

## INFLUENCE OF FACILITIES ON COW TIME BUDGETS

*J. P. Harner<sup>1</sup>, J. F. Smith, and M. J. Brouk*

### Summary

A model was developed to evaluate the impact of facilities on cow time budgets. The model suggests that in inadequate facilities overcrowding of the facility by 25% or more resulted because occupancy rate exceeded 100%. The model also is useful in evaluating the impact of time at milking center and milking frequency on cow time budget. In general, the first groups of cows through the milking parlor will have adequate time for resting, feeding, socializing, and watering. The last groups of cows through the parlor, however, do not have adequate time for these activities if the time at the milking center at each milking is 2 or more hours. Reducing time at the milking center is critical when milking 3 times daily to ensure that the last groups of cows through the parlor have adequate time for normal behavioral activities once back in the housing area.

(Key Words: Facilities, Feedline, Freestalls, Time.)

### Introduction

Daily activities of a dairy cow may be subdivided into feeding, resting, drinking, socializing, and milking. Research shows that a cow allocates, or budgets, a certain amount of time to accomplish these daily tasks, except for milking. Dairy managers or milkers control the time a cow is away from its housing area by the duration of milking procedures and

by milking parlor characteristics. Factors that influence the time away from the housing area include parlor throughput, travel distance to and from the parlor, group size, milking routine, and herd health activities. Published research indicates that cows spend approximately 5 hr for feeding, 3 hr for socializing, and 0.5 hr for drinking. The rest of the time in the housing area is for resting, with 12 hr being the minimum. These time allocations suggest that cows need at least 20.5 hr per day in the housing area. It seems that cows usually will reduce their resting time before changing their drinking, socializing, and feeding behavior patterns.

The purpose of this study was to develop procedures to evaluate the potential impact of facilities on time allocations for feeding and resting in smaller dairies. The impact of time away from the feeding and resting area also was evaluated.

### Procedures

Facilities were evaluated by using the daily percentage occupancy of the feedline and freestalls necessary to meet the baseline requirements for feeding and resting. Feedline occupancy equals:

$$\text{FLO} = (\text{C} \times \text{FT}) / (\text{FS} \times \text{PT}) \times 100$$

where FLO is the average feedline occupancy per day (%), C is number of cows, FT is desired daily feeding time per cow (hr), FS is the

---

<sup>1</sup>Department of Biological and Agricultural Engineering.

number of 24-inch feed spaces available, and PT is the time per day the cows are in the pen (hr).

Feedline occupancy represents the average percentage of the feeding spaces that must be occupied while the cows are in the pen. Pen occupancy time excludes the time cows are traveling to and from the milking parlor or at the milking center. Freestall occupancy equals:

$$\text{FSO} = (\text{C} \times \text{RT}) / (\text{ST} \times \text{PT}) \times 100$$

where FSO is the average feedline occupancy per day (%), C is number of cows, RT is desired daily resting time per cow (hr), ST is the number of freestalls in the pen, and PT is the time per day the cows are in the pen (hr).

Freestall occupancy represents the percentage of the feed stalls that must be occupied during the pen occupancy time for each cow to meet its minimum desired resting time per day.

Knowing the percentage occupancy of freestalls and feedlines provides a means to evaluate the facilities on the basis of a facility occupancy rate defined as:

$$\text{FO} = \text{FSO} + \text{FLO}$$

where FO is the facility occupancy rate (%).

If facility occupancy rate exceeds 100%, then adequate time is not available for cows to exhibit natural behavior. Cows ideally should have an opportunity to reach the desired daily feeding or resting time. This factor assumes that certain cows will use freestalls or feedline spaces even when a greater percentage of the pen is involved in other normal activities. Optimum design results in a facility occupancy rate  $\leq 85\%$ . This occupancy rate allows the cow 3.5 hr per day for water consumption and social activities in the pen, along with 12 hr of rest and 5 hr for feed consumption. A facility

occupancy rate of 85% or less indicates that there is at least one freestall and feed space per cow. If the facility occupancy rate is between 85 and 100%, then the pen is overstocked, but the facilities do not hinder the cow's normal behavior. Once the facility occupancy rate exceeds 100%, some cows must choose between feeding or resting because there are inadequate facilities and time to meet the targeted time budget.

## Results and Discussion

Table 1 shows the potential impact of milking times on facility occupancy rate for a 100-cow dairy, assuming no overstocking of the feedline or freestalls. The dairy was assumed to be milking twice daily, and parlor capacity was evaluated based on milking 100, 50, and 33 cows per hr, or 1, 2, and 3 hr per milk shifts.

Table 1 indicates that, on average, the facilities are not a limiting factor because the facility occupancy rate is  $< 100\%$ . Research suggests, however, that 20.5 hr in the housing area is the minimum time required for a cow to socialize, rest, and feed. Table 1 shows that when facilities are not overstocked, the freestalls will only be occupied an average of 60 to 70% of the time, even with the longer milking times.

Cows in the milking center more than 3.5 hr daily may not have adequate time for normal activities. To evaluate the impact of time at the milk center, cow-time budgets for the first group through the parlor and last group through the parlor were evaluated. Table 2 shows the impact of the milking shift on resting time available for those cows milked near the beginning and end of the milking shift for a 100-cow dairy example shown in Table 1.

Facilities potentially enable the first cows through the parlor to rest for 15 hr per day, compared with a target of 12 hr. The last cows through the parlor obtain the targeted 12 hr of

rest per day if the group is milked in 1 hr or less. The latter groups do not receive adequate resting time if they are at the parlor 2 or more hr per shift. Cows moving through the parlor during the first half of the milking shift have adequate time to meet normal their behavior activity.

Table 3 shows the impact of overcrowding a dairy facility, assuming the current herd size is 100 cows. If a 67-cow facility is overcrowded by 50% (100 lactating cows), the facility occupancy rate equals 132%. To ensure adequate resting time, 93% of the freestalls must be occupied all the time that cows are not at the milking center. In addition, 39% of the feeding spaces must be occupied. Once the facility occupancy rate exceeds 100%, then some cows must choose between feeding or resting because inadequate facilities and time exist to meet the targeted cow-time budget. Reducing time at the milking center from 120 to 60 minutes per milk shift decreases the facility occupancy rate from 110 to 100%. Thus, reducing the time at the milking center by 60 minutes per milk shift provides the minimum time for resting and feed-

ing, even if the facility is overcrowded by 25%. Facilities are still inadequate, even if the time at the milking center is reduced, when a dairy opts to overcrowd facilities by 50%.

Table 4 shows the impact of milking twice or 3 times daily. Milking 3 times daily does not impact the resting of the first cows through parlor. The resting time of the last cows through the parlor is influenced by milking interval, time at the milking center, and overcrowding. The model suggests that the time at the milking center must be reduced to less than 1 hr when milking 3 times daily, because occupancy rate exceeds 100%. The last cows through the parlor only have 8.5 hr of resting available per day when milking occurs 3 times daily and time at the milk center is 2 hr.

Facility occupancy rates provide a methodology for evaluating the influence of feedline space and freestalls on the time budget of cows. Milking frequency and time away from the housing area have an influence on available time for resting and feeding.

**Table 1. Facility Occupancy Rate Based on Time at the Milking Center for Each Milking**

| Time at Milking Center per Milking, min | Travel Time To and From the Parlor, min | Freestall Occupancy Rate, % | Freestall Occupancy Rate, % | Facility Occupancy Rate, % |
|---|---|-----------------------------|-----------------------------|----------------------------|
| 60                                      | 10                                      | 56                          | 23                          | 80                         |
| 120                                     | 10                                      | 62                          | 26                          | 88                         |
| 180                                     | 10                                      | 69                          | 29                          | 98                         |

**Table 2. Influence of Time at the Milking Center on the Resting Time of Cows Milked First and Last in the Parlor**

| Time at Milking Center, min | Travel Time                     |  | First Cows Through Parlor, hr | Last Cows Through Parlor, hr |
|-----------------------------|---------------------------------|--|-------------------------------|------------------------------|
|                             | To and From Milking Parlor, min |  |                               |                              |
| 60                          | 10                              |  | 15                            | 12.8                         |
| 120                         | 10                              |  | 15                            | 10.8                         |
| 180                         | 10                              |  | 15                            | 8.8                          |

**Table 3. Influence of Overcrowding Facilities and Time at the Milking Center on Facility Occupancy Rate**

| Time at Milking Center, min | Percentage Overcrowding of Facilities | Freestall Occupancy Rate, % | Feedline Occupancy Rate, % | Facility Occupancy Rate, % |
|-----------------------------|---------------------------------------|-----------------------------|----------------------------|----------------------------|
| 120                         | 0                                     | 62                          | 26                         | 88                         |
| 120                         | 25                                    | 78                          | 32                         | 110                        |
| 120                         | 50                                    | 93                          | 39                         | 132                        |
| 60                          | 25                                    | 70                          | 30                         | 100                        |
| 60                          | 50                                    | 84                          | 36                         | 120                        |

**Table 4. Influence of Milking Frequency on Facility Occupancy Rate and Resting Time**

| Time at Milking Center, min | Daily Milking Frequency, no. of times | Number of Stalls per Pen | Percentage Overcrowding of Facilities | Facility Occupancy Rate, % | Available Resting Time, hr |                          |
|-----------------------------|---------------------------------------|--------------------------|---------------------------------------|----------------------------|----------------------------|--------------------------|
|                             |                                       |                          |                                       |                            | First Cows Through Parlor  | Last Cows Through Parlor |
| 120                         | 3                                     | 100                      | 0                                     | 100                        | 13.1                       | 8.5                      |
| 120                         | 3                                     | 80                       | 25                                    | 125                        | 13.1                       | 8.5                      |
| 120                         | 2                                     | 100                      | 0                                     | 80                         | 13.9                       | 10.8                     |
| 120                         | 2                                     | 80                       | 25                                    | 110                        | 13.9                       | 10.8                     |
| 60                          | 3                                     | 100                      | 0                                     | 85                         | 14.1                       | 11.5                     |
| 60                          | 3                                     | 80                       | 25                                    | 106                        | 14.1                       | 11.5                     |
| 60                          | 3                                     | 100                      | 0                                     | 85                         | 14.6                       | 12.8                     |
| 60                          | 2                                     | 80                       | 25                                    | 100                        | 14.6                       | 12.8                     |