MAKE OR BUY, FEASIBILITY OF INTERMEDIATE GOOD PRODUCTION

by

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ABSTRACT

In the manufacturing process one decision that is common to all industries is the sourcing of intermediate goods used in production. The decision to make internally verses to outsource can affect a firm's comparative advantage and increased company profits. This project deals with sourcing trace minerals used in the production of feed for the commercial production of food animals in the United States. From looking at the sources of minerals to the industry to the current market structure of the trace mineral production industry in the U.S. the question is asked whether trace minerals can be sourced differently for the client to gain this advantage.

The specific objective of this research project is to determine whether it is more profitable either to purchase or manufacture trace mineral blends for use in feed ration formulations for a number of plants owned by a representative livestock feed company in western Kansas. The company has several feed plants in operation in the central Great Plains region. Does the company have enough volume of trace mineral usage to enable it to profitably produce its own mineral blends at one of its feed plants? If trace minerals can be profitably produced by the company, it will lead to a decrease in feed production cost for all of its plants. It is possible that this study will show that there is a large enough degree of consolidation in the U.S. mineral blending industry that there is little or no "room" or opportunity available in the competitive raw ingredient market to increase margin by self-producing trace minerals verses outsourcing. The rationale behind this perspective is that the supply of trace mineral blends is controlled tightly by a few existing suppliers / manufacturers who have enough market power and the subsequent ability to limit the entry

of new firms. The raw ingredients required to produce these blends could not be purchased economically enough to realize any cost savings in the trace mineral production process.

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CHAPTER 1: INTRODUCTION

Proper intake of vitamins and minerals is important in the diets of every living organism, including livestock. To meet this nutritional requirement trace minerals are added to the feeds at commercial feed mills. Most feed mills buy trace minerals in pre packaged blends for ease of use, much like purchasing a multivitamin supplement at the drugstore.

A particular livestock feed ingredient company operating in western Kansas supplies protein supplements to the commercial cattle feeding industry in the region. These supplements not only provide protein but also vitamins and minerals to balance the diets of cattle on feed. A substantial amount of trace mineral premixes are used in those supplements.

Competitive pressures in the livestock feed ingredient manufacturing market motivate companies to search for ways to lower production costs. The general objective in this thesis project is to examine ways in which the procurement cost of livestock feed ingredients used in the manufacture of animal feed products can be reduced in the western Kansas feed ingredients market.

The specific objective of this research project is to determine whether it is more profitable either to purchase or manufacture livestock feed trace minerals for use in feed ration formulations for a number of plants owned by a representative livestock feed company in western Kansas. The representative company examined in this study has several feed plants in operation in the central Great Plains region.   The key issue in this study is whether or not the representative feed ingredient company uses enough trace mineral to profitably produce its own mineral blends at one of its mills. If trace minerals can be profitably produced by this representative company, it will lead to a decrease in its feed production cost for all of its plants. It is possible that this study will show that there is a high enough degree of consolidation in the U.S. mineral blending industry that there is little or no “room” or opportunity left in raw ingredient pricing to capture any margin from self-producing trace mineral blends. The rationale behind this perspective is that the trace mineral supply is controlled tightly enough by a few or limited number of low cost suppliers/ manufacturers that ingredients could not be purchased economically enough to realize a cost savings from trace mineral production.

The approach used in this thesis will be to examine whether the available supply of the raw ingredients for trace mineral blend production can be economically transported to a representative production plant located in western Kansas to be blended in to a premix and then delivered to the other plants as opposed to purchasing pre-formulated trace mineral blends from existing suppliers. This analysis will involve evaluating the cost associated with sourcing trace minerals for blending, and the logistical advantages or disadvantages of such blending at a plant in western Kansas as opposed to the other existing plant locations in the United States.

The two existing primary blenders of trace minerals in the United States are located to the eastern part of the country along major inland waterways. It is hypothesized that these existing plants in the eastern U.S. are capable of transporting raw materials by barge in to their production facilities on a very competitive low cost basis as opposed to another plant having to transport these same raw materials to a trace mineral manufacturing plant located in western Kansas. -The key issue to be addressed in this research is whether there it is economically profitable from a logistical perspective to locate production of these mineral blends closer to end users in the Great Plains regions rather than farther away from end users in the eastern United States.

Data acquisition for this project should be straightforward. First, a list of the available raw materials needed for blending this product will be compiled with sourcing information. Second, market prices for needed raw materials will be used along with estimates of product combination or manufacturing costs to determine whether there is any “gross” economic advantage to producing those trace mineral blends “in house”. Consideration of freight / transportation costs will not yet be considered at this point in the economic analysis. The purpose of omitting transportation costs at this stage of the analysis is as follows. First, a pre-transportation cost perspective may provide a truer picture of the market power in terms of production cost held by the current set of trace mineral blenders, and the potential profit margin that may be captured with the “in house” production of this product. The second reason is to look at the issue of the logistical optimization of the geographic placement of a trace mineral production plant to produce these blends in the western plains region of the U.S. Although the western Kansas representative company currently may have the capacity to manufacture this product in one particular location, there may be more logistically efficient manufacturing plant facility location options to consider elsewhere.

CHAPTER 2: LITERATURE REVIEW

This project is a feasibility study analyzing a "produce versus purchase" decision for a product that could be an internally produced by a company. Most similar studies have been performed in the private sector and are proprietary knowledge, and therefore are not publicly available for review. The same is also true of the logistical component of the project. With the locations to be considered being proprietary in nature there is little or no publically available research to review that is relevant to this specific project. This limits the literature that can be reviewed to theory that will be used in the analysis.

(Tallman 2010), discusses the strategic outsourcing of knowledge processes for optimizing the use of company resources. As stated in the article (p. 1434), "A basic premise of outsourcing is that firms should concentrate internally on activities that are strategically important to them, and through which they are capable of generating sustainable competitive advantage". In analyzing the project in this thesis, it is important to assess whether this change is going to provide a comparative advantage in the market by producing a particular product internally as opposed to continued outsourcing. Even though Tallman deals with the outsourcing of knowledge based processes and not physical processes, the underling theoretical issues are the same. Are resources better used elsewhere instead of in house to produce an item?

(Chen 2011), deals with the strategy of sourcing for the deterrence of entry, and gives a good history of real world business examples of where producers have used supply agreements to keep a potential entrant out of the market for producing a similar good. This is relevant in this case since it provides some insight as to how companies A and B may potentially react to the entry of an additional western Kansas feed ingredient processing plant, producing this product in house instead of purchasing it from them as has been done over time. Since Companies A and B are two of the main trace mineral blenders in the United States it might be considered that they implicitly form or operate as an oligopoly in the market for these feed ingredient products.

(Baye 2009), teaches about the production function and the marginal product of labor. The analysis in this project needs to establish the efficient level of production to determine the available existing excess plant capacity that can be utilized. Theoretical principals associated with the firm's production function and the marginal product of labor will be instrumental in estimating the firm's efficient production level.

The common perception is that if a firm is utilizing excess capacity then there is no cost associated with extra production. When using excess capacity accelerated wear of equipment must be accounted for (Brealey, Myers and Allen 2008). The authors outline how to account for accelerated equipment usage from excess capacity utilization in a net present value framework. The increased cost will be taken into account in this project.

When evaluating a project one of the easiest ways to determine the added value that the project contributes to a firm is through the use of a Net Present Value Calculation or NPV as it is more commonly known. A discussion of NPV in "The Principals of Corporate Finance" (Brealey, Myers and Allen 2008), describe how to calculate a NPV for a project and the factors that need to be included. Based on this information the NPV for the project will be calculated to determine its value to the client.

CHAPTER 3: THEORY

In commercial livestock production many factors are involved in meeting the daily nutritional requirements of the animals being fed. Protein supplements are often the method of conveyance of trace nutrients to the livestock feeding operation. These supplements provide not only needed proteins to the diet but also carry the needed vitamins and trace minerals. The supplements are formulated to the specifications of the specific customer to balance the final rations for protein, vitamins, major and minor minerals. To facilitate the ease of production of the protein supplement in a commercial feed mill, often a trace mineral premix with the ingredients that supply the needed nutrients is used (Table 3.1).

The proper balance of trace minerals is important in the nutrition of every living organism. These minerals are available in all feed ingredients that food production animals eat on a daily basis. As confined animal feeding operations have developed in the United States the diets fed to these animals are vastly different from the natural diets these animals would otherwise receive. For efficient production animals need trace mineral supplementation regardless of the diet received, animals fed in confinement often require higher levels of trace mineral supplementation. This is the basis for the trace mineral deficiency that is supplemented by the trace mineral premixes. The available sources listed in Table 3.1 are the most economical way to achieve this.

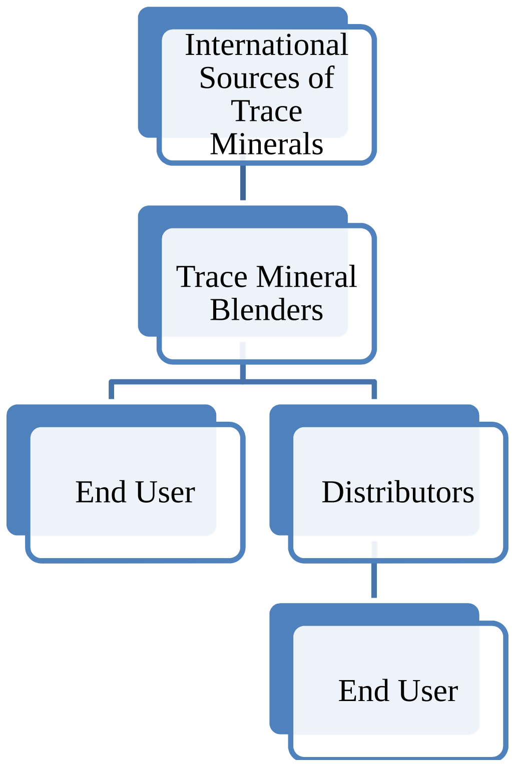
It is proven to be more efficient for the feed manufacturer to weigh one premix and add it to the batch than to use multiple ingredients and add them to the batch multiple times. This increases the efficiency of the mixing process, and reduces the opportunity for mixing errors in the weighing process.

Table 3.1 Trace Mineral Sources for Cattle Feeding

	Trace Mineral Sources	
Nutrient	Source	Location
Zinc	Zinc Oxide	China, Peru
	Zinc Sulfate	India, USA
		Canada
Copper	Copper Sulfate	USA
	Tri Basic Copper Chloride	Peru
	Copper Oxide	Australia
		Chile
Cobalt	Cobalt Carbonate	Africa, Russia
	Cobalt Sulfate	Australia
Iodine	Calcium Iodiate	Chile, Japan
	EDDI	
	Potassium Iodide	
Iron	Ferrous Sulfate	Norway
	Ferrous Carbonate	
Manganese	Manganous Oxide	Africa, Brazil
	Manganese Sulfate	Australia
		China, India
Selenium	Sodium Selentite	Japan, Russia
	Selenium Yeast	Belgium, Canada

The current market structure in the United States for sourcing trace mineral ingredients is illustrated in figure 3.2. There are two main trace mineral blenders in the U.S. that source the ingredients from all over the world, as shown in Table 3.1. Several of these trace minerals are not produced domestically and must be sourced internationally. The distribution of feed ingredient sources for these two primary blenders depends on the volume of the end user and their buying power in the market. Larger end users, such as the representative company, are able to purchase truckload quantities direct from one of these two primary blenders. Smaller users alternatively go through wholesale distributors to enable them to efficiently purchase less than full truck load amounts.

Figure 3.1 Trace Mineral Market Structure



The question posed by the owners of the representative western Kansas feed ingredient company is as follows: can the company economically utilize excess capacity at its western Kansas facility to blend and distribute raw materials instead of buy premixes? Along with that question comes the issue of alternative uses for that excess capacity, which complicates the analysis. For example there is an emerging market for range mineral products that can be produced with the current excess capacity. With most of the equipment in place in the representative company, can the raw materials for trace mineral production be sourced efficiently enough and transported to the other end use facilities more efficiently than is done by the current two major players in the U.S. feed ingredient market? Another implication or key issue to assess is the opportunity cost lost of pursuing this option verses other potentially profitable business investment possibilities.

CHAPTER 4: METHODS

4.1 Objective and Data source

To evaluate whether it is economically profitable to produce a portion (or all) of the trace mineral premix needs for a representative company at its western Kansas location, several factors that are likely to influence the profitability of this decision will be examined. There are three components to this project. The first involves examining the physical trace mineral production capabilities of the current facility in western Kansas. The second component consists of a financial evaluation of the actual raw product procurement and production cost of the trace mineral formula versus the cost of purchasing the completed product. The third component will be an analysis of the logistical aspect of transporting the premix from the representative plant or other locations to the end use locations.

4.1.1 Physical Facilities

The current physical facility examined in this study was built in 1972 as a plant designed to produce dry pelleted protein supplements. Part of this project will examine the current production process, warehousing capacities, and available production capacity of this facility.

Based on tours and/or reviews of similar types of facilities in the Midwest and on information gathered from industry professionals, the current production process will be evaluated to determine if the existing equipment can be adapted to the production of a trace mineral premix product. This will involve physically testing the current equipment to determine if it is capable of producing this type of product, and determining if additional equipment is needed to handle the extra ingredients required.

Commercial cattle feeding is cyclical in nature due to the seasonal availability of alternative feeds. Because of this there are times of the year when the plant has excess capacity available that could be used for the seasonal production of trace mineral blends. Using historical production data from the facility, we will analyze this seasonal production cycle in addition to determining an efficient level of production. These two data points will then be used to determine the amount of excess production capacity in the current plant configuration that is available for trace mineral premix production.

Finally, listed in the physical facilities section will be the storage available for finished product. Since most of the excess production capacity is expected to be available in the summer time, storage space will be required for a portion of the product produced. This requires an evaluation of the current available warehouse space that can be allotted to the product as well as inventory management strategies that can be used.

4.1.2 Production Cost

Evaluating the production cost of trace minerals will involve comparing the cost of manufacturing the trace mineral premix in house against the competing bids of companies A and B to provide the finished product. This will determine whether there is any operating margin to be captured (i.e., whether the process of producing the feed ingredients in house is profitable). Since the formulas for the trace mineral premix are proprietary in nature, the optimization and pricing of the internal cost will be done using a commercial formulation package to determine formula cost for comparison. Data for the internal cost of production are derived from the cost of ingredients provided by company A. Select ingredients will be priced direct from the manufacturer to verify the pricing available from company A. The purchase cost data for the outsourced trace mineral blends have been obtained from the monthly price lists that are provided by companies A and B.

This section will conclude with the analysis of the opportunity cost of production for an alternative feed ingredient product. Mineral supplements used by cattle grazing out on native grasses compromise a sizeable retail feed market for the representative company that requires the same in house equipment to produce as the trace mineral premix. Range mineral supplements are sold directly to the end user and are typically priced and marketed at a higher margin. By determining the potential profits that can be gained from the production of a trace mineral pre mix it is possible to calculate the a) breakeven level of production for the range mineral product, and b) the opportunity cost if the full excess capacity was utilized for the production of range mineral.

4.1.3 Delivery Logistics

The evaluation process for the logistical cost will involve an examination of the freight rates of trace mineral premix products from the representative company's western Kansas location to the end users as compared to the transportation rates from the current supplier. There are some overlaps of transportation routes due to the physical location of the various destinations involved in relation to the location of the raw materials needed to manufacture the finished product. Since the representative company operates multiple end use locations, the plants that can be shipped to efficiently and economically will be evaluated. For instance, the analysis may show that it is initially profitable to produce the trace mineral premix at the western Kansas plant location but then not ultimately cost effective to do so because the freight cost associated with transporting the product to end users.

CHAPTER 5: DATA

5.1 Mill Modifications

After consulting with professionals in the feed ingredient industry, it was determined that the current equipment in the mixing system at the western Kansas plant location is adequate for the production of either the trace mineral mix or a range mineral product. By industry standards a mix is considered adequate if a mixer test is performed and a coefficient of variation of 10% or less can be achieved. To verify this, a mixer test was performed to ensure that the existing equipment could properly mix this type of a product. This test was performed as recommended by two different commercial testing laboratories. Ten separate samples were taken from the downstream product flow of the mixer. These samples were then analyzed for manganese and zinc content at a commercial lab. These two minerals were selected because they are only available to the formula from a single source.

In table 5.1 the results were then compared statistically, yielding a 7.39% coefficient of variation (i.e., average of the two tests performed). This is well within range needed to confidently produce the trace mineral blend or the range mineral product.

Table 5.1 Mixer Test Results

Sample	Zinc	Manganeese
1	5200	2870
2	510	2980
3	5210	2640
4	5880	2740
5	6110	2880
6	6050	3380
7	5270	2560
8	5890	2690
9	6050	3020
10	5640	3040
Mean	5681	2880
Standard Devation	364	241
Coeffocoent of Varation	6.41%	8.37%

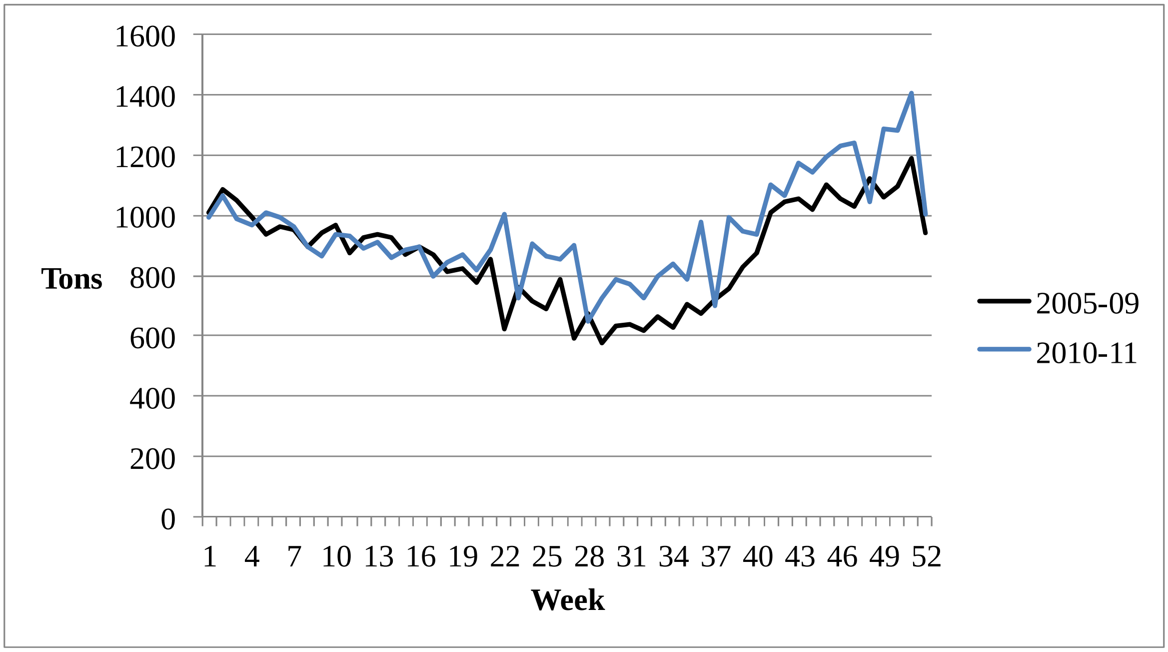
Currently the raw mineral source ingredients that are used in the facility are hand weighed in small amounts when needed. Most of the facilities current ingredient needs to supply the needed nutrients are purchased in a trace mineral blend. To be able to efficiently purchase and handle the ingredients at the plant site, all ingredients need to be purchased in 2,000 pound super sacks for trace mineral blend production. This, in turn, will require additional plant equipment to enable the super sacks to be efficiently used in the mixing system.

Five volumetric feeders will be required to weigh the mineral ingredients, along with a conveyor system to transport the minerals to the mixer. The additional equipment needed at the facility will cost $150,000 based on current industry estimates. If we assume a 5 year payback is required on this investment at a 5% interest rate, an average accrued operating profit of at least $34,646 per year will be needed for five years for the feed mix investment to at least breakeven financially. Even though the equipment has a life span longer than 5 years, this time frame was used due to the desire by the client to recapture the investment quicker.

5.2 Available Production Capacity

The protein supplement market for the cattle feeding industry in the United States is highly seasonal in nature. With the typical summer grazing season there is an abundance of pasture in which to graze cattle - causing a decrease in cattle populations in the feedlots. Figure 5.1 shows a chart of seasonal production, using historical production data from the facility for the past two years. The chart indicates that there has been a definite upward shift in the historical quantity of production for the western Kansas facility in the last two years. This has occurred as additional product lines have been added and due to an early influx of cattle in to the feedlots in 2011 caused by drought conditions in the Southern Plains. These factors have caused a decrease in excess summer production capacity of approximately 2,700 tons.

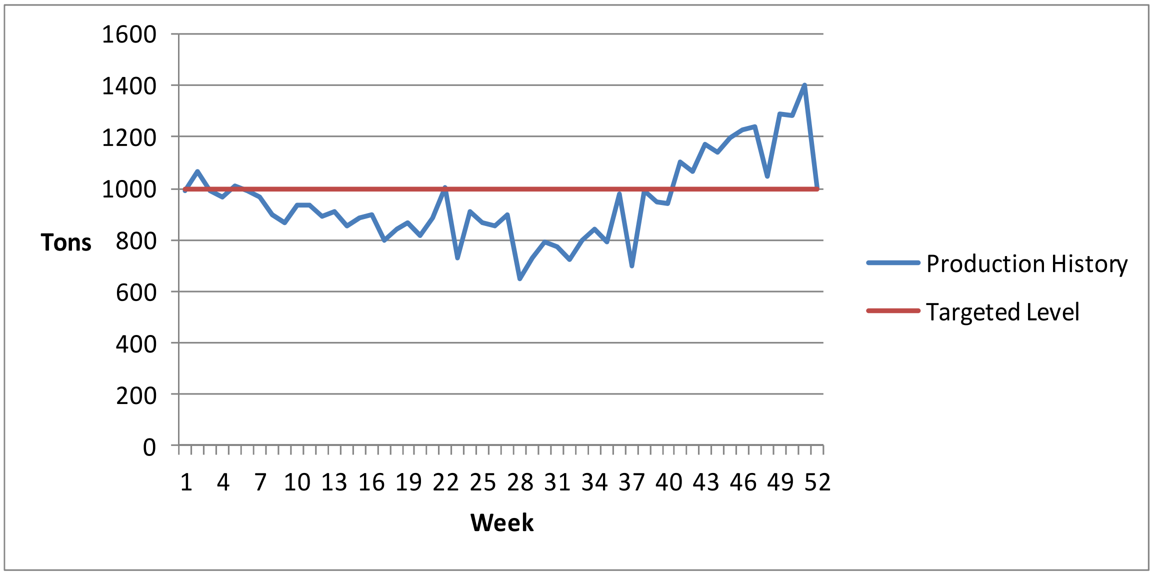
Figure 5.1 Production History



Based on the data of production history for the last ten years it is estimated that the available production capacity for the current facility is 300 tons per day or 12.5 tons per hour. As of this writing the western Kansas facility is operating a five day work week with two shifts per day. With this labor constraint in mind the facility is able to produce 200 tons per day using two shifts. This production level can be done in an efficient manner with no increase in labor cost due to either overtime or adding an additional shift. Using the theoretical assumptions associated with the relationship between the firm's production function and its marginal product of labor, it is still likely to be profitable to produce more than this level of product up to a certain point, but that issue is not the primary focus of this thesis.

Using the labor constraint for the western Kansas plant facility discussed above, a production level of 200 tons per day approximates a production frontier or the efficient level of production that is targeted in this analysis. For this project targeted is defined as production capacity available operating 2 shifts with no overtime. The following graph (Figure 5.2) illustrates this point assuming a 5 day work week.

Figure 5.2 Production History vs. Targeted Production Level



Using the data from the above graph there is, on average, 4,630 tons of excess production capacity available in any given calendar year - starting approximately in week 6 and ending around week 40 of the calendar year. The amount of excess production capacity available is calculated by taking the area that is below the targeted production level and above the line representing the production history. The sum of this area is the available excess production capacity.

5.3 Cost of Utilizing Excess Capacity

In analyzing the net present value for this potential investment in trace mineral production and distribution capability, it is important to determine whether the cost of utilizing excess capacity is an actual cost or an economic cost? In this case it is an actual cost that must be taken account of in the investment analysis; excess capacity is not without increased cost as some might think. The increased usage from making more efficient use of excess capacity causes the plant and equipment to wear out faster, thus increasing variable cost and extracting value out of fixed plant assets at a quicker or faster rate than otherwise, and hastening the time when that equipment will need to be replaced or repaired.

In this analysis the cost of utilizing excess capacity will be applied equally to the trace mineral blends that are being evaluated and the range mineral product that is being used for comparison as a source of opportunity cost. Both of these products are similar in nature and utilize the same equipment during production of the final product produced for sale. Any increase in production by either will have the same net effect per ton of increased usage on the fixed assets of the facility.

The representative western Kansas facility operated by the client has an average annual production of approximately 48,000 tons per year. The excess capacity that is being used or captured equalizes to an additional 4,630 tons annually, representing a potential plant production output increase of 9.6%. Based on this potential increase and historical financial data, using this excess capacity will add $1.35/ton to the cost of the product. This amount of additional production cost is accounted for in the estimated manufacturing and handling cost in section 5.5

5.4 Warehousing Cost

With the goal of this project being to utilize the excess plant capacity that is available during certain times of the year there will be warehousing cost incurred by the client. Production of trace minerals will occur during otherwise "slow" times of the year and the finished good will need to be stored until when it is needed. With average annual trace mineral needs projected to be approximately 3,500 tons, the ability to store approximately

1200 tons or an 18 week supply is needed to cover or span the time from week 40 to week 6 of the following year when excess capacity becomes available again. The representative western Kansas facility already has such space available on site that could be used without markedly disrupting current business operations. If this space was reallocated to storage for this new product from its current use, the extra cost associated to this product would be $3.42/ton.

5.5 Raw Ingredient and Cost Analysis

To produce the trace mineral premixes in question we will not only evaluate the main trace mineral used in all of the plants, but also the trace mineral premixes used in the western Kansas plant. The reasoning for this analysis is to try to get a truer picture of the pricing structure and control of the market by the main two blenders. As hypothesized above, input purchasing power will likely be the key for the western Kansas representative firm to being able to compete with the established main suppliers in the trace mineral production market. The pricing data listed in table 5.2 represents a delivered input price to the western Kansas facility. This data has been derived from multiple sources in order to find the least cost source for each. The majority of the price information is from company A, with the balance being directly priced from the manufacturer or third party distributors. Additional pricing information can be found in appendix A. The appendix shows the difference in delivered price of selected raw materials shipped from the blender verses direct shipped from the source.

Table 5.2 Ingredient Cost (as of January 2012)

Ingredient	Cost/Ton
Ferrous Sulfate	$ 420.00
Calcium Carbonate	$ 58.00
Zinc Oxide	$ 1,550.00
Manganous Oxide	$ 1,175.00
Copper Chloride	$ 7,340.00
Sodium Sulfate	$ 364.00
Copper Sulfate	$ 2,310.00
Organic Iodine	$ 65,563.00
Cobalt Carbonate	$ 27,043.00
Mineral Oil	$ 940.00
Zinc Sulfate	$ 1,150.00
Mangeneese Sulfate	$ 955.00
Selenium	$ 2,200.00

The trace mineral premix formulas use a variety of the above ingredients as needed to meet the manufacturing needs of the various plants. These ingredients were formulated to the proprietary specifications of the client using a commercial feed formula optimization program. Not all of the ingredients are used in all of the formulas; instead they are utilized by the feed formula optimization program as needed. In table 5.2 is the ingredient cost for the formulas to be evaluated based on the ingredient prices listed in Table 5.3 as formulated by the optimization software.

Table 5.3 Formula Cost (as of January 2012)

Formula	Cost/Ton
1	$ 1,144.01
2	$ 2,120.37
3	$ 1,177.44
4	$ 2,033.67

These formulas were formulated using a commercial least cost optimization program. The table above includes only the raw material cost. Manufacturing and transportation cost will be added in later in the analysis.

There are four main formulas that are used in the facilities operated by the client. Regional livestock nutrition needs and the type of feeds being produced and/or supplemented determines the different trace mineral blend formulations. Formulas 1 and 2 are used in the western Kansas plant, formula 3 is used in all plants and formula 4 is used in about ½ of the plants in this analysis.

5.6 Manufacturing and Handling Cost

In the manufacture of a product there are different types of variable cost. In the production of the trace mineral blends in question in this analysis there are two types; the labor and machinery cost to make the product, and the additional labor and materials to handle the finished good.

Based on prior production history for the past two years the manufacturing variable cost for a ton of feed in this facility is $21.86. This accounts for both the variable costs that affect the cost of production and the expected increase in repairs from the use of excess capacity in the western Kansas production facility. Fixed cost is not included in this expense estimate since they are already a "sunk cost" and must be paid regardless of the choice to make either of these two products.

Handling of the product after manufacture will involve placing the product into a super sack capable of holding 2,000 pounds. Cost of the super sacks is $7.56/ sack to hold the product.

To calculate the labor requirements to fill the sacks we will take in to account the following factors. Two workers can fill 10 sacks per hour. Using a cost per worker hour of $18.25, including taxes and benefits, this equates to a labor cost of $3.65/ton of trace mineral produced. Totaling up the manufacturing cost there is a total of $33.07/ton as listed below in table 5.4.

Table 5.4 Manufacturing and Handling Cost

Variable Cost		
Manufacturing	$	21.86
Bagging Material	$	7.56
Bagging Labor	$	3.65
Total Variable Cost	$	33.07

5.7 Logistics of Trace Mineral Premix

Optimal plant location and associated logistics are likely among the largest factors affecting the outcome of this analysis. In some instances raw ingredients will be transported past one or more of the end-users to the representative facility to be blended into a trace mineral premix, and then hauled back to those same end user facilities. This "backtracking" or doubling of freight adds cost and potential inefficiencies in the system. The production and logistical distribution of calcium carbonate is a prime example of this; the raw product originates in eastern Nebraska and gets transported past two of its final post processing destination locations as it is transported to the western Kansas facility.

To illustrate the freight differences, table 5.5 compares the freight cost from the current supplier of formula number 4 (company B) and the representative company's western Kansas location to the six end use destinations, and lists the freight advantage that could be gained by the in house production of the trace mineral blends by the western Kansas representative company.

Table 5.5 Freight Comparison

Destination	Outsource	In House	Advantage
1	$ 67.75	$ 6.80	$ 60.95
2	$ 73.41	$ 37.10	$ 36.31
3	$ 43.17	$ 28.40	$ 14.77
4	$ 58.54	$ 46.30	$ 12.24
5	$ 19.46	$ 41.60	$(22.14)
6	$ 31.05	$ 64.80	$(33.75)

5.8 Opportunity Cost

In evaluating this project the opportunity cost of the potential added investment also has to be considered. The alternative or economic opportunity being used for this analysis is that of producing range mineral products for retail sale. The margin or gross profit projected to be available when selling direct to the customer is greater than what is available in a wholesale transaction. The representative facility has already been expanding into this product area for the past two years with sales projected to increase in this product line in the future. Any large scale production of trace mineral blends will directly influence the available production capacity that could potentially be allocated to the range mineral production process.

To date sales margins have been highly variable in this product - depending on many external factors that affect the selling price and company production. Based on internal company data, the average profit margin per ton is $43.29 in the production of range mineral products.

CHAPTER 6: RESULTS

In performing the Net Present Value analysis on the data for this project there are two different product factors that need to be taken into account of in the production decision. One being the value added by the trace mineral blend production for the end use locations, and the second being the value added by the trace mineral blend production for products that are used internally at the representative western Kansas facility. The combination of the added value to the client from these two will then be used to calculate the NPV to the organization.

6.1 Supplying the End Use Facilities

Listed in table 6.1 is the financial contribution of each plant in the net present value calculation for this analysis by delivery location. The locations and the delivery cost associated with each location vary greatly. As expected this variability has a dramatic effect on the individual financial contribution by plant. Location 1, which is closest to the proposed production plant, does allow for positive NPV margin from these proposed changes. Location 2 projects to be a slight NPV loss, but could switch to positive with small changes to the cost matrix. The remainder of the locations (3, 4, 5 and 6) have large enough negative NPV margins that it is not likely that reasonable changes in either production or logistical cost assumptions could switch their NPV margins to positive. Because of this, locations 2,3,4,5 and 6 will not be considered in the analysis.

Table 6.1 Financial Contribution

Destination	Supplier Outsource	Supplier In House	Gross Margin	Net Margin	Financial Contribution
1	$ 2,097.15	$ 2,040.47	$ 56.68	$ 23.61	$ 22,235.07
2	$ 2,102.81	$ 2,070.77	$ 32.04	$ (1.03)	$ (693.44)
3	$ 2,072.57	$ 2,062.07	$ 10.50	$ (22.57)	$ (9,924.25)
4	$ 2,087.94	$ 2,079.97	$ 7.97	$ (25.10)	$ (7,671.19)
5	$ 2,048.86	$ 2,075.27	$ (26.41)	$ (59.48)	$ (53,195.94)
6	$ 2,060.45	$ 2,098.47	$ (38.02)	$ (71.09)	$ (25,582.45)

In table 6.1, column 1 is the end use destination starting with destination 1, which is closest to the representative western Kansas facility - up to destination 6, the farthest away. Column 2 is the delivered price from Company B to the respective locations. Represented in column 3 this is the raw material cost plus freight to the destination locations. The difference between column 2 and 3 gives us the gross margin in column 4. The manufacturing and handling cost of $33.07 is then subtracted to yield the net margin. In the final column of financial contribution is the net margin times the two year average usage to get the total annual cash flow per destination.

6.2 Internal Use

Another contributor to the net present value calculation are the trace mineral blends that are used in production at the representative western Kansas facility. These will be manufactured as needed to meet the internal production needs of the plant. There are currently three trace mineral blends used on a regular basis in production, listed in table 6.2. Their annual financial contributions to the NPV from each of these formulas are also listed in this table.

Table 6.2 Internal Financial Contributions

Formula	Supplier Outsource	Supplier In House	Gross Margin	Net Margin	Financial Contribution
1	$ 1,278.00	$ 1,144.01	$ 133.99	$ 100.92	$ 11,041.66
2	$ 2,255.00	$ 2,120.77	$ 134.23	$ 101.16	$ 5,417.12
3	$ 1,227.00	$ 1,177.44	$ 49.56	$ 16.49	$ 2,264.57

6.3 Net Present Value of the Project

As listed in Table 6.3, the net present value (NPV) of the project is $27,329.47. In looking at the net present value of the project we are using the following assumptions:

- Interest rates are 5%
- Time horizon is 5 years
- Fixed costs are discounted at 5%
- Formula 4 is only produced and delivered to Location 1, as the other locations are unprofitable.

Table 6.3 Net Present Value of Project

Formula 1	$ 11,041.66
Formula 2	$ 5,417.12
Formula 3	$ 2,264.57
Formula 4	$ 22,235.07
Fixed Cost	$ (34,646.00)
Annual Cash Flow	$ 6,312.42
Net Present Value	$ 27,329.47

The trace mineral blends are profitable for the client to produce given the current market conditions. Producing the above formulas will use up approximately 1,242 tons of the excess production capacity.

There are potential pitfalls of this analysis. This NPV calculation is based on estimates of current data for a projection of five years into the future. There are several risks that need to be kept in mind. Examples of this include changes in future market conditions or technological changes in manufacturing technology. The NPV estimates are only that, an estimate based on the current information.

6.4 Opportunity Cost

In evaluating the opportunity cost for this project, it is calculated that the representative western Kansas facility has to produce a minimum of 146 tons of the range mineral type product annually for 5 years to return an equal contribution to the net present value of the firm from trace mineral production as listed above in table 6.3, i.e., $27,329.47 (table 6.4). A key issue to consider in this analysis is that neither the profitable trace mineral blending options nor the opportunity cost option exceeds the defined production capacity of the plant. It is possible that both options may be pursued by the client if adequate plant capacity exists to accommodate both.

Table 6.4 Opportunity Cost Breakeven Production

Trace Mineral NPV	$27,329.47
Annual Cash Flow	$ 6,312.42
Opportunity Cost/Ton	$ 43.29
Indifference Point	145.82

To put this into perspective, the product used in the example of the opportunity cost has been in production for the last four years. As listed in table 6.5 the production of these products has grown to an annual level of 865 tons per year. For the indifference point to be met the annual production of range mineral products will need to grow to 1011 tons produced annually. This represents an increase in sales of this product of 16.86%.

Table 6.5 percent Increase to Reach Indifference Point

Average Production	865
Indifference Point	145.82
Production Level	1010.82
Sales Increase	16.86%

6.5 Internal Rate of Return

Based on the cash flows used in the net present value calculation, an internal rate of return (IRR) for the project can be determined as shown in table 6.6. By using earlier NPV results, removing the annual charge for the equipment investment and allotting it to be paid at the beginning of the investment period, one is able to calculate the IRR for the trace mineral blend project – equaling 11.36% based on the 5 year project time span.

Table 6.6 Internal Rate of Return

Initial Investment	$	150,000.00
Formula 1	$	11,041.66
Formula 2	$	5,417.12
Formula 3	$	2,264.57
Formula 4	$	22,235.07
Annual Cash Flow	$	40,958.42
IRR		11.36%

Another way to view IRR is that it represents the "payback time" for the project, i.e., how long it will take the company to recoup its cost and start turning a profit. For this project, if the investment in question is able to meet the cash flow projections in table 6.6, it would take 3.6 years to recoup the cost of the investment before starting to turn a profit.

CHAPTER 7: CONCLUSIONS AND IMPLICATIONS

In concluding this analysis some key factors have to be taken into consideration when viewing the results. First, what is the true rate of return to the client of such a potential investment, and is that rate of return acceptable to their management? Second, from an agribusiness perspective, there is sometimes a difference between profitable and practical courses of business actions. A key issue to consider relates to the potential and/or likely market response from the current suppliers if a portion of the trace mineral blends used by the client is moved to in house production by the client's representative western Kansas facility.

Is the IRR indicated in this study for this investment an acceptable rate of return to the client? It is the author's opinion based on this analysis that the decision of whether to invest in trace mineral production is unclear or "borderline". Currently the client likes to see a three year or shorter payback on its internal investments. In comparison, the 11.36% return is positive enough to be given serious consideration in the current agribusiness environment, especially when considering current rates of return for other exchange traded financial instruments with presumably less risk.

In the conclusions and implications section of this paper it is appropriate to consider the broader competitive impacts and implications of this potential investment in trace mineral production for the representative western Kansas company. It is not easy to predict the competitive or anti-competitive market response of the current suppliers that in essence the client would be entering into direct competition with. These potential competitors with their oligopolistic market structure have several options at their disposal to raise effective barriers to entry to deal with the potential threat to their positions in the market. For instance, they could offer to enter into long term supply agreements at a more competitive price, with the western Kansas company, thus eliminating the profit potential from the project for the client. Also they could raise the prices for the trace mineral blends to the other destinations that the client is not economically able to ship to in order to recover the financial losses that they would incur from increased competition. These and other potential actions could be taken by current trace mineral producers that would have the effect of lowering the net gain of this potential investment to the client - diminishing the expected returns from the project.

If approached judiciously by the client, there is a potential win - win solution for both parties, both the existing firm(s) in the trace mineral production market and the western Kansas representative firm. Because there is a definite logistical advantage for the client to produce the trace mineral blend for two locations, it is reasonable to explore the possibility of using the current supplier of the trace mineral blends as the broker for the raw material needed by the client to produce the blends for these two facilities. This could create a synergistic relationship between the two that is not adversarial, but instead, mutually beneficial. It could also lead to future collaborations with the client providing blending services for the supplier's other customers in the geographic region of the client's blending facility.

CHAPTER 8: RECOMMENDATION

The final decision of whether to implement this project or not is up to the management of the client. There is one area that deserves more study before the decision to implement the production of trace mineral blends is made. A market study needs to be performed to determine the true market potential of the range mineral product that was used as the opportunity cost option in this analysis. Because it was proven that this is a profitable opportunity with less initial investment cost to the client, the true potential of this product line needs to be explored before investment in any additional equipment by the representative western Kansas facility and proceeding with the trace mineral blend project.

If it can be proven that there is still adequate capacity for the production of the trace mineral blend product after the potential range mineral product production can be achieved in the five year time frame that was used in the analysis, the client should consider initiating a dialogue with the current supplier to find common ground - allowing the client to utilize its excess capacity without posing a market threat to the supplier.

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APPENDIX A

Price Differences of select Ingredients

Ingredient	Delivered Price/ton Distributor	Supplier	Savings
Copper Sulfate	$ 2,316.00	$ 2,230.00	$ 86.00
Zinc Sulfate	$ 1,260.00	$ 1,190.00	$ 70.00
Zinc Oxide	$ 1,625.00	$ 1,550.00	$ 75.00
Manganese Sulfate	$ 1,018.00	$ 955.00	$ 63.00
Manganous Oxide	$ 1,175.00	$ 1,125.00	$ 50.00