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Preface

The transportation of milk in tank trucks from farm to plant has become important only in the 1950's. In many areas it has developed rapidly. It usually brings about other important changes, both welcome and unwelcome. The United States Department of Agriculture recognized the need of economic analysis of this significant new development.

The Department has a broad program of research in agricultural marketing, designed to improve the efficiency of the marketing process. The research resulting in this report was a part of that program. The work was done by the University of New Hampshire under contract with the United States Department of Agriculture. The Agricultural Marketing Service administered the contract for the Department, with Clem C. Linnenberg, Jr., of the Marketing Research Division, supervising the contract on the Department's behalf.

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Transition to the Bulk Assembly of Milk in Northern New England

By James R. Bowring and Kenneth A. Taylor*

I. Introduction

TECHNOLOGICAL changes are no less apparent in the dairy industry than in agriculture as a whole. Increased production per cow, increases in the number of cows per dairy farm worker, are symbolic of the new feeds and the labor saving devices and building designs which have been developed.

Increased competition among farmers and among milk dealers for the sale of milk intensifies the drive for the adoption of cost reducing techniques to keep prices down. One of these new methods which has been adopted in many areas with large farms but which is now reaching to the smaller dairy farms is the tank assembly of milk. Under this system milk is cooled and stored on the farm, in refrigerated bulk tanks, transferred to a tank truck by means of a power-driven pump, delivered to the dealer, and transferred from the tank truck to the dealer's tank for processing. Handling and cleaning of milk cans is no longer necessary, waste is reduced, and the probability of contamination after leaving the farm is minimized. Under can assembly, title to the milk passes at the plant; under bulk assembly, the point of sale is at the farm.

The process of change from cans to tank is based in large measure on the dealer's incentive of profit and the producer's estimate of his profit or loss if he converts or stands pat. Either the producer's expected gain must exceed the cost or the loss he thinks he will avoid by converting must exceed the cost. Therefore local differences in the structure of the industry, such as size of farm, distance from market, and selling agreements, will result in different rates of change-over to bulk assembly. The educational job, the financing arrangements, the reorganization of established routes and the loss of capital investments are obstacles which must be overcome before the transition can be completed. Technological change proceeds at varying speeds.

It is the purpose of this Bulletin to describe and discuss various phases of the transition to bulk handling in three New England States — New Hampshire, Maine and Vermont. Information will be provided on the reaction of producers, dealers, and truckers to the change-over both in prospect and in operation. These may provide guides to community farm leaders and agricultural extension personnel in the development of educational programs.

Special emphasis will be given to the potential savings to the industry in transportation and assembly costs. It is in this area that many of the economic advantages lie. Therefore a discussion of costs, rates, and neces-

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sary adjustments is proper. From this analysis it is possible to estimate reductions in hauling costs.

Some further discussion of the problems of transition will point out the joint responsibilities of all members of the industry and of the farm communities where change may affect taxes or employment. It is a challenge to look ahead, to visualize the future problems and to plan for a smooth transition in keeping with a healthy and dynamic dairy industry.

The New England area chosen for study is not unique. In the United States there are many similar milksheds of small farms and broken terrain where the adoption of tank assembly is in process or can be expected in the near future. It is hoped that this study will provide some framework and guide for the economic solutions of problems arising from the transition.

II. The Setting

1. The Boston Milk Shed

Milk produced in northern New England is shipped to the major markets of Massachusetts and New York or sold on local markets in the producing states. The Greater Boston Marketing Area is the major outlet. The milk receipts in this marketing area for 1955 show Vermont the leading supplier, followed by Maine.

Table 1. Receipts of Milk from Producers in the Greater Boston Marketing Area — 1955

State	Milk in Thousands of lbs.	Percent of Total
Maine	229,121	14
Massachusetts	48,984	3
Vermont	1,189,320	71
Other States[1]	203,599	12
Total	1,671,024	100

[1] The greater part of the receipts from "Other States" was from New Hampshire. A lesser amount was from a small area in New York State. It is not permissible to show these separately, as that would result in disclosure of the approximate receipts from certain individual plants.

The prices paid on this market influence the prices paid on secondary markets. However, State Market Administrators in the three northern New England states set prices high enough to give to producers shipping to local markets a greater return per hundredweight, over and above transportation charges, than that received by the same producers when shipping to Greater Boston. This allows local dealers the opportunity to maintain an adequate supply of milk for local use.

Table 2. Number and Type of Plants in Vermont, Maine, and New Hampshire, by Size, Purchasing Milk for Resale — 1955

Retail Bottling Plants Qts. per Day	State			Total
	Vermont[2]	Maine	New Hampshire	
249 and under[1]	50	58	61	169
250 to 499	27	30	47	104
500 to 999	24	57	40	121
1000 to 3999	24	44	33	101
4000 and over	8	11	6	25
Country Receiving Plants	71	12	7	90

[1] For Vermont — 10-249 quarts per day. For New Hampshire — 100-249 quarts per day.

[2] 8 manufacturing plants included here.

A Federal milk marketing order defines the Greater Boston Marketing Area, and it zones out from Boston the minimum price payable to farmers who sell milk in that market. As the distance from Boston increases, the price at the farm decreases. The decrease is accounted for by increased transportation and by handling charges to move the milk from plants.

In 1955, 55 percent of the milk receipts in the Greater Boston Marketing Area was sold as fluid or Class I milk. The remaining 45 percent was utilized in Class II or non-fluid outlets.

The three states, Maine, New Hampshire, and Vermont have certain unique characteristics. Total milk production is greater in Vermont than in either of the others. (See Figure 1.) A comparison of the dairy herd sizes by States shows that within each State the largest proportion of herds in 1954 was in the 10-29 cow group.

Table 3. Percentage Distribution of Dairy Herds by Number of Cows per Herd — 1954[1]

	Less than 10	10-29	30-49	50 or more	All Herds
Maine	23	65	10	2	100
New Hampshire	22	59	15	4	100
Vermont	11	58	24	7	100

[1] U. S. Census of Agriculture, 1954, vol. II, ch. VI, Table 26, page 493.

The herd sizes were larger in Vermont, which had about one-third of its herds with 30 cows or more, while Maine had only 12 percent of its dairy herds in that size group. Average milk production per herd was as follows:

Table 4. Average Annual Milk Production per Herd by Herd Size in Thousand lbs. — 1954[1]

	Less than 10	10-29	30-49	50 or more	All Herds
Maine	33	98	241	386	99
New Hampshire	32	104	244	462	115
Vermont	35	105	215	430	145

[1] U. S. Census of Agriculture, 1954, Economic Area Table 10.

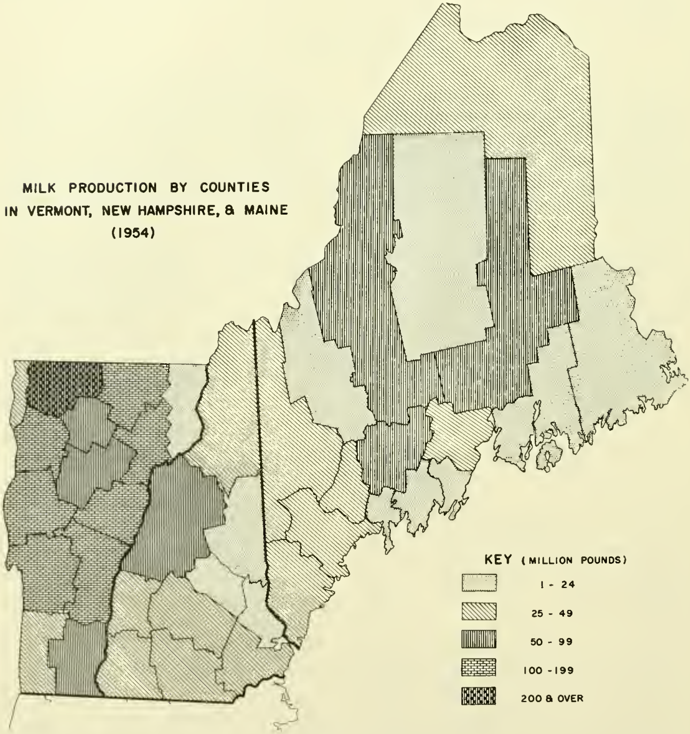


Figure 1.

Milk is purchased from farmers by dealers for bottling and sale in local markets, for manufacturing or for shipment to more distant markets.

The size of dealers varies with sales ranging from a few quarts up to 54,000 quarts per day. The number of small dealers changes from year to year.

2. Retail Bottling Plants In Secondary Markets

Dealers who purchase milk for processing and sale at retail are in general located close to consuming centers. A high proportion of their milk is sold as fluid and the rest as cream, cottage cheese and skim. In some cases the skim is dumped or fed to livestock. As noted above, local bottling plants pay producers a premium for milk sold locally. At the time of this study, the size of the premium varied from $.25 to $1.00 per 100 lbs. over the price paid for milk shipped to the Boston Milk Shed pool market. This premium provides a preferred market, and some selection and choice of producers to meet their supply requirements is possible for local dealers. The distance from farms to dealers will vary with the terrain and the density of production. In Vermont, for example, producers are more densely distributed than in Maine. A town or city like Windsor, Vermont may reach out for milk on all sides. Transportation is thus minimized. In Maine, however, where a market like Portland is on the coast, the milk supplies come some distance from producing areas north and west of the city. Therefore, the average miles which milk travels will be greater. It is to the advantage of producers to ship to the nearest dealer paying the highest price.

3. Manufacturing Plants

During certain seasons, milk in excess of fluid requirements provides the material for manufacturing plants. Some cooperatives own plants to manufacture cheese or process dried milk in order to provide a market for their members. Large companies may operate cheese plants in producing areas to minimize transportation costs. Similarly, large companies may utilize the manufacturing outlets to complement their marketing policies and diversion programs. They play an important part in reducing the impact of seasonal production on the fluid milk markets of New England.

4. Country Receiving Plants

The metropolitan areas of Massachusetts rely on northern New England — a net surplus area — for their milk supplies. The major processors and bottling plants for milk sold in these cities are located nearby, where retail delivery costs can be minimized. Milk produced in Massachusetts is generally sold in local markets. Milk for the Greater Boston Marketing Area is assembled from farms in Vermont, Maine and New Hampshire, a considerable distance from the bottling plants. To take advantage of reduced costs possible from large lot shipments, the milk is hauled from farms to country receiving stations where it is held for reshipment. The milk is then loaded into over-the-road tank trucks or rail tank cars and shipped to the metropolitan areas for processing and bottling. A company which owns several manufacturing or bottling plants has a greater possibility of adjusting supplies to each plant than has a single plant which relies on producers shipping from one locality.

Collection of milk at country receiving stations before shipping to plants means that the cost of maintenance of the stations is an addition to the assembly and transportation cost. The cost has been justified in the past as the most economical way to assemble and ship milk. With the advent of tank truck assembly of milk, however, the maintenance of receiving stations must be subject to economic re-evaluation. The cost of maintaining receiving stations varies with the extent of use. Many months of the year the plant may be only partially used. As an alternative, milk may be assembled by tank from farms then transferred to a mobile receiving station such as a tank truck or a rail car. Much of the handling costs can thus be eliminated or reduced.

5. Long and Short Hauls

The transportation of milk from farms to processing plants can be classified by length of haul. Milk moving to Boston and vicinity from Vermont, New Hampshire and Maine entails longer distances in general than milk shipped to secondary or local markets. An exception may be found in Maine, for example, where local dealers assemble milk from distances up to 95 miles.

Returns to producers shipping from northern New England to Massachusetts markets will be less than if they ship to local markets, provided that the same price for delivered milk is paid by dealers on these markets and the same form of transportation is used. In point of fact, the price paid to New Hampshire and Maine dairy farmers for milk to be used locally in fluid consumption is fixed by the respective State Milk Control Boards at a level equal to that paid at Boston. The northern New England producer's relative disadvantage in shipping to Boston — a disadvantage by comparison to nearer producers — would be reduced if the cost of transporting milk were reduced on long distance hauls relatively to short hauls.

Any means by which transportation charges can be reduced is equivalent to an increased price at the farm. This would have the most significance to farmers shipping long distances. As most of the milk from Vermont and a major part of the milk from New Hampshire is shipped to Massachusetts there could be an increase in farm income to these states from reduced transportation costs. To a lesser extent the farmers selling on local markets would benefit from lower charges per cwt.

III. Procedure of Study

Information incorporated in this study was obtained in 1955 and 1956 from producers, dealers, and truckers already operating with partial or complete bulk tank assembly and, for comparison, from producers, dealers, and truckers still using cans. The purpose of the interviews was to obtain operating experiences of those using tank truck assembly and the attitudes of those members of the industry who had not converted from cans towards the adoption of tank assembly.

The questions answered in this survey form the basis for this analysis. Every effort was made to draw a 20 percent random sample of dealers selling on local markets (Table 2), a 20 percent random sample of dairy farms shipping to the dealers sampled, and 100 percent coverage of truckers asembling milk from farms for the dealers sampled. A preliminary division was made between secondary market plants (Figure 2) and plants from which milk is hauled to more distant dealers, which in this case are on the Boston Federal Order Market (Figure 3). The plants were located on a map by size groups and by use of the serpentine technique a sample was obtained for each size group. The location of the secondary market sample is shown in Figure 4 and the location of the sample of plants shipping to the Boston Marketing Area is given in Figure 3.

By this method the dealer sample was representative by geographic location and by size. As the sample was taken, substitutes were drawn, to be used where needed, and thus to insure that it was representative.

All dealers with tank assembly in 1955 were interviewed. A sample of dairy farms and truckers from these tank operations was also studied by means of interviews. For producers, regardless of whether they used bulk or can assembly, all sampling was of dairy *farms* rather than of *farmers.* A man with two dairy farms was twice as likely to be interviewed in the study as was a one-farm operator. Hence the producer tables based on the interviews refer to the number

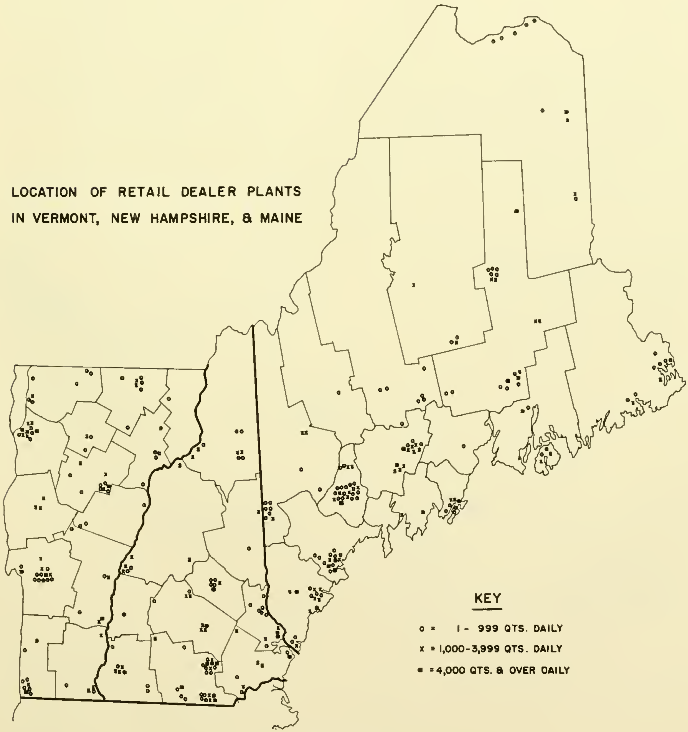


Figure 2.

of farms, not the number of producers. In all, information was obtained from 120 plants (including 31 with bulk assembly), 332 truckers, and 1,650 dairy farms.

The majority of dairy farms in Maine, New Hampshire, and Vermont were still shipping their milk in cans and the following discussion illustrates certain of their characteristics, plans and attitudes towards the adoption of bulk tanks. This is followed by a discussion of producers who have already converted to tanks, their experiences, and their production plans.

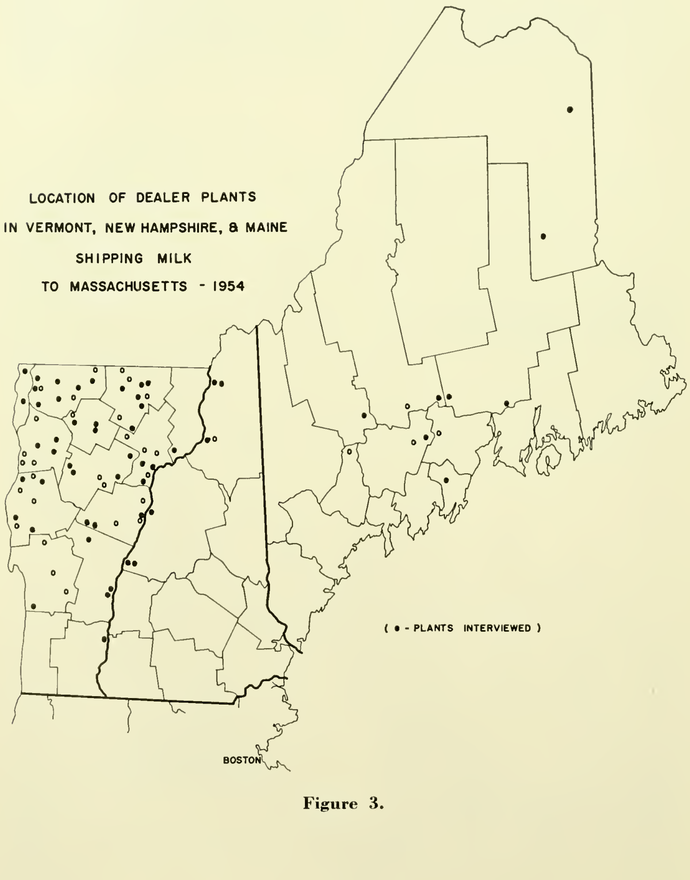
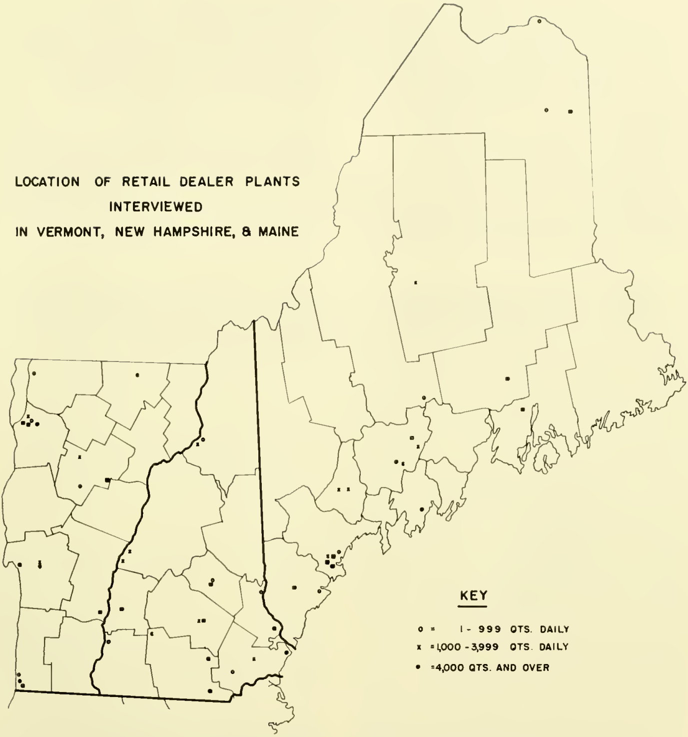


Figure 3.



LOCATION OF RETAIL DEALER PLANTS
INTERVIEWED
IN VERMONT, NEW HAMPSHIRE, & MAINE
KEY
o = 1 - 999 QTS. DAILY
x =1,000 - 3,999 QTS. DAILY
• =4,000 QTS. AND OVER

Figure 4.

IV. Plans and Attitudes of Producers Shipping Milk in Cans Towards Bulk Tank Assembly

1. Size of Dairy Farms

The majority of dairy farms in the milk shed using cans shipped 1000 lbs. or less per day in the peak production period. The sample taken showed 80 percent of producers interviewed shipped less than 1000 lbs. per day in the peak month. The distribution is as follows:

Table 5. Percentage Distribution of Farms Shipping Milk in Cans in Maine, New Hampshire, and Vermont by Maximum Production per Day Compared with Farms Shipping by Tank Truck

Average lbs. per Day in Peak Month	Can Shippers	Tank Shippers
	Percent	Percent
299 and under	17	4
300 - 399	12	4
400 - 499	13	11
500 - 599	9	12
600 - 799	17	12
800 - 999	12	29
1000 - 1199	8	1
1200 and over	12	27
	100	100

On the assumption that cows average 25 lbs. per day during the peak, then for can shippers approximately 80 percent of the herds had fewer than 40 cows and 42 percent of the herds had fewer than 20 cows. For tank shippers, 72 percent of the herds were under 40 cows and 19 percent were fewer than 20 cows. This emphasizes that the study was concerned primarily with herds of 40 cows and less.

2. Production Plans

The production plans of producers varied with individual circumstances. In 1956, 39 percent of all producers using cans had plans for immediate herd expansion. Of those the immediate plans were mostly in terms of 5 to 9 cows for the herds of up to 30 cows.

Table 6. Percentage Distribution of Planned Herd Increases for Farms Shipping Milk in Cans, by Size of Increase

No. of Cows to be Added	Percentage Distribution of Herds to be Increased
1 - 4	54
5 - 9	34
10 - 14	7
15 - 19	5
1 - 19	100

Table 7. Farms Shipping Milk in Cans, by Size of Herd: Percentage Planning a Herd Increase

No. of Cows per Herd	Planning Increase	Percentage of Farms Not Planning Increase	Total
1 - 19	33	67	100
20 - 29	46	54	100
30 - 39	54	46	100
40 - 49	49	51	100
50 - 74	47	53	100
75 and over	36	64	100

3. Reasons for Plans

The reasons for planned increases are varied. A few were planning an expansion with the prospect of using a farm bulk milk tank.

Table 8. Farms Shipping Milk in Cans: Farmers' Reasons for Planned Increase in Herd Size

	Percent
To use existing building capacity	22
Added help available	5
Herd improvement plans	27
Improved pasture program	1
To increase income	34
In preparation for bulk tank	11
	100

The 61 percent who planned no increase in herd size gave reasons varying from old age to problems of capacity of farm or buildings.

Table 9. Farms Shipping Milk in Cans: Farmers' Reasons for Having No Planned Increases in Herd Size

	Percent
Farm acreage too small	26
Existing tie up capacity used in full	34
Additional help limited	17
Age and health	11
Off-farm work	8
Dissatisfied with income prospects	4
	100

4. Relationship of Producers With Cans to Truckers

There is a joint responsibility between dealers and producers to use the most dependable form of shipment. The charge for hauling milk from a farm to a dealer is generally deducted as a cost from the farmer's milk price. Milk is hauled by the farmer himself, or is picked up by other farmers or by independent specialized truckers. There are in general no formal contracts for hauling milk. In Vermont 19 percent of the producers using cans were self haulers, with 13 percent in Maine and 22 percent in New Hampshire. For every 100 producers in the three states — Maine, New Hampshire and Vermont, 18 were self-haulers. The roads are passable all year round for trucks hauling cans.

The co-ops tended to have a smaller proportion of their producers as self-haulers than did the independent dealers. This was due largely to the situation in Vermont, where 24 per cent of the producers shipping to independent dealers were self-haulers compared with 17 percent of those shipping to cooperatives. The proportions were 14 and 10 percent in Maine and 26 and 14 percent in New Hampshire.

5. Bulk Milk Tanks in Place Of Can Coolers

In its own day, the refrigerated can cooler was a marked improvement in container equipment on the farm over the spring water and ice cooling methods formerly used. Lower bacteria count and a better tasting product were the result, along with larger and more attractive milk-rooms. The compressor was continually improved and finally the sulphur dioxide gas was replaced by the more efficient freon gas.

The farm bulk milk tank relieves the producer from back-straining manipulation of 40-quart cans and produces a more perfect control of milk temperature and bacteria counts. The *ice bank machines* follow along the more familiar pattern of the refrigeration units with a water and ice jacket. They operate with lower motor capacities and build up a reserve bank of refrigeration at off-load times and over a longer period of time. The *direct-expansion type* usually operates only for the milking period each morning and afternoon, but with a motor of larger capacity than the ice bank cooler. Considerations of compactness of the unit in relation to milk house size, size of motors to the availability of power without extra rate assessments, and the quality of the repair service are important factors in making a choice between the two types.

With the tank collection of milk, the driver samples and weighs the milk, passes on its appearance and odor quality, and accepts delivery at the farm. The producer has the responsibility and the advantage of having complete control of the product up to the point of sale. All the milk is rapidly cooled and held at about 38° until it is pumped into the insulated (but not refrigerated) tank truck for transfer to the depot holding tanks or to the carrier for final disposition.

Aside from its part in the mechanization of the dairy farm, modern tank assembly of milk reduces back-labor for producer, trucker, and receiver. It improves the taste of the product as testified by producers. It is the requisite of modern, quick, and efficient transfer of milk from producer to processor.

6. Towards the Adoption Of Bulk Tank

The introduction of bulk milk handling in an area meets mixed reaction from producers. A dealer may be successful in forcing producers to convert to tank by taking the initiative and announcing a change-over on some particular date. The result of this approach has frequently been the loss of some producers to other proprietary dealers or to cooperatives or by their ceasing production. On the other hand, many dealers discuss the proposed investment with their producers and by these discussions exert minor pressure on producers to plan an investment.

Similarly, dealers may be under pressure to adopt bulk handling from those producers who visualize advantages to their own farm operations. The same producers influence their neighbors, and the adoption of tanks will no doubt be speeded up as local farm leaders make the investment. The opinions of farmers towards buying a bulk milk tank are conservative. Among producers using cans only 41 percent indicated they would install bulk milk tanks. The largest proportion in all three states believed the initial expense would be too great to be borne by their present milk sales. A somewhat smaller yet substantial number preferred to delay any decisions and to wait and see the turn of events before making a change. The need for a bigger premium from dealers was expressed in a few cases. In Vermont a few producers were located so close to their local dealers that they had no plans for a change from cans. This was generally confirmed by the dealers themselves.

When posed the question as to what they would do if the dealer changed to bulk handling and required that farmers invest in a farm tank, the reactions were as follows:

Table 10. Proposed Action on Farms Using Cans if the Dealer Should Convert to Tank

Action	Maine	New Hampshire	Vermont	3 State Total
	Percent	Percent	Percent	Percent
Change to dealer with cans	38	57	40	45
Install Tank	43	29	47	41
Go out of business	19	14	13	14
	100	100	100	100

The action of changing to another dealer would be dependent on a producer's ability to find another dealer willing to buy his milk in cans. Some cooperatives have been willing to take on these producers in the past. This can only be regarded as a temporary expedient, however. The handling problems and costs associated with receiving cans may force cooperatives themselves to change. Further pressure on farmers to make a decision with this outlet closed to them would result in their making the investment or going out of business. If the proportion of those proposing to change dealers were divided equally between those making the investment and those going out of business, one could estimate (on the basis of the opinions recorded) that approximately a third of the dairy farmers would go out of business if tank assembly was their only alternative. This should not be interpreted to mean, however, the required tank investment would be the sole cause for their going out of business or that it would mean a loss of one-third of the milk supply.

7. Cost of Change-over

To the cost of the farm tank[1] must be added the cost of needed changes on the farm. An enlarged or remodeled milk house, adequate ventilation for air cooled compressors, the provisions of hot water for cleaning, concrete or tile floors and insulated ceilings and improvement in farm driveways are examples of additional costs. These will vary among producers.

The producers' estimates of the additional dollar cost required for change-over is shown in Table 11. These were advance estimates by farmers who were still using can assembly.

Table 11. Percentage Distribution of Farms Using Cans by Farmers' Estimated Cost of Change-over Exclusive of Farm Tank Cost

Cost Dollars	Percent			
	Maine	New Hampshire	Vermont	3 State Total
0 - 349	34	28	26	27
350 - 749	29	37	38	37
750 and over	37	35	36	36
	100	100	100	100

[1] See Appendix I, Table 39.

A decision on investment in a tank is frequently forced by the need to replace a can cooler. Some estimate of this potential decision among can users is indicated by the age of the can coolers in use at the time of the study.

The relatively high proportion of coolers which were over 6 years of age indicated that many replacement decisions would be made within the next few years. The replacement by a bulk tank as a result of these decisions would depend on the factors discussed above which influence producer behavior.

Table 12. The Proportion of Can Coolers which Had Been in Use 6 Years or More, by Size

Size of Cooler	Percent
2 can	64
4 can	62
6 can	49
8 can	36
10 can	58
12 can	64

V. Experiences and Plans of Producers Who Had Changed to Bulk Milk Tanks

The majority of tanks in the three states under study had been installed 6 to 36 months. Therefore the full consequences of their operation had perhaps not been experienced.

With the exception of a few days, the farm lanes and secondary roads were passable all year round. There are certain maximum gross weight restrictions in connection with the tank truck transportation of milk.[1]

1. Motive for Changing To Bulk Tank

An analysis of the reasons for producers' shifting from cans to a farm tank shows there were several important influences, apart from the fact that usually the dealer, on converting to bulk assembly, fixed a deadline after which he would receive no more milk in cans. The

[1] See Table 41, in Appendix I.

price differential offered to producers on local markets in Maine, New Hampshire, and Vermont placed the dealer in a favorable position for switching to tank, as producers preferred to retain the local price advantage. In Maine, 45 percent of the producers changing to a bulk tank were able to retain a local price advantage which they would have lost by continuing to use cans and having to switch to Massachusetts outlets. In Vermont and New Hampshire, the percentages were 19 and 10. In Vermont, 15 percent of the producers who changed, and in Maine 5 per cent of them, were paid a premium by the dealer for bulk milk as compared to what they had been getting for milk in cans. Seventeen percent of the producers in Vermont making the change-over entered into group purchase plans in buying their farm tanks, thus holding down somewhat the cost of the equipment.

Lack of alternative markets undoubtedly encouraged compliance with a dealer's change-over deadline. There was an occasion, however, when a number of producers shipping to a plant organized their own route and sold to a dealer willing to accept milk in cans. In such a case the transition has been delayed until such time as producers have been convinced of the economic advantages of tanks. Such factors as equipment dealer services, enterprising salesmanship or the satisfaction of community leaders with their tanks will do much to influence local opinion while eliminating the resentment created by a milk dealer deadline.

2. Size of Tank

Choice of the right size of tank is important for minimizing costs to the producer.[1] This decision becomes more difficult if the seasonality of production is high. In general, producers have based their estimates for tank size on the peak production period with every-other-day delivery. This means a tank large enough to hold twice their maximum daily production. If there is a big range in production from low to high months, many farmers may have tanks with unused capacity for several months of the year. Some estimate of future requirements based on an expansion of herd size was apparently not common in the initial establishment of tank size.

3. Type of Tank

The two major types of farm tanks in use are direct expansion and ice bank. The choice of type has depended on individual preferences for the respective advantages and local electric power company requirements.[2]

Seventy-one percent of producers in Maine, had direct expansion tanks, 62 percent in New Hampshire and 69 percent in Vermont. Only 11 per cent of the interviewed farmers with tanks had subsequently found the size of the tank inadequate; but most of them had acquired their tanks rather recently.

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[1] See Tank Truck Assembly of Milk in New Hampshire. Agr. Exp. Sta. Bull. 410, March 1954.

[2] The direct expansion equipment is more conducive to peaks in electricity consumption than is the ice bank type. Hence at least one local power co-operative makes a demand charge for the use of a direct expansion farm tank — a flat monthly fee, based upon the rated horsepower of the motor, in addition to the monthly charge based on the amount of electricity used. This co-op assesses no demand charge for the use of the ice bank type of tank.

4. Cost of Alterations

Alterations to the milk house for the installation of the tank were frequently unnecessary or slight. Data on the additional costs to producers for the conversion show that, for the majority, the costs other than the price of the tank were less than $350.

Table 13. Percentage Distribution of Farms by Their Actual Cost of Change-over from Can to Tank Cooling, Exclusive of the Cost of the Farm Tank

Cost - Dollars	Percent			
	Maine	New Hampshire	Vermont	3 State Total
349 and under	71	54	60	63
350 - 749	25	28	21	23
750 and over	4	18	19	14
	100	100	100	100

5. Disposal of Cooler

There was little return from the sale of can coolers after their replacement by tanks. Some machinery dealers had given a trade-in allowance up to $75.00 for the old cooler while some producers kept them for water troughs or dismantled them for parts.

Table 14. Methods of Disposal of Can Coolers

	Percent
Kept on farm	20
Traded in on tank	60
Junked	7
Sold	13

6. Financing of Tank

The purchase of the tank may have been for cash or, as in most cases, financed by installment payments. Support for producers to borrow was provided by some dealers by co-signing notes at the bank. The sources of credit were varied and in general were spread over a period of five years. The sources of payment were as follows:

Table 15. Source of Payment or Credit for Farm Tank

Source	Percent
Production Credit Association	35
Farmers Home Administration	8
Milk Dealer	4
Bank	48
Cash	5
	100

For the majority of transactions based on selective credit, the interest rate was 6 percent per annum on the unpaid balance.

7. Change in Herd Size

Any change in herd size which occurred since the adoption of a farm tank may or may not be attributable to the tank. Between 1950 and 1954, the number of farms in Maine, New Hampshire, and Vermont reporting fewer than 10 cows declined from 25,600 to about 19,000, while the number of farms reporting at least 30 cows rose from below 3,000 to above 4.000 (Table 16). These figures apply to all farms reporting milk cows, regardless of whether the farms used bulk assembly in either year.[1]

Table 16. Farms in Maine, New Hampshire, and Vermont Reporting Milk Cows, by Herd Size Group, 1950 and 1954*

Herd Size	No. of Farms		Percentage Distribution of Farms	
	1950	1954	1950	1954
Under 10	25,602	19,030	63	55
10 - 29	12,079	11,099	30	32
30 - 49	2,298	3,230	6	9
50 and over	603	986	1	3
All	40,582	34,345	100	100

*Source: U. S. Census of Agriculture, 1954, vol. II, ch. VI, Table 21, pages 476-477.

The proportion of each herd-size group which had added cows since the installation of a tank reveals the extent to which increases were taking place. Among the farms studied, 31 percent of those purchasing tanks increased their herds after the shift to bulk assembly (Table 17).

Table 17. Percentage of Farms with Tanks Increasing Herd Size Since Purchase of Tank, by Herd Size Group

Herd Size after Increase	Percentage of Farms		
	Increasing	Not Increasing	Total
1 - 19	14	86	100
20 - 39	32	68	100
40 - 59	37	63	100
60 and over	60	40	100
All herds	31	69	100

The herd increases were more frequent in the larger herds. The number added to herds indicates that the majority of increases were less than 5 cows, which presumably were added without major alterations to existing facilities.

[1] Moreover, it was necessary to use the data regarding "all farms reporting milk cows" rather than figures on "all dairy farms," as comparable data for the two years were not available on the latter basis.

Table 18. Percentage of Farms with Tanks Increasing Herd Size, by Number of Cows Added Since Tank was Purchased

No. Cows Added	Percentage of Farms Reporting Increase
1 - 4	61
5 - 9	26
10 - 14	9
15 - 19	4
1 - 19	100

Table 19. Percentage of Farms with Tanks Planning a Herd Increase, by Herd Size

No. of Cows per Herd	Percentage of Farms Planning Increase	Not Planning Increase	Total
1 - 19	42	58	100
20 - 39	56	44	100
40 59	49	51	100
60 - and over	29	71	100
All herds	48	52	100

8. Production Plans

About 50 percent of the owners of tanks had plans for herd size increases in the future. The plans were most frequent among the 20-49 cow herd owners, but were present in other groups also.

In comparison with the can users the planned herd increases were more frequent among tank users for the same herd size groups. (See Table 7.) The extent of the increases is indicated by the number of cows that were planned to be added in the near future.

In comparison with can users, where the largest proportion planned increases of up to 4 cows, the most frequent increase planned by tank users was 5 to 9 cows per herd. (See Tables 6 and 20.)

Table 20. Percentage Distribution of Planned Herd Increases on Farms with Tanks, by Size of Increase

No. of Cows to be Added	Percentage of Herds
1 - 4	38
5 - 9	48
10 - 14	6
15 - 19	8
1 - 19	100

VI. Seasonality of Production in Relation to the Assembly of Milk

1. Unused Capacity is a Cost

Variation in production means variation in the utilization of equipment. The farm tank capacity may be fully used at certain times and partially used at others. Tanks which hold the peak month production will have unused space in the lowest production month. Similarly, tank trucks purchased for the assembly of milk to dealers will be hauling partial loads during certain months, if the number of producers remains the same. Unused capacity of tank trucks means a higher cost per cwt. for milk transported than if the tank were full and will increase average costs per cwt. for the year's supply of milk handled. A trucker hauling from producers with equal monthly production could keep his tank more fully utilized with a resulting lower unit cost per cwt. of milk than can a trucker who has a varied load size.

The receipts in the Greater Boston Marketing Area by month discloses the seasonality pattern. Seasonal patterns for milk receipts on local markets indicate less monthly variation.[1]

Table 21.
Seasonality of Milk Receipts in the Greater Boston Marketing Area for 1955

Month	Percentage of Annual Receipts[1]
January	6.8
February	7.0
March	8.1
April	9.0
May	10.7
June	11.0
July	8.6
August	7.8
September	8.4
October	7.9
November	7.2
December	7.5
	100.0

[1] Adjusted for difference in number of days per month.

2. A Measure of Seasonality

A measurement of production seasonality which will be used here is the *seasonality ratio*. This ratio is the relationship of the producer's monthly production during his lowest production month to the production of his highest month. A hundred per cent ratio therefore would indicate no seasonality. A ratio of 30 would indicate that production in the lowest month was only 30 percent of production in the highest month, which is a highly seasonal production pattern.

3. Seasonality of Producers Using Cans

For those producers delivering in cans there were 17 percent with seasonality ratios of 80 to 100. There were 48 percent with ratios of 50 to 70 and 35 percent with ratios below 50. This last group showed the greatest seasonality and the greatest potential handling and transportation cost. There is greater likelihood of

[1] Unpublished study on local market receipts by Homer Metzger, Department of Agricultural Economics, University of Maine.

Table 22. Percentage Distribution of Farms Shipping Milk in Cans, by Production Size Group and by Seasonality of Production in Vermont, New Hampshire, and Maine, 1955-1956

Size Group, Lbs. per Day	Seasonality Ratio			
	80 - 100	50 - 79	0 - 49	Total
	Percent	Percent	Percent	Percent
499 and under	18	42	40	100
500 - 999	16	52	32	100
1000 and over	19	52	29	100
All groups	17	48	35	100

high seasonality among the smaller producers than among the larger. This is apparent in the breakdown by farmer size group (Table 22).

Eighty-three percent of the producers who were using cans would require tank sizes which would have a substantial degree of unused capacity most of the year. Similarly, truckers assembling milk from producers would be faced with the same problem of carrying unused capacity. Transportation firms large enough to plan alternative routes and uses for their tanks would not have the same cost problem as those truckers with limited alternatives to their everyday milk assembly routes.

4. Seasonality of Producers Using Tanks

In comparison with the producers using cans, a higher percentage of producers with tanks had less seasonality of production. Twenty-five per cent had ratios of 80 and over, 58 per cent between 50 and 79, and only 17 percent less than 49. This comparatively lower seasonality of tank users might have been due to the selective process of tanks being purchased first by uniform producers, and it might have been due in part to the effect of the tank on the production practices of the producer. A comparison of seasonality and size is given in the following table.

Table 23. Percentage Distribution of Farms with Bulk Milk Tanks by Production Size Group and by Seasonality of Production, in Vermont, New Hampshire, and Maine, 1955-56

Size Group, Lbs. per Day	Seasonality Ratio			
	80 - 100	50 - 79	0 - 49	Total
	Percent	Percent	Percent	Percent
499 and under	31	49	20	100
500 - 999	23	60	17	100
1000 and over	24	61	15	100
All groups	25	58	17	100

5. Farm Tank Use and Size of Producers

There was a larger proportion of small producers with cans than of small producers with tanks. A distribution of producers by size groups shows that 43 percent of the can producers were shipping less than 500 lbs. per day compared with 16 per cent of producers on tanks. The adoption of tanks was perhaps related to the greater financial ability of the larger producers where this came from lower costs of production and superior credit standing.

Table 24. Percentage Distribution of Farms Shipping Milk in Cans and in Tanks, by Production Size Group, for Vermont, Maine and New Hampshire

Size of Group Lbs. per Day	Can Users	Tank Users
	Percent	Percent
499 and under	43	16
500 - 999	46	52
1000 and over	11	32
All groups	100	100

There is some indication that the purchase of tanks was proportionately heavier among the larger producers than those shipping less than 1000 lbs. per day.

6. Dealer Operating Problems Arising from Seasonal Production

The conversion to 100 percent tank assembly by a proprietary milk dealer who does not want to lose producers or by a producer cooperative may be made more difficult because of seasonal production. The financing of farm tanks becomes more difficult when income is uneven. Seasonality of production presents the dealer with disposal problems during the excess months and it may result in procurement problems during other months. These operations add to his total cost and will result in lower returns per unit of milk handled.

The highly seasonal producers are more predominantly in the smaller size classes, which in general have lower income. To this extent the plant will be hampered in its conversion to a basis of 100 percent tank assembly. Refusal to accept supplies of milk because of the increased transportation and plant costs associated with high seasonal production will solve the problem for the dealer provided other sources of milk are available.

VII. Cooperatives and Bulk Assembly of Milk

1. Proprietary Dealer's Decisions to Change

So far as concerns the milk handled in Northern New England by proprietary dealers, decisions to change to the receiving of milk at the plant in bulk have, of course. been made by the dealers and not by milk producers. The decision making has rested either with the owner or with a small group of directors and a manager. The techniques of announcing the decision to change are similar. Announcement of a deadline to producers that only milk from farm tanks will be purchased beginning at a certain date is one technique. This has met with various degrees of success. In some cases the producers organized opposition to the change over and in others the producers complied. Some modifications of deadlines have been necessary according to local conditions and producer reactions. Adjustment is, in general, proceeding. Some producers have shifted to dealers accepting cans; and, when no such alternative is available, they have either gone out of business or planned for a change-over.

Dealers who have shifted to bulk milk have presumably been interested in cost savings in the process of receiving milk, as well as in the quality of the product. A recent study of some fluid milk plants in Georgia shows a very substantial percentage of saving, on direct labor and equipment, in the receiving of milk in bulk as compared to receiving it in cans.[1]

2. The Decision for Farmer Cooperatives

In the case of farmer cooperatives, however, the decision making process is more complicated. Farmer members are represented on the board of directors. The plant manager operates under the orders of the directors. Therefore, a change-over plan must come from producers before action can be taken. The reaction of producers varies with size and with plans for growth. Cooperatives do not necessarily have smaller producers than do independent dealers. Similarly, cooperative members are not less likely to have plans for growth than other producers. The apparent time lag in the adoption of bulk assembly by farmer cooperatives will likely be overcome as the potential loss of the larger producers to milk handlers with tank assembly exceeds the cost of bulk-milk premium payments by the general membership and the cost of necessary facilities.

Some members of producer cooperatives were already torn between their loyalty to the cooperative and the apparent advantage of shipping to a dealer using a tank truck. The pressure on the directors can be expected to grow, forcing a change to be made. Indeed, this factor had already had some effect. This trend may be unpopular with those producers who shifted to cooperatives from private dealers because of the tank ultimatum. Their voices and their voting strength will influence different cooperatives in different de-

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[1] James C. Taylor and Ralph W. Brown, "Fluid Milk Plants in the Southeast — Methods, Equipment, and Layout," a Marketing Research Report of the U. S. Department of Agriculture, scheduled to be published in 1958.

grees. At the same time a cooperative may develop a policy which will facilitate the adoption of tank assembly by producers and overcome the major objections of financial strain. A mixed operation of cans and tank may be continued in the short run although maximum savings can be obtained only with one hundred per cent conversion.

3. A Purchase Policy for Cooperatives

Some cooperatives have entered into quantity purchase plans for farm tanks with manufacturers. These quantity purchases have allowed a price discount. The models purchased will be standard for all producers and may be either the model already in production by that company or a cooperative sponsored economy model of tank.

Cooperatives in an area could join together in an inter-cooperative purchase plan which would provide greater opportunity for quantity discounts. The cooperative might also purchase farm tanks and lease them to members unable to meet the initial cost. This introduces the problem of providing adequate service for producers. The cooperatives are generally in a more favorable position to borrow funds than individuals.

In addition, the cooperatives, at some future time, might own the tank trucks and return any savings or earnings to producers through their annual dividend payments.

4. Operating Problems for Cooperatives and Non-Cooperatives are Similar

There is no important difference between the seasonality of production of cooperative members and of nonmembers, the size of producers, or the distance milk is assembled. Therefore, the operating problems facing both types of organizations are similar. Differences in dealer operating problems tend to be between states rather than between types of milk handlers.

Table 25. Percentage of Farms Supplying 1000 lbs. per Day and Under

	Farms Served by Cooperatives	Farms Served by Proprietary Dealers
Maine	88.4	92.2
New Hampshire	86.4	89.1
Vermont	91.0	96.1

Table 26. Percentage of Farms with Low-high Month Seasonality Ratio of 50 and over

	Farms Served by Cooperatives	Farms Served by Proprietary Dealers
Maine	57.3	64.7
New Hampshire	65.1	76.4
Vermont	62.4	61.4

Table 27. Average Distance of Farms from Dealers' Plants (miles)

	Farms Served by Cooperatives	Farms Served by Proprietary Dealers
Maine	16.6	23.9
New Hampshire	9.9	12.1
Vermont	11.7	6.9

VIII. Experiences and Plans of Milk Dealers in the Bulk Assembly of Milk

1. Number of Producers Per Dealer

Handlers or milk dealers may be independent operators or farmer-owned cooperatives. The number of producers per dealer of all types averaged 79 for Vermont, 65 for Maine, and 39 for New Hampshire. Cooperatives in Vermont averaged 145 producers per plant; in Maine, 238 producers; and in New Hampshire, 89 producers per plant. The cooperatives averaged more producers per plant than the independents, which averaged 51 producers in Vermont, 53 in Maine, and 32 in New Hampshire. The larger number of producers in cooperatives increases the task of converting to tanks by those organizations although this was not necessarily a limiting factor.

The adoption of tanks in an area will influence the sales behavior of producers. Some producers will stay with the dealer originating tank assembly, but others will search for a different dealer still accepting milk in cans. Similarly, dealers receiving milk solely in cans may lose producers to dealers buying milk in tanks. This occurs when producers are convinced of the advantages to them of tank over the present system. For example, 10 percent of the can assembly dealers lost an average of 10 producers to dealers with tanks. On the other hand, 20 percent gained an average of 10 producers each from other dealers who had switched to tanks.

2. Plans for Bulk Assembly

Conversion costs for most dealers would include new ramping, washing, and storage facilities. There were many dealers giving serious consideration to a change-over to bulk assembly. Others were resisting the change-over for reasons peculiar to their own operations. A third of the dealers were under some form of pressure to change and a fourth of those still using cans were planning or were in process of change. The pressure is created by competitors in the area or by producer requests. If a dealer should shift to tank assembly and pick up milk from farms adjacent to those selling in cans, the competitive position of producers is changed. The pressures on dealers reflect these influences.

Obstacles cited by dealers against shifting to bulk assembly were related both to cost and to the size of their producers. The following distribution of reasons for not shifting was given.

Table 28. Obstacles to the Adoption of Bulk Assembly of Milk, as Stated by Milk Dealers Using Cans

	Percent
Institutional	10
Financial	47
Producer Volume	32
Terrain	3
Wholesale Delivery on Assembly Routes	1
No Apparent Advantages	7
	100

The institutional obstacles were found in cooperatives, where members control decisions through their representation. A proprietary milk plant may be under the management of a central office where major decisions are made, although this was not found to be an obstacle.

Financial considerations refer to the investment in farm tanks and tank trucks, in the event that this would have to be carried by the existing volume of milk sales with no prospective change in milk prices or payments to truckers for hauling.

With regard to producer volume, many of the dealers had reservations about their producers' being big enough to justify additional investments in a farm tank. Hence this accent on the producers' small size was only another way of mentioning the financial obstacle to conversion.

Among the dealers who saw no apparent advantages in bulk assembly were some who asembled, processed, and distributed milk daily without use of a storage tank. In their plants, cans were weighed and then emptied directly into the pasteurizer.

As reported by dealers, opinions of producers using cans were 40 per cent in favor of tanks and 60 percent against. Can truckers were 30 per cent in favor of tanks and the majority against. This opposition represented the then prevailing personal opinions and no doubt reflected the psychic conflict created by the prospects of new purchases and new capital investment.

3. Experiences of Dealers Receiving Milk in Bulk

Of the 31 plants receiving milk from farms in tanks in 1955, only two were cooperatives. The average number of bulk-assembly producers per plant was 24 in Vermont, 61 in Maine, and 30 in New Hampshire. Many of the plants had combined tank and can operations; therefore the above numbers do not indicate the size of the plants. In Maine there were proportionately fewer combined operations than in Vermont and New Hampshire.

Farm bulk milk cooling tanks had been in operation an average of 16 months at the time of interview.

Table 29. Percentage Change in Dealers' Number of Producers Since Dealers' Adoption of Tank Truck Assembly

	Percent
Dealers with increase	23
Dealers with no change	35
Dealers with decrease	42
	100

In Table 29 the increases represent producers who changed dealers so as to convert to tank assembly. The decreases represent producers who shifted to dealers still accepting cans and farmers who closed down production because advanced age or ill health made any radical change too severe a challenge. The dealers who had no change in number of producers may have lost some and replaced them.

Premiums by dealers to producers who invested in farm tanks were offered in the form of reduced transportation rates, quality premiums for the milk, or advantages of selling on local markets at a higher price than on the Boston market. The size of premiums varied from 5 to 10 cents per cwt. and were offered by dealers to encourage the change-over so that plant economies could be introduced.

Of 46 tank trucks in operation, 14 were owned by the dealers, and their drivers were employees. This may be characteristic of the transition stage until loads and routes are developed to guarantee a pay load as incentive for truckers to enter the business on their own.

IX. Characteristics of Truckers Assembling Milk

1. Can Truckers

Eighty-five percent of for-hire trucks hauling milk in cans were owned by the drivers. Up to 95 per cent were owner-drivers in Vermont, 64 percent in Maine, and 79 percent in New Hampshire. The remainder of the trucks were owned by independent truckers who hired drivers and who contracted their services to dealers. The truck drivers might be hired farm help. In very few cases did milk dealers own their transportation facilities for can assembly from farms.

The assembly of milk in cans is generally by independent truckers who charge a specified amount per cwt. for carrying the milk from farm to plant. The dealers are dependent on the truckers' bringing in the milk each day irrespective of weather conditions. Despite this dependence, however, there are few formal contracts between can truckers and dealers.

Competition between small truckers with unspecialized trucks — almost any sort is adaptable to the purpose — insures the producer that rates are held down to a minimum. The dealer, as an agent of the producers, deducts the agreed haulage rate from the price of the milk and turns it over to the trucker at regular intervals. In addition to the agreed haulage rate, the dealer — by unwritten agreement — sometimes guarantees the trucker a specified weekly gross income and makes a suplementary payment to him whenever the trucker's gross income from the haulage rate falls short of the guaranteed minimum. Guarantees of this general type foster loyalty to the dealer and also improve the competitive position of truckers. Such help is important if competition is keen. Thirty-six percent of the can truckers mentioned that they were receiving some kind of supplementary payment by the dealer. Thirty percent of the dealers using cans disclosed that they were making supplementary payments to independent truckers during months of low volume. As for the *amount* of such payment, dealers and truckers said nothing very revealing. This suggests that any given dealer probably did not have a uniform scheme of supplementary payments to all of the truckers hauling milk to his plant.

Competition between can truckers is acute in many areas because truck ownership attracts resources. The independence which appears to be obtained from owning and driving a truck is one attraction. Another major attraction is that trucks suitable for can pick-up can also be used for other ventures. Further than this, the trucking may be only a part time venture with other income earned in other jobs. For this reason many of the announced trucking rates had not changed radically during the past years. Instead subsidies, special grants, low labor returns to owners plus supplementary occupations had probably relieved the trucking rates from their full cost burden.

Some indication of other sources of income was provided by the study. Over 60 percent of the truckers had other sources of income. The source of this income varied as follows:

Table 30. Source of Outside Income of Can Truckers

Source	Percent of Total Truckers
Milk Production	46
Custom Haulers[1]	18
Farm Help	8
Non-Farm Jobs	5
Trucks for other Dealers[2]	12
Employee in Milk Plant	11
	100

[1] Feed, grain, pulp, etc.

[2] Route income was increased by assembling cans for more than one dealer.

The competitive reactions had been borne more by the dealers and producers than by the truckers. Routes can be changed and pay adjustments made. There was apparently little turnover of truckers between dealers. In most cases, the years truckers had been hauling milk coincided closely with the years they had been with the same dealer.

2. Can Truck Characteristics

The most common truck size was the 2 ton followed by the 1½ ton and to a lesser extent by 3¾ ton sizes. The stake type of body was predominant in Vermont while the van type of body was most common in Maine. In New Hampshire truckers favored the stake type, although both kinds were in use.

Can haul trucks were commonly rated from ¾ ton pickups to 3 ton stake and van type vehicles.

The pick-up truck has an open, metal body to match the cab. The stake truck has an open, wooden body with sides of four-bar wooden removable units. The van type truck has a wooden body with steel slide strips. Sides, top, and doors are wood and steel; and it is completely insulated, but not refrigerated. Typical gross vehicle weights observed were as follows:

Capacity ¾	ton,	5,000 lbs. g.v.w.
Capacity 1½	ton,	15,000 lbs. g.v.w.
Capacity 2	ton,	17,000-19,500 lbs. g.v.w.
Capacity 2½	ton,	21,000 lbs. g.v.w.
Capacity 3	ton,	22,000 lbs. g.v.w.

In the stake type truck, cans may be arranged in rows on the floor with another tier on top covered with canvas. The van type truck has planks for the second tier with holding chains. Some van trucks have a center walk with floor bins and upper bins on either side. The upper bins are generally used for the return of empty cans.

The majority of trucks (80 per cent) were bought new. If bought second-hand, then the most common age at purchase was 2 years. The age distribution of trucks currently in operation is given below:

Table 31. Age of Trucks Hauling Milk in Cans: Percentage Distribution

Age in Years	Percent
under 1	4
1	13
2	24
3	18
4	16
5	14
6 and over	11
	100

3. Paying for Can Trucks

Less than half the truckers paid cash for their trucks, and a minority used finance companies and equipment dealers' purchase plans. The majority of them financed their purchases through the banks.

The milk haulage check was the only source of income to pay for the truck for 60 percent of the truckers. Twenty-seven percent paid over half of the truck costs (but less than total costs) from milk haulage returns. The remaining 13 percent paid less than half of their truck costs from milk trucking and were probably producer truckers who used their trucks for other work.

4. Opinions of Can Truckers On Conversion Problems

A third of the truckers expressed the opinion that the seasonality of production on their routes would be unfavorable for the use of a farm tank and tank-truck pickup. Another third of the truckers said farm lanes were unfavorable for tank trucks of 1500 to 2000 gallon capacity.

The majority of truckers believed that the volume on their present can routes was inadequate to pay for a tank truck. It is generally agreed that the introduction of tank trucks will require some reorganization of routes with perhaps the elimination of routes now followed. This risk is carried by the trucker and he recognizes this when considering the purchase of a tank truck. Many expressed their reluctance or inability to buy tank trucks without milk dealer backing. This could change the ownership pattern and the past dealer-trucker relationships, in which truckers received little or no assistance from dealers to buy a truck.

5. Tank Truckers

As with the can truckers there were no instances of written contacts between truckers and dealers. Some form of unwritten agreement guaranteeing a minimum gross income was mentioned in 42 percent of the cases of tank truckers interviewed. These arrangements were highly diverse, but very little information was available from dealers or truckers as to the exact amount of supplementary payment by the dealer. One independent tank trucker was guaranteed, by the dealer, a minimum gross income of $30 per day. Another, picking up bulk milk at farms in a northern New England state and hauling it to Massachusetts, had a special type of guarantee for the period of transition from can to bulk assembly. Each time when he had covered his pick-up route, he was to drive to a country receiving station of his dealer, fill out his load with can-assembled milk, and proceed to Massachusets. He thus was paid on the basis of a full load. Another dealer charged the producers 20c per cwt. for tank trucking of milk from farm to plant, but paid the trucker 25c — a 5c per cwt. supplement by the dealer.

Over 50 percent of the truckers relied entirely on the assembly of milk for their income while the others had supplementary sources. The supplementary income was earned from interplant hauls or by working in the dealer's plant.

Most of the trucks in use for assembly from the farm had a conventional 2 axle chassis with dual wheels on the rear axle When fully loaded, the trucks weighed from 17,000 lbs. (1000 gal. tank) to 30,000 lbs. (2000 gal tank). The size of tanks varied from 1000 gallons to 2000 gallons. Thirty percent of the tanks were 1800 gallons; 30 percent, 2000 gallons; 20 percent, 1560 gallons; and the remainder were distributed in the other size groups.

6. Financing Payments for Tank Trucks

Commercial banks provided selective credit for the purchase of tank trucks at a 6 percent interest rate on the unpaid balance. Approximately half of the owners intended to pay for the tank truck entirely from earnings on the milk routes. The other purchasers expected to contribute to payments from other sources of earned income until the routes were built up.[1]

[1] See Table 40, in Appendix I.

7. Rejection of Milk

In all cases the driver of the tank truck had the initial responsibility for rejecting milk. In a third of the cases studied this responsibility was shared with the dealer's fieldman. In cases where milk had been rejected by dealers the odor of milk was the predominant reason, followed by dirty tank and high bacteria count because of inadequate cooling. Few cases of rejection were found.

X. Comparison of Milk Transportation Rates Charged by Various Modes of Transport

1. Tank Truck Assembly Rates Lower than Can

Producers pay transportation charges from the farm to the processing plant. The farther a producer is located from a dealer the greater the cost of shipping his milk and the lower the net price received by the farmer. There are, of course, individual exceptions to this rule when the transportation charge is reduced by the dealer as a form of supplementary payment for milk.

The relationship of distance to rate per cwt.[1] for trucks carrying cans is illustrated in Figure 5 and Table 32. The rates for distances of about 6 miles in the three state area varied from 10 cents to 35 cents per cwt. The average rate for such a distance was about 18 cents per cwt. This increased with the distance, but not in proportion to distance, up to 50 cents per cwt. for 50 miles and over. (The average rate per cwt. is expressed in the regression equation

$Y = 14.6 + 0.64\ X.$
$Y =$ rate in cents per cwt.
$X =$ miles.)

The rate per cwt. for tank trucks was somewhat lower.[1] For the initial 6 miles, 16 cents per cwt. was average for the three state region. The increase in rates for longer hauls, however, was less rapid than for the can trucks and averaged 39 cents for 50 miles. The rate/mile relationship is given in Figure 5 (with a rate regression estimate of $Y = 15.6 + 0.44\ X$).

The rates shown in Table 32 show a distance of about 6 miles as the most common length of haul from farm to plant, in both can and bulk assembly. Nevertheless, the same table shows 20c per cwt. as the most common rate charged by can truckers, and 15c per cwt. as the most common charge by tank truckers.

[1] For both tank and can trucking, the rates in the comparison omit any supplementary payments to the trucker by the dealer.

Table 32. Three State[1] Local Can and Tank Pickup Rates, Showing Distances from Farms to Plants and Numbers of Farms at Each Distance

Can Haul

Charge per Cwt.	Approximate Mileage																	Total No. of Farms
	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	
$0.55										6		8				7	6	27
0.50									1				3	1	3	2	10	20
0.45								2		7	2	1	1	1	4	9	14	41
0.40					6	3	5	10	3	2	4	1	4	2	4	7		51
0.35	4	3	14	11	9	4	4	13		10	8	2	10					92
0.30	12	19	10	16	21	7	7	5	4	10	4		3					118
0.25	20	42	34	19	26	16	5	10	3	2	1							178
0.20	90	91	56	40	8	6	7	6	2	1	0							307
0.15	93	60	22	7	3	3	2	0	0	0	0							190
0.10	34	2	0	0	0	0	0	0	0	0	0							36
Total No. of Farms	253	217	136	93	73	39	30	46	13	38	19	12	21	4	11	25	30	1,060

Tank Haul

Charge per Cwt.	Approximate Mileage																	Total No. of Farms
	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	
$0.55																		
0.50																		
0.45																		
0.40				3					2	2						18		25
0.35		1	5	3	1	6	2	4	1	2	2	1		2				30
0.30	2	3	4	1	2	5	3			2								22
0.25	7	2	5	3	1	5	2	2	2		3			2		1		35
0.20	15	9	5	5	5	3	1				1							44
0.15	31	14	5	5	7	2	0	1										65
0.10	19	2	2	1	1	3	3	1										32
Total No. of Farms	74	31	26	21	17	24	11	8	5	6	6	1	0	4	0	19	0	253

[1] New Hampshire, Maine, Vermont.

2. Rail and Truck Rates to the Greater Boston Marketing Area

Although this study was focused on the movement of milk from farm to plant, transportation of milk to Boston plants from the region studied is sometimes in the can or tank trucks which pick up the milk at the farms, and sometimes involves transfer from those trucks to larger, over-the-road tank trucks (with a capacity such as 4,000 gallons) or to rail tank cars or rail cars hauling cans, for completion of a trip of, let us say, 150 to 200 miles to the Greater Boston Marketing Area. For

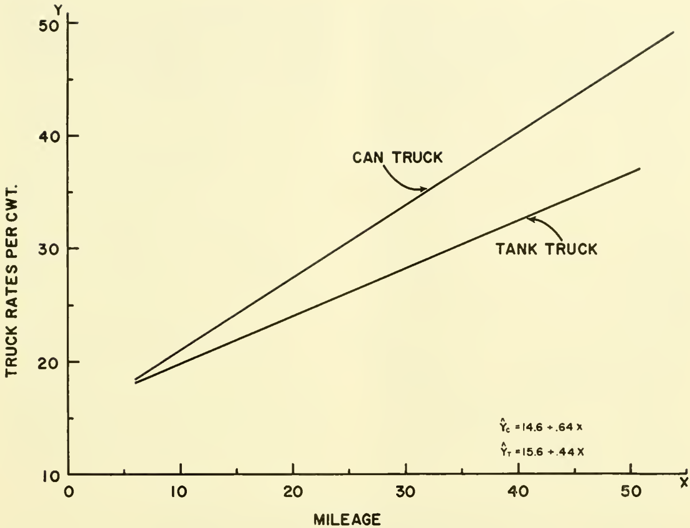

Figure 5. Average truck rates per cwt. for hauling milk in cans and in tank trucks by length of haul in Maine, New Hampshire, and Vermont, 1955-56.

this movement, when rail and truck transportation are both available, the familiar rail-versus-truck rate pattern appears: with increasing distance, the trucks' advantage gives way to a railroad advantage. The available data show that, for distances over 100 miles, the rail tank car rate for a minimum of 2,000 gallons was less than the tank truck rate with a 3,000-gallon minimum. In the rail movement of 40-quart cans, the rates for distances between 126 and 226 miles were about equal to the tank truck rates. Beyond this range, the rail rates on milk in cans were generally less than the tank truck rates. A comparison of the rates is given in Figure 6.

The rail rates shown were in effect on March 20, 1957. The tank truck rates were those of a large for-hire motor carrier.[1] In the interstate trucking of milk (as of other agricultural commodities), no governmental body controls the rates, and there is no governmental requirement that the rates be published. This particular motor carrier had issued a tariff as of March 1, 1953, and stated in 1956 that the tariff was still in use without change. At that time, the carrier ceased to make its rates

[1] New England Joint Tariff M No. 9, Milk and Cream, for railroads; rates effective March 20, 1957.

Local Motor Freight Tariff of the Dairy Transport Company (a motor carrier), Somerville, Mass.; rates effective March 1, 1953, and stated by carrier to be still in effect in 1956.

public, and there may or may not have been some change in its milk haulage rates by March 20, 1957, the date of the rail rates used here. Any small rate changes by the trucking firm would not have changed the general nature of the rate relationship shown in Figure 6.

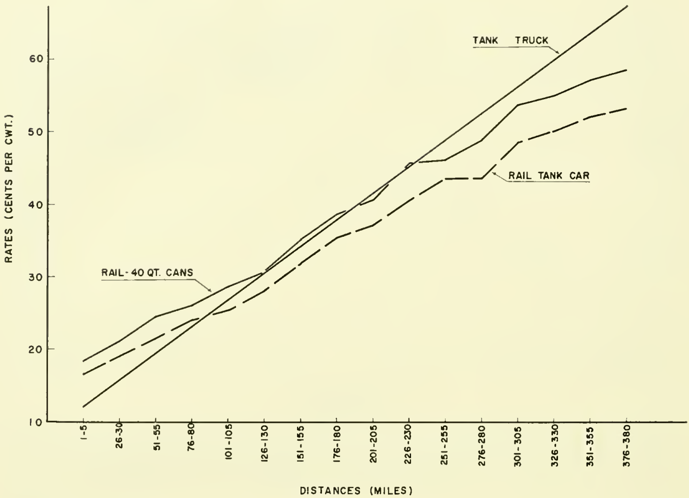

Figure 6. Typical rates per cwt. of milk for hauls up to 400 miles by tank truck and by rail in New England, 1956-57.

XI. Can Transportation Costs and Rates Be Reduced?

1. Costs and Profits on Can Assembly Routes

The adoption of tank truck assembly can be justified if the total transportation and handling costs on and off the farms can be reduced.

The variation between routes, between trucks, and between drivers results in variations in costs of operation. Rates will vary between districts or regions as competition for truck services varies. Low cost truck operators will net greater returns than higher cost operations if the same rate is charged by both. There may be instances when higher rates enable less efficient operators to equal the net returns of low cost operators.

From 14 can assembly routes, data were obtained on costs and revenue for one year. From this information, Table 33 has been constructed. The data are shown in more detail in Appendix I, Tables 42 and 43.

Table 33 shows an average daily load of 83.7 cwt., trucked from farm to plant at a cost of 26 cents per cwt. for a 122-mile average length of route, measured from the plant to the successive farms and back to the plant. On half the routes, the cost was below 28c per cwt.; on half, above that. This refers to the costs incurred by the trucker — not to the rates charged by him — and includes the trucker's own estimated amount for wages if he was an owner-driver. The revenue minus the cost shows an average profit of 8.9c per cwt. of milk carried and an average profit of $7.44 per route per day, apart from any supplementary payments by dealers to truckers. This "profit" includes the return on investment.

2. Costs and Profits on Tank Truck Assembly Routes

Variations in cost and revenue were also apparent for tank assembly routes. Cost data were obtained for 6 tank trucks covering 12 assembly routes. Each truck served 2 routes, covering each route every other day. From these data, Table 34 — as well as the more detailed Table 44, in Appendix I — has been constructed; Tables 33 and 34 provide a cost comparison of can trucks and tank trucks. The average daily load for tank trucks was 135.6 cwt., with 114 miles as the average length of route from the plant to the farms and back to the plant — the corresponding figures for the can routes in Table 33 being, as noted above, 83.7 cwt. and 122 miles. The average cost per cwt. on the tank truck routes was 21c. Subtraction of the cost from the revenue reveals an average profit of 5.8c per cwt., which is 3.1c less per cwt. than that shown by can assembly truckers. The average profit per

Table 33. Average Cost and Profit: Fourteen Trucks Assembling Milk in Cans[1]

Truck Number[2]	Average Daily Cwt.	Average Daily Cost	Cost Per Cwt.	Average Daily Revenue	Daily Miles Travelled	Average Daily Profit or Loss	Average Profit or Loss per Cwt.
1	80.0	$ 17.24	$0.22	$ 18.40	73	+$ 1.16	+$0.015
2	40.0	8.89	0.22	8.00	27	— 0.89	— 0.011[3]
3	75.0	23.97	0.32	30.00	150	+ 6.03	+ 0.080
4	85.5	17.23	0.20	19.66	65	+ 2.43	+ 0.028
5	84.0	19.27	0.23	25.20	117	+ 5.93	+ 0.071
6	84.0	17.64	0.21	25.50	110	+ 7.86	+ 0.094
7	104.0	19.22	0.18	41.52	90	+ 22.30	+ 0.214[4]
8	86.0	26.73	0.31	30.10	100	+ 3.37	+ 0.039
9	62.5	22.57	0.36	28.13	140	+ 5.56	+ 0.089
10	82.5	25.06	0.30	30.53	135	+ 5.47	+ 0.066
11	83.0	25.00	0.30	20.75	120	— 4.25	— 0.051
12	78.5	23.02	0.29	35.30	178	+ 12.28	+ 0.156
13	115.8	31.83	0.27	57.90	215	+ 26.07	+ 0.225[5]
14	70.8	30.23	0.43	41.10	186	+ 10.87	+ 0.154
Total	1171.6	$307.90	—	$412.09	—	$104.19	—
Average	83.7	$ 21.99	$0.26	$ 29.44	122	$ 7.44	+$0.089

[1] For cost details see Tables 42 and 43, in Appendix I. All figures in Tables 33, 42, and 43 omit any supplementary payments by dealers to truckers.

[2] Each truck served 1 route — covering it daily.

[3] Taken over by dealers and run at a loss awaiting adjustment.

[4] Larger than average load and shorter distance kept costs down. Owner had truck dealership and garage.

[5] Larger than average loads and fewer stops kept costs down, despite a long haul to depot.

tank truck per day was $7.87 — only 43c more than for the considerably less expensive vehicles which assembled milk in cans.

The difference between can and tank trucks, as to how much profit they yielded, is unavoidably affected to an unknown extent by the supplementary payments from dealers to truckers. The revenue figures in this study, and hence the profit figures, omit any supplementary payments by dealers to truckers. But the 5c difference in *milk assembly costs per cwt.*, as between can and tank trucks, is not affected by this unknown factor and can be the basis for a continued difference in the trucking rates charged for the 2 modes of assembly.

3. Continued Lower Rates for Tank Assembly

The lower rates per cwt. for milk assembled in bulk as compared to the rates on milk assembled in cans, noted above in Chapter X, would probably disappear on most routes as the supply of milk in farm tanks increases — if this rate advantage stemmed solely from the dealers' supplementary payments to truckers. Even if the greater number of arrangements for such payments to truckers proves to have been used only during the transition to bulk assembly, there will probably continue to be some arrangements of this sort, between dealers and tank truckers, when conversion in any given area is complete. Just as some dealers who receive milk in cans have given a gross-income guarantee to truckers in order to avoid one type of breakdown in milk supply — a breakdown for lack of transportation — so also it is likely that some dealers will be willing to give such guarantees to tank truckers even after the transition phase is passed.

However, at that time the rates charged by truckers are likely to be a function of their costs and of the competition for their services. The investment in a tank truck means investment in a more specialized piece of equipment than the truck used for can pick up. This may reduce the number of truckers in milk assembly, which could in turn reduce competition between them and improve route organization. Their ability to charge higher rates would be improved. Nevertheless, tank truck rates

Table 34. Average Cost and Profit: Six Tank Trucks Used in Milk Assembly[1]

Truck Number[2]	Average Daily Cwt.	Average Daily Cost	Cost Per Cwt.	Average Daily Revenue	Daily Miles Travelled	Average Daily Profit or Loss	Average Profit or Loss per Cwt.
1	205.0	$ 42.82	$0.21	$ 51.25	200	+$ 8.43	+$0.041
2	108.6	27.81	0.26	32.58	120	+ 4.77	+ 0.044
3	112.0	27.16	0.24	33.60	90	+ 6.44	+ 0.057
4	243.3	39.13	0.16	72.99	193	+ 33.86	+ 0.139
5	80.0	23.00	0.29	16.00	55	— 7.00	— 0.087
6	64.5	8.96	0.14	9.68	27	+ 0.72	+ 0.01
Total	813.4	$168.88	—	$216.10	685	+$47.22	—
Average	135.6	$ 28.15	0.21	$ 36.02	114	+$ 7.87	+$0.058

[1] For cost details see Appendix I, Table 44. All figures in Tables 34 and 44 omit any supplementary payments by dealers to truckers. The truckers owning vehicles 5 and 6 said they were receiving such payments.

[2] Each truck served 2 routes, covering each route every other day.

below can truck rates can be continued if costs were minimized by a reduced number of calls at individual farms and by improved types of tank trucks with higher pay loads, and if monopolistic action by truckers is not practiced. To eliminate reductions in transportation rates would be to eliminate one of the incentives for producers to invest in a farm bulk milk tank.

Because tank trucks had only recently been introduced into the New England farm assembly of milk, the problem of breakdowns and replacements had not yet generally been faced when this study was made. The provision of substitute trucks in case of breakdown will be an additional cost. The price of replacements by new types and models will eventually influence the rate structure.

4. Ways to Reduce Assembly Costs

To reduce assembly costs per cwt. necessitates the greatest possible use of capacity with as low a mileage as possible to be travelled. One such way is by every-other-day pick-up.

(a) Every-other-pay Pickup

The can truck calls at the farm each day to pick up milk. The cost of this service is paid by the producer at an agreed rate per cwt. of milk. Milk in cans immersed in a water cooler will not maintain its quality for any great length of time and most sanitation laws require that it be delivered and processed every day. When milk is stored in a bulk tank, however, the prompt reduction of the temperature enables the milk to be kept safely for several days. Therefore, it is not necessary for the dealer to pick up the milk every day. The length of time the milk can be kept in the farm tank depends on the size of the tank and the milk production of the farmer as well as the health regulations in the particular State.

For the tank trucker, there are some tasks performed on each trip to a given farm which take the same amount of time regardless of the volume of milk he picks up at that farm. Driving from the highway to the milk room and back; agitating the milk in the farm tank before taking a sample for butterfat testing at the plant; taking the sample; connecting the tank-truck hose to the farm tank and later disconnecting it; flushing out the emptied farm tank with water — these are sources of overhead costs in terms of the trucker's own time and in terms of an expensive vehicle which sits idle for that period of time. These tasks are performed twice as frequently under every-day pick-up as they are with pick-up every-other-day. The reduction in calls to each farm by a trucker reduces the trucker's total transportation cost per cwt. of milk. below what it would be in tank trucking on a daily pick-up basis. Any savings in costs brought about by every-other-day or 3-times-per-week pick-up can be passed on to the producer in the form of a reduced rate. This reduction in rates is at least partly contingent upon the trucker's increasing the total number of producers he calls on in order fully to utilize the tank truck. For a tank-trucker to use daily pick-up, as sometimes happens, is to miss an opportunity for a cost advantage inherent in bulk assembly.

It is likely that, with every-other-day pick-up, a greater number of producers can be served by one truck. This would spread the fixed costs of the truck.

(b) Reduced Mileage for Same Amount of Milk

The cost per cwt. of milk hauled can be reduced if the distance which the milk is hauled can be reduced.

This may require reorganization of routes or is possible when every-other-day pick-up is introduced. For example, two trucks hauling cans show a reduction in cost per cwt. of milk hauled from 30 cents to 20 cents when the mileage is reduced from 100 to 50 miles. The cost per cwt. for a truck of 19.000 pounds gross vehicle weight carrying 8.600 lbs. per trip is reduced from 28 cents to 19 cents as the mileage is reduced from 100 to 50 miles. (Table 35. Trucks 2a and 2b.)

(c) An Adequate Size of Farm Tank Necessary

It is apparent that if the production of milk on farms served by a given truck varies during the year, the load to be carried by the trucker will vary equally. During periods of a seasonal flush such as May and June, production is frequently considerably above that in November. A farmer who owns a farm tank big enough to handle production during flush periods for every-other-day or three times a week pick-up, poses no problem to the trucker. In cases where the farm tank cannot hold two or three days' milkings during flush production periods, then the trucker must call more frequently if he wants the farm's total production. Misjudgment of farm tank size or subsequent increases in the size of herd may create this condition. The transportation cost advantage possible from less frequent visits is lost. It should be emphasized that the opportunity for reduced transportation costs — and hence reduced rates — resulting from fewer trips can be lost by inadequate planning of production in relation to farm tank size and vice versa.

5. Comparison of Costs of Trucks with Can Truck Costs after Transition Period

In order to estimate the probable cost reductions from tank truck assembly, budgets or models were calculated for 5 tank trucks and 5 can assembly trucks. The data included in these budgets were adjusted to apply to uniform daily mileages of 50 and 100, and are based on the data obtained from actual operations in Northern New England, including the figures set out in Tables 42, 43, and 44, in Appendix I.

Table 35 shows the costs, miles travelled, and weight carried for 5 typical can truck routes.

The haulage cost per cwt. of milk varied from 19 cents to 30 cents. Each of the high-cost routes was marked by a smaller pay-load (less milk carried), or longer hours of work, or a longer distance traveled, or some combination of these factors.

Table 36 shows the costs for 5 typical tank-truck and load combinations.

The average cost per cwt. varied from 17 cents to 21 cents. Carrying a capacity load of milk, twice a day, gave Truck No. 3 the lowest cost per cwt.

A comparison of can with tank truck assembly costs is possible from the budget data. For 3 trucks of comparable size, Table 37 shows cost and load data extracted from Tables 35 and 36. For the same load but half the distance travelled, the tank truck (Example II) would cost 7 cents per cwt. less than the can truck (Example I). This is assumed to represent every-other-day pick-up by the tank truck instead of every day pick-up by the can truck. Fifty percent is the maximum mileage sav-

Table 35. Cost Budgets for One Year for Various Sizes of Can Trucks and Loads[1]

Truck No.	1 a	1 b	2 a	2 b	3 a
Gross vehicle weight (lbs.)[2]	14,500	14,500	19,000	19,000	25,000
Type of Body	Stake	Stake	Stake	Stake	Van
Fixed expenses (dollars)					
Depreciation					
Chassis (term, 3 yrs.)	700.00	700.00	800.00	800.00	1,100.00
Body (term, 8 yrs.)	32.00	32.00	56.00	56.00	138.00
Body upkeep	38.00	38.00	63.00	63.00	100.00
Taxes — excise	49.00	49.00	58.00	58.00	90.00
Federal use					45.00
Insurance	267.00	155.00	275.00	160.00	314.00
Registration	90.00	90.00	114.00	114.00	150.00
Total	1,176.00	1,064.00	1,366.00	1,251.00	1,937.00
Variable expenses, except wages (dollars)					
Gasoline	1,136.00	568.00	1,362.00	681.00	1,703.00
Oil	58.00	29.00	58.00	29.00	59.00
Tires and tubes	480.00	240.00	750.00	375.00	900.00
Repairs	233.00	156.00	567.00	378.00	867.00
Federal transportation tax (3%)	228.00	228.00	283.00	283.00	424.00
Total	2,135.00	1,221.00	3,020.00	1,746.00	3,953.00
Total fixed and variable expenses, except wages (dollars)	3,311.00	2,285.00	4,386.00	2,997.00	5,890.00
Wages					
Hourly wage rate (dollars)	1.45	1.45	1.45	1.45	1.45
Weekly hours	56	38	56	38	102
Yearly hours	2,920	1,947	2,920	1,947	5,840
Yearly wages, incl. Soc. Sec. tax (dollars)	4,307.00	2,871.00	4,307.00	2,871.00	7,711.00
Total yearly expenses (dollars)	7,618.00	5,156.00	8,693.00	5,868.00	13,601.00
Yearly miles travelled	36,500	18,250	36,500	18,250	36,500
Yearly cwt. carried	25,404	25,404	31,390	31,390	47,085
Daily miles travelled	100	50	100	50	100
Daily cwt. carried	69.6	69.6	86.0	86.0	129.0
Cost per vehicle mile (dollars)	0.21	0.28	0.24	0.32	0.37
Cost per cwt. of milk (dollars)	0.30	0.20	0.28	0.19	0.29

[1] Based chiefly on Tables 42 and 43 in Appendix I, but adjusted to mileages of 50 and 100. For methods used in developing Table 35, see Appendix II. All trucks in Table 35 used every-day pick-up.

[2] Weight of vehicle plus a full load.

Table 36. Cost Budgets for One Year for Various Sizes of Tank Trucks and Loads[1]

Truck No.	1	2	3	4	5
Gross vehicle weight (lbs.)[2]	17,000	18,000	18,000	23,000	30,000
Tank capacity (gals.)	1,000	1,000	1,000	1,500	2,000
Fixed expenses (dollars)					
Depreciation					
Chassis (term, 3 yrs.)	737.00	967.00	967.00	1,317.00	2,119.00
Tank (term, 3 yrs.)	528.00	528.00	528.00	628.00	731.00
Upkeep of tank	75.00	75.00	75.00	100.00	100.00
Taxes — excise Federal use	150.00	163.00	163.00	209.00	272.00
Insurance	320.00	320.00	330.00	439.00	576.00
Registration	108.00	108.00	108.00	178.00	180.00
Total	1,918.00	2,161.00	2,171.00	2,871.00	3,978.00
Variable expenses, except wages (dollars)					
Gasoline	601.00	639.00	1,278.00	1,460.00	1,703.00
Oil	29.00	29.00	58.00	58.00	58.00
Tires and tubes	510.00	660.00	990.00	1,125.00	1,125.00
Repairs	233.00	233.00	350.00	400.00	600.00
Federal transportation tax (3%)	235.00	235.00	470.00	470.00	471.00
Total	1,608.00	1,796.00	3,146.00	3,513.00	3,957.00
Total fixed and variable expenses, except wages (dollars)	3,526.00	3,957.00	5,317.00	6,384.00	7,935.00
Wages					
Hourly wage rate (dollars)	1.45	1.45	1.45	1.45	1.45
Weekly hours	35	35	70	70	70
Yearly hours	1,820	1,820	3,640	3,640	3,640
Yearly wages, incl. Soc. Sec. tax (dollars)	2,693.00	2,693.00	5,384.00	5,384.00	5,384.00
Total yearly expenses (dollars)	6,219.00	6,650.00	10,701.00	11,768.00	13,319.00
Yearly miles travelled	18,250	18,250	36,500	36,500	36,500
Yearly cwt. carried	31,390	31,390	62,780	62,780	62,780
Daily miles travelled	50	50	100	100	100
Daily cwt. carried	86	86	172	172	172
Cost per vehicle mile (dollars)	0.34	0.36	0.29	0.32	0.36
Cost per cwt. of milk (dollars)	0.20	0.21	0.17	0.19	0.21

[1] Based chiefly on Table 44, in Appendix I, but adjusted to mileages of 50 and 100. For methods used in developing Table 36, see Appendix II. All trucks in Table 36 used every-other-day pick-up.

[2] Weight of vehicle plus a full load.

ing possible per day through every-other-day pick-up; but, with most road patterns in the region studied, the route mileage reduction per day, resulting from every-other-day operations, might be as little as 35 or 40 percent. Regardless of whether the route-mileage per day is shortened by 50 percent or by 35 percent, the important fact is that the saving shown is of a type which is contingent on using every-other-day pick-up (or even less frequent pick-up).

If now the load carried and the distance travelled by the tank truck were doubled, as could be the case if the number of producers served is doubled and the truck thus makes two trips per day in place of one, the cost can be reduced from 21 cents to 17 cents per cwt. This situation is set out in Example III. It assumes that the wage bill would be doubled, and makes no assumption as to whether the added hours of work would be put in by the same driver or by a second one. The economy derived from fuller utilization of the truck stems from the fact that about $2,200 of the tank truck's yearly expenses are fixed.

There are some comparisons between vehicles in Table 35 and vehicles in Table 36 which would be misleading because — unlike the comparisons set out in Table 37 — they would not involve practices which were alternatives to each other. For example, Truck No. 2b in Table 35 (a vehicle hauling cans) and Trucks 1 and 2 in Table 36 (tank trucks) all traveled 50 miles per day. Each of these three vehicles assembled 86 cwt. per day. The cost per cwt. was closely similar for the three vehicles, but with the can truck slightly less costly than the other two. The cost per cwt. amounted to 19c for the can truck, 20c and 21c respectively for the two tank trucks. The two tank trucks seem, at first glance, to have been making an unimpressive showing.

However, they were already using every-other-day pick-up and — despite that — they had to travel the

Table 37. Comparison of Can and Tank Truck Costs per Cwt. of Milk[1]

Example No.	I	II	III
Type of truck	Can Truck	Tank Truck[2]	Tank Truck[3]
Gross vehicle wt. (pounds)[4]	19,000	18,000	18,000
Frequency of pick-up	daily	every-other-day	every-other-day
Daily load carried (pounds)	8,600	8,600	17,200
Daily Distance Travelled (miles)	100	50	100
Total cost per cwt. of milk (dollars)	0.28	0.21	0.17

[1] Example I in this table is Truck No. 2a from Table 35. Examples II and III in this table are Trucks 2 and 3 from Table 36. They were selected for comparison because I and II have identical loads; III is a variant of II; and I, II, and III all involve vehicles of about the same size.

[2] The same load as in Example I, for half the mileage per day. This does not assume the full utilization of the truck possible by serving other routes to increase the total pay-load.

[3] In Example III, 8,600 pounds is carried on each of two trips. Each trip is 50 miles long. Compare the load and mileage in Example III to those of Examples I and II.

[4] Weight of vehicle plus a full load.

same distance per day, to assemble 86 cwt. of milk, as did the can truck. This means that the dairy farms served by these two tank trucks were farther apart than those served by the can truck. In that sense, the can truck had a more favorable route than did these particular tank trucks. Hence, it would not be valid to make a direct comparison on the assumption that the operating conditions were alike for all three trucks. The only valid comparison would be to say that, by using every-other-day pick-up, these two tank trucks had costs per cwt. almost as low as did this can truck, despite the relatively unfavorable routes of the tank trucks.

The can truck, of course, used every-day pick-up.

6. The Break-even Point

Most truckers will want to know the minimum capacity at which they can operate at given rates. This particular pay load will depend on the cost of running the truck and the rates which can be charged for the job. Therefore, each truck and each route will have conditions peculiar to it which will govern the break-even point.

The method of computing the break-even point is illustrated in Table 38. There, the tank trucks and mileages are those covered by Table 36, and — simply as one example out of many possible rates — it is assumed that the rate which the trucker is considering is $0.25 per cwt. In order to break-even, the operator of Truck No. 1 would need to have a daily pay-load averaging 79 percent of the truck's capacity. The operator of Truck No. 3 would need to have a daily pay-load averaging 137 percent of the truck's capacity — which would be possible if the vehicle served two routes per day.

If the trucker does attempt to operate at any given rate, such as $0.25 per cwt., and finds that he consistently has a pay-load below his break-even point (computed in Table 38), he then needs to serve more producers or to raise his rates — unless the dealer will make up the trucker's deficit.

Table 38. Minimum Capacity Use of Tank Truck to Break-Even at a Rate of $0.25 per Cwt., with Various Trucks and Mileages

Truck No.	Gross Vehicle Weight	Capacity		Average Daily Miles	Average Daily Cost	Cost per cwt. of Milk	Break-even Point	
							Cwt. Carried per Day	Percentage of Capacity Used
	(Pounds)	Gals.	Cwt.		(Dollars)[1]	(Dollars)		
1	17,000	1000	86	50	17.04	0.1981	68	79
2	18,000	1000	86	50	18.22	0.2119	73	85
3	18,000	1000	86	100	29.32	0.1704	117	137[2]
4	23,000	1500	129	100	32.24	0.1801	129	100
5	30,000	2000	172	100	36.49	0.2122	146	85

[1] Includes both fixed and variable expenses. See Table 36, on which this table is based.

[2] Two routes to total 100 miles.

XII. Problems of Transition to Tank Truck Assembly

1. Incentives to Change

In Maine, New Hampshire, and Vermont — a region where big dairy farms are scarce — milk dealers take the initiative in the change to bulk assembly of milk. The producer's investment in a farm storage tank and — commonly in this region — the trucker's investment in a tank truck are essential to the dealer's change-over to the receiving of milk in bulk. But the producer's and trucker's decisions to invest in this costly equipment are, as noted earlier, results of a dealer's decision. This may come about because the dealer is aware of such a system's economies to himself. Or it may be that, when one dealer has taken the lead in conversion and thus starts a new competitive effort at getting the more satisfactory producers and more favorable routes, other dealers will need to convert, regardless of their previous views on the matter. The latter dealers then, in turn, provide the producers and truckers with incentives for change.

This dealer initiative may take several positive forms, apart from the negative one of eventually refusing to receive milk in cans. An effort is made to convince producers of the farm economies or convenience from conversion. Milk dealers may offer financial assistance in the purchase of the farm tank. For example, dealers may co-sign notes for tank purchases and guarantee transfer of the notes in case the tank is sold. Dealers may organize quantity purchases of tanks at a discount rate. Milk dealers may guarantee a return to truckers so that a reduced transportation rate can be offered to producers. Dealers may offer quality premium payments for milk held in farm tanks over milk received in cans. Each of these procedures has been used in Northern New England by co-operatives or proprietary dealers or both.

2. Financing the Purchase of the Farm Tank

Producers, however, are still faced with the basic problem of financing the farm bulk milk tank. This can be done through the local bank, or the Production Credit Association or through a finance company as provided by the equipment dealer. The payments may then be deducted from his milk check or by whatever arrangement is convenient. The cost, less any savings to the farmer through reduced transportation charges, must be absorbed in the farm expenses.

A farmer with heavy indebtedness due to previous capital or machinery purchases may face difficulties of obtaining the necessary credit just as would farmers with poor credit standing in the community. These producers may be left behind in the transition to bulk assembly either because they are unable to obtain additional credit or for other reasons. Some producers were already finding it necessary to refinance their entire farm under one package deal in order to change to bulk assembly.

3. Farm Plans

The plans of the operator must be reviewed before additional investment is made. His age and the lack of family or other labor may encourage the adoption of labor saving equipment such as the farm tank, or the initial cost may force him to retire from production if this is his only alternative.

There may be necessary alterations to or relocation of the milk house. The yard or the farm lane may have to be drained and gravelled. In addition, certain herd management decisions must be made. Does the farm tank presuppose a herd expansion? If so, what does this mean in terms of housing, additional pasture, feed and seasonality of production? Is land available for expansion? A variation in production through the year means a variation in the use of the farm tank and in income. Some inducement to reduced seasonality may be offered by a farm tank.

4. Community Plans

The widespread adoption of tank assembly in a community may have an indirect effect on the tax load. A reduction in the number of producers paying taxes on their farm assets or any additional expenses for road improvement and bridges consequent on the use of tank trucks may increase the tax load of producers who stay in production. This forecast will be conditional on the extent to which other industrial or employment activities develop in the community. The closing of a receiving plant or depot in a community would likely have tax and income repercussions which would require some reorganization or local budgets.

The success of complete conversion to tank trucks will depend on the degree of community participation and cooperation. It may well reduce the number of dealers who can stay in business. It may reduce the number of truckers needed as well as the number of producers. A concerted effort with the assistance of county agents and the extension service can provide plans to reduce the financial and social impact during the transition phase.

5. Increased Dealer Responsibilities

While the initiative for change-over may come from one or a few dealers, there are many other dealers who must later decide whether to change. The initial phase of change-over will not give dealers the full benefit they expect from a complete conversion of the plant to tank assembly. They must be prepared, at least for a time, to carry the financial load of premium payments to producers for bulk milk or supplementary payments to tank truckers, or both. Also, few plants in the region studied had yet been able to convert 100 percent to tank assembly; and a plant receiving milk both in bulk and in cans does not show the full saving on labor and equipment likely from the elimination of can handling.

Nearness of producers to the market may contribute to maintaining competition between dealers for milk supplies. Producers will favor those dealers providing more services or a higher milk price. Larger producers may favor dealers with tank assembly facilities. These competitive forces will influence the decision of dealers. In addition they must attempt to assess the potential savings in the local plant operation. What labor can be reduced? What operating costs can be eliminated? The cooling of milk in the farm tank instead of at the plant is one fairly obvious means of reducing plant operating costs.

6. Exceptions to Change

On the other hand there are dealers with can assembly who are so located that they do not worry about losing their producers to dealers with tank assembly because they have a preferred local market for their milk and can pay higher prices. The producer-dealer relationship is satisfactory and there is no incentive to change over from cans to farm tanks. Dealers may not handle enough milk to justify investment in a holding tank or to guarantee an income to a tank truck driver. Small producers and small dealers in local areas will slow down the transition to bulk assembly within any milkshed. To this extent the total possible gains in the milkshed are reduced, but until the competitive position of these dealers and producers changes by the action of other dealers or by a shift in local pricing techniques then change to bulk assembly will be delayed.

7. Effects on Trucking Industry

With the adoption of bulk milk assembly in a milkshed, there will be basic changes in the structure of the transportation industry.

The displacement of trucks for carrying cans by specialized milk tank trucks poses a financing problem to the trucker. The general tendency in the past for milk truckers to be independent operators suggests that some attempt will be made by many truckers and dealers to retain this ownership pattern. Certainly there are numerous self-employed truckers who, like various other small businessmen, have a strong desire to go on working in a comparatively independent way rather than to become employees. At the same time, many milk dealers prefer not to have to concern themselves with transportation problems. There are certain characteristics of can and tank trucking, however, which must be considered.

8. Milk Trucking More Specialized

As noted above, truckers of milk in cans from farms to dealers may or may not be full-time truckers. There are a number of self-truckers, i.e., farmers who haul their own milk to the dealer to save on transportation. There are many truck owners who have other jobs such as mailman, or driver of the school bus, or who haul other products on their trucks. The efficient utilization of tank trucks to carry the greatest quantity of milk for the least distance presupposes that such trucks are in use for the full work day. Milk assembly by tank truck with its increased responsibilities is a full-time job. Hauling milk would disappear as a supplementary source of income for local owner-drivers of trucks and as a means for dairy farmers to hold down expenses.

The initial purchase of a tank truck, with its lack of alternative uses, is a major investment tied in closely with potential income from hauling milk. The trucker loses not only the opportunity to obtain supplementary income from an investment in a single truck by trucking other commodities but also his opportunity for readily shifting out of milk trucking altogether. He becomes more closely tied to a single source of livelihood so long as he retains his tank truck. Hence dealers may need to provide some guarantee of minimum earnings as an inducement for the trucker to retain the truck ownership responsibilities. This agreement may be a formal contract, which heretofore has been non-existent, or it may be an income guarantee derived from additional work for the trucker in the plant or on inter-plant hauls.

9. Greater Dealer Controls

There will be cases when the dealer must own the truck and hire the driver, particularly if the earnings are not attractive enough because of location and size of producers. However, even without outright dealer ownership of the truck the dealer-trucker relationships will change fundamentally from what they have been. Efficient operation means a continual reorganization of routes to meet changing supply conditions. This will require some central direction and control. The tank trucker must be trained to assume responsibilities for rejection or acceptance of milk at the farm. He becomes a public relations man for the dealer, and in many other respects has closer dealer ties which make him comparable to an employee even when he continues to own the truck which he operates. From the dealer's standpoint, he becomes more dependent on the tank trucker for both his supply and the quality of his supply. In all, the dealer will have more control over the trucking operation than has been true in the past, regardless of whether the trucker becomes an employee of the dealer. The close relationship between savings from tank truck assembly and the efficient operation of trucks and truck routes means that a close coordination between trucker and dealer is not only essential but may lead to more dealer ownership of trucks. This will depend on the future competition between truckers and the ability of dealers to obtain adequate service.[1]

Certainly the adoption of bulk assembly of milk increases the responsibility and importance of transportation to the dairy industry.

XIII. Sources of Savings and Added Costs in Bulk Assembly

1. Can versus Bulk Handling on the Farm

From the available data, it is impossible to itemize the total dollar costs and potential savings to the dairy industry of Maine, New Hampshire, and Vermont stemming from a complete or partial transition to the bulk assembly of milk.

In this study, an attempt was made at getting data from producers with farm tanks as to the monthly savings to the farmer resulting from his having the tank, but the producers were not able to answer this question well enough. What the shift to bulk assembly means to the dairy farmer in terms of a net saving or a net increase in his expenses is an important factor which would have to be included in any comprehensive measure of the dollars-and-cents significance of this method of assembling milk. Here is a new technology which — where dairy farms are not big — is wanted more by the dealers than by the farmers; but if the dealers are to adopt the new technology, a substantial capital outlay is needed on the farm. To determine the impact of bulk assembly on the dairy farmer, detailed studies of on-farm costs are needed, under conditions of both bulk and can assembly.

[1] Dealers can be expected to avoid as long as possible the additional management problem involved in having their own assembly trucks.

Some studies along that line have been made in various other milk sheds.[1]

2. Can versus Tank Trucking

The cost of moving milk from farms to a transfer station[2] or directly to the processing plant should be reduced by savings associated with a tank truck operation. As noted in Chapter XI, these possible savings may be as much as 7 to 11 cents per cwt. (Table 37) if pick-up is not every-day but every-other-day (or even more frequent).

Against this saving on transportation, some possible added expense must be offset. Notably, if bulk assembly will cause the dealer to exercise closer control over truckers (with or without their becoming his employees), this supervision will itself involve an expense to the dealer.

But closer control of truckers by the dealer — even if undertaken chiefly to maintain the quality of the milk, to maintain good relations with producers, and so on — could lead to a more efficient organization of assembly routes. For example, some cross-hauling could be eliminated.

3. Country Receiving Stations versus Transfer Facilities

Milk is hauled from farms to country receiving plants for reshipment by rail tank car or in a large tank truck. There were 90 such receiving stations or depots in Vermont, New Hampshire, and Maine at the time of this study. At least 14 of these stations had supplementary facilities for manufacturing or local retail market responsibilities. Therefore there were perhaps 76 depots which could eventually be closed, provided adequate transfer facilities from local assembly trucks to long-haul trucks or to rail cars were provided. The closing of country receiving plants will be one source of reduced expenses for the dealers. The milk will be handled less and will either move directly to the processors from the farm or be transferred to over-the-road tank trucks or to rail tank cars for continuance of the movement to the dealer's processing plant. The cost of handling milk in country receiving depots in the area here studied has been estimated at 25 cents per cwt.[3]

Eliminating the traditional type of receiving station would not mean a net saving of this 25 cents per cwt. On the longer hauls to the processing plants, the comparatively small tank trucks used in assembly of milk from farms are now regarded, and would probably still be regarded, as not sufficiently economical to be used for the whole trip from farm to processing plant. If milk will continue to be assembled in these relatively small trucks and then transferred to

[1] See "Bulk Handling of Wisconsin Milk, Farm to Plant," by Arthur H. Miller, Research Bulletin 192, University of Wisconsin, Madison, Wis., February 1956, pages 4-13; "Marketing Milk by the Bulk Tank Method," by Jerry H. Padgett, Circular N. S. 5, College Experiment Station, College of Agriculture, University of Georgia, Athens, Ga., June 1956, pages 21-23; "Questions and Answers about Bulk Milk Tanks," by Willis W. Marshall, Jr., and Joseph H. Yeager, Circular No. 120, Agricultural Experiment Station, Alabama Polytechnic Institute, Auburn, Ala., June 1957, pages 9-11, 22-23; "How Bulk Assembly Changes Milk Marketing Costs," by Donald B. Agnew, Marketing Research Report No. 190, Agricultural Marketing Service, U. S. Department of Agriculture, Washington 25, D. C., July 1957, pages 36-46; "Economics of Bulk Milk Handling," by Sidney Ishee and W. L. Barr, Bulletin 631, Agricultural Experiment Station, College of Agriculture, Pennsylvania State University, University Park, Pa., March 1958.

[2] "Transfer stations" are discussed in Section 3 of this chapter.

[3] "Pricing Class II Milk in the Boston Market, A Report of the Boston Class II Price Committee," February 1951; prepared for the Federal Milk Market Administrator, Greater Boston Marketing Area.

larger trucks or to rail tank cars for completion of the trip, this will mean that — with the elimination of the traditional type of country receiving station — some other type of transfer facility will be needed. Perhaps this will be less expensive than a country receiving station; but the cost of handling milk at such a facility will need to be offset against the saving of 25c per cwt. noted above.

The size of investment and the conditions for the transfer of milk at this transfer facility will depend in part on health regulations prescribed by various governments. The facility would probably include a hot water supply for cleaning the tank of the assembly truck, plus a receiving ramp under a roof. A holding tank might be needed — not one large enough to hold, all at one time, the entire supply of milk which passes through the facility in one day, but a tank large enough to avoid having several assembly trucks either delay or be delayed by an over-the-road truck or a rail car, since in and out movements can never be synchronized perfectly. Furthermore, until a satisfactory metering device for milk can be developed, a man to supervise the milk transfer station might be needed. Having such a man spend part of his day in field work ("contact work" with producers) or in the testing of milk for bacteria count and butterfat content could help to keep down the operating cost of the transfer facility.

Hitherto, the country receiving stations have been a means of contact between the dealer and his producers, in addition to the dealer's having field men who visit dairy farms to keep an eye on sanitation, maintain satisfactory relations with the producers, and so on. A contact is needed by the dealer if an adequate supply of satisfactory milk is to be maintained. With the elimination of the country receiving station, the dealer will need to replace *that* form of contact — perhaps through the personnel of the transfer facilities or perhaps through the tank trucker on the assembly route, regardless of whether the latter man becomes an employee of the dealer or is a self-employed trucker who, in the contact work, is an agent of the dealer.

Testing of milk for bacteria count and for butterfat content has been a part of the service performed by the country receiving station. Eliminating the country receiving station does not eliminate the testing but merely shifts its location, whether to a new type of transfer facility or to the processing plant or elsewhere.

4. Receiving Milk in Cans or in Bulk at Plants

At the plant where milk is received by the dealer from the assembly trucks, there is — as noted above — a saving of a substantial percentage of the cost of the receiving operation if the milk arrives in bulk instead of arriving in cans. To name one factor involved: the washing of cans is more costly than washing a tank on a truck. Another example of the difference is in the amount of labor involved in emptying cans or in emptying a tank — a mainly hand-labor operation versus the use of a power-driven pump.

Even when all milk pick-up at the farm was in cans, milk moving from a country receiving station to a processing plant was in bulk. Only the milk which moved directly from the comparatively nearby farms to the processing plant reached the latter in cans. In any estimate of total savings from bulk assembly, the saving from eliminating the country receiving plants should, of course, be applied only to the volume of milk which has moved through those plants; and the saving from receiving milk in bulk should be applied only to the volume which has moved directly from farms to processing plants.

5. The Indirect Financial Effects

It should not be assumed that the region studied would have about the same dairy farms after complete conversion to bulk assembly as it had before conversion began. As noted above, there are dairy farmers who, faced with the need for converting or going out of business, have simply gone out of business Also in the course of the study it was generally observed that, among the farmers still using cans, the smaller ones were the likeliest to say that a need for converting or leaving the dairy business would mean the latter. To the extent that bulk assembly thus contributes toward eliminating some of the smallest dairy farms, it probably will reduce somewhat the unit cost of milk transportation, in as much as the tank truck will then make fewer stops in assembling a load. Whether this impact will be, on the whole, a good or bad thing is not a dollars-and-cents question.

6. Factors beyond Dollars and Cents

Indeed, a comprehensive look at bulk assembly would be incomplete if it were solely in terms of dollars and cents. At a time when milk dealers are putting a heavy emphasis on the quality of the milk they buy, the effect of bulk assembly on quality receives a good deal of attention. But it is beyond the scope of this study to appraise the beneficial or other effect of bulk assembly on the quality of milk.

Another non-financial factor is that, to many a dairy farmer with a bulk tank, this new technology gives a welcome relief from the drudgery of handling cans, especially if — having installed a bulk tank — he then makes the further change of installing pipeline milking. A 40-quart can, filled with milk, weighs about 100 pounds. To a farmer who handles the cans himself, it may be less important to estimate what use he could make of the time he would save by not carrying cans, than it is to know that a tank would ease his back.

In this study, the focus was meant to be on the transportation aspect of bulk assembly. Viewed as transportation, bulk assembly showed its efficiency in the analysis undertaken in this bulletin. But the other aspects of bulk assembly must not be lost from sight.

XIV. Summary

1. This study is based on interviews with 120 milk plant managers. 332 truckers and 1650 milk producers in Maine, New Hampshire and Vermont during 1955 and 1956. This was a representative sample of the dairy industry in the three state region, by size and location of plants.

2. An estimated 80 percent of farms shipping their milk in cans, in Maine, New Hampshire and Vermont were producing less than 1000 lbs. per day during their peak production months. Of all farms, shipping in cans, over four-fifths had herds of fewer than 40 cows; for farms shipping by tank, a somewhat smaller proportion had herds below 40 cows. The farms discussed in this study, therefore, were predominantly in this size group.

3. About a third of the farms using cans planned herd expansion, as compared with fifty percent of farms with tanks. Of all such producers' plans for increases, over four-fifths were for additions of 1 to 9 cows. This appears to be a realistic estimate because, of those farms already using bulk tanks, thirty percent had increased their herd size and, of those increases, sixty-one percent were 1 to 4 cows and twenty-six percent were 5 to 9 cows.

4. Reasons given for planned herd increases by producers shipping milk in cans were to make greater use of existing buildings, to increase farm income from herd improvement plans, and to increase production. In one tenth of the cases, herd increase plans were specifically aimed at the future purchase of a farm bulk milk tank.

5. The major reason for producers' planning no increases in herd size was labor limitations such as shortage of hired help, age and health of the operator, and time required for off-farm work. Other reasons were that farm acreage was too small and that existing buildings were used to capacity.

6. Producers using cans were asked what they would do if their present milk dealer changed to bulk assembly. Forty-five percent said they would change to a dealer willing to accept their milk in cans. Fourteen percent would go out of business. The remaining 41 percent would install a farm bulk milk tank. These reactions presumed that other dealers would be willing to accept their milk in cans or that there would be alternative employment opportunities. Therefore, these proposed actions are subject to change.

7. By farmers still using can assembly, the expected cost of changeover, exclusive of the farm bulk tank purchase, was estimated at less than $350 for 27 percent of the farms, between $350 and $749 for 37 percent, and $750 or more for 36 percent of the farms. The experience of producers who had actually changed to a farm bulk milk tank was better than this. Sixty-three per cent of the farms required additional costs of less than $350. For 37 per cent, the figure was $350 or more.

8. Two-thirds of the farm bulk milk tanks purchased in Maine, New Hampshire and Vermont were direct expansion type. The preference for this type will depend on local electric power service rates and policies, as well as on the individual preference of the producer. The power requirements for the direct expansion type of farm bulk milk tanks are greatest during milking, whereas the power needs for the ice bank type of bulk cooler are more evenly distributed through the day.

9. The most frequent methods of financing farm bulk milk tanks were through local banks and the Production Credit Association. The milk dealer frequently co-signed the purchase note at the bank and the interest rate was generally 6 percent on the unpaid balance.

10. Unused capacity of tank trucks means a higher cost per cwt. for milk transported than if the tank were full. The seasonal variation in production was greater for producers shipping in cans than for farm tank users. There was insufficient evidence that the use of a farm bulk milk tank had encouraged more even production, but the difficulty of a trucker in hauling a full load will be increased as the production of producers on his route varies from month to month. In addition, variations in milk sales will increase a producer's difficulty of meeting the payments on a new farm bulk milk tank.

11. The change from cans to bulk assembly creates operating problems for farmer cooperatives no different from those for proprietary dealers, once the decision to change has been made. The decision-making process for farmer cooperatives may be somewhat lengthier than for proprietary dealers if full member participation is the aim. However, there was evidence that the time lag is shortened when the possible loss of volume from larger producers, who may leave the cooperative in favor of a tank assembly outlet, exceeds the cost of adopting bulk assembly and the premium payments which may be necessary to retain them.

12. Not all milk dealers are planning a changeover to bulk assembly. Of those receiving milk in cans, thirty percent were under some form of pressure to change. This pressure in two-thirds of the cases was represented by competition from other dealers for producers' supply and the remainder came from their own year-round producers who wanted to change to bulk assembly.

The major obstacle mentioned by dealers, to conversion to bulk assembly of milk, was the cost of the necessary trucks and farm facilities. It was believed that the cost of the latter would be especially burdensome to the small farms which were typical sources for many of these dealers' milk.

13. Over four-fifths of the for-hire trucks assembling milk in cans were owned by the drivers. Three-fifths of the owner-drivers supplemented their income from milk assembly by producing milk, by custom hauling of other products, and as employees in milk plants. For every 100 producers shipping in cans, 18 were self-haulers, trucking only their own milk. They are not here considered as truckers.

14. There were no instances of written contracts between dealers and either can or tank truckers. In the case of tank truckers, however, at least two-fifths had some form of income guarantee from the dealer. The initial investment in a tank truck may require more financial and income support from the dealer than has been true for the can truck. The trucker now becomes more closely tied to a single source of livelihood, and the loss of alternative sources of income must be replaced by some form of minimum income guarantee if trucking service is to be assured without the truckers' becoming a dealer-employee. This will be particularly true during the initial phases of developing tank truck routes.

15. The tank truck haulage rates charged producers were, in general, lower than those charged producers shipping in cans, for equal distances. This reflects lower transportation costs, and, in some instances, a dealer policy of helping to pay the tank trucker for hauling milk, partly for the purpose of inducing producers to shift to bulk assembly.

16. On the assembly routes studied, the most frequently found rates charged by truckers to producers were 20-cents per cwt. by can truckers and 15-cents per cwt. by tank truckers. In addition to the payment from farmer to trucker, there were — as noted above — instances in which the dealer made a supplementary payment to the tanker — especially a tank trucker — through some such method as guaranteeing him a minimum gross income per week.

17. Through the shift to bulk assembly, the cost to the trucker, in hauling milk from farm to plant, can be reduced by 7 to 11 cents per cwt., for comparable sizes of trucks — for example, a reduction from 28 cents

to a cost between 21 and 17 cents. To achieve such a saving, the trucker must change to every-other-day pickup or 3-times-per-week pickup, and, preferably, get fuller utilization of his truck by serving more farms than are served by the comparable can truck.

18. The average profit on six milk tank truck routes was 6 cents per cwt. of milk and $7.87 per route per day. For fourteen can assembly routes, the corresponding figures were 9 cents and $7.44. The narrow difference in the return per route per day, despite substantial difference in the cost of the respective vehicles, is perhaps merely an aspect of the transition phase.

19. Most of the country receiving stations used solely for assembly and reshipment to markets can be eliminated by a system of direct transfer from local assembly trucks to over-the-road trailer tank trucks or to rail tank cars, whichever is the more economical. For this transfer, a relatively simple type of facility will be needed, to replace the country receiving station.

20. Under bulk assembly, with purchase of milk by the dealer shifted from his plant to the farm, and with commingling of milk from the various farms on a route, dealers will eventually asume a greater responsibility in connection with assembly than they have borne when all milk was picked up in cans. Tank truckers — even if they come to be under substantial control by dealers — will have a more responsible role than that of can truckers. With the point of sale pushed back to the farm, the situation no longer exists in which the milk leaves the farm and is subjected to some possibility of spoilage on the way to the plant, while still owned by the farmer. Under bulk assembly, producers retain control over the quantity and quality of their milk up to the point of sale. The many problems of transition to bulk assembly of milk require concerted action by dealers, truckers, and producers for a satisfactory solution.

Appendix I

Table 39. Price Range for Farm Tanks f.o.b. Boston, May 1957

Size in Gals.	Ice Bank	Direct Expansion Self Contained	Direct Expansion With Remote Compressor
100	$1500	$1100 - 2000	$1500 - 1800
150	1600 - 1800	1400 - 2200	1800 - 2000
200	1900 - 2200	2000 - 2300	1800 - 2300
250	2000 - 2300	2000 - 2600	2000 - 2600
300	2200 - 2600	2400 - 3000	2200 - 2800
400	2900 - 3200	2600 - 3100	2500 - 3200
500	3000 - 3600	3000 - 3300	2900 - 3500
600	3600 - 4200	3300 - 3600	3100 - 4100
700	3000 - 4400	-	3900 - 4300
800			4500 - 5500
900			4800 - 5800
1000			4800 - 6000

Table 40. Price Range of Truck Tanks[1] f.o.b. Boston, May 1957

Size in Gals.	Average Price	Range in Prices
1000	$7110	$6000 - 8400
1200 - 1250	6722	6100 - 8400
1500	6835	6500 - 7400
1600	7486	6900 - 8100
1700	6970	6800 - 7100
1800	7338	7000 - 7600
2000	7945	7300 - 8500
2200	8436	8000 - 9700
2500	8784	8200 - 9900

[1] Mild steel jackets, stainless steel tank mounted on customer's chassis at plant. To calculate the price of the entire vehicle, it is necessary to add the price of the truck (chassis plus cab) to the tank price.

Table 41. Motor Vehicle Regulations as to Maximum Gross Weight on Highways in Maine, New Hampshire, and Vermont, 1957

	Axles	Axle Spacing	Vermont 1000 lbs.	New Hampshire 1000 lbs.	Maine 1000 lbs.
A. Trucks or Tractors					
	2		30	33.4	32.0
	3[1]	40″	40	40.0	48.0
B. Trucks or Tractors with Trailer and Semi-Trailer[3]					
Trailer	2		50	52.8	50.0
Semi-Trailer	1		50	52.8	50.0
C. Truck Tractor[2] with Trailer or Semi-Trailer[3]					
Trailer	2	48″	60	66.4	50.0
Semi-Trailer	2	48″	60	66.4	50.0[4]

[1] Extra wheels can be raised or lowered — must have brakes.

[2] Tractor weight not to exceed 30,000 lbs. Each axle of tandem shall be equipped with brakes adequate to control the movement and to stop and to hold such vehicle — applied by driver and automatically applied in case of break-away of trailer.

[3] Total length — Maine and New Hampshire 45′, Vermont 50′.
Vermont
16 M lbs. limit on Town roads.
20 M lbs. limit on State aid roads.
60 M lbs. limit on State roads.

[4] Legislation pending in 1957 to raise limit to 60,000 lbs.

Table 42. Can Haul Route Field Cost Studies, 1955-1956 (One Year) Every-Day Pick-up

Truck No.	1	2	3	4	5	6	7
Capacity	1½ Ton	2 Ton	2 Ton	2 Ton	2 Ton	2 Ton	2 Ton
Type of Body	Stake	Stake	Van	Van	Van	Van	Van
Fixed expenses (dollars)							
Depreciation			220.00[1]				
Chassis	509.00	445.00	748.00	(427.00[2]	425.00	750.00	833.00
Body	100.00	175.00	85.00	(	102.00	120.00	90.00
Insurance	136.00	96.00	75.00	136.00	(200.00	(200.00	75.00
Registration	75.00	100.00	175.00	102.00	(	(	150.00
Taxes	n.a.[3]	131.00	n.a.	n.a.	270.00	270.00	n.a.
Garage	60.00	n.a.	60.00	60.00	n.a.	n.a.	n.a.
Total	880.00	947.00	1,363.00	725.00	997.00	1,340.00	1,148.00
Variable expenses, except wages (dollars)							
Gasoline	782.00	505.00	1,841.00	851.00	1,560.00	1,635.00	
Oil	21.00	33.00	54.00	20.00	66.00	60.00	
Tires and tubes	(279.00	262.00	683.00	(213.00	460.00	600.00	
Repairs	(	418.00	785.00	(	350.00	150.00	
Total	1,082.00	1,218.00	3.363.00	1,084.00	2,436.00	2,445.00	2,679.00[4]
Total fixed and variable expenses, except wages (dollars)	1,962.00	2,165.00	4,726.00	1,809.00	3,433.00	3,785.00	3,827.00
Wages							
Hourly wage rate (dollars)	1.50	1.45	1.35	1.50	1.25	.90	1.06
Weekly hours	56	14	56	56	56	56	56
Yearly hours	2920	730	2920	2920	2920	2920	2920
Yearly wages (dollars)	4,328.00	1,079.00	4,020.00	4,480.00	3,600.00	2,652.00	3,182.00
Total yearly expenses (dollars)	6,290.00	3,244.00	8,746.00	6,289.00	7,033.00	6,437.00	7,009.00
Yearly miles travelled	26,416	10,000	55,000	23,400	42,000	40,150	32,850
Yearly Cwt. carried	29,200	14,600	27,375	31,204	30,660	30,660	37,900
Daily miles travelled	73.0	27.4	150.0	65.0	117.0	110.0	90.0
Daily Cwt. carried	80.0	40.0	75.0	85.5	84.0	84.0	104.0
Cost per vehicle mile (dollars)	0.24	0.33	0.16	0.27	0.17	0.16	0.21
Cost per cwt. of milk (dollars)	0.22	0.22	0.32	0.20	0.23	0.21	0.18
Av. cwt. hauling charge (dollars)	0.23	0.20	0.40	0.23	0.30	0.30	0.40

[1] Unexpired chassis depreciation in excess of trade-in allowance.

[2] Each bracketed figure covers two different costs.

[3] Symbol "n.a." means "not available."

[4] Not available in more detail.

Table 43. Can Haul Route Field Cost Studies, 1955-1956 (One Year) Every-Day Pick-up

Truck No.	8	9	10	11	12	13	14
Capacity	2½ Ton	2½ Ton	2½ Ton	3 Ton	3 Ton	3 Ton	3 Ton
Type of Body	Van	Van	Van	Van	Van	Van	Van
Fixed expenses (dollars)							
Depreciation							500.00[1]
Chassis	1,000.00	1,000.00	660.00	900.00	867.00	1,800.00	1,067.00
Body	250.00	100.00	200.00	150.00	70.00	100.00	88.00
Insurance	365.00	72.00	(250.00[2]	(250.00	(250.00	100.00	75.00
Registration	365.00	100.00	(	(	(	175.00	175.00
Taxes	92.00	205.00	n.a.[3]	n.a.	n.a.	40.00	268.00
Garage	183.00	n.a.	n.a.	n.a.	60.00	n.a.	180.00
Total	2,255.00	1,477.00	1,110.00	1,300.00	1,247.00	2,215.00	2,353.00
Variable expenses, except wages (dollars)							
Gasoline	1,570.00	(2,000.00			2,555.00	3,285.00	3,000.00
Oil	91.00	(			54.00	117.00	105.00
Tires and tubes	730.00	1,000.00			696.00	648.00	300.00
Repairs	1.095.00	50.00			500.00	50.00	500.00
Total	3,486.00	3,050.00	4,858.00[4]	4,112.00[4]	3,805.00	4,100.00	3,905.00
Total fixed and variable expenses, except wages (dollars)	5,741.00	4,527.00	5,968.00	5,412.00	5,052.00	6,315.00	6,258.00
Wages							
Hourly wage rate (dollars)	1.38	1.25	1.25	1.25	1.15	1.45	1.60
Weekly hours	56	56	49	56	56	70	56
Yearly hours	2920	2920	2548	2920	2920	3650	2920
Yearly wages (dollars)	4,015.00	3,713.00	3,182.00	3,713.00	3,351.00	5,304.00	4,775.00
Total yearly expenses (dollars)	9,756.00	8,240.00	9,150.00	9,125.00	8,403.00	11,619.00	11,033.00
Yearly miles travelled	36,500	51,000	50,000	43,800	65,000	78,500	67,900
Yearly Cwt. carried	31,390	22,813	30,112	30,295	28,652	42,267	25,860
Daily miles travelled	100.0	140.0	135.0	120.0	178.0	215.0	186.0
Daily Cwt. carried	86.0	62.5	82.5	83.0	78.5	115.8	70.8
Cost per vehicle mile (dollars)	0.27	0.16	0.18	0.21	0.13	0.15	0.16
Cost per cwt. of milk (dollars)	0.31	0.36	0.30	0.30	0.29	0.27	0.43
Av. cwt. hauling charge (dollars)	0.35	0.45	0.37	0.25	0.45	0.50	0.58

[1] Unexpired chassis depreciation in excess of trade-in allowance.

[2] Each bracketed figure covers two different costs.

[3] Symbol "n.a." means "not available."

[4] Not available in more detail.

Table 44. Tank Haul Route Field Cost Studies, 1955-1956 (One Year) Every-Other-Day Pick-up

Truck No.	1[1]	2	3	4	5	6
Size of Chassis	2 Ton	3 Ton	3 Ton	3 Ton	3 Ton	2½ Ton
Size of Tank	2000 Gal.	1800 Gal.	1600 Gal.	2250 Gal.	1800 Gal.	1200 Gal.
Fixed expenses (dollars)						
Depreciation						
Chassis		1,040.00	1,040.00	1,500.00		200.00
Body		700.00	700.00	780.00		239.00
Insurance		282.00	282.00	(300.00[1]		150.00
Registration		315.00	284.00	(		150.00
Garage		n.a.[2]	n.a.	n.a.		60.00
Total		2,337.00	2,306.00	2,580.00		799.00
Variable expenses, except wages (dollars)						
Gasoline		1,878.00	1,485.00	(3,390.00		328.00
Oil		132.00	145.00	(		28.00
Tires and tubes		1,030.00	1,129.00	990.00		165.00
Repairs		94.00	169.00	300.00		484.00
Total		3,134.00	2,928.00	4,680.00		1,005.00
Total fixed and variable expenses, except wages (dollars)	10,950.00[3]	5,471.00	5,234.00	7,260.00	5,475.00[3]	1,804.00
Wages						
Hourly wage rate (dollars)	1.20	2.05	2.05	1.60	2.00	1.30
Weekly hours	75	44	44	84	28	22
Yearly hours	3900	2283	2283	4368	1460	1144
Yearly wages (dollars)	4,680.00	4,680.00	4,680.00	7,020.00	2,920.00	1,465.00
Total yearly expenses (dollars)	15,680.00	10,151.00	9,914.00	14,280.00	8,395.00	3,269.00
Yearly miles travelled	73,000	39,024	35,844	70,262	20,075	10,000
Yearly Cwt. carried	74,825	39,653	40,905	88,818	29,200	23,542
Daily miles travelled	200.0	107.0	98.0	192.5	55.0	27.5
Daily Cwt. carried	205.0	108.6	112.0	243.3	80.0	64.5
Cost per vehicle mile (dollars)	0.21	0.26	0.28	0.20	0.42	0.33
Cost per cwt. of milk (dollars)	0.21	0.26	0.24	0.16	0.29	0.14
Av. cwt. hauling charge (dollars)	0.25	0.30	0.30	0.30	0.20	0.15

1 Each bracketed figure covers two different costs.

2 Symbol "n.a." means "not available."

3 Not available in more detail.

Appendix II

Methods Used in the Development of Tables 35 and 36—Cost Data on Comparable Can and Tank Routes in Maine, New Hampshire, and Vermont

A. Basis for Adjustment of Fixed Cost

1. Depreciation

Each chassis was depreciated on a three-year, straight line method based on dealers' average price, less estimated trade-in. Can truck bodies were depreciated over an eight-year period, and the tank truck bodies over a ten-year period.

2. Taxes

To amortize the excise tax, it was figured on the new truck price, or first-year valuation, at 1.7 percent.

Federal Transporation Tax of 3 percent was figured on the estimated route yearly billing to producers for transportation.

3. Insurance

Cost of insurance varied considerably between routes, according to the maximum density of population in the area served and the length of the route. For example, rates on Bodily Injury and on Property Damage for routes in entirely rural areas were considerably less than for those in which some trucking occurred under city hazards. Increasing route mileage from fifty, or under, to one hundred miles may double or triple the cost of Comprehensive Fire and Theft and Collision rates. These differences were allowed for in examples of the fifty and hundred-mile routes.

4. Registration

Trucks were rated according to New Hampshire cost brackets on two-axle vehicles, as follows:

Gross Vehicle Weight	Fee
To 4200 lbs.	$15.50
To 5000 lbs.	$19.50
To 6000 lbs.	$25.00
To 8000 lbs.	based on $ 0.50 per cwt.
Over 8000 lbs.	based on $ 0.60 per cwt.

5. Interest on Investment

No charge was included for interest on investment.

B. Basis for Adjustment of Variable Costs

1. Gasoline

Size of Chassis of Can Truck	Estimated Miles per Gallon[1]
1½ Ton Class	9.0
2 Ton Class	7.5
3 Ton Class	6.0
Class of Tank Truck	
1000 Gallon Tank	8.0
1500 Gallon Tank	7.0
2000 Gallon Tank	6.0

[1] Based on reports of truck operators in farm-to-plant assembly. (The average for the main-highway tankers of from 3000 to 4500 gallons is approximately 5.0 miles per gallon, or less.)

2. Oil

Based on an oil change each 2000 miles.

3. Tires and Tubes

A set of tires and tubes each twenty thousand miles was used as a basis for this expense.

4. Repairs

Costs were estimated for each size of equipment for the 1st, 2nd and 3rd years, respectively, based on performance reports in the field. Costs were applied, using the three-year average for the type of chassis and can or tank body.

C. Estimates of the Carrying Capacities of Can and Tank Milk Trucks

1. 1½-ton Stake, 14,500 lbs. vehicle weight

Capacity was based on 90 (40 qt.) can average at 77.4 lbs. of milk per can or 6,966 lbs. (Forty quarts of milk weigh 86 lbs., but the cans are assumed to be only 90 percent full.)

2. 2-ton Stake, 19,000 lbs. vehicle weight

Capacity was based on 111 (40 qt.) can average at 77.4 lbs. of milk per can, or 8,600 lbs.

3. 3-ton Van 25,000 lbs. vehicle weight

Capacity was based on 168 (40 qt.) can average at 77.4 lbs. of milk per can, or 12,900 lbs.

4. 1,000-Gallon Tank

Capacity was figured at 8.6 lbs. per gallon of milk, or 8,600 lbs.

5. 1500-Gallon Tank

Capacity was figured at 8.6 lbs. per gallon of milk, or 12,900 lbs.

6. 2,000-Gallon Tank

Capacity was figured at 8.6 lbs. per gallon of milk, or 17,200 lbs.

D. Method of Adjusting Estimated Costs to 100 and 50 Mile Routes

An important segment of operational costs obtained in the field was based on actual commercial trucking data from sources not identified in this study. The average mileage was 100 and pay load 8,000 lbs. or the milk from approximately fifteen dairy farms.

Adjustment from 100 miles to 50 miles for insurance is covered under that section. The other fixed expenses were not adjusted because of mileage variance, although it is conceivable that the trade-in would be higher for a truck with less total mileage used. Much depends on the driver and on the type of maintenance given a truck.

Gas and oil costs in these studies were adjusted proportionately to mileage. In actual practice, any rate of performance per gallon is, of course, subject to the variances in the terrain.

Tire replacement and repairs to equipment are costs that reduce roughly in proportion to reduced mileage. Standard tires were used in the data on can trucks, with the exception of the 3-ton van truck, which used oversized tires. Cost of heavy duty tires were figured on all tank trucks. Many major repairs involve standard parts and labor costs. Therefore, in the drop of 50 percent of the mileage, their costs were reduced 33⅓ percent as a conservative figure.

Appendix III

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