	18.58	20.01	21.35
Insurance--building[c]	1.86	2.00	2.13
Repairs and maint.--building[d]	12.39	13.34	14.23
Interest--building[e]	18.58	20.01	21.35
Taxes--building[f]	8.65	9.31	9.93
Sub-total	60.06	64.67	68.99
Utilities			
Electricity	16.50	28.02	33.36
Total--Annual Operating Costs	1784.76	2843.49	3817.48
Per Unit Cost[g]	.00993	.01307	.01604

[a]The size criterion was total sales.

[b]Building and land costs allocated to fluid milk x 3 percent.

[c]Building and land costs allocated to fluid milk divided by 100 x $.30.

[d]Building and land costs allocated to fluid milk x 2 percent.

[e]Building and land costs allocated to fluid milk divided by 2 x 6 percent.

Table 3 (continued)

[f]Building costs allocated to fluid milk x .40 divided by 100 then x $3.49.

[g]Per unit costs based on quart equivalents of 179,723, 217,538, and 237,915 for the small, medium, and large size stores, respectively.

There should be a full-time employee at the service desk when the store is open. This employee insures that the returnable containers are usable and the kind the store handles. The returnable containers are placed in a temporary storage area at the service desk until a part-time employee takes them to the back room where they are stored until representatives of the milk companies pick them up.

The service desk employee refunds deposits on returnable milk containers and soft drink bottles, sells specialty items, such as tobacco, provides information, and furnishes check cashing services.

Additional building space is required for the service desk method of handling returnable plastic milk containers. Space is needed at the service desk for temporary storage of the containers; therefore, a portion of the working area should be charged to handling returnable milk containers. Additional area in the back room is needed to store the containers until the milk companies pick them up. The depreciation, interest, and other costs associated with the building investment for the service desk were calculated in the same way as in the cost analysis for the disposable paperboard containers.

Additional labor is needed to operate the service desk. It was assumed that 20 percent of the full-time employee's time is spent in working with returnable milk containers. This portion of the cost of the full-time employee was charged to handling returnable plastic milk containers. Labor requirements associated with the service desk are given in Appendix Table 17.

The service desk method requires additional equipment for each different size store. A cash register and manual checkout counter is

required for servicing the customers. Since it was assumed that 20 percent of the activities of the service desk were associated with returnable milk containers, 20 percent of the equipment costs were allocated to handling returnable milk containers. The depreciation, interest, and other costs associated with the equipment were handled in the same way as the equipment costs for handling milk in disposable paperboard containers.

Additional utility costs will be incurred when using the service desk method of handling returnable plastic containers. The cash register will be the only piece of equipment requiring electricity. Twenty percent of the total utility cost of the service desk was charged to the handling of returnable milk containers.

A summary of the costs associated with the service desk for the three size stores is given in Table 4.

Table 4. A Summary of the Costs Associated with the Service Desk System of Handling Returned Plastic Milk Containers for the Three Size Stores

	Size of Store[a]		
	Small	Medium	Large
	---------- Dollars ----------		
Investment Outlays			
Building	742.39	790.57	854.62
Land	19.64	23.66	26.11
Equipment	1086.00	1135.00	1270.00
Total	1848.03	1949.23	2150.73
Annual Operating Costs			
Wages and salaries			
Full-time	1778.40	1971.22	2368.70
Part-time	858.00	1345.24	1838.72
Sub-total	2636.40	3316.46	4207.42
Annual overhead allowances			
Depreciation--equipment[b]	19.55	20.43	22.86
Depreciation--building[c]	22.86	24.43	26.42
Insurance--equipment[d]	.65	.68	.76
Insurance--building[e]	2.28	2.44	2.64
Repairs and maint.--equipment[f]	4.34	4.54	5.08
Repairs and maint.--building[g]	15.24	16.28	17.61
Interest--equipment[h]	7.17	7.49	8.38
Interest--building[i]	22.86	24.43	26.42
Taxes--equipment[j]	15.16	15.85	17.73
Taxes--building[k]	10.64	11.37	12.30
Sub-total	120.75	128.94	140.20
Utilities			
Electricity	2.52	2.95	3.36
Total--Annual Operating Costs	2759.17	3448.35	4349.98
Per Unit Cost[1]	.01535	.01585	.01828

[a]The size criterion was total sales.

[b]Equipment cost allocated to fluid milk minus the salvage value x 10 percent.

[c]Building and land costs allocated to fluid milk x 3 percent.

Table 4 (continued)

[d]Equipment cost allocated to fluid milk divided by 100 x $.30.

[e]Building costs allocated to fluid milk divided by 100 x $.30.

[f]Equipment costs allocated to fluid milk x 2 percent.

[g]Building and land costs allocated to fluid milk x 2 percent.

[h]Equipment costs allocated to fluid milk + salvage value divided by 2 x 6 percent.

[i]Building and land costs allocated to fluid milk divided by 2 x 6 percent.

[j]Equipment costs allocated to fluid milk x .40 divided by 100 then x $3.49.

[k]Building costs allocated to fluid milk x .40 divided by 100 then x $3.49.

[l]Per unit costs based on quart equivalents of 179,723, 217,538, and 237,915 for the small, medium, and large stores, respectively.

CHAPTER IV

COSTS OF HANDLING MILK IN RETURNABLE PLASTIC CONTAINERS

The same volume of milk handled by each size store using disposable paperboard containers set forth in the analysis in Chapter II is now handled using returnable plastic gallon and half-gallon containers rather than paperboard containers of the same size. Milk packaged in containers smaller than the half-gallon will continue to use disposable paperboard containers. The costs involved in handling milk in plastic returnable containers were computed in the same way as the costs were calculated for the disposable paperboard containers.

The returnable plastic gallon and half-gallon containers use 21 percent and 47 percent more display space, respectively, than disposable paperboard containers of the same capacity. Space allocation for fluid milk in the dairy case in each size store was increased to allow the same number of returnable containers to be displayed as disposable paperboard containers.

Since additional space is needed in the dairy case when returnable plastic containers are used, there is additional equipment costs associated with the use of plastic containers. The dairy case equipment costs were allocated to fluid milk on the basis of the percentage of the dairy case used for fluid milk. The depreciation, interest, and other costs associated with the equipment investment were computed in the same way as the equipment costs were computed for the paperboard containers.

The principal costs associated with building investment for handling milk in returnable plastic containers were computed in the

same way as the building costs were computed for disposable paperboard containers. Additional building space associated with handling milk in the plastic containers is necessary because of additional space allotted to fluid milk in the dairy case. The building requirements associated with handling milk in returnable plastic containers are given in Appendix Table 14.

Utility costs associated with handling milk in returnable plastic containers were calculated using the same rates used for the utility costs of handling milk in disposable paperboard containers. The percentage of the dairy case allotted to fluid milk was used to allocate dairy case utility costs to handling of fluid milk. The percentage of total sales of fluid milk was used to allocate checkout utilities to fluid milk.

Labor requirements, excluding the labor used in any one of the three methods of handling returned containers, remained the same as the labor required for disposable paperboard containers.

A summary of the costs of handling milk in plastic returnable containers is given in Table 5. A summary of the costs of handling milk in returnable plastic containers using each of the three systems of handling returned containers for each of the three different size store is given in Table 6.

Table 5. A Summary of the Costs Associated with Handling Milk in Returnable Plastic Containers for the Three Size Stores

	Size of Store[a]		
	Small	Medium	Large
	---------- Dollars ----------		
Investment Outlays			
Building	652.54	1094.60	1204.37
Land	16.82	31.78	35.70
Equipment	3326.98	4849.63	5302.74
Total	3996.34	5976.01	6542.81
Annual Operating Costs			
Wages and salaries			
Full-time	1048.80	1283.66	1316.92
Part-time	547.80	390.04	445.12
Sub-total	1596.60	1674.70	1762.04
Annual overhead allowances			
Depreciation--equipment[b]	299.43	436.47	477.25
Depreciation--building[c]	19.58	32.84	36.13
Insurance--equipment[d]	9.98	14.55	15.91
Insurance--building[e]	1.96	3.28	3.61
Repairs and maint.--equipment[f]	66.54	96.99	106.05
Repairs and maint.--building[g]	13.05	22.53	24.80
Interest--equipment[h]	109.79	160.04	174.99
Interest--building[i]	20.08	33.79	37.20
Taxes--equipment[j]	46.44	67.70	74.03
Taxes--building[k]	9.34	15.72	17.31
Sub-total	596.19	883.91	967.28
Utilities			
Electricity	133.23	156.16	173.68
Total--Annual Operating Costs	2326.02	2714.77	2903.00
Per Unit Cost[l]	.01294	.01247	.01220

[a]The size criterion was total sales.

[b]Equipment cost allocated to fluid milk minus the salvage value x 10 percent.

[c]Building and land costs allocated to fluid milk x 3 percent.

Table 5 (continued)

[d]Equipment cost allocated to fluid milk divided by 100 x $.30.

[e]Building costs allocated to fluid milk divided by 100 x $.30.

[f]Equipment costs allocated to fluid milk x 2 percent.

[g]Building and land costs allocated to fluid milk x 2 percent.

[h]Equipment costs allocated to fluid milk + salvage value divided by 2 x 6 percent.

[i]Building and land costs allocated to fluid milk divided by 2 x 6 percent.

[j]Equipment costs allocated to fluid milk x .40 divided by 100 then x $3.49.

[k]Building costs allocated to fluid milk x .40 divided by 100 then x $3.49.

[l]Per unit costs based on quart equivalents of 179,723, 217,538, and 237,915 for the small, medium, and large size stores, respectively.

Table 6. A Summary of the Related Costs Associated with Handling Milk in Returnable Plastic Containers Using Each of the Methods of Handling Returned Containers in Each of the Three Size Stores

Size of Store	Method Used to Handle Returned Bottles	Annual Cost	Per Unit Cost[a]
		------- Dollars	---------
Small	Honor System	3913.18	.02177
	Checkout System	4110.78	.02287
	Service Desk	5085.19	.02829
Medium	Honor System	5193.22	.02387
	Checkout System	5558.26	.02555
	Service Desk	6163.12	.02833
Large	Honor System	6470.63	.02719
	Checkout System	6720.48	.02824
	Service Desk	7252.98	.03048

[a]Per unit costs are based on quart equivalents for each size model store.

CHAPTER V

SUMMARY AND CONCLUSIONS

I. SUMMARY

The objectives of the study were: (1) to determine the unit cost of handling fluid milk in disposable paperboard containers by retail food chains; (2) to outline and compare three retailer systems of handling returnable plastic milk containers; and (3) to estimate the per unit cost of handling the same milk in returnable plastic containers.

The general approach used was the synthetic cost analysis. The study focused on the dairy department in supermarkets with emphasis on handling fluid milk.

An attempt was made in the study to estimate the unit cost of handling milk in disposable paperboard containers for the three different size retail food stores. The dairy operations were synthesized for the three size stores representing typical supermarkets operating in the Knoxville area.

Three systems were outlined that could be used to handle returned milk containers by retail food stores: (1) the honor system, (2) the checkout system, and (3) the service desk system. The operations for each of these systems were synthesized and the costs were estimated.

The unit costs of handling milk in disposable paperboard containers were found to be 1.229; 1.185; and 1.152 cents per quart equivalent for the small, medium, and large size stores, respectively. The most

important cost item in the handling costs was labor. The least important cost item was the cost of utilities.

The results showed that the honor system had the lowest unit cost for handling returned plastic milk containers in each size store. The checkout system had the next lowest cost. All three systems of handling returned plastic milk containers required a large amount of labor in working the returned containers as well as additional checkout time for handling deposits and refunds. Labor costs associated with each of the three systems were the most important cost element. Because wage rates were higher for the larger stores, the cost per quart equivalent associated with each system was higher for the larger stores.

Based on these estimates, the honor system had the lowest unit cost. Even if an allowance for loss of deposit due to dishonesty by some customers were added to the cost associated with this system, the cost would still be lower than for the service desk and about the same as the checkout system.

The costs of handling milk in returnable plastic containers, excluding the costs associated with handling returned containers, were computed for each size store. These estimates, plus the costs associated with each system of handling returned milk containers, gave an estimate of the cost of handling milk in returnable plastic containers for each different size store. It was found that the costs of handling milk in returnable plastic containers by the three size stores using the honor system ranged from 2.177 cents per quart equivalent for the small store to 2.719 cents per quart equivalent for the large store. The costs of handling milk for the three size stores ranged from 2.287 cents

per quart equivalent for the small store to 2.824 cents per quart equivalent for the large store when the checkout system was used and from 2.829 cents per quart equivalent for the small store to 3.048 cents per quart equivalent for the large store when the service desk was used.

The increase in costs of handling milk in the returnable plastic containers versus disposable paperboard containers, based on quart equivalents, was .948, 1.202, and 1.567 cents for the small, medium, and large size stores, respectively, assuming the honor system was used to handle the returned containers.

II. CONCLUSIONS

The results indicated a significant increase in the cost of handling milk when returnable plastic gallon and half-gallon containers are used in the retail store. It is likely that all or part of this increase would be passed on to the consumer in the form of higher fluid milk prices.

Based on the assumptions used, the honor system involves the lowest unit cost of handling returned milk containers in the retail store. This indicates that this system would be the best procedure for handling returnable milk containers in retail food stores. However, stores that are currently using other systems for handling soft drink bottles will likely use their present system of handling returnable milk containers because of the costs involved in changing from one system to another.

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APPENDIX

Table 7. Specifications and Physical Characteristics of the Small Size Store

Item	Amount
Store Size	5525 square feet
Number of Checkout Lanes	2
Space Allocated to Dairy Department	155 square feet
Space Allocated to Fluid Milk in Dairy Department	92 square feet
Length of Dairy Case	28 feet
Total Linear Feet of Display Area in the Dairy Case	106 feet
Total Linear Feet of Display Area in Dairy Case Allotted to Milk	24 feet
Part-time Wage Rate	$1.65 per hour
Full-time Wage Rate	$1.90 per hour
Gross Sales of Store Per Year	$641,000
Fluid Milk Sales Per Year	$54,600
Number of Gallon Containers of Milk Sold During the Year	18,042
Number of Half-Gallon Containers of Milk Sold During the Year	48,435
Number of Quart Containers of Milk Sold During the Year	9,927
Number of Pint Containers of Milk Sold During the Year	3,033
Total Units of Milk Sold During the Year in Quart Equivalents	179,723

Table 8. Specifications and Physical Characteristics of the Medium Size Store

Item	Amount
Store Size	18,055 square feet
Number of Checkout Lanes	5
Space Allocated to Dairy Department	330 square feet
Space Allocated to Fluid Milk in Dairy Department	164 square feet
Length of Dairy Case	36 feet
Total Linear Feet of Display Area in the Dairy Case	116 feet
Total Linear Feet of Display Area in Dairy Case Allotted to Milk	28 feet
Part-time Wage Rate	$1.99 per hour
Full-time Wage Rate	$2.34 per hour
Gross Sales of Store Per Year	$1,742,000
Fluid Milk Sales Per Year	$65,780
Number of Gallon Containers of Milk Sold During the Year	32,604
Number of Half-Gallon Containers of Milk Sold During the Year	37,134
Number of Quart Containers of Milk Sold During the Year	11,960
Number of Pint Containers of Milk Sold During the Year	3,654
Total Units of Milk Sold During the Year in Quart Equivalents	217,538

Table 9. Specifications and Physical Characteristics of the Large Size Stores

Item	Amount
Store Size	18,600 square feet
Number of Checkout Lanes	6
Space Allocated to Dairy Department	378 square feet
Space Allocated to Fluid Milk in Dairy Department	102 square feet
Length of Dairy Case	48 feet
Total Linear Feet of Display Area in the Dairy Case	214 feet
Total Linear Feet of Display Area in Dairy Case Allotted to Milk	31 feet
Part-time Wage Rate	$2.08 per hour
Full-time Wage Rate	$2.92 per hour
Gross Sales of Store Per Year	$2,986,000
Fluid Milk Sales Per Year	$72,644
Number of Gallon Containers of Milk Sold During the Year	36,006
Number of Half-Gallon Containers of Milk Sold During the Year	39,837
Number of Quart Containers of Milk Sold During the Year	13,208
Number of Pint Containers of Milk Sold During the Year	4,036
Total Units of Milk Sold During the Year in Quart Equivalents	237,915

Table 10. Equipment Items Associated with Handling Fluid Milk for the Small Size Store

Equipment Item	Estimated Life	Cost[a]
	Years	Dollars
Dairy Case		
Dairy Case, 28 feet	10	5810.00
Compressor for Dairy Case, 2 Horsepower	10	916.00
Compressor for Dairy Case, 5 Horsepower	10	1614.00
Accessories for Dairy Case	10	2569.00
Accessories for 2 Horsepower Compressor	10	328.00
Accessories for 5 Horsepower Compressor	10	409.00
Shipping Charges ($100 per Section of Dairy Case)	--	300.00
Installation Charges ($70 per foot of Dairy Case)	--	1960.00
Sales Tax	--	695.30
Total Cost of Dairy Case[b]		14601.30
Checkout Equipment		
Manual Checkout Counters (2)	10	716.00[c]
Cash Registers (2)	10	2300.00[c]
Register Protectors (2)	10	35.00
Plastic Waste Baskets (2)	10	9.00
Total Cost of Checkout[d]		3060.00

[a]Source: Butcher's Supply Company, Inc., Knoxville, Tennessee; National Cash Register Company, Inc., Knoxville, Tennessee; Burroughs Division of Lear Siegler, Inc., Kalamazoo, Michigan.

[b]A portion of this total was allocated to the handling of fluid milk based on the percentage of total feet in the dairy case used for fluid milk.

[c]Includes 10 percent for shipping and installation.

[d]A portion of this total cost was allocated to the handling of fluid milk based on the percentage of total sales attributed to fluid milk.

Table 11. Equipment Items Associated with Handling Fluid Milk for the Medium Size Stores

Equipment Item	Estimated Life	Cost[a]
	Years	Dollars
Dairy Case		
Dairy Case, 36 feet	10	7550.00
Compressor for Dairy Case, 2 Horsepower (2)	10	1832.00
Compressor for Dairy Case, 5 Horsepower	10	1614.00
Accessories for Dairy Case	10	3521.00
Accessories for 2 Horsepower Compressor (2)	10	656.00
Accessories for 5 Horsepower Compressor	10	409.00
Shipping Charges ($100 per Section of Dairy Case)	--	400.00
Installation Charges ($70 per Foot of Dairy Case)	--	2520.00
Sales Tax	--	925.10
Total Cost of Dairy Case[b]		19427.10
Checkout Equipment		
Single Belt Checkout Counter (5)	10	5300.00[c]
Cash Register (5)	10	8500.00[c]
Chain Aisle Close Off (5)	10	97.50
Register Protector (5)	10	87.50
Plastic Waste Baskets (5)	10	22.50
Total Cost of Checkout[d]		14007.50
Reserve Cooler		
Walk-in Cooler, 20 square feet	10	629.00
Total Cost of Cooler		629.00

[a]Source: Butcher's Supply Company, Inc., Knoxville, Tennessee; National Cash Register Company, Inc., Knoxville, Tennessee; Burroughs Division of Lear Siegler, Inc., Kalamazoo, Michigan.

[b]A portion of this total cost was allocated to the handling of fluid milk based on the percentage of total feet in the dairy case used for fluid milk.

[c]Includes 10 percent for shipping and installation.

[d]A portion of this total cost was allocated to the handling of fluid milk based on the percentage of total sales attributed to fluid milk.

Table 12. Equipment Items Associated with Handling Fluid Milk for the Large Size Store

Equipment Item	Estimated Life	Cost[a]
	Years	Dollars
Dairy Case		
Dairy Case, 48 feet	10	9880.00
Compressor for Dairy Case, 2 Horsepower	10	916.00
Compressor for Dairy Case, 5 Horsepower (2)	10	3228.00
Accessories for Dairy Case	10	4186.00
Accessories for 2 Horsepower Compressor	10	328.00
Accessories for 5 Horsepower Compressor (2)	10	818.00
Shipping Charges ($100 per Section of Dairy Case)	--	500.00
Installation Charges ($70 per foot of Dairy Case)	--	3360.00
Sales Tax	--	1160.80
Total Cost of Dairy Case[b]		24376.80
Checkout Equipment		
Single Belt Counters (6)	10	8568.00[c]
Cash Registers (6)	10	16500.00[c]
Chain Aisle Close Off (6)	10	117.00
Register Protectors (6)	10	105.00
Plastic Waste Baskets (6)	10	27.00
Total Cost of Checkout[d]		25317.00
Reserve Cooler		
Walk-in Cooler, 25 square feet	10	786.25
Total Cost of Cooler		786.25

[a]Source: Butcher's Supply Company, Inc., Knoxville, Tennessee; National Cash Register Company, Inc., Knoxville, Tennessee; Burroughs Division of Lear Siegler, Inc., Kalamazoo, Michigan.

[b]A portion of this total cost was allocated to the handling of fluid milk based on the percentage of total feet in the dairy case used for fluid milk.

[c]Includes 10 percent for shipping and installation.

[d]A portion of this total cost was allocated to the handling of fluid milk based on the percentage of total sales attributed to fluid milk.

Table 13. Building Requirements for the Three Size Stores Using Disposable Paperboard Containers

Size of Store	Component	Area	Cost[a]
		Square Feet	Dollars
Small	Dairy Case	16.80	371.62
	Checkout	9.47	209.48
	Total	26.27	581.10
Medium	Dairy Case	19.60	384.55
	Checkout	11.29	221.51
	Reserve Cooler	20.00	392.40
	Total	50.89	998.46
Large	Dairy Case	21.70	417.29
	Checkout	10.33	198.65
	Reserve Cooler	25.00	480.75
	Total	57.03	1096.69

[a]Computed on the building cost of $22.12, $19.62, and $19.23 per square foot for the small, medium, and large size stores, respectively.

Table 14. Building Requirements for the Three Size Stores Using Plastic Returnable Containers

Size of Store	Component	Area	Cost[a]
		Square Feet	Dollars
Small	Dairy Case	20.03	443.06
	Checkout	9.47	209.48
	Total	29.50	652.54
Medium	Dairy Case	24.50	480.69
	Checkout	11.29	221.51
	Reserve Cooler	20.00	392.40
	Total	55.79	1094.60
Large	Dairy Case	27.30	524.97
	Checkout	10.33	198.65
	Reserve Cooler	25.00	480.75
	Total	62.63	1204.37

[a]Computed on the building cost of $22.12, $19.62, and $19.23 per square foot for the small, medium, and large size stores, respectively.

Table 15. Building Requirements for the Three Size Stores Using Each of the Three Systems for Handling Returnable Milk Containers

Size of Store	System of Handling Milk Containers	Area	Cost[a]
		Square Feet	Dollars
Small	Honor System	28.00	619.36
	Checkout System	28.00	619.36
	Service Desk	34.45	762.03
Medium	Honor System	34.00	667.08
	Checkout System	34.00	667.08
	Service Desk	41.50	814.23
Large	Honor System	37.00	711.51
	Checkout System	37.00	711.51
	Service Desk	45.80	880.73

[a]Computed on building and land costs of $22.12, $19.62, and $19.23 per square foot for the small, medium, and large stores, respectively.

Table 16. Labor Requirements for Handling Milk in Disposable Containers by the Three Size Stores

Size of Store	Type of Labor	Annual Quantity	Annual Cost[a]
		Hours	Dollars
Small	Full-time	552	1048.80
	Part-time	332	547.80
	Total		1596.60
Medium	Full-time	549	1284.66
	Part-time	196	390.04
	Total		1674.70
Large	Full-time	451	1316.92
	Part-time	214	445.12
	Total		1762.04

[a]Computed on the wage rates for each size store given in the specifications and physical characteristics of each store.

Table 17. Labor Costs Associated with the Three Systems of Handling Returnable Milk Containers for Each of the Three Size Stores

Size of Store	System of Handling Milk Containers	Type of Labor	Annual Quantity	Annual Cost
			Hours	Dollars
Small	Honor System	Part-time	676	1115.40
		Full-time	208	395.20
		Total		1510.60
	Checkout System	Part-time	676	1115.40
		Full-time	312	592.80
		Total		1708.20
	Service Desk	Part-time	520	858.00
		Full-time	936	1778.40
		Total		2636.40
Medium	Honor System	Part-time	832	1655.68
		Full-time	312	730.08
		Total		2385.76
	Checkout System	Part-time	832	1655.68
		Full-time	468	1095.12
		Total		2750.80
	Service Desk	Part-time	676	1345.24
		Full-time	842	1971.22
		Total		3316.46
Large	Honor System	Part-time	936	1946.88
		Full-time	520	1518.40
		Total		3465.28
	Checkout System	Part-time	936	1946.88
		Full-time	572	1670.24
		Total		3617.12
	Service Desk	Part-time	884	1838.72
		Full-time	811	2368.70
		Total		4207.42

Table 18. Amount of Dairy Case Allocated to Fluid Milk by Each Size Using Disposable Paperboard and Returnable Plastic Containers

Size of Store	Length of Dairy Case	Amount Allocated to Milk Using Disposable Containers	Percent of Total[a]	Amount Allocated to Milk Using Returnable Plastic Containers	Percent of Total[b]
	Feet	Feet		Feet	
Small	28	4.8	17	5.8	21
Medium	36	5.6	16	7.0	19
Large	48	6.2	13	7.8	16

[a]These percentages were used to allocate a portion of the total dairy case equipment costs to handling of fluid milk for each size store using disposable containers.

[b]These percentages were used to allocate a portion of the total dairy case equipment costs to handling of fluid milk in plastic returnable containers for each size store.

Table 19. Equipment Requirements Using the Service Desk System of Handling Returnable Plastic Containers by Each of the Three Size Stores

Size of Store	Equipment Item	Estimated Life	Installed Cost[a]	Amount Allocated to Handling Fluid Milk[b]
		Years	Dollars	Dollars
Small	Cash Register	10	895.00[c]	179.00
	Manual Checkout	10	191.00[c]	38.20
	Total		1086.00	217.20
Medium	Cash Register	10	925.00[c]	185.00
	Manual Checkout	10	210.00[c]	42.00
	Total		1135.00	227.00
Large	Cash Register	10	1025.00[c]	205.00
	Manual Checkout	10	245.00[c]	49.00
	Total		1270.00	254.00

[a]Source: National Cash Register Company, Inc., Knoxville, Tennessee; Burroughs Division of Lear Siegler, Inc., Kalamazoo, Michigan.

[b]Twenty percent of the installed cost was allocated to the handling of fluid milk because 20 percent of the activities of the service desk involves handling of returned milk containers.

[c]Includes 10 percent for shipping and installation.

VITA

Joe T. Davis was born in Martin, Tennessee, on January 22, 1946. He graduated from Martin High School in 1964. The following September he entered The University of Tennessee at Martin, and in June, 1968, he received a Bachelor of Science degree in General Agriculture. The following September he accepted a National Defense Educational Act Fellowship at the University of Tennessee, Knoxville, and began working toward a Master's degree. In February of 1969, he entered the United States Army for two years active duty. He was discharged from the Army in December of 1970 and returned to The University of Tennessee to complete work on his Master's degree. He received this degree in December of 1972.

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