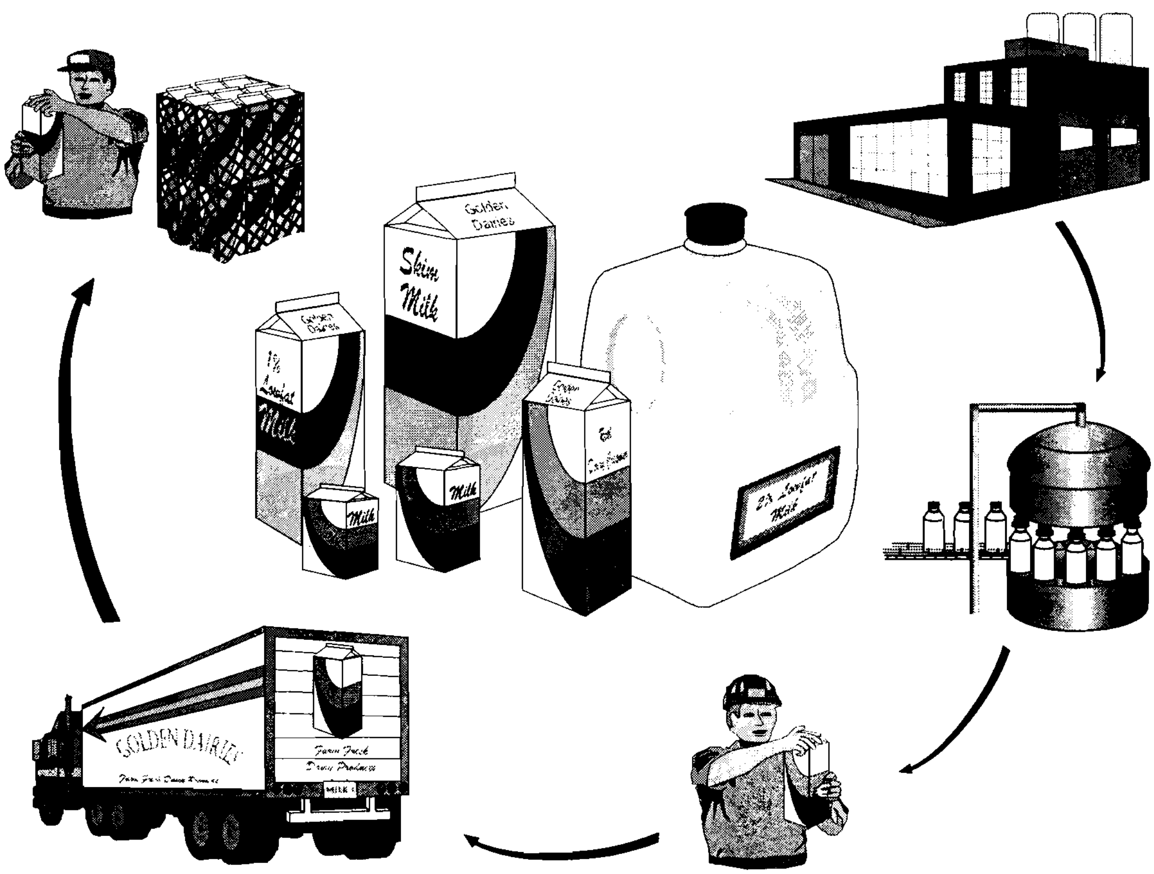
March 1997

E.B. 97-03

Labor Productivities and Costs in 35 of the Best Fluid Milk Plants in the U.S.

Eric M. Erba
Richard D. Aplin
and
Mark W. Stephenson



A Publication of the
Cornell Program on Dairy Markets and Policy

Department of Agricultural, Resource and Managerial Economics
College of Agriculture and Life Sciences
Cornell University
Ithaca, NY 14853-7801

Acknowledgments

Eric M. Erba is a Ph.D. candidate, Richard D. Aplin is a Professor Emeritus, and Mark W. Stephenson is a Senior Extension Associate in the Department of Agricultural, Resource, and Managerial Economics at Cornell University.

We would like to thank George Johnson, Jr. (JAI Engineers) of Sarasota, Florida and Al Hamilton of Somerset, Kentucky, for their assistance in several aspects of the study. We also thank James Pratt, Lois Willett, William Tomek, and Andrew Novakovic from the Department of Agricultural, Resource, and Managerial Economics at Cornell University for their advice and insightful comments throughout the duration of the study.

We are grateful to the personnel from the participating dairy companies who invested many hours to research and report data from all aspects of their respective organizations. Without their efforts, this study would not have been possible.

Finally, we wish to thank TetraPak, Inc. for generously providing a portion of the funding for this research.

For additional copies of this publication or other Cornell publications cited in this report, please contact:

Wendy Barrett
ARME Department
Cornell University
348 Warren Hall
Ithaca, NY 14853-7801
607-255-1581
GJB2@CORNELL.EDU

Table of Contents

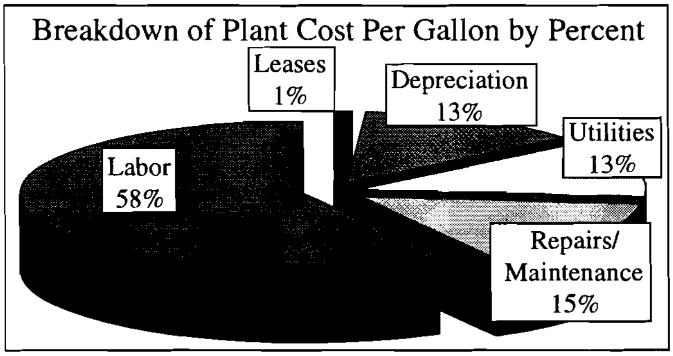
Wide Variations in Labor Productivity and Costs in 35 of the Best Fluid Milk Plants in the U.S.

This report summarizes the findings of the Cornell study on Fluid Milk Plants.[1]

All 35 plants studied were medium or large size, well-managed and highly respected in the industry. Although they are considered to be among the best fluid operations in the United States, labor productivity and costs varied widely both in the plants and on the wholesale distribution routes. Labor productivity in the 35 plants averaged 174 gallon equivalents per hour but varied from approximately 110 gallons per hour to more than 280 gallons per hour. Total plant cost (not including cost of ingredients or packaging materials) also varied widely, averaging 21¢ per gallon equivalent and ranging from a low of about 13¢ per gallon to a high of approximately 27¢ per gallon.

Labor 58% of Total Plant Cost Per Gallon

The following pie chart illustrates the contributions by various cost categories to the average plant cost per gallon including depreciation. Cost of labor represented the largest category of plant cost per gallon, accounting for about 58% of the total. Repairs and maintenance accounted for about 15% of total plant cost, and utilities and depreciation costs each accounted for about 13% of total plant cost. Leases represented only about 1% of total plant cost.



Research Analyzed Labor Productivity and Costs— Did Not Consider Revenues or Profitability

As you study the labor productivity and plant costs, remember that:

➢The plant with the highest labor productivity or the lowest cost per gallon is not necessarily the most profitable. Many factors affect profitability. We did <u>not</u> analyze profits or revenues.

[1]A more detailed account of the study results is available as, *An Analysis of Processing and Distribution Productivity and Costs in 35 Fluid Milk Plants,* by Erba *et al.*, R.B. 97-03, Department of Agricultural, Resource and Managerial Economics, Cornell University, February 1997.

➢Productivity and unit costs were calculated on a gallon equivalent basis which included ALL beverage products processed and packaged in the plant. Items aside from fluid milk products included creamers, juices, drinks, bottled water, and ice cream mixes.

➢Labor hours and labor costs reflected direct labor from the raw milk receiving bays through the cooler and load out area. Labor from the following areas was also included: maintenance, plant quality control, plant office support, and plant management. The blow mold area was excluded from plant cost and productivity measures, but was analyzed separately.

➢Labor hours and labor costs did NOT include any labor dedicated to production of soft products (e.g., cottage cheese, sour cream, and yogurt). Raw milk procurement, packaging supplies, distribution, selling, and general and administrative expenses were also excluded.

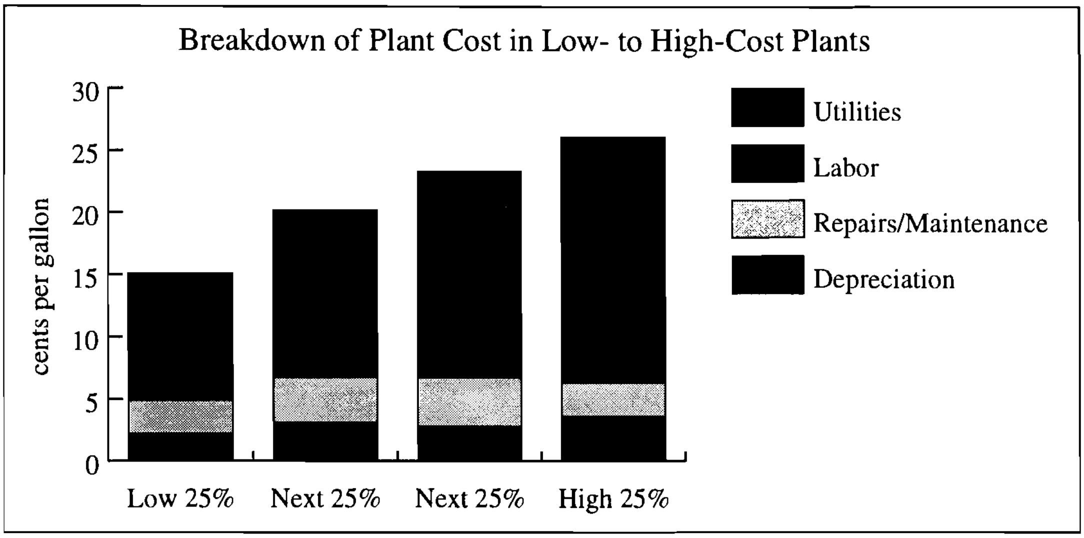
➢Formulas used to calculate plant labor productivity and cost per gallon are given in the appendix of this report.

Plant Labor Productivity Ranged From 110 Gallons Per Hour to More Than 280 Gallons Per Hour. Total Plant Cost Per Gallon (Exclusive of Package) Ranged From 15¢ to 27¢ Per Gallon

Labor productivity and costs in the 35 plants can be summarized as follows:

Efficiency or Cost Measures	Average of 35 Plants	Average of Lowest 25%	Average of Next 25%	Average of Next 25%	Average of Highest 25%
Gallon equivalents per hour of labor	174	118	147	178	256
Labor cost per gallon	12.3¢	8.3¢	11.2¢	13.9¢	16.1¢
Cost of utilities per gallon	2.6¢	1.9¢	2.3¢	2.7¢	3.7¢
Plant cost per gallon, depreciation excluded	18.2¢	12.9¢	17.1¢	20.5¢	22.5¢
Plant cost per gallon, depreciation included	21.1¢	15.1¢	20.2¢	23.3¢	26.1¢

Each increment, or quartile, represents 25% of the plants. For example, the labor productivity reported in the second column represents the average productivity of the 9 plants with the lowest cost per gallon. **Each line is computed independently, so the 9 plants with the highest labor productivity are not necessarily the 9 plants with the lowest costs.**



Using the data for plant cost per gallon, including depreciation. Each of the bars represents the build-up of cost by the four major cost categories. Although variation in each of the four categories is evident across the quartiles, labor cost is the most relevant factor affecting the variability in cost.

Key Characteristics of Plants Studied

The plants studied are widely dispersed throughout the United States. Although 14 of the plants are located in the Northeast, 7 plants are located in Western and Mountain states, 7 are located in the Middle Atlantic and Southeast, and 7 are in the Upper Midwest. The 35 plants are operated by 23 companies. Eight are owned and operated by supermarket companies (i.e., captive plants), 5 are operated by farmer owned milk marketing cooperatives, and the remaining 22 are independently owned and operated. Labor unions are present in 27 of the 35 plants. Most plants submitted data from 1993 or 1994 calendar years.

The following table presents other key characteristics of the 35 plants studied. These factors apparently contribute to the wide variation in labor productivity and plant costs.

Factors Affecting Efficiency and Cost	Average of 35 Plants	Average of Low 3	Average of High 3
Fluid products processed, mil. gal./mo.	3.2	1.6	6.0
Average labor cost per hour, (wages and fringes)	$20.20	$13.10	$27.90
Plant capacity utilization	76%	43%	100%
Volume in gallons and half-gallons	86%	55%	100%
Processing technology, score from 1 to 10	7.4	4	9
SKUs processed	148	26	367
SKUs stored in cooler	250	40	539
Volume handled on pallets	41%	0%	100%
Electricity, per kwh	6.7¢	2.2¢	13.2¢
Natural gas, per therm	42.6¢	18.1¢	66.0¢

The figures in the column labeled "Average of Low 3" and "Average of High 3" represent the average values of the 3 highest (lowest) plants calculated for each characteristic. High and low averages for each characteristic were computed independently. For example, the largest 3 plants in terms of gallons of fluid product processed are not necessarily the same three plants with the largest number of SKUs processed, the highest labor cost per hour, or any other category.

Nine Factors That Cause Labor Productivity and Cost Per Gallon to Vary

We used two analytical techniques to help us determine the factors that apparently caused the wide variations in labor productivity and cost per gallon in the 35 plants studied. One analytical method was a statistical procedure called regression analysis, which uses the relationships between productivity and costs and factors thought to have significant effects on them. Neural networks was the second analytical method used.[2]

For the most part, the two analytical methods gave similar results. Although the two methods differed in their estimates of the magnitude of the effects of some factors, the two methods only gave fundamentally different results in the case of one factor: the effect of unionization on labor productivity and costs. As discussed later, multiple regression suggested that union plants had higher productivity and lower costs than non-union plants. On the other hand, neural network analysis suggested that plants with unionized labor would be less productive and higher cost, all other factors being the same.

Our analyses, for the most part, support what seems intuitive about plant labor productivity and costs:

- Captive supermarket plants, everything else (e.g., plant size, product mix, etc.) being the same, were expected to have higher labor productivity and lower costs per gallon than plants owned by other organizations.

- Higher labor cost per hour was associated with higher labor productivity but was also associated with higher costs per gallon.

- Increases in percent of products packaged in gallon and half-gallon containers and in percent of plant capacity utilized increased labor productivity and decreased cost per gallon.

- Despite the large scale of the operations in the study, larger plants, as measured by actual monthly processing volumes, realized higher labor productivity and lower costs per gallon.

[2]For more information on neural networks, see *Pattern Recognition and Neural Networks* by B. D. Ripley. Cambridge University Press. Cambridge, MA. 1996.

≻Although less important than previously listed factors, plants with more advanced equipment in the processing and filling area had slightly higher labor productivity with little impact on costs per gallon. Plants with more advanced equipment in the cooler and load out area also had significantly higher labor productivity and slightly lower costs per gallon.

≻Processing fewer stock keeping units increased labor productivity and decreased plant cost per gallon, but a large decrease in the number of products processed was necessary to produce substantial effects.

≻More intensive use of pallets was predicted to increase labor productivity and decrease cost per gallon, but a large increase in the percent of volume handled on pallets was necessary to produce these effects.

Quality of Management and Quality of Work Force Not Measured

Quality of management and quality of the work force are likely to impact the cost and productivity of even well-managed plants. However, neither quality of management nor quality of the work force lent itself to a systematic, quantitative evaluation among participating plants.

Plant Ownership, Wage Rates, Package Mix, Capacity Utilization, Plant Size, Plant Technology Are The Biggest Factors Causing Wide Variation in Labor Productivity

As noted before, we used regression and neural network analyses to identify and to measure the impacts of factors apparently causing the wide variation in labor productivity and cost per gallon in the participating plants. For the most part, both methods led us to the same conclusions. We will use the results of the regression analysis as the basis for this discussion of the apparent importance of these various factors. We will note the results of the neural network analysis only when it suggested somewhat different results than the regression analysis.[3]

We present these impacts as percentages. For example, we found that a 10% increase in the percent of processing volume packaged in gallon and half-gallon containers increased plant labor productivity by 6%.

The regression method of analysis offers a feature that is particularly useful—all of the factor effects are net of the other factors that were tested. In other words, in determining the 6%

[3]For details of the results of the regression analysis of the 35 plants, see *An Analysis of Processing and Distribution Productivity and Costs in 35 Fluid Milk Plants,* by Erba *et al.*, R.B. 97-03, Department of Agricultural, Resource and Managerial Economics, Cornell University, February 1997. For details of the results of the neural network analysis of the 35 plants, see *Comparisons of Costs and Efficiencies Between Cooperative, Proprietary, and Captive Fluid Milk Processors: A Neural Network Approach,* by Erba *et al.*, R.B. 96-13, Department of Agricultural, Resource and Managerial Economics, Cornell University, September 1996.

increase in labor productivity cited above, we have already accounted for the impacts of labor cost per hour, size of plant, type of ownership, level of plant technology, and so forth on plant labor productivity. The 6% increase is the impact attributable to just the container size mix, everything else being held constant.

Captive Plants Have 28% Higher Labor Productivity

Compared to full-line proprietary plants, captive plants realized 28% higher plant labor productivity. **This effect was net of any other factors tested that have an effect on plant labor productivity.** For example, after accounting for differences in labor cost, percent of product packaged in gallon and half-gallon containers, percent plant capacity utilization, SKUs processed, and plant technology, captive plants still had an advantage of 28% in labor productivity compared to plants under different ownership.

For those who are not familiar with captive plants, it may be insightful to review some of the differences between captive plants and other full-line dairies. For example, captive plants typically maintain narrower product mixes, i.e., they process fewer products under fewer labels and use fewer packaging sizes. Furthermore, most products are packaged in gallon and half-gallon containers, and only a small percentage of products are packaged in quart, pint or half-pint containers. Because captives only serve their own stores, there is a greater opportunity to handle products on less labor-intensive systems, such as bossie carts and pallets. At least some of the advantage realized by captive plants in these respects were captured by the other factors tested. Relatively few (if any) finished products from outside sources are brought into the coolers of captive plants for distribution, reducing the number of products in the cooler and simplifying filling of orders and load-out procedures. Captives serve supermarket stores that place orders for similar mixes of products with relatively little variation in order size. In combination, the characteristics described point toward operations with high product turnover and high labor productivity, which are inherently less complex and easier to manage.

Higher Cost Work Force More Productive

The study of these 35 plants suggests that plants hiring plant employees at a higher cost have more productive work forces, perhaps because the higher wages attract and keep more motivated and efficient workers. This effect should not be confused with any possible result of rewarding existing plant employees with higher wages. Also, higher labor cost per hour, despite leading to higher productivity, also leads to higher total plant costs per gallon.

Packaging More Products In Gallons and Half-Gallons Increases Labor Productivity

As expected, plants that packaged a large percent of their total production in gallon and half-gallon containers tended to have higher labor productivity. Our regresion analysis suggested that a 10% increase in the volume packaged in half-gallon and gallon containers increased labor productivity by about 6%. Neural network analysis of the 35 plants also suggested that increasing the proportion of output packaged in half-gallon and gallon containers increased labor productivity but not to the same degree as the regression analysis.

Operating Closer to Maximum Capacity Increases Labor Productivity

Plants operating closer to their maximum sustainable capacity realized significant gains in labor productivity. A 10% increase in percent capacity utilization resulted in a 2.5% increase in labor productivity, equivalent to 4.5 gallons per hour. This effect was net of any other factors tested that have an effect on plant labor productivity. For example, after accounting for the effects of labor cost per hour, percent of product packaged in gallon half-gallon containers, size of plant, and so forth, increasing plant capacity utilization by 10% increased plant labor productivity by 2.5%.

Larger Plants Have Higher Labor Productivity

By industry standards, the participating plants were large. On average, the plants processed and packaged 3.2 million gallons per month with a range of about 1.4 million gallons per month to 6.0 million gallons per month. Although the size of plants in the study was not representative of fluid milk plants throughout the U.S., plant size was investigated as a potential factor affecting labor productivity. Despite the relatively large size of the 35 plants, the results revealed that plant size was a relevant factor affecting labor productivity, although relatively large changes in plant size were required to affect plant labor productivity appreciably. As plant size increased from about 2 million gallons per month to 4 million gallons per month, labor productivity increased by about 3.5%. Furthermore, increasing plant size from 4 million gallons per month to 6 million gallons per month increased labor productivity by about 1.7%.

Fewer SKUs Processed and Higher Percent of Product Shipped On Pallets Increased Labor Productivity Slightly

Both of our analytical methods suggested that a larger number of SKUs processed by plants decreases labor productivity. Both also indicated that more intensive use of pallets leads to higher labor productivity. However, the neural network method suggested that the number of SKUs processed and the use of pallets have much larger impacts on productivity than does regression analysis. And even the neural network analysis suggested that a large increase or decrease in the number of SKUs or in the use of pallets is needed to produce significant changes in labor productivity.

Effects of Level of Automation in Processing and Filling Area and Level of Technology in Cooler Area on Labor Productivity Are Significant, But Small

Although the 35 plants were all good operations—rather than a random sample of plants in the U.S., we expected the level of technology in the plants to have a significant effect on productivity and costs. The degree of automation and technology in the cooler and load-out area and the degree of automation and technology in the processing and filling area were evaluated by the plant manager at each participating plant. A 10-point scale was used to assess the level of technology (1 = the lowest level of technology, and 10 = the latest, most innovative technology).

Both of our approaches to analyzing factors that influenced productivity in the 35 plants indicate that more advanced technology in both the processing and filling area and cooler and load out area apparently led to higher labor productivity. However, the neural network methodology suggested that the impact of technology on productivity was much larger than the regression analysis.

Effects of Unionization on Labor Productivity Inconclusive

Some managers with whom we consulted thought that unionized labor would lead to lower labor productivity due to narrow job descriptions, jurisdictional limitations, work rules, and reduced work force flexibility. Other industry executives expected unionization to have a positive effect on labor productivity. They argued that unions tend to lead to lower job turnover rates, to more experienced and skilled workers, and to more stability and order in the work environment. Some thought that unions compelled company executives to become better managers.[4]

Although the negative effects of unionized labor are probably real and highly publicized, these positive effects are not as well known. We expected that the gross effect of unionized labor would very likely encompass a combination of both the positive and negative effects, but we were undecided as to the direction of the net effect of unionization. Our study is inconclusive as to the effect, if any, of unionization on plant labor productivity because the two methods of analysis gave conflicting results. Regression analysis suggested that unionized plants outperformed non-unionized plants in terms of gallon equivalents of product processed per hour of labor. On the other hand, the other analytical method, neural networks, suggested that labor productivity in union plants, everything else being the same, was lower than in non-union plants.

Two Assessments of Plant Cost Per Gallon: With Depreciation and Without Depreciation

Two measures were developed to assess the cost of operating each of the 35 fluid plants. Both measures represented plant cost per gallon of fluid product processed, but while one measure included the cost of depreciation, the other did not. Depreciation is an expense, albeit a noncash expense, and it could be argued that depreciation costs should be included to paint a more accurate and complete portrait of plant costs. On the other hand, including reported depreciation costs in the calculation may be misleading because depreciation costs as reported in this study are based on bookkeeping methods. For older equipment and older plants, depreciation costs are low if the building and much of the equipment are fully depreciated. In addition, depreciation costs for new equipment and new plants may be determined on an accelerated basis, which shows up as a higher depreciation cost in the early stages of the useful life of the assets.

The true economic cost of the investment in these fluid milk plants is not the accounting depreciation that was reported. Rather, it is the economic depreciation of the assets based on current replacement costs and the cost of capital tied up in the assets (opportunity cost of capital).

---

[4] For a more complete study of unionization and its effect on labor productivity, see *What Do Unions Do?* by Richard B. Freeman and James L. Medoff, Basic Books, Inc., New York, NY, 1984.

Unfortunately, neither economic depreciation nor opportunity cost information lent itself well to straight forward assessments by accounting personnel or controllers at the participating plants.

To avoid problems associated with bookkeeping depreciation in plant cost comparisons, we calculated two separate measures of plant cost per gallon. Specifically, one measure of plant cost accounted for the costs of labor, electricity, gas, water, sewage, building and equipment depreciation (excluding any depreciation charged to blow molding equipment), leases, repairs, maintenance, parts, cleaners, lubricants, plant supplies, pest control, refuse collection, security, property taxes, and insurance relative to the volume processed in gallon equivalents. The second measure included all of the above items, except depreciation expenses. The two measures should bracket total costs including the true economic depreciation.

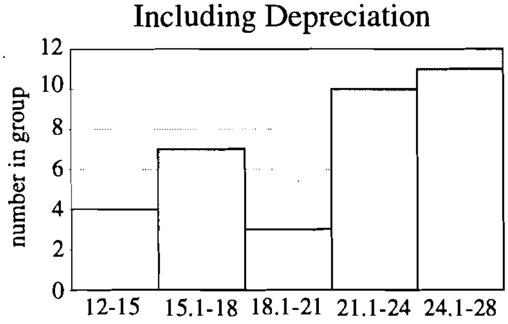
The cost of packaging materials (e.g., the cost of in-house blow molding or purchased paper containers) and ingredient costs were **not** included in either calculation of plant cost per gallon. Any labor used in producing soft dairy products (e.g., cottage cheese, sour cream, and yogurt) was also excluded, as well as the costs of milk procurement, research and development, distribution, selling, and general and administrative personnel.

Among the 35 plants, plant cost per gallon, including depreciation, showed large variability, ranging from about 12¢ per gallon to more than 27¢ per gallon (figure on following page). The average cost was 21.1¢ per gallon. About 65% of the plants fell within the range of 15¢ per gallon to 25¢ per gallon. About one-third of the plants had calculated plant costs of less than 18¢ per gallon.

When depreciation expenses were excluded, plant cost per gallon dropped to an average of 18.2¢ per gallon and ranged from about 10¢ per gallon to about 26¢ per gallon (figure on following page). About three-fourths of the plants fell within the range of 13¢ per gallon to 23¢ per gallon.

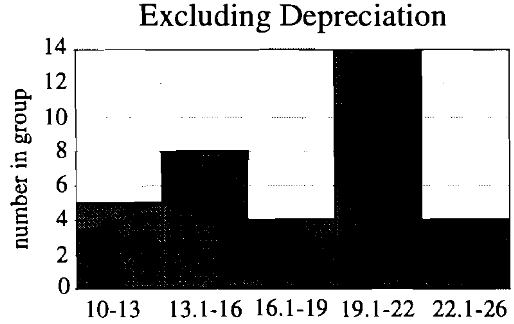
When depreciation expenses were included, labor costs constituted about 58% of plant cost per gallon. Building and equipment depreciation accounted for about 13%, and the cost of water, sewage, electricity, and other fuels accounted for an additional 13%. As a group, repairs, maintenance, parts, cleaners, lubricants, plant supplies, pest control, refuse collection, taxes, and insurance totaled 15% of plant cost per gallon. Leases accounted for about 1% of plant cost per gallon.

Plant Cost Per Gallon, Including Depreciation



mean = 21.1¢ median = 21.8¢

Plant Cost Per Gallon, Excluding Depreciation



mean = 18.2¢ median = 20.1¢

Whether or Not Plant Was A Captive Supermarket Plant, Labor Rates and Volume of Milk Processed the Most Important In Explaining Wide Variation In Plant Cost Per Gallon.

As with plant labor productivity, the plant cost data were analyzed using two approaches: statistical regression and neural networks. With but one exception, both approaches provided basically similar results as to what factors were apparently causing the wide variation in plant costs per gallon. The one exception was the effect of unionized labor on costs. Regression analysis suggested that unionized plants have slightly lower costs. On the other hand, the neural network approach suggested that unionized labor led to significantly higher costs per gallon. Thus, our analyses gave inconclusive results as to the effect, if any, of unionization on plant costs per gallon.

Eleven factors were significant in explaining the wide variation in plant cost per gallon (exclusive of depreciation) in the 35 plants. However, the effects of some factors were much larger than other factors. **The following factors were <u>most important</u> in explaining the wide variation in plant cost per gallon in the 35 plants:**

- ➢Whether or not the plant was owned by a supermarket chain (captive plant)—cost per gallon 15% lower in captive plants.
- ➢The level of wages and fringe benefits—10% higher labor cost per raised cost per gallon 9%.
- ➢The size of the plant as measured by the number of gallon equivalents processed — ncreasing volume processed from 2 million gallons to 4 million gallons per month lowered cost per gallon 8%. Increasing from 4 to 6 million gallons decreased cost per gallon 4%.

The cost advantage of captive plants over full-line plants reported in this study does not imply that it is necessarily good decision for a supermarket chain to build and operate its own fluid milk plant. By no means do the costs of dairy firms supplying food chains determine the prices supermarkets pay. Moreover, a supermarket chain must be concerned with the costs of all dairy products that it buys from fluid milk suppliers, not just the beverage products typically processed and packaged in captive plants. Thus, it is not a foregone conclusion that it is more profitable for a retail chain to establish its own plant, especially one designed to produce only fluid milk products.

Our study does not take into account the capital outlays required to establish a fluid milk plant or the cost of capital involved in such a venture. These types of considerations lead many retail chains to decide that investing in their own fluid milk plant would not yield an adequate return on investment, considering the many alternative investment opportunities.

The following factors were "<u>moderately important</u>" in explaining the variation in plant cost per gallon:

- ➢The percent of total volume packaged in gallon and half-gallon containers—10% increase in the percent of plant volume in gallons and half gallons decreased cost 1.7%.

➢The extent to which plant capacity was used—10% increase in capacity utilization decreased cost per gallon by 1.0%.

Five other factors, although statistically significant, were <u>much less important</u> in explaining variations in plant cost per gallon:

➢Level of technology in the processing and filling area
➢Level of technology in the cooler and load-out area
➢Number of SKUs processed
➢Location of plant
➢Percentage of product handled on pallets

Blow Mold Center Labor Productivity Ranged From 975 to Over 5,000 Jugs Per Hour

Blow mold facilities were operated in 33 of the 35 plants in the study. All blow mold operations produced plastic gallon jugs, and about one-third of the plants also produced quart and/or half-gallon plastic jugs.

The number of jugs produced per hour of blow mold labor ranged from about 975 to more than 5,000 and averaged about 2,245. The number of jugs included all container sizes produced at each facility, but 92% of all jugs produced were gallon containers (range: 53% to 100%). Although the blow mold labor productivity in a few plants was exceptional, about 85% of the plants operating a blow mold facility produced fewer than 2,600 jugs per hour of labor.

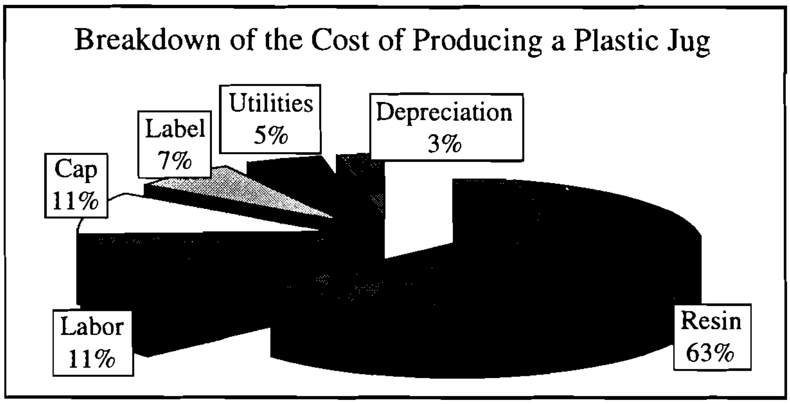
With Resin at 45¢ Per Pound, Resin Comprises 63% of Cost of Blow Molding a Jug

Using a resin price of 45¢ per pound for all plants, the cost of producing a plastic gallon jug averaged about 9.1¢ and ranged from 7.4¢ to 10.4¢.

Resin accounted for about 63% of the cost of producing a jug. Labor cost and the cost of a cap were nearly equal, each accounting for about 11% of jug production cost. The cost of a label, the cost of utilities, and the cost of depreciation on blow molding equipment and structures comprised the remaining 15% of the production costs.

More Than 50% of Plants' Volumes Distributed on Specialized Routes Serving Large Customers. 43% of Customers Take 64% of the Total Volume Distributed

All 35 plants submitted general information on their distribution operations. The following provides an overview of their route operations.



Route Labor Productivity and Direct Delivery Costs Only Are Analyzed for Specialized "Supermarket" Routes Serving Large Accounts

As you study the summary of route labor productivity and costs, remember that:

Route Operation Characteristic	Average of All Plants	Average of Low 3	Average of High 3
Percent of plant volume distributed by:			
• specialized routes	52	5	100
• mixed or peddle routes	18	0	71
• branch, depot, or warehouse routes	23	0	47
• other routes	7	0	73
Size of customer			
Over 100 cases per delivery			
• percent of customers	43	1	100
• percent of volume	64	2	100
Less than 50 cases per delivery:			
• percent of customers	32	0	0
• percent of volume	10	0	0
Frequency of delivery to large accounts:			
• 3 days per week, %	43	0	97
• 4 days per week, %	24	0	77
• 5 days per week, %	10	0	97
• 6 days per week, %	11	0	75

➢The route labor productivity and costs only reflect the productivity and costs of routes serving large customers, such as supermarkets and club stores. These routes typically used tractor-trailers for delivery. An average of 5 customers per day were served by these specialized routes.

➢The cost per case of serving smaller customers, such as small supermarkets and convenience stores, Mom and Pop stores, delis and restaurants would be **much higher** than the direct delivery costs reported here. Except for captive supermarket plants, most, if not all, fluid milk businesses could not survive by only serving these large accounts.

➢Some factors—for example, number of stops—that are not very significant in explaining variations in route labor productivity and direct delivery costs on these specialized routes serving only a few very large accounts, would probably be much more important in explaining variations in productivity and costs on regular mixed (or peddle) routes that serve large numbers and a variety of customers.

➢Route labor productivity and cost per case were calculated based on a 16-quart case.

➢Twenty of the 35 plants submitted complete surveys detailing their specialized routes. These 20 plants operated 270 specialized routes.

➢**The routes with the highest labor productivity or the lowest cost per case are not necessarily the most profitable. Many factors affect profitability, and we did not attempt to analyze profitability.**

On Supermarket Routes, Driver Labor Productivity Averaged 110 Cases Per Hour and Direct Delivery Cost Averaged 37¢ Per Case

Labor productivity, direct labor cost per case, and direct delivery cost per case are summarized in the following table:

Efficiency or Cost Measure	Average of All Plants	Average Low 10% of Routes	Average High 10% of Routes
Cases delivered per hour of labor*	108	52	216
Driver labor cost per case*	16.8¢	10.1¢	47.8¢
Direct delivery cost per case**	36.8¢	17.3¢	63.1¢

* Reflects 270 specialized routes operated by 20 plants
** Reflects 180 specialized routes operated by 15 plants which reported delivery vehicle costs as well as route labor costs

Direct labor cost only included wages and fringes of routemen. Direct delivery cost included cost of vehicle as well as cost of routeman. Other selling expenses such as wages and benefit costs of distribution management, sales management, or route supervisors, sales representatives and order takers, advertising and promotion expenses, bad debt expenses, or allocations of general and administrative expenses were not included in the two cost measures.

Average Specialized Route Delivers 18,900 Cases, Travels 3,150 Miles, And Makes 97 Customer Stops Per Month

Of the 270 specialized routes, 105 were operated by 5 captive supermarket plants and served only the stores owned by the chain. The routemen on 230 of the specialized supermarket routes were members of a union.

Other key characteristics of the 270 specialized routes are in the following table:

Specialized Route Characteristic	Average All 270 Routes	Average Low 10% of Routes	Average High 10% of Routes
Cases delivered per month	18,900	10,200	35,000
Driver labor cost per hour (wages & fringes)	$23.39	$16.55	$32.27
Number of miles per month	3,150	745	6,850
Number of customer stops per month	97	48	168
Percent of load on pallets	49%	0	100%
Percent of dock deliveries	83%	13%	100%

Whether Or Not Routes Were Operated By A Supermarket Captive Dairy Had The Most Impact on Route Labor Productivity. Whether Or Not Routemen Were Unionized Had No Significant Impact On Route Labor Productivity

While most of the 270 specialized routes studied delivered between 60 and 180 cases per hour, the bottom 10% of the routes averaged only 52 cases per hour. On the other hand, the top 10% of the routes averaged 216 cases per hour.

Four factors were significant in explaining the wide variation in driver labor productivity on the routes dedicated to serving large accounts. However, the effects of some were much larger than others.

The effects of various factors on driver labor productivity on the specialized routes were:

A route operated...	...resulted in ...
by a captive plant	24% more cases delivered per hour

A 10% increase in...	...resulted in a change in cases delivered per hour of...
Labor cost per hour	8.9% (increase)
Miles travelled per month	1.4% (decrease)
Percentage of product on pallets	0.5% (increase)

Type of ownership had the largest effect, with routes operated by captive plants outperforming routes operated by both cooperative and proprietary plants. Hiring labor at a higher cost and increasing the volume of product handled on pallets increased driver labor productivity. Routes with higher mileages were found to have lower driver labor productivity. We did not find any significant differences in driver labor productivity for routes that employed unionized labor, had higher proportions of dock deliveries or had fewer customer stops per month.

What might explain the higher routeman labor productivity on routes operated by captive plants? Scheduling and coordination of deliveries are likely to be better than that experienced on other routes because supermarket personnel and routemen work for the same organization. Furthermore, delivery personnel on captive routes are more likely to receive assistance from store personnel during the course of delivery. Finally, deliveries from captive plants to their supermarkets may also get priority when unloading. For example, if several delivery vehicles are waiting to unload, the supermarket may give its own trucks the privilege of jumping to the front of the line. Although we have provided some possible explanations, there may be other reasons to account for the higher labor productivity on routes operated by captive plants.

On 180 Supermarket Routes, Direct Delivery Cost Per Case Ranged from 17¢ to 63¢ Per Case

Although all routes studied in depth were supermarket routes serving only large accounts, direct delivery costs (route labor and vehicle costs) still varied widely—from 17.3¢ per case on the 10% of the routes with lowest costs to 63.1¢ per case on the 10% of the supermarket routes with highest costs. Direct delivery costs on the 180 routes operated by 15 dairies which submitted information on both route labor and delivery vehicle costs averaged 36.8¢ per case.

Remember the cost per case on mixed or peddle routes serving smaller customers, such as small convenience stores, Mom & Pop stores, delis and restaurants would be <u>much higher</u> than the direct delivery cost reported here. Also remember, we did not include the cost of plant load out labor, other plant costs, selling expenses, and general and administrative expenses in the calculation of direct delivery cost.

Whether Or Not Routes Operated By a Captive Supermarket Dairy Operation and The Cost of Driver Wages and Benefits Most Important Factors In Explaining Large Variation in Direct Delivery Costs

Six factors were significant in explaining the wide variation in direct delivery cost per case on the routes dedicated to serving large accounts:

A route operated...	...resulted in ...
by a captive plant	24% lower direct delivery cost per case
A 10% increase in...	...resulted in a change in direct delivery cost per case of...
Labor cost per hour	7.6% (increase)
Miles travelled per month	2.9% (increase)
Number of stops per month	1.1% (increase)
Percentage of dock-deliveries	0.8% (decrease)
Percentage of product on pallets	0.3% (decrease)

The results supported what seems intuitive about direct delivery cost per case. Type of ownership had the largest effect with routes operated by captive plants outperforming routes operated by full-line plants. Direct delivery cost per case was higher for routes which paid more per hour for driver labor despite the fact that they appeared to have higher labor productivity. Routes with higher mileage and more customer stops were found to have higher direct delivery costs per case. Two factors—percent of product handled on pallets and percent of dock-deliveries—decreased direct delivery cost per case, but their effects were small.

Given the earlier analysis of factors causing route labor productivity to vary, it should not be a surprise that routes operated by captive plants had lower direct delivery costs per case. Specifically, we found that the direct delivery cost per case of routes operated by captive plants was 24% lower than routes operated by proprietary or cooperative milk plants. This effect was net of any other factors tested that have an effect on direct delivery cost. For example, after accounting for differences in labor cost per hour, percent of product handled on pallets, route mileage, and number of customer stops, routes operated by captive plants had an advantage of 24% in direct delivery cost per case. This amounted to about 9.9¢ per case.

What might explain the lower delivery cost on routes operated by captive plants? We would assert that the same factors that contribute to higher labor productivity on routes operated by captive plants also contribute to lower direct delivery costs. Briefly, scheduling of deliveries are likely to be more coordinated than that experienced on other routes because supermarket personnel and routemen work for the same organization. Furthermore, routemen are more likely to receive assistance from store personnel during the course of delivery. Finally, deliveries from captive plants to their supermarkets may also get priority when unloading.

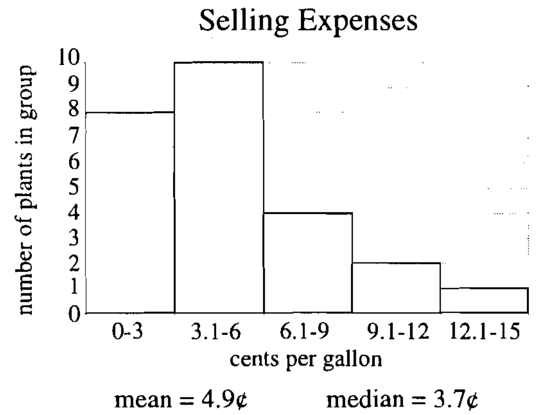
Besides whether or not the routes were part of a captive supermarket operation, another highly significant factor affecting the direct delivery cost per case or the supermarket routes was the level of routemen wages and fringes benefits. However, higher labor cost per hour leads to higher direct delivery cost per case despite leading to higher route labor productivity.

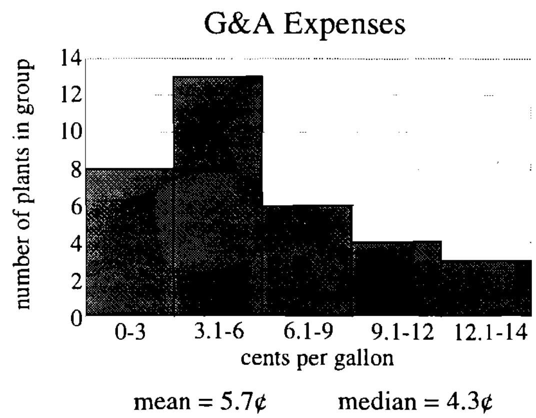
Miles traveled, number of customer stops and population density of the city in which the plant is located were of moderate importance in explaining variation in direct delivery costs. Although statistically significant, the percentages of dock-delivered orders and of product handled on pallets were of minor importance in explaining direct delivery cost variations.

Selling Expenses and General and Administrative Expenses Reported But Not Studied In Depth

Selling expenses and general and administrative (G&A) expenses were **not** included in calculations of plant costs or distribution costs. These "overhead" expenses are required to support both the plant and distribution operations and were not incurred to support only specialized routes.

In reporting these expenses, no attempt was made to allocate the selling expenses among different types of routes, nor was any attempt made to allocate the G&A expenses between the plant and distribution operations. The selling expenses and G&A expenses are reported on the basis of total cost per gallon of all beverage product processed and packaged in the plant. Thirty-five plants reported G&A expenses, and 25 plants reported selling expenses. In general, captive plants did not report selling expenses.





Selling expenses included wages and benefits for distribution management, sales management, route supervision foremen, sales representatives and order takers, advertising and promotion expenses and bad debt expenses. For G&A, expenses included wages and benefits for office personnel, salaries and benefits for administrative personnel, office overhead (electricity, depreciation, supplies, dues, data processing, communications, contributions and public relations), interplant hauling fees, snow removal, security, legal fees, consulting fees and allocated corporate overhead.

Selling expenses and G&A expenses are presented as costs per gallon of product processed. For the 25 plants reporting, selling expenses averaged 4.9¢ per gallon and ranged from less than 1¢ per gallon to over 12¢ per gallon. G&A expenses ranged from about 1¢ per gallon to about 13¢ per gallon and averaged about 5.7¢ per gallon. Captive plants tended to have lower G&A expenses per gallon than full-line operations. The 8 captive plants averaged 4.1¢ per gallon, and the proprietary and cooperative plants averaged 6.2¢ per gallon.

APPENDIX

Description of Productivity and Cost Measures

Plant Labor Productivity

Plant labor productivity for the 35 plants reflected the gallon equivalents of all milks, creams, buttermilks, juices, drinks, bottled water, and ice cream mixes processed, divided by the total hours worked by direct processing, cooler, and all other plant labor. Direct processing labor included all processing plant employees from the receiving bay to the cooler wall, and cooler labor included employees in the cooler and load out areas as well as any jockey labor. "All other plant labor" was a general plant labor category that included maintenance, engineers, plant quality control, plant office support, and plant management.

Plant labor productivity did **not** include any work from the blow mold operation, nor did it include any labor used in producing soft dairy products (e. g., cottage cheese, sour cream, and yogurt). Hours worked in milk procurement, research and development, distribution, selling, and general and administrative personnel were also excluded.

Plant Cost per Gallon

Two measures were developed to assess the cost of operating each of the 35 fluid plants—one measure included the cost of depreciation, and the other did not. Plant cost accounted for the costs of labor, electricity, gas, water, sewage, building and equipment depreciation (excluding any depreciation charged to blow molding equipment), leases, repairs, maintenance, parts, cleaners, lubricants, plant supplies, pest control, refuse collection, taxes, and insurance. The second measure included all of the above items, except depreciation expenses. Each of the cost measures was summed over all included cost categories and divided by the gallon equivalents of all milks, creams, buttermilks, juices, drinks, bottled water, and ice cream mixes processed.

Packaging costs and ingredient costs were **not** included in either calculation of plant cost per gallon. Any labor used in producing soft dairy products (e. g., cottage cheese, sour cream, and yogurt) was also excluded, as well as the costs of milk procurement, research and development, distribution, selling, and general and administrative personnel.

Cost of Blow Molding a Gallon Jug

Because some plants did not meter blow mold utilities separately, two cost of production figures were developed for blow molding. The cost of production estimate included the cost of resin, labor, depreciation on blow mold equipment, cap, and label. The second cost of production estimate included the same cost categories in addition to the cost of utilities per jug. Because resin cost per pound was lower for plants that submitted data in the fall of 1994, a single resin cost was calculated by using the resin costs submitted by 13 plants from January 1995 to June 1995. A resin cost of 45.8¢ per pound was assigned to all 33 plants with blow molding facilities. The two cost measures were summed over all included cost categories and divided by the total number of jugs produced.

Route Labor Productivity

The measure of labor productivity used for the delivery operations was the total number of cases of product delivered divided by the hours worked by driver(s) assigned to the route. For each distribution operation, driver labor productivity was averaged across all specialized routes for which data was submitted to generate one measure per operation.

Direct Delivery Cost per Case

Two cost components determined direct delivery cost per case for specialized routes—the cost of driver labor and the cost of operating the delivery vehicle. The cost of driver labor included wages and benefits (FICA, workman's compensation, unemployment, medical, vacation, pension and gifts). The cost of delivery vehicle operation included depreciation, lease payments, insurance, fuel, oil, tires, maintenance, repairs, garage costs, truck washing expenses, registration fees, and highway taxes. For each distribution operation, total labor and vehicle cost per case was averaged across all all specialized routes for which data was submitted to generate one measure per operation.

OTHER AGRICULTURAL, RESOURCE, AND MANAGERIAL ECONOMICS EXTENSION BULLETINS

ORDER NO.	TITLE	AUTHOR(S)
E.B. 96-13	Bibliography of Horticultural Product Marketing and Related Topic Papers Third Edition	E.E. Figueroa
E.B. 96-14	Trade Liberalization and the U.S. and Canadian Dairy Industries	M.A. Doyon A.M. Novakovic
E.B. 96-15	A Comparative Assessment of the Milk Hauling Sector in the U.S. and Argentina	E. de Guiguet J.E. Pratt
E.B. 96-16	Dairy Farm Business Summary Eastern New York Renter Summary 1996	S.F. Smith L.D. Putnam
E.B. 96-17	Tax Myths, Truths, and Examples Concerning Farm Property Dispositions	S. Smith
E.B. 96-18	Farm Income Tax Management and Reporting Reference Manual	S. Smith C. Cuykendall
E.B. 96-19	New York Economic Handbook 1997	A.R.M.E. Staff
E.B. 96-20	Supermarket Development in China	G. German J. Wu M.L. Chai
E.B. 97-01	Changing Patterns of Fruit and Vegetable Production in New York State, 1970-94	K. Park E.W. McLaughlin C. Kreider
E.B. 97-02	Micro DFBS: A Guide to Processing Dairy Farm Business Summaries in County and Regional Extension Offices for Micro DFBS Version 4.0	L.D. Putnam W.A. Knoblauch S.F. Smith

These publications should be requested from:

Bonnie Gloskey
Publications Office
Cornell University
46 Warren Hall
Ithaca, NY 14853-7801
607/255-2102
bmg1@cornell.edu