NORTH DAKOTA STRATEGIC FREIGHT ANALYSIS

Item II. Logistical Factors Influencing the Success of Value Added Processing Facilities

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ABSTRACT

One significant consideration when examining a business venture is to define the network for the product. The network design should take into account the number, size, and location of suppliers, producers, distributors, wholesalers, and retailers.

There are many specific factors to examine when considering the location of one particular component of the network, for example, a value added processing facility. These include: 1) labor climate, 2) transportation availability, 3) proximity to markets/customers, 4) quality of life, 5) taxes/industrial development incentives, 6) supplier networks, 7) land costs/utilities, and 8) company preference.

There are a number of these factors that can be easily examined in a linear programming spreadsheet model to help make a location decision. These include the availability and cost of raw materials, the capacity and operating costs of the proposed processing facilities/plants, the transportation costs to ship from raw material sources to the plants and from the plants to the customers, and customer demand.

The spreadsheet model allows consideration of a number of important factors, and the inputs to the model can be changed easily to allow for examining many different scenarios. For example, the model can demonstrate the benefits of a certain location over another based on such things as available freight rates and land or labor costs. However, when making a final decision, other important factors such as labor climate and quality of life, etc. should also be taken into consideration.

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EXECUTIVE SUMMARY

One significant consideration when examining a business venture is to define the network for the product. The network design should take into account the number, size, and location of suppliers, producers, distributors, wholesalers, and retailers.

There are many specific factors to examine when considering the location of one particular component of the network, for example, a value added processing facility. These include: (1) labor climate, 2) transportation availability, 3) proximity to markets/customers, 4) quality of life, 5) taxes/industrial development incentives, 6) supplier networks, 7) land costs/utilities, and 8) company preference. Within each of these there are additional items to consider.

There are a number of these factors that can be easily examined in a linear programming spreadsheet model to help make a location decision. These include the availability and cost of raw materials, the capacity and operating costs of the proposed processing facilities/plants, the transportation costs to ship from raw material sources to the plants and from the plants to the customers, and customer demand.

Several case studies illustrate that a spreadsheet model can be *one* useful tool when making a location decision for a processing facility. It allows consideration of a number of important factors, and the inputs to the model can be changed easily to allow for examining many different scenarios. For example, the model can demonstrate the benefits of a certain location over another based on such things as available freight rates and land or labor costs. In fact, the case studies reveal that lower plant to customer freight rates from a location outside of North Dakota are not enough to offset the higher

operating and fixed costs for a plant there. However, when making a final decision, other important factors such as labor climate and quality of life, etc. should also be taken into consideration.

INTRODUCTION

Company investment decisions are based on profit-maximizing goals. As North Dakota competes for these investment dollars, logistical advantages, such as land values and labor costs, may be nullified by logistical disadvantages, such as freight rates and intermodal access. It is important to identify and understand these factors to help improve North Dakota's competitive position.

When considering a business venture, other than a clear product and market definition (including the total size of the market, as well as the number and size of competitors); the next most important consideration is to define the network for the product. The network design should take into account the number, size, and location of suppliers, producers, distributors, wholesalers, and retailers.

As illustrated in the following graphic, the specific factors to examine when considering the location of one particular component of the network, for example, a value added processing facility, include the following:

(1) Labor climate

(2) Transportation availability

(3) Proximity to markets/customers

(4) Quality of life

(5) Taxes/Industrial development incentives

(6) Supplier networks

(7) Land costs/utilities

(8) Company preference

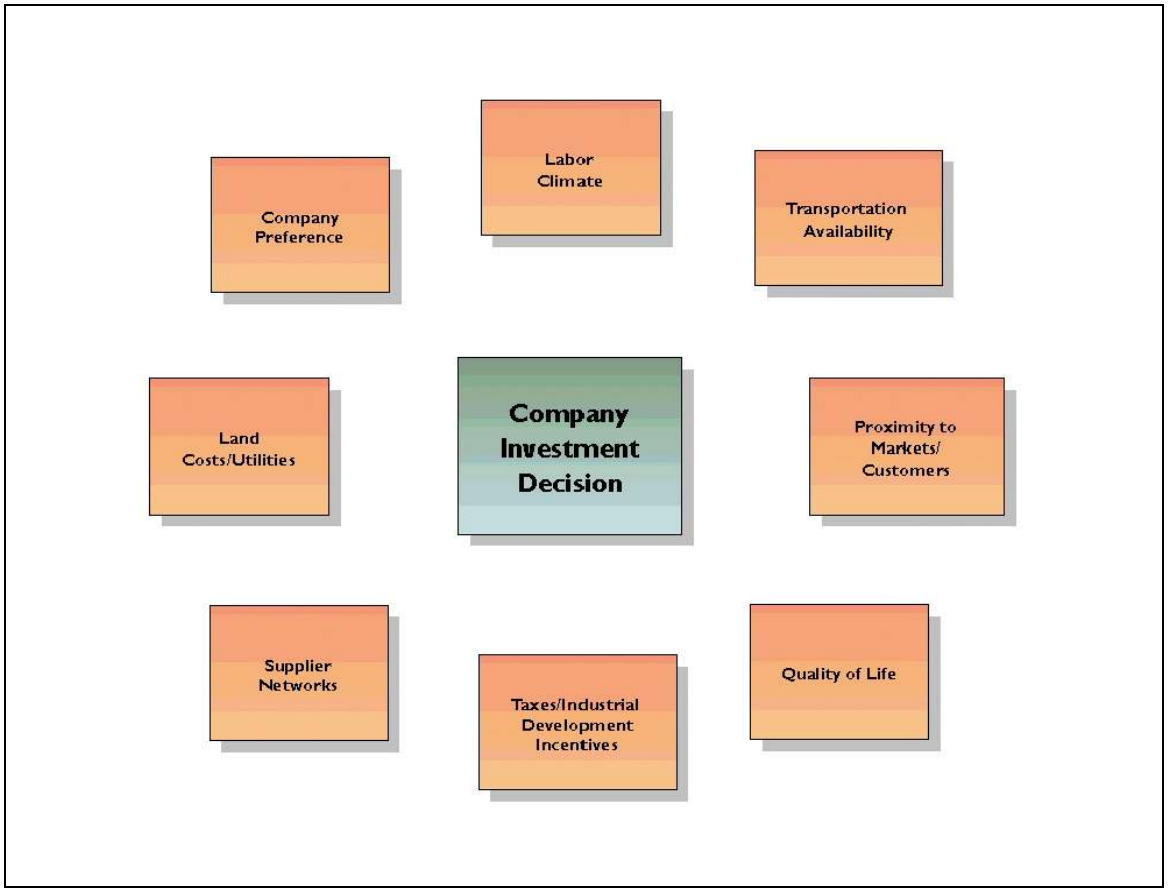

Figure 1. Specific factors to examine when considering the location of one particular component of the network.

DESCRIPTION OF LOCATION FACTORS

The following discussion relates a brief description of each of the location factors to consider.

Labor Climate

Items to consider regarding the labor climate include the availability of labor that is needed, and the cost. In addition, the degree of unionization, skill level, work ethic, and the average productivity of available labor should be examined, as well as the rate of unemployment in the area.

Transportation Availability

The main items to study regarding transportation availability include whether or not there is interstate highway access and/or rail facilities. In addition, the number of carriers willing and/or able to serve the area must be considered.

Proximity to Markets/Customers

Regarding proximity to markets/customers, the main areas to examine include the freight transportation cost to move the product to applicable markets, and the market size/demand that can be served on a same-day or next-day basis.

Quality of Life

The quality of life at a location affects both the well-being of employees and the quality of their work. Areas to examine include the climate, housing, health care, crime, education, and recreation opportunities.

Taxes/Industrial Development Incentives

When considering a location, one should study the state/local taxes, the inventory/property taxes, and the personal taxes that are in place. Similarly, an examination of any tax incentives (reduced rates or abatements), or any available financing should occur. Finally, other considerations may include reduced water/sewage rates or rent-free buildings available.

Supplier Networks

The availability and cost of raw materials from supply sources, and the cost of transporting the materials to the location in question should be considered.

Land Costs/Utilities

The availability and cost of utilities, the cost of land, the cost of construction, and particular building codes should be examined.

Company Preference

Finally, an examination should be completed of any existing company preferences. These may include a company policy to locate near competitors or other similar firms, which may allow for common access to factors, such as labor, marketing resources, and key suppliers.

LINEAR PROGRAMMING SPREADSHEET MODEL

A number of important factors described above can be easily examined in a linear programming spreadsheet model to help make a location decision. These factors include the availability and cost of raw materials, capacity and operating costs of the proposed processing facilities/plants, transportation costs to ship from raw material sources to the plants and from the plants to the customers, and customer demand. One example of such a model is presented below.

The objective of the model described in the following case studies is to minimize total costs subject to four constraints: (1) each customer region's demand must be met, (2) for each supply source, raw material supply capacities can not be exceeded, (3) for each plant, the capacity of the plant can not be exceeded, and (4) for each plant, the amount of raw materials transported to the plant should equal the amount of product transported from the plant (i.e., there can not be more output than input).

North Dakota Location Case Study

The first case study used to illustrate the model considers the problem of whether to locate a new processing plant in Northwest, South Central, North Central, or Northeast North Dakota. This case study assumes that there is raw material supply available in Northeast, Northwest, and Southeast North Dakota, as well as in Central Montana, to serve a proposed plant. It also assumes that the amount and the cost of raw material supply available are equal at each location. For simplicity, the case study further assumes that for each proposed plant, the plant capacity, fixed costs, and operating costs would be equal. These all are variables that can be changed in the model to reflect more accurate information as it is available.

The first inputs to the model that are needed are transportation costs to ship from each raw material supply source to each proposed plant, and the plant capacity and fixed/operating costs. The particular costs used in this case study are illustrated in Table 1, and are on a per hundredweight basis.

Table 1. Costs to Ship from Raw Material Supply Sources to Plants (Case 1)					
Raw materials to plants		*Costs to ship from raw material source x to plant y*			
	RM Price	NW ND	S. Central ND	N. Central ND	NE ND
NE ND	11.00	1.5500	0.7000	0.7000	0.1000
NW ND	11.00	0.6000	0.6000	0.6000	0.8000
SE ND	11.00	1.7000	0.6500	0.8000	0.5000
Central MT	11.00	2.7000	2.8000	2.8000	2.8500
Plant Capacity (units/yr)		15,000,000	15,000,000	15,000,000	15,000,000
Plant Fixed Costs		4,000,000	4,000,000	4,000,000	4,000,000
Plant Operating Costs		18.200	18.200	18.200	18.200

The second set of inputs to the model are the costs to ship from each proposed plant to each customer, and an estimate of the customer demand. Information used in this case study is displayed in Table 2.

Table 2. Costs to Ship from Plants to Customers and Customer Demand (Case 1)					
Plants to customers		*Costs to ship from plant y to customer z*			
	Demand	NW ND	S. Central ND	N. Central ND	NE ND
Los Angeles	3,313,000	5.5100	5.6000	6.3000	6.4600
Dallas	3,444,000	5.0000	3.9000	4.5000	3.9700
Chicago	3,210,000	3.4400	2.7500	2.7000	2.4300
Baltimore	1,238,000	6.3900	5.4200	5.3500	5.2700
Seattle	2,350,000	3.9300	4.3000	4.5000	4.8800
TOTAL	13,555,000				

The first decision part of the model considers the supply available at each raw material supply source and the volume to ship from each source to each plant. In the case study example in Table 3, the model recommends shipping 13,555,000 units from the supply source in NE North Dakota to a plant, which also is located in NE North Dakota.

Table 3. Volume to Ship from Raw Material Supply Sources to Plants (Case 1)						
Raw materials to plants		*Volume to ship from raw material source x to plant y*				
	Supply Avail.	NW ND	S. Central ND	N. Central ND	NE ND	Total Shipped
NE ND	15,000,000	0	0	0	13,555,000	13,555,000
NW ND	15,000,000	0	0	0	0	0
SE ND	15,000,000	0	0	0	0	0
Central MT	15,000,000	0	0	0	0	0
TOTALS		0	0	0	13,555,000	13,555,000

The second decision part of the model considers the volume to ship from each plant to each customer. The case study model in Table 4 recommends making all shipments to customers from the NE North Dakota plant.

Table 4. Volume to Ship from Plants to Customers (Case 1)					
Plants to customers	*Volume to ship from plant y to customer z*				
	NW ND	S. Central ND	N. Central ND	NE ND	Total Shipped
Los Angeles	0	0	0	3,313,000	3,313,000
Dallas	0	0	0	3,444,000	3,444,000
Chicago	0	0	0	3,210,000	3,210,000
Baltimore	0	0	0	1,238,000	1,238,000
Seattle	0	0	0	2,350,000	2,350,000
TOTALS	0	0	0	13,555,000	13,555,000

Given the above decisions from the case study model, total costs for the proposed plant are displayed in Table 5. Based on particular inputs for this case study, the model recommends locating a plant in Northeast North Dakota with a total annual cost of $8,580,287. This location would have the lowest annual total costs of the locations considered.

Table 5. Total Costs (Case 1)					
COSTS	TOTALS:	NW ND	S. Central ND	N. Central ND	NE ND
Plant to Customer Freight	608,672	0	0	0	608,672
Plant Operating Cost	2,467,010	0	0	0	2,467,010
Raw Material to Plant Freight	13,555	0	0	0	13,555
Raw Material Costs	1,491,050	0	0	0	1,491,050
VARIABLE COSTS	**4,580,287**	0	0	0	4,580,287
Plant Fixed Costs	4,000,000	0	0	0	4,000,000
TOTAL COSTS	**8,580,287**	0	0	0	8,580,287

The remaining locations would have annual total costs of approximately $8.68 million, $8.62 million, and $8.66 million, respectively. There is nearly a $100,000 difference between the lowest and highest total costs based only on a difference in shipping costs.

As a further illustration, assume that each plant capacity is only 10 million units per year instead of 15 million, so a second plant would be needed (all other inputs remain the same as above). In this case, the model would provide the following conclusion.

In this example, with two plants needed, the model recommends shipping 7,892,000 units from the supply source in NE North Dakota to a plant, which also is located in NE North Dakota; and 5,663,000 units from the supply source in NW North Dakota to a plant also located in NW North Dakota (Table 6).

Table 6. Volume to Ship from Raw Material Supply Sources to Plants (Case 1a)

Raw materials to plants	Supply Avail.	*Volume to ship from raw material source x to plant y* NW ND	S. Central ND	N. Central ND	NE ND	Total Shipped
NE ND	15,000,000	0	0	0	7,892,000	7,892,000
NW ND	15,000,000	5,663,000	0	0	0	5,663,000
SE ND	15,000,000	0	0	0	0	0
Central MT	15,000,000	0	0	0	0	0
TOTALS		5,663,000	0	0	7,892,000	13,555,000

For this example, the second decision part of the model, which considers the volume to ship from each plant to each customer, recommends the following (Table 7). The NW North Dakota plant would serve Los Angeles and Seattle; while the NE North Dakota plant would serve Dallas, Chicago, and Baltimore.

Table 7. Volume to Ship from Plants to Customers (Case 1a)

Plants to customers	*Volume to ship from plant y to customer z* NW ND	S. Central ND	N. Central ND	NE ND	Total Shipped
Los Angeles	3,313,000	0	0	0	3,313,000
Dallas	0	0	0	3,444,000	3,444,000
Chicago	0	0	0	3,210,000	3,210,000
Baltimore	0	0	0	1,238,000	1,238,000
Seattle	2,350,000	0	0	0	2,350,000
TOTALS	5,663,000	0	0	7,892,000	13,555,000

Given the above decisions from this case study, total costs for the proposed plants are displayed in Table 8. Based on particular inputs, the model recommends locating one plant in northeast North Dakota and one plant in northwest North Dakota, with a total annual cost of $12,554,804. Interestingly, the total variable costs under this scenario are less than the previous one due to lower plant-to-customer freight costs. The total cost is higher because of the additional fixed costs.

Table 8. Total Costs (Case 1a)

COSTS	TOTALS:	NW ND	S. Central ND	N. Central ND	NE ND
Plant to Customer Freight	554,874	274,901	0	0	279,972
Plant Operating Cost	2,467,010	1,030,666	0	0	1,436,344
Raw Material to Plant Freight	41,870	33,978	0	0	7,892
Raw Material Costs	1,491,050	622,930	0	0	868,120
VARIABLE COSTS	**4,554,804**	1,962,475	0	0	2,592,328
Plant Fixed Costs	4,000,000	4,000,000	0	0	4,000,000
TOTAL COSTS	**12,554,804**	5,962,475	0	0	6,592,328

Possible Location Outside North Dakota Case Study

To better understand some of the significant factors in a location decision, a second case study is examined considering a plant location outside of North Dakota. Instead of considering a plant in North Central North Dakota, this case study will consider a plant in Central Minnesota. Because of the location, it is anticipated that the costs to ship from this plant to customers will be lower; however the fixed and operating costs (for example, land and/or labor costs) for the plant will be higher.

As before, the first inputs needed for the model are the transportation costs to ship from each raw material supply source to each proposed plant, as well as the plant capacity and fixed/operating costs. The particular costs used in this case study are illustrated in Table 9, and remain on a per hundredweight basis. This case study assumes the fixed costs for the Central Minnesota location are 20 percent higher, and the operating costs are 10 percent higher than for the North Dakota locations.

Table 9. Costs to Ship from Raw Material Supply Sources to Plants (Case 2)					
Raw materials to plants		*Costs to ship from raw material source x to plant y*			
	RM Price	NW ND	S. Central ND	Central MN	NE ND
NE ND	11.00	1.5500	0.7000	0.2000	0.1000
NW ND	11.00	0.6000	0.6000	0.9000	0.8000
SE ND	11.00	1.7000	0.6500	0.4000	0.5000
Central MT	11.00	2.7000	2.8000	3.0000	2.8500
Plant Capacity (units/yr)		15,000,000	15,000,000	15,000,000	15,000,000
Plant Fixed Costs		4,000,000	4,000,000	4,800,000	4,000,000
Plant Operating Costs		18.200	18.200	20.020	18.200

The second set of inputs to the model are the costs to ship from each proposed plant to each customer, and the estimate of the customer demand. The information used for this case study is displayed in Table 10. This case study assumes that rates from the central Minnesota location to Dallas, Chicago, and Baltimore would be lower than the North Dakota locations; and the rates to Los Angeles and Seattle would be only slightly higher.

Table 10. Costs to Ship from Plants to Customers and Customer Demand (Case 2)					
Plants to customers		*Costs to ship from plant y to customer z*			
	Demand	NW ND	S. Central ND	Central MN	NE ND
Los Angeles	3,313,000	5.5100	5.6000	6.5000	6.4600
Dallas	3,444,000	5.0000	3.9000	3.5000	3.9700
Chicago	3,210,000	3.4400	2.7500	2.1000	2.4300
Baltimore	1,238,000	6.3900	5.4200	5.1000	5.2700
Seattle	2,350,000	3.9300	4.3000	4.9000	4.8800
TOTAL	13,555,000				

When the model is run given the above inputs, the final decision is identical to that in the first case study (Tables 3, 4, and 5). The decision is still to locate the plant in Northeast North Dakota. The lower plant-to-customer freight rates from the Central Minnesota location are not enough to offset the higher operating and fixed costs for a plant there. In fact, the variable costs for the Central Minnesota location are approximately $4.81 million, about $200,000 more than any of the North Dakota locations. Considering the additional $800,000 fixed costs, the Central Minnesota location is more than $1 million more expensive than the North Dakota locations.

CONCLUSION

A model, such as the one described in the previous case studies, can be *one* useful tool when making a location decision for a processing facility. It allows consideration of a number of important factors such as transportation costs, raw material availability and cost, as well as costs associated with proposed plants. In addition, inputs to the model can easily be changed to allow for examining many different scenarios. As illustrated, the model can demonstrate benefits of a certain location over another based on elements such as available freight rates and land or labor costs. However, as detailed in the introduction, when making a final decision, other factors, such as labor climate and quality of life, etc., also should be taken into consideration.