July 1983

A.E. Res. 83-29

An Analysis of Milk Receiving Practices

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PREFACE

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Financial support for this project was provided by the New York State Department of Agriculture and Markets, Division of Dairy Industry Services. We wish to thank Herbert Kling, Ron Pearce and Lyle Newcomb for their continued support throughout this project.

We owe a special thanks to Robert Forsythe and Thomas Decker of Northeast Dairy Cooperative Federation, Inc. for their kind assistance during the data collection phase of the study, and to all the truck drivers who graciously participated in the study. We also appreciate the efforts of William Shope and Deborah Figliola who served as field enumerators. Finally, we extend our thanks to Robin Greenhall for her diligence and patience in typing this report.

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SECTION I

INTRODUCTION AND METHODOLOGY

Introduction

As milk transportation costs continue to increase, transport efficiency will receive greater attention. Current inefficiencies in milk assembly are due to several factors: under-utilization of vehicles, poor route management and little coordination between farmers, cooperatives, haulers and handlers. Probably the most visible inefficiency is milk hauling delays. Delays occur at the farm, on the road and at the plant, but plant delays are particularly common and frustrating for milk haulers.

The purpose of this study was to increase our understanding of the milk receiving process and to determine whether or not receiving operations at balancing plants are a major source of inefficiency in the milk assembly system. Specific objectives included:

1) To conduct a time study of plant receiving operations,

2) To compare milk receiving practices between periods of high and low milk production,

3) To identify problems and possible causes of truck delays at receiving plants, and

4) To suggest management alternatives to improve the efficiency of plant receiving operations.

Methodology

This time study was carried out at one receiving plant; Northeast Dairy Cooperative Federation's (NEDCO's) Middlebury Center plant located outside of Middlebury Center, Pennsylvania.

Observations were made during two four-day periods. The first period of data collection was June 23-26, 1981. This represented a period of high milk production, since it was about three weeks after the plant handled its maximum volume of milk for the year. Information on receiving practices was also collected for January 8-11, 1982. This was a period of relatively low milk production. A copy of the survey form used is presented in Appendix A.

During the course of the study receiving and unloading operations were timed by field enumerators. In addition, drivers were asked to supply route information on each load. General information concerning seasonal variations in pick-up routes, waiting time, rest stops, and common hauling obstacles was also obtained.

The number of trucks and loads involved in the study are presented in Table 1. Each day some trucks had two loads. The number of loads observed on the last day of each period did not represent all the loads received at the plant on those days. Data collection ceased late in the afternoon on the last day of each period before all trucks had arrived at the plant. Moreover, in January poor weather conditions delayed the normal arrival schedule. However, there is no reason to believe additional data would have changed the conclusions of this study.

TABLE 1. Number of Trucks and Loads Observed, By Day, June 1981 and January 1982, One Plant.

	June 1981		January 1982	
Day	Number of Trucks	Number of Loads	Number of Trucks	Number of Loads
1	15	19	11	15
2	14	19	11	13
3	14	19	12	15
4	13	18	8	9
TOTAL		75		52

Each stage of the receiving and unloading process was timed to the nearest minute, except for sample and wash times. Due to the physical difficulty of monitoring these functions observations on sample and wash time are accurate to four and three minutes, respectively. The quality of route information supplied by truck drivers was thought to be generally very good. While the following data is not meant to illustrate typical receiving operations in the dairy industry, the data does provide a good basis for identifying common problems and their causes.

For the purposes of this study the receiving operation was divided into several discrete steps. Those steps are illustrated in Exhibit 1. Times were recorded for the beginning and/or end of each stage of the process. Subtracting the time of subsequent observations resulted in the number of minutes devoted to each step in the receiving process. For example, by subtracting the time the vehicle started the load (Exhibit 1) from the time the truck left the last farm results in the time the vehicle devoted to milk assembly. Times were computed for each of the following functions: milk assembly, delivery to the plant, waiting in the plant yard, bay entry, pumping, wash preparation, washing, bay exit, and plant departure.

Five additional times were also calculated: route time, arrival wait time, departure wait time, bay occupancy time and plant time. Route time is merely the sum of assembly time and delivery time.

Arrival wait time is designed to be an approximate measure of unnecessary wait time upon arrival. It was computed by subtracting weigh-in time and sample time from plant yard time and bay entry time. It is only an approximate measure of unnecessary wait time because arrival wait time also includes the time it takes to back into the bay and attach the pump. Departure wait time was also

EXHIBIT 1. Information Collected and Computed

Observation Times	Receiving Function	Additional Times
Start Load [1]		
	Assembly Time	Route Time
Leave Last Farm [1]		
	Deliver Time	
Arrive at Plant		
(Weigh-In Time) [2]	Plant Yard Time	Arrival Wait Time
Enter Bay		
(Sample Time) [2]	Bay Entry Time	
Start Pump		
	Pump Time	Bay Occupancy Time
Stop Pump		
	Wash Preparation Time	
Start Wash		
	Wash Time	
Stop Wash		
	Bay Exit Time	
Leave Bay		Departure Wait Time
(Weigh-Out Time) [2]	Plant Departure Time	
Leave Plant		

Plant Time: Arrive at Plant through Leave Plant.

[1] These times were obtained from truck drivers.

[2] These times were subtracted when computing wait times.

meant to be an approximate measure of unnecessary wait time. It was calculated by subtracting weigh-out time from the sum of bay departure time and plant departure time. It is approximate because departure wait time includes the time it takes to remove the wash equipment, leave the bay and drive out of the plant yard.

Bay occupancy time indicates the amount of time vehicles spent in the bay. The plant studied had two receiving bays and bay occupancy can be considered a measure of bay utilization.

Plant time represents the length of time each vehicle spent at the plant - the interval between entering and leaving the plant yard. It includes the time it took to perform all receiving functions at the plant, as well as any waiting time.

During both observation periods several trucks had two daily routes. When a vehicle had two routes the same day its tank was not washed after the first load. Consequently there were no observations for the start and stop of the wash for the first loads. In those cases bay exit includes the time from when the pump was turned off until the truck left the bay.

Load and Truck Characteristics

The characteristics of milk loads and vehicles varied somewhat between the two observation periods. These factors had an impact on the time it took to perform certain receiving operations.

Number of Stops Per Load

In June, the average number of farm stops per load was 10.5 compared to 12.5 in January. This primarily reflects the increased production per farm during the summer flush. The greater the number of farm stops per load, the longer it is likely to take to assemble a load.

Miles Per Load

The number of miles traveled per load also exhibited a significant difference between the two periods. In June, vehicles averaged 81.8 miles per load compared to 95.4 miles per load in January. Miles per load will probably be directly related to delivery time.

Pounds Per Load

The pounds of milk transported per load did not vary very much between the two periods. In June, loads average 31,370 pounds of milk and in January they averaged 31,580 pounds. Pump time will likely increase as load size increases.

Truck Types

During the four day period in June, six of the loads arrived in 6,000 gallon tractor trailer vehicles. The other 69 loads were hauled on straight chassie vehicles. In January, only three of the vehicles were 6,000 gallon tractor trailers while 49 were straight chassie trucks. The average tank size of straight chassie vehicles in both periods was 4,000 gallons.

SECTION II

RESULTS

Discussion of the results of this study is divided into three parts. The first part consists of presenting summary data on each step in the receiving process. The second part of this section is devoted to analyzing arrival wait time, departure wait time, bay occupancy time and total plant time. The last part summarizes a few qualitative aspects of the receiving process.

Analysis of Steps in the Receiving Process

Assembly Time

Assembly time was defined as the interval between when the vehicle started its load by leaving the garage or plant until it left the last farm on the route. In this study, assembly time included driving time to the first farm, which in most hauling studies is typically not classified a part of assembly time. This difference in terminology was not considered a major problem due to this study's emphasis on receiving operations. The distribution, average and range of assembly times per load are presented in Table 2.

TABLE 2. Assembly Time Per Load: Distribution, Average and Range, June 1981 and January 1982, One Plant.

Time Per Load	June	January
Distribution (minutes)		
100-150	7	1
151-200	12	4
201-250	16	13
251-300	13	16
301-350	7	7
351-400	7	2
401-450	4	4
451+	0	2
Unknown	9	3
TOTAL (vehicles)	75	52
AVERAGE (minutes)	259	281
RANGE (minutes)		
Highest	450	480
Lowest	105	150

In June, average assembly time was 259 minutes (4 hours and 19 minutes), while in January it amounted to 281 minutes (4 hours and 41 minutes). The longer assembly time in January reflects the fact that, on average, trucks were visiting two more farms in January than in June.

Delivery Time

Delivery time represented the time it took to travel from the last farm to the plant. In June, average delivery time was 53 minutes, and in January, it was 69 minutes (Table 3). During periods of high milk production haulers apparently completed their loads nearer the plant. This may be due in part to the fact that there are more loads during peak production and greater opportunity to finish a load at a relatively near-by farm. This conclusion is supported by the fact that the average vehicle traveled a longer distance in January (95 miles versus 82 miles in June). However, poor weather conditions also contributed to the longer delivery times in January.

TABLE 3. Delivery Time Per Load: Distribution, Average and Range, June 1981 and January 1982, One Plant.

Time Per Load	June	January
Distribution (minutes)		
1-10	3	3
11-20	14	6
21-30	12	5
31-40	8	9
41-50	9	8
51-60	4	0
61-70	1	4
71+	15	17
Unknown	9	3
TOTAL (vehicles)	75	52
AVERAGE (minutes)	53	69
RANGE (minutes)		
Highest	257	488
Lowest	5	1

Route Time

Route time involves the time it takes to pick-up and to transport a load of milk to the plant. It consists of two components - assembly time and delivery time. In other words, it represents the interval from the time the load was started, whether at the garage or the plant, until the load arrived at the plant. Data on route time is presented in Table 4.

In June, route time averaged 310 minutes (5 hours, 10 minutes) compared to 350 minutes (5 hours, 50 minutes) in January. Route time was longer in January because both assembly and delivery time were greater in January. In January, trucks on average picked up two more farms per load and traveled more miles to complete each load. The extra mileage probably meant trucks completed their loads further from the plant.

TABLE 4. Route Time Per Load: Distribution Average and Range, June 1981 and January 1982, One Plant.

Time Per Load	June	January
Distribution (minutes)		
100-200	14	1
201-250	11	3
251-300	9	14
301-350	12	13
351-400	8	5
401-450	5	5
450-500	5	4
501+	4	7
Unknown	7	3
TOTAL (vehicles)	75	52
AVERAGE (minutes)	310	350
RANGE (minutes)		
Highest	572	653
Lowest	143	193

Plant Yard Time

This is the amount of time that elapses from when the truck arrives at the plant until it enters the bay. In June, average plant yard wait time was 24 minutes. In January it was 35 minutes. The distribution, average and range of plant yard time per load are illustrated in Table 5.

It is somewhat surprising to find plant yard time longer in January (the low production period) than in June (during the flush). Closer examination of the data suggests a possible explanation (Table 6). During the off-peak period (January) there was a greater bunching of vehicle arrivals - more trucks arrived at the plant at approximately the same time. In June, there was only one half-hour period when three vehicles arrived at the plant. 1/ In January, by

1/ The Middlebury Center plant had 2 unloading bays. Trucks spent an average of 53 to 59 minutes per load in the unloading bay. Consequently, three vehicles in one half hour period is a good indicator of waiting problems.

TABLE 5. Plant Yard Time Per Load: Distribution, Average and Range, June 1981 and January 1982, One Plant.

Time Per Load	June	January
Distribution (minutes)		
1-10	30	28
11-20	8	1
21-30	11	4
31-40	6	0
41-50	6	2
51-60	0	5
61+	7	12
No Data	7	0
TOTAL (vehicles)	75	52
AVERAGE (minutes)	23.5	35.3
RANGE (minutes)		
Highest	137	265
Lowest	1	2

TABLE 6. Vehicle Arrival Time During Four Days, June 1981 and January 1982, One Plant.

Time of Day	June, Days Observed (Number of Vehicles)				January, Days Observed (Number of Vehicles)			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th
before 9:00 am	1	1	1	1	1	1	1	
9:00	1		1					
10:00		2		1				
11:00	2	1	2	2	1		1	1
12:00 noon			1		1	1	1	3
12:30 pm	2	1				1		1
1:00		1	1	1	2			
1:30	2	1	2			1		
2:00					1			
2:30	2	1	1	1		1	1	
3:00	1	2	3	2	3		2	
3:30	2	1	1	1		1		1
4:00	1	2	1	1			3	
4:30	1	1	1	1			2	1
5:00	2	1	1	2	2	1		
5:30	1	2	2	1	1		3	1
6:00				2	3	3		1
6:30	1	1		1		2		
after 7:00 pm	—	1	1	1	—	1	1	—
TOTAL	19	19	19	18	15	13	15	9

comparison, there were six half hour periods with three truck arrivals. It appears that during periods of high milk production and more truck arrivals, milk haulers made a greater effort to informally schedule their routes to reduce waiting time at the plant.

Weigh-In Time

Upon arrival at the plant, trucks weigh-in. The time required for this operation varied between one and five minutes (Table 7) and averaged 2.3 minutes in June and 2.6 minutes in January.

TABLE 7. Weigh-In Time Per Load: Distribution and Average, June 1981 and January 1982, One Plant.

Time Per Load	June	January
Distribution (minutes)		
1	4	2
2	44	27
3	22	15
4	2	7
5	0	1
Unknown	3	0
TOTAL (vehicles)	75	52
AVERAGE (minutes)	2.3	2.6

Bay Entry Time

Bay entry time was the interval from when the vehicle started to enter the bay until the pump was started. Some of this time was spent backing in to the bay and hooking up the pump. For many trucks it also included time spent waiting for the milk test to be completed. The characteristics of bay entry time are illustrated in Table 8. Average bay entry times was nearly the same in both periods - 18.6 and 18.5 minutes for June and January, respectively.

Sample Time

Sample time represented the time spent waiting for completion of the antibiotic test. Some samples were submitted after the truck had backed into the bay, but in other instances the sample was submitted while the vehicle was waiting in the plant yard. The procedure followed depended on whether or not other trucks occupied the bays. Average sample time was 24.5 minutes in June and 24.1 minutes in January (Table 9).

TABLE 8. Bay Entry Time: Distribution, Average and Range, June 1981 and January 1982, One Plant.

Time Per Load	June	January
Distribution (minutes)		
1-10	29	19
11-20	6	7
21-30	18	19
31-40	12	6
41-50	3	1
51+	0	0
No Data	7	0
TOTAL (vehicles)	75	52
AVERAGE (minutes)	18.6	18.5
RANGE (minutes)		
Highest	50	44
Lowest	1	2

TABLE 9. Sample Time: Distribution, Average and Range, June 1981 and January 1982, One Plant.

Time Per Load	June	January
Distribution (minutes)		
0	4	0
1-14	6	0
15-19	5	11
20-24	14	17
25-29	15	13
30-34	2	4
35+	6	7
Unknown	27	0
TOTAL (vehicles)	75	52
AVERAGE (minutes) 1/	24.5	24.1
RANGE (minutes) 1/		
Highest	50	48
Lowest	12	15

1/ Of those sampled at plant

In June there was difficulty determining the time it took to complete the sample. When there was a question about the accuracy of the observation, it was not included in the analysis. Also in June, four loads were tested prior to leaving another facility and the results of the sample were phoned to the plant. Consequently these loads were not tested at the receiving plant.

Pump Time

Pump time was from when the pump was started until the pump was stopped. Pump time averaged 17.4 minutes in June, and 18.4 minutes in January (Table 10). The slightly longer time in January was probably due to slightly larger loads (31,600 lbs. in January vs. 31,400 lbs. in June) during that period.

TABLE 10. Pump Time: Distribution, Average and Range, June 1981 and January 1982, One Plant.

Time Per Load	June	January
Distribution (minutes)		
1-14	13	4
15-16	16	14
17-18	14	14
19-20	10	8
21-22	7	6
23-24	1	4
25-26	2	1
27+	2	1
No Data	9	0
TOTAL (vehicles)	75	52
AVERAGE (minutes)	17.4	18.4
RANGE (minutes)		
Highest	44	37
Lowest	9	13

Wash Preparation Time

The time from when the pump was shut off until the wash was started was defined as wash preparation time. It was devoted to unhooking the pump and preparing for the wash.

Vehicles that had more than one load per day did not wash out their tanks after the first load. It took an average of 2.2 minutes in June and 3.2 minutes in January to prepare to wash the tank (Table 11). One possible explanation for this variation is that haulers felt more time pressure during the flush period than during the period of low milk production.

TABLE 11. Wash Preparation Time: Distribution, Average and Range, June 1981 and January 1982, One Plant.

Time Per Load	June	January
Distribution (minutes)		
No Wash	21	17
1-2	26	24
3-4	7	4
5-6	4	2
7-8	2	1
9+	3	4
No Data	12	0
TOTAL (vehicles)	75	52
AVERAGE (minutes)	2.2	3.2
RANGE (minutes)		
Highest	25	15
Lowest	1	1

Wash Time

Wash time varied significantly between the two periods. In June, average wash time was 14.9 minutes compared to 20.0 minutes in January (Table 12). The two periods also exhibited significantly different distributions of wash time. In June, one-half of the tanks washed were completed in 15 minutes. However, in January it took 18-21 minutes to wash over two-thirds of the tanks.

Perhaps the larger number of trucks handled during the peak production period encouraged less time being spent on washing tanks. There was no way to determine if the shorter time spent washing tanks in June had a negative impact on milk quality. If not, there may be an opportunity to improve the efficiency of milk hauling by hastening the wash phase.

Bay Exit Time

Bay exit time was defined as the interval from completion of the wash until the trucks left the unloading bay. For those vehicles that did not wash their tanks it was the time from when the pump was shut off until the truck left the bay.

In June, bay exit time averaged 5.1 minutes and in January it averaged 6.3 minutes. In both cases the minimum time was 1 minute and the maximum time 24 minutes (Table 13).

TABLE 12. Wash Time: Distribution, Average and Range, June 1981 and January 1982, One Plant.

Time Per Load	June	January
Distribution (minutes)		
No wash	21	17
1-15	21	2
16-17	2	5
18-19	7	10
20-21	3	14
22-23	5	2
24+	4	2
No Data	12	0
TOTAL (vehicles)	75	52
AVERAGE (minutes) 1/	14.9	20.0
RANGE (minutes) 1/		
Highest	37	38
Lowest	4	14

1/ Does not include tanks not washed.

TABLE 13. Bay Exit Time: Distribution, Average and Range, June 1981 and January 1982, One Plant.

Time Per Load	June	January
Distribution (minutes)		
1-5	46	28
6-10	11	20
11-15	3	1
16-20	1	2
21-25	1	1
26+	0	0
No Data	13	0
TOTAL (vehicles)	75	52
AVERAGE (minutes)	5.5	6.3
RANGE (minutes)		
Highest	24	24
Lowest	1	1

Weigh-Out Time

Each truck weighed-out after leaving the bay. Average weigh-out times were nearly identical for both periods. In June it was 2.2 minutes and in January it was 2.3 minutes (Table 14).

TABLE 14. Weigh-Out Time: Distribution and Average, June 1981 and January 1982, One Plant

Time Per Load	June	January
Distribution (minutes)		
1	5	13
2	25	19
3	7	14
4	4	6
5	0	0
No Data	34	0
TOTAL (vehicles)	75	52
AVERAGE (minutes)	2.2	2.3

Plant Departure Time

Plant Departure time included the time from when the truck left the bay until it left the plant yard. Some vehicles parked at the plant over night, and they were not included.

In June, average plant departure time was 2.6 minutes and in January it was 4.7 minutes (Table 15). The higher January average was influenced by two vehicles that waited 34 and 71 minutes to leave the plant yard.

TABLE 15. Plant Departure Time: Distribution, Average and Range, June 1981 and January 1982, One Plant.

Time Per Load	June	January
Distribution (minutes)		
1-2	36	25
3-4	17	16
5-6	1	3
7+	2	2
No Data	19	6
TOTAL (vehicles)	75	52
AVERAGE (minutes)	2.6	4.7
RANGE (minutes)		
Highest	10	71
Lowest	1	1

Analysis of Receiving Operations

The purpose of this section is to evaluate specific phases of the receiving operation. Items discussed include: arrival wait time, departure wait time, bay occupancy time and total plant time.

Arrival Wait Time

Arrival wait time was designed as an approximate measure of unnecessary wait time spent upon arrival at the plant. It consists of four components: a) plant yard time, b) weigh-in time, c) bay entry time and, d) sample time. Arrival wait time was determined by subtracting weigh-in time and sample time from plant yard time and bay entry time.

Arrival wait time was meant to indicate idle time at the plant that could be reduced and almost eliminated through improved receiving practices. Arrival wait time averaged 15.9 minutes in June and 28.1 minutes in January (Table 16). The sole factor responsible for the longer wait time in January was plant yard time. This is illustrated in the summary of arrival wait time (Table 17).

TABLE 16. Observed Arrival Wait Time: Distribution, Average and Range, June 1981 and January 1982, One Plant.

Time Per Load	June	January
Distribution (minutes)		
0-10	27	27
11-20	10	7
21-30	6	1
31-40	0	4
41-50	1	1
51-60	2	6
61+	2	6
No Data	27	0
TOTAL (vehicles)	75	52
AVERAGE (minutes)	15.9	28.1
RANGE (minutes)		
Highest	150	226
Lowest	0	0

Both computed and observed average arrival wait time are presented in Table 17. Computed average wait time is based on the averages of each individual step in the arrival process (Tables 5 and 7-9). Observed average wait time is the average of all vehicles for which there was a complete set of data on all four components of arrival wait time (Table 16). There is a slight difference in the two numbers because the averages of each component of computed arrival wait time had a different number of observations. One conclusion, however, is very clear. Waiting time at the plant appears to be more serious during periods

TABLE 17. Computed and Observed Average Arrival Wait Time: June 1981 and January 1982, One Plant.

	June	January
	----------minutes----------	
Average Plant Yard Time	23.5	35.3
Average Weigh-In Time	-2.3	-2.6
Average Bay Entry Time	18.6	18.5
Average Sample Time	-24.5	-24.1
Computed Average Arrival Wait Time	15.3	27.1
Observed Average Arrival Wait Time	15.9	28.1

of low milk production (January) than high milk production (June). There is no reason to expect this plant is any different than similar facilities in the milk industry.

While is should be possible to reduce average arrival wait time to only a few minutes, the data indicates that arrival waiting time at this plant is not as serious a problem as it is reported to be at some balancing operations. The short wait time during the flush period is commendable, especially since the plant does not formally schedule plant arrivals.

Departure Wait Time

Departure wait time was calculated by subtracting weigh-out time from bay exit time and plant departure time. The number was determined in two ways. The first method consisted of calculating the average wait time over all vehicles. The results were termed observed average departure wait time and are reported in Table 18.

TABLE 18. Departure Wait Time: Distribution, Average and Range, June 1981 and January 1982, One Plant.

Time Per Load	June	January
Distribution (minutes)		
0-5	43	25
6-10	11	22
11-30	8	3
31-60	0	1
61+	2	1
No Data	19	6
TOTAL (vehicles)	75	52
AVERAGE (minutes)	5.9	9.0
RANGE (minutes)		
Highest	28	89
Lowest	1	0

The second method, called computed average departure wait time, is the sum of the averages of each individual step in the departure process (Table 13-15). The results are summarized in Table 19.

TABLE 19. Computed and Observed Average Departure Wait Time: June 1981 and January 1982, One Plant.

	June	January
	(minutes)	
Average Bay Exit Time	5.1	6.3
Average Weigh-Out Time	-2.2	-2.3
Average Plant Departure Time	2.6	4.7
Computed Average Departure Wait Time	5.5	8.7
Observed Average Departure Wait Time	5.9	9.0

Wait time averaged 5.5 to 5.9 minutes in June and 8.7 to 9.0 minutes in January, depending on the method used. While there was some difference in the results of the two methods it was relatively insignificant and due to the lack of weigh-out times on all vehicles.

Departure wait time was much less than arrival wait time. However, like arrival wait time, departure wait time was greater in January than in June. Some of this was due to preparation for winter driving, but it is unlikely the entire difference can be attributed to this factor.

Bay Occupancy Time

Bay occupancy time was defined as the interval from when vehicles entered the bay until they left the bay. It was the sum of: bay entry time, pump time, wash preparation time, wash time and bay exit time. Bay occupancy time was calculated for both those vehicles that washed their tanks and those that did not wash their tanks. The distribution, average, and range of bay occupancy times are presented in Table 20.

Bay occupancy for all vehicles averaged 53.0 minutes in June and 58.6 minutes in January. On average, vehicles were in the bay 5.6 minutes longer in January than in June. In January, vehicles that washed their tanks were responsible for the longer average time spent in the bay since the trucks that did not wash their tanks were in the bay a shorter period than similar vehicles in June.

Plant Time

Plant time was defined as the amount of time the vehicle was at the plant - from the time it arrived until it departed. Again, this was derived in two ways. First, by finding the average time for all vehicles that had complete component of plant time, and second by adding the averages of each component of plant time. The former was called observed average plant time and the latter was termed computed average plant time.

TABLE 20. Bay Occupancy Time: Distribution, Average and Range, Four Days in June 1981 and January 1982, One Plant.

Time Per Load	June Vehicles with Tanks: Not Washed	June Vehicles with Tanks: Washed	June Total	January Vehicles with Tanks: Not Washed	January Vehicles with Tanks: Washed	January Total
Distribution (minutes)						
1-30	2	0	2	5	0	5
31-40	1	7	8	2	0	2
41-50	10	11	21	5	7	12
51-60	6	10	16	2	7	9
61-70	2	7	9	3	8	11
71-80	0	2	2	0	8	8
81+	0	5	5	0	5	5
No Data	-	-	12	-	-	0
TOTAL (vehicles)	21	42	75	17	35	52
AVERAGE (minutes)	47.5	57.0	53.0	43.6	65.9	58.6
RANGE (minutes)						
Highest	68	98	98	67	109	109
Lowest	20	31	20	22	43	22

The distribution, average and range of observed average plant times for individual vehicles is presented in Table 21.

TABLE 21. Plant Time: Distribution, Average and Range, June 1981 and January 1982, One Plant

Time Per Load	June	January
Distribution (minutes)		
1-50	10	5
51-70	17	9
71-90	22	15
91-110	7	6
111-130	5	8
131+	3	9
Unknown	11	0
TOTAL (vehicles)	75	52
AVERAGE (minutes)	77.2	98.0
RANGE (minutes)		
Highest	175	309
Lowest	29	25

Average plant time is summarized in Table 22. Plant time averaged 77-79 minutes in June and 98-101 minutes in January depending on the methods used. With both methods, plant time averaged 27 percent (about 21 minutes) higher in January than in June, despite less milk being handled in January.

TABLE 22. Computed and Observed Average Plant Time: June 1981 and January 1982, One Plant.

Breakdown of Plant Time	June	January
	(minutes)	
Plant Yard	23.5	35.3
Bay Entry	18.5	18.6
Pump Time	17.4	18.4
Wash Hook-Up	2.1	3.2
Wash Time 1/	10.0	14.4
Bay Exit	5.1	6.3
Departure Time	2.6	4.7
Computed Average Plant Time	79.2	100.9
Observed Average Plant Time	77.2	98.0

1/ Wash time was adjusted for the proportion of tanks washed, by multiplying average wash time by the percentage of vehicles washed. In June 66.7 percent (42 of 63) were washed and in January 67.3 percent (35 of 52) were washed.

The primary sources of the additional plant time in January were time spent waiting in the plant yard (11.8 minutes more), washing time (4.4 minutes more) and departure time (2.1 minutes more). However, it should be noted that, on average, all unloading operations took longer in January than June. Consequently, the data suggest there was a tendency to improve the efficiency of all unloading functions in June, when the milk hauling and processing system was operating near full capacity.

Summary

One of the primary purposes of this study was to determine whether or not receiving operations are a major source of inefficiency in the milk hauling system. The cause of the inefficiencies would be unnecessary wait time at the plant. The study employed two measures of unnecessary wait time: arrival wait time and departure wait time. These measures are summarized in Table 23 where both computed and observed average wait times are presented.

TABLE 23. Computed and Observed Average Wait Time: June 1981 and January 1982, One Plant

Time Per Load (minutes)	June, Average		January, Average	
	Computed	Observed	Computed	Observed
Arrival Wait Time	15.3	15.9	27.1	28.1
Departure Wait Time	5.5	5.9	8.7	9.0
TOTAL	20.8	21.8	35.8	37.1

These are only approximate measures and may overstate unnecessary wait time for the reasons previously discussed. However, they do suggest that vehicles and drivers do spend considerable idle time at the plant. In June it amounted to 21-22 minutes and in January it averaged 36-37 minutes. While these numbers may seem insignificant, excessive wait time represented about 27 percent of total plant time in June and 36 percent of total plant time in January.

Additional Observations

While collecting time data on receiving operations it was possible to obtain information on other aspects of the receiving process.

Unplanned Arrivals

During the January phase of the study, three unplanned loads were accepted at the plant. Two of these loads were rejected from a fluid milk plant, and the other came because its normal route was blocked by heavy snow. Unplanned arrivals caused excessive waiting time for vehicles regularly delivering milk to this plant. One method to improve the efficiency of the receiving system may be to formally structure the way unplanned arrival are handled.

Plant Shut-Downs

When the supply of milk became low the plant was forced to shut-down. This situation was a costly one because machinery and labor remained idle until sufficient milk was received to start the plant again. The problem could be avoided if the flow of milk into the plant was more systematically scheduled.

Too Much Milk

Occasionally, too much milk was received at the plant. When additional storage capacity was unavailable, trucks were used as temporary storage facilities. Once again, this situation could be reduced or avoided if milk inflows were allocated throughout the day in a more systematic fashion.

Extended Night Operations

It took 4 hours to clear, wash, and rinse the milk lines after the last vehicle was unloaded. If the last load of the night arrived late, workers could not leave the plant until 4 or 5 a.m. These late hours represented a substantial increase to normal labor expenses. Since late arrivals were often due to unforeseen and uncontrollable circumstances, there is probably little that can be done to prevent them. However, management should constantly keep in mind the cost of extended operations.

Driver Attitudes Toward Waiting Time

Drivers did not appreciate long waits at the plant. Although they were paid for this idle time, most drivers indicated they would rather be doing something else. They also seemed to accept waiting time as a "fact of life," and felt that farmers would be resistant to any proposed scheduling plan. If new procedures to reduce waiting time are adopted, perhaps receiving plants could recruit haulers to help convince producers of the benefits of such changes.

Plant Manager - Hauler Relations

Good communications and relations between the manager of the plant and the managers of hauling firms are essential if the system is to work efficiently. With good relations, planning and scheduling can be much easier tasks than they would be otherwise. Without such communications it would be difficult to bring about improvements at milk receiving stations.

Plant Management - Plant Labor Relations

Workers at the plant appreciated managers who gave them a degree of responsibility over operations. To make necessary improvements, management must explain the need for changes to the workers, and give them the opportunity to be responsible for their particular area of operations.

SECTION III

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to provide greater insight into receiving operations at milk plants and determine whether or not receiving operations at balancing plants were a major source of inefficiency in the milk assembly system. While the study was limited to one plant, there is no reason to believe the general conclusions are atypical. Since it is the authors' impression that waiting problems at some other plants are more serious, other plants should be studied to complement the findings presented in this study.

In general, there is significant potential to improve the efficiency of the milk hauling system by increasing coordination between farmers, milk haulers, and receiving plants. One of the major findings of this study was that vehicles spent longer waiting at plants during the off-peak production period than during the milk flush. The excessive wait time averaged 35-37 minutes in January, compared to 20-22 minutes in June. While an average wait time of 20-37 minutes per load may not seem significant, over one year this would amount to over 2,000 hours at the plant studied. In addition to variable costs (i.e. driver wages, etc.) excess wait time represents a substantial opportunity cost. More trucks are required because a significant amount of vehicle time is spent waiting needlessly at plants. Consequently, excess waiting time implies hauling costs that are higher than necessary.

Receiving operations were found to be less efficient during off peak production (in January) than during the flush (in June). It appears that when milk plants are operating at or near full capacity milk haulers and receiving plants informally improve their operations to handle the larger quantity of milk. One factor that has a major impact is that during the flush period milk haulers distribute their arrivals more evenly throughout the day.

While all receiving functions took longer in January, most idle time was spent in the plant yard waiting to enter the bay.

Steps can be taken to reduce needless waiting time. The major change that can be made is adoption of a plan to systematically schedule arrivals throughout the day. Such a plan need not be sophisticated, but could merely consist of giving each vehicle an unloading time. The driver would then schedule his route to arrive at the appointed time. Of course such a system should keep "open times" to handle unexpected delays and trucks diverted from other plants. A systematic arrival schedule could improve the productivity of plant labor as well as vehicle utilization.

Although the need is not so apparent when a plant is not operating at full capacity, plant management should exert greater control over receiving operations during the off-peak period. Management should be constantly aware that waiting time increases the cost of milk hauling.

While there is an opportunity to significantly improve the efficiency of receiving operations, doing it requires the commitment to make the necessary changes. The purpose of this study was to identify the magnitude and nature of plant waiting time. The coordinated efforts of haulers, receiving plants and farmers are required to actually reduce waiting time at receiving plants.

APPENDIX A

Survey Form

Confidential

Department of Agricultural Economics
CORNELL UNIVERSITY

Milk Receiving Survey

Hauler Name ______________________ Day and Date __________

Truck ID ______________________ License No. __________

	Load # 1	Load # 2	Load # 3
Receiving Operation			
Arrive at Plant	--------	--------	--------
Start into Bay	--------	--------	--------
Start Pump	--------	--------	--------
Stop Pump	--------	--------	--------
Start Wash	--------	--------	--------
Stop Wash	--------	--------	--------
Leave Bay	--------	--------	--------
Leave Plant	--------	--------	--------
Bay Number	--------	--------	--------
Time of Functions			
Weigh-In Time	--------	--------	--------
Sample Time	--------	--------	--------
Rinse Time	--------	--------	--------
Route Information			
Pounds Milk	--------	--------	--------
Number of Farm Stops	--------	--------	--------
*Time Started Load	--------	--------	--------
*Time Left Last Farm	--------	--------	--------
*Load Mileage	--------	--------	--------
*Location of Garage	--------	--------	--------
*Destination of Loads, if other than Middlebury	--------	--------	--------
*Common delays on this load (blocked drives, breakdowns, late milkings, etc.)	--------	--------	--------
Truck Information			
Type of Truck	--------	--------	--------
Tank Capacity	--------	--------	--------

1. What seasonal variations are there in this route during the year?
   a. Number of stops.

   b. Route Mileage

   c. Plant destination of loads

   d. Every day vs. every other day pickup

2. How often do you wait at a plant longer than 1 hour?

3. How much time do you allow for meals and rest stops?

4. What obstacles do you foresee in picking up milk at other times of the day?

5. What can be done to reduce your route time?

6. Other comments.