

## Cost of Processing in Cheese, Whey, Butter and Nonfat Dry Milk Plants

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### Project Justification

Benchmarking the cost of processing is a helpful exercise which can lead to improvement in business performance. Firms often engage in internal benchmarking to understand their own costs and to gauge progress in improving those costs over time. While this is internally useful, it is more difficult to assess whether a plant is performing *well* against competitors. Benchmarking across competitor dairy plants can be difficult because a standard of cost determination does not exist, and without that, plants may be comparing “apples to oranges.”

Modern dairy plants are large and complex in product mix, processing technologies and business arrangements. Multi-plant firms may procure inputs at lower costs due to volume purchases helping to create a low cost operation. But they may also assess their individual operations a headquarter expense that independent plants will not have. Determining a uniform procedure for calculating the cost of processing across a multitude plant experiences must adapt to a changing processing landscape.

With Federal Milk Marketing Order (FMMO) reform back in the late 1990s, replacement of the Minnesota-Wisconsin (M-W) price as the Basic Formula Price (BFP) was deemed essential. As Grade B milk supplies had dwindled, it was felt that the survey of unregulated transactions between dairy plants and farmers was insufficient to provide an adequate representation of national markets for milk. A university study committee was assembled to evaluate the performance of 32 options<sup>1</sup> including Product Price Formulas (PPF).

Product Price Formulas were ultimately selected by the U.S. Department of Agriculture as the new BFP. PPFs work by moving up the marketing chain one step to survey unregulated buying and selling of wholesale dairy products and then using those dairy product prices as the means of back-calculating the minimum price of milk used to make those products. Milk is the primary cost of producing dairy products like cheese

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<sup>1</sup> Knutson, Ronald D., et al., “An Economic Evaluation of Basic Formula Price (BFP) Alternatives.”, AFPC Working Paper 96-5. October 1996.

or butter, but it isn't the only cost. Dairy plants also purchase labor, utilities, packaging, etc. to transform milk into finished products, and those costs must be taken into account in a PPF. These parameters are informally referred to as the "make allowances" in PPFs and are another reason why careful benchmarks of the cost of processing are important today.

In most FMMOs, farms are paid for the pounds of components (butterfat, protein, other solids) that they sell in their milk. One of the PPFs used to determine the monthly value of butterfat is:  $Butterfat\ Price = (Butter\ Price - 0.1715) \times 1.211$  where the Butter Price is determined from a weekly survey of product sales<sup>2</sup>; the value of 0.1715 is the make allowance which literally can be interpreted as "It costs 17.15¢ to transform milk into one pound of butter; and the 1.211 parameter is known as the *yield factor* and can be thought of as one pound of butterfat will make 1.211 pounds of butter."<sup>3</sup>

### Research Qualification

The author has been involved in cost of processing studies for more than 30 years. Early work at Cornell University dated back in the 1970s and 80s included the Dairy Information Management System, or DMIS, which was a project to collect and summarize monthly fluid milk plant processing costs. Later work by the Cornell Program on Dairy Markets and Policy (CPDMP) included studies on the cost of processing cheese<sup>4,5</sup>, whey<sup>6</sup>, butter, nonfat dry milk powder<sup>7,8</sup>, again fluid milk<sup>9</sup> and

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<sup>2</sup> The National Dairy Products Sales Report is published weekly by the Agricultural Marketing Service of the U.S. Department of Agriculture. <https://usda.library.cornell.edu/concern/publications/zs25x847n>

<sup>3</sup> Domestic butter is about 80 percent butterfat.

<sup>4</sup> Mesa-Dishington, Jens K., Richard D. Aplin, and David M. Barbano., "Economic Performance of 11 Cheddar Cheese Manufacturing Plants in Northeast and North Central Regions, Part 1 of a Research Effort on Cheddar Cheese Manufacturing.", A.E. Res. 87-2, Dept. of Agr. Econ., Cornell Univ., January 1987.

<sup>5</sup> Mesa-Dishington, Jens K., David M. Barbano, and Richard D. Aplin., "Cheddar Cheese Manufacturing Costs, Economies of Size and Effects of Different Current Technologies, Part 2 of a Research Effort on Cheddar Cheese Manufacturing.", A.E.Res. 87-3, Dept. of Agr. Econ., Cornell Univ., January 1987.

<sup>6</sup> Hurst, Susan, Richard Aplin, and David Barbano., "Whey Powder and Whey Protein Concentrate Production Technology, Costs and Profitability, Part 4 of a Research Effort on Cheddar Cheese Manufacturing.", A.E.Res. 90-4, Dept. of Agr. Econ., Cornell Univ., April 1990.

<sup>7</sup> Stephenson, Mark W. and Andrew M. Novakovic., "Manufacturing Costs in Ten Butter/Powder Processing Plants.", A.E.Res. 89-19, Dept. of Agr. Econ., Cornell Univ., September 1989.

<sup>8</sup> Stephenson, Mark W. and Andrew M. Novakovic., "Determination of Butter/Powder Plant Manufacturing Costs Utilizing an Economic Engineering Approach.", A.E.Res. 90-6, Dept. of Agr. Econ., Cornell Univ., June 1990.

<sup>9</sup> Erba, Eric M., Richard D. Aplin, and Mark W. Stephenson., "Labor Productivities and Costs in 35 of the Best Fluid Milk Plants in the U.S.", E.B. 97-03, Dept. of Agr., Res., and Mgrl. Econ., Cornell Univ., March 1997.

then ultrafiltered milk. Cost of processing projects were again conducted in 2006<sup>10</sup> and 2007<sup>11</sup> when the results were offered as testimony in Federal Milk Marketing Order hearings for changes to the make allowances at the time.

This project again assesses the costs of processing in cheddar cheese, dry whey, butter and nonfat dry milk plants and builds on knowledge and background of these earlier efforts. Changes in methodology have been implemented to better allocate processing costs across multiple products within a plant.

This report is considered to be a “working paper”. The data and observations reported here are not tentative but an additional report will further explore reasons as to why costs vary from plant-to-plant. This paper documents plant selection, data collection, methodology and processing cost summaries.

### Plant Selection

In previous studies, participating plants were carefully selected to be “best practice” plants and plants with a fairly narrow product mix. We have always included plants of various sizes but we looked for plants that were considered by industry observers to be efficient, low-cost processors at any given size. One of the objectives of those studies was to determine the cost “frontier”, or the lowest possible costs over a range of plant capacities. The narrow product mix also meant that it was easier to allocate costs to the primary product produced at the plant.

In more recent studies (Stephenson, 2006), plants were chosen on the basis of a random draw stratified by plant size and region of the country. This was an attempt to select representative plants whose market and experience could vary by geography and explore the economies of scale.

In this study, plant selection was more targeted. It was felt important to assure that plants producing product that may be included in the National Dairy Products Sales Report should be solicited. The author maintains a proprietary list which currently contains about 681 dairy plants in the U.S. This database contains information on location, ownership type, company, location, primary products produced, estimated plant volume, etc. The National Agricultural Statistics Service report on Dairy Products 2019 Summary reports that there were 1,266 dairy plants in the U.S. in 2019. However, many of these plants are very small and produce products that would not be included in the National Dairy Products Sales Report.

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<sup>10</sup> Stephenson, Mark W., “Cost of Processing in Cheese, Whey, Butter and Nonfat Dry Milk Plants”. Working Paper, Cornell Program on Dairy Markets and Policy. September 2006.

<sup>11</sup> Stephenson, Mark W., “Testimony on Cost of Processing in Cheese, Whey, Butter and Nonfat Dry Milk Plants”. Federal Milk Marketing Order Hearing, Pittsburgh, PA. July 9, 2007.

Ultimately, invitations were sent to 153 plants all of whom manufacture one of more of the products shown in Table 1.

Table 1. Minimum Dairy Product Requirements for Inclusion in Study—One or More.

Products Targeted		Number of Possible Plants with Products
Cheddar Cheese	40 lb Block	42
	640 lb Block	
	500 lb Barrel	
Butter	68 lb or 25 kg box	40
Nonfat Dry Milk or Skim Milk Powder	50 lb or 25 kg bags totes or bulk	45
Dry Whey WPC	bags or totes	41

Participation in this study is voluntary. Plants cannot be compelled and are not compensated for the time spent organizing their data. Individual plant data is considered highly confidential and only summary data are provided in this report.

Of the 153 letters of solicitation, about 50 responded either in the affirmative or the negative. The final number of participating plants who returned data are shown in Table 2. A few of these plants submitted incomplete or inconsistent data which were not rectified and thus not used in the final report.

Table 2. Plant Respondents.

Products Targeted	Number of Plants with Products
Cheddar Cheese	10
Butter	14
Nonfat Dry Milk Skim Milk Powder	29
Dry Whey WPC	8

Plant locations were geographically dispersed across all regions of the country except the Southeast where few manufacturing plants exist with reportable products. There were 8 participating plants from the Northeast, 25 plants from the Midwest, and 24 plants in the western states. Slightly more than 80 percent of the plants were cooperatively owned and operated.

## Data Collection

Earlier survey work was conducted with a printed survey form. Using fixed formats, such as a printed survey, requires that you have enough pages to cover all possible products, package sizes, labor, utilities, etc. for all possible plant configurations. Although filling out such a survey might be a relatively “sparse matrix” for any given plant, the document would be daunting in the number of possible pages and might diminish participation.

A stand-alone computer program was developed that would build a questionnaire based on responses to previous questions. For example, first identifying products produced at the plant generated subsequent questions about package sizes and monthly volume of production of the individual products. And, identifying package sizes then generated questions about the packaging costs for those particular containers. Every survey was unique to the plant responding to the questions. Versions of the program are available for 32 and 64 bit Windows operating systems and 32 and 64 bit Apple OS and Unix platforms.

When surveys were complete, they were submitted as an email attachment or directly from the program. The electronic data collection process streamlined the data entry and reduced possible re-entry errors from keying data into a computer from the paper forms. Anecdotal evidence from participants indicate that completing the survey required between 4 and 8 hours of work depending on the complexity of the plant and the sophistication of the information retrieval systems of the company. Appendix A includes the directions for the Cost of Processing (COP) program with example screen shots for a cheese plant. This gives an idea of the questions that were asked and the data collected.

## Methods

Key questions regarding methods involve: 1) What is included in the cost of processing and 2) How are costs allocated across products produced?

The cost of processing is intended to capture the costs of transforming milk and other dairy ingredients into the dairy products of interest. There is no need to consider the cost of the milk or dairy ingredients purchased nor is there a need to know dollar value of the sales of the finished product. We are not trying to determine profitability of plants, just the cost of processing.

While it might seem as though this strict definition of product transformation would create a bright line of demarcation between included and excluded costs, there are grey areas. One of those areas includes sales and general administrative costs. An attempt is made to separate the overhead costs required to own and operate a processing plant from the marketing expense. Product must be sold for plants to be viable, however, marketing costs can vary tremendously depending on your target channel (e.g., are

plants selling consumer packages to higher end retailers or delivering bulk products to firms specializing in final product marketing). For this reason, all sales expenses are excluded from the cost of processing figures. But, some plants are charged a “headquarters” expense. This expense often covers centralized services such as legal, accounting, etc. that would otherwise be line items in a plant’s general ledger.

Anywhere plant expenses can be directly allocated to a particular products, plants are asked to do so. A good example is utility expense where individual electric or gas meters can be recorded and assigned to a product line such as cheese or powdered products. Some expenses must be indirectly allocated to products.

Labor costs are identified by job function. Functional areas depend on the product mix but include such centers as receiving and tanker washing, cheese processing, cheese packaging, dryer labor, powder bagging, cold room, etc. Cheese processing or packaging labor are clearly assigned to cheese labor costs. However, job functions such as receiving and tanker washing should have labor apportioned to both cheese production, whey processing, etc.

Until recently, the California Department of Food and Agriculture’s (CDFA) Division of Marketing Services had compiled and published manufacturing cost data for many years. For CDFA, any cost that cannot be clearly assigned to a single product line is apportioned according to the percent of milk solids processed in the various product lines. For example, a plant that brought in 100 pounds of raw milk and processed it into cheese, dry whey and whey cream might have sold 5.85 lbs of solids (fat and solids-not-fat) in the cheese, 6.12 lbs of solids in the dry whey and 0.20 lbs of solids in the whey cream. This would mean that \$10,000 of labor in the receiving and tanker washing center would be apportioned as \$4,807 to cheese, \$5,029 to dry whey and \$164 to whey cream. Any other costs which are unallocated to specific product lines are apportioned indirectly in the same way as the labor cost example.

There can be a problem with the CDFA methodology. Suppose that a plant brings in farm milk and makes nonfat dry milk powder and sells the cream. But, the plant also sells some skim milk and also quite a bit of condensed skim milk. If a majority of the total solids are in the skim milk and the condensed skim milk and cream, a large amount of the total costs would be allocated to these minimally processed products and the nonfat dry milk powder would appear to have a very low cost of processing.

To circumvent the problem with the CDFA methodology, we assign a degree of processing transformation to each product sold from the plant. The scale is from 1 to 10 where 1 represents minimal processing and 10 represents a high degree of transformation. If a plant produces cheese and sells wet whey, the cheese is assigned a transformation value of 8 whereas the liquid whey is assigned a value of 1. Transformation values were discussed with processing folks with the University of Wisconsin’s Center for Dairy Research. Table 3 shows the value judgements used for various products.

Table 3. Product Transformation Values.

<b>Product Sold from Plant</b>	<b>Transformation Value</b>
Milk (reload from plant)	1
Skim Milk	2
Cream	2
Skim Condensed	4
Butter	6
Nonfat Dry or Skim Milk Powder	9
Whole Milk Powder	9
Cheese	8
Whey (wet)	1
Condensed Whey	4
Dry Whey	9
Whey Protein Concentrate (wet)	6
Whey Protein Concentrate (powder)	10
Dry Lactose	10

An example of the allocation factor is shown in Table 4. Suppose that a plant used milk to produce and sell butter, nonfat dry milk and cream. The pounds of the finished product are given in the second column and the pounds of solids contained in the finished product are shown in the third column. The degree of transformation is also assigned in the fourth column and these factors produce the allocation factor in the right-hand column.

Table 4. Example Allocation Factor.

<b>Products Produced</b>	<b>Pounds of Product</b>	<b>Pounds of Solids</b>	<b>Degree of Transformation</b>	<b>Percent Allocation</b>
Butter	28,000	24,000	6	16%
NFDM	75,000	74,000	9	75%
Cream	85,000	40,000	2	9%

If the plant has a single electric meter and bill for \$3,000 then the nonfat dry milk is assigned 75% of the cost or \$2,250 which is 3¢ per pound. If you allocated only by the percent solids then the cost per pound would be just a little over 2¢ per pound and probably an understatement of the electric cost.

The data collection application has many places where it can be up to the plant to allocate costs to a product center. This is always preferred as they plant is in a better position to make that judgement. For example, the payroll screen would provide places for labor costs specifically for the butter churn, the cold room, the evaporator, dryer, powder bagging, as well as more general plant payroll such as laboratory personnel or maintenance workers. If costs are given for specific products, those are used. If they are not, they are allocated as shown above.

Every plant's data is scrutinized for completeness and accuracy relative to internal and external benchmarks. All data reported here have satisfied the researcher as to reasonable measures of accuracy and integrity. There are some data which are clear outliers as far as costs go, but plants have been asked to explain these and verify that they were charged to the manufacture of the product.

Another exception to CDFA's procedures is in the calculation of return on investment (ROI). Normally, ROI is a calculation based on the profit of the firm relative to the value of the assets needed to generate the profit (the investment). We are not collecting information on the sale of products nor on the cost of the major ingredients (milk) in this project. As such, we cannot calculate a firm's profit nor the ROI. However, an allowance for a ROI is viewed as an opportunity cost for the firm. If the firm invested the value of the capital assets in another venture or in financial instruments, they would expect a return.

CDFA calculates a ROI allowance based on the book value of individual assets depreciated by their own schedule. This is an attempt to determine a true economic depreciation and not a tax value depreciation (which tends to undervalue older plant and equipment). Determining the original purchase price and setting up a depreciation schedule for every building and piece of equipment for each plant is beyond the scope of this project. Plant's were asked to provide "market value of assets" for the plant and this is the value that is used to calculate a ROI allowance. Some plants were not able to estimate the plant's market value and left these fields blank. Those plants did not have a ROI allowance included in their cost of production.

Valuation of assets is half of the information needed to calculate a ROI allowance—a suitable rate of return is the other. CDFA had used the Moody's Baa corporate bond index as their rate and this project does also. This index is considered to be a medium-grade investment vehicle. It is comprised of bonds better than "junk" status but not as solid as "gilt edged" bonds—In other words, a middle of the road rate of return. Appendix B shows the monthly Moody's Baa Corporate Bond Index values for the last three years. The Moody's Baa Corporate Bond Index value used to calculate a return on the value of assets was 4.62%.



### Processing Cost Results

At the time of publication of this report, a few plants had not completed all of their data entry or responded to questions about data submitted. There were 10 cheese and 8 whey plants, 12 butter and 27 nonfat dry milk plants with completed data. There was good geographic dispersion of the plants from all dairy regions of the U.S. including the West, Central, Upper Midwest, Northeast.

Plants were asked to supply one year's worth of data. Many of the values are requested as an annual summary but some are requested on a monthly basis. It is suggested that a plant select the most recent twelve-month period which corresponds to their fiscal year. Because the plants have some latitude for time period, the results do not always correspond to a calendar year or even to the same twelve-month period. Participating plant data span an 39 month period of time from October, 2017 through December, 2020. The modal observations were for the 2018 calendar year.

Plants may have processed several products but only cheddar cheese, dry whey, butter and nonfat dry milk powder results are presented here. The other products have had processing costs allocated to them in just the same way and those costs are not born by the products of interest. Although whey protein concentrate processing costs were of interest, there were too few to report.

The reporting format and the cost categories shown here are the same as CDFA's. "Processing Labor" includes all direct and indirectly allocated labor except for plant management and clerical labor. "Utilities" include all electric, natural gas or other energy costs. "Packaging" includes boxes, liners, totes, tape, labels, glue, pallets, pallet sheets, stretch wrap, etc. "Non-Labor or Utilities Processing" includes all non-dairy ingredients, such as salt, starter, etc., depreciation, taxes, cleaning, laboratory and general supplies, etc. "General & Administrative" includes management and clerical labor (but not sales or marketing), dues, postage, legal & accounting, headquarters expense and short-term interest. The "Return on Investment" is calculated as the applicable Moody's Baa rate times the market value of the plant and equipment. A few firms did not include a market value estimate so an ROI was not calculated as a cost for the firm.

As in previous cost of processing studies, there is a great range in the total cost of processing. The tables below show the weighted average of all participating plants and these plants are also rank separated by the 50% lowest and 50% highest total cost of processing.

### Observations

Comments regarding differences from previous study are making comparisons to the 2006 cost of procession study. The 2007 update was a quick look at a subset of plants in the 2006 study who also participated in the 2007 update. The 2006 study was the more comprehensive evaluation.

Butter processing costs have only slightly increased over the last decade since the previous cost study was done. The weighted average costs are about 3¢ per pound higher and can mostly be attributed to higher processing labor costs. Packaging and other processing costs are about the same.

In contrast to butter, nonfat dry milk processing costs have risen the most. The range on total cost of processing for NFDM plants has become much larger than earlier studies, but even the low cost plants have substantially higher costs than in previous work. As with butter, labor costs per pound have about doubled but the non-labor processing costs are much higher.

In cheese plants, the lowest cost plants today are managing to achieve approximately equal costs to plants of ten years ago. Labor costs in the low cost plants are even lower today than they were in the best plants a decade ago suggesting that labor saving mechanization has been employed in these plants. The high cost cheese plants have labor costs per pound that is about 3 times higher than the low cost plants. Comparing the labor costs per pound in the high cost plants of today to the high cost plants of a decade ago, we see that labor costs have about doubled which is a similar observation to the butter and powder plants. This reinforces the notion that the high cost plants have not invested in labor saving technology like the low cost plants have. The high cost cheese plants have also experienced a near doubling of the non labor processing costs while the low cost plants have managed to keep those costs in check as well.

Whey processing costs are higher today than they were a decade ago. The average volumes processed in the survey plants is similar to plants in the 2006 study. Labor costs per pound are about double in the current survey compared to the earlier studies. Even though more product was shipped in bulk in the current survey, average packaging costs were only slightly lower in this study.

The cost structure processing has clearly changed over the last ten years. The results hold true when looking at the same plants that have participated in both studies, and they are more generalizable to the different plants in the three cost surveys. The lowest cost plants have found means of cost control to moderate the rise in input prices while the higher cost plants have not. The range of processing costs across all products is noticeably greater today than it was in 2006.

Table 5. Plant Costs for Nonfat Dry Milk Processing.

	Product Pounds	Processing Labor	Utilities	Non-Labor or Utilities Processing	Packaging	General and Administrative	Return on Investment	Total Cost
<b>Low Cost</b>	61,887,431	\$0.0558	\$0.0316	\$0.0924	\$0.0156	\$0.0034	\$0.0140	\$0.2128
<b>High Cost</b>	29,874,445	\$0.0932	\$0.0426	\$0.2167	\$0.0238	\$0.0341	\$0.0218	\$0.4323
<b>All Plants</b>	44,425,802	\$0.0695	\$0.0356	\$0.1380	\$0.0186	\$0.0146	\$0.0168	\$0.2933
<b>N =</b>	27							

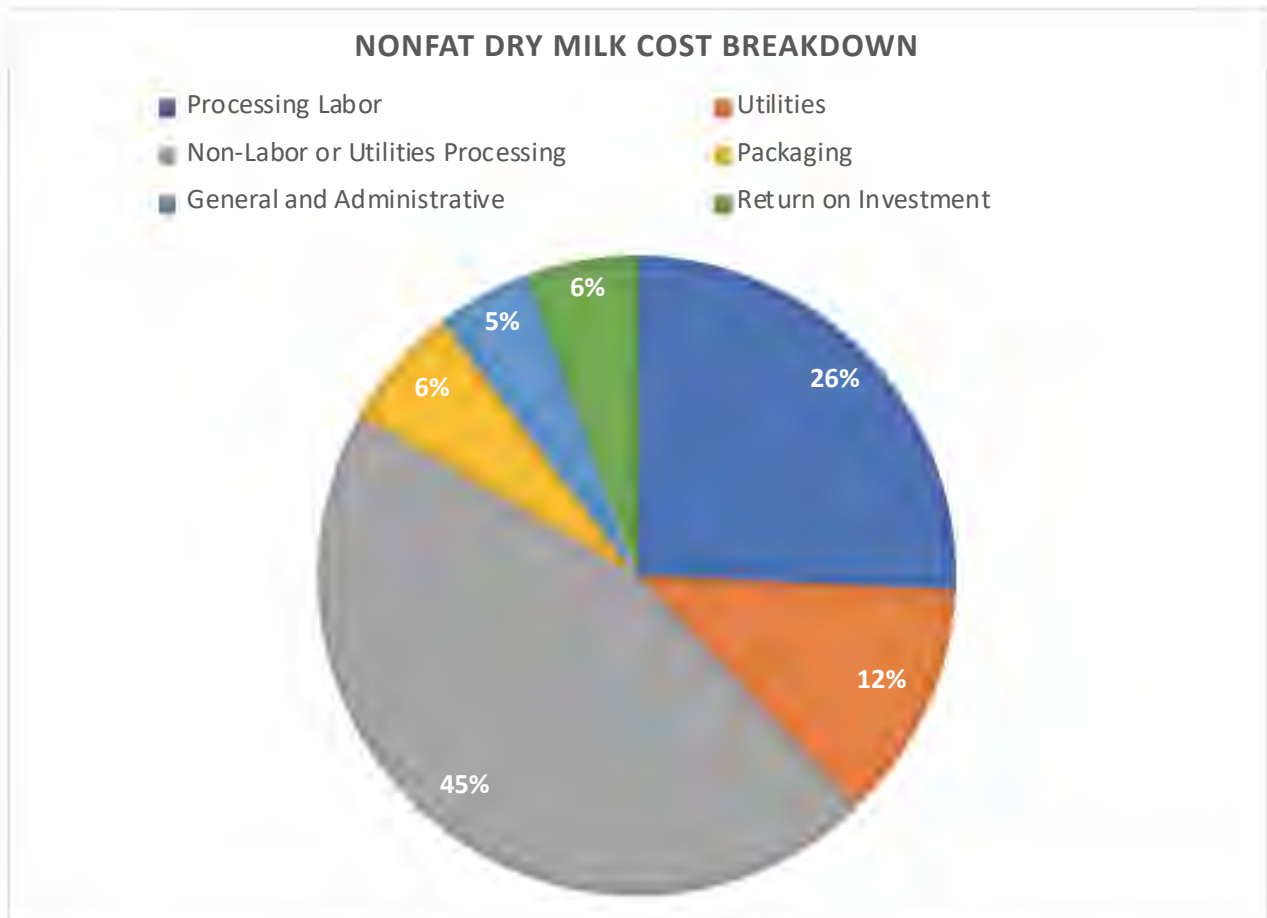


Figure 1. Proportional Breakdown of Costs in Nonfat Dry Milk Plants.

Table 6. Plant Costs for Butter Processing.

	Product Pounds	Processing Labor	Utilities	Non-Labor or Utilities Processing	Packaging	General and Administrative	Return on Investment	Total Cost
<b>Low Cost</b>	175,421,749	\$0.0382	\$0.0078	\$0.0442	\$0.0175	\$0.0018	\$0.0055	\$0.1151
<b>High Cost</b>	77,781,269	\$0.1021	\$0.0128	\$0.0708	\$0.0167	\$0.0203	\$0.0063	\$0.2289
<b>All Plants</b>	136,365,557	\$0.0528	\$0.0089	\$0.0503	\$0.0174	\$0.0060	\$0.0057	\$0.1411
<b>N =</b>	12							

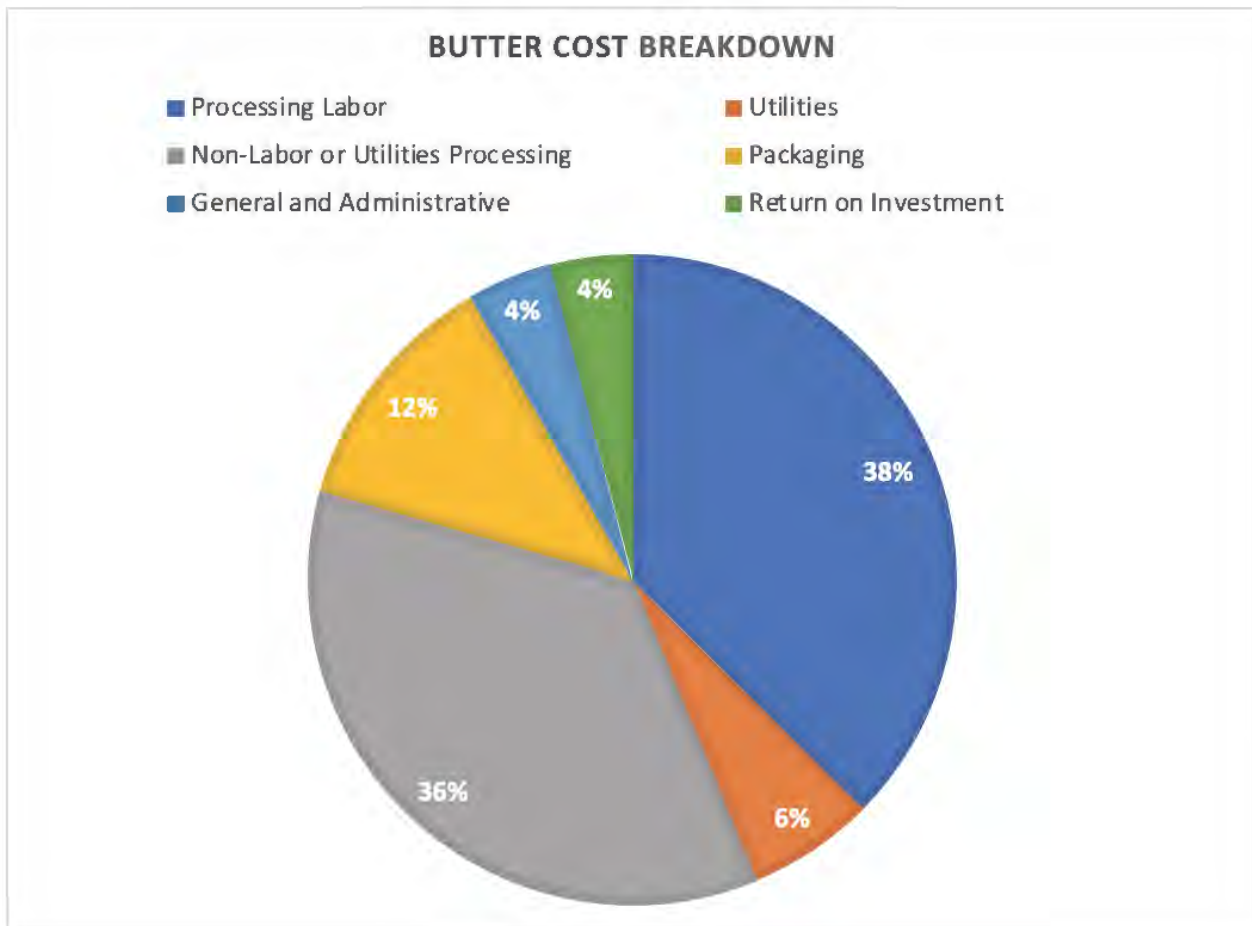


Figure 2. Proportional Breakdown of Costs in Butter Plants.

Table 6. Plant Costs for Cheddar Cheese Processing.

	Product Pounds	Processing Labor	Utilities	Non-Labor or Utilities Processing	Packaging	General and Administrative	Return on Investment	Total Cost
<b>Low Cost</b>	68,700,515	\$0.0405	\$0.0142	\$0.0627	\$0.0179	\$0.0011	\$0.0089	\$0.1454
<b>High Cost</b>	53,401,020	\$0.0974	\$0.0266	\$0.1882	\$0.0149	\$0.0324	\$0.0197	\$0.3792
<b>All Plants</b>	61,050,768	\$0.0654	\$0.0197	\$0.1176	\$0.0166	\$0.0148	\$0.0136	\$0.2476
<b>N =</b>	10							

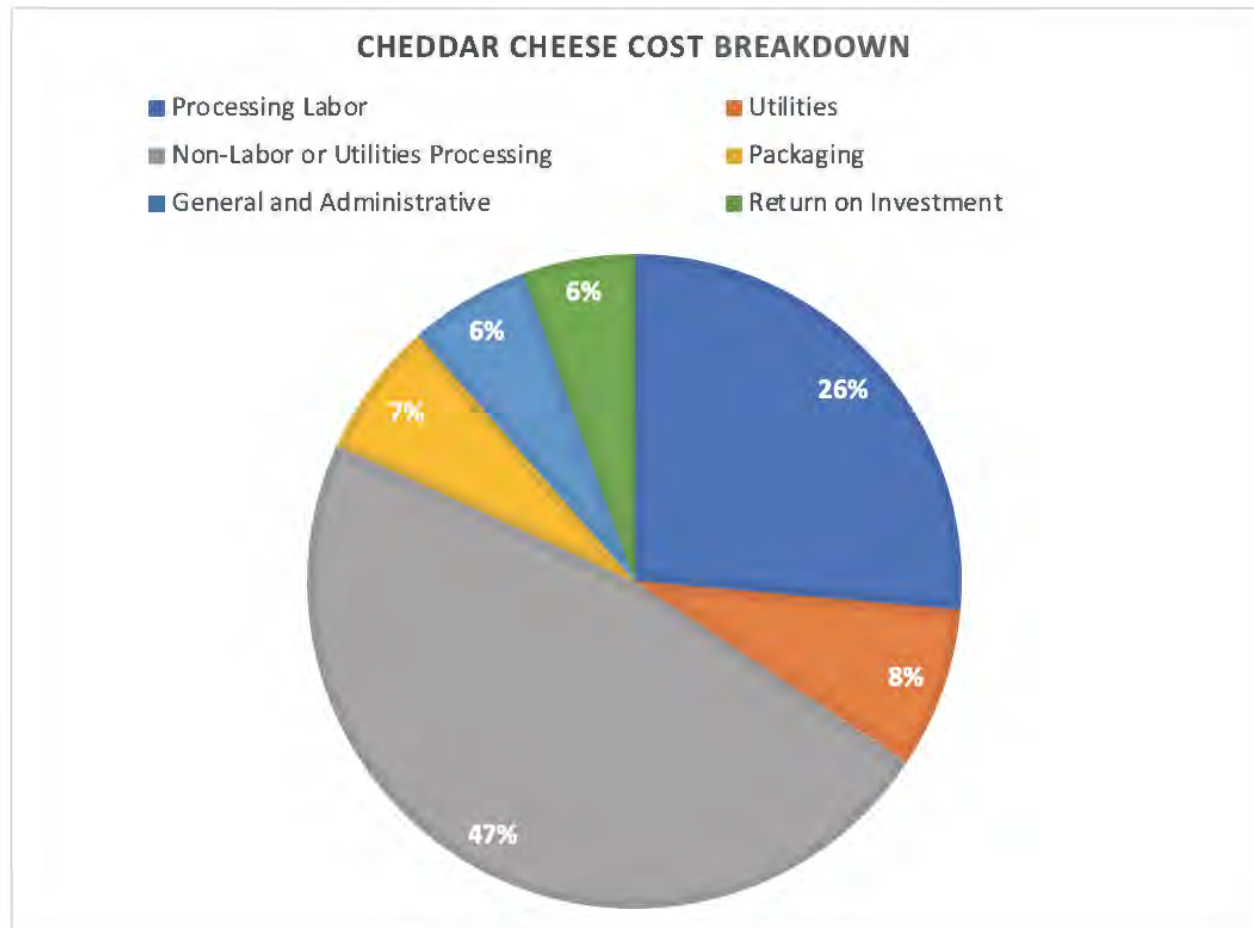


Figure 3. Proportional Breakdown of Costs in Cheddar Cheese Plants.

Table 7. Plant Costs for Dry Whey Processing.

	Product Pounds	Processing Labor	Utilities	Non-Labor or Utilities Processing	Packaging	General and Administrative	Return on Investment	Total Cost
<b>Low Cost</b>	37,785,800	\$0.0783	\$0.0233	\$0.0526	\$0.0098	\$0.0028	\$0.0227	\$0.1895
<b>High Cost</b>	33,547,011	\$0.0987	\$0.0284	\$0.1567	\$0.0139	\$0.0000	\$0.0524	\$0.3502
<b>All Plants</b>	35,666,405	\$0.0879	\$0.0257	\$0.1016	\$0.0117	\$0.0015	\$0.0366	\$0.2650
<b>N =</b>	8							

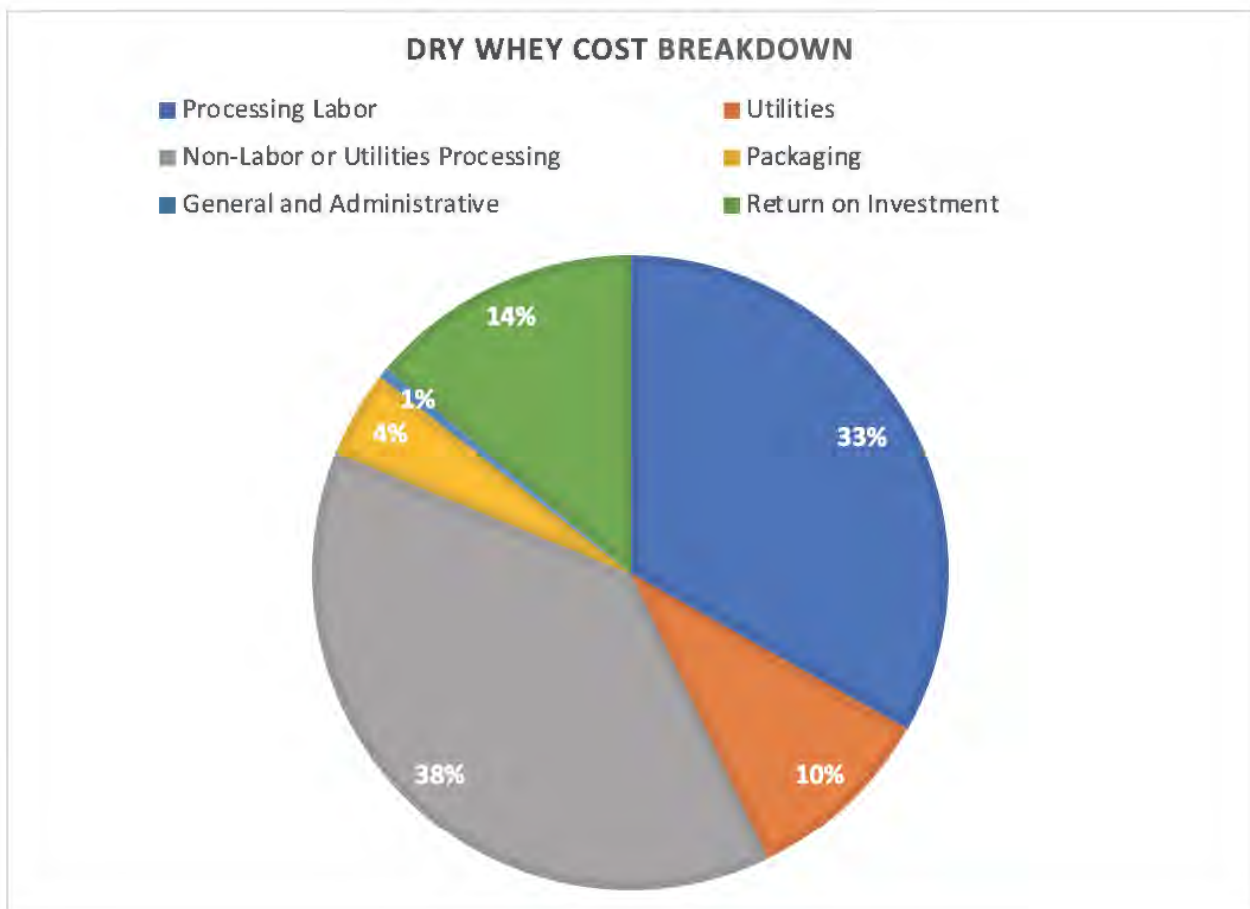


Figure 4. Proportional Breakdown of Costs in Dry Whey Plants.

Appendix A—Directions for Using the Cost of Processing Program

Welcome to the Cost of Processing project (COP). We have been conducting cost of processing projects for more than 30 years. In the past, fluid plants, cheese and whey plants, and butter/nonfat dry milk plants have been surveyed and the costs of processing determined. This project is in the same family of projects but it has some new features.

Previous efforts sought out “best practice” plants and plants with a fairly streamlined product mix. This meant that we didn’t need to make a significant effort to allocate costs across multiple enterprises. We typically conducted those surveys with a paper response form. This time, we are able to include plants with a much wider product mix and, because the survey instrument is a computer program, we are able to limit the questions asked to those which are relevant to each plant.

Please rest assured that the confidentiality of your responses is of the utmost concern to us. We have never had a breach of confidence in any of our previous projects and we will continue to hold ourselves to that high standard. Although this survey is being conducted on the computer, it is a stand-alone program that resides on your computer only until you are ready to send in the results. When you are ready to send results you will need to be connected to the internet. The database itself that is sent is encrypted and the connection that is made to Cornell is done with a “secure socket layer” assuring that your data cannot be lost or stolen—our security is as high as web sites which accept credit card data.

## Starting the program

The program which you have downloaded or received on a disk is entitled “COP.exe” and is compatible with Windows 2000 through Windows Vista. It is also available in Macintosh or Linux format. If you would prefer one of those operating systems, please contact Mark Stephenson at (608) 890-3755 or email at mark.stephenson@wisc.edu and it will be sent to you.

There is no installation of the program other than to copy the program file to a new directory. The first time that you launch the program a dialog box will appear as follows:



A new file will be created in the Application Support directory of your user folder, and it will be called “COP.rsd”. This is the database file with your responses in it. If you change the name of this file or delete it, a new file will be created with the original file name. As you

enter data into the program, there is no need to save the data. Every time you navigate from one screen to another, or when you quit the program, the data are automatically written to the disk.



The first data entry screen collects contact information. This should be filled out with the name and other information about who we should contact if we have questions about any data entries. It also tells us a bit about the plant itself—its location and ownership type.

The screenshot shows a web-based data entry form titled "General Information". At the top, there is a dropdown menu with "Wonderful Cheese" selected and a "Next Screen" button. On the left, there is a yellow sticky note icon labeled "Add Notes". The form is divided into two columns. The left column contains fields for "Contact Person" (Fred Smith), "Company Name" (Wonderful Cheese Co.), "Contact Address1" (123 Milky Way), "Contact Address2" (empty), "City, State, ZIP" (Vista, WI, 54000), "Country" (USA), "Contact Phone1" ((715) 123-4567), "Contact Phone2" (empty), and "Contact eMail" (Fred@Wonderful.com). The right column contains a section titled "Plant Location" with fields for "Plant Name" (Wonderful Cheese), "Plant Address1" (123 Milky Way), "Plant Address2" (empty), "City, State, ZIP" (Vista, WI, 54000), and "Country" (USA). Below these fields is a question "What is the structure of plant ownership?" with a dropdown menu set to "Private". At the bottom left, there is a note: "You will need to enter a year's worth of data--please choose a recent 12 month period. Some values will be requested on a monthly basis and some on an annual basis. You may want to select your most recently completed fiscal year." To the right of this note is a dropdown menu showing "Jan-04 through Dec-04".

On this screen you also need to choose a recent 12 month time period. Much of the data that we ask for is annual but there are a few places where we would like monthly data. This helps us have a clearer idea of how seasonally the plants operates. We suggest that you choose a 12 month time period that corresponds to your fiscal year if that will make annual data summary easier for you.

When you are finished with this screen, you navigate to the next screen by clicking on the "Next Screen" button in the upper right-hand corner of the screen or by selecting "Next Screen" from the Screens menu. Alternately, you can use the key combination "ctrl-N" (cmd-N on an Apple computer) to move forward to the next screen.

You will notice that every screen has an “Add Notes” button in the upper left-hand corner. This button will present a small window that will enable you to enter any reminder notes to yourself or explanations to me about unusual data entries. For example, in the first screen you might have a note that explains: “The plant had a major investment in drying facilities during this fiscal year.” Adding notes are not mandatory but they may provide clarity. Any screen that has a note added will be labeled with “Edit Notes” instead of “Add Notes” button.

To some extent, the data need to be entered in a sequential order. This is done because the answers on any given screen will determine which questions you are asked on subsequent pages. For example, the screen below determines what products were produced and sold from the plant during the year that you chose. Select or enter all of the relevant products from the pulldown boxes. If you produce a unique product that isn't in the selection list, you may simply type your product in the pulldown box. For example, Edam was not a cheese type in the list. The selections on this page will determine questions on subsequent pages.

Again, “ctrl-N” moves you to the next page. The next page(s) will ask you questions about the annual production in various package sizes for all of the products that you selected on the previous screen. You may enter package sizes which are not listed but you should give an indication of the package size—such as “5 kg bag”.

Here, you can see that the questions are being asked about the cheddar cheese that you selected on the previous screen. At the bottom of the page, the total annual production of cheddar cheese in various package sizes is shown.

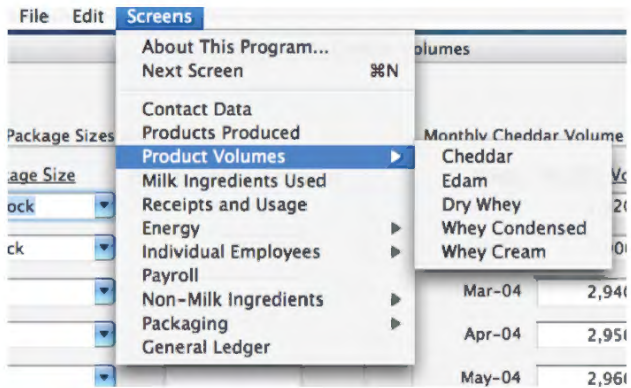
**Cheddar Package Sizes and Volumes**

Package Size	Annual Volume in Package
640 lb Block	26,250,000
40 lb Block	8,750,000
<b>Total</b>	<b>35,000,000</b>

**Monthly Cheddar Volume**

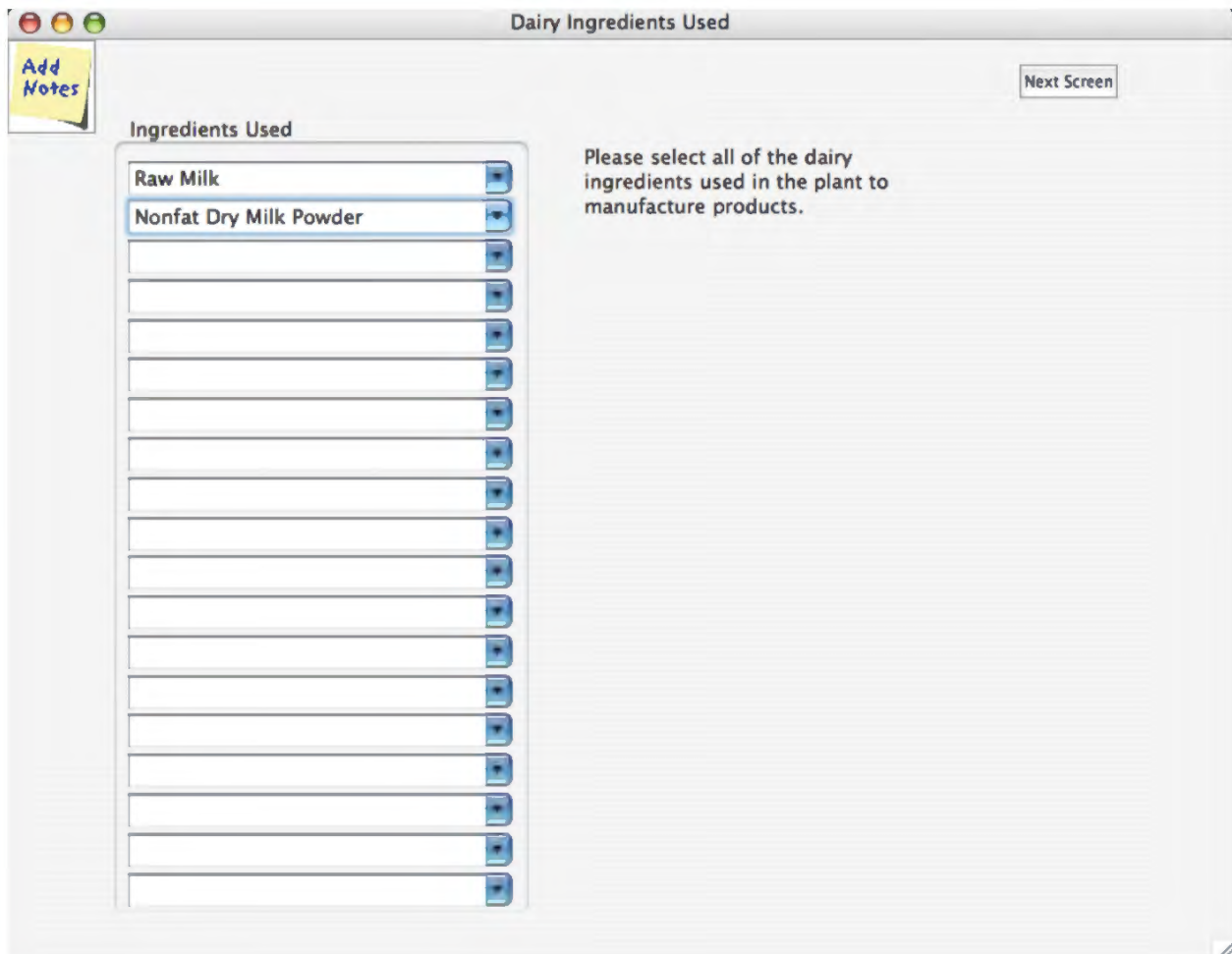
Month	Monthly Volume
Jan-04	2,920,000
Feb-04	2,900,000
Mar-04	2,940,000
Apr-04	2,950,000
May-04	2,960,000
Jun-04	2,970,000
Jul-04	2,970,000
Aug-04	2,950,000
Sep-04	2,900,000
Oct-04	2,900,000
Nov-04	2,900,000
Dec-04	2,740,000
<b>Total</b>	<b>35,000,000</b>

The right-hand side of the screen asks questions about the monthly production of products. This will help us understand the seasonality of your production. The total annual production is calculated as you enter values in the months and this total should equal the calculated total from the annual package volumes. If the totals are not approximately equal, a notice will inform you and you can make appropriate changes.



The Screens Menu lets you navigate through all of the entry screens. Once the products and package sizes have been entered, you will see that the screens menu now has additional screens to access such as the product volume screens and the package sizes.

The next page is similar to the screen that allowed you to select the products produced at the plant. However, this screen asks you to select all of the milk ingredients used at the plant. You may select ingredients from the list or enter other dairy ingredients by typing them in.



After selecting the dairy sources used to make product at the plant, you are asked to reconcile their component usage in the plant. Here, we need inventories and purchases of the butterfat and the solids-not-fat (SNF) for the year as well as an accounting of their use. These do not need to exactly equal as there is an allowance for plant shrink. However, please try to carefully account for the solids used during the year.

This is an important data screen. The pounds of total solids in various products are used in the calculations to allocate processing costs that can't otherwise be allocated. If you don't know the the SNF in the cheese produced, it can be estimated by accounting for the SNF in the cheese vat and subtracting from that the SNF in the whey products produced from the vat.

Reconciliation of Receipts and Usage

Add Notes Next Screen

Receipts	Jan-04 Bfat Inventory, lbs	Jan-04 SNF Inventory, lbs	Pounds Butterfat Purchased	Pounds SNF Purchased	Dec-04 Bfat Inventory, lbs	Dec-04 SNF Inventory, lbs
Raw Milk	36,700	87,500	13,101,900	31,237,500	33,030	78,750
Nonfat Dry Milk Powder	225	43,650	1,164	231,636	250	48,500
	36,925	131,150	13,103,064	31,469,136	33,280	127,250
	13,106,709 total pounds of butterfat available		31,473,036 total pounds of solids-not-fat available			

Usage:	Pounds Butterfat Used in Product	Pounds SNF* Used in Product
Cheddar	12,360,000	8,750,000
Edam	5,340	6,130
Dry Whey	30,000	19,185,000
Whey Condensed	94,741	2,131,680
Whey Cream	98,000	3,400
	12,588,081	30,076,210
	12,588,081 total pounds of butterfat used	
	30,076,210 total pounds of solids-not-fat used	

\* Please note that SNF in cheese may be estimated by accounting for the SNF in the cheese vat and subtracting from that the SNF in all whey products produced from that cheese vat.

The next set of pages deals with energy usage in the plant. These should be entered on a monthly basis so that we can determine the cost and units used. The first pull-down box lets you choose the energy source—Electricity, various forms of gas, fuel oils, coal and purchased steam. To the extent possible, use the next pull-down box to allocate the usage. For example, if you have an electric meter that is unique to the cheese plant, then you should select either “Cheese Products” (as shown below). This should be done for all electric or gas meters. If a meter is not specific to say the cheese or whey operations in the plant, you should choose “Unallocated” and we will allocate the usage for you.

You may add as many meters and/or energy sources as needed by using the “Add Another Energy Source” button on the bottom right corner of the screen. When you are done with the last energy source, “ctrl-N” will take you to the next set of screens.

Energy Costs

Add Notes

Next Screen

Electricity

Product Category: Cheese Products

Invoice Identity: Cheese plant

	Cost	kWh
Jan-04	16,800	240,000
Feb-04	14,000	200,000
Mar-04	17,500	250,000
Apr-04	17,850	255,000
May-04	18,200	260,000
Jun-04	18,550	265,000
Jul-04	17,500	150,000
Aug-04	16,800	240,000
Sep-04	16,450	235,000
Oct-04	16,100	230,000
Nov-04	16,100	230,000
Dec-04	15,750	225,000
Annual Total	201,600	2,780,000

Please report all forms of energy used in the plant. If you receive energy bills for more than one meter at the plant, please try to assign it's use to product categories. For example, if one electric bill is for a meter into the cheese plant then report that as energy used for cheese processing. If a second meter is for the whey facility, then report that as energy for whey. If a meter records energy for many products, then report it's costs and units as unallocated. You can identify your meters in the box above like: "Shore-to-Shore Electric, meter 3".

Add Another Energy Source

The next set of screens are the employee screens. Because labor is perhaps the most important cost of processing, please take time to do this carefully. We would like you to enter each employee separately in the program (although there is another option that will be explained later on the next page). On this screen you have the option of entering the payroll and benefits on a monthly basis or as an annual total for the employee. The example is showing a monthly entry where the annual amount is automatically totaled for you.

The most important part of the employee cost screens are that you allocate their labor across the possible job descriptions in the pull-down boxes on the right-hand side of the page. The example below shows that Elmer spent about 75% of his time in Receiving, 20% in the Pasteurizer/Separator/CIP area, and about 5% as general plant labor. This kind of breakdown should be done for each employee. Add additional employees by clicking on the “Add Another Employee” button on the bottom right. When done, you may advance to the next screen by hitting “ctrl-N”.

The screenshot shows a software window titled "Employees". On the left, there is a yellow sticky note that says "Add Notes". The main area contains the following elements:

- Employee Information:**
  - Employee Name: Elmer Watkins
  - Employee ID: 377-48-1234 (optional)
- Monthly Data Table:**

	Payroll	Tax and Fringes
Jan-04	3,333	1,100
Feb-04	3,333	1,100
Mar-04	3,333	1,100
Apr-04	3,333	1,100
May-04	3,333	1,100
Jun-04	3,333	1,100
Jul-04	3,333	1,100
Aug-04	3,333	1,100
Sep-04	3,333	1,100
Oct-04	3,333	1,100
Nov-04	3,333	1,100
Dec-04	3,333	1,100
<b>Annual Total</b>	<b>39,996</b>	<b>13,200</b>
- Job Allocation Section:**
  - Job Description** | **% of Time**
  - Receiving & Tanker Washing | 75
  - Pasteurizer/Separator/CIP | 20
  - General Plant Labor | 5
  - (Empty dropdown) | (Empty input)
  - (Empty dropdown) | (Empty input)
  - (Empty dropdown) | (Empty input)
- Buttons:** "Next Screen" (top right), "Add Another Employee" (bottom right).

Because we realize that this is a time consuming task for larger plants and these plants may already have this level of disaggregation in their accounting system, there is a second option.

If you have entered all employees on the previous screens, you will find the summary of payroll by job functions on this screen. If all employees have been entered individually, then there is no need to do anything on this screen.

**If you already keep payroll by these, or similar, job descriptions as a part of your plant accounting, then you do not need to enter employees individually on the previous screens but can enter the summary values on this screen instead.**

Job Function	Gross Payroll For the Period	Total Payroll Allocation
Receiving & Tanker Washing	29,997	39,897
Pasteurizer/Separator/CIP	7,999	10,639
Hard Cheese Processing		
Hard Cheese Packaging		
Whey Processing		
Whey Hauling		
Evaporator Labor		
Dryer Labor		
Powder Bagging		
Bulk Load Out		
Dry Warehouse Labor		
Cold Room Labor		
General Plant Labor	2,000	2,660
	39,996	53,196

Other Known Factors From Payroll	
Temporary Labor	<input type="text"/>
Plant Superintendent	<input type="text"/>
Plant Supervisors	<input type="text"/>
Plant Clerical	<input type="text"/>
Laboratory	<input type="text"/>
Maintenance Engineers	<input type="text"/>
	0

<b>Total Plant Payroll Costs</b>	53,196
----------------------------------	--------

The lower group of job functions shown as “Other Known Factors” should be just entered as the total payroll dollars (including benefits).



The next screen(s) captures information about the non-dairy ingredients used to make products. The example below shows the data needed for a cheese plant. Some information about vat size, the typical yields of cheese, ingredient use and costs are requested. Please note: for these costs, you should use the cost from the most recent ingredient purchase and not an average cost from the year. We are trying to determine the current cost of processing and because these ingredients are often inventoried, we think that this approach is easier for you than adjusting all ingredients for beginning and ending inventories.

In general, you should tell us what you are using to put into a vat and not include product losses. We will add a 1% product loss to account for shrink.

45,000 Lb. vat makes
4,540. Lbs. of Cheese =
9.91 Yield per cwt.

---

Starter Tank:	Unit Ingredient Cost*	Unit	Units Used per Tank
Starter Culture: \$	<input type="text" value="6."/>	per <input type="text" value="can"/>	<input type="text" value="8.9"/> cans used per starter tank
Starter Medium: \$	<input type="text" value="70."/>	per <input type="text" value="pound"/>	<input type="text" value="1.2"/> pounds used per starter tank

Vats can be made per tank of starter culture.

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	Unit Ingredient Cost*	Unit	Units Used per Vat
Rennet: \$	<input type="text" value="0.4297"/>	per <input type="text" value="ounce"/>	<input type="text" value="100."/> ounces used per vat
Color: \$	<input type="text" value="0.0922"/>	per <input type="text" value="ounce"/>	<input type="text" value="50."/> ounces used per vat
Salt: \$	<input type="text" value="0.0593"/>	per <input type="text" value="pound"/>	<input type="text" value="85."/> pounds used per vat
Calcium Chloride: \$	<input type="text" value="0.009"/>	per <input type="text" value="ounce"/>	<input type="text" value="120."/> ounces used per vat
<input type="text"/>	<input type="text"/>	per <input type="text"/>	<input type="text"/> s used per vat
<input type="text"/>	<input type="text"/>	per <input type="text"/>	<input type="text"/> s used per vat
<input type="text"/>	<input type="text"/>	per <input type="text"/>	<input type="text"/> s used per vat
<input type="text"/>	<input type="text"/>	per <input type="text"/>	<input type="text"/> s used per vat

\* Please calculate the cost from the most recent receipt of the ingredient purchased--not an average cost.

Total cost per vat = \$67.44

Total cost per Lb. of cheese = \$0.014855

The next screen(s) relate to packaging costs. We are again asking you to use recent receipts for costs and not an annual average cost. We are building up the cost of packaging based on usage. If you use something else, like glue or labels, then please add them on a per unit basis (in this example, 40 lb block). Also, a 1% loss factor will be applied to the calculated packaging costs in the summary.

Please note: we are only collecting the costs of packaging for 640, 500 and 40 lb. blocks/barrels of cheese; bags and totes of various sizes for powders; and butter in 1/4 and 1 lb. consumer packages and larger commercial sizes (not restaurant packages).

If you purchase pallets for one-way use—in other words, you don’t expect them to come back again—then enter the cost of a pallet in the appropriate box. If you purchase pallets and expect that most of them will come back at a later time, the annual pallet expense will be added on the “General Ledger” screen later.

The screenshot shows a software window titled "40 Lb Cheese Packaging". It contains several input fields for packaging parameters and a table for unit packaging costs.

**Input Fields:**

- Average cheese weight per 40 Lb. block: 41.50 lbs.
- Average inches of tape used to seal a 40 Lb. box: 32 inches
- Average feet of stretch wrap used to secure a pallet: 100 feet
- Average number of blocks secured on a pallet: 45 blocks
- If using one-way pallets, what is the cost of a pallet: 10 per pallet

**Unit Packaging Cost\* Table:**

Category	Unit Packaging Cost*
Cost per 40 Lb. box	0.5190
Cost per bag	0.1869
Cost per liner	0.2800
Cost yard of tape	0.0100
Cost per yard of stretch wrap	0.0120

**Summary:**

- Total cost per 40 Lb. block = \$1.2259
- Total cost per lb. of cheese = \$0.0295

**Footnote:**

1. If the pallets are not disposable, i.e. they eventually are returned to you, an annual pallet cost will be entered later.  
 \* Please calculate the cost from the most recent receipt of the ingredient purchased--not an average cost.

General Ledger Expenses					
Account #	General Ledger Account	General Plant	Cheese Products	Powder Products	Bulk Products
1001	Market Value of Assets	400,000	4,800,000	7,500,000	
1003	Depreciation	40,000	380,000	7,000,000	
4020	Property Taxes	500,000			
2400	Water, Garbage Sewage	85,000			
	Whey Disposal				
	Outside Storage		35,500		
3040	Grading		28,800		
3050	Inspection	86,000			
3060	Pallet Expense (if owned)		7,700	1,200	
3070	Travel & Entertainment	12,500			
3080	Telephone	86,000			
3090	Insurance	120,000			
3095	Laundry	45,000			
	Taxes & Licenses				
	Equipment Rental				
	Cleaning Supplies				
	Laboratory Supplies				
	General Supplies				
	Repair & Maintenance				
	Third Party Testing				
	Dues & Subscriptions				
	Postage				
	Miscellaneous				
	Advertising & Promotion				
	Fees & Assessments				
	Professional Services				
	Legal & Accounting				
	Headquarters Expense				
	Short-term Interest Expense				
<b>Total (Not including Market Value of Assets)</b>		974,500	452,000	7,001,200	0

This is the last entry screen. On it you will be asked to enter general plant expenses that have not already been accounted for. The first column for "Account #" is optional and only for your use. The subsequent columns are provided for you to enter other costs that the plant has experienced. If the cost can be complete or partially allocated to a major center, then please do so. For example, the pallet expense might be split between pallets purchased for cheese production from those used in the whey side of the plant. Some costs probably cannot be allocated such as the telephone or laundry expenses. Those should be just entered in the "General Plant" column.

The most accurate accounting of the costs of processing would include the consumption of your capital. In order to do this, we would have to look at an economic depreciation of the plant and equipment—this is beyond the scope of the study. Instead, we are asking for the depreciation that was claimed on your tax forms recognizing that it will overstate the consumption of newer equipment and understate the the loss of older (fully depreciated) equipment.

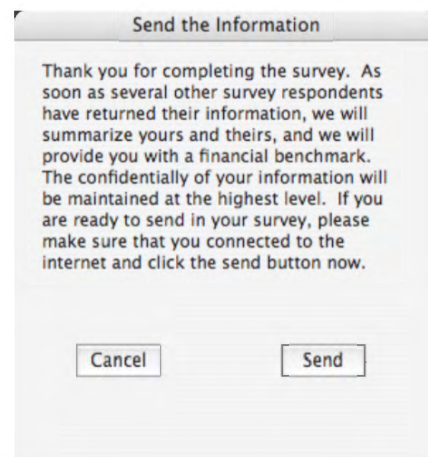
We are also asking you to provide a market value estimate of your plant and equipment. You probably haven't considered the sale of your plant recently but you shouldn't agonize over this number. The number will be used to calculate a return on investment as a legitimate cost of your business.

The bottom of the page also includes a short-term interest expense. This value should not include the interest paid on long-term loans as this value will be captured in the return on investment. However, it should include the interest on loans of one year or less and is meant to reflect a cost of working capital.

### Finishing Up

You may quit the program any time that you wish and return to entering values later. When you quit the program, all data are automatically saved to the file. We consider the current version of the program to be very workable but not final. If your computer is connected to the internet the program will check to see if a newer version is available. We have been correcting errors and adding features as we get feedback from users. If a newer version is available, you will be prompted as to whether you want to download the latest version. If you do, simply replace your existing program with the one you have downloaded. The data file will not have to be altered.

When you are done and satisfied with the data, you will need to submit it to us. The File menu at the top of the screen has a selection entitled "Mail the Survey". Selecting this brings up the following dialog box:



Just hit the "Send" button on this screen and the program will send us the encrypted data file on a secure port. As soon as it is sent, the send screen will go away.

When the data are submitted, it will be scrutinized by us for completeness, accuracy and consistency. If there are errors or questions, we will contact you for clarification. You, of course are welcome to contact us at any time to ask questions or report problems with the program.

We will send you an acknowledgment that we have received your submission. We thank you for participating in the project and we will send you a report of your plant and later, when all of the plants are done, a benchmark of your plant's performance relative to other participating plants.

Appendix B—Recent Monthly Values for Moody’s Baa Corporate Bond Index

Table 8. Interest Rate on Moody's Baa Corporate Bond Index.

<b>Date</b>	<b>Percent Annual Rate</b>
Jan-2017	4.66
Feb-2017	4.64
Mar-2017	4.68
Apr-2017	4.57
May-2017	4.55
Jun-2017	4.37
Jul-2017	4.39
Aug-2017	4.31
Sep-2017	4.30
Oct-2017	4.32
Nov-2017	4.27
Dec-2017	4.22
Jan-2018	4.26
Feb-2018	4.51
Mar-2018	4.64
Apr-2018	4.67
May-2018	4.83
Jun-2018	4.83
Jul-2018	4.79
Aug-2018	4.77
Sep-2018	4.88
Oct-2018	5.07
Nov-2018	5.22
Dec-2018	5.13
Jan-2019	5.12
Feb-2019	4.95

<b>Date</b>	<b>Percent Annual Rate</b>
Mar-2019	4.84
Apr-2019	4.70
May-2019	4.63
Jun-2019	4.46
Jul-2019	4.28
Aug-2019	3.87
Sep-2019	3.91
Oct-2019	3.92
Nov-2019	3.94
Dec-2019	3.88
Jan-2020	3.77
Feb-2020	3.61
Mar-2020	4.29
Apr-2020	4.13
May-2020	3.95
Jun-2020	3.64
Jul-2020	3.31
Aug-2020	3.27
Sep-2020	3.36
Oct-2020	3.44
Nov-2020	3.30
Dec-2020	3.16