LABOR INPUT REQUIREMENTS AND EFFICIENCY OF A MULTI-PRODUCT DAIRY PROCESSING PLANT AS DETERMINED BY A RATIO-DELAY ANALYSIS

by

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INTRODUCTION

Background

Fluid milk markets seldom receive the exact quantities of milk needed for bottling uses.[1] This situation arises because of the difficulty of equating daily, seasonal, or yearly production with consumer demand for bottled milk products. In order to cover bottling needs in the periods of smallest producer output, surpluses tend to be produced in other periods.[2]

Historically, surpluses rather than shortages have dominated milk markets of the Midwest. This problem has become more important nationally with the increasing importance of fluid milk markets under Federal Milk Marketing Orders. According to Williams,

> In 22 North Central markets that had been regulated by Federal Orders since 1950 or before, only 63 per cent of the milk received from producers was used in bottled milk products in 1955. Utilization in bottled products in 1955 was two percentage points above the average for the preceding five years. A 1954 study in the Northeast showed 65 per cent of the inspected milk produced in that region used in bottled milk and cream (12).

As these markets further develop, the magnitude of surplus milk promises to continually grow with them. Accordingly, this will lead to serious problems in the marketing of fluid milk.

Types of Surplus

There are several types of fluid milk surplus. Day-to-day surpluses

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[1] Fluid milk is milk that is produced under health regulations which will allow it to be used in bottled milk products.

[2] In a general way, surplus milk is defined as that part of the fluid milk supply not consumed as fluid milk. This milk is diverted into the production of other dairy products such as ice cream, butter, cheese, evaporated milk and dry milk (6). Although it is of the same quality, surplus milk does not come under the same health regulations for processing as does fluid milk.

have developed in recent years due to every-other-day delivery and day-to-day variation in sales through stores. Supermarket sales vary a great deal, especially just before a weekend when consumer sales are particularly heavy. The problem of day-to-day surpluses are met in part by carrying producers' milk over from light to heavy bottling days. This practice is limited by holding capacity, quality considerations, and health regulations.

Seasonal surplus results from a rather wide variation in milk production from season to season. Typically milk production is highest in the spring, tapers off during the summer until a low is reached in early winter, then increases until the high is again reached in the spring. In contrast, sales of fluid milk are rather constant over the year. The extra milk received from producers during the spring and summer months above the fluid needs plus an "operating reserve" is referred to as seasonal surplus.[1]

Periodic surplus is the surplus in a market in a given month, which varies from year to year. This amount is the surplus which can not be explained by day-to-day or seasonal variations in supply.

SETTING

After World War II, many producers' associations found they no longer could control the entry of producers into a market area. Even though the market was adequately supplied with fluid milk, dealere would by-pass the producers' association to obtain more fluid milk by adding new producers without the consent of the producers' association. Generally, this milk went into surplus uses whieh resulted in a reduction in the blend price of milk and

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[1]Operating ressrve is the supply of fluid milk necessary to meet day-to-day fluctuations in demand for fluid milk.

a decline in the bargaining power of producers' associations. In the Midwest, this additional milk was primarily diverted into the production of high quality ice cream products which were normally manufactured from lower quality manufacturing milk. As a result, dealers supplying this better quality product were in a favorable position to compete with dealers in other areas who were unable to obtain the necessary quantities of fluid milk, at comparable prices, for this product. This tended to destroy the marketing structure of the existing markets in some areas.

With the bargaining power of the producers' associations reduced, further downward pressure on milk prices developed and market stability was decreased. Due to this situation, producers and other interested parties in the South Central section of the United States requested the United States Department of Agriculture to investigate the price determining procedures and the problems associated with the handling of surplus milk in their area. As a result of this request, the Department of Agriculture is currently studying the over-all problem of surplus milk pricing and handling in this area. A continuation and expansion of this study is now underway in the North Central Region under the direction of representatives of the NCM-12 Technical Committee on Dairy Marketing Research.

One method that could be used to provide some insight into the problems associated with the marketing of surplus milk would be to construct synthetic models of different marketing structures. The effects of a great number of changes in the market institutions of a particular market could then be analyzed and evaluated with the assumed goal of society to be profit maximization and economic efficiency.

As implied earlier, the two dominant power groups most often found in

surplus milk market areas are the dealers and the producers' marketing associations. The first power group to be considered is the producers' marketing association. It consists of a number of producers cooperatively banded together to market their milk.[1] The extent of producer participation in ths association influencss its bargaining power. If all producers are members of an association, the association may have a dominant role in setting price and dstermining how much milk sach dealer will receive. This is especially true if the producers' association has facilities for handling surpluses, or if it has an agreement with one dsaler for handling all of its surplus.

The other power group normally present is either one dominant dealer or a group of dealers acting under a tacit agreement regarding price and market sharing. This arrangement can be particularly harmful to producers if there is a definite lack of cooperation among producers.

There can be all kinds of market agreements and degrees of influencing power by producers and dealers in a market. The powers or effects of these power groups and their rslative importancs in synthetic models leads to an income distribution or welfare problem. Becauss of ths value judgements explicit in this type of analysis and the lack of economic tools and models necessary for proper evaluation, this study will not attempt to prssent the proper balancs of powers necessary for the most efficisnt mcthod of handling surplus milk under any market structurs or group of market structurss.

With the assumptions of a continuing supply of surplus milk, it seems dssirabls to empirically identify and study the institutions in several market

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[1] Producers' associations often carry on other activities for their members, such as checking weights and performing butterfat tests. Some producer groups also have facilities for processing their own surplus milk.

areas in a framework of economic efficiency. A study of this kind would attempt to determine the effect of changes in the alternative methods of handling various volumes of surplus milk with a given set of institutions. It would also provide some insight into the most efficient method of handling surpluses under a given market structure. This synthesis would then yield information as to the most efficient system of handling surpluses under different market structures.

Even with the most efficient system of handling surpluses under different market structures, there is no assurance that savings would be passed on to consumers. This is true because of the monopoly elements present in some institutions within certain market structures. However, this information would be very desirable in making policy decisions affecting producers, dealers, and consumers. It is within this framework that this study is confined. Major emphasis in this study will be directed towards providing "building block" data on costs for the types of synthetic analysis discussed above.

OBJECTIVES

The major objective of this study was to provide fixed and variable labor requirements, by skill categories, for basic processes and products of a large multi-product dairy processing plant, handling the largest portion of surplus milk from a large Federal Order market.

The second objective was to provide estimates of the electrical, steam, and refrigeration requirements by processes and products for each major piece of equipment used in this plant.

The third objective was to briefly analyze the labor efficiency by basic processes and by individual workers within each basic process.

The fourth objective was to adequately describe each basic process as to the work elements required and equipment used.

The fifth objective was to evaluate the use of ratio-delay methodology in a flexible milk processing plant.

SCOPE OF STUDY

As a part of the North Central Regional study, the Department of Agricultural Economics at Kansas State University selected for study, one particular market structure handling surplus milk. Within the market structure, the existing market institutions were defined. Almost all institutions, such as the Federal Milk Marketing Order, existing health regulations, the producers' association, bargaining arrangements, etc., were held constant. All other processing plants and the existing degree of technology were also held constant. Within this structure, the one selected milk processing plant, handling the largest share of surplus milk under the existing market structure, was analyzed by a detailed cost of production study.[1] A major objective of the broader study is to determine the most efficient method of marketing surplus milk in the market previously mentioned. Although knowledge of the cost structure of the plant is not a sufficient condition for evaluating economic efficiency, it is a necessary one. This thesis is a part of the cost of production study.

The most significant single item of cost in a dairy processing plant is labor. It has been estimated that 60 per cent of the total cost in a milk processing and bottling plant could be attributed to labor (2). In 1957, labor in plant A accounted for approximately 40 per cent of the total operating cost.

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[1] The one selected multi-product dairy processing plant will hereafter be referred to as plant A.

While major emphasis of this study will be placed on labor, other components of cost such as electricity, steam, and refrigeration will be discussed. In this analysis, it seemed desirable to present these inputs in physical terms, whenever possible, for each major piece of equipment or basic process in plant A. A basic process was defined as a complete operation on a product, from the time a decision was made to perform this operation, until the operation was completed and the product in such a state that it could have had alternative uses in its present form.

From the input requirements of each piece of equipment or basic process, unit product requirements can be calculated for basic processes. A synthesis of these requirements will yield the total input requirements per unit of product produced in plant A.

The methodology used to gather information for determining labor input requirements was also used to analyze the general labor efficiency of plant A. The labor efficiency analysis was confined to the relative labor efficiency by basic processes and individual workers within basic processes. By definition, the labor efficiency analysis is relevant only to plant A, but the methodology used in determining the relative labor efficiency can be adapted to fit the needs of many other jobs and industries.

MODEL

A general description of the economic model as to the independent and dependent variables within the given market structure was outlined in the scope of the study. As explained earlier, this study is a detailed cost of production analysis of a large multi-product dairy processing plant.

For most economic analysis of this kind, it is convenient to divide physical inputs into fixed and variable categories. For this analysis, fixed

inputs were defined to be constant for a production run. Here a production run was defined as a complete processing cycle involving setting up equipment, processing, disassembling, and cleaning equipment. Limits were set to the length of a production run by restraints such as length of work day, market requirements, and technical considerations. Technical restraints such as the need for periodic cleaning and maintenance of equipment, quality considerations, equipment capacities, technical supervision, and the existing degree of technology were considered limiting. The output of a production run varied widely from a minimum practical level to the limits imposed by the restraints previously mentioned.

The general form of the functional relationship expressing inputs in physical terms for a particular process is given as follows:

$$Y_{ij} = a_{ij} + b_{ij} X_j ,$$

and

i = factor 1 through factor n,

j = process 1 through process 37,

where

Y_{ij} = total input of factor i in physical terms for process j and output X_j for a particular production run,

a_{ij} = physical inputs of fixed factor i for process j for a production run,

b_{ij} = physical inputs of variable factor i for process j per unit of output X_j ,

X_j = units of output of product in physical units for process j for a particular production run.

Assuming constant variable requirements over the output range possible for a particular production run, this general equation will express the physical fixed and variable inputs required for a production run for any process in plant A.

METHODOLOGY

General Description of the Ratio-Delay Technique

The ratio-delay technique was originated and developed by L. H. C. Tippett, a statistician, in the British textile industry in 1935.[1] Tippett concluded that if random observations were taken on a worker, the number of observations falling into various work classifications would be in proportion to the amount of time expended on each of these work classifications (10).

This technique was virtually ignored until some years later when Robert R. Morrow applied it in the United States under the name of ratio-delay. Morrow further developed the technique and proved it a highly practical statistical technique for obtaining the percentage of time machines or workers were in operation or productive (7). Using ratio-delay, he determined the area of gross inefficiency in three different industries.

Since Morrow's adaptation, the ratio-delay method has steadily grown in popularity in this country. It is now used in a great variety of jobs and industries. It appears to the author that the present refinements of ratio-delay will enable its growth in popularity to continue to encompass an even larger portion of labor-efficiency studies.

The advantages of a ratio-delay study are numerous, some of which are (5):

1. It gives a maximum of information in a minimum of time. It generally costs from 33 to 80 per cent less than traditional stopwatch time-studies (1) and (3).

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[1] Ratio-delay is a random-observation, time-study technique. It is also called snap-reading, activity analysis, activity sampling, work-sampling, and when photographic equipment is used, memomotion or memomotion analysis.

2. One can study any section or part of an operation or plant desired.
3. It doesn't interfere as much with normal plant operations as do the typical time-study or production-study techniques.
4. It can show the variability within a job or process by observing the activities over a period of time.
5. It allows supervisors to define and evaluate specific jobs and to participate in the study.
6. It is accepted by most labor unions.

There are some limitations to a ratio-delay study which should be presented, such as (5) and (11):

1. It can not be used for micro levels of behavior.
2. It does not show employee efficiency, that is, the rate or speed at which a worker works.
3. It is subject to "observer effect" when a worker is influenced by the presence of the observer.

Performing a ratio-delay study is similar to many other problems in that one starts by stating the objectives of the study, then planning the study, making the study, and finally evaluating and presenting the results of the study.

Objectives of the Study. The primary objective of most ratio-delay studies is to reduce the amount of non-productive labor and increase the productive. A secondary objective might be to determine specific labor requirements of jobs or machines.

Planning the Study. A ratio-delay study involves everyone in the plant from top management who makes the decision to have the study, to supervisors and observers who make the study, to the working personnel being studied. Everyone must be informed of the study to mitigate any ill feelings that might develop due to insufficient knowledge.

Once the decision has been made to make the study, specific job or work classifications must be precisely defined, a plant layout drawn, the necessary forms prepared, and the observers trained (8). It is best if these jobs are performed by line supervisors in cooperation with the study director. Supervisors are in the best position to know their respective areas of work, and they can evaluate the work being done ae they take the observations. They may also take stepe to eliminate obvious diseconomies of operation (5). The next step is for the observere to use the plant layout to determine observation points and to become thoroughly familiar with the route, the obeervation pointe, and the workere normally stationed in each work area.

The recording forms are a neceesary part of the preliminary work. They must be of sufficient sizs to define the work categoriee with precision, provide enough space to record one day's observatione, and give the time for etarting each round of observations as predetermined by a random sampling scheme. It is essential that observatione be taken at random to eliminate systematic errors.[1] The number of observations necessary each day will depend on the information desired, the nature of the operation, and the time allocated for the study.

Making thc Study. It is extremely important for the observer to record exactly what he eees upon reaching an observation point. He must not anticipate what the worker will be doing or what he has been doing. The observer should not always follow the same route, as thie leads to "conditioning" the workers to look busy when the observer entere the area. If the sampling plan has been

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[1] Systematic errors are those arising from taking obeervations on a regular schedule and having a worker or machins on the eame operating cycle or schedule.

randomized properly, the proportion of time spent in each work category can be estimated.

A pilot study is desirable to familiarize the observere and workers with the study. With around 400 observations the pilot study can give a good overall index of performance which might allow for groeely inefficient work areae to be corrected before the study is continued. It will aleo allow the recording forms to be adjusted as necessary to become more functional.

After all necessary adjustments are completed, the study proceeds with observers taking obeervations at predetermined timee.

Evaluating the Study. In evaluating the data, there are two important criteria--validity and reliability. Validity means being able to justify the results by eupportable evidence; here there is no eubstitute for precision in setting up the study and gathering the data. Reliability ie the confidence that can be placed on the results. In the case of ratio-delay, it is primarily governed by the number of observations and the probabilities of different work classifications as they approach either 0.0 or 1.0 from 0.5 according to the binomial frequency distribution.[1]

In the case of ratio-delay, the estimate of the ratio of time spent in one work category to the time spent in all work categories is taken by a ratio of observations. Thie involves a sampling process, and as such, the estimates of the true ratios are subject to sampling error. For a large sample, the magnitude of the sampling error can be measured as follows:

$$\sigma_{\hat{p}} = \sqrt{\frac{\hat{p}\ (\ 1 - \hat{p}\ )}{n}}\ ,$$

[1]For a complete description of the binomial theorem as applied to ratio-delay see reference (5), chapters 6, 7, and 8.

where

$\sigma_{\hat{p}}$ = standard error of $\hat{p}$,

n = total number of observations, and

$\hat{p}$ = estimate of the probability ratio of one event.

For large sample, it is assumed that $\hat{p}$ is approximately normally distributed. With a one in 20 chance of error, it can be expected that the true ratio of the number of observations taken in any one work classification will be within $2\sigma_{\hat{p}}$ units of $\hat{p}$. Therefore, the per cent error can be calculated by the following formula:

$$e = \frac{200\sqrt{\frac{\hat{p}\,(\,1-\hat{p}\,)}{n}}}{\hat{p}} = 200\sqrt{\frac{(\,1-\hat{p}\,)}{n\,\hat{p}}}$$

where

e = the error given in per cent,

$\hat{p}$ = estimate of the probability ratio of the event, and

n = total number of observations.

Using the error formula given above, the number of observations necessary to be within a given sampling error can be determined as follows:

$$n = \frac{4\,(\,1-\hat{p}\,)}{\left(\frac{e}{100}\right)^2 \hat{p}} .$$

For example, workers in a certain labor classification are observed productive 70 per cent of the time and idle 30 per cent of the time. Assuming 95 per cent confidence limits, the number of observations necessary to be assured that the true population percentage is within $\pm$ five per cent of the sample estimate of the population percentage would be as follows:

$$n = \frac{4\,(.30)}{\left(\frac{5}{100}\right)^2 (.70)} = 686 .$$

This is the number of observations necessary for the 95 per cent confidence limits given above.

After the sample size is determined for a particular confidence level, the degree of confidence to be attained can be determined by equating the value of the additional information received with the cost of gathering additional information (4). Here again, the objectives of the study play a dominant role. After the desired confidence level is reached, the results of the study can be presented in a variety of ways depending on what decisions are to be made and who will make them. The most commonly used methods of presentation are tables, charts, and various kinds of graphs.

On the basis of the study, management may decide to make some changes in order to reduce the areas of gross inefficiency. After the desired changes are effectuated, a continuation of the study may be in order to appraise the effects of the changes. The new probability ($\hat{p}'$) is calculated and tested for significance against the old probability ($\hat{p}$) for the same process or job. The test for significance could be one of many non-parametric tests such as the chi-square or analysis of variance tests.[1]

The relationship of the time spent in various categories can be used to estimate the total labor requirements thereof. The total labor requirements of a particular process can then be divided by the total production for a given period to give the estimated labor requirements for some standard unit of product. This is a very desirable and inexpensive method of determining unit costs. There are a number of other uses for a ratio-delay study such as determining the efficiency of workers or machines in different work categories, and determining

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[1] For a description of the chi-square and analysis of variance tests for significance see reference (9), pages 18-26 and 90-91.

the exact flow of products through a plant. The possibilities are only limited by the disadvantages given earlier.

Determining Utility Requirements [1]

After the basic procesees in plant A were defined, operating information was obtained for each piece of equipment used in each process. The name, manufacturer, model, serial number, capacity, and utility requirements (whenever possible) were obtained for each piece of equipment by inspecting the manufacturer's plate on each piece of equipment, by examining equipment inventory cards from the plant's files, and by direct correspondence with equipment manufacturers. After the equipment information was assembled, utility requirements were calculated by two Mechanical Engineering etudents under the direction of members of the Mechanical and Agriculture Engineering Departments of Kansas State University.

Steam and refrigeration requirements were calculated on a unit of output basis wherever possible. If not on a unit of output basis, these requirements were calculated for a particular process as one unit. Steam and refrigeration requirements are given in Btu's per unit. Electrical requirements were calculated for each motor at a given level of efficiency from engineering handbooks. Electrical requirements are given in kilowatts per hour of machine running time.[2] It was assumed that the utility requirements per unit of operating time were constant at some given level of efficiency for the output range possible for a

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[1] Utility requirements covered in this study include electricity, steam, and refrigeration.

[2] The method of calculating unit costs for steam, refrigeration, and electricity ie available upon requeet from the Agricultural Economics Department, Kansas State University, Manhattan, Kansas.

production run in any particular process in plant A. The specific utility requirements for each piece of equipment, by processes in plant A, are given in Appendix I, Tables 39 through 68.

EMPIRICAL INVESTIGATION

Plant Selection

The general background for this study was given in the scope of the study. The particular market structure selected for study was determined on the basis of a judgement sample. The reasons for selecting this particular market structure were: -1- it was a relatively large Federal Order market in the Midwest, -2- it was a fairly "tight" or compact market, -3- it was of such a nature that one milk processing plant handled most of the surplus milk, -4- it had a well organized producers' association, -5- it was a well organized market, -6- institutions within the market had been very cooperative in previous studies, and -7- this particular market structure was better identified and understood due to the factors mentioned above.

Selection of the one dairy processing plant within the selected market structure was also done by a judgement sample. Due to the institutional arrangements of the dairy processing plants in the market, it seemed best not to select the plant at random.

Once the market structure and the dairy processing plant within this market were selected, the plant's management was consulted. The management was very receptive to a study of this type; therefore, the cost of production study of plant A was inaugurated.

Sampling Procedure Within Plant A

Before undertaking the actual ratio-delay study, it was necessary to become familiar with the physical layout of plant A. The first step undertaken was to determine the physical flow of product inputs through each piece of equipment to final products. The flow of products through plant A is given in Plats I; and the identification of the equipment, plant areas, and products illustrated in Plate I, are enumerated in Table I.

The second step was to decide the scope of this phase of the study. Due to practical limitations, it was decided to include only the physical cost of producing products by basic processes in plant A from the time inputs entered the plant until final products were in trucks ready for shipment.[1] The costs of assembling the inputs, distributing final products to wholesalers or retailers, and general control are included in another phase of the general study.

The next step was to precisely define each work element within each process. As given earlier the definition of a basic process was a complete operation on a product, from the time a decision was made to perform this operation, until the operation was completed and the product in such a state that it could have had alternative uses in its present form. An example might be the process of receiving can milk. Once the milk entered the plant, it was pumped to storage tanks. Management here had the choice of either selling the raw milk or further processing it in the plant.

The advantages of defining basic processes as a complete and separate

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[1] This study did not include any functions performed by truck operators, but it did include all shipping functions performed by regularly employed plant personnel.

EXPLANATION OF PLATE I

Schematic diagram showing the movement of basic products through successive processes to final outputs, plant A, August-September, 1957. Legend is given in Table 1.

PLATE I

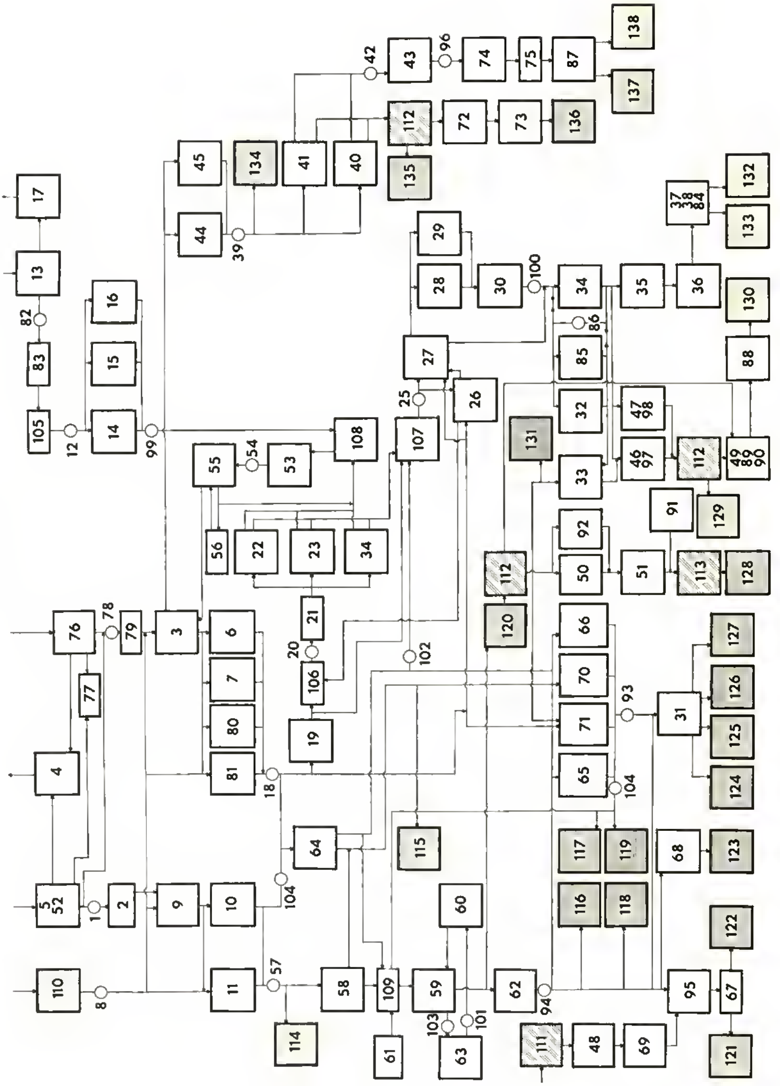

Table 1a. Identification and description of equipment, areas, and final products presented in Plate I, plant A.

Code	Item	Capacity	Electricity*	Steam *	Refrigeration*
1	Milk pump	3 h.p.	X		
2	Pressure filter				
3	Plate heat exchanger	21 plates			X
4	Milk can washer	13 cans/min.	X	X	
5	Milk intake pan	100 gal.			
6	Storage tank	5,000 gal.	X		
7	Storage tank	5,000 gal.	X		
8	Milk pump	20,000 lbs./hr.	X		
9	Plate heat exchanger	20,000 lbs./hr.			X
10	Storage tank	3,000 gal.	X		
11	Storage tank	2,000 gal.	X		
12	Cream pump	½ h.p.	X		
13	Dump tank	100 gal.			
14	Twin-coil pasteurizer	500 gal.	X	X	X
15	Twin-coil pasteurizer	500 gal.	X	X	X
16	Twin-coil pasteurizer	500 gal.	X	X	X
17	Cream can washer	3 cans/min.	X	X	
18	Milk pump	3 h.p.	X		

Table 1a (cont.) Identification and description of equipment, areas, and final products preeented in Plate I, plant A.

Code	Item	Capacity	Electricity	Steam	Refrigeration
19	Plate heat exchanger	17 plates		X	
20	Milk pump	7½ h.p.	X		
21	Pressure filter				
22	Separator	10,000 lbs./hr.	X		
23	Separator	10.000 lbs./hr.	X		
24	Separator	10.000 lbs./hr.	X		
25	Milk pump	5 h.p.	X		
26	Bleeder heater				
27	Tubular heater	20,000 lbs./hr.		X	
28	Hot well	1,000 gal.			
29	Hot well	1,000 gal.			
30	Two stage evaporator	18,000 lbs./hr.	X	X	
31	Carton machine	35 cartons/ min.	X	X	X
32	Storage vat	550 gal.	X		X
33	Storage tank	2,000 gal.	X		X
34	Plate heat exchanger	20,000 lbs./hr.		X	X
35	Homogenizer	15 h.p.	X		
36	Spray drier	1,200 lbs./hr.	X	X	

Table 1a (cont.) Identification and description of equipment, areas, and final products presented in Plate I, plant A.

Code	Item	Capacity	Electricity	Steam	Refrigeration
37	Cyclocentric screen and bagger		X		
38	Electric hoist		X		
39	Milk pump	1 h.p.	X		
40	Churn	4,200 lbs.	X		
41	Vane churn	5,200 lbs.	X		
42	Milk pump	3 h.p.	X		
43	Storage tank	1,500 gal.	X		
44	Storage tank	1,000 gal.	X		X
45	Storage tank	1,000 gal.	X		X
46	Cheese vat	10,400 lbs.	X	X	
47	Chease vat	10,400 lbs.	X	X	
48	Case washar	10 cases/min.	X	X	
49	Mixing vat	30 gal.			
50	Mixing vat	50 gal.	X		
51	Continuous fraazar	80 gal./hr.	X		X
52	Weighing tank	1,000 lbs.			
53	Vacuumizer and pump	3½ h.p.	X		
54	Milk pump	1 h.p.	X		
55	Tubular heater	8,000 lbs./hr.		X	
56	Pressure filter				

Table 1a (cont.) Identification and description of equipment, areas, and final products presented in Plate I, plant A.

Code	Item	Capacity	Electricity	Steam	Refrigeration
57	Milk pump	2 h.p.	X		
58	Standardizer clarifier	1,000 gal./hr.	X		
59	Short-time pasteurizer	1,000 gal./hr.		X	X
60	Homogenizer	25 h.p.	X		
61	Vitamin dispenser		X		
62	Storage tank	2,000 gal.	X		X
63	Vacuumizer and pump	3 h.p.	X		
64	Separator	300 gal./hr.	X		
65	Processing vat	300 gal.	X	X	X
66	Processing vat	300 gal.	X	X	X
67	Seal-on machine	32-50 bottles/ min.	X		
68	Carton machine	25 cartons/min.	X	X	X
69	Bottle washer	24 bottles/min.	X	X	
70	Processing vat	100 gal.	X	X	
71	Processing vat	200 gal.	X	X	
72	Butter printing machine	1,000 lbs./hr.	X		

Table 1a (cont.) Identification and description of equipment, areas, and final products presented in Plate I, plant A.

Code	Item	Capacity	Electricity	Steam	Refrigeration
73	Butter wrapping machine	1,200 lbs./hr.	X		
74	Roller drier		X		
75	Pulverizer		X		
76	Weigh tank and milk intake pan	1,000 lbs.			
77	Vacuum sampler and pump	¼ h.p.	X		
78	Milk pump	3 h.p.	X		
79	Pressure filter				
80	Storage tank	5,000 gal.	X		
81	Storage tank	4,000 gal.	X		
82	Cream pump	1½ h.p.	X		
83	Pressure filter				
84	Sewing machine		X		
85	Storage vat	550 gal.	X		X
86	Milk pump	2 h.p.	X		
87	Bagger				
88	Filler and capper	35-45 bottles/ min.	X		
89	Cheese mixer		X		

Table 1a (concl.) Identification and description of equipment, areas, and final products presented in Plate I, plant A.

Code	Item	Capacity	Electricity	Steam	Refrigeration
90	Cheese mixer hoist		X		
91	Fruit feeder		X		
92	Mixing vat	50 gal.	X		
93	Milk pump	½ h.p.	X		
94	Milk pump	½ h.p.	X		
95	Bottling machine	18-24 gal./min. 33 ⅓ gal./min.	X		
96	Milk pump	½ h.p.	X		
97	Cheese vat agitator	½ h.p.	X		
98	Cheese vat agitator	½ h.p.	X		
99	Milk pump	3/4 h.p.	X		
100	Extraction pump	3 h.p.	X		
101	Milk pump	1½ h.p.	X		
102	Milk pump	½ h.p.	X		
103	Milk pump	3 h.p.	X		
104	Milk pump	2 h.p.	X		
105	Surge tank	20 gal.			
106	Surge tank	40 gal.			
107	Surge tank	40 gal.			
108	Surge tank	40 gal.			
109	Surge tank	30 gal.			

*Specific requirements are given in Appendix I, Tables 39 through 68.

Table 1b. Identification and description of equipment, areas, and final products presented in Plate I, plant A.

Code	Plant Areas
110	Bulk receiving
111	Receiving glass bottles and cases
112	Cold storage*
113	Ice cream hardening room*

*Refrigeration requirements are given in Appendix IV.

Table 1c. Identification and description of equipment, areas, and final products presented in Plate I, plant A.

Code	Product	Unit size
114	Raw, cooled, Grade A milk	10 gallons
115	Raw, cooled, Grade A cream	10 gallons
116	Pasteurized Grade A milk	10 gallons
117	Pasteurized Grade A cream	10 gallons
118	Pasteurized Grade A milk	Five-gallon dispenser cans
119	Chocolate milk	Five-gallon dispenser cans
120	Ice cream mix, ice milk mix, sherbet mix, cheese dressing	10-gallon cans
121	Whole milk	One-gallon glass jugs
122	Whole milk, orange drink, grape drink	One-half gallon glass
123	Whole milk	One-half gallon paper
124	Whole milk, chocolate milk, skim milk, buttermilk, half and half, whipping cream	Quarts paper
125	Half and half	Pints paper

Table 1c (concl.) Identification and description of equipment, areas, and final products presented in Plate I, plant A.

Code	Product	Unit size
126	Whole milk, chocolate milk	One-third quart paper
127	Whole milk, chocolate milk, whipping cream, half and half	One-half pint paper
128	Ice cream, ice milk, sherbet	Two-and-one-half gallons, one-half gallon, pints
129	Cottage cheese curd	10-gallon cans
130	Creamed cottage cheese	Five pounds, two pounds, 12 ounces
131	Condensed whole or skim milk	10-gallon cans
132	Dry whole milk or non-fat dry milk	100-pound bags
133	Dry whole milk or non-fat dry milk	220-pound barrels
134	Pasteurized Grade C cream	10-gallon cans
135	Bulk butter	64-pound boxes
136	Packaged butter	One-pound cartons, one-pound quarters, one-half pound quarters
137	Dried buttermilk	100-pound bags
138	Dried buttermilk	220-pound barrels

operation on various products seems obvious. On economic grounds, the definition used provided decision making points within plant A and a choice criteria for management to make decisions at these points. It also provided "building block" material for developing synthetic analyses to be used in this study or other studies of a similar nature.

Work elements within each process were developed by the study director in cooperation with the plant superintendent and assistant superintendent. Work elements were defined as specific work tasks performed within each process. Work elements were grouped together within departments according to divisions of labor. The divisions of labor were classified as variable, fixed--other than maintenance, fixed--maintenance, and idle time according to the requirements thereof.[1] Departments (an aggregation of divisions of labor) were defined as major operations within each basic process. This gave a process labor classification by departments (major operations within a process), divisions of labor (variable, fixed, and idle), and work elements (specific work tasks). This labor classification is given for each process in the detailed process descriptions found in Appendix I.

The ratio-delay study of plant A fairly well followed the procedure given in the previous section. In preparation of the ratio-delay study, a layout of equipment and areas of the plant were drawn to determine the best observation points for each process. In order to keep the identity of plant A unknown, the layout of plant A is not given in this study. Instead, a layout developed by French of a dairy processing plant showing equipment, areas, and workers is

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[1]Fixed--maintenance was work done for the care and maintenance of the equipment and area surrounding the equipment in each process while fixed--other than maintenance was work such as hooking up or cleaning equipment which was fixed for a production run.

given in Plate II as an example of the type used in this study (3). In addition to the above, this layout shows the route followed by the person taking the labor-performance observations and the observation points.

Using the plant layout, flow diagram, labor classification data, and detailed process descriptions; recording forms were developed and the observers trained. The recording forms, examples of which are given in Appendix III, listed each department and work element within each process. The forms provided for classifying each observation taken on a worker as to whether the worker was productive or delayed. Delay was further categorized into avoidable, unavoidable, and loafing. Avoidable delay was defined as breakdowns or work stoppage in the observed process which could and should have been avoided by proper maintenance and operation of equipment in the observed process. Unavoidable delay was work stoppage in the observed process due to work stoppage in some prior process upon which the observed process was dependent for its product or supplies. The recording forms were tried in plant A for two days while the observers were becoming accustomed to the observation route and jobs performed by each worker. After the trial period, the observers were able to identify each worker by an assigned number and were adequately familiar with the plant to formally start the study.

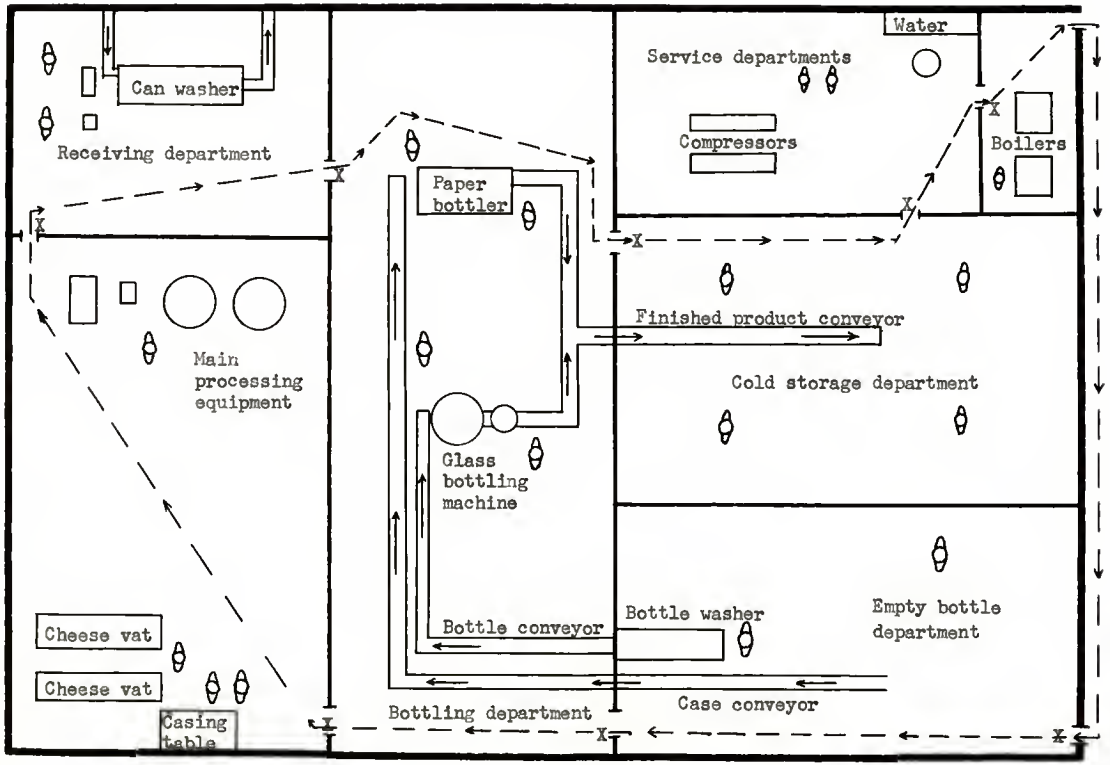
It was decided to take as many observations as possible during the normal eight-hour working day. It took approximately 17 minutes to complete one round of observations covering all areas of the processing part of the plant. In order to randomize the sample and reduce systematic errors, numbers from one to five were drawn at random to determine the number of minutes each observer would wait from the time one round of observations was completed until the next round was started. The route was frequently reversed during each sample day in order to reduce the observer effect which is inherent in this type of

EXPLANATION OF PLATE II

Schematic diagram of a hypothetical milk processing plant layout showing major equipment, areas, and employees (indicated by circles). Dash-line shows path followed by person making labor-performance observations, and X's indicate some logical observation points.

Source: French, Charles E., "Fast and Simple Sampling Method for Checking Labor Performance", Food Engineering, April, 1957, p. 64.

PLATE II


Can washer
Receiving department
Paper bottler
Service departments
Water
Compressors
Boilers
Finished product conveyor
Main processing equipment
Cold storage department
Glass bottling machine
Cheese vat
Cheese vat
Casing table
Bottle conveyor
Bottle washer
Empty bottle department
Bottling department
Case conveyor

study.

With the observers recording exactly what each worker was observed doing upon reaching an observation point, the labor study continued for 21 working days during the months of August and September, 1957.

Method of Determining Labor Requirements for Plant A

After the necessary labor-study tabulations were completed for workers and processes, all workers appearing in each process were classified into skill categories. Skill class 1 (supervisory labor) could perform any job in the plant. Skill class 2 could perform any task requiring a lower skill class, but not a task which required supervisory decisions. Skill class 3 could perform tasks requiring more than a general knowledge of the particular operation, but not those tasks requiring a higher skill class. Skill class 4 was defined as general labor, and these workers could do only those jobs which did not require special training or knowledge. These skill categories were determined on the basis of pay schedules established by the plant manager. It was believed this would be the best classification since a worker's ability and experience was generally remunerated accordingly.

Within the labor classification previously given, labor input requirements in minutes were estimated for fixed and variable labor by skill classes within each process. In order to give the fixed requirements performed by workers normally assigned to a process, only the fixed--other than maintenance type of labor was included in deriving the fixed coefficients.[1] Each fixed and variable skill-class coefficient was calculated by one of the following formulas:

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[1] Fixed--maintenance was usually performed by workers assigned to the maintenance department. It was not always required for each production run.

for variable requirements,

$$V_{bj} = \frac{\frac{TV_{bj} - LV_{bj}}{T_b} \cdot M_b}{P_j}$$

and for fixed requirements,

$$F_{bj} = \frac{\frac{TF_{bj} - LF_{bj}}{T_b} \cdot M_b}{R_j}$$

where

V_{bj} = minutes of variable labor required for skill class b in process j per unit of product,[1]

F_{bj} = average minutes of fixed labor required for skill class b in process j per production run,

TV_{bj} = total variable observations in skill class b for process j,

LV_{bj} = variable loafing observations in skill class b for process j,

TF_{bj} = total fixed observations in skill class b for process j,

LF_{bj} = fixed loafing observations in skill class b for process j,

T_b = total observations in skill class b for all processes,

M_b = total minutes worked for all workers in skill class b for all processes during the sample period,[2]

P_j = total product handled in process j during the sample period,[3]

R_j = number of production runs for process j during the sample period.

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[1]The unit of product varies from one process to another according to what was believed to be the most commonly used unit in the dairy industry.

[2]Total minutes worked for all workers during the sample period were obtained from time cards kept by plant A.

[3]Total product handled in each process was obtained from plant A's production records.

Labor coefficients derived by the formulas given above did allow for fatigue and personal allowances since workers were not observed during their two allowable 15 minute breaks and while attending to personal needs. These coefficients estimate the minutes of fixed and variable labor required for each of the four skill classes in each process of plant A. A summation of the skill class requirements of each process gives the total fixed and variable labor requirements for each process. Assuming constant requirements of the variable labor over the output range possible for a production run, these formulas will express the minutes of labor required for a production run for any process in plant A.

A brief description of each process and its labor requirements are given in the following section. It is believed that these labor coefficients are applicable to plant A; beyond this no inference is intended. Some coefficients in this study are in close agreement with those of other studies; this is true because many operations in milk processing plants are similar as to volume, layout, and types of equipment used.

DESCRIPTION AND LABOR REQUIREMENTS OF PROCESS ANALYSIS

Process I. Receiving Can Milk

Process I covered receiving, cooling, and storage of all Grade A and Grade C milk entering the plant in 10-gallon cans. Three workers were usually assigned to receive can milk. A total of 2,565 observations were taken on all workers observed in this process.

Variable labor included opening cans with a rubber mallet, grading milk by organoleptic inspection, dumping cans of milk into the dump tank, recording the weight of each producer's milk, sampling each producer's milk, washing milk cans using a mechanical can washer, and making routine checks of the first-

holding tank (Table 2).

Fixed labor included providing supplies to the process as needed, setting up equipment, and cleaning equipment and area surrounding the equipment.

Table 2. Minutes of labor required per 100 pounds of milk received in cans, plant A, receiving an average of 31,200 pounds of milk each production run, August-September, 1957.[1]

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	-	0.0029
2	155.3598	0.4300
3	325.5587	0.7424
4	195.0495	0.6278
Total[2]	675.9680	1.8030

[1]Production run was defined as a complete processing cycle including setting up equipment, processing, disassembling, and cleaning equipment.

[2]Throughout this paper, the totals may not equal the sum of their parts due to rounding.

Process II. Receiving Bulk Milk

Process II included receiving, cooling, and storage of all Grade A or Grade C milk entering the plant by bulk trucks. One worker was usually assigned to receive bulk milk. A total of 54 observations were taken on all workers observed in this process.

Variable labor included hooking up the plant intake milk pipe to the bulk truck, pumping milk from the truck tank to first-holding tanks in the plant, taking a sample of milk, unhooking the milk pipe from the truck tank, and making routine checks of the pumping process (Table 3).

Fixed labor in this process included setting up and cleaning the equipment.

Table 3. Minutes of labor required per 100 pounds of milk received in bulk, plant A, receiving an average of 73,009 pounds of milk each production run, August-September, 1957.

Skill class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	-	-
2	3.6046	0.0167
3	122.2578	0.0753
4	61.7522	0.0875
Total	187.6147	0.1795

Process III. Receiving Can Cream

Process III included receiving and storage of all route or station cream entering plant A (all cream entered in 10-gallon cans). Three workers were usually assigned to receive can cream. A total of 1,954 observations were taken on all workers observed in this process.

Variable labor included opening cans with a rubber mallet, grading cream by organoleptic inspection, dumping cream from cans into the dump vat, recording the weight of each producer's cream, sampling each producer's cream, washing cream cans using a mechanical can washer, stacking empty cream cans, and making observations of the coil vats into which cream was pumped (Table 4).

Fixed labor included providing supplies as needed, setting up equipment, and cleaning equipment and area surrounding the equipment.

Table 4. Minutes of labor required per 100 pounds of cream received in cans, plant A, receiving an average of 2,885 pounds of cream each production run, August-September, 1957.

Skill class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	-	-
2	28.8702	1.5929
3	116.8962	10.1319
4	161.7475	9.4778
Total	307.5138	21.2026

Process IV. Separating Grade C Milk

Process IV included all separation and processing activities from the time Grade C milk left the first-holding tanks until skim milk was in the separator surge tank and cream was in cream holding tanks. One worker was usually assigned to separate milk. A total of 288 observations were taken on all workers observed in this process.

Variable labor included observing and adjusting equipment in the process as necessary for efficient operation and, occasionally, canning cream in 10-gallon cans as it came from the separators (Table 5).

Fixed labor included setting up equipment, hooking up pipe lines to the equipment, and cleaning equipment and area surrounding the equipment.

Table 5. Minutes of labor required per 100 pounds of milk separated, plant A, separating an average of 48,658 pounds of milk each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	-	-
2	17.5463	0.0305
3	272.0411	0.9054
4	161.0295	-
Total	450.6169	0.1259

Process V. Condensing Operation

Process V included pre-heating, condensing, cooling, and storage of condensed skim milk or whole milk. If the product was to be dried, it was not cooled but pumped to drier surge tanks. Products included Grade A and Grade C whole milk and Grade C skim milk. One worker was usually assigned to condense milk. A total of 703 observations were taken on all workers observed in this process.

Variable labor included all activities necessary to forewarm the product and those activities necessary to evaporate and store the product (Table 6).

Fixed labor included hooking up pipes and equipment, setting equipment into an operational state of readiness, and cleaning equipment and area surrounding the equipment.

Table 6. Minutes of labor required per 100 pounds of condensed milk, plant A, producing an average of 17,115 pounds of condensed milk each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	2.8175	0.1262
2	38.8413	0.1321
3	399.8079	0.9159
4	169.8435	-
Total	611.3102	1.1743

Process VI. Condensing Transfers

Process VI included only those activities necessary to fill 10-gallon cans with condensed milk and to transport filled cans to the south cold room. Two workers were usually assigned to transfer condensed milk. A total of 221 observations were taken on all workers observed in this process.

Variable labor included transporting empty cans to the condensed storage tank, adjusting condensed milk to tho desired per cent solids by adding water, filling 10-gallon cans with condensed milk, and transporting filled cans of condensed milk to the south cold room (Table 7).

No fixed labor was involved in this process as cleaning the storage tank was assigned to Process V (Condensing Operation).

Table 7. Minutes of labor required per 100 pounds of condensed milk transferred to storage, plant A, transferring an average of 4,325 pounds of condensed milk each production run, August-September, 1957.

Skill class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	-	0.0241
2	-	0.9306
3	-	1.6868
4	-	0.3605
Total	-	3.0021

Process VII. Selling Condensed Milk

The only labor involved in this process was variable labor needed to transport 10-gallon cans of condensed milk to the conveyor in the south cold room and to place these cans on the conveyor. Loading the truck from the conveyor was performed by the truck operator, and he was not observed in this study (Table 8). Two workers were usually assigned to help load out condensed milk. A total of 52 observations were taken on all workers observed in this process.

No fixed labor was charged to this process.

Table 8. Minutes of labor required for filling and selling a can of condensed milk, plant A, selling an average of 66 cans of condensed milk each production run, August-September, 1957.[1]

Skill class	Fixed labor per production run	Variable labor per can
	(minutes)	(minutes)
1	-	0.0258
2	-	0.2246
3	-	0.3603
4	-	0.2483
Total	-	0.8590

[1]A 10-gallon can was defined to contain 93 pounds of condensed milk.

Process VIII. Spray-Drying Operation

Process VIII included heating condensed milk (either skim or whole), pumping condensed milk to the dryer, and drying. One worker was usually assigned to the drying operation. A total of 1,007 observations were taken on all workers observed in the process.

Variable labor included observing and adjusting the equipment used in this process as necessary for efficient operation (Table 9).

Fixed labor included hooking up pipes and equipment, setting equipment into an operational state of readiness, changing equipment to handle another product, and cleaning equipment and area surrounding the equipment.

Table 9. Minutes of labor required per 100 pounds of spray-dried milk, plant A, drying an average of 6,877 pounds of dry milk each production run, August-September, 1957.[1]

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	-	-
2	10.3749	0.0217
3	445.6016	2.5929

Table 9 (concl.). Minutes of labor required per 100 pounds of spray-dried milk, plant A, drying an averags of 6,877 pounds of dry milk each production run, August-September, 1957.[1]

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
4	924.7026	0.0099
Total	1,380.6791	2.6245

[1]Dry milk includes both non-fat dry milk and dry whole milk. All dry milk is spray-dried.

Process IX. Packaging Dry Milk

Process IX included all activities necessary to package and seal dry milk (either skim or whole) in 220 pound barrels or 100 pound plastic lined bags and to prepare packages for storage. One worker was usually assigned to package dry milk. A total of 504 observations were taken on all workers observed in this process.

Variable labor included transporting barrels and bags to the packaging area; labeling packages as to fat, solids-not-fat, and weight; adding plastic liners to packagss; positioning packages under the filler; filling packages; sampling one package in forty for laboratory use; sealing packages; and providing other supplies to the processs as needed (Table 10).

Fixed labor included setting up pipes and equipment, setting equipment into an operational state of readiness, and cleaning equipment and area surrounding the equipment.

Table 10. Minutes of labor required per 100 pounds of dry milk packaged in 100 pound bags or 220 pound barrels, plant A, packaging an average of 6,877 pounds of dry milk each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	-	-
2	-	0.0217
3	74.5616	2.3805
4	207.2295	1.5170
Total	281.7911	3.9193

Process X. Storing Dry Milk

Process X included those activities necessary to move barrels and bags of dry milk from the packaging location to the storage area and those activities necessary for stacking. One worker was usually assigned to store dry milk. A total of 181 observations were taken on all workers observed in this process.

Variable labor included transporting barrels and bags of dry milk to storage, stacking, and returning the empty dolly from the storage area to the packaging area (Table 11).

Fixed labor included taking inventory of products in storage and rearranging products in storage as needed for ease of handling or for prevention of falling.

Table 11. Minutes of labor required per 100 pounds of dry milk stored, plant A, storing an average of 6,877 pounds of dry milk each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	-	-
2	4.4798	0.0217

Table 11 (concl.). Minutes of labor required per 100 pounds of dry milk stored, plant A, storing an average of 6,877 pounds of dry milk each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
3	30.8630	0.5023
4	220.1393	0.4064
Total	255.4821	0.9305

Process XI. Shipping Dry Milk

Process XI included all activities necessary to move bags or barrels of dry milk from the storage area into a truck at the loading dock. Three workers were usually assigned to load out dry milk. A total of 280 observations were taken on all workers observed in this process.

Variable labor included preparing the loading dock for loading, preparing the truck for hauling, loading the dolly with product, transporting the loaded dolly into the truck, stacking the product in the truck, and transporting the empty dolly back to the storage area (Table 12).

Fixed labor was not included in this process.

Table 12. Minutes of labor required per 100 pounds of dry milk shipped, plant A, shipping an average of 7,718 pounds of dry milk each production run, August-September, 1957.[1]

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	-	0.0885
2	-	-
3	-	0.9265
4	-	2.9320
Total	-	3.9470

[1]Dry whole milk and non-fat dry milk in 100 pound bags and 220 pound barrels.

Process XII. Processing and Storing Route Cream

Process XII included activities performed from the time cream entered the coil vats until the cream was neutralized, pasteurized, vacuumized, cooled, and stored in holding tanks in preparation for churning. One worker was usually assigned to process route cream. A total of 272 observations were taken on all workers observed in this process.

Variable labor included dumping returned butter and cream into the coil vats, testing cream for acidity, adding neutralizer to cream, and observing and adjusting equipment as necessary for efficient operation (Table 13).

Fixed labor was not recorded for this process. Cleaning of equipment and area surrounding equipment used in this process was charged to Process XIV (Buttermaking).

Table 13. Minutes of labor required per 100 pounds of 40 per cent cream processed and stored, plant A, processing and storing an average of 7,370 pounds of cream each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	-	0.0121
2	-	1.6836
3	-	0.0890
4	-	0.0299
Total	-	1.8146

Process XIII. Selling Pasteurized Cream

Process XIII included activities necessary to fill 10-gallon cans with cream, to transport cans to the south cold room, and to load cans on the conveyor in the south cold room. Two workers were usually assigned to help load out cream. A total of 104 observations were taken on all workers observed in

this process.

Variable labor included transporting empty 10-gallon cans to cream holding tanks, taking a sample of cream for butterfat tests, filling cans, transporting full cans to the south cold room, and placing full cans on the conveyor leading to a truck (Table 14).

Fixed labor was not charged to this process. As the volume of cream sold was insignificant compared to the amount churned, cleaning of equipment used in this process was charged to Process XIV (Buttermaking).

Table 14. Minutes of labor required for filling and selling a 10-gallon can of 40 per cent cream, plant A, selling an average of 32 cans of cream each production run, August-September, 1957.[1]

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	-	0.2195
2	-	0.7585
3	-	0.7375
4	-	0.6546
Total	-	2.3701

[1]A 10-gallon can was defined to contain 83 pounds of 40 per cent cream.

Process XIV. Buttermaking

Process XIV included activities necessary to churn and store butter. Three workers were usually assigned to buttermaking. A total of 1,956 observations were taken on all workers observed in this process.

Variable labor included taking a sample of cream for a butterfat test; filling the churn; churning; preparing baskets and boxes to receive butter; adding butter color and sale; working butter, testing butter for fat, moisture, and salt content; pulling butter from the churn; weighing and recording the

weight of the butter; filling baskets or boxes; transporting butter to the south cold room; transporting empty dolly back to churning area; pumping buttermilk to a storage tank; and providing supplies to the process as necessary (Table 15).

Fixed labor included cleaning equipment and area surrounding the equipment used in Processes XII, XIII, and XIV; sanitizing churns; and hooking up pipes and equipment used in this process.

Table 15. Minutes of labor required per 100 pounds of butter churned, plant A, churning an average of 2,404 pounds of butter each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	19.7719	3.8239
2	257.0679	5.3029
3	120.0591	11.7508
4	128.3089	3.0350
Total	525.2077	23.9126

Process XV. Selling Bulk Butter

Process XV included only variable labor involved in moving 64-pound boxes of butter from stacks in storage onto the conveyor in the south cold room. The truck operator loaded his own truck, and he was not observed in this study (Table 16). Two workers were usually assigned to help load out bulk butter. A total of 66 observations were taken on all workers observed in this process.

No fixed labor was assigned to this process.

Table 16. Minutes of labor required per 64-pound box of butter prepared for sale, plant A, selling an averags of 22.5 boxss of butter each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per box
	(minutes)	(minutes)
1	-	-
2	-	0.1817
3	-	0.8681
4	-	1.5880
Total	-	2.6378

Processs XVI. Printing and Wrapping Butter in Individual Quarters--Ons Brand Only

Process XVI included all activities necessary to print, wrap, case, and transport to the north cold room individually wrapped quarters of butter in one-half pound or one-pound cartons. Two workers were usually assigned to print and wrap butter. A total of 186 observations were taken on all workers observed in this process.

Variabls labor included transporting baskets of butter from the south cold room to the print room, cutting butter into small chunks, operating butter printer, opsrating butter wrapper, packaging butter in one-half or one-pound cartons, casing butter, recording the amount of butter cartoned, transporting casss of butter to the north cold room, and providing supplies to the procsss as necessary (Table 17).

Fixed labor included hooking up equipment, taking inventory of butter in the cold room, and cleaning equipment and area surrounding the squipmsnt.

Table 17. Minutes of labor required per 100 pounds of butter packaged in individually wrapped quarters, plant A, packaging an average of 512 pounds of butter in individually wrapped quarters each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	-	-
2	-	-
3	25.4032	41.7137
4	2.3483	30.4186
Total	27.7516	72.1323

Process XVII. Printing and Wrapping Butter--Exclusive of the Special Brand of Process XVI

Process XVII included all activities necessary to print, wrap, case, and transport to the north cold room all butter except that in Process XVI. Butter was packaged in the following type cartons: -1- one-pound parchment wrapped, -2- one-pound parchment wrapped in cartons, -3- one-pound individually wrapped quarters, and -4- one-half pound individually wrapped quarters. Two workers were usually assigned to print and wrap butter. A total of 816 observations were taken on all workers observed in this process.

Variable labor included transporting baskets of butter from the south cold room to the print room, cutting butter into small chunks, operating butter printer, operating butter wrapper, wrapping butter by hand, packaging butter in one-half or one-pound cartons, casing butter, recording the amount of butter cartoned, transporting cases of butter to the north cold room, and providing supplies to the process as necessary (Table 18).

Fixed labor included hooking up equipment, taking inventory of butter in the cold room, and cleaning equipment and area surrounding the equipment.

Table 18. Minutes of labor required per 100 pounds of butter packaged in various size containers, plant A, packaging an average of 1,356 pounds of butter each production run, August-September, 1957.[1]

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	-	-
2	-	-
3	46.0586	27.9725
4	7.6046	27.5832
Total	53.6632	55.5557

[1]Container sizes included: -1- one-pound parchment wrapped, -2- one-pound parchment wrapped in cartons, -3- one-pound individually wrapped quarters, and -4- one-half pound individually wrapped quarters.

Process XVIII. Processing Cottage Cheese

Process XVIII included all activities necessary to pasteurize, cool, manufacture, and store cottage cheese by the long-set method. Two workers were usually assigned to make cottage cheese. A total of 844 observations were taken on all workers observed in this process.

Variable labor included observing the pasteurization and cooling operations, filling cheese vats with skim milk, preparing starters, performing various tests on skim milk and curd, cutting curd, cooking curd, draining whey, hauling whey from processing area, filling 10-gallon straight-sided cheese cans with curd, and transporting cans of cottage cheese to the south cold room (Table 19).

Fixed labor included hooking up equipment and pipes, sanitizing equipment, and cleaning equipment and area surrounding the equipment.

Table 19. Minutes of labor required per 100 pounds of milk products used in producing cottage cheese, plant A, processing an average of 10,075 pounds of milk products each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	2.6836	0.0399
2	129.3617	2.8551
3	30.3909	0.5279
4	18.4011	0.4383
Total	180.8372	3.8613

Process XIX. Packaging Cottage Cheese

Process XIX included the following activitiee: -1- moving cans of cottage cheese to the packaging area, -2- packaging cottage cheeee in five, two, or three-fourths pound cartons, and -3- transporting cartons to the north cold room. Two workers were usually assigned to package cottage cheese. A total of 1,859 observations were taken on all workers observed in this process.

Variable labor included transporting cans of cottage cheese to the packaging area, providing supplies and cartons to the process as necessary, dumping cans into the mixing vat, mixing salt and dressing with the curd, packaging creamed cottage cheeee, repackaging creamed cottage cheese in different size containers, casing cartons, and transporting cases of cartons to the north cold room where they were ready for sale (Table 20).

The only fixed labor involved wae cleaning the mixing vat and the packaging table. Plant and equipment maintenance were charged to Procese XVIII (Processing Cottage Cheese).

Table 20. Minutes of labor required per 100 pounds of cottage cheese packaged in five, two, or three-fourths pound cartons, plant A, packaging an average of 1,654 pounds of cottage cheese each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	-	0.0568
2	-	6.6775
3	-	1.4974
4	60.8011	53.1170
Total	60.8011	61.3487

Process XX. Processing Ice Cream Products

Process XX included all activities necessary to make various flavors of ice cream, ice milk, and sherbet from mix stored in the south cold room or in the Grade A handling room. One worker was usually assigned to process ice cream products. A total of 353 observations were taken on all workers observed in this process.

Variable labor included transporting mix to freezer vats, flavoring and coloring the mix, providing supplies as necessary, loading mix into the freezer, operating the continuous freezer, and transporting empty 10-gallon cans to the can washing area (Table 21).

Fixed labor included hooking up pipes and equipment, keeping records of formulas and production data, and cleaning equipment and area surrounding the equipment.

Table 21. Minutes of labor required per gallon of ice cream processed, plant A, processing an average of 364 gallons of ice cream products each production run, August-September, 1957.[1]

Skill Class	Fixed labor per production run	Variable labor per gallon
	(minutes)	(minutes)
1	-	-

Table 21 (concl.). Minutes of labor required per gallon of ice cream proceesed, plant A, processing an average of 364 gallons of ice cream producte each production run, August-September, 1957.[1]

Skill Class	Fixed labor per production run	Variable labor per gallon
	(minutes)	(minutee)
2	0.7949	0.0066
3	-	0.0054
4	206.0272	0.3238
Total	206.8221	0.3358

[1]Products include ice cream, ice milk, and sherbert.

Process XXI. Packaging and Storing Ice Cream Products

Process XXI included all activities necessary to package ice cream, ice milk, or eherbet into 2½ gallon, one-half gallon, pint, cup, or brick containers and to etore full containers in the ice cream hardening room. Two workers were usually assigned to package and store ice cream products. A total of 1,380 obeervations were taken on all workers observed in this procees.

Variable labor included providing supplies ae necessary, assembling cartons, positioning cartons under the outlet nozzle, filling cartons, checking carton weights, closing tops of cartone, placing cartone in paper sacks, cutting or elicing individual slices, stamping or decorating individual slicee, and wrapping or unwrapping individual slices (Table 22).

Fixed labor included changing from one eize container to another, rearranging products in the cooler, taking inventory of the cooler, and cleaning equipment and area eurrounding the equipment.

Table 22. Minutes of labor required per gallon of ice cream products packaged and stored, plant A, packaging and storing an average of 364 gallons of ice cream products each production run, August-September, 1957.[1]

Skill Class	Fixed labor per production run	Variable labor per gallon
	(minutes)	(minutes)
1	-	-
2	2.3839	0.0940
3	-	-
4	94.3712	3.0330
Total	96.7552	3.1270

[1]Products include ice cream, ice milk, and sherbet.

Process XXII. Selling Ice Cream

Process XXII included only variable labor involved in moving ice cream, ice milk, or sherbet products from the hardening room onto the conveyor in the south cold room. The truck operator loaded his own truck, and he was not observed in this study (Table 23). A total of 23 observations were taken on the one worker observed in this process.

Fixed labor was not assigned to this process.

Table 23. Minutes of labor required per gallon of ice cream products prepared for sale, plant A, selling an average of 459 gallons of ice cream each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per gallon
	(minutes)	(minutes)
1	-	-
2	-	-
3	-	-
4	-	0.0671
Total	-	0.0671

Process XXIII. Selling Raw Milk--Grade A or Grade C

Process XXIII included only variable labor involved in transporting empty cans to holding tanks, filling cans with milk, and transporting and loading cans into the buyer's truck. If milk was to be sold in bulk, variable labor included making the necessary connections and observing the operation until the desired amount of milk was pumped into the truck's tank (Table 24). One worker was usually assigned to help load out raw milk. A total of 32 observations were taken on all workers observed in this process.

Fixed labor was not assigned to this process.

Table 24. Minutes of labor required for filling and selling a 10-gallon can of milk, plant A, selling an average of 28 cans of milk each production run, August-September, 1957.[1]

Skill Class	Fixed labor per production run	Variable labor per can
	(minutes)	(minutes)
1	-	-
2	-	0.8316
3	-	0.6349
4	-	-
Total	-	1.4665

[1]A 10-gallon can was defined to contain 86 pounds of milk containing 3.5 per cent butterfat.

Process XXIV. Processing and Storing Grade A Products

Process XXIV included all activities necessary to standardize, vitamin D fortify, pasteurize, homogenize, cool, and store Grade A milk for bottling; and those activities necessary to separate, standardize, pasteurize, vitamin D fortify, homogenize, cool, and store Grade A skim milk and Grade A cream for

bottling.[1] Two workers were usually assigned to process Grade A products. A total of 1,363 observations were taken on all workers observed in this process.

Variable labor included observing and adjusting equipment as necessary for efficient operation, and transporting full and empty 10-gallon cans as needed for handling various products (Table 25).

Fixed labor included providing supplies to the process as necessary, hooking up pipes and equipment, sanitizing all milk contact equipment, changing equipment to handle another product, keeping proper records of all products processed, and cleaning equipment and area surrounding the equipment.

Table 25. Minutes of labor required per 100 pounds of Grade A milk processed and stored, plant A, processing and storing an average of 65,307 pounds of Grade A milk each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	15.6526	0.0160
2	417.3930	0.0791
3	98.9717	0.0739
4	321.3154	0.0009
Total	853.3327	0.1699

Process XXV. Processing Dairy Mixes

Process XXV included all activities necessary to standardize, pasteurize, and cool cheese dressing, ice cream mix, ice milk mix, and sherbet mix in the

[1] The author has given two different meanings to the word standardize. In the latter case, the author means adjusting the composition of the product to the desired composition of fat and solids-not-fat by the addition of some concentrated product; while in the forepart of the sentence, standardize refers to the adjusting of raw milk to at least the legal per cent fat by removing cream from the milk using a centrifugal standardizer.

Grade A handling room. Two workers were usually assigned to process dairy mixes. A total of 238 observations were taken on all workers observed in this process.

Variable labor included transporting empty 10-gallon milk cans to processing vats, filling processing vats with raw products, transporting ingredients into the process as necessary, adding other ingredients to mixes, making various mixes, testing mixes for desired composition, processing mixes, filling cans with various mixes, tagging cans as to product and date, transporting full 10-gallon milk cans of product to the south cold room or to the proper department for use, washing cans by hand in the process area, and transporting empty milk cans to the can washing area (Table 26).

Fixed labor was not charged to this process. Cleaning equipment and area surrounding the equipment, and keeping proper records of all products produced was considered variable in this case. Hooking up and sanitizing equipment was charged to Process XXIV (Processing and Storing Grade A Products).

Table 26. Minutes of labor required per 100 pounds of dairy mixes processed, plant A, processing an average of 1,616 pounds of mixes each production run, August-September, 1957.[1]

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	-	0.4281
2	-	3.4966
3	-	2.2581
4	-	3.3336
Total	-	9.5164

[1] Dairy mixes included cheese dressing, ice cream mix, ice milk mix, and sherbet mix.

Process XXVI. Processing Specialty Products

Process XXVI included all activities necessary to make buttermilk, chocolate milk, orange drink, and grape drink; and to store these products in processing vats until they were ready for bottling. Two workers were usually assigned to process specialty products. A total of 276 observations were taken on all workers observed in this process.

Variable labor included transporting raw products and supplies to processing vats, preparing buttermilk starter, filling processing vats with raw products and other ingredients, making specialty products, and transporting empty cans and materials from the processing area (Table 27).

Fixed labor included hooking up and sanitizing equipment, keeping proper records of all products produced, and cleaning equipment and area surrounding the equipment.

Table 27. Minutes of labor required per 100 pounds of specialty products processed, plant A, processing an average of 3,255 pounds of products each production run, August-September, 1957.[1]

Skill Class	Fixed labor per production run	Variable labor per cwt.
	(minutes)	(minutes)
1	1.9774	0.1822
2	47.2835	1.9865
3	16.0181	1.7087
4	2.6894	0.0196
Total	67.9684	3.8970

[1]Specialty products included buttermilk, chocolate milk, orange drink, and grape drink.

Process XXVII. Preparing, Filling, and Storing Five-Gallon Dispenser Cans

Process XXVII included all activities necessary to fill five-gallon

dispenser cans with Grade A processed milk or chocolate milk and to transport these cans to storage. Two workers were usually assigned to fill dispenser cans by hand. A total of 185 observations were taken on all workers observed in this process.

Variable labor included washing dispenser cans by hand, sanitizing cans, placing a hose and metal cap on each can, filling cans by hand from any convenient outlet, placing a lid and attaching metal seals on each can, and transporting full five-gallon cans to the north cold room (Table 28).

No fixed labor was charged to this process.

Table 28. Minutes of labor required for filling and sealing by hand five-gallon dispenser cans, plant A, packaging an average of 12 dispenser cans of milk each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per can
	(minutes)	(minutes)
1	-	0.6477
2	-	1.6960
3	-	1.7694
4	-	6.9133
Total	-	11.0264

Process XXVIII. Bottling Milk in Glass Bottles

Process XXVIII included all activities necessary to bottle milk in one-gallon glass bottles. One worker was usually assigned to bottle milk. A total of 522 observations were taken on all workers observed in this process.

Variable labor included providing supplies to the process as necessary, moving cases and bottles to the process, operating bottler, hand filling and capping extra bottles, selecting cases for bottles, casing bottles, and setting full cases on the conveyor leading to the north cold room (Table 29).

Fixed labor included hooking up pipes and equipment, changing from one storage tank to another, taking inventory, keeping production records, and cleaning equipment and area surrounding the equipment.

Table 29. Minutes of labor required per one-gallon glass bottle of milk bottled, plant A, bottling an average of 2,788 gallons of milk each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per bottle
	(minutes)	(minutes)
1	-	0.0064
2	9.3714	0.0092
3	31.8930	-
4	43.3025	0.0656
Total	84.5669	0.0812

Procees XXIX. Bottling Orange and Grape Drink in Glass Bottles

Process XXIX included all activities necessary to bottle orange and grape drink in one-half gallon glass bottles. One worker was ueually assigned to bottle orange and grape drink. A total of 68 observations were taken on all workers observed in this process.

Variable labor included providing supplies to the process as necessary, moving cases and bottles to the process, operating bottler, hand filling and capping extra bottles, selecting cases for bottles, casing bottles, and transporting cases to the south cold room for storage (Table 30).

Fixed labor included hooking up pipes and equipment, changing from one storage tank to another, taking inventory, keeping production records, and cleaning equipment and area surrounding the equipment.

Table 30. Minutes of labor required per one-half gallon glass bottle of orange or grape drink bottled, plant A, bottling an average of 535 bottles of orange or grape drink each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per bottle
	(minutes)	(minutes)
1	-	0.0117
2	0.8795	0.0079
3	6.5244	0.1477
4	17.3930	0.2522
Total	24.7968	0.4196

Process XXX. Packaging Milk in Half-Gallon Paper Cartons

Process XXX included all activities necessary to package milk in half-gallon paper cartons by a Pure-Pak Junior Model "D" machine. Two workers were usually assigned to package milk. A total of 1,248 observations were taken on all workers observed in this process.

Variable labor included providing supplies to the process as necessary, moving cases and cartons to the process, operating carton machine, dumping milk from improperly sealed cartons into 10-gallon cans, selecting cases for cartons, casing cartons, and setting full cases on the conveyor leading to the north cold room (Table 31).

Fixed labor included hooking up pipes and equipment, changing from one tank to another, taking inventory, keeping production records, and cleaning equipment and area surrounding the equipment.

Table 31. Minutes of labor required for filling and packaging one-half gallon paper cartons, plant A, packaging an average of 6,300 cartons of milk each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per carton
	(minutes)	(minutes)
1	65.7408	0.0152
2	10.3321	0.0042
3	68.4995	0.0156
4	149.9548	0.0677
Total	294.5273	0.1028

Process XXXI. Packaging Milk Products in Quart or Smaller Size Paper Cartons

Process XXXI included all activities necessary to bottle milk, skim milk, chocolate milk, buttermilk, and cream in quart, pint, or half-pint paper cartons by a Pure-Pak Junior Model "J" machine. Two workers were usually assigned to package milk products. A total of 1,161 observations were taken on all workers observed in this process.

Variable labor included providing supplies to the process as necessary, moving cases and cartons to the process, operating carton machine, dumping milk from improperly sealed cartons into processing vats or 10-gallon cans, selecting cases for cartons, casing cartons, and setting full cases on the conveyor leading to the north cold room (Table 32).

Fixed labor included hooking up pipes and equipment, changing from one storage tank or product to another, taking inventory, keeping production records, and cleaning equipment and area surrounding the equipment.

Table 32. Minutes of labor required for filling and packaging milk products in quart or smaller size paper cartons, plant A, packaging an average of 5,113 cartons of milk products each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per carton
	(minutes)	(minutes)
1	61.2918	0.0197
2	39.4313	0.0162
3	62.4222	0.0149
4	87.1738	0.0450
Total	250.3190	0.0958

Process XXXII. Handling North Cold Room Products

Process XXXII included all activities necessary to handle incoming products, to stack cases of products, and to handle outgoing products until they reached the rear of the distributor's truck. Four workers were usually assigned to the north cold room. A total of 2,420 observations were taken on all workers observed in this process.

Variable labor included handling products coming in on a dolly from the south cold room or some other department, moving cases along incoming conveyor, pulling cases by hand to the desired location for stacking, stacking products in stacks five or six cases high, arranging products in the cold room for easier shipping, making up orders for shipment, loading cases on conveyor for shipment, setting cases in rear of truck, and keeping records of all incoming and outgoing products (Table 33).

Fixed labor included cleaning the north cold room and taking inventory of products therein.

Table 33. Minutes of labor required per case of products handled in north cold room, plant A, handling an average of 1,599 cases each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per case
	(minutes)	(minutes)
1	-	-
2	-	0.0003
3	45.9907	0.2633
4	7.6235	0.8385
Total	53.6142	1.1021

Process XXXIII. Receiving Empty Bottles and Cases

Process XXXIII included all activities necessary to receive and stack empty bottles and cases. One worker was usually assigned to receive empty bottles and cases. A total of 540 observations were taken on all workers observed in this process.

Variable labor included taking cases of bottles from the rear of the truck and placing them inside the plant (Table 34).

Fixed labor included cleaning the loading dock and area immediately inside the plant used to stow incoming bottles and cases.

Table 34. Minutes of labor required per case of empty bottles received and stacked, plant A, receiving and stacking an average of 1,378 cases each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per case
	(minutes)	(minutes)
1	-	-
2	0.4542	-
3	-	-
4	45.2770	0.2177
Total	45.7312	0.2177

Process XXXIV. Handling Returned Products

Process XXXIV included those activities necessary to salvage or dispose of returned products. One worker was usually assigned to handle returned products. A total of 222 observations were taken on all workers observed in this process.

Variable labor included crediting the truck driver with his returned products, sorting returns as to salvable or waste, dumping salvable products into 10-gallon cans, transporting cans to and from the area, and disposing of waste products by dumping them down a sewer drain or into trash cans (Table 35).

Fixed labor included taking inventory of returned products, disposing of waste cartons, and cleaning the area used for handling returns.

Table 35. Minutes of labor required per unit of product returned from routes, plant A, handling an average of 335 returned units each production run, August-September, 1957.[1]

Skill Class	Fixed labor per production run	Variable labor per unit
	(minutes)	(minutes)
1	-	-
2	1.3622	-
3	0.5132	-
4	75.9939	0.2260
Total	77.8694	0.2260

[1] Any size carton or container was defined as one unit. For a list of products returned, see Process XXXIV in Appendix I.

Process XXXV. Checking and Stacking Empty Bottles and Cases

Process XXXV included all activities necessary to sort, check, and stack near the case and bottle washers all empty bottles and cases received. Two

workers were usually assigned to check and stack empty bottles and cases. A total of 972 observations were taken on all workers observed in this process.

Variable labor included checking and sorting bottles into two stacks (those belonging to the plant and those belonging to other dairies), hauling "off brand" bottles to a special location from whence they were hauled to the local bottle exchange, moving the plant's bottles to the bottle washer, and transporting new bottles from the warehouse to the bottle washer (Table 36).

No fixed labor was charged to this process.

Table 36. Minutes of labor required per case of bottles checked and stacked, plant A, checking and stacking an average of 1,378 cases each production run, August-September, 1957.

Skill Class	Fixed labor per production run (minutes)	Variable labor per case (minutes)
1	-	-
2	-	0.0173
3	-	0.0019
4	-	0.3710
Total	-	0.3902

Process XXXVI. Washing Bottles

Process XXXVI included all activities necessary to wash glass milk bottles with a mechanical washer. One worker was usually assigned to wash bottles. A total of 621 observations were taken on all workers observed in this process.

Variable labor included loading bottles into the bottle washer, inspecting bottles as they came from the washer, breaking unwashable bottles, and placing clean bottles on a conveyor leading to the bottler (Table 37).

Fixed labor included providing supplies to the washer as necessary, hooking up bottle washer and conveyor, changing bottle washer to handle another

size bottle, and cleaning the bottle washer and area surrounding the bottle washer.

Table 37. Minutes of labor required per bottle washed, plant A, washing an average of 2,877 bottles each production run, August-September, 1957.[1]

Skill Class	Fixed labor per production run	Variable labor per bottle
	(minutes)	(minutes)
1	-	-
2	0.7071	0.0014
3	-	-
4	83.1536	0.1012
Total	83.8607	0.1026

[1] Included washing one-half gallon and one-gallon glass bottles.

Process XXXVII. Washing Cases

Process XXXVII included all activities necessary to wash empty milk cases with a mechanical case washer. One worker was usually assigned to wash cases. A total of 507 observations were taken on all workers observed in this process.

Variable labor included pulling cases to the case washer, loading cases into the washer, and directing and observing cases as they came from the washer (Table 38).

Fixed labor included providing supplies to the washer as necessary, hooking up case washer and conveyor, disposing of any accumulated waste, and cleaning case washer and area surrounding the case washer.

Table 38. Minutes of labor required per case washed, plant A, washing an average of 3,255 cases each production run, August-September, 1957.

Skill Class	Fixed labor per production run	Variable labor per case
	(minutes)	(minutes)
1	-	-
2	0.6699	-
3	-	-
4	18.8973	0.2811
Total	19.5673	0.2811

LABOR EFFICIENCY ANALYSIS

The analysis of relative labor efficiency will be presented in this section by general process efficiency and the efficiency of workers in each process. This analysis is based on the results of the ratio-delay study, explained earlier, which gave the total number of observations and the percentage of these observations falling into different labor categories (productive, avoidable delay, unavoidable delay, and loafing) for individual plant workers and processes, Appendix II, Tables 69, 70, 71, and 72. When taken in their proper setting, these figures will give some idea of the relative efficiency of individual workers and processes within plant A.

No definite statement can be made concerning the general efficiency of a process without first taking into consideration such factors as the nature of the operation, volume handled, equipment used, condition of equipment, and the position of the process in relation to product flow through the plant.

To analyze the efficiency by workers within a process, it is necessary to compare each worker's efficiency in all processes with his efficiency in a particular process and to compare the efficiency of all workers in a particular process with the efficiency of each worker within this process.

In interpreting the results of this analysis, it should be remembered that the study took account of fatigue and personal allowances by not observing the workers during the two allowable 15 minute breaks and while attending to personal needs. For this reason, the productive percentages given in this section may be higher than those of other studies concerned with labor efficiency in dairy processing plants.

Process I. Receiving Can Milk

Over-all labor efficiency of receiving can milk was considered substandard. Workers in this process were observed loafing 10.72 per cent of the time and unavoidably delayed 4.13 per cent of the time. The nature of the receiving operation was subject to inefficiency due to sporadic delivery of milk. A productive figure of 84.95 per cent for the process was considerably lower than the total plant figure of 89.27 per cent. Of workers normally assigned to receive can milk, one was productive 92.7 per cent of the time, four were approximately 80 per cent productive, and one was productive only 73 per cent of the time. Workers not normally assigned to receive can milk were much more productive, approximately 95 per cent. This can be explained in part by the nature of the receiving operation, and the fact that extra workers were used only during peak receiving periods of the day.

It was believed that three workers usually assigned to this process were more than necessary to perform the tasks demanded of them. One of the workers helped receive milk from bulk trucks and was not available at all times for receiving milk in cans. This led to some inefficiency which could have been eliminated by holding milk in the bulk trucks until a break occurred in receiving milk in cans. Another economy that could have been introduced was

rearrangement of the receiving equipment slightly cutting the usual work force down to two men. The unavoidable delay could have been reduced by assigning jobs to the receiving crew such as sorting empty bottles and performing preventative maintenance tasks. This also might have had the effect of reducing the amount of avoidable and unavoidable delay time in other processes.

Process II. Receiving Bulk Milk

In general, receiving milk from bulk trucks was an efficient operation. All workers were observed productive 95.4 per cent of the time, and individual worker productivity was nearly the same with one exception. Worker 54 was less efficient than any other worker normally assigned to this process, but even worker 54 was more productive here (91 per cent) than in the other two processes in which he was normally assigned.

Bulk receiving was performed by one worker taken from the can milk or can cream receiving processes, and the worker was only used when a bulk tank arrived for unloading. The worker would complete the necessary work associated with receiving bulk milk and then return to his usual assignment. This arrangement was conducive to the high percentage of time productive in this process.

The only recommendation to increase labor efficiency might have been to assign a worker from a department other than receiving to help unload bulk trucks or to rearrange the route schedule to have bulk trucks unload after all can milk and cream had been received. This could have reduced the labor requirements in the three receiving processes by one or two men.

Process III. Receiving Can Cream

Receiving can cream was one of the most inefficient processes in the plant. All workers combined were observed productive 82.44 per cent of the time and loafing 15.05 per cent of the time. As in Process I, cream receiving was subject to inefficiency due to intermittent receipts of cream from the routes.

Of workers normally assigned to receive cream, all except three were observed productive approximately 85 per cent of the time. These three workers, who were least productive of all workers in this process, were less productive in this process than in all other processes to which they were normally assigned. This might suggest that they did not prefer to help receive can cream as much as other jobs in the plant. If a situation had arisen where a supervisor had the choice of assigning one of these three workers or some other plant worker to help receive cream, it might have been advantageous to assign someone other than one of these three to this process.

The workers usually assigned to receive can cream were also used to receive can milk. Two of these workers were more efficient in cream receiving than in can milk receiving, and two others were more efficient in can milk receiving than in cream receiving. This might suggest that it would have been advantageous to place these workers in the departments where they apparently worked with a relatively higher degree of efficiency.

Process IV. Separating Grade C Milk

The nature of the separation process might tend to lead to inefficiency, but this was not the case in plant A. A large number of workers (15) were observed in this process and this in itself could have led to some inefficiency.

All workers combined were productive 94.44 per cent of the time; and of the three workers observed most often, only one worker (worker 56) was productive less than 95 per cent of the time. Worker 56 was productive 86.84 per cent of the time observed, and this was below his average of 91.45 per cent productive for all processes. He was generally observed cleaning the separators in this process, and possibly he was not very enthusiastic about this job. The only recommendation this author might have made would be to investigate the possibility of moving worker 56 to concentrate on some other process in which he was more productive.

Process V. Condensing Operation

As in Process IV, the nature of the operation could have led to some loafing or labor inefficiency. Here again this was not the case in plant A as all workers were, on the average, 93.17 per cent productive. Avoidable and unavoidable delay were insignificant, and loafing accounted for only 6.54 per cent of the time expended.

Most of the workers observed in this process also worked in Process IV. With the exception of the relief man (worker 55), operation of the vacuum pan, laborwise, was almost 100 per cent productive. Worker 55 was observed productive 88.89 per cent of the time while operating the pan and 100 per cent during clean-up. Worker 56, one of the pan operators, seemed to have a tendency to be not quite as productive during the cleaning operation. He was observed loafing 10.93 per cent of the time while the equipment was being cleaned. Since worker 56 was apparently in charge of the vacuum pan part of the time, his responsibilities probably more than justified the relatively small degree of inefficiency observed in cleaning the equipment.

Process VI. Condensing Transfers

The process of filling 10-gallon cans with condensed milk and transporting the filled cans to storage was considered efficient. One of the factors leading to the high degree of efficiency was that workers were taken from other processes to perform the work in this process; when finished, they returned to their normal work assignments. The only worker not observed to be 100 per cent efficient was worker 56, and he was observed productive 96.67 per cent of the time.

Process VII. Selling Condensed Milk

This process was similar to process VI in that the workers assigned to transport and place cans of condensed milk on the conveyor in the south cold room were taken from other processes, and they returned to their normal work assignments after completing the loading out activities. Selling condensed milk was performed only 13 times during the sample period and only 52 observations were taken on all workers during this time.

The labor efficiency was relatively good. All workers combined were productive 94.23 per cent of the time observed and unavoidably delayed the other 5.77 per cent of the time. Unavoidable delay was usually caused by workers having to wait for cans being filled from a storage vat.

Process VIII. Spray-Drying Operation

Laborwise, this process appeared to be fairly efficient. Workers operating the spray-dryer were observed productive almost 99 per cent of the time. Workers performing maintenance on the dryer were observed productive approximately 95 per cent of the time.

Cleaning the spray-dryer seemed to go a little slowly. Workers 56 and 53 were observed loafing 14.81 and 7.99 per cent of the time respsctively. Worker 56 appeared to feel that he was of supervisory capacity (mors than his position justified) and that cleaning equipment should not be his responsibility. Worker 53 was observed mors productive than worker 56, but worker 53 was avoidably and unavoidably delayed more than a normal amount and seemed to move at a rather slow pace. In accordancs with Parkison's Law, these two workers may have bsen trying to fit ths job to taks up ths remaining part of their working day.

Process IX. Packaging Dry Milk

This process was dominated by worker 53. He was almost always present when dry milk was bsing packaged. Most of ths other worksrs obssrved in the process appeared to be less productivs than worker 53. This might be a slightly deceiving observation because most workers worked at a rate considerably faster than did worker 53. As in process XIII, worker 53 apparently made the cleaning operation fill the work day fairly well.

Over-all, the dry milk packaging operation was fairly productive. Because of its nature in plant A, this process was suitsd to a moderately slow worker. Not enough milk was dried to keep a fast worksr busy at all times. On the other hand, if a faster working man had been performing ths packaging operation, he might have been able to reduce the labor rsquirements of Process X (Storing Dry Milk) by doing mors of the storing himself.

Process X. Storing Dry Milk

Storing dry milk was usually accomplished with a minimum of idle time

(1.66 per cent). Unavoidable delay in the cleaning operation may have been a little high (4.55 per cent). Thie wae caused in part by aesigning workere to clean the storage area while etoring was etill in progress, thue clean-up workers had to etand aside while etacking wae being accomplished. All workers combined were observed productive 95.58 per cent of the time.

There were not enough observations taken on individual workers in this process to analyze their efficiency in any detail. It might be well to point out that worker 53 was observed productive 98.8 per cent of the time. This eeemed logical when it wae realized that he wae probably hurrying to get back to the packaging operation.

Procese XI. Shipping Dry Milk

The procese labor efficiency was not as high ae it might have been expected (90.36 per cent productive) for a procees requiring periodic work. The main job was loading trucke with dry milk as they arrived at the plant. Three workere usually performed this work. Almoet all of the usual workere were observed productive about 90 per cent of the time. The relatively high unavoidable delay time of 3.21 per cent was partially caused by waiting for the truck to be properly positioned for loading. The process loafing time of 6.43 per cent might be considered a little high for this process. When analyzed by individual workers, almost all workere were lese productive in thie process than in any other process in which they worked. In part, thie could have been due to the greater physical activity required in loading dry milk.

Process XII. Proceeeing and Storing Route Cream

Procees labor efficiency was obeerved to be 100 per cent productive. This

process was dominated by worker 30, and he was a very conscientious and diligent worker. On an average of all processes in which he appeared, worker 30 was observed productive 98.17 per cent of the time.

One reason for the high labor productivity in this process was that the process only required periodic checks to be made on the equipment, and a worker could make these checks while performing another job in a different process.

Process XIII. Selling Pasteurized Cream

Workers in this process appeared to be very efficient. The process labor efficiency was observed to be 99.04 per cent productive. Filling and loading cans of cream required the use of workers usually assigned to other processes. The job required the workers to be in a cold room, and apparently they wanted to get the job done in order to return to a more favorable working temperature. The limited number of observations taken of this process made it difficult to evaluate the efficiency of individual workers with a reasonable degree of reliability.

Process XIV. Buttermaking

Process XIV was a relatively efficient operation considering the nature of the process. All workers combined were observed productive 93.97 per cent of the time, unavoidably delayed 1.18 per cent of the time, and loafing 4.81 per cent of the time.

Variable labor appeared to be quite efficient relative to fixed labor. With the exception of worker 97, all workers performing variable jobs were productive approximately 98 per cent of the time. Fixed labor was observed productive approximately 90 per cent of the time. Here again, worker 97 was

productive only about 80 per cent of the time.

Unavoidable delay was believed to be a little high in this process. This appeared to be partly due to worker 97's thinking he was delayed when actually there was work that could have been done. Another cause for unavoidable delay was in the nature of the operation which might have caused workers to be delayed while the cream was being churned.

The loafing figure of 4.81 per cent was high due to the observed inefficiency of worker 97 who was apparently loafing 14.49 per cent of the time. Excluding worker 97, this was a very efficient process relative to all processes combined.

Worker 97 was primarily a clean-up worker assigned to the buttermaking process. He was observed productive 91.13 per cent of the time while operating the churns but only 79.8 per cent productive while doing fixed work such as cleaning equipment. Since cleaning was his main job, it might have been assumed that he did not like this work and a transfer to another process might have improved his efficiency. All other workers were as efficient in this process as they were in all other processes in which they were observed working.

Process XV. Selling Bulk Butter

The process labor efficiency of 96.97 per cent observed time productive seemed to be adequate for loading out 64-pound boxes of butter. Any available plant worker was assigned to this process, and there were not enough observations taken on any one worker to permit a reliable analysis by workers. It was generally believed that working in the cold room was enough of an incentive to provide for labor efficiency in this process.

Process XVI. Printing and Wrapping Butter in Individual Quarters--One Brand Only

Over-all labor efficiency of 96.24 per cent observed time productive was believed to be adequate for the two workers dominating the butter printing and wrapping operation. This process might be thought of as two distinct operatione. Worker 34, a man, procured the butter and printed it into quarter-pound pieces. Worker 35, a woman, took the quarter-pound pieces and wrapped and cartoned them. Worker 35 was dependent on worker 34 for her work; therefore, worker 35 was subject to unavoidable delay caused by the operation performed by worker 34. Worker 34 was observed productive 97.25 per cent of the time, and worker 35 was observed productive 95.95 per cent of the time. Both workers were quite proficient in their respective jobs and no changes were recommended for this process with the existing equipment.

Process XVII. Printing and Wrapping Butter--Exclusive of the Special Brand of Process XVI

The same two workers were dominant in this process as in Process XVI. Labor efficiency in thie process was observed to be 94.49 per cent productive, this wae slightly less than in Process XVI. Worker 34 was observed productive 98.3 per cent of the time, and worker 35 was observed productive 90.4 per cent of the time. Worker 35 was unavoidably delayed 6.31 per cent of the observed time which, in part, might have been explained by the differences in her work requiremente as alternative products were wrapped and cartoned. Under the existing degree of technology, it was believed that this process and individual workers within this process were about as efficient as could be expected.

Process XVIII. Processing Cottage Cheese

The process labor efficiency was considered to be adequate at the observed productive figure of 97.75 per cent. Two workers were usually present in processing cottage cheese and both of them appeared to be highly efficient workers (productive about 98 per cent of the time).

The nature of this process was such that a moderate amount of free time was available between different operations within the process. During this time, workers might have had a tendency to work at a less rapid rate or not work at all for short periods. This was not the case with the two workers most often observed in this process. They usually managed to find enough repair and maintenance work to keep themselves busy during the slack periods.

Process XIX. Packaging Cottage Cheese

Two workers were usually assigned to package cottage cheese, and they were relatively efficient. The process efficiency of 95.64 per cent observed time productive was considered adequate for this operation under the existing degree of technology in plant A. All workers, other than the two normally assigned to this process, were observed productive approximately 95 per cent of the time. Due to the fact that no previous training was necessary for this type of work, a large number of workers were observed in this process from time to time.

Workers 71 and 86, the two most frequently observed in this process, were observed productive 93.13 and 97.88 per cent of the time respectively. Both workers were considered quite efficient in the packaging operation itself. Worker 86 was also assigned to the laboratory, and she worked in this process only when cottage cheese was being packaged. This might have explained in part

the higher efficiency of worker 86. Another apparently significant factor in explaining the difference in efficiency between these two workers was that worker 71 tended to make this process fill the work day; consequently, on days requiring a small amount of cottage cheese to be packaged, worker 71 tended to create apparently unnecessary jobs in order to appear busy.

Process XX. Processing Ice Cream Products

This process was dominated by workers 77 and 93, and they were observed productive approximately 95 per cent of the time. Worker 77 was observed loafing 5.36 per cent of the time while worker 93 only 2.56 per cent, but worker 93 was also observed avoidably and unavoidably delayed 1.7 per cent of the time. With the existing equipment, this process was considered quite adequately efficient as far as labor was concerned.

Process XXI. Packaging Ice Cream Products

As in Process XX, workers 77 and 93 were dominant in this process. Worker 77 was observed productive 98.54 per cent of the time, and worker 93 was observed productive 96.16 per cent of the time. Both workers were quite efficient during the actual filling and packaging operations; but during the prepackaging operation (providing supplies, forming cartons, etc.), worker 93 was observed working most of the time, but at a slower pace. The over-all process efficiency was good. This process was a relatively minor operation in the plant and might have required too much manual labor.

Process XXII. Selling Ice Cream

Only one worker was observed in this process and he was observed pro-

ductive 100 per cent of the time. This process required the worker (worker 77) to work in the ice cream hardening room; and at this low temperature, almost anyone would tend to be quite fast and efficient with his work.

Process XXXIII. Selling Raw Milk--Grade A or Grade C

This was a relatively minor operation with only a total of 32 observations taken during the sample period. Individual workers were not observed enough to show any general labor efficiency trend. The only statement that might be made would be that the process, although appearing to be efficient laborwise, tended to be inefficient due to the layout of equipment.

Process XXIV. Processing and Storing Grade A Products

Process efficiency was observed to be 86.94 per cent productive and 12.4 per cent loafing. Variable labor appeared to be relatively productive as all workers were observed to be productive 98.75 per cent of the time.

Fixed labor of all workers combined was observed productive only 85.44 per cent of the time and loafing 13.81 per cent of the time. Of the five workers most frequently observed in this process, worker 42 was observed loafing 3.16 per cent of the time, workers 41 and 51 approximately 9.1 per cent of the time, worker 44 nearly 16 per cent of the time, and worker 47 about 20 per cent of the time. Worker 42 was the only worker who was considered efficient in the cleaning operation. The other four workers were less efficient in this process than in any other process to which they were normally assigned. There did not appear to be any reasonable explanation for the inefficiency observed in this process. It was granted that cleaning processing vats, milk pipe, separators, etc. was not the most desirable job in plant

As nevertheless, it was an important job from a cost point of view and should not have been taken so lightly by those performing this taek.

Process XXV. Processing Dairy Mixes

This process only included variable labor and was considered efficient. All workers combined were observed productive 96.64 per cent of the time and no worker was observed productive less than 92.5 per cent of the time. Due to the limited number of observations and the relatively high efficiency, no changee were recommended for this process.

Procees XXVI. Processing Specialty Products

This was a minor but relatively efficient process. Over-all labor efficiency was observed to be 95.65 per cent productive, and no worker wae obeerved productive less than about 90 per cent of the time. The one item worthy of note was the fixed labor. Workers performing fixed labor were observed productive 100 per cent of the time. This was a very unusual circumetance and could only be explained by the small number of observations taken.

Process XXVII. Preparing, Filling, and Storing Five-Gallon Dispenser Cans

This process included the variable labor involved in hand filling dispenser cans from any convenient outlet in the Grade A processing room. Although all workers in thie process were observed 96.22 per cent productive, this did not adequately show the proper degree of process efficiency. Preparing dispenser cans wae a minor operation and no special equipment was available for this job. There wae entirely too much human labor involved in

this operation to make it profitable to the plant even though the efficiency of the workers was believed to be adequate.

Process XXVIII. Bottling Milk in Glass Bottles

At first, labor in this process did not seem to be adequately efficient with an observed average productive figure of 88.12 per cent. Upon further study it was observed that there were a few distinguishing characteristics of this process which set it apart from other processes.

First of all, this process was dominated by one worker (worker 46). Worker 46 was observed productive 86.27 per cent of the time, but he was observed loafing 15.62 per cent of the time while performing fixed labor. In addition, he was observed being avoidably and unavoidably delayed more than the average for all workers or processes. It appeared to this author that worker 46 did not like to do clean-up work and that he quite possibly did not take the best possible care of the milk bottling machine.

The process labor efficiency was higher for fixed jobs than for variable jobs. This was largely true because of the large amount of unavoidable delay. Unavoidable delay in this process was largely caused by an insufficient supply of glass bottles at all times to the bottling machine. This might suggest an abnormal amount of inefficiency in the bottle washing process.

Excluding unavoidable delay and loafing observed for worker 46 during clean-up, this process seemed to be fairly efficient; but, if the unavoidable delay had not been encountered, loafing might have been more prominent.

Process XXIX. Bottling Orange and Grape Drink in Glass Bottles

This was a minor operation and only 66 observations were taken on all

workers observed in the process. The same analysis applied here with respect to unavoidable delay as in Process XXVIII. It might be well to note that worker 46 was the only worker observed loafing in this process; but due to the small number of observations taken, not much significance was attached to this observation.

Process XXX. Packaging Milk in Half-Gallon Paper Cartons

General process efficiency was considered adequate. All workers were observed productive 95.03 per cent of the time and loafing only 3.21 per cent of the time. Some variation in efficiency was observed among the four workers most commonly observed working in this process. When milk was being bottled, all workers were productive about 96 per cent of the time. During clean-up, workers 48 and 51 were observed productive 95.15 and 100 per cent of the time respectively while workers 40 and 22 were observed productive only about 85 per cent of the time. Worker 40 was usually more than 85 per cent productive, but worker 22 apparently did not like to do clean-up work.

Avoidable and unavoidable delay were considered normal, and the only recommendation that might have been made would have been to give worker 22 a slight boost during the cleaning operation.

Process XXXI. Packaging Milk Products in Quart or Smaller Size Paper Cartons

Considering the nature of this operation, this process appeared to be adequately efficient. Average labor efficiency was 89.92 per cent productive, 6.8 per cent unavoidably delayed, and 3.01 per cent loafing. The only difference in general efficiency of this process from Process XXX was the amount

of unavoidably delayed time. Unavoidable delay was caused by changing the cartoning machine to handle a different size container, a different product, or a different brand of the same product.

As in Process XXX variable labor was slightly more efficient than fixed labor. All regular workers were reasonably efficient except worker 47. Worker 47 was productive 85.5 per cent of the time doing variable work and only 60.34 per cent productive doing clean-up work. Most of the worker 47's delay was considered quasi-unavoidable, because she could have been doing something productive during the change-over operation such as providing supplies, keeping records, or cleaning the process area.

Process XXXII. Handling North Cold Room Products

This process was observed the least productive of all processes in plant A. All workers combined were productive only 75.5 per cent of the time and unavoidably delayed 22.6 per cent of the time. Loafing and avoidable delay time was considered minor for this process.

Workers performing fixed labor were observed productive about 99 per cent of the time while the five workers most often observed performing variable labor were productive only 73.82 per cent of the time. Almost all of the delay time was classified as unavoidable.

The amount of unavoidable delay time observed for each worker depended on the nature of his job. Worker 85 was unavoidably delayed 26.67 per cent of the time loading out trucks while worker 45 was unavoidably delayed only 15.98 per cent of the time stacking cases.

The inefficiency in the north cold room was largely attributed to the lack of adequate storage space, less than maximum efficiency in the scheduling

of production operations in the plant, and sporadic loading requirements. Unavoidable delay might have been reduced considerably by increasing the cold room capacity to eliminate unnecessary movement of products, by installing a floor conveyor to eliminate dragging cases across the floor, and by rescheduling the bottling and loading operations to provide a more uniform work load in the cold room. Had these recommendations been effectuated, they might have reduced the labor requirements of other processes in the plant as well as those of the cold room, and the rescheduling of operations might have reduced the power factor requirements of the plant.

Process XXXIII. Receiving Empty Bottles and Cases

This process was observed almost as unproductive as Process XXII. Overall, workers were observed productive 76.3 per cent of the time, unavoidably delayed 14.63 per cent of the time, and loafing 9.07 per cent of the time.

Fixed labor was observed productive about 91 per cent of the time, but variable was observed productive only 75 per cent of the time.

The inefficiency of both types of delay was largely due to waiting for route trucks to return with empty bottles and cases. This delay might have been reduced considerably by using workers from other processes which were not at a critical point in their respective operations. In plant A, more of the work could have been done by the truck operators, the case washers, and the bottle washers.

Process XXXIV. Handling Returned Products

All workers were considered sufficiently efficient in this process. Handling returns was directly connected with the receiving of empty bottles

and cases and most workers were observed in both processes. Since handling of returns was dependent on their receipt, the unavoidable time observed was most often charged to Process XXXIII. Worker 92 was the least productive of the workers most commonly observed in this process, but not snough observations were taken in the work catsgoriss to properly analyze individual workers.

Procese XXXV. Checking and Stacking Empty Bottles and Cases

The ovsr-all observsd worksr efficiency of 82.92 per cent productive was considered to be sub-standard for checking and stacking empty bottles and cases. The workers observed in thie process should not have been fatigued as they apparently had plenty of rest from working in Proceeses XXXIII and XXXIV.

There was no apparent reason for the 13.99 psr cent loafing observed for all workers combined. Of the four workers most often observed, worker 92 was loafing 8.62 per cent of the time, worker 99 approximately 14 per cent of the time, worksr 46 almost 25 per cent of ths time, and worker 100 about 28.5 per cent of the time. Thess figures were entirely too high considering the nature of ths process, especially since most of the unavoidabls delay was charged to Procsss XXXIII. It appearsd to this author that this whole area of the plant was more or lsss the take-it-easy or dawdling area.

Procsss XXXVI. Washing Bottles

The nature of this operation and the equipment involved may have led to some insfficiency in washing bottles. The observed labor efficiency of 81.8 per cent productive for all workers would have normally been considered low, but the observed unavoidable delay of 12.88 per cent was not considered to be high in this case. Unavoidable delay of variable labor was caused by either

a shortage of glass bottles to be washed or, more commonly, by a stoppage in the glass bottling operation for some reason. Either of these causes was not a direct result of the worker operating the bottle washer.

Fixed labor efficiency was considered adequate for workers most often observed cleaning the bottle washer. All things considered, this process was more efficient than was evidenced by only looking at the productive percentage.

Process XXXVII. Washing Cases

This process was similar to Process XXXVI in that it was considered adequately productive. The observed unavoidable delay of 8.68 per cent was not considered high, because the bottling processes did not require a constant flow of cases. With worker 44 dominating the process, over-all labor efficiency was observed to be 85.4 per cent productive.

Fixed labor was observed to be highly efficient. This was largely true because worker 44 also worked quite often in Process XXIV, Processing and Storing Grade A Products.

Summary of Labor Efficiency Analysis

With the exception of the receiving processes, the north cold room process, and handling of returned cases and bottles, plant A appeared to be reasonably efficient with respect to labor. Combining all processes, workers in plant A were observed productive 89.27 per cent of the time, avoidably delaysd 0.17 per cent of the time, unavoidably delayed 4.55 per cent of the time, and loafing 6.02 per cent of the time. It is again important to point out that workers were not observed during their two allowable 15 minute breaks and while attending to personal needs. This tended to make the productive

figures higher in this study than those of other studies related to dairy processing plants.

As stated in the process analysis, it was believed that the receiving processes could have eliminated one or two workers, the north cold room could have been expanded and one worker eliminated, and the empty bottles and cases processes either could have eliminated one man or had other plant personnel perform this work.

This analysis also showed that individual workers performed better doing some jobs than others. This suggests that the over-all plant labor efficiency could probably have been improved by transferring workers to jobs where they were more productive. Of course there are some practical limitations to this relocation.

LIMITATIONS AND RECOMMENDATIONS FOR FUTURE STUDIES

In retrospect, limitations to any piece of research work are obvious. These limitations, some of which can be eliminated, are much more easily seen after the analysis is completed than while gathering the data. For this reason, the recommendations for future studies given in this section are largely an outgrowth of problems encountered in analyzing the data of this study.

The ratio-delay analysis included 21 working days during August and September. This is normally the period of lowest raw product supply during the year. For this reason, work requirements for individual employees might not have been as great during the sample period as during periods of greater product supply. Because it is impractical to hire and fire employees with each variation in supply of raw products, this may have had the effect of

lowering the efficiency of some employees during the sample period. The obvious remedy for this limitation would be to survey the plant during periods corresponding to variations in supply.

Observations were taken on the workers during the normal eight-hour working day. Due to the nature of some operations in plant A, a few employees worked before and after the observation period. This led to some value judgement evaluations concerning these workers when calculating their efficiency during the non-observed period of the day. For this reason, it is recommended that the labor efficiency study be continued for as long as necessary during a day to include all work performed.

Due to the nature of some processes, a limited number of observations were taken on minor processes; and the reliability of the coefficients from these processes was not too high. To improve the reliability, it would have been desirable to observe minor operations more often when they were operative. This leads to another limitation of this study, namely that of statistical analysis. The coefficients given are point estimates. Confidence limits can be placed on each coefficient using the formula given in the methodology section. The confidence limits will be determined for each coefficient, but this was not considered necessary for this phase of the general study.

As stated earlier, workers were not included if they were not observed in any of the predetermined work processes. It was assumed these workers were attending to personal needs during this time. The validity of this assumption might be questioned on very logical grounds. If a worker was not at one of his assigned stations, he could have been down in the boiler room smoking instead of attending to personal needs as was assumed. This assumption does affect the validity of the labor requirements because the time allocated to each process

was derived by subtracting the loafing observations from the total observations. This figure was then used as part of the numerator in the formula for determining the labor requirements for each skill class in each process.

The observed efficiency of employees does not include the rate or speed at which an employee works. For this reason, one employee observed more productive than another might be less valuable to the process because he worked at a much slower rate. This limitation is inherent in any ratio-delay study, and any corrective factor would have to be based on value judgements expressed by the observers or study director.

Production records kept by the plant were used in this study. Although good record keeping procedures were used by plant A, it was difficult to adapt their production records to the survey period in some cases. For this reason, it would seem desirable for the study director or some other designated person to keep accurate daily production records for the survey period.

It is recommended that very detailed records be kept on all phases of the study. It is much easier to aggregate various records than it is to make them more detailed after the data is gathered.

As stated earlier, it is believed that this analysis is quite applicable to plant A; beyond this no inference is intended. The author does believe that through a synthesis of studies of this nature, standard input requirements can be derived for many operations in dairy processing plants. These standard requirements can then be used as a general guide for evaluating the efficiency of a particular plant which approximately possesses the same physical facilities and state of technology as those plants from which the standard requirements were derived.

SUMMARY AND CONCLUSIONS

This study was a part of an economic efficiency study of one selected multiproduct dairy processing plant in the Midwest. Within this plant, each basic process (a complete operation on a product) was precisely defined as to equipment used and product flow through the process. Labor requirements within each process were classified by departments, divisions of labor, and work elements into fixed, variable, and unassigned idle time categories.

Since labor is apparently the most significant item of cost in most dairy processing plants, a detailed labor study was undertaken to determine the fixed and variable labor requirements by skill categories for each major process and each product produced in plant A. The method used to determine labor requirements was a random-observation, time-study technique. This technique, termed ratio-delay, is a relatively new and highly practical statistical technique for determining the percentage of time workers are productive or delayed. Random observations were taken on all workers in plant A for a 21 day period during August and September, 1957. The ratios of the number of observations falling into the various labor classifications to the total number of observations in all labor classifications were assumed to be proportional to the amount of time expended in each of these labor classifications. Under this assumption, fixed and variable labor requirements in minutes per unit of produot were determined by skill classes for each process in plant A.

The most important consideration of this study was determining fixed and variable labor coefficients for each basic process in plant A. These coefficients were "actual" or "real" requirements and were not developed from a synthetic analysis. It is believed that this study was the first to integrate all operations of a dairy processing plant in one study. A synthesis of the process

requirements enables one to determine the unit coet of producing any and all final products produced in plant A. Although there are some problems or biases implicit in this eynthesie, it is very useful to linear programing. By computing the physical requirements and costs of all inputs and by assuming given product prices, the optimum combination of final outputs can be determined for a given plant and state of technology by equating the marginal rate of substitution between final products with the inverse of their price ratio. The analysis may also show that the linear model as eet up might not be as applicable as the non-linear model, but this question is beyond the scope of thie study.

Although major emphasis of this study was placed on labor, the utility requiremente were also given. To determine the utility requirements for each piece of equipment in plant A, each piece of equipment was identified as to name, model, eerial number, capacity, and utility requirements (whenever possible) by inspecting the manufacturer's plate on each piece of equipment, by examining plant A's equipment inventory cards, and by direct correspondence with equipment manufacturers. Steam and refrigeration requirements were given in Btu's per unit of product for each process, and the electrical requiremente were given in kilowatts per hour of machine running time. These requirements were calculated at a given level of efficiency for each piece of equipment; therefore, the utility requirements might be considered about "normal" for most operations in plant A.

The ratio-delay analyeie was also used to evaluate the relative labor efficiency of workers in each process and the relative efficiency among the various processes. This analysis was again the firet in a series of studies in the Midwest to determine the relative efficiency of all operations in dairy processing plants. The efficiency figures given in this study are not intended to

be interpreted as standards for the dairy industry. A synthesis of many studies on a variety of dairy processing plants operating under differsnt market structurss might yield some broad standards of relative efficiency in various operations of dairy procsssing plants. These standards might thsn be used as a general guide to evaluate the efficiency of various opsrations in a particular dairy processing plant. With a given technology factor, these standards might bs used as a basing point to compare the relative efficiency of various operations in dairy processing plants over various periods of time.

In plant A, a total of all workere in all processes were observed productive almost 90 per cent of the time. Thie figure is apparently higher than those of other studies related to dairy processing plants. This ie largely due to hot observing workers in this study during the two allowabls 15 minute breaks and while they wers attending to personal needs. For this reason, it would be quite difficult to compare the labor efficiency of plant A with other labor efficiency studies.

The three procssses of receiving raw products, the process of handling products in the cold room, and the five processes of handling rsturned cases and bottles were the only processes in plant A that wers considered grossly inefficient with respect to labor. The receiving processes could have eliminated one or two msn without any apparent reduction in receiving capacity. The cold room capacity could havs been increased, a floor conveyor installed, and one or two worksrs eliminated. Ths labor efficiency of the processes handling returned cases and bottles could have been improved by eliminating one or two workers and by transferring some of ths work requirements of these processes to other plant personnel.

The ratio-delay analysis also showod that individual workere were much more

productive when performing certain tasks than when performing others. This suggested that the over-all labor efficiency of plant A probably could have been improved by relocating workers to jobs where they were apparently more efficient.

This study also demonstrated the practicability of a ratio-delay analysis in dairy processing plants. In the first place, it made evident the decision making points in the flow of products through the plant. It required management to precisely define each man's job or jobs and become more familiar with each operation. It proved to be a much more accurate method of assigning costs to particular operations than the cost accounting techniques presently used by many plants. The ratio-delay study required a minimum of time and cost, and it produced no apparent ill effects on the workers or operation of plant A during the study period.

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APPENDIX I

Detailed Process Descriptions and Utility Requirements

Process I. Receiving Can Milk

Process Description. All can milk entered the plant at this point. It was either Grade A or Grade C milk. The process included all activities from the time milk entered the plant until it was cooled and ready to leave the storage tank.

This process began when the truck operator removed the cans of milk from his truck at the receiving dock and placed them on the power conveyor which brought cans into the receiving room. Prior to receiving the first can of milk, pumps (1,78), filters (2,79), and pipes to the plate heat exchangers (3,9) had been assembled.[1] Cleaning compounds and sanitizing agents had been placed in the can washer (4).

A worker loosened can lids with a rubber mallet and made a quick organoleptic inspection of the milk. Milk that was rejected on the basis of the organoleptic test was returned to the producer. The worker may or may not have made a sediment test of the milk as this was not a daily requirement.

The worker operating the weigh tank (52 or 76), removed the can's lid and placed it in the can washer intake. He then inverted the can filled with milk allowing milk to flow into the weigh tank. After milk had drained from the can, the empty can moved into the can washer. A conveyor moved the can through the washer and returned it outside of the building where it was picked up by the truck operator and returned to the producer. When all of one producer's milk was in the weigh tank, milk was weighed and recorded.

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[1] Throughout Appendix I, numbers in parenthesis refer to pieces of equipment which are given in numerical order in the table following each process description.

A sample of milk was taken with a vacuum type sampling device (77) for a butterfat, bacteria, or any other milk quality test desired. Milk flowed by gravity into the milk intake pan (5 or 76). Milk returns (Process XXIX) also re-enter the Grade C department at this point. The pumps (1 or 78), which started automatically when milk was in the intake pan, pumped the milk through the pressure filter (2 or 79), and then through the plate heat exchanger (3 or 9) where it was cooled to less than 40° F. Milk then went to storage tanks (6,7,10,11,80,81), which were not refrigerated, but had agitators to keep the milk well mixed.

The process of receiving, cooling and storage of milk ended when milk was ready to leave the storage tanks.

Cleaning activities involved disassembling, cleaning, and rinsing of milk pipes, filters, and heat exchangers; washing the intake pans; cleaning the can washer and floor; and scrubbing the inside of the storage tanks.

At this point in the flow of milk through the plant, decisions were made as to the milk's ultimate use.

Product Alternatives. Milk from storage tanks might have entered any of the following alternative uses:

A. Grade A
   1. Sold in 10-gallon cans
   2. Sold in bulk
   3. In plant transfers

B. Grade C
   1. Sold in 10-gallon cans
   2. Sold in bulk
   3. In plant transfers

Entry into one of these alternative uses constituted the beginning of a new process.

Maintenance. Equipment maintenance included labor required for the care and maintenance of equipment listed in Table 39.

Plant maintenance included labor required for the care and maintenance of the building housing this equipment.

Labor Classification. This process was divided into five departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Receiving -- South Line
- Variable:
  - Opening cans
  - Grading
  - Dumping
  - Recording
  - Sampling
  - Can washing
- Fixed -- other than maintenance:
  - Supplies
  - Clean-up
  - Set-up

Receiving -- South Line -- Maintenance
- Fixed--maintenance:
  - Plant maintenance
  - Equipment maintenance

Receiving -- South Line -- Idle Time
- Idle time:
  - Unassigned idle time

First Holding -- Operations
- Variable:
  - Tank operation
- Fixed -- other than maintenance:
  - Set-up
  - Clean-up

First Holding -- Maintenance
- Fixed -- maintenance:
  - Plant maintenance
  - Equipment maintenance

Table 39. Electrical, steam, and refrigeration requirements and capacity of equipment used in Procesa I, Receiving Can Milk.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
1	Milk pump	Century	3 h.p.	2.2378						
2	Preasure filter	Cherry-Burrell								
3	Plate heat exchanger	Creamery Package	21 plates					60°	40°	22.1/lb. milk
4	Milk can washer	Lathrop-Paulson	13 cans/min.	9.9461			2,100/can			
5	Milk intake pan	Lathrop-Paulson	100 gal.							
6	Storage tank	Cherry-Burrell	5,000 gal.	0.5599						
7	Storage tank	Heil	5,000 gal.	0.7462						
9	Plate heat exchanger	Creamery Package	20,000 lbs./hr.					60°	40°	22.1/lb. milk
10	Storage tank	Cherry-Burrell	3,000 gal.	0.5599						
11	Storage tank	Cherry-Burrell	2,000 gal.	0.3727						

Table 39 (concl.) Electrical, steam, and refrigeration requirements and capacity of equipment used in Process I, Receiving Can Milk.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
52	Weighing tank		1,000 lbs.							
76	Weigh tank and milk intake pan	Lathrop-Paulson	1,000 lbs.							
77	Vacuum sampler and pump	Lathrop-Paulson	½ h.p.	0.1872						
78	Milk pump		3 h.p.	2.2378						
79	Pressure filter	Cherry-Burrell								
80	Storage tank	Sanitank	5,000 gal.	1.1189						
81	Storage tank	Creamery Package	4,000 gal.	0.7462						

Process II. Receiving Bulk Milk

Process Description. All bulk milk entered the plant at this point. It was either Grade A from farm sources or other plants or Grade C from other plants. This process included all activities from the time milk entered the plant until it was cooled and ready to leave the storage tanks.

This process began with raw cooled milk in the bulk tank truck parked at the receiving dock. Prior to arrival of the first milk, the pump (8) was assembled. If the milk was to be used in the Grade C department, pipes were connected to the plate heat exchanger (3). From the plate heat exchanger (3), pipes were connected to the storage tanks (6,7,80,81). If milk was to be used in the A department, pipes were connected from the pump (8) to the plate heat exchanger (9). From the plate heat exchanger, milk flowed to storage tanks (10,11).

When a truck loaded with milk arrived at the receiving dock, a worker placed two small wooden ramps in front of the truck's front wheels. The truck was driven up on these ramps so that the front of the truck was elevated about six inches. This facilitated draining the tank. A worker then took a sample of the milk with a long dipper. He sent part of the sample to the laboratory for a butterfat, bacteria, or any other milk quality test desired; and the remainder was used to determine the temperature of the load of milk.

The intake hose of the pump (8) was connected to the outlet on the truck, and the milk pumped to either of the plate heat exchangers (3,9) in the Grade A or Grade C departments. Milk that was to be processed the same day it was received was not cooled, but pumped directly to the storage tanks. When the truck was empty, the hose was disconnected and the truck sent to the service area for washing. Washing the truck was not included in this process. Storage

tanks in both departments were not refrigerated, but had agitators to keep the milk well mixed.

The process of receiving, cooling and storage of milk ended when milk was ready to leave the storage tanks.

Cleaning activities included disassembling and cleaning of the milk pump, pipes, and heat exchangers; scrubbing the inside of storage tanks; and cleaning the floor in this area of the plant.

Product Alternatives. At this point milk from the storage might have entered any of the following alternative uses:

A. Grade A
   1. Sold in 10-gallon cans
   2. Sold in bulk
   3. In plant transfers

B. Grade C
   1. Sold in 10-gallon cans
   2. Sold in bulk
   3. In plant transfers

Entry into one of the alternative uses constituted the beginning of a new work process.

Maintenance. Equipment maintenance included labor required for the care and maintenance of equipment listed in Table 40.

Plant maintenance included labor required for the care and maintenance of the building housing this equipment.

Labor Classification. This process was divided into two departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Bulk Receiving -- Operations
   Variable:
      Hook-up
      Pumping
      Unhook
      Sampling
      Tank operation

Table 40. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process II, Receiving Bulk Milk.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
3	Plate heat exchanger	Creamery Package	21 plates					60°	40°	22.1/lb. milk
6	Storage tank	Cherry-Burrell	5,000 gal.	0.5599						
7	Storage tank	Heil	5,000 gal.	0.7462						
8	Milk pump	Creamery Package	20,000 lbs./hr.	3.7302						
9	Plate heat exchanger	Creamery Package	20,000 lbs./hr.					60°	40°	22.1/lb. milk
10	Storage tank	Cherry-Burrell	3,000 gal.	0.5599						
11	Storage tank	Cherry-Burrell	2,000 gal.	0.3727						
80	Storage tank	Sanitank	5,000 gal.	1.1189						
81	Storage tank	Creamery Package	4,000 gal.	0.7462						

Fixed -- other than maintenance:
Set-up
Clean-up

Bulk Receiving -- Maintenance
Fixed -- maintenance:
Plant maintenance
Equipment maintenance

Process III. Receiving Can Cream

Process Description. All route and station cream entered the plant at this point. This process included all activities from the time cream entered the plant until it was in the twin-coil pasteurizers ready for neutralization.

This process began when the truck operator placed full cans of cream on the power conveyor leading into the cream receiving room. Prior to receiving cream, pumps (12,82) had been assembled, dump tank (13) set up, and pipes connected to the twin-coil pastsurizers (14,15,16). Cleaning and sanitizing agents had been added to the can washer (17).

After cans were placed on the conveyor, a worker placed a sample bottle on top of each can. A worker opened the cans, made an organoleptic inspection, and then took a sample which was placed in the sample bottle. After the sample was taken, cream was weighed in the can and the weight recorded. The can was then inverted over the dump tank (13) and allowed to drain before moving into the can washer (17). If the cream remaining in the can was unusually thick, the can was sprayed with hot water to loosen fat sticking to the sides of the can. The can moved through the washer and on out to the empty can storage room. Cans were stacked on a rack to be picked up later by the truck operator and returned to producers or cream stations. When the dump tank became full, a pump (82) was started. It pumped cream through a pressure

filter (83) to the surge tank (105). Cream was then pumped (12) to the twin-coil pasteurizers (14,15,16). Twin-coil pasteurizers were used only as storage tanks and as a place for neutralization.

Cleaning activities included disassembly of pumps, washing dump tanks, dismantling pipes, cleaning the can washer and scrubbing the floor. A receiving crew did the cleaning in this process.

Process III ended with the raw cream in twin-coil pasteurizing vats.

Product Alternatives. At this point, cream entered the pasteurization process only.

Maintenance. Equipment maintenance included labor required for the care and maintenance of equipment listed in Table 41.

Plant maintenance included labor required for the care and maintenance of the building housing this equipment.

Labor Classification. This process was divided into four departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Receiving -- North Line
- Variable:
  - Opening cans
  - Grading
  - Dumping
  - Recording
  - Sampling
  - Can washing
  - Stacking cans
- Fixed -- other than maintenance:
  - Supplies
  - Clean-up
  - Set-up

Receiving -- North Line -- Maintenance
- Fixed -- maintenance:
  - Plant maintenance
  - Equipment maintenance

Table 41. Electrical, steam, and rafrigeration requirements and capacity of equipment used in Process III, Receiving Can Craam.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
12	Cream pump	Cherry-Burrell	½ h.p.	0.3727						
13	Dump tank		100 gal.							
14	Twin-coil pasteurizer	Cherry-Burrell	500 gal.	2.2378				60°	40°	18.9/lb. cream
15	Twin-coil pastaurizer	Cherry-Burrell	500 gal.	2.2378				60°	40°	18.9/lb. cream
16	Twin-coil pasteurizer	Cherry-Burrell	500 gal.	2.2378				60°	40°	18.9/lb. cream
17	Craam can washer	Lsthrop-Paulson	3 cans/min.	3.8229			4,500/can			
82	Cream pump	Waukesha	1½ h.p.	1.1189						
83	Pressure filter	Cherry-Burrell								
105	Surge tank		20 gal.							

Receiving -- North Line -- Idle Time
    Idle time:
        Unassigned idle time

First Holding -- Can Cream
    Variable:
        Tank operation
    Fixed -- other than maintenance:
        Set-up
        Clean-up

Process IV. Separating Grade C Milk

Process Description. This process began with cooled milk in storage tanks (6,7,80,81). After all pipe connections were made and the separators (22,23,24) assembled, milk was pumped (18) from storage tanks into the plate heat exchanger (19) where it was heated to 90° F. If the vacuum pan was operating, milk was pumped from the storage tanks to the bleeder heater (26) in order to utilize this heat. Milk flowed back to the surge tank (106) where it mixed with milk from the plate heat exchanger (19). From the plate heat exchanger, milk went to a surge tank (106). Milk was then pumped (20) through a pressure filter (21). From the filter, milk went to the separators.

The cream was then vacuumized (53), pasteurized (55), cooled (3), and stored in storage tanks (44,45) as in Process XII (Processing and Storing Route Cream).

This process ended when skim milk left the surge tank (107) at the separator location, and cream was in storage tanks ready for selling or churning.

Cleaning activities included disassembly and cleaning of separators and plate heat exchanger (pre-heater), dismantling of pipes, and cleaning of surge tanks. Most of the cleaning was performed by a night crew.

Product Alternatives. At this point skim milk from surge tanks and cream in storage might have entered any of the following alternative uses:

A. Skim milk
   1. Sold in 10-gallon cans
   2. In plant transfers

B. Cream
   1. Sold in 10-gallon cans
   2. In plant transfers

Maintenance. Equipment maintenance included labor required for the care of equipment listed in Table 42.

Plant maintenance included labor required for the care and maintenance of the building housing this equipment.

Labor Classification. This process was divided into two departments which were divided into divisions of labor. The divisions of labor were further divided into work elements.

Separation
- Variable:
  - Processing
  - Holding
  - Canning cream
- Fixed -- other than maintenance:
  - Hook-up
  - Machine set-up
  - Clean-up

Separation -- Maintenance
- Fixed -- maintenance:
  - Plant maintenance
  - Equipment maintenance

Process V. Condensing Operation

Process Description for Skim Milk. This process included all activities from the time skim milk left the surge tank at the separators until cooled condensed skim milk entered the storage tank or warm condensed skim milk entered the drying process.

Table 42. Electrical, steam, and refrigeration equipment and capacity of equipment used in Process IV, Separating Grade C Milk.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
3	Plate heat exchanger	Creamery Package	21 plates					190°	40°	148/lb. cream
6	Storage tank	Charry-Burrell	5,000 gal.	for identification only						
7	Storage tank	Heil	5,000 gal.	for identification only						
18	Milk pump	Cherry-Burrell	3 h.p.	2.2378						
19	Plate heat exchanger	Charry-Burrall	17 plates		40°	90°	55.3/lb. milk			
20	Milk pump	Creamery Package	7½ h.p.	5.5953						
21	Pressure filter	Cherry-Burrall								
22	Separator	Delaval	10,000 lbs./hr.	2.2378						
23	Separator	Delaval	10,000 lbs./hr.	2.2378						
24	Separator	Delaval	10,000 lbs./hr.	2.2378						

Table 42 (concl.) Electrical, steam, and refrigeration equipment and capacity of equipment used in Process IV, Seperating Grade C Milk.

Code	Item	Mfr.	Capacity	Electricity: kw./hr.	Steam: Temp.(F) In	Steam: Temp.(F) Out	Steam: b.t.u.	Refrigeration: Temp.(F) In	Refrigeration: Temp.(F) Out	Refrigeration: b.t.u.
26	Bleeder heater	Part of equipment inventory 30, the bleeder heeter was used to reduce the heat requirement of the tubular heater when the vacuum pen was in operation.								
44	Storage tank	Cherry-Burrell	1,000 gal.	0.3727				40°	40°	642.35/hr.
45	Storage tank	Cherry-Burrell	1,000 gal.	0.3727				40°	40°	642.35/hr.
53	Vecuumizer and pump	Cheeter-Jensen	3½ h.p.	2.6105						
55	Tubular heater	Chester-Jensen	8,000 lbs./hr.		145°	190°	44.1/lbs. cream			
80	Storage tank	Sanitank	5,000 gal.	for identification only						
81	Storege tank	Creamery Package	4,000 gal.	for identification only						
106	Surge tank		40 gal.							
107	Surge tank		40 gal.							

The process began with skim milk in the surge tank (107) at the separator location. Milk was pumped (25) to the bleeder heater (26) on the evapoator (30) for pre-heating. From the bleeder heater, milk flowed to the tubular heater (27) where it was heated to 180° F. There were two ways of handling the milk here. It may have been handled as described above or it may have been pumped directly from the surge tank to the tubular heater. The first method increaeed the capacity of the tubular heater.

From the tubular heater, milk went to the two hot welle (28,29). Milk was drawn from the hot wells to the first and second stage evaporator (30) where it was condensed to a ratio of 4:1. From the eecond stage evaporator, condensed milk was pumped (100) to the plate heat exchanger (34) and then to a etorage tank (33) or storage vats (32,85). If condensed milk wae to be dried, it did not flow through the plate cooler, but entered storage vate (32,85) which were actually ueed as a surge tank for the drying process.

Thie process ended with cooled condensed ekim milk in the storage tank or warm condensed skim milk at 130° F. as it entered the drying procees.

Process Description for Whole Milk. This process included all activities from the time whole milk was in the storage tank until cooled condensed whole milk entered the storage vat or warm condensed whole milk entered the drying process.

Thie process began with whole milk in storage tanks (6,7,80,81). Cream was transported in 10-gallon cans to the storage tanks and added to the whole milk. Cream was added in order to increase the fat content to the specifications of 26 per cent butterfat for dry whole milk. The enriched milk was pumped (18) to the bleeder heater (26) on the evaporator or directly to the tubular heater (27) as described in the ekim milk process. The remainder of

the process is identical to the process for evaporation of skim milk with the exception that whole milk was condensed to a ratio of 3:1.

The process ended with cooled condensed whole milk in the storage tank or warm condensed whole milk as it entered the drying process.

Cleaning activities included cleaning all equipment listed in Table 43.

Product Alternatives. Condensed milk from the condensing operation might have entered any of the following alternative uses:

A. Condensed skim milk
   1. Sold in 10-gallon cans
   2. Sold in bulk
   3. In plant transfers

B. Condensed whole milk
   1. Sold in 10-gallon cans
   2. Sold in bulk
   3. In plant transfers

Maintenance. Equipment maintenance included labor required for the care and maintenance of equipment listed in Table 43.

Plant maintenance included labor required for the care and maintenance of the building housing this equipment.

Labor Classification. This process was divided into three departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Vacuum Pan -- Operations
- Variable:
  - Forewarming
  - Processing
- Fixed -- other than maintenance:
  - Hook-up
  - Machine set-up
  - Clean-up

Vacuum Pan -- Maintenance
- Fixed -- maintenance:
  - Plant maintenance
  - Equipment maintenance

Table 43. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process V, Condensing Operation.

Code	Item	Mfr.	Capacity	Electricity: kw./hr.	Steam: Temp.(F) In	Steam: Temp.(F) Out	Steam: b.t.u.	Refrigeration: Temp.(F) In	Refrigeration: Temp.(F) Out	Refrigeration: b.t.u.
6	Storage tank	Cherry-Burrell	5,000 gal.	for identification only						
7	Storage tank	Heil	5,000 gal.	for identification only						
18	Milk pump	Cherry-Burrell	3 h.p.	2.2378						
25	Milk pump	Creamery Package	5 h.p.	3.7302						
26	Bleeder heater	Part of equipment inventory 30, the bleeder heater was used to reduce the heat requirement of the tubular heater when the vacuum pan was in operation.								
27	Tubular heater	Chester-Jensen	20,000 lbs./hr.		120°	180°	66.35/1b. whole milk			
					90°	180°	99.5/1b. whole milk			
					90°	165°	82.9/1b. skim milk			
28	Hot well		1,000 gal.							
29	Hot well		1,000 gal.							
30	Two stage evaporator	Rodgers	18,000 lbs./hr.	49.2353			305.5/1b. milk entering 925.7/1b. condensed leaving			

Table 43 (concl.) Electrical, steam, and refrigeration requirements and capacity of equipment used in Process V, Condensing Operation.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
32	Storage vat	Cherry-Burrell	550 gal.	0.5599				40°	40°	389.74/hr.
33	Storage tank	Cherry-Burrell	2,000 gal.	0.3727				40°	40°	837/hr.
34	Plate heat exchanger	Creamery Package	20,000 lbs./hr.		40°	170°	122.2/lb. whole and skim	130°	40°	99.5/lb. milk
					130°	170°	44.2/lb. whole and skim	165°	70°	105/lb. milk for cheese
80	Storage tank	Sanitank	5,000 gal.	for identification only						
81	Storage tank	Creamery Package	4,000 gal.	for identification only						
85	Storage vat	Cherry-Burrell	550 gal.	0.5599				40°	40°	389.74/hr.
100	Extraction pump	Howell	3 h.p.	2.2378						
107	Surge tank		40 gal.							

Vacuum Pan -- Idle Time
Idle time:
Unassigned idle time

Process VI. Condensing Transfers

Process Description. This process began with cooled condensed milk in storage vats (32, 85). Cans were transported to the vats on a dolly where they were gravity filled with condensed milk. If the order called for a lower per cent of solids-not-fat than the condensed milk contained, water was added to obtain the desired per cent of solids. After 10-gallon cans were filled, they were transported to the south cold room. This process ended with full cans of condensed skim milk in the south cold room.

Product Alternatives. Condensed milk in 10-gallon cans might have entered either of the following alternative uses:

A. Sold in 10-gallon cans

B. In plant transfers

Maintenance. No plant or equipment maintenance was charged to this process. Care of storage vats (Table 44) was charged to Process V (Condensing Operation).

Labor Classification. This process was divided into two departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Vacuum Pan -- Operations
Variable:
Transfer to next dept -- canning
Transfer empty cans

South Cold Room -- Operations
Variable:
Product in -- plant

Table 44. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process VI, Condensing Trsnsfers.

Code	Item	Mfr.	Capacity	Electricity: kw./hr.	Steam: Temp.(F) In	Steam: Temp.(F) Out	Steam: b.t.u.	Refrigeration: Temp.(F) In	Refrigeration: Temp.(F) Out	Refrigeration: b.t.u.
32	Storage vat	Cherry-Burrell	550 gal.	for identification only						
85	Storage vat	Cherry-Burrell	550 gal.	for identification only						

Process VII. Selling Condensed Milk

Process Description. This process included labor required for loading 10-gallon cans of condensed milk for shipment. The process began with cans of condensed milk in the south cold room. When a truck arrived for loading, a worker transported cans of condensed milk to the gravity conveyor with a two-wheeled dolly and set the cans on the conveyor. This process ended with cans on the conveyor outside the building ready to be loaded into the truck by the truck driver. The truck driver was not observed in this study.

Equipment Used. The only equipment used was a two-wheeled dolly and the gravity conveyor.

Product Alternatives. This was a final product.

Maintenance. No cleaning or maintenance was observed in this process.

Labor Classification. This process included one department, one division of labor, and one work element.

South Cold Room -- Operations
Variable:
Product out -- ship

Process VIII. Spray-Drying Operation

Process Description. This process included all activities from the time condensed milk (either non-fat or whole) left the storage tanks until it was dried and reached the bagger.

This process began with cooled condensed milk in the storage tanks (32, 33,85) or warm condensed milk at the evaporator (30). Condensed milk was pumped (86) to the plate heat exchanger (34) where it was heated to 160-170° F. From the plate heat exchanger, milk went to the homogenizer (35), which was

used as a pump to put the milk into the dryer (36).

Dry milk left the dryer by an auger and the force of gravity. This process ended when dry milk entered the cyclocentric screen and bagger.

Cleaning of the dryer is a major item of work as the walls, ceiling, and floor were brushed and washed. Jets were also dismantled and cleaned daily or after each production run.

Product Alternatives. The only alternative was to package the dry milk.

Maintenance. Equipment maintenance included labor required for the care and maintenance of equipment listed in Table 45.

Plant maintenance included labor required for the care and maintenance of the building housing this equipment.

Labor Classification. This process was divided into two departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Spray Drying -- Processing -- Operations
Variable:
Processing operation
Fixed -- other than maintenance:
Set-up
Change over
Clean-up

Spray Drying -- Processing -- Maintenance
Fixed -- maintenance:
Plant maintenance
Equipment maintenance

Process IX. Packaging Dry Milk

Process Description. This process included all activities from the time dry milk left the dryer until it was in sealed packages ready for storage.

This process began when dry milk entered the cyclocentric screen and bagger (37). If the product was dry whole milk, the dry milk did not pass

Table 45. Electrical, steam and refrigeration requirements and capacity of equipment used in Process VIII, Spray-Drying Operation.

Code	Item	Mfr.	Capacity	Electricity: kw./hr.	Steam: Temp.(F) In	Steam: Temp.(F) Out	Steam: b.t.u.	Refrigeration: Temp.(F) In	Refrigeration: Temp.(F) Out	Refrigeration: b.t.u.
30	Two stage evaporator	Rodgers	18,000 lbs./hr.	for identification only						
32	Storage vat	Cherry-Burrell	550 gal.	for identification only						
33	Storage tank	Cherry-Burrell	2,000 gal.	for identification only						
34	Plate heat exchanger	Creamery Package	20,000 lbs./hr.		40°	170°	122.2/lb. whole and skim			
					130°	170°	44.2/lb. whole and skim			
35	Homogenizer	Manton-Caulin	15 h.p.	11.1897						
36	Spray drier	Rodgers	1,200 lbs./hr.	35.2496	170°	212°	2,235/lb. dry milk			
85	Storage vat	Cherry-Burrell	550 gal.	for identification only						
86	Milk pump	Cherry-Burrell	2 h.p.	1.4924						

over the screen, but fell directly into a 100 pound bag or 220 pound barrel. Dry whole milk did not pass over the cyclocentric screen. Breaking up powder flakes would destroy the emulsion of fat in milk solids and result in flavor deteriorating reactions. If the product was non-fat dry milk, it passed over the screen to break up milk particles providing a more soluble product. Prior to filling the first containers, bags or barrels were transported from the warehouse to the bagging area and labeled as to fat content, solids-not-fat content and weight. After a bag was filled, it was sealed and the top closed with a special sewing machine (84). After a barrel was filled, the plastic liner was sealed and a metal top clamped on. One out of every forty containers was set back for laboratory personnel to sample.

This process ended with dry milk in the sealed container at the bagger location.

Cleaning activities included cleaning the bagger, the screen, and the entire floor of the packaging room.

Product Alternatives. Dry milk was packaged in the following size containers:

A. Non-fat dry milk
   1. 100-pound bags
      a. U.S. Extra Grade
      b. U.S. Standard Grade
   2. 220 pound barrels
      a. U.S. Extra Grade
      b. U.S. Standard Grade

B. Dry whole milk
   1. 100 pound bags
      a. U.S. Extra Grade
      b. U.S. Standard Grade
   2. 220 pound barrels
      a. U.S. Extra Grade
      b. U.S. Standard Grade

Maintenance. Equipment maintenance included labor required for the care and maintenance of equipment listed in Table 46.

Table 46. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process IX, Packaging Dry Milk.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
37	Cyclocentric screen and bagger	Patterson	1 h.p.	0.7462						
84	Sewing machine		¼ h.p.	0.1872						

Plant maintenance included labor required for the care and maintenance of the building housing this equipment.

Labor Classification. This process was divided into two departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Spray Drying -- Packaging -- Operations
- Variable:
  - Transport packages from storage to packaging area
  - Position package
  - Filling
  - Sampling one container in 40
  - Sealing package
  - Labeling
  - Supplied
  - Package preparation
- Fixed -- other than maintenance:
  - Set-up
  - Machine set-up
  - Clean-up

Spray Drying -- Packaging -- Maintenance
- Fixed -- maintenance
  - Plant maintenance
  - Equipment maintenance

Process X. Storing Dry Milk

Process Description. This process included all hauling of the sealed dry milk containers from the time they were moved from the packaging area until they were in place on a stack in storage.

This process began with the filled bag or barrel at the bagger location. The container was placed on a two-wheel dolly and transported to the stack. The container was removed from the dolly and placed on the hoist (38). The hoist elevated the container to the top of the pile where a worker removed the container and positioned it on the stack. The dolly was then transported back to the packaging area.

This process ended with the bag or barrel in place on the stack.

Product Alternatives. Dry milk might have entered either of following alternative uses:

A. Sold as dry milk.

B. In plant transfers.

Maintenance. No equipment or plant maintenance was observed in this process. The only equipment used was an electric hoist (Table 47) and a two-wheel dolly.

Labor Classification. This process included one department which was divided into divisions of labor. Divisions of labor were further divided into work elements.

Spray Drying -- Packaging -- Operations
- Variable:
  - Transport to storage
  - Stacking
  - Transport empty dolly
- Fixed -- other than maintenance:
  - Inventory
  - Storage rearrangement

Process XI. Shipping Dry Milk

Process Description. This process began with full bags or barrels of dry milk on the stack in the storage area. Electric hoist (38) was used to lower the top bags or barrels from the pile. Containers were then placed on a two-wheel dolly and transported to the truck. Containers were stacked in the truck after cardboard or paper was placed on the truck floor. It was frequently necessary to prepare an elevated ramp for the truck if the truck was too high for the loading dock.

This process ended with bags or barrels in place in the truck ready for shipment.

Product Alternatives. There were no alternate uses for this product as dry milk was now an end product.

Maintenance. No equipment or plant maintenance was observed in this process. The only equipment used was an electric hoist (Table 48) and a two-wheel dolly.

Labor Classification. This process included one department and one division of labor. The division of labor was divided into work elements.

Spray Drying Packaging -- Operations
Variable:
Load out dolly for shipping
Transport to truck
Stacking in truck
Transport empty dolly to storage
Preparing loading dock
Preparing truck for hauling

Process XII. Processing and Storing Route Cream

Process Description. This process included all activities from the time cream was stored in twin-coil pasteurizers until it left holding tanks for sales or churning.

The process began with raw route cream in twin-coil pasteurizers (14,15, 16). Some returned cream and butter were added to route cream, but this was small in comparison to the amount received from the route. The acidity of the cream was taken, and the cream heated. Upon reaching 145° F., the proper amount of neutralizer was added to the warm cream. The twin-coil pasteurizers were actually used as holding tanks rather than pasteurizers. From the twin-coil pasteurizers, cream was pumped (99) to a surge tank (108) and then pulled through the vacuumizer (53). From the vacuumizer, cream was pumped by a timing pump (54) through three-fourths of the tubular heater (55). Cream then went through the pressure strainer (56), the remaining one-fourth of the

Table 48. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XI, Shipping Dry Milk.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
38	Electric hoist	Star	1½ h.p.	1.1189						

tubular heater, held at 190° F. for fifteen seconds in the holding tube for pasteurization, and then cooled to 40° F. in the plate heat exchanger (3). From the heat exchanger, cream went to storage tanks (44,45) which were refrigerated.

Some route cream was run through the vacuumizer and tubular heater twice. This was the case because there was a three-way valve just before the holding tube which allowed cream to flow back, by means of a circulation line, to the surge tank in order to maintain a constant level of cream in the surge tank. This was a self adjusting process, so, the rate of pasteurization was dependent upon the rate of flow of incoming cream from the twin-coil pasteurizers.

This process ended with cooled, pasteurized cream in storage tanks ready to be sold or churned.

Cleaning activities included cleaning of equipment listed in Table 49 and the floor area around this equipment. This labor was included in Process XIV (Buttermaking).

Product Alternatives. Cream from storage tanks might have entered either of the following alternative uses:

A. Sold in 10-gallon cans

B. In plant transfers

Entry into one of these alternative uses constituted the beginning of a new process.

Maintenance. Maintenance for this process was included in Process XIV (Buttermaking).

Labor Classification. This process included one department and one division of labor. The division of labor was divided into two work elements.

Butter Making -- Operations
Variable:
Pre-churn operation -- pasteurization and neutralization
Dumping cream in pasteurizer -- returns

Table 49. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XII, Processing and Storing Route Cream.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
3	Plate heat exchanger	Creamery Package	21 plates					190°	40°	148/lb. cream
14	Twin-coil pasteurizer	Cherry-Burrell	500 gal.	2.2378	40°	145°	105/lb. cream			
15	Twin-coil pasteurizer	Cherry-Burrell	500 gal.	2.2378	40°	145°	105/lb. cream			
16	Twin-coil pasteurizer	Cherry-Burrell	500 gal.	2.2378	40°	145°	105/lb. cream			
44	Storage tank	Cherry-Burrell	1,000 gal.	0.3727				40°	40°	642.35/hr.
45	Storage tank	Cherry-Burrell	1,000 gal.	0.3727				40°	40°	642.35/hr.
53	Vacuumizer and pump	Chester-Jensen	3½ h.p.	2.6105						
54	Milk pump	Waukesha	1 h.p.	0.7462						
55	Tubular heater	Chester-Jensen	8,000 lbs./hr.		145°	190°	44.1/lb. cream			

Table 49 (concl.) Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XII, Processing and Storing Route Cream.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
56	Pressure filter	Stamsvik								
99	Milk pump	Waukesha	3/4 h.p.	0.5599						
108	Surge tank		40 gal.							

Process XIII. Selling Pasteurized Cream

Process Description. This process included all activities from the time cream left the storage tanks until it left the south cold room for shipment.

This process began with cooled, pasteurized, sweet cream or route cream in storage tanks (44,45). A sample of cream was taken, and a butterfat test performed to determine the per cent butterfat. This was essential to determine price. Ten-gallon cans were transported to the storage tank area on a dolly. Cans were filled from the tanks by gravity flow. Full cans were tagged as to date and per cent butterfat and transported to the south cold room. Cans were then placed on the gravity conveyor. This process ended with full cans of cream on the conveyor ready to be loaded into a truck.

Product Alternatives. This was an end product, cream would not be removed from the storage tanks in cans unless it was to be sold.

Maintenance. The only equipment used in this process were storage tanks (Table 50). Maintenance for this process was charged to Process XXIV (Buttermaking).

Labor Classification. This process was divided into two departments which were divided into divisions of labor. The divisions of labor were further divided into work elements.

Butter Making -- Operations
    Variable:
        Transport cans of cream to cooler
        Filling cans

South Cold Room -- Operations
    Variable:
        Products in -- plant
        Products out -- ship

Table 50. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XII, Selling Pasteurized Cream.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
44	Storage tank	Cherry-Burrell	1,000 gal.	for identification only						
45	Storage tank	Cherry-Burrell	1,000 gal.	for identification only						

Process XIV. Buttermaking

Process Description. This process included all activities from the time cooled, pasteurized cream left storage tanks until it was stored as butter in the south cold room.

This process began with cooled, pasteurized cream in storage tanks (44, 45). This could have been either sweet cream for making 92 score butter or route cream for making 90 score butter. Each grade of cream was churned separately. The butterfat content of the cream was derived and an expected yield calculated. After the churn had been sanitized, cream was pumped (39) from storage tanks to the churns (40,41). Coloring material was added to the cream when necessary. While the cream was churning, workers prepared baskets or boxes for storing butter. Containers were lined with wet parchment paper. When the butter was churned and the buttermilk drained, the butter was washed and salted. Salt was then worked into the butter and a test run to determine the butterfat, moisture, salt, and acid content of the butter. Proper adjustments were made in the moisture and salt content, and the butter reworked until the desired consistency was obtained. Butter was removed from the churn, weighed, and placed in 64-pound boxes or 62-pound baskets (boxes if it was to be sold in bulk and baskets if it was to be printed in the plant). Boxes or baskets were then sealed and labeled before being transported on a dolly to the south cold room. As the buttermilk drained, it was pumped (42) to a storage tank (43). This process ended with butter in the south cold room and buttermilk in the storage tank.

Cleaning activities for this process included dismantling pipes to the storage tanks and cleaning equipment listed in Tables 49, 50, 51.

Product Alternatives. Butter and buttermilk might have entered any of

Table 51. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XIV, Buttermaking.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
39	Milk pump	Waukesha	1 h.p.	0.7462						
40	Churn	Cherry-Burrell	4,200 lbs.	11.1897						
41	Vane churn	General Dairy	5,200 lbs.	5.5953						
42	Milk pump	Fairbanks-Morse	3 h.p.	2.2378						
43	Storage tank	Creamery Package	1,500 gal.	0.7462						
44	Storage tank	Cherry-Burrell	1,000 gal.	for identification only						
45	Storage tank	Cherry-Burrell	1,000 gal.	for identification only						

the following alternate uses:

A. Ninety-two score butter
   1. Sold in 64-pound boxes
   2. Printed
   3. In plant transfers

B. Ninety score butter
   1. Sold in 64-pound boxes
   2. Printed
   3. In plant transfers

C. Buttermilk
   1. In plant transfers

Maintenance. Equipment maintenance included labor required for the care and maintenance of equipment listed in Tables 49, 50, and 51.

Plant maintenance included labor required for the care and maintenance of the area housing this equipment.

Labor Classification. This process was divided into three departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Butter Making -- Operations
- Variable:
  - Filling churn
  - Churning
  - Testing
  - Pulling
  - Basket preparation
  - Filling baskets or boxes
  - Transport product to cooler
  - Transport empty dolly back
  - Recording
  - Pumping buttermilk
  - Supplies
- Fixed -- other than maintenance:
  - Sanitize
  - Hook-up
  - Clean-up

Butter Making -- Maintenance
- Fixed -- maintenance:
  - Plant maintenance
  - Equipment maintenance

South Cold Room -- Operations
Variable:
Product in -- plant

Process XV. Selling Bulk Butter

Process Description. The process began when a truck operator arrived for a load of butter. Bulk butter in 64-pound boxes was placed on a dolly and moved to the gravity conveyor in the south cold room. Boxes were placed on the conveyor. The truck operator removed the boxes from the conveyor and loaded his truck. This process ended with butter on the conveyor ready to be loaded into the truck. Truck operators were not observed in this study.

Equipment Used. A dolly and the conveyor were the only pieces of equipment used in this process.

Product Alternatives. This was a final product.

Maintenance. Maintenance was not included in this process.

Labor Classification. This process included one department, one division of labor, and one work element.

South Cold Room -- Operations
Variable:
Products out -- ship

Process XVI. Printing and Wrapping Butter in Individual Quarters -- One Brand Only

Process Description. This process included all activities from the time butter was received in the printing room until it was printed, wrapped, cased, and moved into the north cold room. This process included only one brand name so that exact production figures could be used.

This process began with bulk butter in the south cold room. Bulk butter

was transported to the printing room in 62-pound baskets. After bulk butter was in the printing room and other supplies provided as necessary, butter was cut into smaller chunks with a wire cutter. Chunks of butter were placed into the printer (72) which molded butter into one-fourth pound pieces.

One-fourth pound pieces of butter were moved by hand to the wrapping machine (73). This machine wrapped the quarters, and a worker moved them to the packaging table. Wrapped quarters were placed in cartons by hand, cartons placed in cases, and the number of cartons filled recorded on a production sheet. Cases of butter were moved on a dolly into the north cold room where this process ended.

Cleaning activities for this process included cleaning of the wrapping tables and machines.

Product Alternatives. Ninety-two score butter was packaged in the following size cartons:

A. One-pound individually wrapped quarters

B. One-half pound individually wrapped quarters

Maintenance. Equipment maintenance included labor required for the care and maintenance of equipment listed in Table 52.

Plant maintenance included labor required for the care and maintenance of the butter printing room.

Labor Classification. This process was divided into three departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Butter Printing -- Printer
    Variable:
        Supplies
        Product in
        Operation

Table 52. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XVI, Printing and Wrapping Butter in Individual Quarters - One Brand Only.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
72	Butter printing machine	Doering	1,000 lbs./hr.	1.1189						
73	Butter wrapping machine	Lynch	1,200 lbs./hr.	0.3727						

Fixed -- other than maintenance:
Hook-up
Clean-up

Butter Printing -- Wrapping
Variable:
Supplies
Operation
Packaging
Casing in
Product out
Recording
Fixed -- other than maintenance:
Clean-up
Inventory

Butter Printing -- Maintenance
Fixed -- maintenance:
Plant maintenance
Equipment maintenance

Process XVII. Printing and Wrapping Butter -- Other Than the Special Brand of Process XVI

Process Description. This process included all activities from the time bulk butter was received in the printing room until it was printed, wrapped, cased, and transported into the north cold room.

This process began with bulk butter in the south cold room. Bulk butter was transported to the printing room in 62-pound baskets. After bulk butter was brought into the printing room and other supplies provided as necessary, butter was cut into smaller chunks with a wire cutter. Chunks of butter were placed into the printer (72) which molded butter into one-fourth pound pieces.

Butter that was to be individually quarter-wrapped was moved by hand to wrapping machine (73). A worker moved machine-wrapped butter to the packaging table. Wrapped quarters were placed in cartons by hand, and the cartons placed in cases. The number of cartons filled were recorded on a production sheet.

Butter that was not individual quarter-wrapped was wrapped by hand in one pound packages after it came out of the printer. The amount was recorded on a production sheet. Some wrapped butter was placed in cartons before casing and some of it was not. Cases of butter were then moved into the north cold room on a dolly where this process ended.

Cleaning activities included cleaning the wrapping tables and machines.

Product Alternatives. Ninety-score butter was packaged in the following type cartons:

A. One-pound parchment wrapped

B. One-pound parchment wrapped in cartons

C. One-pound of individually wrapped quarters

D. One-half pound of individually wrapped quarters.

Maintenance. Equipment maintenance included labor required for the care and maintenance of equipment listed in Table 53.

Plant maintenance included labor required for the care and maintenance of the butter printing room.

Labor Classification. This process was divided into three departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Butter Printing -- Printer
- Variable:
  - Supplies
  - Product in
  - Operation
- Fixed -- other than maintenance:
  - Hook-up
  - Clean-up

Butter Printing -- Wrapping
- Variable:
  - Supplies
  - Operation
  - Hand wrap

Table 53. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XVII, Printing and Wrapping Butter - Exclusive of the Special Brand of Process XVI.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
72	Butter printing machine	Doering	1,000 lbs./hr.	1.1189						
73	Butter wrapping machine	Lynch	1,200 lbs./hr.	0.3727						

Packaging
Casing in
Product out
Recording
Fixed -- other than maintenance:
Clean-up
Inventory

Butter Printing -- Maintenance
Fixed -- maintenance:
Plant maintenance
Equipment maintenance

Process XVIII. Processing Cottage Cheese

Process Description. This process began with skim milk in the surge tank (107) near the separators (22,23,24). Skim milk was pumped (25) from the surge tank through the tubular heater (27) and through the plate heat exchanger (34) to the cheese vats (46,47). After all milk was in the vats, starter, which had been previously prepared from skim milk in the Grade A department, was added. The temperature of the milk was raised, and the milk set overnight at 70° F. in the vats. The following morning tests were run to determine the proper time for cutting the curd. When the curd had devsloped properly for cutting, it was cut with wire cutters by hand; and the temperature raised for cooking. While the cheese was cooking, it was stirred with mechanical agitators (97,98); however, some hand stirring was necessary in addition to the agitators in order to free the curd that had been caught in the corners of the vats. After the necessary time for cooking (about two hours) the whey was drained; and the curd washed and drained with water two or three times. Drained curd was then placed in plastic-lined, ten-gallon, straight-sided cheese cans which, when full, contained 70 pounds of curd. Canned curd was moved on two-wheel dollies to the south cold room for temporary storage. Whey was drained into a tank and later hauled off and dumped.

This process ended with cottage cheese curd in special cheese cans in the south cold room.

Cleaning activities for this process included cleaning the plate heat exchanger, cheese vats, and the floor of the cheese processing area.

Product Alternatives. Special cans of cottage cheese might have entered either of the following uses:

A. Sold as non-creamed cottage cheese in 10-gallon cans

B. Stored to be packaged

Maintenance. Equipment maintenance included labor required for the care and maintenance of equipment listed in Table 54.

Plant maintenance included labor required for the care and maintenance of the area housing this equipment.

Labor Classification. This process was divided into three departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Cottage Cheese
- Variable:
  - Filling vats
  - Testing
  - Cutting
  - Cooking
  - Draining
  - Temporary storage -- in plant
  - Preparing starters
  - Hauling whey
- Fixed -- other than maintenance:
  - Hook-up
  - Sanitizing
  - Clean-up

Cottage Cheese -- Maintenance
- Fixed -- maintenance
  - Plant maintenance
  - Equipment maintenance

South Cold Room -- Operations
- Variable:
  - Product in -- plant

Table 54. Electricel, steam, and refrigeration requirements end capacity of equipment used in Process XVIII, Processing Cottage Cheese.

Code	Item	Mfr.	Capacity	Electricity: kw./hr.	Steam: Temp.(F) In	Steam: Temp.(F) Out	Steam: b.t.u.	Refrigeration: Temp.(F) In	Refrigeration: Temp.(F) Out	Refrigeration: b.t.u.
22	Separator	Delavel	10,000 lbs./hr.	for identification only						
23	Separator	Delaval	10,000 lbs./hr.	for identification only						
24	Separator	Deleval	10,000 lbs./hr.	for identification only						
25	Milk pump	Creamery Package	5 h.p.	3.7302						
27	Tubular heater	Chester-Jensen	20,000 lbs./hr.		90°	165°	82.9/lb. skim milk			
34	Plate heet exchanger	Creamery Package	20,000 lbs./hr.					165°	70°	105/lb. skim milk
46	Cheese vat	Damrow	10,400 lbs.	0.7462	70°	115°	52.8/lb. skim milk			
47	Cheese vet	Damrow	10,400 lbs.	1.1189	70°	115°	52.8/lb. skim milk			
97	Cheese vat agitator		½ h.p.	0.3727						
98	Cheese vet agitetor		½ h.p.	0.3727						
107	Surge tank		40 gel.							

Process XIX. Packaging Cottage Cheese

Process Description. This process included all activities from the time cottage cheese curd left the south cold room until it was packaged and moved to the north cold room ready to be placed in stacks.

This process began with cottage cheese curd in special cheese cans in the south cold room. Cans of curd were moved on a two-wheel dolly to the packaging area. Prior to packaging, cheese cartons and cases had been moved to the packaging area. Cans of cheese were dumped into a mixing vat (49). Salted cheese dressing was mixed into the curd by hand with a cottage cheese fork.[1] Cartons were then hand filled with creamed cottage cheese, capped, and placed in cases. It was sometimes necessary to dump packages of cottage cheese back into the mixing vat and repackage the cottage cheese in different size containers. Cases were moved on a two-wheel dolly to the north cold room. This process ended with creamed cottage cheese in retail size cartons in the north cold room. Stacking of cases of cottage cheese was not included in this process, but it was included in Process XXXII (Handling North Cold Room Products).

Cleaning activities for this process included cleaning the mixing vat, packaging table, and area surrounding this equipment.

Product Alternatives. Creamed cottage cheese was packaged in the following size containers:

---

[1] Salted cheese dressing was cheese dressing that had been prepared in the Grade A department. It contained approximately six per cent butterfat. Salt was added to the cheese dressing at a rate of one per cent of the dry curd weight. Salt was dissolved in the dressing before the dressing was applied to the dry curd.

A. Five-pound cartons

B. Two-pound cartons

C. Twelve-ounce cartons

Maintenance. No maintenance was charged to this process. The maintenance observed was included in Process XVIII (Processing Cottage Cheese). This was a small item as the only equipment used was a mixing vat and a cottage cheese fork (Table 55).

Labor Classification. This process was divided into two departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Cottage Cheese
    Variable:
        Salt and dressing
        Supplies and cans
        Temporary storage -- out
        Packaging
        Product out
        Prepackage

South Cold Room -- Operations
    Variable:
        Product out -- plant

Process XX. Processing Ice Cream Products

Process Description. This process began with ice cream, ice milk, or sherbet mix in the south cold room or the Grade A handling room. Mix was transported to the processing area on a dolly in 10-gallon cans, and other supplies were brought in as necessary. After all necessary connections of the pipes and equipment was completed, mix was poured into the mixing vats (50, 92). Flavoring and coloring were added to the mix, and nuts or fruit were placed in the fruit and nut feeder (91) on the freezer. From the mixing vats, mix was run through the continuous freezer (51). If more than one flavor of

Table 55. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XIX, Packsging Cottage Cheese.

Code	Item	Mfr.	Capacity	Elsctricity: kw./hr.	Steam: Temp.(F) In	Steam: Temp.(F) Out	Steam: b.t.u.	Refrigerstion: Temp.(F) In	Refrigerstion: Temp.(F) Out	Refrigerstion: b.t.u.
49	Mixing vat		30 gal.							
88	Filler and capper	Seal Co.	35-45 cartons/min.	not in use during sample period						
89	Cheese mixer	Grace		not in use during sample period						
90	Cheese mixer hoist	General Electric		not in use during sample period						

product or products were produced during one production run, it was usually necessary to shut down briefly to provide additional supplies to the process. Production records and per cent overrun were kept on all products produced. This process ended with partially frozen product coming from the freezer ready to be packaged.

Cleaning activities for this process included cleaning mixing vats, the continuous freezer, and the area surrounding this equipment.

Product Alternatives. During this process, these alternative products might have been made:

A. Ice cream flavors
   1. Vanilla
   2. Chocolate
   3. Strawberry
   4. Cherry nut
   5. Chip chocolate
   6. Butter brickle
   7. Pecan taffy
   8. Chocolate revel
   9. Black cherry
   10. Lemon chiffon
   11. Butter pecan
   12. Butterscotch revel
   13. Whitehouse cherry
   14. Pecan crunch
   15. Butterscotch filbert
   16. Country cousin
   17. Black walnut

B. Ice milk flavors
   1. Vanilla
   2. Chocolate
   3. Strawberry

C. Sherbet
   1. Lime
   2. Orange
   3. Lemon
   4. Pineapple
   5. Raspberry
   6. Watermelon

Maintenance. Equipment maintenance included labor required for the care and maintenance of equipment listed in Table 56.

Plant maintenance included labor required for the care and maintenance of the area immediately surrounding the ice cream processing equipment.

Labor Classification. This process was divided into three departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Ice Cream -- Processing
- Variable:
  - Transporting mix
  - Flavor and color
  - Load in mix
  - Operation
  - Supplies
  - Transport empty cans
- Fixed -- other than maintenance:
  - Hook-up
  - Clean-up
  - Records and formula

Ice Cream -- Maintenance
- Fixed -- maintenance:
  - Plant maintenance
  - Equipment maintenance

South Cold Room -- Operations
- Variable:
  - Products out -- plant

Process XXI. Packaging and Storing Ice Cream Products

Process Description. This process began with ice cream, ice milk, or sherbet as it left the continuous freezer (51). Cartons and other supplies for the products had been transported to the packaging area, assembled by hand, and stamped with product name prior to starting the filling operation. A worker positioned a carton under the outlet nozzle and filled the carton, he then handed the full carton to another worker who closed the top of each

Table 56. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XX, Processing Ice Cream Products.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
50	Mixing vat	Cherry-Burrell	50 gal.	0.0927						
51	Continuous freezer	Vogt	80 gal./hr.	5.5953				40°	24°	405/gal. ice cream
91	Fruit feeder	Cherry-Burrell		0.1239						
92	Mixing vat	Cherry-Burrell	50 gal.	0.1872						

carton by hand. The second worker also checked carton weights frequently to determine per cent overrun. If overrun was not somewhat near 100 per cent, the first worker would adjust the continuous freezer accordingly. After a certain number of cartons were filled, the second worker placed a group of cartons in a paper sack. He waited until a few sacks of cartons had accumulated, and then he placed these sacks in the hardening room. Two and one-half gallon cartons were not placed in sacks but were put directly into the hardening room.

If slices of ice cream were to be produced, the ice cream was placed in brick containers as it came from the continuous freezer. Bricks were frozen in the hardening room, then they were sliced and wrapped by hand into either 24 or 32 slices per brick. Slices were occasionally stamped or stenciled depending on the individual order.

Ice cream, ice milk, and sherbet were arranged and rearranged in the hardening room according to age. An inventory was taken of these products weekly. Cleaning activities included cleaning the area around the packaging table.

Product Alternatives. Ice cream products might have been packaged in the following size cartons:

A. Two and one-half gallon cartons

B. One-half gallon cartons

C. Pint cartons

D. Cups

E. Bricks for slicing

F. Individual slices

Maintenance. No maintenance was charged to this process. The only equip-

ment listed in this process was the continuous freezer (Table 57), and maintenance for it was charged to Process XX (Processing Ice Cream Products).

Labor Classification. This process was divided into two departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Ice Cream -- Processing
- Variable:
  - Load in cooler
- Fixed -- other than maintenance:
  - Rearrange cooler
  - Inventory

Ice Cream -- Filling
- Variable:
  - Supplies
  - Position package
  - Weight test
  - Filling
  - Sacking
  - Capping
  - Cutting and slicing
  - Wrapping
  - Unwrapping
  - Stamping
  - Decorating individual slices
- Fixed -- other than maintenance
  - Change-over
  - Clean-up

Process XXII. Selling Ice Cream

Process Description. This process included all activities from the time packaged ice cream products left the hardening room until they were in the truck for shipment.

The process began with packaged ice cream products in the hardening room. When a truck driver arrived with an order for ice cream, a worker used a dolly to transport ice cream from the hardening room to the conveyor in the south cold room. The worker placed the products on the gravity conveyor. The process ended with ice cream products ready to be loaded into the truck. The

Table 57. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XXI, Packaging and Storing Ice Cream Products.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
51	Continuous freezer	Vogt	80 gal./hr.	for identification only						

truck operator was not observed in this study.

Equipment Used. The only equipment used in this process was a two-wheel dolly and the gravity conveyor.

Product Alternatives. There were no product alternatives as this was a final product.

Maintenance. No plant or equipment maintenance was observed in this process.

Labor Classification. This process was divided into two departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Ice Cream -- Processing
Variable:
Load out -- cooler

South Cold Room -- Operations
Variable:
Product in -- ship

Process XXIII. Selling Raw Milk -- Grade A or Grade C

Process Description. This process began with cooled raw milk in the storage tanks (6,7,10,11). Empty 10-gallon cans were transported to the storage tank area by the purchaser and a plant worker. Cans were filled by gravity flow from the storage tanks. Full cans were transported on a dolly to the buyer's truck. When selling bulk milk, the plant worker connected lines from the storage tanks (10,11, 6,7) to the bulk truck. A pump was started and the desired quantity of milk pumped from the storage tanks to the bulk truck. This process ended with full cans of raw milk in the buyer's truck or the buyer's bulk truck filled with the desired quantity of milk.

Product Alternatives. There were no product alternatives for this process.

Maintenance. Cleaning and maintenance were not observed for this process. Four storage tanks were the only pieces of equipment used (Table 58) and their maintenance was charged to Process I (Receiving Can Milk).

Labor Classification. This process was divided into two departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Handling A -- Milk
  Variable:
    Filling cans
    Loading cans in truck

First Holding -- Operations
  Variable:
    Filling cans to ship out

Process XXIV. Processing and Storing Grade A Products

Process Description. This process included all activities from the time cooled Grade A whole milk left the storage tanks until it was processed and ready to be bottled as whole milk, skim milk, or cream. This process ended with milk as it left the final holding tank or as skim milk or cream as they left the processing vats.

This process began with raw cooled milk in storage tanks (10,11). After the equipment had been connected and sanitized, milk was pumped (57) to the standardizer (58) if the milk was to be bottled as whole milk. Vitamins were added to the milk by the vitamin dispenser (61) while the milk was in the surge tank (109). After vitamins were added, the milk went to the regeneration section of the short-time pasteurizer (59). From the pasteurizer, milk was pumped (103) to the vacuumizer (63). Milk was then pumped by the timing pump (101) to the homogenizer (60) and returned to the pasteurization section of the pasteurizer. It was then heated to 170° F. and held for 15 seconds in the

Table 58. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XXIII, Selling Raw Milk - Grade A or Grade C.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
6	Storage tank	Cherry-Burrell	5,000 gal.	for identification only						
7	Storage tank	Heil	5,000 gal.	for identification only						
10	Storage tank	Cherry-Burrell	3,000 gal.	for identification only						
11	Storage tank	Cherry-Burrell	2,000 gal.	for identification only						

holding tube of the pasteurizer, run back through the regeneration section of the pasteurizer, then cooled to 40° F. in the cooling section of the pasteurizer. After cooling, milk went to the storage tank (62).

Milk that was to be separated for bottled skim milk and cream did not go to the standardizer but was pumped (104) to the separator (64). From the separator, cream flowed to processing vats (65,66,70,71) or was canned directly in 10-gallon cans if used to enrich whole milk powder, and skim milk flowed to the surge tank (109) at the pasteurizer (59). Cream that was to be sold as whipping cream was pasteurized at 155° F. for 30 minutes in the processing vat (65,66,70, or 71). It was then cooled to less than 40° F. in the same vat. Cream that was to be sold as half and half was standardized in the processing vat and pumped (104) to the surge tank (109) at the short-time pasteurizer location. It followed the same route as whole milk and was returned cooled to a processing vat (65,66,70,71). The processing vat served as a holding tank until the cream was bottled.

After skim milk entered the short-time pasteurizer (59) it followed the same route as whole milk. After it was cooled, skim milk was returned to a processing vat (65,66,70,71) which served as a holding tank until it was bottled. In order to get enough cream for bottling, more skim milk was usually produced than was desired for bottling. This surplus skim milk was pumped (102) to the Grade C department where it was mixed with Grade C skim milk.

This process ended with whole milk, skim milk, or cream as they left the storage tank or processing vats to be bottled or packaged. In this process, raw cooled milk had been standardized, clarified, pasteurized, vacuumized, vitamin D fortified, and homogenized to be bottled as whole milk. Milk that was not sold as whole milk in bottles or cans was separated, pasteurized, and cooled to be sold as bottled skim milk or cream. Of course proper records

were kept of all products produced in this department.

Cleaning activities for this process involved disassembly and cleaning of all equipment and area surrounding the equipment listed in Table 59. Most of the cleaning was done by one man at night.

Product Alternatives. Whole milk, cream, and skim milk might have entered any of the following alternative uses:

A. Whole milk
   1. Sold in 10-gallon cans
   2. Sold in five-gallon dispenser cans
   3. Packaged in the plant

B. Cream
   1. Sold in 10-gallon cans
   2. Packaged in the plant

C. Skim milk
   1. Sold in 10-gallon cans
   2. Packaged in the plant
   3. In plant transfers

Maintenance. Equipment maintenance included labor required for the care and maintenance of equipment listed in Table 59.

Plant maintenance included labor required for the care and maintenance of the area housing this equipment.

Labor Classification. This process was divided into two departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Handling A -- Milk
   Variable:
      Processing -- separation, homogenization and pasteurization
   Fixed -- other than maintenance:
      Sanitizing
      Hook-up
      Supplies
      Clean-up
      Change-over
      Records

Handling A -- Idle Time

Table 59. Electrical, steam, and refrigeretion requirements and capacity of equipment used in Process XXIV, Proceasing and Storing Grade A Products.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeretion		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
10	Storage tank	Cherry-Burrell	3,000 gal.	for identification only						
11	Storage tank	Cherry-Burrell	2,000 gal.	for identificstion only						
57	Milk pump	Creamery Package	2 h.p.	1.4924						
58	Standard-izer clarifier	Delaval	1,000 gal./hr.	2.2378						
59	Short-time pasteurizer	Creamery Package	1,000 gal./hr.		136°	170°	38/lb. product	136°	40°	106/lb. product
60	Homogenizer	Creamery Package	25 h.p.	18.6501						
61	Vitamin dispenser	Meter-flo		0.0472						
62	Storage tank	Creamery Package	2,000 gal.	0.7462				40°	40°	837/hr.
63	Vacuumizer and pump	Chester-Jensen	22,000 lbs./hr.	2.2378						

Table 59 (cont.) Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XXIV, Processing and Storing Grade A Products.

Code	Item	Mfr.	Capacity	Electricity: kw./hr	Steam: Temp.(F) In	Steam: Temp.(F) Out	Steam: b.t.u.	Refrigeration: Temp.(F) In	Refrigeration: Temp.(F) Out	Refrigeration: b.t.u.
64	Separator	Delaval	300 gal./hr.	2.2378						
65	Processing vat	Creamery Package	300 gal.	0.3727	90°	155°	60.6/lb. whipping cream	40° 155°	40° 40	411.8/hr. 97.75/lb. whipping cream
66	Processing vat	Creamery Package	300 gal.	0.3727	90°	155°	60.6/lb. whipping cream	40° 155°	40° 40	411.8/hr. 97.75/lb. whipping cream
70	Processing vat	Creamery Package	100 gal.	0.1872	90°	155°	60.6/lb. whipping cream	40° 155°	40° 40	211.7/hr. 97.75/lb. whipping cream
71	Processing vat	Creamery Package	200 gal.	0.2479	90°	155°	60.6/lb. whipping cream	40° 155°	40° 40	294.2/hr. 97.75/lb. whipping cream
101	Milk pump	Waukesha	1½ h.p.	1.1189						
102	Milk pump	Cherry-Burrell	½ h.p.	0.3727						

Table 59 (concl.) Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XXIV, Processing and Storing Grade A Produots.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
103	Milk pump	Cherry-Burrell	3 h.p.	2.2378						
104	Milk pump	Waukesha	2 h.p.	1.4924						
109	Surge tank		30 gal.							

Idle time:
Unassigned idle time

Process XXV. Processing Dairy Mixes

Process Description. This process included all activities for processing cheese dressing, ice cream mix, ice milk mix, and sherbet mix. All activities from the time ingredients left the storage tanks until finished products were in the south cold room or the areas for further processing were included in this process.

The process for cheese dressing began with processed whole milk in the storage tank (62). After the pipes and equipment had been connected and sanitized, milk was pumped (94) to processing vats (65,66,70,71) where cream and condensed milk were added to make cheese dressing. Dressing was pumped (104) to the surge tank (109) where it followed the same route as whole milk for pasteurization (59), homogenization, and vacuumization. Dressing was pumped (94) into 10-gallon cans after cooling and transported to the south cold room for storage.

The process for ice cream mix and ice milk mix began with raw whole milk in storage tanks (6,7,80,81). Milk was transported in 10-gallon cans to the processing vats (65,66,70,71) where cream, condensed milk, stabilizer, and sugar were added (mixes vary as to composition). Mix was pumped (104) to the surge tank (109) where it followed the same route as whole milk except that some mixes were not homogenized. After cooling, mix was pumped into 10-gallon cans and transported to the south cold room for aging.

The process for sherbet mix began with skim milk as it came from the separator (64). From the separator, skim milk flowed to processing vats (65, 66,70, or 71). Stabilizer and sugar were added to the skim milk, and the mix

was pumped (104) to the surge tank (109) where it followed the same route as ice cream mixes. After cooling, mix was put into 10-gallon cans and transported to the south cold room for aging.

All of these products required a certain amount of supplies to be provided, and they all ended with the mixes in the south cold room or in the cottage cheese area for use in other processes. The formulas for the mixes and other record keeping was done as time permitted while the products were being processed.

Cleaning activities for this process included cleaning processing vats and pipes from the holding tanks to the vats. Most of the cleaning was done by one worker on the night shift.

Product Alternatives. Mixes might have entered the following alternative uses:

A. Cheese mix
   1. Sold in 10-gallon cans
   2. In plant transfers

B. Ice cream mix
   1. Sold in 10-gallon cans
   2. In plant transfers

C. Ice milk mix
   1. Sold in 10-gallon cans
   2. In plant transfers

D. Sherbet mix
   1. Sold in 10-gallon cans
   2. In plant transfers

Entry into one of these alternative uses constituted the beginning of a new process.

Maintenance. No equipment or plant maintenance was charged to this process. The products in this process were usually produced after the equipment (Table 60) and area surrounding the equipment had already been used in Process

Table 60. Electrical, steam, and refrigeration requirements and capacity of equipment used in Proceee XXV, Processing Deiry Mixea.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeretion		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
6	Storage tank	Cherry-Burrell	5,000 gal.	for identification only						
7	Storage tank	Heil	5,000 gal.	for identification only						
59	Short-time pasteurizer	Creamery Package	1,000 gal./hr.		40°	170°	122.2/lb. mixee	170°	40°	122.2/lb. mixee
62	Storage tank	Creamery Package	2,000 gal.	for identification only						
64	Separator	Delaval	300 gal./hr.	for identification only						
65	Processing vat	Creemery Package	300 gal.	0.3727				40°	40°	411.8/hr.
66	Processing vat	Creamery Package	300 gal.	0.3727				40°	40°	411.8/hr.
70	Processeing vat	Creamery Package	100 gal.	0.1872				40°	40°	211.7/hr.
71	Processing vat	Creamery Package	200 gal.	0.2479				40°	40°	294.2/hr.
80	Storage tank	Sanitank	5,000 gal.	for identification only						

Table 60 (concl.) Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XXV, Processing Dairy Mixes.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
81	Storage tank	Creamery Package	4,000 gal.	for identification only						
94	Milk pump	Cherry-Burrell	½ h.p.	0.3727						
104	Milk pump	Waukesha	2 h.p.	1.4924						
109	Surge tank		30 gal.							

XXIV (Processing and Storing Grade A Products).

Labor Classification. This process was divided into four departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Handling A -- Mix
  Variable:
    Making mix
    Transport cans -- clean
    Transport cans -- full
    Can return
    Testing
    Filling cans
    Filling vat
    Transporting ingredients in
    Washing cans
    Transporting cheese dressing
    Adding ingredients

Handling A -- By-Product
  Variable:
    Filling cans
    Transporting cans -- full
    Can tags

Receiving -- North Line
  Variable:
    Transport cans in
    Transport cans out

South Cold Room -- Operations
  Variable:
    Products in -- plant
    Products out -- plant

Process XXVI. Processing Specialty Products

Process Description. This process included all activities involved in processing buttermilk, chocolate milk, orange drink, and grape drink.

The process for chocolate milk began when milk was pumped (94) to the processing vats (65,66,70,71) from the storage tank (62), this was bottling grade milk. Chocolate flavoring and sugar were brought into the area and

were added to the milk. This mixture was pasteurized at 155° F. for 30 minutes in the processing vat. After pasteurization, chocolate milk was cooled to less than 40° F. in the vat prior to bottling.

The process for buttermilk began when Grade A skim milk was pumped (104) from the separator (64), to one of the processing vats (65,66,70, or 71). It was pasteurized at 185° F. for one hour in the processing vat then cooled to 70° F. in the vat and set with one per cent starter mother culture. The starter mother culture had been prepared in the laboratory using sterile skim milk and a powdered pure culture supplied by one of the good culture supply companies. The buttermilk was allowed to set over night. When it had developed the desired acidity, it was cooled to less than 40° F. before bottling.

Orange or grape drink was made by running tap water into one of the processing vats (65,66,70, or 71) and adding coloring, flavoring, and sugar as recommended by the flavoring manufacturers. The mixture was cooled to less than 40° F. in the vat before bottling.

The process ended when the products left the processing vats to be bottled. The formulas for the products and other record keeping was done as time permitted while the products were being processed.

Cleaning activities included cleaning the pipes, the equipment listed in Table 61, and the area surrounding this equipment.

Product Alternatives. Chocolate milk, buttermilk, grape drink, and orange drink may have entered any of the following uses:

A. Chocolate milk
   1. Sold in five-gallon dispenser cans
   2. Packaged in the plant

B. Buttermilk
   1. Packaged in the plant
   2. In plant transfers

Table 61. Electrical, steam, and rafrigeration requirements and capacity of equipmant used in Process XXVI, Procassing Specialty Products.

Coda	Item	Mfr.	Capacity	Electricity	Steam			Refrigaration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
62	Storage tank	Creamery Packaga	2,000 gal.	for identification only						
64	Separator	Delaval	300 gal./hr.	for idantification only						
65	Processing vat	Creamery Package	300 gal.	0.3727	40°	155°	127/lb. choc. milk	40°	40°	411.8/hr.
								155°	40°	127.2/lb. choc. milk
					40°	185°	160/lb. buttermilk	185°	40°	160.5/lb. buttermilk
								60°	40°	23.55/lb. orange and grape drink
66	Processing vat	Creamery Package	300 gal.	0.3727	40°	155°	127/lb. choc. milk	40°	40°	411.8/hr.
								155°	40°	127.2/lb. choc. milk
					40°	185°	160/lb. buttermilk	185°	40°	160.5/lb. buttermilk
								60°	40°	23.55/lb. orange and grape drink

Table 61 (concl.) Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XXVI, Processing Specialty Products.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
70	Processing vat	Creamery Package	100 gal.	0.1872	40°	155°	127/lb. choc. milk	40°	40°	211.7/hr.
								155°	40°	127.2/lb. choc. milk
					40°	185°	160/lb. buttermilk	185°	40°	160.5/lb. buttermilk
								60°	40°	23.55/lb. orange and grape drink
71	Processing vat	Creamery Package	200 gal.	0.2479	40°	155°	127/lb. choc. milk	40°	40°	294.2/hr.
								155°	40°	127.2/lb. choc. milk
					40°	185°	160/lb. buttermilk	185°	40°	160.5/lb. buttermilk
								60°	40°	23.55/lb. orange and grape drink
94	Milk pump	Cherry-Burrell	½ h.p.	0.3727						
104	Milk pump	Waukesha	2 h.p.	1.4924						

C. Orange drink and grape drink
   1. Bottled in the plant
   2. In plant transfers

Maintenance. Equipment maintenance included labor required for the care and maintenance of equipment listed in Table 61.

Plant maintenance included labor required for the care and maintenance of the area housing this equipment.

Labor Classification. This process was divided into two departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Handling A -- By-Product
  Variable:
    Processing
    Flavors
  Fixed -- other than maintenance:
    Hook-up
    Clean-up

South Cold Room -- Operations
  Variable:
    Products out -- plant

Process XXVII. Preparing, Filling, and Storing Five-Gallon Dispenser Cans

Process Description. This process included all activities from the time milk left the final holding tank until it was in dispenser cans in the north cold room.

The process began with processed, cooled, milk in the storage tank (62). Dispenser cans were washed by hand and sanitized. A new hose was placed on the outlet and a metal cap placed over the outlet. Dispenser cans were filled with milk pumped (94) from the storage tank through any convenient outlet in the Grade A processing room. This may have been through the bottling machine

(95) or the carton machines (31,68). A lid was placed on the full can, and a wire seal attached to the lid. Full five-gallon dispenser cans were then transported to the north cold room for storage until shipment.

Product Alternatives. There were no product alternatives as milk was packaged in five-gallon dispenser cans only.

Maintenance. No observations of cleaning or maintenance were made in this process. The maintenance of equipment used in this process was assigned to other processes (Table 62).

Labor Classification. This process was divided into four departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Handling A -- Milk
    Variable:
        Preparing dispenser cans

Bottling Glass -- Casing In
    Variable:
        Filling dispenser cans

Bottling Pure-Pak -- Junior Model "J" -- Casing In
    Variable:
        Dispenser

Bottling Pure-Pak -- Junior Model "D" -- Casing In
    Variable:
        Dispenser

Process XXVIII. Bottling Milk in Glass Bottles

Process Description. This process included all activities from the time milk left the final holding tank until it was bottled and moving on the conveyor to the north cold room.

This process began with cooled, processed whole milk in the storage tank (62). Prior to bottling, the seal-on-machine (67) was loaded with caps and

Table 62. Electrical, steam, and refrigeretion requirements and capacity of equipment used in Process XXVII, Preparing, Filling, and Storing Five-Gallon Dispenser Cans.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
31	Carton machine	Ex-cello	35 cartons/ min.	for identification only						
62	Storage tank	Creamery Peckage	2,000 gal.	for identification only						
68	Certon machine	Ex-cello	25 cartons/ min.	for identification only						
94	Milk pump	Cherry-Burrell	½ h.p.	0.3727						
95	Bottling machine	Federal	18-24 gal./ min. 33 ½ gal./ min.	for identification only						

hoods, and other supplies were provided as necessary. Clean bottles and cases moved to the bottling machine (95) on power conveyors, and milk was pumped (94) to the bottling machine. After the operation had started, the operator "picked" full bottles off the small holding area at the bottler and placed them in cases which had been selected from those on the conveyor.

Occasionally the bottler would fail to properly cap or hood a bottle or bottles. In this case, a worker capped these bottles by hand and placed the bottles back into the bottler for sealing the hoods. Full cases were then placed back on the conveyor; and as they moved toward the north cold room, they were sprayed with water to remove any milk that happened to be on the outside of the bottles.

Production records and an inventory of supplies were kept daily on this process as applicable. The process ended with full cases on their way to the north cold room.

Cleaning activities required cleaning the pipes, the equipment listed in Table 63, and the area surrounding this equipment. Cleaning time was allocated on a volume basis between this process and Process XXIX (Bottling Orange and Grape Drink in Glass Bottles).

Product Alternatives. There were no product alternatives as milk was bottled in one-gallon glass jugs only.

Maintenance. Equipment maintenance included labor required for the care and maintenance of equipment listed in Table 63.

Plant maintenance included labor required in tho care and maintenance of the area housing this equipment.

Labor Classification. This process was divided into three departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Table 63. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XXVIII, Bottling Milk in Glass Bottles.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
62	Storage tank	Creamery Package	2,000 gal.	for identification only						
67	Seal-on machine	Sealright	32-50 bottles/min.	2.5000						
94	Milk pump	Cherry-Burrell	½ h.p.	0.3727						
95	Bottling machine	Federal	18-24 gal./min. 33 ⅓ gal./min.	0.2479						

Bottling Glass -- Operations
- Variable:
  - Supplies
  - Operation
  - Hand filling
- Fixed -- other than maintenance:
  - Hook-up
  - Change-over
  - Inventory

Bottling Glass -- Casing In
- Variable:
  - Picking
  - Case selection
- Fixed -- other than maintenance:
  - Change-over
  - Inventory

Bottling Glass - Maintenance
- Fixed -- maintenance:
  - Plant maintenance
  - Equipment maintenance

Process XXIX. Bottling Orange and Grape Drink in Glass Bottles

Process Description. This process included all activities from the time orange or grape drink left the processing vats until they were stored in cases in the south cold room.

This process began with cooled orange or grape drink in the processing vats (65,66,70, or 71). After caps and hoods had been placed in the seal-on-machine (67) and other supplies provided as necessary, the drink was pumped (93) to the bottler (95). Cases and bottles entered the bottling area on power conveyors. After the bottler had filled, capped, and hooded the bottles; the operator "picked" the bottles off the holding area and placed them in cases which had been selected from those on the conveyor. Occasionally the bottler would fail to properly cap or hood a bottle or bottles. In this case, a worker capped these bottles by hand and placed the bottle back into the

bottler for sealing the hoods. The cases were then placed on a two-wheel dolly and transported to the south cold room. (They were transported and not conveyed, because they were stored in the south cold room, and the conveyor from the bottler runs to the north cold room only.)

Production records and an inventory of supplies were kept daily in the process as applicable. The process ended with filled cases in the south cold room ready for shipment.

Cleaning activities required cleaning pipes, equipment listed in Table 64, and the area surrounding this equipment. Cleaning time was allocated on a volume basis between this process and Process XXVIII (Bottling Milk in Glass Bottles).

Product Alternatives. There were no product alternatives as orange and grape drink were only bottled in one-half gallon glass bottles.

Maintenance. Equipment maintenance included labor required for the care and maintenance of equipment listed in Table 64.

Plant maintenance included labor required in the care and maintenance of the area housing this equipment.

Labor Classification. This process was divided into four departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Bottling Glass -- Operations
- Variable:
  - Supplies
  - Operations
- Fixed -- other than maintenance:
  - Hook-up
  - Change-over
  - Inventory

Bottling Glass -- Casing In
- Variable:

Table 64. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XXIX, Bottling Orange and Grape Drink in Glass Bottles.

Code	Item	Mfr.	Capacity	Electricity: kw./hr.	Steam: Temp.(F) In	Steam: Temp.(F) Out	Steam: b.t.u.	Refrigeration: Temp.(F) In	Refrigeration: Temp.(F) Out	Refrigeration: b.t.u.
65	Processing vat	Creamery Package	300 gal.	for identification only						
66	Processing vat	Creamery Package	300 gal.	for identification only						
67	Seal-on machine	Sealright	32-50 bottles/min.	2.5000						
70	Processing vat	Creamery Package	100 gal.	for identification only						
71	Processing vat	Creamery Package	200 gal.	for identification only						
93	Milk pump	Cherry-Burrell	½ h.p.	0.3727						
95	Bottling machine	Federal	18-24 gal./min. 33 ½ gal./min.	0.2479						

Picking
Case selection
Transporting products to cooler
Fixed -- other than maintenance:
Change-over
Inventory

Bottling Glass -- Maintenance
Fixed -- maintenance:
Plant maintenance
Equipment maintenance

South Cold Room -- Operations
Variable:
Products in -- plant

Process XXX. Packaging Milk in Half-Gallon Paper Cartons

Process Description. This process began with cooled, pasteurized milk in the storage tank (62). Supplies consisting of cartons, wax, and wire for staples were loaded into the carton machine. Prior to starting the bottling operation, milk was pumped (94) to the carton machine (68). The carton machine automatically formed, glued, coated with wax, filled, closed, stapled, coded, and placed cartons on a small table at the end of the machine. Cases were moved to the carton machine by a power conveyor where a worker selected a case and "picked" the cartons from the table and placed them in cases. This process continued with product being pumped to the carton machine and supplies being furnished as needed during the bottling operation. When a case was full, it was set on the power conveyor. The conveyor moved the full cases to the north cold room.

Sometimes the carton filler did not form, seal, or staple a carton correctly. In this case, a worker (the one filling the cases) would set the improperly formed carton aside to be opened a short time later. The contents were poured into a 10-gallon can.

This process snded with full cases on the convsyor on their way to the north cold room. Cleaning activities for this process involved disassembling and cleaning the carton machine and pipes lsading to the carton machines.

Product Alternatives. In this process, milk was packaged in one-half gallon paper cartons only.

Maintenance. Equipment maintenance included labor required in the care and maintenance of equipment listed in Table 65.

Plant maintenance included labor required in the care and maintenance of the building housing this equipment.

Labor Classification. This process was divided into three departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Bottling Pure-Pak -- Junior Model "D" -- Operation
- Variable:
  - Supplies
  - Operation
- Fixed -- other than maintenance:
  - Hook-up
  - Change-over
  - Clean-up

Bottling Pure-Pak -- Junior Model "D" -- Casing In
- Variable:
  - Picking
  - Case selection
- Fixed -- other than maintenance:
  - Change-over
  - Clean-up
  - Inventory

Bottling Pure-Pak -- Junior Model "D" -- Maintenance
- Fixed -- maintenance:
  - Plant maintenance
  - Equipment maintenance

Table 65. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XXX, Packaging Milk in Half-Gallon Paper Cartons.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
62	Storage tank	Creamery Package	2,000 gal.	for identification only						
68	Carton machine	Ex-cello	25 cartons/ min.	3.9000			37/carton			48/½ gal.
94	Milk pump	Cherry-Burrell	½ h.p.	0.3727						

Process XXXI. Packaging Milk Products in Quart or Smaller Size Paper Cartons

Process Description. This process included all activities from the time one of the milk products left the storage tank or the processing vats until it was packaged and on the conveyor moving to the north cold room.

The process began with processed whole milk in the storage tank (62) or cream, chocolate milk, buttermilk, or skim milk in the processing vats (65,66, 70, or 71). Supplies consisting of cartons, wax, and wire for staples were loaded into the carton machine (31). Prior to starting the bottling operation, milk was pumped (94) from the storage tank, and the other products were pumped (93) from processing vats to the carton machines. The carton machine automatically formed, glued, coated with wax, filled, closed, stapled, coded and placed the cartons on a small table at the end of the machine. Cases were moved to the carton machine by a power conveyor where a worker "picked" the cartons from the table and placed them in cases. This process continued with product being pumped to the carton machine and supplies being furnished as needed during the bottling operation.

Since different size containers were used in this process, it was necessary to adjust the carton machine each time a different size carton was used. Sometimes the carton filler did not form, seal, or staple a carton correctly. In this case, a worker (the one filling the cases) would set the improperly formed carton aside to be opened a short time later. The contents were poured back into the processing vats (65,66,70,71).

This process ended with full cases on the conveyor as they entered the north cold room. Cleaning activities for this process included disassembling

the carton machine, cleaning its parts and cleaning the pipes leading to the carton machine.

Product Alternatives. The products might have entered any of the following alternative uses:

A. Whole milk
   1. Quart paper cartons
   2. Pint paper cartons
   3. Half-pint paper cartons

B. Cream
   1. Whipping cream
      a. Quart paper cartons
      b. Half-pint paper cartons
   2. Half and half
      a. Quart paper cartons
      b. Pint paper cartons

C. Skim milk
   1. Quart paper cartons
   2. Pint paper cartons

D. Chocolate milk
   1. Quart paper cartons
   2. Half-pint paper cartons

E. Buttermilk
   1. Quart paper cartons
   2. Pint paper cartons

Maintenance. Equipment maintenance included labor required in the care and maintenance of equipment listed in Table 66.

Plant maintenance included labor required in the care and maintenance of the building housing this equipment.

Labor Classification. This process was divided into three departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Bottling Pure-Pak -- Junior Model "J" -- Operation
   Variable:
      Supplies
      Operation

Table 66. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XXXI, Packaging Milk Products in Quart or Smaller Size Peper Cartons.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeretion		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
31	Carton machine	Ex-cello	35 cartons/ min.	3.6003			18.6/carton			28.6/qt. 19.12/pt. 13.71/½ pt.
62	Storage tank	Creamery Package	2,000 gal.	for identification only						
65	Processing vat	Creamery Package	300 gal.	for identification only						
66	Processing vat	Creamery Package	300 gal.	for identification only						
70	Processing vat	Creamery Package	100 gal.	for identification only						
71	Processing vat	Creamery Package	200 gal.	for identification only						
93	Milk pump	Cherry-Burrell	½ h.p.	0.3727						
94	Milk pump	Cherry-Burrell	½ h.p.	0.3727						

Fixed -- other than maintenance:
Hook-up
Change-over
Clean-up
Inventory

Bottling Pure-Pak -- Junior Model "J" -- Casing In
Variable:
Picking
Case selection
Dumping
Fixed -- other than maintenance:
Change-over
Clean-up
Inventory

Bottling Pure-Pak -- Junior Model "J" -- Maintenance
Fixed -- maintenance:
Plant maintenance
Equipment maintenance

Process XXXII. Handling North Cold Room Products

Process Description. This process included all activities from the time filled cases of bottled products and cases or cartons of non-bottled products entered the north cold room until these same products were in the delivery trucks for wholesale distribution.

The process began as bottled products entered the north cold room on the gravity conveyor; and as cottage cheese, butter, orange drink, and grape drink entered the north cold room on a two-wheel dolly. When cases entered on the gravity conveyor, they were pushed to the desired location and set off on the floor. They were then stacked five or six cases high and pulled to the desired floor location with a metal hook. It was sometimes necessary to stack cases more than six high due to the limited cold storage area. Products brought in on a dolly were wheeled to the desired floor location and stacked the desired height to minimize space requirements.

As orders for products came in, products were formulated in the desired

quantities and pulled to the outgoing gravity conveyor in the north cold room. Cases were then placed on the conveyor, and they rolled to the rear of the trucks. A plant worker lifted the cases from the conveyor and set them into the trucks. The truck operators loaded their own trucks, and they were not observed in the study. Detailed records and inventories were kept daily of all incoming and outgoing products in the north cold room. The process ended with cases of products in the rear of the delivery trucks.

Cleaning activities involved cleaning the north cold room. Most of the cleaning involved cleaning milk from paper carton "leakers".

Equipment Used. The only equipment included in this process was a two-wheel dolly and the two gravity conveyors.

Product Alternatives. There were no product alternatives as these were all final products.

Maintenance. Equipment maintenance included labor required in the care and maintenance of the two gravity conveyors.

Plant maintenance included labor required in the care and maintenance of the north cold room.

Labor Classification. This process was divided into four departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

South Cold Room -- Operations
    Variable:
        Product in -- plant
        Product out -- plant
        Product out -- ship

North Cold Room -- Load In
    Variable:
        Move cases
        Stacking
        Non-bottled products handling
        Non-bottled products stacking

Fixed -- other than maintenance:
Clean-up
Inventory

North Cold Room -- Load Out
Variable:
Arrangement
Load Out
Records
Orders
Fixed -- other than maintenance:
Clean out

North Cold Room -- Maintenance
Fixed -- maintenance:
Plant maintenance
Equipment maintenance

Process XXXIII. Receiving Empty Bottles and Cases

Process Description. This process began when the truck operators returned from their routes with empty bottles and cases. Drivers placed cases of bottles in the rear of their trucks where plant workers picked them up and placed them inside the empty bottle room. Bottle trippage was estimated by plant personnel at 23 trips per bottle.

This process did not include any of the activities involved with the sorting of bottles or the care of returns. The process ended with empty bottles stacked on the floor in the receiving room.

Cleaning activities involved cleaning the loading dock and area immediately inside the plant used to stow incoming bottles and cases.

Equipment Used. No equipment was used in this process.

Product Alternatives. There were no products in this process.

Maintenance. No equipment maintenance was charged to this process. Plant maintenance included labor required for the care and maintenance of the empty bottle receiving room.

Labor Classification. This process was divided into three departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Empty Bottles, Cases, and Returns -- Receiving
  Variable:
    Receiving
  Fixed -- other than maintenance:
    Clean-up

Empty Bottles, Cases, Returns -- Maintenance
  Fixed -- maintenance:
    Plant maintenance
    Equipment maintenance

Empty Bottles, Cases, and Returns -- Idle Time
  Idle time:
    Unassigned idle time

Process XXXIV. Handling Returned Products

Process Description. This process began when returns were received in the empty bottle receiving room. A worker checked the returns and credited the driver with them. After the returns were checked they were transported to the south cold room and sorted into salvable or non-salvable products. Cottage cheese, chocolate drink, buttermilk, orange drink, and grape drink were all dumped as waste down a sewer drain or into trash cans. Bottled milk was dumped into cans and returned to the receiving room to be reprocessed in the Grade C department. Cream and butter were returned to the route cream processing department to start reprocessing. This process ended with all returns either dumped as waste or started in the reprocessing routes.

Cleaning activities involved cleaning the floor area used for handling returns and cans used for dumping.

Equipment Used. A dolly and 10-gallon cans were the only equipment used in this process.

Product Alternatives. Returns entered the following processes:

A. Milk was returned to Process I (Receiving Can Milk).

B. Cream and butter were returned to Process XII (Pasteurizing and Storing Route Cream).

Maintenance. No maintenance was observed in this process.

Labor Classification. This process was divided into two departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Empty Bottles, Cases, and Returns -- Receiving
- Variable:
  - Returns
- Fixed -- other than maintenance:
  - Waste disposal

South Cold Room -- Operations
- Variable:
  - Returns -- transport empty cans
  - Returns -- dumping
- Fixed -- other than maintenance:
  - Returns -- clean-up
  - Returns -- inventory

Process XXXV. Checking and Stacking Empty Bottles and Cases

Process Description. This process began with bottles just inside the door of the empty bottle receiving room. Cases of bottles were sorted and those bottles belonging to other dairies were stacked in a separate area. The plant's bottles were moved to the case and bottle washing area. When a load of "off brand" bottles had accumulated, they were hauled to the local bottle exchange. When the supply of returned bottles was not adequate for current bottling needs, new bottles were transported from the warehouse to the bottle washing area.

This process ended with sorted bottles and cases in position to be run

through the washing processes. This process did not include any cleaning activities or handling of returns as both of these activities were included in Process XXXIV (Handling Returned Products).

Equipment Used. No equipment was used in this process.

Product Alternatives. There were no products in this process.

Maintenance. No maintenance was observed in this process.

Labor Classification. This process was divided into two departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Empty Bottles, Cases, and Returns -- Receiving
Variable:
Checking and stacking
Hauling "off brand" bottles out

Empty Bottles, Cases and Returns -- Washing Bottles
Variable:
Receiving new jugs, bottles, and cases
Warehouse for new bottles

Process XXXVI. Washing Bottles

Process Description. This process began with cases of empty bottles in stacks at the bottle washer location. Prior to starting the washer, cleaning compounds were brought into the area and placed in the bottle washer (69). The washer was then filled with water and the power conveyor leading to the bottling machine (95) started. A worker removed bottles from the cases and placed them in individual slots in the bottle washer. The worker inspected clean bottles as they came from the machine; and if they were not clean, he ran them through the bottle washer again or broke those that seemed impossible to wash. The worker placed clean bottles on the power bottle conveyor. It was necessary for the worker to adjust the machine when changing from one size

bottle to another. This process ended with clean bottles on the power conveyor that led to the bottling machine.

Cleaning activities for this process included cleaning the bottle washer and area surrounding this machine (Table 67).

Product Alternatives. Clean bottles were used for:

A. Gallon glass milk

B. Half-gallon glass orange drink

C. Half-gallon glass grape drink

Maintenance. There was no maintenance observed in this process.

Labor Classification. This process was divided into two departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Empty Bottles, Cases and Returns -- Washing Bottles
- Variable:
  - Loading machine
- Fixed -- other than maintenance:
  - Supplies
  - Hook-up
  - Clean-up
  - Change-over

Empty Bottles, Cases, and Returns -- Washing Bottles -- Maintenance
- Fixed -- maintenance:
  - Plant maintenance
  - Equipment maintenance

Process XXXVII. Washing Cases

Process Description. This process began with empty cases at the bottle washer (69). Cases were pulled to case washer (48) by hand. Prior to starting the washer, a worker loaded the washer with water and washing compounds. After starting the machine, the worker placed empty cases on the conveyor leading into the machine. Pulling cases to the machine, loading them on the incoming

Table 67. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XXXVI, Washing Bottles.

Code	Item	Mfr.	Capacity	Electricity	Steam			Refrigeration		
				kw./hr.	Temp.(F) In	Temp.(F) Out	b.t.u.	Temp.(F) In	Temp.(F) Out	b.t.u.
69	Bottle washer	Lsdewig	24 bottles/ min.	2.9840			140/bottle			
95	Bottling machine	Federal	18-24 gal./ min. 33 ⅓ gal./ min.	for identification only						

conveyor, and dirscting the cases onto ths proper power conveyor as they came out of the case washer were the only steps in operating this machine. Any waste that had accumulated in the area was disposed of by the operator of the case washer. The process ended with clean cases coming out of the washer on the power conveyor leading to bottling machine (95) or the carton machines (31,68).

Cleaning activitiss includsd clsaning the cass washer and area surrounding this machins.

Product Alternatives. Cases might have entered any of the following alternative uses:

A. Cottage cheese packaging

B. Milk packaging in paper cartons - all sizes

C. Cream packaging in paper cartons - all sizss

D. Chocolate milk packaging in paper cartons - all sizes

E. Buttermilk packaging in paper cartons - all sizes

F. Skim milk packaging in paper cartons - all sizes

G. All bottling in glass bottles - both sizes

Maintenance. Equipment maintenance included labor required for ths care and maintenance of the case washer listed in Tabls 68.

Plant maintenance included labor required for ths care and maintenance of the area housing the case washer.

Labor Classification. This processs was divided into two departments which were divided into divisions of labor. Divisions of labor were further divided into work elements.

Empty Bottles, Cases, and Returns -- Washing Cases
Variabls:
Loading

Table 68. Electrical, steam, and refrigeration requirements and capacity of equipment used in Process XXXVII, Washing Cases.

Code	Item	Mfr.	Capacity	Electricity: kw./hr.	Steam: Temp.(F) In	Steam: Temp.(F) Out	Steam: b.t.u.	Refrigeration: Temp.(F) In	Refrigeration: Temp.(F) Out	Refrigeration: b.t.u.
31	Carton machine	Ex-cello	35 cartons/ min.	for identification only						
48	Case washer	Girton	10 cases/ min.	6.7150			350/case			
68	Carton machine	Ex-cello	25 cartons/ min.	for identification only						
69	Bottle washer	Ladewig	24 bottles/ min.	for identification only						
95	Bottling machine	Federal	18-24 gal./ min. 33 ½ gal./ min.	for identification only						

Fixed -- other than maintenance:
Supplies
Hook-up
Waste disposal
Clean-up

Empty Bottles, Cases, and Returns -- Washing Cases -- Maintenance
Fixed -- maintenance:
Plant maintenance
Equipment maintenance

APPENDIX II

Tables

Table 69. Classification of work and delay by processes, plant A, August-September, 1957.

Process*	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
1	2,565	84.95	0.19	4.13	10.72
2	544	95.40	0.18	0.92	3.49
3	1,953	82.44	0.26	2.25	15.05
4	288	94.44	0.35	0.69	4.51
5	703	93.17	0.14	0.14	6.54
6	221	98.64			1.36
7	52	94.23		5.77	
8	1,007	91.86	0.50	0.79	6.85
9	504	93.85		0.79	5.36
10	181	95.58		2.76	1.66
11	280	90.36		3.21	6.43
12	272	100.00			
13	104	99.04			0.96
14	1,956	93.97	0.05	1.18	4.81
15	66	96.97		1.52	1.52
16	186	96.24		1.61	2.15
17	816	94.49		3.06	2.45
18	844	97.75		0.12	2.13
19	1,859	95.64	0.22	0.32	3.82
20	353	94.90	0.28	0.57	4.25
21	1,380	97.46		1.23	1.30
22	23	100.00			
23	32	84.38		12.50	3.12
24	1,363	86.94	0.15	0.51	12.40
25	238	96.64		0.42	2.94
26	276	95.65	0.36	0.36	3.62
27	185	96.22			3.78
28	522	88.12	1.15	7.09	3.64
29	68	83.82		14.71	1.47
30	1,248	95.03	0.08	1.68	3.21
31	1,161	89.92	0.26	6.80	3.01
32	2,420	75.50	0.17	22.60	1.74
33	540	76.30		14.63	9.07
34	222	94.14		0.90	4.95
35	972	82.92	0.10	2.98	13.99
36	621	81.80	0.16	12.88	5.15
37	507	85.40	0.20	8.68	5.72
Total	26,532	89.27	0.17	4.55	6.02

*Throughout Appendix II, Arabic numerals instead of Roman numerals will be used to designate basic processes.

Table 70. Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor*		Total observations	Productive	Delay		
	Labor div.	Maint. aggr.			Avoidable	Unavoidable	Loafing
				%	%	%	%
Process 1							
10	1	0	289	85.81	0.35	12.80	1.04
10	2	0	335	92.24		2.39	5.37
10	2	1	73	94.52			5.48
10	3	0	58				100.00
Worker Total			755	82.91	0.13	5.96	10.99
11	1	0	80	96.25		2.50	1.25
11	2	0	79	93.67		1.27	5.06
11	2	1	7	85.71			14.29
11	3	0	33		3.03		96.97
Worker Total			199	78.89	0.50	1.51	19.10
12	1	0	330	96.06		3.64	0.30
12	2	0	364	96.98		1.10	1.92
12	2	1	60	96.67			3.33
12	3	0	31		3.23		96.77
Worker Total			785	92.74	0.13	2.04	5.10
17	1	0	58	93.10		6.90	
17	2	0	56	85.71		3.57	10.71
17	2	1	6	66.67			33.33
17	3	0	15		13.33	6.67	80.00
Worker Total			135	78.52	1.48	5.19	14.81
30	1	0	1	100.00			
Worker Total			1	100.00			
40	1	0	1	100.00			
Worker Total			1	100.00			
41	1	0	1	100.00			
41	2	0	7	100.00			
Worker Total			8	100.00			
43	1	0	3	100.00			
43	2	0	20	100.00			
43	2	1	1	100.00			
Worker Total			24	100.00			

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive	Delay: Avoidable	Unavoidable	Loafing
				%	%	%	%
50	1	0	176	84.66		15.34	
50	2	0	110	90.00			10.00
50	2	1	17	94.12			5.88
50	3	0	30				100.00
Worker Total			333	79.28		8.11	12.61
51	2	0	8	100.00			
Worker Total			8	100.00			
52	1	0	7	100.00			
52	2	0	14	100.00			
52	2	1	1	100.00			
Worker Total			22	100.00			
53	2	0	1	100.00			
Worker Total			1	100.00			
54	1	0	55	94.54		3.64	1.82
54	2	0	46	76.09		6.52	17.39
54	2	1	19	84.21			15.79
54	3	0	21				100.00
Worker Total			141	73.05		3.55	23.40
55	1	0	2	100.00			
55	2	0	5	100.00			
55	2	1	1				100.00
Worker Total			8	87.50			12.50
56	1	0	17	94.12			5.88
56	2	0	15	93.33			6.67
Worker Total			32	93.75			6.25
58	2	0	2	100.00			
Worker Total			2	100.00			
60	2	0	6	83.33			16.67
Worker Total			6	83.33			16.67
61	2	0	1	100.00			
Worker Total			1	100.00			

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
62	2	0	2				100.00
Worker Total			2				100.00
63	2	0	2	50.00			50.00
Worker Total			2	50.00			50.00
83	2	0	1	100.00			
Worker Total			1	100.00			
88	1	0	34	94.12		5.88	
88	2	0	15	93.33			6.67
88	2	1	5	80.00			20.00
88	3	0	1				100.00
Worker Total			55	90.91		3.64	5.45
99	1	0	16	93.75		6.25	
99	2	0	16	75.00			25.00
99	3	0	5				100.00
Worker Total			37	72.97		2.70	24.32
101	1	0	2	100.00			
101	2	0	4	100.00			
Worker Total			6	100.00			
Total Process 1			2,565	84.95	0.19	4.13	10.72
			Process 2				
10	1	0	28	96.43			3.57
10	2	0	8	100.00			
10	2	1	2	50.00			50.00
Worker Total			38	94.74			5.26
11	1	0	54	98.15		1.85	
11	2	0	62	96.77			3.22
Worker Total			116	97.41		0.86	1.72
12	1	0	25	100.00			
12	2	0	33	100.00			
12	2	1	3	66.67			33.33
Worker Total			61	98.36			1.64

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
17	1	0	50	98.00		2.00	
17	2	0	49	100.00			
17	2	1	2	50.00			50.00
Worker Total			101	98.02		0.99	0.99
44	2	0	2	100.00			
Worker Total			2	100.00			
50	1	0	21	90.48		9.52	
50	2	0	20	100.00			
50	2	1	1	100.00			
Worker Total			42	95.24		4.76	
54	1	0	25	92.00			8.00
54	2	0	128	91.41		0.78	7.81
54	2	1	4	75.00			25.00
Worker Total			157	91.08		0.64	8.28
88	1	0	8	100.00			
88	2	0	9	100.00			
Worker Total			17	100.00			
99	1	0	7	100.00			
99	2	0	3	66.67	33.33		
Worker Total			10	90.00	10.00		
Total Process 2			544	95.40	0.18	0.92	3.49
			Process 3				
10	1	0	105	94.29	0.95	1.90	2.86
10	2	0	66	95.45			4.54
10	2	1	31	93.55			6.45
10	3	0	26				100.00
Worker Total			228	83.77	0.44	0.88	14.91

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Type of labor: Maint. aggr.	Total observations	Productive	Delay: Avoidable	Delay: Unavoidable	Delay: Loafing
				%	%	%	%
11	1	0	293	94.88	0.68	1.71	2.73
11	2	0	118	90.68		1.69	7.63
11	2	1	8	25.00		12.50	62.50
11	3	0	39			2.56	97.44
Worker Total			458	84.50	0.44	1.96	13.10
12	1	0	85	95.29	1.18	2.35	1.18
12	2	0	59	94.92			5.08
12	2	1	28	85.71	3.57	3.57	7.14
12	3	0	12				100.00
Worker Total			184	87.50	1.09	1.63	9.78
17	1	0	179	95.53			4.47
17	2	0	84	94.05		1.19	4.76
17	2	1	25	92.00			8.00
17	3	0	16			6.25	93.75
Worker Total			304	89.80		0.66	9.54
21	1	0	2	100.00			
Worker Total			2	100.00			
22	1	0	4	100.00			
Worker Total			4	100.00			
30	2	0	1	100.00			
Worker Total			1	100.00			
50	1	0	121	91.74		1.65	6.61
50	2	0	92	90.22		2.17	7.61
50	2	1	15	86.67			13.33
50	3	0	36				100.00
Worker Total			264	78.41		1.52	20.08
51	1	0	2	100.00			
Worker Total			2	100.00			
54			167	89.82		3.59	6.59
54			67	77.61			22.39
54			33	78.79		6.06	15.15
54			40			2.50	97.50
Worker Total			307	74.27		2.93	22.80

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive	Delay: Avoidable	Unavoidable	Loafing
				%	%	%	%
88	1	0	45	88.89		6.67	4.44
88	2	0	52	80.77			19.23
88	2	1	3	100.00			
88	3	0	5				100.00
Worker Total			105	80.95		2.86	16.19
97	1	0	13	92.31			7.69
Worker Total			13	92.31			7.69
99			35	100.00			
99			30	73.33		6.67	20.00
99			16			62.50	37.50
Worker Total			81	70.37		14.81	14.81
Total Process 3			1,953	82.44	0.26	2.25	15.05
			Process 4				
13	2	0	15	100.00			
Worker Total			15	100.00			
17	2	0	1	100.00			
Worker Total			1	100.00			
30	1	0	4	100.00			
30	2	0	2	50.00			50.00
Worker Total			6	83.33			16.67
43	1	0	22	95.45		4.54	
43	2	0	67	98.51			1.49
Worker Total			89	97.75		1.12	1.12
51	2	0	3	100.00			
Worker Total			3	100.00			
52	1	0	25	100.00			
52	2	0	33	96.97			3.03
52	2	1	1	100.00			
Worker Total			59	98.30			1.69

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
53	2	1	4	100.00			
Worker Total			4	100.00			
55	1	0	1	100.00			
55	2	0	14	92.86			7.14
Worker Total			15	93.33			6.67
56	1	0	24	87.50		4.17	8.33
56	2	0	52	86.54	1.92		11.54
Worker Total			76	86.84	1.32	1.32	10.53
58	2	0	1	100.00			
Worker Total			1	100.00			
60	2	0	4	100.00			
Worker Total			4	100.00			
61	2	0	1	100.00			
Worker Total			1	100.00			
62	2	0	2	100.00			
Worker Total			2	100.00			
83	2	0	4	75.00			25.00
Worker Total			4	75.00			25.00
101	1	0	3	100.00			
101	2	0	5	100.00			
Worker Total			8	100.00			
Total Process 4			288	94.44	0.35	0.69	4.51
			Process 5				
17	2	0	8	100.00			
Worker Total			8	100.00			
40	1	0	23	100.00			
40	2	0	4	50.00	25.00		25.00
Worker Total			27	92.59	3.70		3.70

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
41	2	0	1	100.00			
Worker Total			1	100.00			
43	1	0	8	100.00			
43	2	0	71	98.59			1.41
Worker Total			79	98.73			1.26
52	1	0	24	100.00			
52	2	0	63	100.00			
52	2	1	1	100.00			
Worker Total			88	100.00			
53	2	0	1	100.00			
Worker Total			1	100.00			
54	2	0	1	100.00			
Worker Total			1	100.00			
55	1	0	45	88.89			11.11
55	2	0	15	100.00			
55	3	0	1				100.00
Worker Total			61	90.16			9.84
56	1	0	171	91.81			8.19
56	2	0	183	88.52		0.55	10.93
56	2	1	15	100.00			
56	3	0	1				100.00
Worker Total			370	90.27		0.27	9.46
58	2	0	1	100.00			
Worker Total			1	100.00			
60	2	0	8	100.00			
Worker Total			8	100.00			
61	2	0	7	100.00			
Worker Total			7	100.00			
62	2	0	8	100.00			
Worker Total			8	100.00			

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
83	2	0	2				100.00
Worker Total			2				100.00
101	1	0	24	95.83			4.17
101	2	0	16	100.00			
101	2	1	1	100.00			
Worker Total			41	97.56			2.44
Total Process 5			703	93.17	0.14	0.14	6.54
			Process 6				
30	1	0	1	100.00			
Worker Total			1	100.00			
40	1	0	1	100.00			
Worker Total			1	100.00			
43	1	0	18	100.00			
Worker Total			18	100.00			
52	1	0	50	100.00			
Worker Total			50	100.00			
53	1	0	12	100.00			
Worker Total			12	100.00			
54	1	0	3	100.00			
Worker Total			3	100.00			
55	1	0	1	100.00			
Worker Total			1	100.00			
56	1	0	90	96.67			3.33
Worker Total			90	96.67			3.33
77	1	0	5	100.00			
Worker Total			5	100.00			
88	1	0	5	100.00			
Worker Total			5	100.00			

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive	Delay: Avoidable	Unavoidable	Loafing
				%	%	%	%
92	1	0	9	100.00			
Worker Total			9	100.00			
97	1	0	2	100.00			
Worker Total			2	100.00			
101	1	0	24	100.00			
Worker Total			24	100.00			
Total Process 6			221	98.64			1.36
			Process 7				
15	1	0	4	100.00			
Worker Total			4	100.00			
31	1	0	1	100.00			
Worker Total			1	100.00			
40	1	0	1	100.00			
Worker Total			1	100.00			
43	1	0	5	100.00			
Worker Total			5	100.00			
50	1	0	3	100.00			
Worker Total			3	100.00			
52	1	0	8	100.00			
Worker Total			8	100.00			
53	1	0	4	100.00			
Worker Total			4	100.00			
56	1	0	14	92.86		7.14	
Worker Total			14	92.86		7.14	
97	1	0	2	100.00			
Worker Total			2	100.00			

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
99	1	0	1			100.00	
Worker Total			1			100.00	
101	1	0	9	88.89		11.11	
Worker Total			9	88.89		11.11	
Total Process 7			52	94.23		5.77	
			Process 8				
13	2	0	44	93.18			6.82
Worker Total			44	93.18			6.82
15	2	0	8	100.00			
Worker Total			8	100.00			
43	1	0	6	100.00			
43	2	0	18	100.00			
Worker Total			24	100.00			
51	2	0	2	100.00			
51	2	1	19	94.74		5.26	
Worker Total			21	95.24		4.76	
52	1	0	2	100.00			
52	2	0	9	88.89			11.11
52	2	1	10	90.00		10.00	
Worker Total			21	90.48		4.76	4.76
53	1	0	1	100.00			
53	2	0	363	89.87	1.10	1.10	7.99
53	2	1	246	93.09	0.41	0.81	5.69
Worker Total			610	91.15	0.82	0.98	7.05
55	1	0	17	94.12			5.88
55	2	0	2	50.00			50.00
55	2	1	2	100.00			
Worker Total			21	90.48			9.52

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive	Delay: Avoidable	Delay: Unavoidable	Delay: Loafing
				%	%	%	%
56	1	0	47	97.87			2.13
56	2	0	54	85.19			14.81
56	2	1	42	97.62			2.38
Worker Total			143	93.01			6.99
57	2	0	2	100.00			
57	2	1	1	100.00			
Worker Total			3	100.00			
58	1	0	1	100.00			
58	2	0	13	92.31			7.69
58	2	1	2	100.00			
Worker Total			16	93.75			6.25
59	2	1	1	100.00			
Worker Total			1	100.00			
61	2	0	22	100.00			
Worker Total			22	100.00			
62	2	0	9	88.89			11.11
Worker Total			9	88.89			11.11
77	2	0	1	100.00			
Worker Total			1	100.00			
91	2	0	36	86.11			13.89
Worker Total			36	86.11			13.89
92	2	0	19	89.47			10.53
Worker Total			19	89.47			10.53
99	2	0	2	50.00			50.00
Worker Total			2	50.00			50.00
101	2	0	6	100.00			
Worker Total			6	100.00			
Total Process 8			1,007	91.86	0.50	0.79	6.85

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Msint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
			Process 9				
13	1	0	8	100.00			
13	2	0	8	75.00			25.00
Worker Total			16	87.50			12.50
15	2	0	2	50.00			50.00
15	2	1	1	100.00			
Worker Total			3	66.67			33.33
17	2	0	7	85.71			14.28
Worker Total			7	85.71			14.28
43	1	0	5	100.00			
Worker Total			5	100.00			
52	1	0	2	100.00			
52	2	1	1	100.00			
Worker Total			3	100.00			
53	1	0	218	98.62		0.92	0.46
53	2	0	98	89.80			10.20
53	2	1	28	92.86			7.14
Worker Total			344	95.64		0.58	3.78
54	2	0	7	85.71			14.28
Worker Total			7	85.71			14.28
56	2	0	5	100.00			
56	2	1	8	87.50			12.50
Worker Total			13	92.31			7.69
57	1	0	3	66.67		33.33	
Worker Total			3	66.67		33.33	
58	1	0	37	97.30		2.70	
58	2	1	1	100.00			
Worker Total			38	97.37		2.63	
59	1	0	4	100.00			
Worker Total			4	100.00			

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
62	1	0	1	100.00			
Worker Total			1	100.00			
83	1	0	7	85.71			14.28
Worker Total			7	85.71			14.28
91	1	0	12	91.67			8.33
91	2	1	8	87.50			12.50
91	2	1	3	100.00			
Worker Total			23	91.30			8.70
92	1	0	12	91.67			8.33
92	2	0	6	83.33			16.67
92	2	1	3	66.67			33.33
Worker Total			21	85.71			14.28
99	2	0	5	80.00			20.00
99	2	1	4	75.00			25.00
Worker Total			9	77.78			22.22
Total Process 9			504	93.85		0.79	5.36
			Process 10				
13	1	0	1	100.00			
Worker Total			1	100.00			
15	2	0	1	100.00			
Worker Total			1	100.00			
43	1	0	3	100.00			
Worker Total			3	100.00			
52	1	0	2	100.00			
52	2	0	6	100.00			
Worker Total			8	100.00			
53	1	0	43	97.67			2.33
53	2	0	40	100.00			
Worker Total			83	98.80			1.20

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive	Delay: Avoidable	Delay: Unavoidable	Delay: Loafing
				%	%	%	%
56	1	0	1	100.00			
56	2	0	2	100.00			
Worker Total			3	100.00			
57	1	0	1	100.00			
Worker Total			1	100.00			
58	1	0	8	100.00			
Worker Total			8	100.00			
61	2	0	1	100.00			
Worker Total			1	100.00			
91	1	0	1	100.00			
91	2	0	38	92.11		5.26	2.63
Worker Total			39	92.31		5.13	2.56
92	1	0	1	100.00			
92	2	0	25	92.00		4.00	4.00
Worker Total			26	92.31		3.85	3.85
99	1	0	2	100.00			
99	2	0	5	60.00		40.00	
Worker Total			7	71.43		28.57	
Total Process 10			181	95.58		2.76	1.66
			Process 11				
13	1	0	11	90.91		9.09	
Worker Total			11	90.91		9.09	
15	1	0	9	100.00			
Worker Total			9	100.00			
40	1	0	4	100.00			
Worker Total			4	100.00			
43	1	0	14	85.71		7.14	7.14
Worker Total			14	85.71		7.14	7.14

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
53	1	0	50	90.00		2.00	8.00
Worker Total			50	90.00		2.00	8.00
56	1	0	18	77.78		16.67	5.56
Worker Total			18	77.78		16.67	5.56
58	1	0	3	100.00			
Worker Total			3	100.00			
83	1	0	20	90.00			10.00
Worker Total			20	90.00			10.00
91	1	0	53	92.45			7.55
Worker Total			53	92.45			7.55
92	1	0	62	90.32		1.61	8.06
Worker Total			62	90.32		1.61	8.06
99	1	0	36	91.67		5.56	2.78
Worker Total			36	91.67		5.56	2.78
Total Process 11			280	90.36		3.21	6.43
			Process 12				
30	1	0	256	100.00			
Worker Total			256	100.00			
31	1	0	4	100.00			
Worker Total			4	100.00			
40	1	0	1	100.00			
Worker Total			1	100.00			
43	1	0	7	100.00			
Worker Total			7	100.00			
97	1	0	4	100.00			
Worker Total			4	100.00			
Total Process 12			272	100.00			

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive	Delay: Avoidable	Unavoidable	Loafing
				%	%	%	%
			Process 13				
17	1	0	2	100.00			
Worker Total			2	100.00			
30	1	0	26	100.00			
Worker Total			26	100.00			
31	1	0	4	100.00			
Worker Total			4	100.00			
40	1	0	6	100.00			
Worker Total			6	100.00			
43	1	0	18	100.00			
Worker Total			18	100.00			
50	1	0	3	100.00			
Worker Total			3	100.00			
52	1	0	5	100.00			
Worker Total			5	100.00			
53	1	0	1	100.00			
Worker Total			1	100.00			
54	1	0	1	100.00			
Worker Total			1	100.00			
56	1	0	7	100.00			
Worker Total			7	100.00			
77	1	0	1	100.00			
Worker Total			1	100.00			
88	1	0	1	100.00			
Worker Total			1	100.00			
97	1	0	17	94.12			5.88
Worker Total			17	94.12			5.88

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Delay: Unavoidable %	Delay: Loafing %
99	1	0	4	100.00			
Worker Total			4	100.00			
101	1	0	8	100.00			
Worker Total			8	100.00			
Total Process 13			104	99.04			0.96
			Process 14				
10	2	0	1	100.00			
Worker Total			1	100.00			
12	2	0	1	100.00			
Worker Total			1	100.00			
30	1	0	240	98.33		0.83	0.83
30	2	0	487	97.54		0.62	1.85
30	2	1	22	90.91			9.09
Worker Total			749	97.60		0.67	1.74
31	1	0	332	97.29		1.51	1.20
31	2	0	89	89.89	1.12	1.12	7.87
Worker Total			421	95.72	0.24	1.43	2.61
34	1	0	2	100.00			
Worker Total			2	100.00			
40	1	0	93	98.92		1.08	
40	2	0	22	90.91			9.09
Worker Total			115	97.39		0.87	1.74
41	2	1	2	100.00			
Worker Total			2	100.00			
43	1	0	120	99.17			0.83
43	2	0	104	94.23		0.96	4.81
43	2	1	16	93.75			6.25
Worker Total			240	96.67		0.42	2.92

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
55	2	0	1	100.00			
Worker Total			1	100.00			
60	2	0	2	100.00			
Worker Total			2	100.00			
97	1	0	124	91.13		5.65	3.23
97	2	0	264	79.17		0.76	20.08
97	2	1	33	84.85		3.03	12.12
Worker Total			421	83.14		2.38	14.49
101	2	0	1	100.00			
Worker Total			1	100.00			
Total Process 14			1,956	93.97	0.05	1.18	4.81
			Process 15				
8	1	0	5	100.00			
Worker Total			5	100.00			
13	1	0	5	100.00			
Worker Total			5	100.00			
15	1	0	2	100.00			
Worker Total			2	100.00			
43	1	0	6	100.00			
Worker Total			6	100.00			
50	1	0	1	100.00			
Worker Total			1	100.00			
53	1	0	5	100.00			
Worker Total			5	100.00			
56	1	0	14	100.00			
Worker Total			14	100.00			
82	1	0	2	100.00			
Worker Total			2	100.00			

Tabla 70 (cont.) Clasaification of work and delay by type of labor within workers and by workers within a process for all procesaes, plant A, August-Saptember, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productiva %	Delay: Avoidable %	Unavoidable %	Loafing %
85	1	0	12	91.67			8.33
Worker Total			12	91.67			8.33
97	1	0	1	100.00			
Worker Total			1	100.00			
99	1	0	7	100.00			
Worker Total			7	100.00			
101	1	0	6	83.33			16.67
Worker Total			6	83.33			16.67
Total Procass 15			66	96.97		1.52	1.52
			Procaaa 16				
34	1	0	99	97.98			2.02
34	2	0	9	88.89			11.11
34	2	1	1	100.00			
Workar Total			109	97.25			2.75
35	1	0	73	95.89		4.11	
35	2	0	1	100.00			
Workar Total			74	95.95		4.05	
82	1	0	1	100.00			
Worker Total			1	100.00			
85	1	0	2	50.00			50.00
Worker Total			2	50.00			50.00
Total Procaas 16			186	96.24		1.61	2.15
			Process 17				
8	1	0	1	100.00			
Workar Total			1	100.00			

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
34	1	0	376	98.40			1.60
34	2	0	26	96.15			3.85
34	2	1	10	100.00			
Worker Total			412	98.30			1.70
35	1	0	389	90.23		6.43	3.34
35	2	0	7	100.00			
Worker Total			396	90.40		6.31	3.28
45	1	0	1	100.00			
Worker Total			1	100.00			
84	1	0	1	100.00			
Worker Total			1	100.00			
85	1	0	4	100.00			
Worker Total			4	100.00			
86	2	1	1	100.00			
Worker Total			1	100.00			
Total Process 17			816	94.49		3.06	2.45
			Process 18				
13	1	0	8	100.00			
Worker Total			8	100.00			
17	2	0	1	100.00			
Worker Total			1	100.00			
40	1	0	4	75.00			25.00
40	2	0	2	100.00			
Worker Total			6	83.33			16.67
42	2	1	8	87.50			12.50
Worker Total			8	87.50			12.50

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive: %	Delay: Avoidable %	Unavoidable %	Loafing %
43	1	0	30	100.00			
43	2	0	30	96.67			3.33
Worker Total			60	98.33			1.67
45	1	0	1	100.00			
Worker Total			1	100.00			
50	1	0	12	100.00			
Worker Total			12	100.00			
51	1	0	1	100.00			
Worker Total			1	100.00			
52	1	0	199	97.99			2.01
52	2	0	50	100.00			
Worker Total			249	98.39			1.61
55	1	0	4	75.00			25.00
55	2	0	3	100.00			
Worker Total			7	85.71			14.28
56	1	0	30	96.67			3.33
56	2	0	2	50.00			50.00
Worker Total			32	93.75			6.25
58	1	0	11	100.00			
58	2	0	15	100.00			
Worker Total			26	100.00			
71	1	0	6	100.00			
71	2	0	2	100.00			
71	2	1	3	100.00			
Worker Total			11	100.00			
82	1	0	4	100.00			
Worker Total			4	100.00			
86	1	0	4	100.00			
86	2	0	2	100.00			
86	2	1	23	100.00			
Worker Total			29	100.00			

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
91	1	0	6	83.33			16.67
Worker Total			6	83.33			16.67
101	1	0	226	99.12			0.88
101	2	0	137	95.62		0.73	3.65
101	2	1	20	100.00			
Worker Total			383	97.91		0.26	1.83
Total Process 18			844	97.75		0.12	2.13
			Process 19				
13	1	0	78	98.72			1.28
13	2	0	3	100.00			
Worker Total			81	98.77			1.23
40	1	0	1	100.00			
Worker Total			1	100.00			
43	1	0	20	95.00			5.00
Worker Total			20	95.00			5.00
44	1	0	1	100.00			
Worker Total			1	100.00			
45	1	0	2	100.00			
Worker Total			2	100.00			
52	1	0	38	100.00			
Worker Total			38	100.00			
53	1	0	2	100.00			
Worker Total			2	100.00			
54	1	0	2	100.00			
Worker Total			2	100.00			
56	1	0	17	100.00			
Worker Total			17	100.00			

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
58	1	0	1	100.00			
Worker Total			1	100.00			
71	1	0	833	93.28	0.12	0.72	5.88
71	2	0	70	91.43			8.57
Worker Total			903	93.13	0.11	0.66	6.09
77	1	0	2	100.00			
77	2	0	2	100.00			
Worker Total			4	100.00			
82	1	0	60	96.67			3.33
Worker Total			60	96.67			3.33
84	1	0	25	96.00			4.00
Worker Total			25	96.00			4.00
85	1	0	23	95.65			4.35
Worker Total			23	95.65			4.35
86	1	0	439	97.72	0.46		1.82
86	2	0	33	100.00			
Worker Total			472	97.88	0.42		1.69
91	1	0	5	100.00			
Worker Total			5	100.00			
97	1	0	6	100.00			
Worker Total			6	100.00			
99	1	0	1	100.00			
Worker Total			1	100.00			
101	1	0	195	98.46	0.51		1.03
Worker Total			195	98.46	0.51		1.03
Total Process 19			1,859	95.64	0.22	0.32	3.82

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
			Process 20				
13	1	0	1	100.00			
13	2	0	4	100.00			
Worker Total			5	100.00			
43	1	0	1	100.00			
Worker Total			1	100.00			
56	1	0	1	100.00			
Worker Total			1	100.00			
71	1	0	1	100.00			
Worker Total			1	100.00			
77	1	0	95	93.68			6.32
77	2	0	128	94.53		0.78	4.69
77	2	1	1	100.00			
Worker Total			224	94.20		0.45	5.36
93	1	0	23	95.65	4.35		
93	2	0	94	95.74		1.06	3.19
Worker Total			117	95.73	0.85	0.85	2.56
101	1	0	3	100.00			
101	2	0	1	100.00			
Worker Total			4	100.00			
Total Process 20			353	94.90	0.28	0.57	4.25
			Process 21				
13	1	0	54	100.00			
13	2	0	4	100.00			
Worker Total			58	100.00			
71	1	0	47	100.00			
Worker Total			47	100.00			

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
77	1	0	504	98.81		0.20	0.99
77	2	0	44	95.45		2.27	2.27
Worker Total			548	98.54		0.36	1.09
86	1	0	29	96.55		3.45	
Worker Total			29	96.55		3.45	
93	1	0	590	96.78		1.69	1.53
93	2	0	61	90.16		6.56	3.28
Worker Total			651	96.16		2.15	1.69
101	1	0	44	97.73			2.27
101	2	0	3	100.00			
Worker Total			47	97.87			2.13
Total Process 21			1,380	97.46		1.23	1.30
			Process 22				
77	1	0	23	100.00			
Worker Total			23	100.00			
Total Process 22			23	100.00			
			Process 23				
41	1	0	4	100.00			
Worker Total			4	100.00			
51	1	0	4	100.00			
Worker Total			4	100.00			
52	1	0	6	100.00			
Worker Total			6	100.00			
56	1	0	10	70.00		20.00	10.00
Worker Total			10	70.00		20.00	10.00

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
101	1	0	8	75.00		25.00	
Worker Total			8	75.00		25.00	
Total Process 23			32	84.38		12.50	3.12
			Process 24				
12	2	0	1	100.00			
Worker Total			1	100.00			
22	2	0	29	51.72			48.28
Worker Total			29	51.72			48.28
40	1	0	11	90.91			9.09
40	2	0	18	83.33			16.67
40	3	0	1				100.00
Worker Total			30	83.33			16.67
41	1	0	74	98.65			1.35
41	2	0	212	89.15	0.47	0.47	9.91
Worker Total			286	91.61	0.35	0.35	7.69
42	2	0	158	96.20	0.63		3.16
Worker Total			158	96.20	0.63		3.16
44	1	0	1	100.00			
44	2	0	281	83.63		0.36	16.01
Worker Total			282	83.69		0.35	15.96
45	2	0	14	78.57		14.28	7.14
Worker Total			14	78.57		14.28	7.14
46	2	0	17	88.24			11.76
Worker Total			17	88.24			11.76
47	2	0	299	79.60		0.33	20.07
Worker Total			299	79.60		0.33	20.07
48	2	0	14	92.86			7.14
Worker Total			14	92.86			7.14

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
51	1	0	74	100.00			
51	2	0	153	89.54		1.31	9.15
Worker Total			227	92.95		0.88	6.17
71	2	0	3	100.00			
Worker Total			3	100.00			
92	2	0	1	100.00			
Worker Total			1	100.00			
99	2	0	1	100.00			
Worker Total			1	100.00			
100	2	0	1	100.00			
Worker Total			1	100.00			
Total Process 24			1,363	86.94	0.15	0.51	12.40
			Process 25				
11	1	0	1	100.00			
Worker Total			1	100.00			
22	1	0	14	92.86			7.14
Worker Total			14	92.86			7.14
40	1	0	7	100.00			
Worker Total			7	100.00			
41	1	0	80	92.50		1.25	6.25
Worker Total			80	92.50		1.25	6.25
42	1	0	1	100.00			
Worker Total			1	100.00			
43	1	0	2	100.00			
Worker Total			2	100.00			
44	1	0	31	96.77			3.23
Worker Total			31	96.77			3.23

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
45	1	0	1	100.00			
Worker Total			1	100.00			
46	1	0	3	100.00			
Worker Total			3	100.00			
47	1	0	4	100.00			
Worker Total			4	100.00			
48	1	0	9	100.00			
Worker Total			9	100.00			
50	1	0	1	100.00			
Worker Total			1	100.00			
51	1	0	52	100.00			
Worker Total			52	100.00			
54	1	0	1	100.00			
Worker Total			1	100.00			
56	1	0	2	100.00			
Worker Total			2	100.00			
77	1	0	10	100.00			
Worker Total			10	100.00			
92	1	0	7	100.00			
Worker Total			7	100.00			
99	1	0	1	100.00			
Worker Total			1	100.00			
100	1	0	2	100.00			
Worker Total			2	100.00			
101	1	0	9	100.00			
Worker Total			9	100.00			
Total Process 25			238	96.64		0.42	2.94

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
			Process 26				
40	1	0	6	83.33	16.67		
40	2	0	2	100.00			
Worker Total			8	87.50	12.50		
41	1	0	99	95.96			4.04
41	2	0	21	100.00			
Worker Total			120	96.67			3.33
42	2	0	19	100.00			
Worker Total			19	100.00			
44	2	0	1	100.00			
Worker Total			1	100.00			
45	2	0	1	100.00			
Worker Total			1	100.00			
46	2	0	2	100.00			
Worker Total			2	100.00			
51	1	0	96	92.71		1.04	6.25
51	2	0	25	100.00			
Worksr Total			121	94.21		0.83	4.96
52	1	0	1	100.00			
Worker Total			1	100.00			
86	2	0	1	100.00			
Worker Total			1	100.00			
99	1	0	1	100.00			
Worker Total			1	100.00			
101	1	0	1	100.00			
Worker Total			1	100.00			
Total Process 26			276	95.65	0.36	0.36	3.62

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
			Process 27				
22	1	0	2	100.00			
Worker Total			2	100.00			
40	1	0	7	100.00			
Worker Total			7	100.00			
41	1	0	15	93.33			6.67
Worker Total			15	93.33			6.67
42	1	0	5	100.00			
Worker Total			5	100.00			
44	1	0	31	96.77			3.23
Worker Total			31	96.77			3.23
45	1	0	7	71.43			28.57
Worker Total			7	71.43			28.57
46	1	0	26	96.15			3.85
Worker Total			26	96.15			3.85
47	1	0	27	96.30			3.70
Worker Total			27	96.30			3.70
48	1	0	4	100.00			
Worker Total			4	100.00			
51	1	0	27	96.30			3.70
Worker Total			27	96.30			3.70
77	1	0	5	100.00			
Worker Total			5	100.00			
99	1	0	17	100.00			
Worker Total			17	100.00			
100	1	0	12	100.00			
Worker Total			12	100.00			
Total Process 27			185	96.22			3.78

Table 70 (cont.) Classification of work and delay by type of labor within workers snd by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
			Process 28				
40	1	0	18	88.89		5.56	5.56
40	2	1	1	100.00			
Worker Total			19	89.47		5.26	5.26
41	1	0	1	100.00			
41	2	1	9	100.00			
Worker Total			10	100.00			
44	1	0	3	100.00			
44	2	0	3	100.00			
Worker Total			6	100.00			
45	2	0	54	98.15			1.85
45	2	1	1	100.00			
Worker Total			55	98.18			1.82
46	1	0	289	86.51	2.08	9.00	2.42
46	2	0	64	84.38			15.62
46	2	1	4	100.00			
Worker Total			357	86.27	1.68	7.28	4.76
47	1	0	4	100.00			
47	2	0	1	100.00			
Worker Total			5	100.00			
51	2	0	1	100.00			
Worker Total			1	100.00			
92	1	0	2	100.00			
Worker Total			2	100.00			
99	2	0	7	100.00			
Worker Total			7	100.00			
100	2	0	1	100.00			
Worker Total			1	100.00			

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
101	1	0	47	78.72		21.28	
101	2	0	11	100.00			
101	2	1	1	100.00			
Worker Total			59	83.05		16.95	
Total Process 28			522	88.12	1.15	7.09	3.64
			Process 29				
40	1	0	1	100.00			
Worker Total			1	100.00			
41	1	0	1	100.00			
Worker Total			1	100.00			
42	2	0	2	100.00			
Worker Total			2	100.00			
45	1	0	22	86.36		13.64	
45	2	0	1	100.00			
Worker Total			23	86.96		13.04	
46	1	0	17	82.35		11.76	5.88
46	2	0	4	100.00			
Worker Total			21	85.71		9.52	4.76
47	1	0	3	100.00			
Worker Total			3	100.00			
48	1	0	8	62.50		37.50	
Worker Total			8	62.50		37.50	
99	1	0	9	77.78		22.22	
Worker Total			9	77.78		22.22	
Total Process 29			68	83.82		14.71	1.47

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
			Process 30				
22	1	0	283	97.53		2.12	0.35
22	2	0	105	83.81			16.19
22	2	1	1	100.00			
Worker Total			389	93.83		1.54	4.63
40	1	0	93	98.92			1.08
40	2	0	71	85.92		2.82	11.27
40	2	1	11	90.91			9.09
Worker Total			175	93.14		1.71	5.14
41	1	0	24	95.83			4.17
41	2	0	15	80.00			20.00
41	2	1	2	100.00			
Worker Total			41	90.24			9.76
42	2	0	1	100.00			
Worker Total			1	100.00			
44	2	0	1	100.00			
Worker Total			1	100.00			
46	1	0	3	100.00			
46	2	0	2	100.00			
Worker Total			5	100.00			
47	1	0	14	92.86		7.14	
47	2	0	3	66.67			33.33
Worker Total			17	88.24		5.88	5.88
48	1	0	222	96.40		3.15	0.45
48	2	0	103	95.15		0.97	3.88
48	2	1	13	100.00			
Worker Total			338	96.15		2.37	1.48
51	1	0	153	96.73		1.96	1.31
51	2	0	105	100.00			
51	2	1	4	75.00			25.00
Worker Total			262	97.71		1.14	1.14

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
101	1	0	19	94.74	5.26		
Worker Total			19	94.74	5.26		
Total Process 30			1,248	95.03	0.08	1.68	3.21
			Process 31				
22	1	0	1	100.00			
22	2	0	53	86.79			13.21
Worker Total			54	87.04			12.96
40	1	0	105	93.33		3.81	2.86
40	2	0	64	96.88			3.12
40	2	1	37	100.00			
Worker Total			206	95.63		1.94	2.43
41	1	0	37	100.00			
41	2	0	14	92.86			7.14
41	2	1	27	100.00			
Worker Total			78	98.72			1.28
42	1	0	33	81.82		9.09	9.09
42	2	0	18	94.44			5.56
42	2	1	23	100.00			
Worker Total			74	90.54		4.05	5.41
44	1	0	7	100.00			
44	2	0	5	60.00		20.00	20.00
Worker Total			12	83.33		8.33	8.33
46	1	0	3	100.00			
46	2	0	3	100.00			
46	2	1	2	100.00			
Worker Total			8	100.00			
47	1	0	393	85.50	0.51	12.98	1.02
47	2	0	58	60.34	1.72	31.03	6.90
47	2	1	2	50.00			50.00
Worker Total			453	82.12	0.66	15.23	1.99

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
48	1	0	4	50.00		50.00	
48	2	0	14	100.00			
Worker Total			18	88.89		11.11	
51	1	0	130	94.62			5.38
51	2	0	102	99.02			0.98
51	2	1	9	100.00			
Worker Total			241	96.68			3.32
92	1	0	2	100.00			
Worker Total			2	100.00			
101	1	0	11	100.00			
101	2	0	2	100.00			
101	2	1	2	100.00			
Worker Total			15	100.00			
Total Process 31			1,161	89.92	0.26	6.80	3.01
			Process 32				
8	1	0	485	61.65	0.41	35.88	2.06
8	2	0	2	100.00			
Worker Total			487	61.81	0.41	35.73	2.05
13	1	0	22	95.45		4.55	
Worker Total			22	95.45		4.55	
15	1	0	11	63.64		36.36	
Worker Total			11	63.64		36.36	
43	1	0	6	100.00			
Worker Total			6	100.00			
45	1	0	732	82.65		15.98	1.37
45	2	0	80	98.75		1.25	
45	2	1	1	100.00			
Worker Total			813	84.26		14.51	1.23

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
46	1	0	1	100.00			
Worker Total			1	100.00			
47	2	0	2	100.00			
Worker Total			2	100.00			
51	1	0	14	71.43		14.29	14.29
51	2	0	1	100.00			
Worker Total			15	73.33		13.33	13.33
77	1	0	5	100.00			
Worker Total			5	100.00			
82	1	0	225	75.11		22.67	2.22
Worker Total			225	75.11		22.67	2.22
84	1	0	289	75.43		22.49	2.08
84	2	0	2	100.00			
Worker Total			291	75.60		22.34	2.06
85	1	0	435	70.80	0.46	26.67	2.07
85	2	0	1	100.00			
Worker Total			436	70.87	0.46	26.61	2.06
86	1	0	2	100.00			
Worker Total			2	100.00			
92	1	0	49	89.80		10.20	
92	2	0	3	100.00			
Worker Total			52	90.38		9.62	
97	1	0	51	78.43		21.57	
Worker Total			51	78.43		21.57	
101	1	0	1	100.00			
Worker Total			1	100.00			
Total Process 32			2,420	75.50	0.17	22.60	1.74

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Delay: Unavoidable %	Delay: Loafing %
			Process 33				
8	1	0	57	64.91		19.30	15.79
8	3	0	2				100.00
Worker Total			59	62.71		18.64	18.64
15	1	0	1	100.00			
15	2	1	3	66.67		33.33	
Worker Total			4	75.00		25.00	
44	3	0	2			50.00	50.00
Worker Total			2			50.00	50.00
46	1	0	10	80.00			20.00
46	2	0	3	100.00			
Worker Total			13	84.62			15.38
47	2	0	1	100.00			
Worker Total			1	100.00			
82	1	0	32	68.75		21.88	9.38
82	2	0	2	100.00			
82	2	1	2	100.00			
82	3	0	1				100.00
Worker Total			37	70.27		18.92	10.81
84	1	0	98	64.29		27.55	8.16
84	2	0	10	80.00			20.00
84	2	1	8	87.50			12.50
84	3	0	1				100.00
Worker Total			117	66.67		23.08	10.26
85	1	0	52	73.08		19.23	7.69
85	2	0	3	100.00			
85	2	1	3	100.00			
85	3	0	2				100.00
Worker Total			60	73.33		16.67	10.00
88	2	0	1	100.00			
Worker Total			1	100.00			

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Delay: Unavoidable %	Delay: Loafing %
92	1	0	175	86.29		10.29	3.43
92	2	0	45	91.11		4.44	4.44
92	2	1	2	100.00			
Worker Total			222	87.39		9.01	3.60
99	1	0	16	68.75		12.50	18.75
99	2	0	5	100.00			
Worker Total			21	76.19		9.52	14.28
101	1	0	1	100.00			
101	3	0	2				100.00
Worker Total			3	33.33			66.67
Total Process 33			540	76.30		14.63	9.07
			Process 34				
8	1	0	61	98.36			1.64
8	2	0	22	95.45			4.55
Worker Total			83	97.59			2.41
42	1	0	1				100.00
Worker Total			1				100.00
45	2	0	1	100.00			
Worker Total			1	100.00			
82	1	0	1				100.00
82	2	0	1	100.00			
Worker Total			2	50.00			50.00
84	1	0	8	100.00			
84	2	0	13	100.00			
Worker Total			21	100.00			
85	1	0	22	90.91		4.55	4.55
85	2	0	19	100.00			
Worker Total			41	95.12		2.44	2.44

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. eggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
88	1	0	2	100.00			
Worker Total			2	100.00			
92	1	0	10	90.00		10.00	
92	2	0	51	92.16			7.84
Worker Total			61	91.80		1.64	6.56
99	2	0	7	71.43			28.57
Worker Total			7	71.43			28.57
101	2	0	3	100.00			
Worker Total			3	100.00			
Total Process 34			222	94.14		0.90	4.95
			Process 35				
8	1	0	49	87.76		6.12	6.12
Worker Total			49	87.76		6.12	6.12
15	1	0	7	85.71		14.29	
Worker Total			7	85.71		14.29	
42	1	0	3	100.00			
Worker Total			3	100.00			
44	1	0	6	83.33			16.67
Worker Total			6	83.33			16.67
45	1	0	6	66.67		16.67	16.67
Worker Total			6	66.67		16.67	16.67
46	1	0	190	74.74		0.53	24.74
Worker Total			190	74.74		0.53	24.74
47	1	0	18	83.33		5.56	11.11
Worker Total			18	83.33		5.56	11.11
82	1	0	22	90.91		4.55	4.55
Worker Total			22	90.91		4.55	4.55

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive %	Delay: Avoidable %	Unavoidable %	Loafing %
84	1	0	32	87.50			12.50
Worker Total			32	87.50			12.50
85	1	0	42	88.10		4.76	7.14
Worker Total			42	88.10		4.76	7.14
86	1	0	1				100.00
Worker Total			1				100.00
91	1	0	8	75.00			25.00
Worker Total			8	75.00			25.00
92	1	0	290	86.55	0.34	4.48	8.62
Worker Total			290	86.55	0.34	4.48	8.62
99	1	0	197	84.26		2.03	13.71
Worker Total			197	84.26		2.03	13.71
100	1	0	56	69.64		1.79	28.57
Worker Total			56	69.64		1.79	28.57
101	1	0	45	91.11		2.22	6.67
Worker Total			45	91.11		2.22	6.67
Total Process 35			972	82.92	0.10	2.98	13.99
			Process 36				
8	1	0	5	80.00		20.00	
8	2	0	3	100.00			
Worker Total			8	87.50		12.50	
15	1	0	1	100.00			
Worker Total			1	100.00			
40	2	1	1	100.00			
Worker Total			1	100.00			

Table 70 (cont.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive	Delay: Avoidable	Unavoidable	Loafing
				%	%	%	%
41	1	0	5	100.00			
41	2	0	1	100.00			
41	2	1	2	50.00			50.00
Worker Total			8	87.50			12.50
44	1	0	4	100.00			
Worker Total			4	100.00			
46	1	0	12	91.67		8.33	
46	2	0	24	79.17			20.83
46	2	1	23	73.91		26.09	
Worker Total			59	79.66		11.86	8.47
47	1	0	11	81.82			18.18
47	2	0	3	100.00			
Worker Total			14	85.71			14.29
48	1	0	10	90.00			10.00
Worker Total			10	90.00			10.00
50	1	0	9	88.89			11.11
50	2	1	6	100.00			
Worker Total			15	93.33			6.67
51	2	1	1				100.00
Worker Total			1				100.00
82	2	0	2	100.00			
Worker Total			2	100.00			
91	1	0	7	71.43		14.29	14.29
Worker Total			7	71.43		14.29	14.29
92	1	0	14	92.86		7.14	
92	2	0	1	92.86		7.14	
92	2	1	1			100.00	
Worker Total			16	87.50		12.50	
97	2	0	2	100.00			
Worker Total			2	100.00			
99	1	0	260	80.38	0.38	16.54	2.69
99	2	0	90	83.33		3.33	13.33

Table 70 (concl.) Classification of work and delay by type of labor within workers and by workers within a process for all processes, plant A, August-September, 1957.

Worker number	Type of labor: Labor div.	Maint. aggr.	Total observations	Productive	Delay: Avoidable	Delay: Unavoidable	Delay: Loafing
				%	%	%	%
99	2	1	3	100.00			
Worker Total			353	81.30	0.28	13.03	5.38
100	1	0	97	82.47		17.53	
100	2	0	14	92.86			7.14
100	2	1	6			100.00	
Worker Total			117	79.49		19.66	0.85
101	1	0	1	100.00			
101	2	1	2	100.00			
Worker Total			3	100.00			
Total Process 36			621	81.80	0.16	12.88	5.15
			Process 37				
40	2	1	1	100.00			
Worker Total			1	100.00			
41	2	0	1	100.00			
Worker Total			1	100.00			
44	1	0	457	84.03	0.22	9.63	6.13
44	2	0	34	97.06			2.94
44	2	1	8	100.00			
Worker Total			499	85.17	0.20	8.82	5.81
47	1	0	3	100.00			
Worker Total			3	100.00			
51	2	1	2	100.00			
Worker Total			2	100.00			
71	1	0	1	100.00			
Worker Total			1	100.00			
Total Process 37			507	85.40	0.20	8.68	5.72

*Type of labor was categorized as follows: division of labor, -1- variable, -2- fixed, and -3- idle or loafing; maintenance aggregation, -0- other than maintenance work and -1- maintenance work.

Table 71. Classification of work and delay by workers, plant A, August-September, 1957.

Worker number	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
8	692	68.64	0.29	27.31	3.76
10	1,022	83.56	0.20	4.60	11.64
11	774	85.01	0.39	1.68	12.92
12	1,032	92.15	0.29	1.84	5.72
13	266	96.99		0.75	2.26
15	50	86.00		12.00	2.00
17	559	88.73	0.36	1.79	9.12
21	2	100.00			
22	492	90.65		1.22	8.13
30	1,040	98.17		0.48	1.35
31	430	95.81	0.23	1.40	2.56
34	523	98.09			1.91
35	470	91.28		5.96	2.77
40	618	94.34	0.32	1.46	3.88
41	655	93.74	0.15	0.31	5.80
42	272	94.49	0.37	1.10	4.04
43	621	97.58		0.48	1.93
44	878	85.54	0.11	5.35	9.00
45	925	84.97		13.41	1.62
46	702	83.33	0.85	5.13	10.68
47	846	82.27	0.35	8.51	8.87
48	401	95.01		3.24	1.75
50	674	80.86		4.90	14.24
51	988	95.55		0.91	3.54
52	558	98.75		0.18	1.08
53	1,117	93.29	0.45	0.81	5.46
54	620	78.71		2.42	18.87
55	114	90.35			9.65
56	842	91.45	0.12	0.95	7.48
57	7	85.71		14.29	
58	96	97.92		1.04	1.04
59	5	100.00			
60	20	95.00			5.00
61	32	100.00			
62	22	86.36			13.64
63	2	50.00			50.00
71	966	93.58	0.10	0.62	5.69
77	826	97.46		0.36	2.18
82	355	79.72		16.62	3.66
83	34	82.35			17.65
84	487	76.39		18.89	4.72

Table 71 (concl.) Classification of work and delay by workers, plant A, August-September, 1957.

Worker number	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
85	620	75.32	0.32	20.81	3.55
86	535	97.76	0.37	0.19	1.68
88	186	86.56		2.69	10.75
91	177	89.27		1.69	9.04
92	790	88.35	0.13	5.44	6.08
93	768	96.09	0.13	1.95	1.82
97	519	83.82		4.05	12.14
99	809	81.46	0.25	8.90	9.39
100	189	78.31		12.70	8.99
101	904	96.24	0.22	1.77	1.77
Total	26,532	89.27	0.17	4.55	6.02

Tabla 72. Classification of work and dalay by procassaa for a worker over all workers, plant A, August-Saptember, 1957.

Process	Total observations	Productiva	Dalay		
			Avoidable	Unavoidabla	Loafing
		%	%	%	%
		Worker 8			
15	5	100.00			
17	1	100.00			
32	487	61.81	0.41	35.73	2.05
33	59	62.71		18.64	18.64
34	83	97.59			2.41
35	49	87.76		6.12	6.12
36	8	87.50		12.50	
Worker Total	692	68.64	0.29	27.31	3.76
		Workar 10			
1	755	82.91	0.13	5.96	10.99
2	38	94.74			5.26
3	228	83.77	0.44	0.88	14.91
Worker Total	1,022	83.56	0.20	4.60	11.64
		Worker 11			
1	199	78.89	0.50	1.51	19.10
2	116	97.41		0.86	1.72
3	458	84.50	0.44	1.96	13.10
25	1	100.00			
Workar Total	774	85.01	0.39	1.68	12.92
		Worker 12			
1	785	92.74	0.13	2.04	5.10
2	61	98.36			1.64
3	184	87.50	1.09	1.63	9.78
14	1	100.00			
24	1	100.00			
Worker Total	1,032	92.15	0.29	1.84	5.72

Table 72 (cont.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
		Worker 13			
4	15	100.00			
8	44	93.18			6.82
9	16	87.50			12.50
10	1	100.00			
11	11	90.91		9.09	
15	5	100.00			
18	8	100.00			
19	81	98.77			1.23
20	5	100.00			
21	58	100.00			
32	22	95.45		4.55	
Worker Total	266	96.99		0.75	2.26
		Worker 15			
7	4	100.00			
8	8	100.00			
9	3	66.67			33.33
10	1	100.00			
11	9	100.00			
15	2	100.00			
32	11	63.64		36.36	
33	4	75.00		25.00	
35	7	85.71		14.29	
36	1	100.00			
Worker Total	50	86.00		12.00	2.00
		Worker 17			
1	135	78.52	1.48	5.19	14.81
2	101	98.02		0.99	0.99
3	304	89.80		0.66	9.54
4	1	100.00			
5	8	100.00			

Table 72 (cont.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
9	7	85.71			14.29
13	2	100.00			
18	1	100.00			
Worker Total	559	88.73	0.36	1.79	9.12
		Worker 21			
3	2	100.00			
Worker Total	2	100.00			
		Worker 22			
3	4	100.00			
24	29	51.72			48.28
25	14	92.86			7.14
27	2	100.00			
30	389	93.83		1.54	4.63
31	54	87.04			12.96
Worker Total	492	90.65		1.22	8.13
		Worker 30			
1	1	100.00			
3	1	100.00			
4	6	83.33			16.67
6	1	100.00			
12	256	100.00			
13	26	100.00			
14	749	97.60		0.67	1.74
Worker Total	1,040	98.17		0.48	1.35

Table 72 (cont.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
		Worker 31			
7	1	100.00			
12	4	100.00			
13	4	100.00			
14	421	95.72	0.24	1.42	2.61
Worker Total	430	95.81	0.23	1.40	2.56
		Worker 34			
14	2	100.00			
16	109	97.25			2.75
17	412	98.30			1.70
Worker Total	523	98.09			1.91
		Worker 35			
16	74	95.95		4.05	
17	396	90.40		6.31	3.28
Worker Total	470	91.28		5.96	2.77
		Worker 40			
1	1	100.00			
5	27	92.59	3.70		3.70
6	1	100.00			
7	1	100.00			
11	4	100.00			
12	1	100.00			
13	6	100.00			
14	115	97.39		0.87	1.74
18	6	83.33			16.67
19	1	100.00			
24	30	83.33			16.67
25	7	100.00			

Table 72 (cont.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
26	8	87.50	12.50		
27	7	100.00			
28	19	89.47		5.26	5.26
29	1	100.00			
30	175	93.14		1.71	5.14
31	206	95.63		1.94	2.43
36	1	100.00			
37	1	100.00			
Worker Total	618	94.34	0.32	1.46	3.88
		Worker 41			
1	8	100.00			
5	1	100.00			
14	2	100.00			
23	4	100.00			
24	286	91.61	0.35	0.35	7.69
25	80	92.50		1.25	6.25
26	120	96.67			3.33
27	15	93.33			6.67
28	10	100.00			
29	1	100.00			
30	41	90.24			9.76
31	78	98.72			1.28
36	8	87.50			12.50
37	1	100.00			
Worker Total	655	93.74	0.15	0.31	5.80
		Worker 42			
18	8	87.50			12.50
24	158	96.20	0.63		3.16
25	1	100.00			
26	19	100.00			
27	5	100.00			
29	2	100.00			
30	1	100.00			

Table 72 (cont.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
31	74	90.54		4.05	5.41
34	1				100.00
35	3	100.00			
Worker Total	272	94.49	0.37	1.10	4.04
		Worker 43			
1	24	100.00			
4	89	97.75		1.12	1.12
5	79	98.73			1.27
6	18	100.00			
7	5	100.00			
8	24	100.00			
9	5	100.00			
10	3	100.00			
11	14	85.71		7.14	7.14
12	7	100.00			
13	18	100.00			
14	240	96.67		0.42	2.92
15	6	100.00			
18	60	98.33			1.67
19	20	95.00			5.00
20	1	100.00			
25	2	100.00			
32	6	100.00			
Worker Total	621	97.58		0.48	1.93
		Worker 44			
2	2	100.00			
19	1	100.00			
24	282	83.69		0.35	15.96
25	31	96.77			3.23
26	1	100.00			
27	31	96.77			3.23
28	6	100.00			
30	1	100.00			
31	12	83.33		8.33	8.33
33	2			50.00	50.00

Table 72 (cont.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
35	6	83.33			16.67
36	4	100.00			
37	499	85.17	0.20	8.82	5.81
Worker Total	878	85.54	0.11	5.35	9.00
		Worker 45			
17	1	100.00			
18	1	100.00			
19	2	100.00			
24	14	78.57		14.28	7.14
25	1	100.00			
26	1	100.00			
27	7	71.43			28.57
28	55	98.18			1.82
29	23	86.96		13.04	
32	813	84.26		14.51	1.23
34	1	100.00			
35	6	66.67		16.67	16.67
Worker Total	925	84.97		13.41	1.62
		Worker 46			
24	17	88.24			11.76
25	3	100.00			
26	2	100.00			
27	26	96.15			3.85
28	357	86.27	1.68	7.28	4.76
29	21	85.71		9.52	4.76
30	5	100.00			
31	8	100.00			
32	1	100.00			
33	13	84.62			15.38
35	190	74.74		0.53	24.74
36	59	79.66		11.86	8.47
Worker Total	702	83.33	0.85	5.13	10.68

Table 72 (cont.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
		Worker 47			
24	299	79.60		0.33	20.07
25	4	100.00			
27	27	96.30			3.70
28	5	100.00			
29	3	100.00			
30	17	88.24		5.88	5.88
31	453	82.12	0.66	15.23	1.99
32	2	100.00			
33	1	100.00			
35	18	83.33		5.56	11.11
36	14	85.71			14.29
37	3	100.00			
Worker Total	846	82.27	0.35	8.51	8.87
		Worker 48			
24	14	92.86			7.14
25	9	100.00			
27	4	100.00			
29	8	62.50		37.50	
30	338	96.15		2.37	1.48
31	18	88.89		11.11	
36	10	90.00			10.00
Worker Total	401	95.01		3.24	1.75
		Worker 50			
1	333	79.28		8.11	12.61
2	42	95.24		4.76	
3	264	78.41		1.52	20.08
7	3	100.00			
13	3	100.00			
15	1	100.00			
18	12	100.00			
25	1	100.00			
36	15	93.33			6.67
Worker Total	674	80.86		4.90	14.24

Table 72 (cont.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
Worker 51					
1	8	100.00			
3	2	100.00			
4	3	100.00			
8	21	95.24		4.76	
18	1	100.00			
23	4	100.00			
24	227	92.95		0.88	6.17
25	52	100.00			
26	121	94.21		0.83	4.96
27	27	96.30			3.70
28	1	100.00			
30	262	97.71		1.14	1.14
31	241	96.68			3.32
32	15	73.33		13.33	13.33
36	1				100.00
37	2	100.00			
Worker Total	988	95.55		0.91	3.54
Worker 52					
1	22	100.00			
4	59	98.30			1.70
5	88	100.00			
6	50	100.00			
7	8	100.00			
8	21	90.48		4.76	4.76
9	3	100.00			
10	8	100.00			
13	5	100.00			
18	249	98.39			1.61
19	38	100.00			
23	6	100.00			
26	1	100.00			
Worker Total	558	98.75		0.18	1.08

Table 72 (cont.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoideble	Loafing
		%	%	%	%
Worker 53					
1	1	100.00			
4	4	100.00			
5	1	100.00			
6	12	100.00			
7	4	100.00			
8	610	91.15	0.82	0.98	7.05
9	344	95.64		0.58	3.78
10	83	98.80			1.20
11	50	90.00		2.00	8.00
13	1	100.00			
15	5	100.00			
19	2	100.00			
Worker Total	1,117	93.29	0.45	0.81	5.46
Worker 54					
1	141	73.05		3.55	23.40
2	157	91.08		0.64	8.28
3	307	74.27		2.93	22.80
5	1	100.00			
6	3	100.00			
9	7	85.71			14.29
13	1	100.00			
19	2	100.00			
25	1	100.00			
Worker Total	620	78.71		2.42	18.87
Worker 55					
1	8	87.50			12.50
4	15	93.33			6.67
5	61	90.16			9.84
6	1	100.00			
8	21	90.48			9.52
14	1	100.00			
18	7	85.71			14.29
Worker Totel	114	90.35			9.65

Table 72 (cont.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
		Worker 56			
1	32	93.75			6.25
4	76	86.84	1.32	1.32	10.53
5	370	90.27		0.27	9.46
6	90	96.67			3.33
7	14	92.86			7.14
8	143	93.01			6.99
9	13	92.31			7.69
10	3	100.00			
11	18	77.78		16.67	5.56
13	7	100.00			
15	14	100.00			
18	32	93.75			6.25
19	17	100.00			
20	1	100.00			
23	10	70.00		20.00	10.00
25	2	100.00			
Worker Total	842	91.45	0.12	0.95	7.48
		Worker 57			
8	3	100.00			
9	3	66.67		33.33	
10	1	100.00			
Worker Total	7	85.71		14.29	
		Worker 58			
1	2	100.00			
4	1	100.00			
5	1	100.00			
8	16	93.75			6.25
9	38	97.37		2.63	
10	8	100.00			
11	3	100.00			
18	26	100.00			
19	1	100.00			
Worker Total	96	97.92		1.04	1.04

Table 72 (cont.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
		Worker 59			
8	1	100.00			
9	4	100.00			
Worker Total	5	100.00			
		Worker 60			
1	6	83.33			16.67
4	4	100.00			
5	8	100.00			
14	2	100.00			
Worker Total	20	95.00			5.00
		Worker 61			
1	1	100.00			
4	1	100.00			
5	7	100.00			
8	22	100.00			
10	1	100.00			
Worker Total	32	100.00			
		Worker 62			
1	2				100.00
4	2	100.00			
5	8	100.00			
8	9	88.89			11.11
9	1	100.00			
Worker Total	22	86.36			13.64

Table 72 (cont.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
Worker 63					
1	2	50.00			50.00
Worker Total	2	50.00			50.00
Worker 71					
18	11	100.00			
19	903	93.13	0.11	0.66	6.09
20	1	100.00			
21	47	100.00			
24	3	100.00			
37	1	100.00			
Worker Total	966	93.58	0.10	0.62	5.69
Worker 77					
6	5	100.00			
8	1	100.00			
13	1	100.00			
19	4	100.00			
20	224	94.20		0.45	5.36
21	548	98.54		0.36	1.09
22	23	100.00			
25	10	100.00			
27	5	100.00			
32	5	100.00			
Worker Total	826	97.46		0.36	2.18
Worker 82					
15	2	100.00			
16	1	100.00			
18	4	100.00			
19	60	96.67			3.33

Table 72 (cont.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
32	225	75.11		22.67	2.22
33	37	70.27		18.92	10.81
34	2	50.00			50.00
35	22	90.91		4.55	4.55
36	2	100.00			
Worker Total	355	79.72		16.62	3.66
		Worker 83			
1	1	100.00			
4	4	75.00			25.00
5	2				100.00
9	7	85.71			14.29
11	20	90.00			10.00
Worker Total	34	82.35			17.65
		Worker 84			
17	1	100.00			
19	25	96.00			4.00
32	291	75.60		22.34	2.06
33	117	66.67		23.08	10.26
34	21	100.00			
35	32	87.50			12.50
Worker Total	487	76.39		18.89	4.72
		Worker 85			
15	12	91.67			8.33
16	2	50.00			50.00
17	4	100.00			
19	23	95.65			4.35
32	436	70.87	0.46	26.61	2.06
33	60	73.33		16.67	10.00
34	41	95.12		2.44	2.44
35	42	88.10		4.76	7.14
Worker Total	620	75.32	0.32	20.81	3.55

Table 72 (cont.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
Worker 86					
17	1	100.00			
18	29	100.00			
19	472	97.88	0.42		1.69
21	29	96.55		3.45	
26	1	100.00			
32	2	100.00			
35	1				100.00
Worker Total	535	97.76	0.37	0.19	1.68
Worker 88					
1	55	90.91		3.64	5.45
2	17	100.00			
3	105	80.95		2.86	16.19
6	5	100.00			
13	1	100.00			
33	1	100.00			
34	2	100.00			
Worker Total	186	86.56		2.69	10.75
Worker 91					
8	36	86.11			13.89
9	23	91.30			8.70
10	39	92.31		5.13	2.56
11	53	92.45			7.55
18	6	83.33			16.67
19	5	100.00			
35	8	75.00			25.00
36	7	71.43		14.28	14.28
Worker Total	177	89.27		1.69	9.04

Table 72 (cont.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
		Worker 92			
6	9	100.00			
8	19	89.47			10.53
9	21	85.71			14.29
10	26	92.31		3.85	3.85
11	62	90.32		1.61	8.06
24	1	100.00			
25	7	100.00			
28	2	100.00			
31	2	100.00			
32	52	90.38		9.62	
33	222	87.39		9.01	3.60
34	61	91.80		1.64	6.56
35	290	86.55	0.34	4.48	8.62
36	16	87.50		12.50	
Worker Total	790	88.35	0.13	5.44	6.08
		Worker 93			
20	117	95.73	0.85	0.85	2.56
21	651	96.16		2.15	1.69
Worker Total	768	96.09	0.13	1.95	1.82
		Worker 97			
3	13	92.31			7.69
6	2	100.00			
7	2	100.00			
12	4	100.00			
13	17	94.12			5.88
14	421	83.14		2.38	14.49
15	1	100.00			
19	6	100.00			
32	51	78.43		21.57	
36	2	100.00			
Worker Total	519	83.82		4.05	12.14

Table 72 (cont.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
		Worker 99			
1	37	72.97		2.70	24.32
2	10	90.00	10.00		
3	81	70.37		14.81	14.81
7	1				100.00
8	2	50.00			50.00
9	9	77.78			22.22
10	7	71.43		28.57	
11	36	91.67		5.56	2.78
13	4	100.00			
15	7	100.00			
19	1	100.00			
24	1	100.00			
25	1	100.00			
26	1	100.00			
27	17	100.00			
28	7	100.00			
29	9	77.78		22.22	
33	21	76.19		9.52	14.29
34	7	71.43			28.57
35	197	84.26		2.03	13.71
36	353	81.30	0.28	13.03	5.38
Worker Total	809	81.46	0.25	8.90	9.39
		Worker 100			
24	1	100.00			
25	2	100.00			
27	12	100.00			
28	1	100.00			
35	56	69.64		1.79	28.57
36	117	79.49		19.66	0.85
Worker Total	189	78.31		12.70	8.99

Table 72 (Concl.) Classification of work and delay by processes for a worker over all workers, plant A, August-September, 1957.

Process	Total observations	Productive	Delay		
			Avoidable	Unavoidable	Loafing
		%	%	%	%
		Worker 101			
1	6	100.00			
4	8	100.00			
5	41	97.56			2.44
6	24	100.00			
7	9	88.89		11.11	
8	6	100.00			
13	8	100.00			
14	1	100.00			
15	6	83.33			16.67
18	383	97.91		0.26	1.83
19	195	98.46	0.51		1.03
20	4	100.00			
21	47	97.87			2.13
23	8	75.00		25.00	
25	9	100.00			
26	1	100.00			
28	59	83.05		16.95	
30	19	94.74	5.26		
31	15	100.00			
32	1	100.00			
33	3	33.33			66.67
34	3	100.00			
35	45	91.11		2.22	6.67
36	3	100.00			
Worker Total	904	96.24	0.22	1.77	1.77
Total	26,532	89.27	0.17	4.55	6.02

APPENDIX III

Sample Survey Forms

Plant_____ Date_____

Interviewer_____ No. of Men Generally Assigned to Process_____

Department Receiving Process_____

Work Element	Worker	Productive	Delay			Observations
			Avoidable	Unavoidable	Loafing	
South Line:						
1. Opening Cans						
2. Grading						
3. Dumping						
4. Recording						
5. Sampling						
6. Can Washing						
7. Supplies						
8. Clean-up						
9. Set-up						
North Line:						
1. Opening Cans						
2. Grading						
3. Dumping						
4. Recording						
5. Sampling						
6. Can Wash						
7. Supplies						
8. Clean-up						
9. Set-up						

Plant_____ Date_____

Interviewer_____ No. of Men Generally Assigned to Process_____

Department Glass Bottling

Product_____

Work Element	Worker	Productive	Delay			Observations
			Avoidable	Unavoidable	Loafing	
Operation:						
1. Supplies						
2. Hook-up						
3. Change Over						
4. Operation						
5. Clean-up						
Casing In:						
1. Picking						
2. Case Selection						
3. Change Over						
4. Clean-up						

Plant_____ Date_____

Interviewer_____ No. of Men Generelly Assigned to Process_____

Department Dryer

Product_____

Work Element	Worker	Productive	Delay			Observations
			Avoidable	Unavoideble	Loafing	
1. Set-up						
2. Process						
3. Change Over						
4. Clean-up						
5. Plent Maint.						
6. Equip. Maint.						

APPENDIX IV

Cold Room Refrigeration Requirements

The total refrigeration requirements of the two cold rooms and the ice cream hardening room were calculated from standard engineering data using standard heat loss allowances. Both cold rooms assumed an outside temperature of 80° F. and an inside temperature of 35° F. The ice cream hardening room assumed an outside temperature of 80° F. and an inside temperature of -20° F.

North Cold Room. The north cold room had a floor area of 880 square feet and a total surface area of 2,730 square feet. The total refrigeration requirement was 9,850 Btu. per hour, and the requirement per case of products handled was estimated at 189 Btu. per case.

South Cold Room. The south cold room had a floor area of 1,075 square feet and a total surface area of 3,640 square feet. The total refrigeration requirement was 13,100 Btu. per hour, and the requirement per unit of product handled was estimated at 164 Btu. per unit.[1]

Ice Cream Hardening Room. The ice cream hardening room had a floor area of 215 square feet, and a total surface area of 980 square feet. The heat lost required a total of 4,900 Btu. per hour or 26.3 Btu. per gallon of ice cream stored when the hardening room was filled to capacity. The hardening of ice cream from an incoming temperature of 24° F. to -20° F. required an estimated 425 Btu. per gallon of ice cream.

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[1] One unit was defined as one-half of a 62-pound basket or 64-pound box of butter, one-half case of orange or grape drink, one 10-gallon can of ice cream mix, one 10-gallon can of cottage cheese, and five gallons of condensed milk.

LABOR INPUT REQUIREMENTS AND EFFICIENCY OF A MULTI-PRODUCT DAIRY PROCESSING PLANT AS DETERMINED BY A RATIO-DELAY ANALYSIS

by

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Historically, surpluses rather than shortages have dominated milk markets in the United States.[1] As these markets continue to grow, it appears that the volume of surplus milk will grow with them, thus causing many problems in the marketing of surplus milk. As a result of these problems, a North Central Regional Committee on Dairy Marketing Research has undertaken a study to determine the most efficient method of handling surplus milk under different market structures. As a part of this general study, the Department of Agricultural Economics of the Kansas Agricultural Experiment Station selected one large multi-product dairy processing plant (plant A) handling the largest portion of surplus milk under a large Federal Order market for a detailed cost of production study. As a part of the cost of production study, this thesis was primarily concerned with the labor input requirements of plant A.

The most significant contribution of this study was the derivation of fixed and variable labor coefficients for all operations in plant A. It is believed that this study was the first to combine all operations of a multi-product dairy processing plant. As a part of a linear programming problem, these coefficients can be used as data to help determine the optimum combination of products to produce in plant A.

The methodology used to determine the labor input requirements was a random-observation, time-study technique. This technique, termed ratio-delay, is a relatively new and highly practical statistical technique for determining the percentage of time workers are productive or delayed. The ratio of the number of observations falling into particular labor classifications to the total number of observations taken in all labor classifications was assumed to

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[1] In a general way, surplus milk is defined as that part of the fluid milk supply not consumed as fluid milk.

be proportional to the amount of time expended in each of these labor classifications. Under this assumption, fixed and variable labor requirements in minutes per unit of product were determined by skill classes for each process in plant A.[2]

Although major emphasis of this study was placed on labor, the utility requirements were also given. Each piece of equipment in each process was identified as to name, model, serial number, capacity, and utility requirements (whenever possible) by inspecting the manufacturer's plate on each piece of equipment, by examining plant A's equipment cards, and by direct correspondence with the manufacturers. Steam and refrigeration requirements were given in Btu's per unit of product for each process, and the electrical requirements were given in kilowatts per hour of machine running time. These requirements were calculated at a given level of efficiency for each piece of equipment; therefore, the requirements might be considered about "normal" for most operations in plant A.

The ratio-delay analysis was also used to provide information to evaluate the relative labor efficiency of workers in each process and the relative labor efficiency among the various processes. The over-all labor efficiency of plant A was considered adequate. A total of all workers in all processes were observed productive approximately 90 per cent of the time. This figure is apparently higher than those of other studies related to dairy processing plants because workers in this study were not observed during the two allowable 15 minute breaks and while attending to personal needs.

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[2] Processes were defined as a complete operation performed on a product, and employees were classified into four skill classes according to their ability and experience.

Receiving raw products, handling products in the cold room, and handling returned cases and bottles were the only processes in plant A that were considered grossly inefficient with respect to labor. The ratio-delay analysis also showed that individual workers were much more productive when performing certain tasks than when performing others. This suggested that the over-all labor efficiency of plant A probably could have been improved by relocating workers to jobs where they were apparently more efficient.

The labor requirements and efficiency analysis were considered applicable for plant A; beyond this, no inference is intended. It is believed that through a synthesis of many studies of this nature, standard input requirements and operating efficiency can be determined for most operations in dairy processing plants. Those standards might then be used as a general guide to evaluate the efficiency of various operations in a particular dairy processing plant. The standards might also be used as a basing point to compare the relative labor efficiency of various operations in dairy processing plants over various periods in time.

This study also demonstrated the practicability of a ratio-delay analysis in dairy processing plants. In the first place, it made evident the decision making points in the flow of products through the plant. It required management to precisely define each man's job or jobs and to become more familiar with each operation. It proved to be a much more accurate method of assigning costs to particular operations than the cost accounting techniques used by many plants. The study required a minimum of time and cost, and it produced no apparent ill effects on the workers or operation of plant A during the study period.