FRUIT INTRODUCTIONS FROM THE UNIVERSITY OF MINNESOTA FRUIT BREEDING FARM

Groups of Fruits and Ornamentals	Number of Varieties
Apple	12
Apple-crab hybrid	1
Cherry	3
Cherry-plum	3
Currant	2
Gooseberry	1
Grape	4
Pear	3
Plum	20
Red raspberry	2
Strawberry	10
Ornamentals	3
TOTAL	64

...on Bulletin 442 June 1957

Manufacturing Costs in Minnesota Creameries

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Manufacturing Costs in Minnesota Creameries

Arvid C. Knudtson and E. Fred Koller[1]

Some very significant technological and economic changes have occurred in the Minnesota creamery industry in the last 20 years. There have been major changes in butterfat assembly, plant operations, and the marketing of products. Among the most important changes has been the large-scale shift from the receipt of farm-separated cream to the receipt of whole milk. This has necessitated numerous adjustments in plant operations and has made possible a wider diversification of products.

In the last two decades there also has been a large change in the number of plants which manufacture butter in Minnesota. In 1935 there were 870 such plants in the state but by 1956 these had declined to 542, a reduction of 38 percent. During the same time butterfat production in the state increased from 277 million pounds in 1935 to 314 million in 1955, an increase of about 13 percent. As a result of these changes the annual butterfat receipts of creameries in the state increased from an average of 284,700 pounds per plant in 1935 to 473,200 pounds in 1955, or an increase of 66.2 percent.

Among other important changes affecting the industry have been changes in equipment, technical methods, sanitary requirements, and other conditions. Many creameries have added or enlarged sideline enterprises—such as feed, poultry, eggs, frozen food lockers, and others. Since World War II there have been large increases in the prices of all of the factors of production needed in the operation of these plants including labor, supplies, and equipment.

The changes outlined above and others have had important effects on the efficiency and costs of operation of the many plants in the industry. Some plants have been able to make prompt and sound adjustments to change and have been able to hold costs in line. Many other plants have had difficulty in adjusting to the changes, with the result that manufacturing costs have risen sharply. With rapidly rising costs butterfat returns to farmers have been affected adversely and the financial condition of many creameries has deteriorated. In view of these conditions, creamery managers and directors have shown

[1] The authors acknowledge with appreciation the generous cooperation of creamery managers and others in the industry who supplied the basic data for this study. Credit is due to Dr. R. W. Cox and Dr. O. B. Jesness of the Department of Agricultural Economics, University of Minnesota, for many helpful suggestions. The assistance of Rueben C. Buse, formerly with the Department of Agricultural Economics, University of Minnesota, who worked on various phases of this study, is gratefully acknowledged.

an increased interest in operating costs and methods that might help lower them.

PURPOSE AND SCOPE OF STUDY

It was the purpose of this study to review the manufacturing operations of Minnesota cooperative creameries in order to determine what adjustments they have made in the last 20 years and the effects of these adjustments on efficiency of operations and costs. Another aim of this study was to determine the effect of the volume of business, product output combinations (product mix), managerial policy, and other factors on the efficiency and costs of these creameries. Still another objective was to point out some ways in which creamery costs may be reduced. This analysis is designed to present information that will be useful to management in making day-to-day decisions and in planning for the future.

This study is part of a larger comprehensive study of changes and adjustments to change in the cooperative creamery industry in Minnesota in the last 20 years. The larger study includes an analysis of changes in milk and cream procurement, product output, manufacturing costs, physical facilities, financing, sideline operations, and many other aspects of creamery organization and operation. To obtain data for the over-all study a sample of 175 creameries was visited. These 175 plants were the identical ones included in a study of the cooperative creamery industry in 1935[2] and were plants from which economic data were obtained at various times during the 20-year period.

Of the basic sample of 175 plants 140 were still operating as creameries in 1955, 27 were closed, and the remaining 8 had shifted to other dairy or business activities. Usable cost data were obtained from 138 of the 140 creameries. The 138 plants include 25 percent of the creameries in the state and are reasonably representative of the industry. The 138 plants were distributed in the state as shown in figure 1.

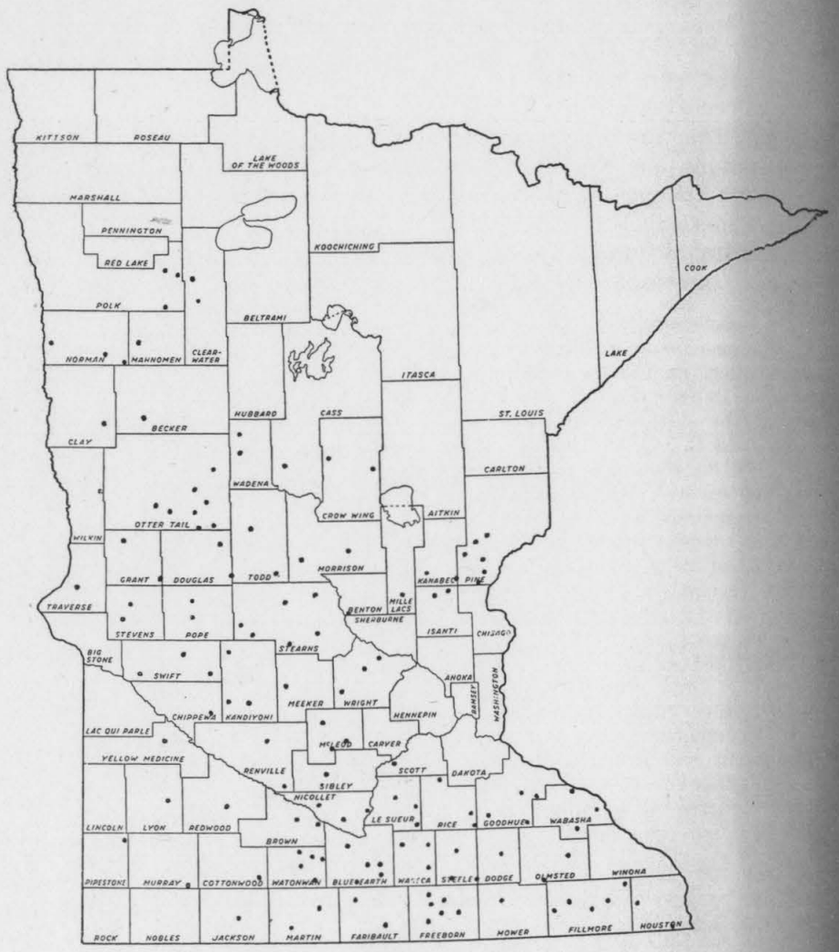

Fig. 1. Location of 138 creameries included in the study, 1954.

DESCRIPTION OF THE PLANTS

TRENDS IN VOLUME OF BUTTERFAT

The annual butterfat volume of the 138 creameries studied has shown a rising trend from an average of 322,942 pounds per plant in 1934 to 480,271 pounds in 1954, or an increase of 48.7 percent. In 1954 the annual butterfat volume of these creameries ranged from less than 80,000 pounds in one plant to over two million pounds in another.

Distribution of the plants according to volume for 1934 and 1954 is shown in table 1. It was found that 55 percent of these plants had a butterfat volume of less than 300,000 pounds in 1934, while only 30 percent of the plants were of this size in 1954. Also, there were three times as many plants in the largest size group in 1954 as there were in 1934.

Table 1. Classification of 138 Minnesota creameries according to annual butterfat volume handled in 1934 and 1954

Butterfat volume	Number and percent of plants in each volume group			
	1934		1954	
thousands of pounds	number	percent	number	percent
Less than 99	2	1.4	3	2.2
100-199	34	24.6	20	14.5
200-299	40	29.0	18	13.0
300-399	32	23.2	26	18.8
400-499	16	11.6	26	18.8
500-599	2	1.4	18	13.0
600-699	4	3.0	7	5.2
700-799	3	2.2	5	3.6
800 and over	5	3.6	15	10.9
Total	138	100.0	138	100.0

TRENDS IN SALES

The dollar sales volume of these creameries increased even more rapidly than did butterfat volume. Annual sales volume averaged $521,402 in 1954 or almost a fourfold increase since 1934. Table 2 shows a comparative distribution of the 138 plants according to sales volume for 1934 and 1954. In 1934 none of the plants had sales in excess of

[2] E. Fred Koller and O. B. Jesness. "Organization and Operation of Minnesota Cooperative Creameries." Minnesota Agricultural Experiment Station Bulletin 333, September, 1937. (Out of print.)

Table 2. Classification of 138 Minnesota creameries according to annual sales volume in 1934 and 1954

Sales volume	Number and percent of plants in each sales volume group			
	1934		1954	
thousands of dollars	number	percent	number	percent
0-249	134	97.1	31	22.5
250-499	4	2.9	57	41.3
500-749	0	0	28	20.3
750-999	0	0	8	5.8
Over 1,000	0	0	14	10.1
Total	138	100.0	138	100.0

$500,000 annually but by 1954 about 46 percent had sales of this size. It must be recognized, however, that much of the increase in sales volume is due to higher prices and only a part is due to an increase in the physical quantities handled.

SHIFT FROM FARM-SEPARATED CREAM TO MILK

There has been a large increase in the amount of butterfat that was received in milk by Minnesota creameries in 1954 as compared to 1934. In 1934 only 1.4 percent of the 138 creameries included in this study received more than 20 percent of their butterfat in milk (table 3). By 1954 the proportion of plants receiving over 20 percent of their butterfat in milk had increased to 76 percent.

Fig. 2. Milk receipts being checked for quality.

Table 3. Distribution of 138 creameries according to the proportion of butterfat received in milk, 1934 and 1954

Percent butterfat received in milk	Number and percent of plants in each group			
	1934		1954	
	number	percent	number	percent
0	97	70.3	23	16.7
0 -19.9	39	28.3	10	7.3
20.0-39.9	1	.7	17	12.3
40.0-59.9	....	....	17	12.3
60.0-79.9	1	.7	26	18.8
80.0-100.0	....	....	45	32.6
Total	138	100.0	138	100.0

CLASSIFICATION OF PLANTS

Analysis and comparison of creamery manufacturing costs in 1954 was much more difficult than 20 years earlier because the operations of creameries in this state have become much more diversified during World War II and the postwar period. In 1934 the 138 plants were primarily butter-producing plants. At that time 90 percent of their total sales were butter sales. Other dairy product sales (including whole milk, cream, skim milk, buttermilk, and dried milk) accounted for only 3.4 percent of sales. The remainder of their sales, 6.6 percent, consisted of such sideline items as poultry and eggs, farm dairy supplies, feed, frozen food locker services, and others.

In contrast, in 1954 butter sales accounted for only 53 percent of total sales in these 138 plants and other dairy product sales had increased to 29.7 percent of the total. Sales of sideline items had grown to 17.3 percent of all sales. Some plants have added sidelines to such an extent that butter production has become a relatively minor source of income.

In view of the fact that butter was clearly the major product in these plants in 1934, cost comparisons could be made in terms of a common unit, namely, costs per pound of butter manufactured. And since there were no wide variations in product output combinations (product mix) all of the plants in the study could be compared readily one with another.

With the widely varying product combinations prevailing in these creameries in 1954 and consequent differences in plant operation they could not all be compared as one homogeneous group as they were in 1934. To facilitate comparison the 138 plants were classified into eight groups with similar product output combinations and plant operations (see table 4). Creamery managers who desire to compare their costs with those in this study should compare with the group of plants having a product combination similar to their own.

The product combinations in the various groups of plants are described below.

Group A. Plants producing only butter: This group includes those plants which manufacture only butter. The sale of dairy products other than butter was

Table 4. Distribution of 138 Minnesota creameries according to product combinations, 1954

Group	Product combinations	Number of plants
	Plants without sidelines	
A	Butter plants	19
B	Butter and bottling plants	7
C	Butter, bottling, and bulk plants	6
D	Butter and bulk plants	15
	Plants with sidelines	
E	Butter and sideline plants	16
F	Butter, bottling, and sideline plants	12
G	Butter, bottling, bulk, and sideline plants	23
H	Butter, bulk, and sideline plants	40
	Total	138

insignificant. The plants in this group had less than five percent of total sales in the form of sidelines.

Group B. Butter and bottling plants: This group includes the plants that manufactured butter and bottled milk. Among the plants in this group, sales of products other than butter and bottled milk amounted to less than 5 percent of total sales.

Group C. Butter, bottling, and bulk plants: Included in this group are those plants that manufactured butter, bottled milk, and also sold whole milk and cream in bulk. Sales from products other than these amounted to less than 5 percent of total sales. The plants that sold whole milk and cream in bulk (can or tank truck quantities) were separated from the plants in group B because per unit costs are usually lower when milk and cream are sold in bulk form.

Group D. Butter and bulk plants: The plants in this group manufactured butter and sold whole milk and cream in bulk form. The sales from products other than butter, and bulk milk and cream amounted to less than 5 percent of total sales. Typically the plants in this group processed the farm-separated cream they received and sold their whole milk receipts to other dairy processing plants.

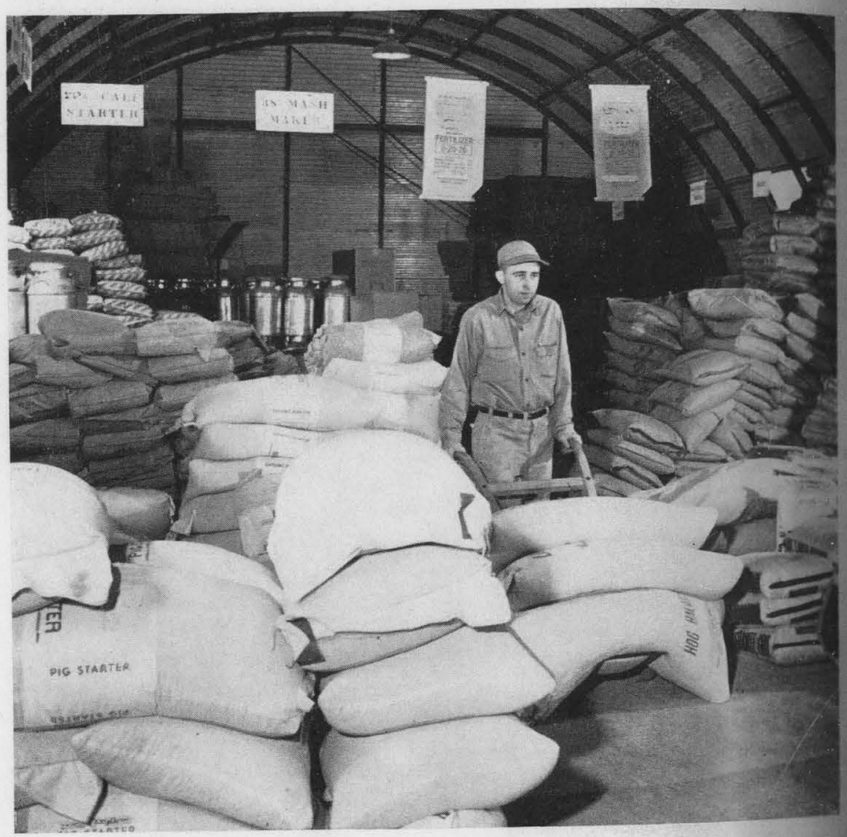

Fig. 3. Feed and dairy supply sales are important sideline operations in many creameries.

Group E. Butter and sideline plants: The plants in this group were similar to the plants in group A in that they manufactured butter as their only dairy product. They differ from the group A plants in that they sold sideline items, which accounted for over 5 percent of their total sales.

Group F. Butter, bottling, and sideline plants: The plants in this group were similar to the plants in group B in respect to dairy product production—they manufactured butter and bottled milk. The difference between groups B and F is that the plants in group F operated sideline departments and had over 5 percent of their total sales in sideline items.

Group G. Butter, bottling, bulk, and sideline plants: The plants in this group all manufactured butter, bottled milk, sold bulk milk and cream, and sold sideline items. These plants are similar to the plants in group C except that in group G sideline sales accounted for more than 5 percent of total sales.

Group H. Butter, bulk, and sideline plants: The plants in this group were similar to the plants in group D; they manufactured butter and sold bulk milk and cream. The difference was that plants in group H handled sidelines which represented over 5 percent of their total sales.

Sideline sales at the 5 percent level were selected as an arbitrary dividing line in classifying plants because it was observed that almost all plants sold a few dollars worth of fly spray, filter disks, separator and milking machine parts, and chemicals. It was observed that sideline sales of less than 5 percent had very little effect on costs.

Also, it was noted that as soon as a plant operated a locker, produce, or a large feed sideline department, the percent that sideline sales were of total sales exceeded 5 percent. As a result 5 percent was used as the dividing line between those plants in which sidelines were relatively insignificant and those plants in which sidelines would have a more important effect on costs.

CREAMERY MANUFACTURING COSTS

The costs considered in this study include only the creamery manufacturing costs. The costs of assembling milk and cream and costs of marketing products were excluded. The manufacturing and cost data included in this report were gathered from plant accounting records, audit reports, and personal visits with the managers of these plants. The accounting cost records of the 138 plants were rearranged to fit a common operating statement.

Since the product combinations in these plants varied considerably it was difficult to find a common unit as a basis for comparing costs between groups. For the 47 plants in groups A, B, C, and D that do not have sideline enterprises, costs are presented in terms of **cost per pound of butterfat.** In a few instances, costs of these 47 creameries are also stated in cents per pound of butter made. For the plants in groups D, E, F, and G costs are presented in terms of **costs per dollar of sales,** because such a large part of their sales and costs are not attributable to butterfat or butter.

In this analysis of creamery manufacturing costs, most of the discussion

is devoted to the 47 plants in groups A, B, C, and D in which butter and dairy processing is the major activity and sideline operations are at a minimum. The task of separating the costs of sideline operations from the dairy operations in most of the plants in groups E, F, G, and H was so difficult it was abandoned. Comparisons of costs are facilitated by concentrating on the simpler and less diversified plants in groups A, B, C, and D.

For purposes of analysis the creamery manufacturing costs were divided into six major classes. These are: plant labor and management; manufacturing and packaging supplies; fuel, utilities, and refrigeration; depreciation; other plant expense; and general and administrative expense.

PLANT LABOR AND MANAGEMENT

Labor is the largest item of expense in the operation of a creamery. Labor accounted for 37 percent of the total operating costs in the 47 plants in groups A, B, C, and D.

Labor costs include all wages, salaries, and commissions paid to the managers, operator-managers, helpers, and others directly employed in the processing operations. Salaries and fees paid directors, officers, and bookkeepers are included under general and administrative expense.

The average labor cost for these 47 creameries was 2.70 cents per pound of butterfat in an average total cost of 7.30 cents. Labor costs among the 47 plants ranged from a low of 1.34 cents per pound of butterfat to a high of 8.45 cents. Some of the factors responsible for these labor cost variations between plants are: differences in volume of output, in product combinations, in rates of wages paid to employees, in the amount of labor employed, and the level of efficiency with which labor is used.

The relationship between the volume of these creameries and per unit labor costs is shown in table 5. Average labor costs declined from 3.07 cents per pound of butterfat in plants with an annual butterfat volume of less than 150,000 pounds to 2.26 cents per pound of butterfat in plants with a volume of more than 600,000 pounds of butterfat per year.

Table 5. Relationship between per unit labor cost and butterfat volume in 47 Minnesota creameries, 1954

Butterfat volume	Number of creameries	Labor cost per pound of butterfat	Labor cost per pound of butter
pounds		cents	
Less than 150,000	4	3.07	2.49
150,000-299,000	9	3.49	2.83
300,000-449,000	15	2.94	2.38
450,000-599,000	13	2.59	2.10
600,000 and over	6	2.26	1.83
Total	47	2.70	2.19

The last column of table 5 indicates what the per unit labor cost would have been if all the butterfat received in the plant had been made into butter. Actually, all except 19 plants sold some butterfat in a form other than butter. To the extent that the other type of plant operations require more or less labor than a straight butter operation of the same butterfat volume, the labor cost per pound of butter will be too high or too low.

Although the amount of labor employed by creameries is an important factor affecting per unit labor costs, the utilization of this labor is even more important. The manager's ability in employing the proper amount of labor relative to the volume of business, the type of product mix, and skill of the workers will determine whether or not a creamery will be able to effectively utilize its labor. The adjustment of the proper amount of labor to the volume of business is one of the most difficult problems the creamery manager faces. In view of the high cost of labor particular attention needs to be given to increasing output per hour of labor. This may be done by giving more train-

Table 6. Personnel combinations employed and factors affecting labor utilization in 47 Minnesota creameries, 1954

Personnel combinations employed	Factors affecting labor utilization: Butter manufactured — Number of creameries	Butter manufactured — Average volume	Butter manufactured — Range in volume	Butter printed — Number of creameries	Butter printed — Average volume	Milk bottling — Number of creameries	Milk bottling — Average volume	Bulk milk and cream — Number of creameries	Bulk milk and cream — Average volume	Total sales — Average volume	Total sales — Range in sales volume
		1,000 pounds	1,000 pounds		1,000 pounds		dollars		1,000 dollars	1,000 dollars	1,000 dollars
Operator only	4	161	115-190	4	17	....	.....	1	24	103	64-145
Operator and FTH*	13	194	81-460	13	37	....	.....	8	250	294	75-605
Operator, 1 FTH, and 1 PTH†	2	285	147-422	2	43	....	.....	1	253	296	249-343
Operator and 2 FTH	10	429	256-615	12	41	....	.....	4	172	369	166-511
Operator and 3 FTH	7	485	120-738	5	52	3	45,742	5	151	462	220-680
Operator and 4 FTH	5	379	132-581	5	77	5	39,378	2	116	365	185-459
Operator, 4 FTH, and 1 PTH	1	280	280	1	111	1	68,691	1	81	329	329
Operator and 5 FTH	2	612	141-1,084	2	116	1	23,742	1	793	891	890-891
Operator, 6 FTH, and 1 PTH	1	488	488	1	67	1	44,491	1	51	489	489
Operator and 7 FTH	1	1,290	1,290	1	67	1	8,517	....	....	1,034	1,034
Operator, 9 FTH, and 1 PTH	1	1,396	1,396	1	99	1	25,512	....	....	1,067	1,067
Total	47	.....	.....	47	.....	13	.....	24	.....	.....	.....

* FTH—Full time helper
† PTH—Part time helper

ing and guidance to employees, using employee incentives, improving plant layout, and by using labor-saving equipment.

In table 6 creameries are classified according to the combinations of personnel employed. Employment of an operator-manager and one full-time helper appears to be the most common combination with an operator-manager and two full-time helpers being the next most frequent combination.

Examination of the third column of table 6 reveals that there are wide ranges in the volume of butter manufactured by any one combination of labor. For example, one operator-manager and one full-time helper made as little as 81,000 pounds of butter on one plant while at the other extreme, the same combination of personnel made 460,000 pounds of butter. It was found that the plants that printed the most butter in 1 pound packages also employed more labor than the other plants.

Differences in wage scales account for part of the variation in labor costs. Table 7 shows the classification of creameries according to the annual salary paid to operator-managers, and relates the size of the operator's salary to the average total sales volume, and the average number of employees in the creamery. Most frequently the operator was paid between $4,000 and $5,000 per year. One operator received as little as $2,400 and at the other extreme another operator received $8,154 per year.

In general, the plants with larger sales volumes paid their operator-managers more than the smaller plants. It was also noted that, except for one case where the operator's salary was less than $3,000, the salaries paid to operators increased as the number of employees working under his supervision increased.

There was a great deal of difference among creameries in the methods used in paying operators. Three of the principal methods of payment were: (1) the straight salary; (2) salary with a commission, and (3) a commission alone. In 1954, 20 of the 46 creameries paid their operator or manager on a straight salary basis, 25 paid their operators on a salary plus a commission basis, and one creamery paid its operator a straight commission. Rates under each method of payment varied widely from plant to plant.

Additional variations occurred in the annual salary of the operator because 18 of the 46 creameries provided their operators with various non-monetary compensation—butter, cream, milk, free house rent, and life and accident insurance—in addition to regular salary and commission. These perquisites and benefits were valued by the operator from $50 to $968 a year, with the average being $296.

The quality of labor hired, length of service, experience, unionization, and location of the plant are other factors which influence the wage scale of operators, managers, and other employees. The effect of these factors was not determined.

Table 7. Relationship between operators' salary, sales volume, and the number of employees in 46 plants, 1954

Total salary	Number of creameries	Average sales volume	Average number of employees
dollars		dollars	
Less than 3,000	1	293,979	2.0
3,000-3,999	7	123,122	.9
4,000-4,999	12	298,504	1.8
5,000-5,999	9	408,890	2.2
6,000-6,999	10	514,632	2.6
7,000-7,999	4	578,146	3.3
8,000-8,999	3	480,013	3.7
Total	46	376,453	2.2

MANUFACTURING AND PACKAGING SUPPLY COSTS

The manufacturing and packaging supply category of costs includes butter packaging supplies, salt, washing powder, chemicals, fluid milk and cream containers, and several other items used in the plant operations. Manufacturing supplies and packaging costs were both included in one category because in many cases these items were not reported separately in the expense statement.

Manufacturing and packaging supplies accounted for the second largest proportion of total cost. On the average, these items constituted 15 percent of total costs.

The cost of manufacturing and packaging supplies per pound of butterfat tended to decrease as butterfat volume increased. In the case of manufacturing and packaging costs, as with labor costs, the per unit cost for the smallest volume group was lower than for the next larger volume group (table 8). The 4 plants in the smallest volume group received only farm-separated cream and manufactured butter only. Ninety percent of the butter production of these 4 plants was packaged in 64-pound fiber boxes. Therefore, packaging cost per pound of butterfat was quite low.

Table 8. Relationship between manufacturing and packaging supply costs and volume in 47 creameries, 1954

Butterfat volume	Number of creameries	Manufacturing supplies and packaging cost per pound
pounds		cents
Less than 150,000	4	1.31
150,000-299,000	9	1.74
300,000-449,000	15	1.06
450,000-599,000	13	1.04
600,000 and over	6	.97
Total	47	1.10

Manufacturing and packaging supply costs will be affected as much by the type of products the plant produces and the prices paid for supplies as they are affected by butterfat volume. For example, plants that bottle milk will have much higher packaging costs per pound of butterfat than will plants that produce only butter. Also, plants that package a large proportion of their butter

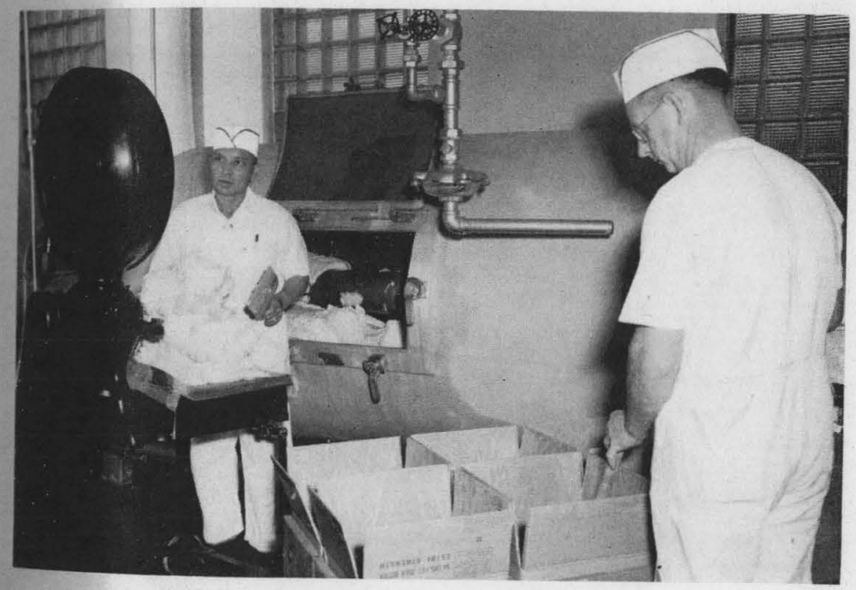

Fig 4. Butter being weighed and packed in 64 pound bulk butter boxes.

Table 9. Distribution of 47 creameries according to the cost of butter packaging materials, 1954

Cost of fiber boxes* and liners	Number of creameries	Cost of one-pound cartons	Number of creameries
cents		cents	
150.0-15.9	3	less than 1.0	6
16.0-16.9	2	1.0-1.4	3
17.0-17.9	5	1.5-1.9	20
18.0-18.9	11	2.0 and over	17
19.0-19.9	18		
20.0-20.9	5		
21.0 and over	2		
Total	46†	Total	46‡

* Fiber boxes are bulk butter boxes of 64 pound capacity.
† One creamery packaged no butter in fiber boxes.
‡ One creamery packaged no butter in one-pound prints.

output in one pound prints will have higher per unit packaging costs than plants that package all their butter in 64-pound fiber boxes.

Table 9 shows the variations in the prices paid by creameries for fiber boxes and liners and one-pound cartons. Forty-six of the 47 plants shipped butter to distant buyers. All of the butter shipped by these 46 plants was packaged in 64-pound fiber boxes. The price of the box including a parchment liner varied from a low of 15 cents to a high of 24 cents with more of the creameries paying 19 cents than any other price.

The containers for one-pound prints of butter ranged from $.002 for some plants using only a parchment wrapper to 2.4 cents for some of the plants using a printed carton and a parchment wrapper. In the majority of plants using a carton and a parchment wrapper these costs averaged 1.8 cents per package. It was observed that by careful buying of packaging supplies substantial savings may be effected.

The effect of the combination of products processed on manufacturing and packaging supply costs is shown by a comparison of these costs in plants that bottle milk as compared with plants that do not bottle milk.

In table 10 it may be seen that in spite of a much larger average butterfat volume the 13 plants with a bottling operation have manufacturing and packaging supply costs which are 60 percent higher per unit than the costs of the plants without bottling operations. The differences in the supply costs of bottling and non-bottling plants are partially accounted for by the fact that the plants which bottle milk have higher packaging costs due to fluid milk and cream container costs. Bottling plants also tend to use more chemicals and cleaning compounds than do the other plants.

Table 10. Effect of product combinations on average manufacturing and packaging supply cost per pound of butterfat for 47 creameries, 1954

Type of operation	Number of creameries	Average butterfat volume	Mfg. and pkg. supplies cost per pound of butterfat
		pounds	cents
Without bottling	34	388,508	.90
With bottling	13	564,576	1.46
Total	47	437,208	1.10

Table 11. Relationship between butterfat volume and fuel, light, power, water, and refrigeration cost per pound of butterfat for 47 creameries, 1954

Butterfat volume	Number of creameries	Fuel, light, power, water, and refrigeration cost per pound of butterfat
pounds		cents
Less than 150,000	4	1.00
150,000-299,000	9	1.12
300,000-449,000	15	.99
450,000 599,000	13	.75
600,000 and over	6	.65
Total	47	.83

FUEL, UTILITIES, AND REFRIGERATION COSTS

This category of costs includes the costs of fuel, power, light, water, and refrigeration. Table 11 shows that these costs vary considerably with butterfat volume. The lowest cost plant was a cream creamery producing only butter, which had an annual butterfat volume of 588,343 pounds and a per unit fuel and power cost of .40 cents.

In addition to volume of butterfat, other factors such as the kinds of fuel used, the prices paid for fuel and power, and differences in their utilization explain a large portion of the variation in fuel and power costs.

Coal and oil were the most commonly used fuels with 18 plants using coal, 20 using oil, and 9 using gas. The smaller volume plants used coal, while the larger plants used oil or gas (see table 12). Per unit fuel costs do not appear to vary significantly according to fuel type. This could be due to differences in the prices paid for fuel as well as to any real differences in the efficiency of the various fuels.

Table 12. Relationship between type of fuel used and fuel cost per pound of butterfat in 47 Minnesota creameries, 1954

Type of fuel used	Number of creameries	Average butterfat volume	Fuel cost per pound of butterfat
		pounds	cents
Coal	18	332,515	.46
Oil	20	489,259	.44
Gas	9	530,925	.43
Total	47	437,208	.44

The 18 plants that used coal paid from $10 to $18 per ton with most plants paying from $16 to $17 per ton for coal. The plants that used fuel oil paid from 7.4 to 14.7 cents per gallon with most plants paying 8.0 cents to 9.0 cents per gallon. Gas rates varied considerably from plant to plant depending upon quantities used, and the success of management in bargaining for lower rates. The same was true for electric rates.

Differences in the level of efficiency in the use of fuel and power accounts for a great deal of the variation in per unit fuel and power costs. Efforts on the part of management to reduce waste of fuel, power, light, water, and refrigeration can reduce these costs considerably. For example, two plants with similar type operations, one with an annual butterfat volume of 337,000 pounds, the other with a volume of 341,000 pounds, had per unit fuel and power costs of 1.33 cents and .49 cents, respectively.

DEPRECIATION COST

This category of cost includes all of the depreciation charges associated with buildings and plant equipment. Depre-

Table 13. Relationship between butterfat volume and depreciation cost per pound of butterfat in 47 creameries, 1954

Butterfat volume	Number of creameries	Depreciation cost per pound of butterfat
pounds		cents
Less than 150,000	4	.59
150,000-299,000	9	1.03
300,000-449,000	15	.88
450,000-599,000	13	.83
600,000 and over	6	.67
Total	47	.82

ciation of trucks was excluded. Depreciation was included in the costs of these plants at the same rates as shown in their audits or annual statements. Three plants did not make any provision for depreciation. For purposes of this analysis depreciation was charged against these plants at the average rate for plants of comparable size and operation.

Depreciation costs varied considerably because of differences in depreciation rates, the period when facilities were constructed or purchased, range of equipment installed in the plant, and the annual volume of output.

Depreciation cost on buildings and equipment accounted for 11 percent of total cost. Since depreciation costs are relatively fixed, the cost per unit decreases very significantly as volume of output increases. Depreciation costs decreased from 1.03 per pound of butterfat in those plants in which the annual volume ranged from 150,000-299,000 pounds to .67 cents in the plants whose butterfat volume was over 600,000 pounds annually (see table 13). The smallest volume group showed a very low depreciation cost because much of the equipment in these small plants was old and fully depreciated.

Depreciation rates charged usually were based on managers' estimates of

Table 14. Distribution of 47 creameries according to rates of depreciation taken on buildings and equipment, 1954

Depreciation rate	Number of plants reporting	
	Buildings	Equipment
percent		
0- .9	2	...
1- 1.9	7	...
2- 2.9	22	3
3- 3.9	12	1
4- 4.9	2	...
5- 5.9	2	10
6- 6.9	...	14
7- 7.9	...	9
8- 8.9	...	6
9- 9.9	...	3
10-10.9	...	1
Total	47	47

Table 15. Effect of product combinations on average depreciation cost per pound of butterfat for 47 creameries, 1954

Type of operation	Number of creameries	Average butterfat volume	Depreciation cost per pound
		pounds	cents
With bottling	13	564,576	.92
Without bottling	34	388,508	.75
Total	47	437,208	.82

the length of the service life of buildings and equipment. Table 14 shows the rates of depreciation taken on buildings and equipment by the various creameries. The average rate for all plants was 2.5 percent on buildings and 6.8 percent on equipment. The depreciation taken on the original cost of buildings ranged from .6 percent to 5.4 percent and on equipment from 2.4 percent to 10 percent.

A review of creamery depreciation schedules showed that actual rates charged on the various items of plant equipment ranged from 5 to 10 percent of original cost. It was found that churns were being depreciated at rates which varied from 5 to 10 percent, as were vats, storage tanks, separators, pumps, boilers, and other items. The actual depreciation rates charged on the creamery buildings varies from 1½ to 5 percent, depending on the type of construction. Three percent was the most common rate.

Table 16. Relationship between butterfat processed per dollar of fixed assets and depreciation cost per pound of butterfat for 47 creameries, 1954

Pounds of butterfat processed per dollar of fixed assets	Number of creameries	Depreciation cost per pound of butterfat
		cents
Less than 4.0	5	1.32
4.0-5.9	18	1.02
6.0-7.9	14	.73
8.0-9.9	7	.54
10.0 and over	3	.41
Total	47	.82

Table 17. Average cost of taxes, insurance, repairs, and miscellaneous plant expense per pound of butterfat for 47 creameries, 1954

Other plant expense	Per plant average	Cost per pound of butterfat
	dollars	cents
Taxes	1,346	.31
Insurance	557	.12
Repairs	1,277	.29
Miscellaneous plant expense	218	.05
Total	3,398	.77

Differences in the combinations of products accounted for important variations in depreciation costs per pound of butterfat. Table 15 shows that those plants with milk bottling equipment had higher per unit depreciation costs than did the plants without such equipment. The higher depreciation costs in the bottling plants occur in spite of the fact that the bottling plants show a much larger annual butterfat volume (table 15).

Another important factor that must be taken into account in explaining the variations in per unit depreciation expense is the difference in use of buildings and equipment. Efficient use of buildings and equipment depends upon the proper adjustment of the size and capacity of physical facilities to the volume of business. Because of the overestimation of the amount of butterfat available and because of increased competition for butterfat, many creameries have buildings and equipment capacity which is in excess of present or future requirements. Unused capacity results in high per unit depreciation expense.

A ratio showing the number of pounds of butterfat processed per dollar of investment in buildings and equipment was used to compare the relative efficiency of the creameries in the use of their physical facilities. The average creamery processed 6 pounds of butterfat per dollar of investment in buildings and equipment. One plant processed as little as 3 pounds per dollar invested, while on the other extreme, one plant used its plant and equipment so effectively that it was able to process 13 pounds of butterfat per dollar invested in the plant and equipment.

The effect of the differences in plant utilization is reflected in per unit depreciation costs. The five plants with the poorest utilization, those with less than 4 pounds of butterfat processed per dollar invested, showed depreciation costs of 1.32 cents per pound of butterfat as compared with .41 cents for the three plants showing the best utilization (see table 16).

OTHER PLANT EXPENSE

Other plant expense includes such items as real estate and payroll taxes, personal property taxes, insurance, repairs, and miscellaneous expenses.

Taxes averaged $1,346 per plant and were the largest item of other plant expense (table 17). Personal property and real estate taxes averaged $963 per

Table 18. Relationship between volume of butterfat and other plant expense for 47 plants, 1954

Butterfat volume	Number of creameries	Taxes and insurance	Repairs	Misc. plant expense	Total other plant expense
pounds		cents per pound of butterfat			
Less than 150,000	4	.56	.26	.10	.92
150,000-299,000	9	.50	.31	.08	.89
300,000-449,000	15	.49	.34	.05	.88
450,000-599,000	13	.42	.25	.03	.70
600,000 and over	6	.35	.27	.04	.66
All plants	47	.43	.29	.05	.77

Table 19. General and administrative expense of 47 creameries, 1954

General and administrative expense items	Annual average	Cost per pound of butterfat	Percent of total cost
	dollars	cents	percent
Director's fees	294	.07	1.0
Office salaries	1,825	.43	5.6
Office supplies	270	.06	.8
Telephone and telegraph	104	.02	.3
Audit and tax fee	187	.04	.5
Advertising, donations, and dues	951	.22	3.0
Quality program	373	.09	1.2
Bank charges and miscellaneous	503	.12	1.6
Interest	128	.03	.4
Total	4,635	1.08	14.4

plant, or 72 percent of total tax expense. Payroll taxes accounted for the balance of the total tax bill. Personal property and real estate taxes were most frequently in the range of $500 to $1,000. The average insurance cost per creamery was $557. For most plants the annual insurance cost ranged from $300 to $600.

The cost of repairs averaged $1,277 per plant. Repair costs were most frequently reported in the range of $1,000 to $2,000.

Total other plant expenses averaged .92 cents per pound of butterfat in the smallest volume group and .66 cents per pound of butterfat among the largest plants (table 18).

On a per unit basis repair costs tended to vary little over the whole range of volume. The costs of taxes and insurance decreased from .56 cents for those plants with an annual butterfat volume of less than 150,000 pounds to .35 cents for those creameries with an annual volume of 600,000 pounds or more.

GENERAL AND ADMINISTRATIVE EXPENSE

Included in this category of cost are such items as officer and director fees, office salaries, office supplies, telephone and telegraph charges, audit fees, organization dues and donations, advertising expense, bank charges, quality control expense, and numerous other small items. Interest expense was also included in this category of costs. The average dollar expenditure and the per unit cost of the various items of general and administrative expense are shown in table 19.

Office salaries accounted for the largest proportion of general and administrative expense. Annual office salaries for full time employees averaged $2,102 within a range of $1,200 to $2,760.

Interest was a very minor item of cost on a per unit basis in the creameries studied. The average creamery incurred interest expense of $128 per year. This amounted to 0.4 percent of the total operating cost. Twenty-seven of the 47 creameries used no borrowed capital. In the remaining 20 plants interest cost during the year ranged from as little as $44 to a high of $787 for a creamery which had just built a large addition to its plant.

General and administrative expense averaged 1.08 cents per pound for the 47 plants (table 20). The range in cost was from .52 cent per pound of butterfat to a high of 3.22 cents per pound. Volume explains a great deal of the variation in general and administrative expense.

Table 20. Relationship between butterfat volume and general and administrative expense in 47 creameries, 1954

Butterfat volume	Number of creameries	General and administrative cost per pound of butterfat
pounds		cents
Less than 150,000	4	.84
150,000-299,000	9	1.49
300,000-449,000	15	1.18
450,000-599,000	13	.95
600,000 and over	6	.90
Average all plants	47	1.08

TOTAL MANUFACTURING COST

The average total cost per pound of butterfat for the 47 creameries was 7.30 cents in 1954 (figure 5). The 7.30 cents included 2.70 cents of labor expense, 1.10 cents of supplies, .83 cents fuel and power expense, .77 cents of other plant expense, and 1.08 cents of general and administrative expense per pound of butterfat.

Of the 47 plants in groups A, B, C, and D, 12 received only cream, while 9 received only whole milk. The 26 remaining plants received various combinations of milk and cream. The 12 cream plants showed average total costs per pound of butterfat of 6.48 cents compared with 6.77 cents for the 9 whole milk plants.

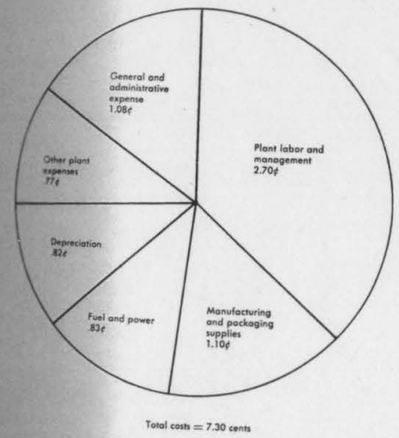

Fig. 5. Manufacturing costs per pound of butterfat in 47 creameries, 1954.

Table 21. Manufacturing costs per pound of butterfat and per pound of butter in 47 creameries, 1954

Cost items	Cost per pound of butterfat	Cost per pound of butter
	cents	cents
Plant labor and management	2.70	2.19
Manufacturing and packaging supplies	1.10	.89
Fuel and power	.83	.67
Depreciation	.82	.66
Other plant expense	.77	.62
General and administrative expense	1.08	.88
Total	7.30	5.91

Table 21 shows a comparison of the costs of these creameries on both a butterfat and butter basis. The cost per pound of butter indicates what the cost of each item would have been had all butterfat been processed into butter at an average overrun of 23.5 percent. All except 19 plants sold some butterfat in some form other than butter.

A review of creamery costs for 1955 shows that the cost per pound of butterfat processed was virtually unchanged as compared with 1954 costs.

EFFECT OF BUTTERFAT VOLUME ON TOTAL COSTS

It was found that the volume of butterfat which a creamery processes has an important effect on its total unit costs. The largest volume plants, those with an annual butterfat volume of over 600,000 pounds, had the lowest per unit cost—6.11 cents per pound of butterfat (table 22). The plants in the volume range from 150,000 to 300,000 pounds had the highest cost—9.76 cents per pound of butterfat.

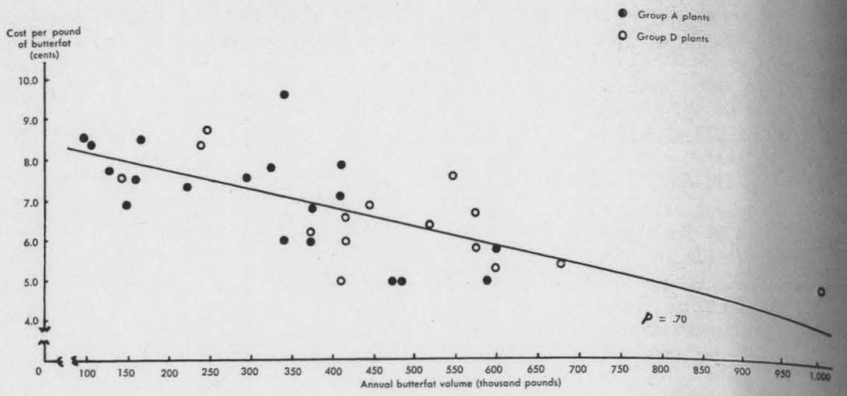

Fig. 6. Relationship between cost per pound of butterfat and annual butterfat volume for 34 creameries without bottling departments, Minnesota, 1954.

The smallest volume group, those with less than 150,000 pound butterfat volume, had total costs per unit of 7.73 cents—somewhat lower than the next larger volume group. An explanation of the somewhat lower unit costs among these small plants may be found in an examination of their labor, supply, and depreciation costs. Three of the four plants in the smallest volume group employed only an operator. It was his duty to perform all the plant operating duties, management functions, and bookkeeping work. General and administrative expenses were low among these four plants because no additional office help was employed.

The effect of volume on creamery manufacturing costs is illustrated in figures 6 and 7. The cost volume relationships for the creameries in groups A and D, those without milk bottling departments, are shown in figure 6. The plants in groups B and C, those with bottling departments, are similarly illustrated in figure 7. Each dot in the figures represent the cost-volume position of a particular plant.

For example, in figure 6 the dot located in the lower right hand corner

Table 22. Total operating cost of 47 creameries classified according to annual butterfat volume, 1954

Cost items	Annual butterfat volume in pounds					
	Less than 150,000	150,000-299,000	300,000-449,000	450,000-599,000	Over 600,000	All plants
	cents per pound of butterfat					
Plant labor and mgt.	3.07	3.49	2.94	2.59	2.26	2.70
Mfg. and pkg. supplies	1.31	1.74	1.06	1.04	.97	1.10
Fuel and power	1.00	1.12	.99	.75	.65	.83
Depreciation	.59	1.03	.88	.83	.67	.82
Other plant expense	.92	.89	.88	.70	.66	.77
Gen. and admin. expense	.84	1.49	1.18	.95	.90	1.08
Total	7.73	9.76	7.93	6.86	6.11	7.30
Number of plants	4	9	15	13	6	47

represents a plant which had an annual butterfat volume slightly over one million pounds, and a per unit cost of about 5.0 cents per pound of butterfat. After the cost-volume positions of all the plants were similarly located a statistical procedure was used to fit the line of average relationship, or line of regression, to the data.

The plants from groups A and D are on the same average cost curve (figure 6). Plants from group D, which sold large quantities of whole milk, tend to have somewhat larger volumes and lower cost positions than the plants from group A. Bulk milk sales enable a plant to handle a large additional volume of butterfat with little increase in costs.

Plants with bottling departments, those in groups B and C, are on a much higher average cost curve (figure 7) than the plants in groups A and D. It should be remembered that although costs for the plants in groups B and C are higher they are processing a product with somewhat higher value—fluid milk and cream. In consequence these plants may be operating as efficiently and profitably as those in groups A and D.

RELATIONSHIP BETWEEN CREAMERY COSTS AND VOLUME

The effect of volume of business on costs has been noted at various places in the foregoing discussion. There are two basic types of cost-volume relationships which need to be considered in any industry. These are referred to by the economist as (1) **short-run cost** and (2) **long-run cost** relationships.

Short-run cost relationships refer to the effect of volume on costs within a given plant. The level of costs within a plant depend on the intensity of use of the plant and its related resources. These costs may also be referred to as "in-plant" costs.

The long-run cost relationship refers to the effect of volume of business on costs as the size of the plant is changed.

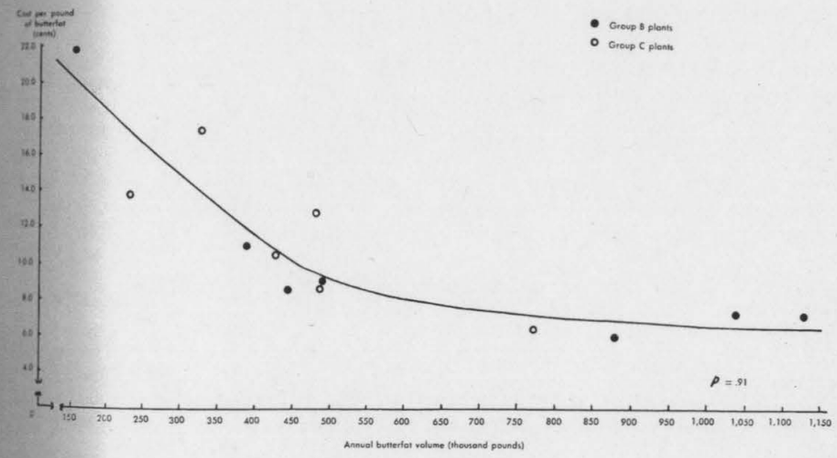

Fig. 7. Relationship between cost per pound of butterfat and annual butterfat volume for 13 creameries that bottle milk, Minnesota, 1954.

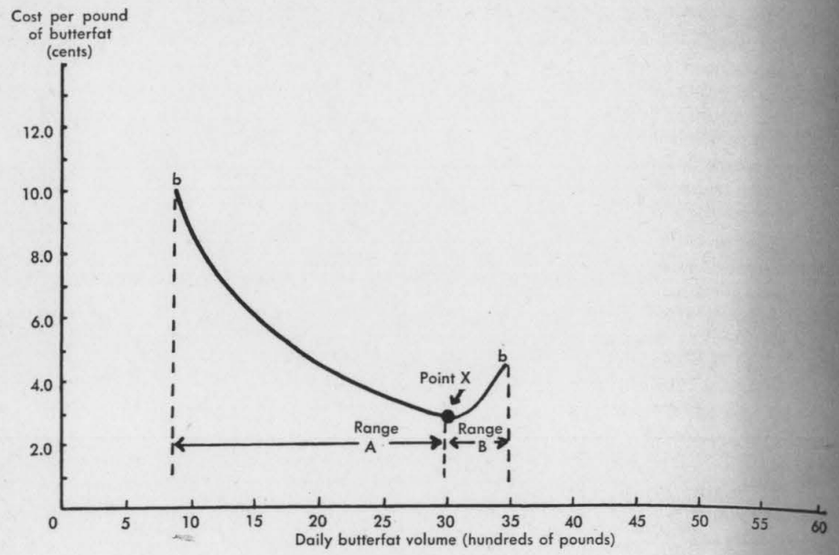

Fig. 8. A hypothetical cost-volume relationship within a plant.

Long-run costs involve a comparison of the processing costs of a series of successively larger plants. This cost-volume relationship is often referred to as "economies of size."

Because of the limitations of the accounting data available in this study and the difficulty of actually arriving at a cost-volume relationship within a plant our discussion of the in-plant costs is presented in theoretical terms.

Within a plant costs per pound of butterfat can be reduced to some point as volume is increased and more complete use is made of buildings, equipment, and other resources (see figure 8). This figure shows the typical relationship of volume and per unit cost within a given plant. It should be remembered that these costs and volumes refer to one hypothetical plant designed for a given capacity. Other plants designed for larger capacities would have their minimum cost points at much larger volumes.

Unused plant capacity causes per unit costs to be much higher than necessary. For example, our hypothetical plant was designed for minimum per unit costs at a daily volume of 3,000 pounds of butterfat (point X). When this plant is operated at lower volumes in range A, per unit costs are higher than the minimum per unit cost of 3.0 cents per pound possible at a daily volume of 3,000 pounds of butterfat.[3]

Beyond a daily volume of 3,000 pounds of butterfat in this plant per unit costs would tend to rise quite rapidly throughout range B. Costs rise in a plant as overcrowding occurs. Overcrowding results from volume increases beyond the volume for which the plant was designed.

[3] Although minimum costs are found at a daily volume of 3,000 pounds the plant would be operated at larger volumes when the price of the product was such that it was profitable.

Many creameries in Minnesota operate at less than the most efficient volumes—they have a good deal of unused capacity. For example, the building in many cases may be too large for the volume of butterfat available to them. An oversize building would cause per unit heating, lighting, cleaning, maintenance, and depreciation costs to be higher than necessary. Unused capacity of plant equipment also causes increased per unit costs. Labor also may be underemployed because of low plant volumes and thereby cause increased per unit labor costs.

From observation and comparisons of plants which are of similar size and operation it is believed that a large proportion of Minnesota's creameries are operating in the "A" range of the cost curve shown in figure 8. Increased butterfat volume would allow most creameries to achieve lower per unit labor costs, fuel and power costs, supply costs, administrative costs, and depreciation costs.

The economies-of-size cost-volume relationship is illustrated hypothetically in figure 9. The long downward sloping curve, PC, that touches each one of the U-shaped cost curves, is called a **planning curve.** Each of the U-shaped cost curves represents the in-plant, or short-run, cost curve for a particular plant. For example, the U-shaped curve labeled "bb" is the same cost curve shown

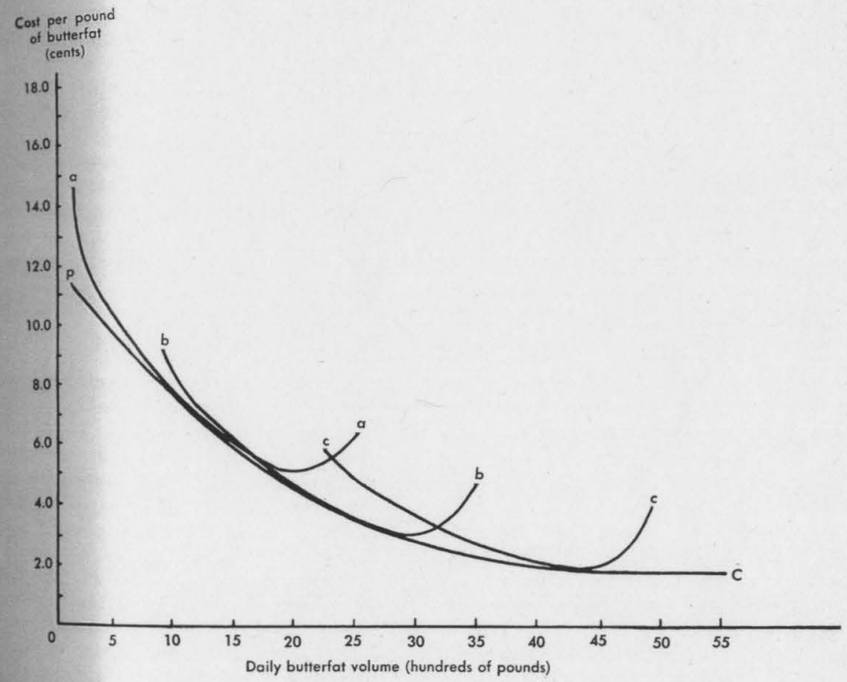

Fig. 9. A hypothetical cost-volume relationship illustrating economies of size.

in figure 8. The minimum cost-volume position for that plant is 3,000 pounds of butterfat daily at a cost of 3.0 cents per pound of butterfat. The planning curve is drawn through a series of near-minimum cost points located on the curves for individual plants.

Each point on the planning curve represents the minimum cost for processing that particular volume of butterfat. With this type of information an organization can review its present and future plant needs and select the plant from the planning curve that would best suit their prospective volume and needs. In many areas the greatest cost savings may be achieved by a reorganization of the creameries in the area. In areas where there are a large number of plants, each operating below capacity, large cost savings can be made by the consolidation of some plants into larger volume plants of more economic size. The potential cost savings from reorganizing creameries in an area into fewer and larger plants may be considerably greater than the potential cost savings possible from in-plant cost savings.

The cost curves presented in figures 6 and 7 are rough approximations of planning curves. These curves are fitted to the cost-volume positions of creameries included in this study. The curves shown in these figures differ from the theoretical planning curve in that they do not represent the near-minimum costs of processing each given volume. The curves in the figures are average curves constructed from average plant costs and lie somewhat above the theoretical planning curve.

The curves shown in figures 6 and 7 are useful in that they each show the average economies-of-size that have been achieved in some areas as the creamery industry shifted toward fewer and larger plants. The potential savings may be greater than the savings indicated by the "average planning curves" shown in the figures.

In figure 6 the cost curve decreases from 8.1 cents per pound at 100,000 pounds to 4.0 cents at one million pounds. This illustrates the potential per unit cost savings possible by building larger, more efficient plants. In figure 7 the cost curve for the plants that bottle milk decreases from 20.5 cents at a volume of 150,000 pounds to 6.4 cents at 800,000 pound volume. In each case further reductions in per unit costs may occur for volumes of butterfat beyond those shown in the charts.

MANUFACTURING COSTS PER DOLLAR OF SALES

In the preceding analysis per unit costs were based on a pound of butterfat. It was pointed out that a per unit cost analysis based on butterfat was valid only for the 47 plants which did not have sideline departments. Among plants with sideline departments a sizeable proportion of the costs and sales are attributable to the sidelines and not to dairy products. Therefore, it is essential that some common denominator, other than butterfat, be selected to facilitate a more accurate cost comparison where plants with sidelines are involved.

A per dollar of sales basis for presenting costs will facilitate comparisons of plants with sidelines. Costs per dollar of sales are calculated by dividing the total costs by the total sales. The ratio indicates the cost involved in making each dollar of sales. The differences in the size of the ratio for different creameries may be explained in part by differences in the costs and returns of various sidelines and dairy product enterprises, by differences in sales volume, and also by the general level of efficiency of the operation.

Table 25. Cost per dollar of sales in 138 creameries grouped by product combinations, 1954

Cost items	Plant groups A	B	C	D	E	F	G	H
	cents							
Plant labor and management	2.9	3.3	4.3	2.5	3.4	5.2	5.0	3.7
Manufacturing and packaging supplies	1.3	1.5	1.6	.9	1.9	3.4	2.0	1.4
Fuel and power	1.0	.9	1.1	.8	1.8	2.2	1.0	1.3
Depreciation	.8	.7	1.4	.9	1.1	1.5	1.2	1.1
Other plant expense	.9	.9	1.3	.7	1.2	1.6	1.4	1.1
General and administrative expense	1.2	1.2	1.5	1.1	1.2	1.9	2.0	1.5
Total	8.1	8.5	11.2	6.9	10.6	15.8	12.6	10.1
Number of plants	19	7	6	15	40	16	12	23
Average butterfat volume (1,000 pounds)	316	655	459	480	515	513	529	460
Sales volume (1,000 dollars)	260	611	433	430	562	640	729	531

Table 25 shows the cost per dollar of sales for each of the eight plant groups. The cost level per dollar of sales is higher among the plants with sidelines than among plants without sidelines. The plants with bottling departments and sidelines, those in groups F and G, show higher costs than do the other plants with sideline departments. The highest cost was 15.8 cents per dollar of sales found in group F. This higher cost in group F may be accounted for by the fact that group F plants had the highest proportion of sideline sales, 31.8 percent of total sales (table 26), and also operated a bottling department. The plants with a large proportion of bulk whole milk or cream sales, those in group D, show the lowest cost per dollar of sales. The bulk sales allow a large volume of product to be handled at relatively low per dollar cost.

The costs per dollar of sales of groups E, F, G, and H are affected by the value of dairy products produced, by the proportion of total sales that are sideline sales, and by the types of sidelines handled. From table 26 it is noted that the proportion of sales made as sideline sales varied from 24.1 percent in group H to 31.8 percent in group F. Table 26 also shows the proportion of plants in each group with each of 3 major sidelines.

Table 26. Sideline sales as a proportion of total sales, and the proportion of plants with three major sidelines, in four creamery groups, 1954

Group	Number of plants	Proportion of plants with sidelines: Feed	Locker	Produce	Percent sidelines sales of total sales
		percent of plants			
E	40	97.5	30.0	27.5	30.7
F	16	87.5	50.0	62.5	31.8
G	12	100.0	50.0	41.7	29.1
H	23	100.0	34.8	26.1	24.1

CREAMERY COST CHANGES, 1934 TO 1954

There has been a large increase in creamery manufacturing costs from 1934 to 1954. Factors such as higher equipment and building costs, more diversified operations, more stringent sanitary requirements, rising labor costs, and increases in the prices of nearly every item used by creameries explain the increases in these costs.

COST PER POUND OF BUTTERFAT

Table 27 shows the extent of per unit cost increases from 1934 to 1954. The average total cost of processing butterfat for the 47 plants in groups A, B, C, and D increased from 3.22 cents per pound in 1934 to 7.30 cents in 1954. Plant labor and management costs have increased the most, with an average increase of 1.72 cents per pound of butterfat. Manufacturing and packaging supply costs show an increase of only .15 of a cent per pound of butterfat for the 47 plants.

Plants in group D showed an increase in average total cost of only 3.0 cents per pound of butterfat. Plants in group D reduced manufacturing and packaging supply costs 0.2 cents per pound of butterfat. A shift to the sale of a large proportion of milk in bulk allowed the plants in group D to reduce packaging costs.

Group C showed the largest cost increase from 3.26 cents to 10.56 cents per pound of butterfat. This can be attributed to the addition of bottling departments in many of these plants. The plants of group B, those with a butter and bottling operation, also have had an increase in per unit costs, from 3.45 to 7.86 cents per pound of butter. The group B plants have had a much larger increase in butterfat volume than the plants of group C and they have much smaller bottled milk sales than plants of group C. These two factors have kept the per unit costs in group B from rising as much as the costs have risen in group C.

An effort was made to approximate the extent to which creamery cost increases in the last 20 years have been due to factors other than a rising price level. For this comparison 1934 average total costs for the 47 plants were translated into 1954 dollars, using an index of wholesale prices for all commodities

Table 27. Comparison of changes in cost per pound of butterfat in 47 Minnesota creameries, 1934 and 1954

Cost item	Plant groups A 1934	A 1954	B 1934	B 1954	C 1934	C 1954	D 1934	D 1954	Average for 47 plants 1934	1954
	cents per pound of butterfat									
Plant labor and management	.99	2.38	1.01	3.06	.83	4.03	1.02	2.24	.98	2.70
Manufacturing and packaging supplies	.91	1.03	.94	1.39	.99	1.56	.98	.78	.95	1.10
Fuel and power	.38	.82	.46	.82	.41	1.03	.35	.76	.39	.83
Depreciation	.27	.69	.36	.70	.36	1.30	.27	.80	.30	.82
Other plant expense	.22	.72	.29	.81	.31	1.20	.23	.64	.25	.77
General and administrative expense	.35	.99	.39	1.08	.36	1.44	.32	.96	.35	1.08
Total	3.12	6.63	3.45	7.86	3.26	10.56	3.17	6.18	3.22	7.30

Table 28. Comparison of changes in cost per pound of butterfat of major cost items for 47 Minnesota creameries in constant dollars, 1934 and 1954

Cost item	1934	1954
	cents per pound of butterfat	
Plant labor and management	2.00	2.70
Management and packaging supplies	1.94	1.10
Fuel and power	.80	.83
Depreciation	.61	.82
Other plant expense	.51	.77
General and administrative expenses	.72	1.08
Total	6.58	7.30

other than farm products and food.[4] It was found by comparing the 1934 and 1954 indices, 1934 costs had to be increased by 204.46 percent to be equivalent to 1954 dollars. In terms of constant dollars, the 47 plants show average total costs of 6.58 cents per pound of butterfat in 1934 as compared with 7.30 cents in 1954 (table 28).

Costs have risen during the period 1934 to 1954 for reasons other than the price level increase. The 0.72 cents increase in average total costs shown in table 28 can be accounted for mainly by changes in the operations of these plants over the 20-year period. Greater diversification in products processed and

Table 29. Comparison of changes in cost per dollar of sales in 138 creameries, 1934 and 1954

Cost item	Plant groups A 1934	A 1954	B 1934	B 1954	C 1934	C 1954	D 1934	D 1954
	cents							
Plant and labor management	1.6	2.9	1.6	3.3	1.3	4.3	1.7	2.5
Manufacturing and packaging supplies	1.5	1.3	1.5	1.5	1.6	1.6	1.6	.9
Fuel and power	.6	1.0	.7	.9	.6	1.1	.6	.8
Depreciation	.5	.8	.6	.7	.6	1.4	.4	.9
Other plant expenses	.3	.9	.5	.9	.5	1.3	.3	.7
General and administration expense	.6	1.2	.6	1.2	.6	1.5	.5	1.1
Total	5.1	8.1	5.5	8.5	5.2	11.2	5.1	6.9

Cost item	Plant groups E 1934	E 1954	F 1934	F 1954	G 1934	G 1954	H 1934	H 1954
	cents							
Plant labor and management	1.5	3.4	1.7	5.2	1.8	5.0	1.7	3.7
Manufacturing and packaging supplies	1.4	1.9	1.3	3.4	1.4	2.0	1.4	1.4
Fuel and power	.6	1.8	.6	2.2	.8	1.0	.9	1.3
Depreciation	.5	1.1	.5	1.5	.6	1.2	.6	1.1
Other plant expenses	.4	1.2	.5	1.6	.5	1.4	.4	1.1
General and administration expense	.5	1.2	.6	1.9	.6	2.0	.5	1.5
Total	4.9	10.6	5.2	15.8	5.7	12.6	5.5	10.1

[4] Statistical Abstract of the United States, 1955, U. S. Department of Commerce, table 370, page 313.

the shift from farm-separated cream to whole milk receipts have had effects on all cost items. Milk handling required increased labor and increased investment and thus resulted in greater labor and depreciation costs.

General and administrative expense increased because of more record keeping arising from additional services to patrons. For example, in some creameries patrons arrange for several deductions to be made from their milk check for the payment of feed bills, artificial breeding fees, payments on loans, and other purposes.

Manufacturing and packaging supply costs have declined for three principal reasons. First, the per unit packaging cost of bulk butter has decreased with the shift from butter tubs to fiber boxes. Second, the increase in bulk milk sales reduced packaging costs considerably. And, finally, technological improvements in cleaning compounds and disinfectants have caused per unit costs of these items to fall.

CHANGES IN COST PER DOLLAR OF SALES

Table 29 shows cost per dollar of sales in 1934 and 1954 for the major expense items for the eight groups of plants. The largest cost increase, 10.6 cents, occurred in group F. This group had the largest proportion of sideline sales and also had bottled milk departments. Group D plants, those that produced butter and sold bulk milk, showed the lowest increase in cost per dollars of sales—0.9 cents increase per dollar of sales. Group D sold a substantial proportion of their butterfat receipts as bulk milk and cream and as a result were able to reduce supply costs by 0.8 cents per dollar of sales between 1934 and 1954.

SUMMARY AND CONCLUSIONS

Some very significant changes have taken place in the Minnesota creamery industry over the past 20 years. The number of plants decreased from 870 in 1935 to 542 in 1956. The plants which have remained in business have increased their butterfat and sales volume.

Among the 138 creameries included in this study annual average butterfat volume increased from 322,942 pounds in 1934 to 480,291 pounds in 1954. The operations of these 138 plants have changed greatly. There has been considerable diversification in dairy products processed and diversification into various sideline enterprises.

The total sales volume of the 138 plants averaged $521,402 in 1954—over 4 times the average sales volume of 1934. Sideline sales increased from 6.6 percent of the total sales in 1934 to 17.3 percent in 1954.

There was a very substantial shift to milk receiving during the 20-year period. In 1934 less than 1.5 percent of the plants received over 20 percent of their butterfat receipts in milk compared with 76 percent of the plants in 1954.

Analysis of the costs of 47 creameries without sideline departments showed that total manufacturing costs averaged 7.30 cents per pound of butterfat in 1954. Labor accounted for 37 percent of the total manufacturing cost or 2.70 cents per pound of butterfat. Factors responsible for variations in labor costs were volume of output, kinds of products produced, wage rates, and the efficiency with which labor was used. The labor cost per pound of butterfat was highest

Fig. 10. Milk receipts are being weighed and sampled.

in the 150,000 to 300,000 pound volume group—3.49 cents per pound—and lowest among the plants in the largest volume group—at 2.26 cents per pound of butterfat.

Manufacturing and packaging supply costs averaged 1.10 cents per pound of butterfat for the 47 plants. This was the second largest item of processing cost—accounting for 15 percent of the total.

Fuel, utilities, and refrigeration costs averaged 1.00 cent per pound of butterfat among plants with an average butterfat volume of less than 150,000 pounds. Among the largest plants, those with over 600,000 pounds of butterfat, the fuel, utilities, and refrigeration costs averaged .65 cents per pound of butterfat. Depreciation costs accounted for 11 percent of the total processing cost among the 47 plants and averaged .82 cents per pound of butterfat.

General and administrative expense averaged 1.06 cents per pound of butterfat. The largest item of general and administrative expense was office salaries, which averaged $1,825 per plant. Annual office salaries for a full-time employee ranged from a low of $1,200 to a high of $2,760.

The total cost of processing butterfat in the 47 creameries ranged from 6.11 cents per pound of butterfat in the largest volume group (plants over 600,000 pounds annually), to 9.76 cents in the 150,000 to 300,000 pound volume group. The smallest volume plants, those with less than 150,000 pounds butterfat annually, averaged 8.93 cents per pound of butterfat.

There has been a considerable increase in the average total cost of processing butterfat over the last 20 years. In 1934 the average total cost per pound of butterfat in the plants included in this study was 3.22 cents compared with 7.30 cents in 1954.

In a large number of cases the principal reason for high per unit processing costs was low volume. In some instances considerable cost reductions could be achieved by increasing the intensity of use of the given plant. In other cases all the plants in an area may be designed for such low volumes that large cost savings may be achieved only by

rebuilding into fewer and larger plants to achieve economies-of-size.

Creamery costs generally can be reduced substantially by increasing efficiency in all phases of creamery operation. The importance of competent management and leadership in efficient creamery operation cannot be overstressed. Much more attention should be given to the wise selection of managers, to their training, and to providing incentives for their improvement.

Labor cost reductions can be achieved by better utilization of the labor force. Improvements in the output per hour of labor can be achieved by the addition of labor saving devices in many cases; in others the improvement of plant layouts will achieve large savings in labor cost. Better employee training programs can be important in reducing labor costs.

Manufacturing and packaging supply costs can be reduced by careful purchasing—by making careful comparisons of supply prices quoted by various companies and taking advantage of quantity discounts when it is feasible. Careful planning to avoid wastes in the use of fuel, power, and refrigeration can be a source of important savings in operating costs. General and administrative costs can be reduced by developing efficient bookkeeping systems that reduce the labor requirements in this line.

Depreciation costs per pound of butterfat can be reduced by more intensive use of the facilities. In many cases plants are operating at volumes which are far too low relative to capacity. Low volumes have the effect of increasing not only per unit depreciation cost but also result in higher unit costs all along the line.

In many cases important savings for dairy farmers could be effected if a group of creameries in a given area reviewed their needs and then reorganized their plants for the most efficient operation. This may involve closing the least needed plants and concentrating the butterfat available in the area in a few larger and more efficient organizations. Although large cost savings may be obtained by improved operation within existing plants, in many areas even larger savings could be effected by bringing together and reorganizing a group of plants.