FEASIBILITY OF BUILDING A GREENFIELD CONTRACT MANUFACTURING PLANT

by

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B.S., Kansas State University, 2000

A THESIS

Submitted in partial fulfillment of the requirements

for the degree

MASTER OF AGRIBUSINESS

Department of Agricultural Economics

College of Agriculture

KANSAS STATE UNIVERSITY

Manhattan, Kansas

2012

Approved by:

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ABSTRACT

Bunge is a global agribusiness company that has invested in a facility to produce extruded ingredients and inclusions in its Woodland, California rice mill. Because Bunge is not a branded food manufacturer, it is in a unique position to be a contract manufacturer to a variety of customers without the potential for a conflict of interest. Also, because Bunge is primary in three of the most common ingredients for extruded products, corn, rice and oil, this would be a move down the value chain that would allow it to be more competitive. The initial investment in Woodland has allowed Bunge to learn more about the manufacture of extruded ingredients and inclusions and also gauge overall market demand. A possible next step would be to build a second facility in the eastern half of the United States to expand capacity and be geographically situated to supply the Midwest, South and Northeast regions of the U.S.

In order to begin exploring the possibility of a greenfield expansion into the contract manufacture of extruded ingredients and inclusions, this thesis considers three subjects. The first is a customer survey case study, which discovers the customer found high price and whether or not the manufacturer was considered a strategic partner to be the most significant factors in how desirable a manufacturer is. The second subject considered is the ideal location for a second manufacturing site based on a number of factors, including distance from both the customer base and inputs, labor issues, and any savings associated with a particular site. It was found that distance from the ultimate customer may be less important overall than the other factors.

The third and final component of the research involved conducting a financial feasibility study. The analyses were conducted under alternative scenarios and subjected to a sensitivity analysis on a number of crucial variables. The weighted average NPV for the alternative scenarios was about $31 million and the IRR of 13.8% cleared the company's investment hurdle rate. The payback period was estimated to be just under six years. All these suggest that the project as presented in this research is feasible and any investment in it, subject to the absence of any unforeseen event, will be profitable. It is hoped that this information can be used as a starting point and a guide to consider a future investment based on demand and other market indicators available at the time such a decision is required.

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ACKNOWLEDGMENTS

The author wishes to thank a number of people for the contributions and support that they provided during this thesis process. First, to Bunge, for providing financial support and time to work on the Masters in Agribusiness program I owe a great debt. I hope that it has been partially repaid by the learning I have already brought from my classes and this thesis into my job. Specifically I would like to extend my thanks to my two managers during my time in the program: Bob Johnson for allowing me to start the program and Brian Anderson for his support and countless hours spent educating me on extrusion as well as business principles. I have certainly learned a lot! Also to Brad Dietrich who helped show me how to put a financial plan together.

To Mary, Deborah, Lynnette and Doctor Featherstone for your support and guidance throughout the MAB, it is most appreciated. You run a well rounded and thoughtfully designed distance Masters program! Doctor Biere, you have helped me to think through a number of things in this thesis that I would not have otherwise. To Doctor Vincent, all of your time and help working through the details of this thesis has been crucial. Your energy and enthusiasm are quite infectious, and you have certainly given me a lot to consider during our many discussions. May you continue to find joy and meaning in all your activities!

I would be most remiss if I did not save my biggest thanks for my family. To my wife Eve and children Morgan, Toby and Henry; you have been incredibly patient with me during this process and understanding when I had to take time from us for me to spend on

this thesis. Thanks for all the support and I look forward to being more a part of all your lives very soon!

CHAPTER I: INTRODUCTION

Bunge Limited is a publically traded agribusiness company headquartered in White Plains, New York, U.S.A. It operates across approximately forty countries in a variety of businesses from commodity trading, storage and transportation to grain milling, oilseed processing and consumer packaged goods. Bunge North America has seven distinct divisions: Grain, Oilseed Processing, Oils, Milling, Biofuels, Fertilizer and Latin America. In the U.S., Bunge Milling has four dry corn mills, two on the eastern side of the Corn Belt and two on the western side. Having a balanced sourcing and supply footprint with locations close to both the source of raw materials and customers has been a key part of Bunge's competitive strategy. In 2010, Bunge Milling division expanded into rice milling when it purchased a rice mill in Woodland, California. Figure 1.1 shows the locations of the five current U.S. milling assets.

Figure 1.1: Bunge North America U.S. Milling Locations

Bunge is constantly looking at new business ventures that will bring value to its customers. One such venture currently being developed is an expansion into the contract manufacture of extruded ingredients and inclusions. The first phase of investment involved locating an extrusion line in an existing rice mill in Woodland, California. The medium grain rice variety that Bunge processes in Woodland is one of the primary ingredients used in extrusion, creating an ingredient cost advantage versus a stand-alone facility. Also, because this line was placed in an existing facility, the land was already paid for, there was an established labor pool and administration support was available, making the initial investment cost relatively low. A potential second phase would involve a greater level of investment. Currently under consideration is whether to build a larger greenfield stand-alone extrusion plant in the Midwest. This would create a balanced footprint for supply into our customers' distribution networks in the Midwest, South and Northeast.

Any such investment must be in alignment with company objectives. Bunge measures success in its mission to be the best agribusiness and food ingredient company in North America by customer satisfaction, operational excellence, employee motivation and financial returns (Bunge North America - About Bunge 2012). Expanding into extrusion contract manufacturing for ingredients and inclusions should increase customer satisfaction. Some key strategic customers have expressed dissatisfaction with the extrusion contract manufacturing industry in terms of responsiveness. If Bunge is able to fill this gap for their customers, it will create stronger partnerships and greater loyalty. Moving down the value chain to an industry with higher profit margins will also bring greater financial returns. Bunge would be vertically integrated in this industry as it currently manufactures two of the most important ingredients for direct expansion extrusion, corn and rice.

1.1 Research Problem and Research Question

The question that this research seeks to address is whether or not building an extrusion contract manufacturing site for ingredients and inclusions in the eastern United States is a good investment. To provide the proper context for the financial results, this thesis considers a number of factors, including Bunge's potential sources of competitive advantage, a case study of what customers find most desirable, location factors, and a financial feasibility study.

Bunge Milling's decision to build their first extrusion contract manufacturing site for ingredients and inclusions in Woodland, California made good business sense for a variety of reasons. In order to justify the second phase of the investment, Bunge needs a roadmap for the project and a starting point for evaluating financial viability. Thus, the research question is: Would a second contract manufacturing site for extruded ingredients and inclusions located in the eastern United States be economically feasible?

1.2 Objectives

The overall objective of this research is to evaluate the feasibility of a proposed extrusion contract manufacturing site in the eastern U.S. By considering their sources of competitive advantage, gathering customer input, looking at location factors and building a financial model, Bunge will not only have a framework from which to view the investment decision, but they will have investigated some broader aspects of the business that should help make the decision process more complete.

1.3 Methods

This research uses several methods to complete its objectives. These include a conjoint analysis of a survey attempting to understand the trade-offs one customer makes between various features including price. There is also a center of population equation that is used to find the central point within a region's population. This center of population is one that may be best situated to supply the region as a whole by virtue of being as close as possible to all of the customer base. Finally, net present value (NPV) and internal rate of return (IRR) determinations are used to evaluate the project's economic feasibility. Some of the assumptions behind the financial model are altered through a series of scenarios in order to explore the financial impact of some different potential business situations.

1.4 Thesis Outline

Chapter 2 consists of the literature review which provides some background on extrusion technology, contract manufacturing, greenfield construction and determining financial feasibility. Chapter 3 will discuss theory and methods and lay out the data. Chapter 4 will present the data and analysis and Chapter 5 will present the summary, conclusions and recommendations regarding the investment.

CHAPTER II: LITERATURE REVIEW

Chapter 2 explores some of the literature that exists on contract manufacturing, direct expanded extrusion, greenfield building projects, business planning and the feasibility process. These topics provide the backdrop for the data, analysis and other topics covered in Chapters 3, 4 and 5.

2.1 Contract Manufacturing

Large companies have learned that they can't do everything for themselves and have placed a greater emphasis on building strategic partnerships in recent years. These partnerships can take a variety of forms to suit a number of purposes including working closely with a supplier to solve a manufacturing issue, forming a joint venture to capture value from a byproduct stream, or contracting with an outside manufacturer to make their products in an arrangement known as co-manufacturing (Hickins 2000).

2.1.1 Benefits of co-manufacturing

Co-manufacturing has become more popular in recent years as it allows companies to generate income while owning fewer assets themselves. This reduction in overhead is helpful for companies who measure financial performance using asset-based accounting figures such as Return on Assets (Clark 2006). Additionally, marketing-oriented companies are able to focus on their core competencies of distributing and selling, allowing them to put more time, energy and resources into their sources of competitive advantage. Conversely, because contract manufacturers tend to have a core competency in manufacturing, the customer can take advantage of their efficiency, process expertise and industry knowledge that come through their work with a large number of customers. Another benefit of using a contract manufacturer is that they are able to take advantage of economies of scale. Particularly when the item being produced does not warrant its own production line, a contract manufacturer can switch between several different products made for a variety of customers and manage to fill their capacity (Patterson and Haas 1999). All these benefits are summarized in Figure 2.1.

Figure 2.1: Key Benefits of Contract Manufacturing

Benefits
Focus on Core Activities
Efficiency of Best-in-Class Suppliers
Industry Knowledge and Expertise
Economies of Scale
Overhead Reduction

Source: (Patterson and Haas 1999)

2.1.2 Risks of Contract Manufacturing

Although there are many potential benefits to using contract manufacturing, it is important to also consider the risks. Contract manufacturers do not always behave perfectly, and some are better as partners than others. One risk that a company takes when going with a contract manufacturer is the loss of skills and expertise necessary to produce the food or ingredient themselves. If the relationship with the contract manufacturer deteriorates, the company would need to establish a new partnership with a different contract manufacturer or potentially bring the capability in house. Both of these options are potentially lengthy and resource-intensive propositions which point to the need for companies to choose their partners carefully.

A second risk of contract manufacturing is that the company could lose control of what is being produced by the manufacturer. This can happen if the goals and objectives of both companies are not in agreement. Thus, it is important to get alignment from the start of each new arrangement on what the key deliverables are. A third risk is confidentiality. Because it is typically necessary for the company to share sensitive information with the contract manufacturer, there must be a confidentiality agreement in place. If there is a breach of contract there would be legal ramifications for the contract manufacturer, but perhaps more significantly, their reputation would be damaged in the industry. Both are strong deterrents, but the damage to their reputation has the ability to impact business far into the future. A fourth concern is that although overhead has been reduced on the company's manufacturing side, they will incur significant monitoring and transaction costs. These costs are due to the need to confirm that food safety and quality standards are met as well as interacting with the contract manufacturer's inventory and accounting systems to eliminate supply disruptions. Many modern information technology systems allow for relatively seamless integration of manufacturing, inventory and accounting systems, which has lowered and will continue to lower these costs. All of these risks are summarized in Figure 2.2.

Figure 2.2: Risks of Contract Manufacturing

Risks
Loss of Skills and Expertise
Loss of Control
Confidentiality
Monitoring Costs

Source: (Patterson and Haas 1999)

Although these risks should be considered and dealt with before entering an agreement with a contract manufacturer, simply putting protections in place does not negate all risk. The contract manufacturing customer is in a relatively vulnerable position in that it has given much of the direct control over the production of something that it will ultimately sell under its label. That is why selecting the right partner is important (Patterson and Haas 1999).

2.1.3 Factors for a Successful Contract Manufacturing Relationship

Companies have moved from combative customer-supplier positions to a desire to form more cooperative partnerships in recent years. This has become necessary to keep up with a constantly changing business landscape and intensified competition as partnership-style relationships tend to be more productive. There are several factors that allow for a strong partnership between the customer and contract manufacturer which are summarized in Figure 2.3.

Figure 2.3: Key Elements of a Successful Contract Manufacturing Partnership

Elements
Shared Objectives
Mutual Need
Risk Sharing
Mutual Trust
Mutual Reliability
Cooperation
Commitment by Senior Management

Source: (Patterson and Haas 1999)

On a foundational level there must be shared objectives and mutual need meaning that both sides must agree to the purpose of the partnership and must each get something they need out of it. There must also be accountability between both parties in the form of risk sharing, mutual trust and mutual reliability. Risk sharing means one party does not take significantly more risk in the relationship than the other. This is important because if there is an imbalance in risk, the company with the greater exposure may be taken advantage of by the company which has taken less risk. Trust is typically developed over time as both parties show their commitment to making the partnership successful, however, selecting contract manufacturers which already have good reputations in the industry can help make establishing trust easier. Mutual reliability means both parties are willing to work through difficult situations and see the partnership through. Finally, cooperation and senior management commitment are necessary components. Cooperation means that important decisions are made together, and senior management commitment makes sure that all components of both the customer and the contract manufacturing organizations stay aligned and committed (Patterson and Haas 1999).

2.1.4 Products that can make good candidates for contract manufacturing

A number of products can be successful in co-manufacturing arrangements. Newly developed products can work well because the inherent risk of a new product failure is shared between customer and manufacturer. On the opposite end of the spectrum, well-established industry standard products can also make good candidates assuming there is no highly proprietary process involved in their manufacture (Clark 2006). Companies with their own production assets may look to co-manufacturers if they want their product put into special packaging such as single serving packs or extra large club store sizes. Other products are commonly outsourced to contract manufactures include dry blended mixes and products that might contaminate the customer's manufacturing lines with an allergen such as peanuts in a chocolate manufacturer's facility, or strong flavors like garlic (Clark 2006).

2.1.5 Contract manufacturing and private label

One trend that has made contract manufacturing more important is the move towards private label, or store brands, which has been on the rise in the U.S. for many years. In a recent survey, 85 percent of consumers stated that many private label store brands are of the same quality as national brands (Toops, Consumer Trends: Private Label is Here to Stay 2011). Based on data from the Nielsen Company, the Private Label Manufacturers Assocation found that in the decade from 2000 – 2010, private label sales grew by forty percent in supermarkets (Toops, Industry Trends: Store Brands Cap a Decade of Growth 2011). In 2011, store brands increased 5% in dollar volume, outgrowing national brands two to one (Private Label Manufacturer's Association 2012). The food industry sees this trend continuing; seventy-seven percent of consumer packaged goods company executives and ninety percent of retail executives expect private label market share in the U.S. to increase or increase significantly in 2012 (Toops, Consumer Trends: Private Label is Here to Stay 2011).

There are some distinctions between contract manufacturing and private label. Private label food manufacturers typically make store brand products or some label other than a national brand. They also tend to manufacture a limited portfolio of products and are less likely to develop unique products for each customer, but want to make similar products for all their customers. By contrast, contract manufacturers are typically told what to produce and given formulation and process information by their customers (Clark 2006). Given that many companies are currently experiencing cutbacks in a variety of areas including research and development, a contract manufacturer that is able to create their own concepts to show to customer and also offers the willingness to manufacture whatever products their customers develop have a source of competitive advantage.

2.2 Extrusion

Extrusion is a relatively old technology that continues to find new applications. At a very basic level, extrusion refers to the process of forcing material through a die opening. The word itself comes from two Latin words meaning “to thrust out” (Seib 1976). Extruders have been designed to serve a number of functions in a number of industries, from making pasta to forming metal pipes to blowing plastic films. In food manufacturing extruders are used to make a variety of finished products such as sausage, pregelatinized flours, pellets, puffed snacks and cereals.

2.2.1 Extrusion History

The first application of the extrusion principle in industrial manufacturing was a hand-operated piston press device made in England in 1797 by Joseph Bramah. This principle was later implemented to produce a variety of products from tile to soap and pasta. The first continuous extruder was made in England by Fellows and Bates in 1869. It was a twin screw design that was used to stuff sausages. The first single screw extruder was developed to process rubber by Phoenix Gummiwerke A.G. of Germany in 1873. The first use of an extruder to make ready-to-eat cereals was by General Mills in the U.S.A. in the late 1930s when they used a single screw extruder to form dough that was subsequently processed by drying, flaking or puffing. In 1939, expanded corn curls were made by the Adams Corporation of Beloit, Wisconsin. In the 1960s, cooking extruders were used to make ready-to-eat cereals in a single processing step. Innovations since this time have been mostly incremental, and include segmented screws that give different cooking profiles and drive assemblies that allow for higher shear processing.

2.2.2 General Extruder Categories

Although there are a variety of extruders available that differ from one another in terms of capacity, flexibility, and application, they can all be generalized into one of two categories: single-screw and twin-screw. Both types of extruders can be used for many of the same applications, however, each has some advantages. The differences between the two types of extruders are summarized in the table below:

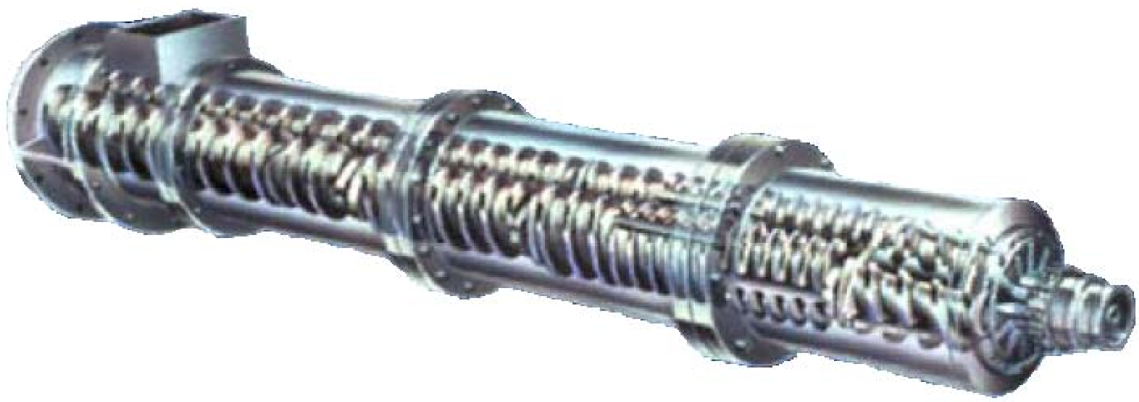
Table 2.1: Comparison of Single vs. Twin Screw Extruders

Feature	Single Screw Extruder	Twin Screw Extruder
Investment Cost	1X	1.5 - 2X
Maintenance Expense	1X	2X
Processing Capabilities	0.75X	1X
Range of Acceptable Feed Materials	Narrower	Wider
Product Flow & Piece Uniformity	Less	More
Cleanup	More Involved	Relatively Easy

Source: (M. Riaz 2010)

Twin screw extruders can handle a greater variety of feed materials. They are particularly well suited to manage wet, sticky or fine feed material that would tend to bridge over the feed screw of a single-screw extruder. Thus, twin screws are particularly well suited for making pet foods which tend to have high protein and oil content. Also, because they contain a second screw, twin-screw extruders have more processing options, tend to be more flexible and show less pulsation at the die exit. Because of the self-wiping characteristics of the twin screw extruder, cleanup tends to be easier than a single screw.

Figure 2.4: Twin Screw Extruder



Source: (Wenger Manufacturing Incorporated 2010)

Some advantages of single screw extruders are that they cost approximately 50 - 75% less than a twin screws, are cheaper to maintain and simpler to operate. Relative to processing capabilities, one estimate is that single-screw extruders can do 70 – 80% of the processes that can be done by twin-screw extruders, making them a good investment as long as they are well suited to the end application and feed materials.

Figure 2.5: Single Screw Extruder

Source: (Wenger Manufacturing Incorporated 2010)

2.2.3 Direct Expanded Extrusion

Extruders can be used to do a number of processes to food products including degassing, shaping, cooking and expanding. When discussing direct expanded extrusion, we are referring to a process where the carbohydrate-based feed material experiences high levels of heat, shear and pressure such that when it exits the die heat, it rapidly “puffs” or expands. This type of extrusion is commonly used to produce a number of snacks, cereals and inclusions from a variety of ingredients, including corn, rice, wheat, oats and starches. Of these, some of the most common ingredients are rice and corn due to a combination of their relative low cost and high expansion. Direct-expanded extrusion differs from cooking/forming extruders which create a firm, dense pellet which is later expanded by rapid heating methods such as gun puffing, frying or microwaving (Riaz 2000).

2.3 Greenfield Decision Factors

There are several factors that go into whether or not to make a greenfield investment. After the decision to enter into some sort of investment has been made, there are some alternatives to building a greenfield manufacturing plant that must be considered. The primary alternatives are mergers and acquisitions (M&A), joint ventures (JV), and exportation. Firm attributes that tend to influence the choice between these different types of investments include total assets, sales, market capitalization and firm size. Larger firms tend to choose greenfield investments, intermediately sized firms tend to choose M&A or JV, and the smallest firms tend to export (Raff, Ryan and Stahler 2004). In another study, it was found that either very quickly or very slowly expanding firms preferred M&A, while those with more research and development intensity preferred greenfield investments. Within industries, those with either very high or very low competition tended to encourage greenfield expansion while those with an intermediate level of competition tended to favor M&A.

Although the influence of some of these firm and market factors may vary by industry, the most consistently reliable statement about the difference between greenfield and M&A is that in the short term, competition increases with greenfield expansion while with M&A it does not. In most situations, M&A is preferred over greenfield except when the company has a special technology that would make a greenfield facility more competitive than an existing one (Muller 2000). If an attractive M&A candidate is not available, however, greenfield expansion may be the best option.

2.4 The Feasibility Process

This thesis examines the conditions under which a greenfield extrusion contract manufacturing facility in the Midwest is feasible. A feasibility determination will be made based on a study of the technical, operational and economic components involved. Technical feasibility explores whether the project can be built, evaluating physical and technological requirements. Operational feasibility looks at the infrastructure and human resource requirements, from how many people will be needed to run operations, sales and customer service to what type of warehouse space will be required. Finally, economic feasibility determines whether the project will make economic sense if it is built. (Amanor-Boadu, Assessing the Feasibility of Business Propositions 2003).

CHAPTER III: THEORY, METHODS AND DATA

In Chapter 3, the theory, methods and data used to support the feasibility study and execution path are developed. First the theory of competitive advantage is explored, including typical sources of competitive advantage for contract manufacturers and specific sources of competitive advantage for Bunge. Next, net present value and internal rate of return are discussed in addition to alternate methods of evaluating the financial benefits of an investment decision. Finally, the data that will be used as the basis for the financial projection and feasibility study is presented and discussed. The data section not only looks at the financial feasibility, but also considers other aspects of the decision including the case study of a customer survey and factors surrounding the build location.

3.1 Theory

3.1.1 Competitive advantage

Competitive advantage is defined as the ability of a firm to maintain profits that exceed the industry average. It is distinguished from comparative advantage, which looks at external resource endowments, by its focus on the internal strategies of the firm. Michael Porter described two primary sources of competitive advantage: cost advantage and differentiation advantage. Companies that pursue cost advantage strategies are focused on the efficiency of their operations and provide the lowest cost product while those pursuing a differentiation strategy look to distinguish their products from the competition in a way that increases profitability (Porter 1980).

The strategy that a company pursues will depend on their resources and capabilities. Resources are relatively tangible company-specific assets that include things like patents, existing customers and reputation. Capabilities are less tangible and refer to the ability of a company to use its resources successfully, for example using its product knowledge to make something cheaper than its competitors. By using their resources and capabilities together, companies can position themselves to pursue either a cost advantage or differentiation advantage strategy (QuickMBA 2012). More recently, studies have indicated that the most effective and profitable companies pursue both low cost and differentiation strategies (Wright 1990).

3.1.2 Sources of competitive advantage in contract manufacturing

There are certain characteristics that make companies highly desirable contract manufacturing partners and serve as sources of competitive advantage. As a starting point, product quality must meet customer expectations or preferably exceed them. If the product does not meet the necessary quality standards it will fail with the consumer who may try the product once but will not be back for any repeat business. The contract manufacturer must also be cost competitive. Inefficient equipment, large product losses and a remote location can all increase costs associated with a manufacturer. In order to help keep costs down, the contract manufacturer should demonstrate a culture of continuous improvement and waste elimination.

On-time execution is a critical factor. This means more than just delivering product on a schedule; it also means striving to meet the customer's fluctuating needs and expectations even when they create scheduling disruptions. If a contract manufacturer has a rigid and inflexible schedule, their customers will be frustrated when demand outpaces their projections and they are unable to ramp up production to meet it.

The quality of the relationship itself is a key factor in choosing a contract manufacturing partner; there should be a basic level of comfort and trust between both parties. The contract manufacturer must know the needs of the customer and the customer must communicate, up front, their requirements (EFY Enterprises Pvt. Ltd. 1999). At a more foundational level than quality, cost, on-time execution, and the relationship is the requirement that the contract manufacturer must be financially stable so that it will be around for the long haul. This is more easily assessed in publically traded companies than privately-held companies which are not required to open their books (Zetter 2006).

3.1.3 Bunge's sources of competitive advantage

Figure 3.1: Sources of Competitive Advantage in Extruded Ingredients and Inclusions

Bunge's Sources of Competitive Advantage
Cost
Ingredient Knowledge
Existing Customer Relationships
Good Reputation
Pilot Plant Capabilities

Bunge has several sources of competitive advantage within the contract manufacturing arena which have been summarized in Figure 3.1. Bunge supplies three of the most commonly-used ingredients in direct-expanded snack and cereal foods: corn, rice and oil (Hui 2006). This fact provides the company with at least three sources of competitive advantage: cost, ingredient knowledge and customer relationships. First, by moving closer to the customer from supplying raw ingredients to supplying extruded inclusions and ingredients, Bunge is able to eliminate steps in the value chain and offer a lower price. Second, because Bunge has first-hand ingredient knowledge, the company can leverage this expertise to be a full-service solutions provider. It can use its understanding of ingredients to solve issues and develop new snacks and cereals in partnership with its customers. Third, because the company is already an ingredients supplier, Bunge has established relationships with several cereal and snack manufacturing companies. The company can leverage these relationships to promote their extrusion offerings. Bunge's existing relationships are a large part of why the extruded ingredients and inclusions were originally considered; the concept was initiated by an existing Bunge customer who asked the company to enter the business.

Since Bunge is not a branded food manufacturer, it is ideally suited to offer contract manufacturing without concerns over conflict of interest. A few companies that offer extrusion contract manufacturing also make extruded snacks and cereals under their own labels. This can limit their customer base by the fact that their competitors are less likely to partner with them. Therefore, another source of competitive advantage is the company's position outside of the branded extruded snacks, cereals and inclusions industry. Bunge has name recognition within the food industry and a good reputation that has been developed over the years. Although reputation is not a capability, it is an asset that can be capitalized on and used to create an instant level of trust.

Bunge's extrusion pilot plant is a multi-dimensional source of competitive advantage and is somewhat unique within the contract manufacturing industry. It allows the company to offer their customer the whole development package: ingredients, a facility to develop the new product on a small, pilot plant scale, and finally manufacturing. It serves to strengthen the customer relationship and increase switching costs as Bunge becomes a one-stop-shop for ingredients, development and manufacturing. The pilot plant also flattens the learning curve from development to production because of Bunge's involvement during the whole development process. The intimate knowledge of what has and hasn't worked, along with their knowledge of potential scale-up issues between the pilot plant and production should make the process smoother and the speed to market faster. Finally, the pilot plant gives Bunge more time to innovate and better operational efficiency because it does not need to interrupt normal production to run new product testing. These advantages are summarized in Figure 3.2.

Figure 3.2: Advantages of Building a Pilot Plant for Extrusion

Bunge's Sources of Competitive Advantage
Strengthen Customer Relationships
Increase Ingredient Knowledge
Improves Speed of Development/Speed to Market
Improves Scalability to Production
Less Need to Interrupt Production

Although it can't be listed as one today, supply footprint would become a competitive advantage if Bunge built a second plant that could cover the eastern U.S. By doing so the company would take its Woodland, California plant that is relatively isolated on the west coast and create a balanced footprint, making it better able to competitively cover most of the country. This is critical because better alignment with our customers' production and distribution points lowers shipping costs and as well as reduces the potential for supply chain disruptions. Location to supply may be more important for expanded product than location to ingredients because the finished product is approximately six times less dense and thus more costly to ship than the ingredients are. A balanced footprint becomes a critical differentiator when dealing with large customers who have nationwide distribution. From the customer's perspective, not only does such a footprint lower the total cost of the product and simplify their logistics, it also reduces the time transferring production knowledge from one co-manufacturer to another if a product made in Woodland would need to be made at another company in the eastern half of the U.S.

3.2 Methods

3.2.1 Net Present Value

Net present value (NPV) is one of a number of financial decision-making tools available when evaluating investment choices. Out of all the available methods, however, NPV creates the best investment decisions. This is because NPV takes into account the time value of money, which says that a dollar today is worth more than a dollar tomorrow because it could be invested now and start earning interest. Thus, the NPV equation shows an initial investment made at time zero, followed by a series of cash flows that are divided by a discount factor which factors in time and the discount rate. Net present value is defined as follows:

$$NPV = -I + \sum_{t=1}^{T} C_t (1+r)^{-t} + S_T$$

where I is the initial investment that is made, C_t is the cash flow in each period t, r is the discount rate and S_T is the discounted salvage value of the investment in the terminal period, T.

The primary weakness of NPV is that it assumes all cash flows are known with certainty. This is certainly not always true, particularly when referring to cash flows far in the future. This is why we refer to all cash flows as expected cash flows. A second weakness is that it does not consider the riskiness of the investment. This can be adjusted for by changing the discount rate. A good investment is one where the NPV is greater than zero.

3.2.2 Internal Rate of Return

Internal Rate of Return (IRR) is closely related to NPV. IRR is defined as the discount rate at which NPV equals zero. A good investment using the IRR tool is one for which the IRR is greater than the opportunity cost of capital, which is simply a rate that we expect we could earn investing in a project of equal risk (Brealey, Myers and Allen 2007). Although NPV is the most preferred method of making financial decisions in academia, Internal Rate of Return tends to be preferred more by executives. This is because they find it an easier method to compare different sized investments than NPV, despite the fact that NPV tends to be more accurate (Pogue 2004).

One of the limitations of IRR is that it can yield multiple values if the investment contains both positive and negative cash flows. This is a relatively common situation as there are typically a negative cash outflow at the beginning of a project, followed by positive cash inflows during the course of the project, and then negative cash outflows at the end of the project. IRR should not be used to compare mutually exclusive projects, as it can ignore the magnitude of the projects; a small project with a smaller NPV may have a higher IRR than a larger project with a larger NPV (Brealey, Myers and Allen 2007). Despite some of IRR's weaknesses, however, it is still an important decision-making tool, and this thesis uses both NPV and IRR to evaluate the financial feasibility of the project.

3.3 Data

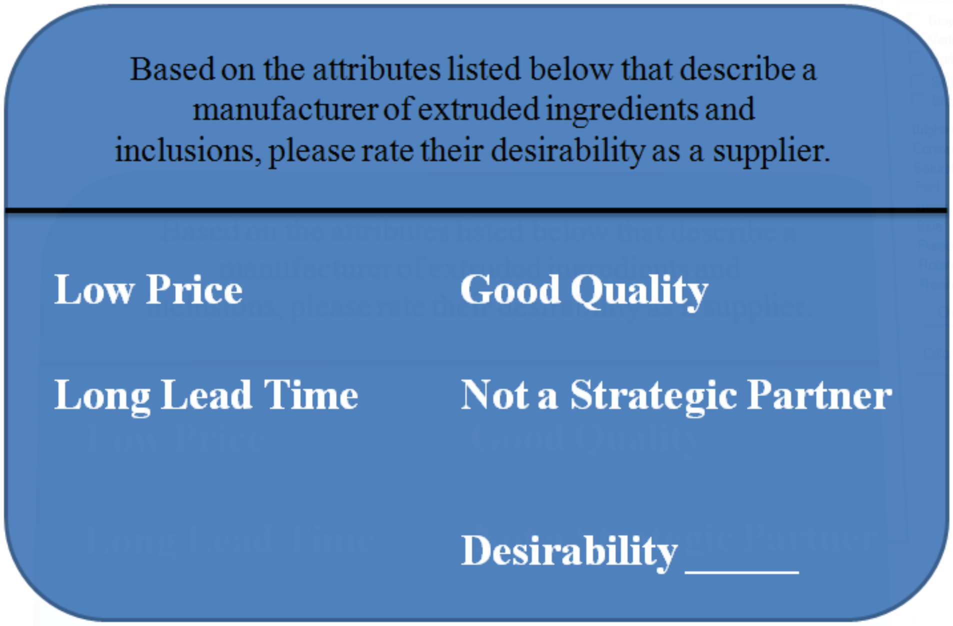
3.3.1 Customer Survey Case Study

The first step in the process of determining whether or not to build a contract manufacturing plant for producing extruded ingredients and inclusions is to understand the customer. Bunge must know not only what their customers say they want but also what they are willing to pay for so that Bunge can concentrate on what is truly most important and not overbuild in other areas. Blue Ocean Strategy, a popular business concept, says to build a company in such a way that it meets needs in the marketplace that are currently undiscovered or ignored. Offerings must be structured in such a way to make the competition irrelevant. By meeting previously unmet needs, higher profits are achieved and new demand is created (Kim and Mauborgne 2005).

As Bunge structures this business, it must not only understand what the unmet needs in the marketplace are but whether or not it makes business sense to invest in the business in such a way to meet those needs. Conjoint analysis is a marketing tool that allows Bunge to understand not only what the customer wants, but also how much they are willing to pay for it. It does this by asking the customer to rate a series of products having different attributes and then performs a regression analysis on the results (Harmon 2010).

A conjoint analysis survey was constructed to determine what trade-offs the customer would be willing to make, for example between price and quality. There were a total of four criteria used in the survey: price (low, fair, high), quality (good or superb), lead time (long or average) and strategic partner (yes or no). These criteria were used to set up a list of twenty-four (3x2x2x2 attributes) different supplier profiles which the customer was asked to rate on a scale of one to ten, with one being not desirable and ten being highly desirable. Based on this ranking, a linear regression was performed and coefficients determined for each of the criteria that indicate each of their relative importance. An example survey question is shown in Figure 3.3.

Figure 3.3: Sample Survey Question



Although it would have been interesting to see even more individual criteria used to define each choice, each two option criteria doubles the number of potential scenarios and questions that must be asked. The criteria were selected by placing several potential options in a matrix and finding those which were thought to have the most potential for customers to be forced to make trade-offs between. Then, attributes which might be able to be combined were in order to reduce the overall number of variables. For example, the criteria of strategic partner was developed in such a way to encompass a number of other potential attributes that could otherwise have been evaluated individually, such as customer service, innovation and flexibility. Strategic partners were defined as suppliers which bring more than a product or ingredient to their customer. They are preferred suppliers because of their ability to bring innovative solutions to the customer, they are flexible and willing to make whatever changes are necessary to meet their customer's requirements, and they provide great customer service.

Not only does the customer survey allow Bunge to better understand its target customers, but it allows them to be viewed across categories. Some categories of customer, such as large, established nationally-branded consumer product companies tend to drive higher volume, lower margin business. Other customers, such as intermediate-sized companies which are looking to grow may be more interested in innovative products and be more willing to pay for them. As Bunge better understand the market and what customers in different categories view as most important and are willing to pay for, they can structure not only the business but also develop a profile for the type of customer or portfolio of customers they might want to pursue to maximize the return on investment.

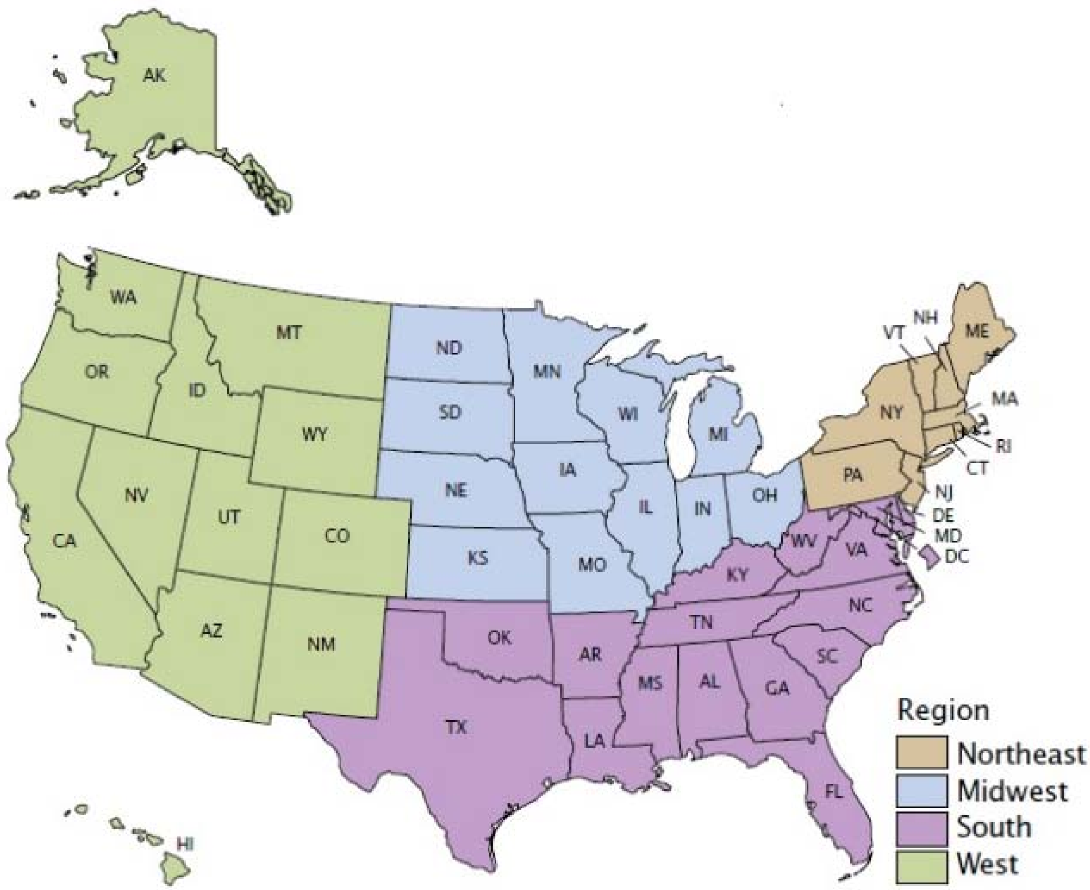
3.3.2 Location

Several factors must be considered when determining where a plant will be located, including labor, shipping costs, and any savings that might be associated with a particular location. As Bunge has already built a plant in California, finding the best location for a second site that complements the facility in California is important. In considering all of the aspects of site selection, we will first explore the location that minimizes shipping costs, and then weigh in the other decision factors to help make the best decision possible.

3.3.2.1 U.S. Regions

The United States can be divided into four regions: West, Midwest, South and Northeast, as shown in Figure 3.4. One of the major problems with shipping product from the West to the other regions is distance, particularly if the origination site is on the west coast. In addition to distance, there are also several mountain ranges that exist in the West, including the Coastal Ranges, Sierra Nevada, Cascade Range and Rocky Mountains. The need to haul freight over mountains also makes shipping rates more expensive due to increased fuel costs and more limited routes.

Figure 3.4: U.S. States and Regions



Source: (U.S. Census Bureau 2011)

Using a manufacturing plant in the West to supply the entire U.S. is inefficient because as shown in Table 3.1, over 75% of the U.S. population is located in the Midwest, South and Northeast. Given that Bunge already has a manufacturing site located in California to cover the Western U.S., having a second, centrally located production facility to supply the other regions at a reasonable freight cost is critical.

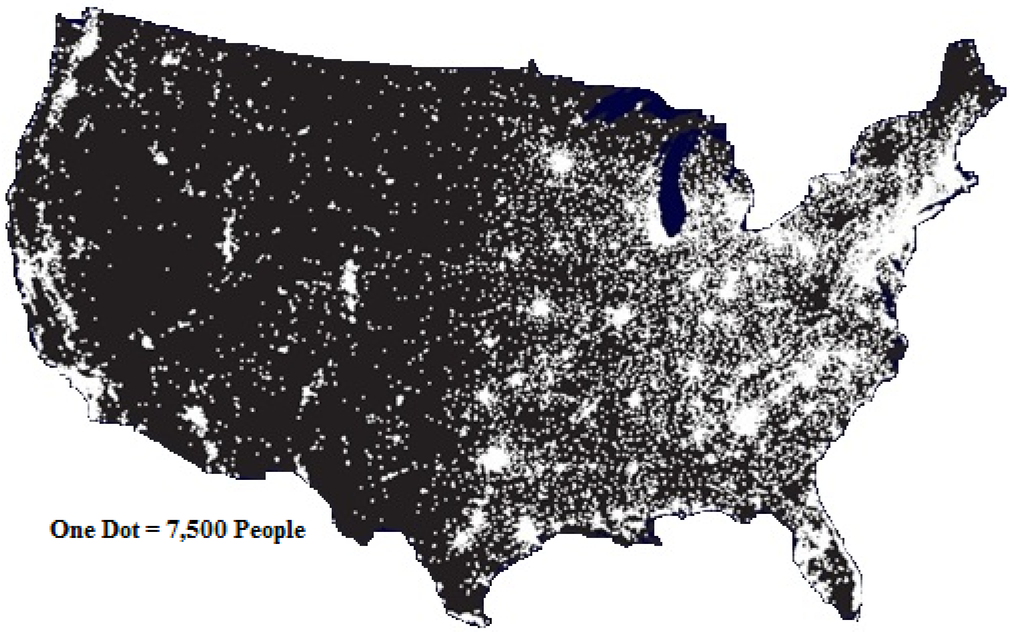
Table 3.1: Population of U.S. Regions

Region	Population	Percent of Total
Midwest, South and Northeast	236,799,985	76.7%
West	71,945,553	23.3%
Total U.S.	308,745,538	100.0%

Source: (U.S. Census Bureau 2010)

Figure 3.5 is a map of the population of the U.S. represented by dots of light on a dark background, known as a Night Sky Population Map. It shows the high population density of the eastern half of the U.S. as well as the largely unpopulated region between the west coast and about the middle of the country. Having a strategically-located facility that is positioned to supply the Midwest, South and Northeast is critical if Bunge wants to compete in the manufacture of extruded ingredients and inclusions at a national level.

Figure 3.5: U.S. Population Distribution Map



Source: (U.S. Census Bureau 2011)

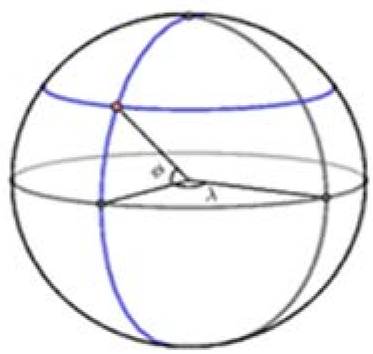
3.3.2.2 Population Center of Midwest, South and Northeast

When choosing a good manufacturing location to serve the Midwest, South and Northeast regions of the U.S., it is important to look for one that has low overall shipping costs. Extruded products have a lower density than their ingredients by an approximate factor of six to one, making truckloads of outgoing finished product lighter than truckloads of incoming ingredients. This may tend to give finished product shipping costs more significance when calculating total shipping costs than ingredient shipping costs do. Thus choosing a location that is close to all potential customers seems important. Although the ultimate customer base is not known with certainty and is in fact is likely to fluctuate over time, we can assume that our customer's distribution centers would be located to optimize distribution to the region's population. Thus, the population center of all the states in the three regions can be used as a proxy for the customer's distribution points. The equation shown in Figure 3.6 is used by the U.S. Census Bureau to determine the center of the U.S. population following each census. It takes into account the relative weight of each population data point in factoring the center of a given set of population data.

Figure 3.6: Center of Population Equation

$$\bar{\phi} = \frac{\sum_i w_i \phi_i}{\sum_i w_i}, \qquad \bar{\lambda} = \frac{\sum_i w_i \lambda_i \cos \phi_i}{\sum_i w_i \cos \phi_i}.$$

where: ϕ_i = latitude (in radians)
λ_i = longitude (in radians)
ω_i = population of a point



Source: (Austin 2005)

Using this equation and data on the population center of each state in the Midwest, South and Northeast from the U.S. Census website, we are able to calculate the population center of these regions as being 37.4387128 degrees latitude and -84.37617077 degrees longitude. This corresponds to 4357 Brindle Ridge Road in Brodhead, Kentucky, located just off of I-75 in the middle of the state between Lexington, Kentucky and Knoxville, TN.

3.3.2.3 Other potential sites

Brodhead, Kentucky is geographically well-situated to serve as a single manufacturing site to supply the population of the eastern half of the U.S., but we must also factor in the cost of bringing in ingredients to better understand how this location compares with others and determine which has the lowest overall shipping costs. Also, Brodhead is a small town with a population of 1,193 people in a relatively remote area, so quantity and quality of available labor may be limited. Thus, two other locations were chosen to compare with Brodhead based on shipping costs, labor, cost to build and other factors.

The first alternate location in Danville, Illinois is the site of an existing Bunge corn mill. Danville is west of Brodhead, but not too far from the geographic center of population. Also, because the site is already owned by Bunge and there would be some management and support functions that would not have to be duplicated, upfront costs in land and yearly H.R. costs would be somewhat lower. Shipping costs for corn ingredients, about 50% of all ingredients used, would be negligible as the corn meal would simply be transferred from one warehouse to the other as needed. Danville is a mid-sized town of around 33,027 which has seen its manufacturing base disappear as jobs moved to other countries. Thus, although it has a good number of workers, it could be difficult to attract highly skilled employees and management to the area.

The second alternate site is in the Indianapolis, Indiana metro area. Indianapolis is slightly closer to Brodhead than Danville, and is located in the business-friendly state of Indiana. It has several major Interstate highways running through it, which would tend to make transportation costs lower and, with a population around 1.7 million in the metro area, availability of skilled workers isn't an issue. Figure 3.7 below shows the relative position of the three locations:

Figure 3.7: Map of Potential Locations

3.3.2.4 Total shipping costs

Both outgoing product shipping costs and incoming raw ingredient costs must be factored in to determine the best location to keep shipping costs at a minimum. In order to make the task of gathering these shipping costs manageable, the ten largest metropolitan areas in the region were identified and used to represent the area as whole. The summary of this information is located in Table 3.2 below:

Table 3.2: Ten Largest Metropolitan Areas in Midwest, South and Northeast

Metro Area	Population
New York	18,897,109
Chicago	9,461,105
Dallas/Fort Worth	6,371,773
Philadelphia	5,965,343
Houston	5,946,800
Washington, D.C.	5,582,170
Miami	5,564,635
Atlanta	5,268,860
Boston	4,552,402
Detroit	4,296,250
Total	**71,906,447**
Percent of Region's Population	**30.4%**

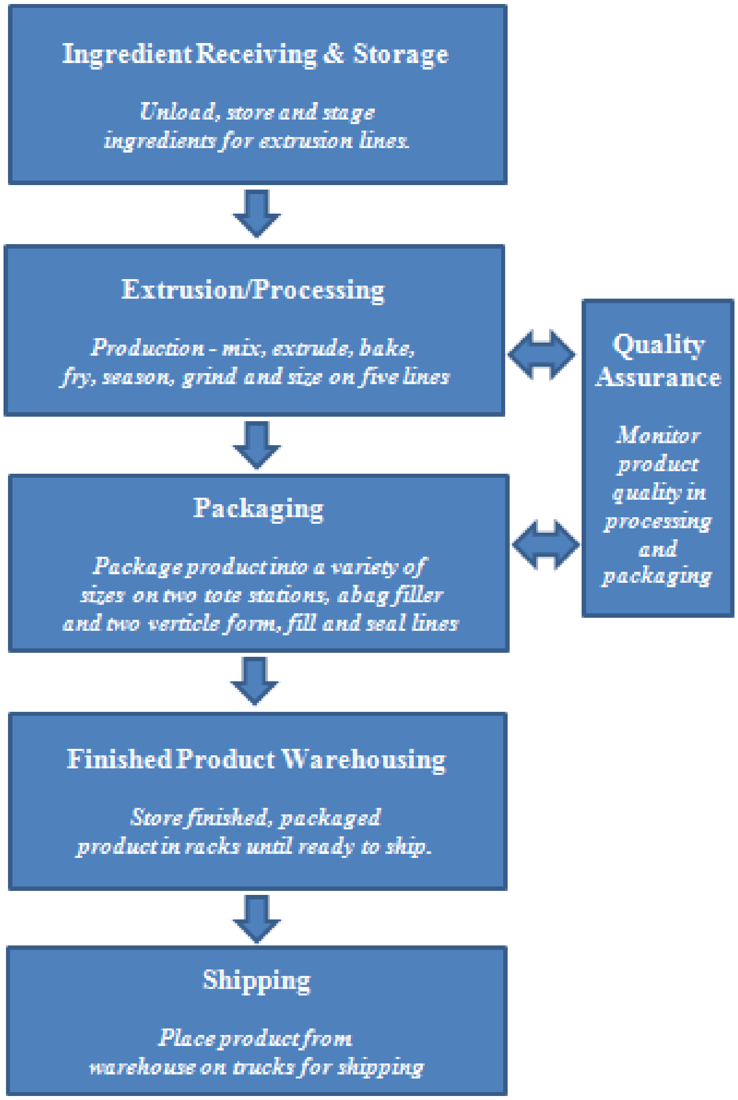
As the table shows, these metropolitan areas represent about 30% of the total population of the three regions. In order to confirm that the ten metro areas closely approximate the overall population, their population center was calculated and found to be Stafford, West Virginia, 142 miles east of Brodhead. Although this is fairly close to the overall population center of Brodhead, it should be noted when interpreting the results that this population center will tend to give lower shipping costs for finished products to Brodhead as compared with Danville and Indianapolis, both of which lie west of Brodhead. Shipping prices were obtained from each potential manufacturing site to the ten metropolitan areas and a weighted average shipping price/pound was determined.

When calculating incoming ingredient shipping costs, three source locations were selected. Corn, which constitutes 50% of all ingredients, will come from Danville, Illinois. Medium grain rice meal will be shipped from Woodland, California, which is located in the major rice growing area around Sacramento. All other ingredients, including various flours, oil, sugar, salt and other miscellaneous minor ingredients will come from a distribution point in the Chicago, Illinois area. Shipping prices were obtained from these three locations to the three potential manufacturing sites, and the weighted shipping cost/pound for ingredients was calculated for each location.

3.3.3 Financial Model

Based on Bunge's experience with extrusion in Woodland, California, a financial model was constructed. This model is based on Bunge's most current understanding of demand and takes into account cost to build, human resource costs, ingredient costs, utilities costs and expected price points in calculating the financial results. The plant was constructed with five separate extrusion lines allowing for up to five different products to be run at the same time. This was done to maximize production time by minimizing the time required for clean-outs between different products. Additionally, warehouse areas for incoming ingredients and finished product storage were planned based on the expectation of the need to store up to thirty days of ingredient and product inventory at a single time. A packaging area with equipment capable of filling totes, large bags and form/fill consumer bags puts the product in a variety of forms appropriate for storage, shipment and use. Areas for offices, shipping and quality assurance are also included. The basic structure and flow of the plant as well as some of the assumptions behind staffing of the shift operations is shown in Figure 3.8. More detail on the cost of building and staffing is located in Appendices 6 - 10.

Figure 3.8: Plant Process Flow



Four of the five different extrusion lines are capable of producing either sweet or savory puffed items. The only difference is whether an oil/seasoning slurry is applied in the coating system after the oven or a sugar syrup is applied in the coating system prior to the oven. Because we have found that most of our customers want savory ingredients, we dedicated three lines to producing "Savory Puffs" and one to producing "Sweet Puffs". The exact mix of products that ultimately are produced on those lines is not critical as their production rates and profits margins are very similar. The fifth line is known as a "Curls" line, which refers to an extruded product similar to a Crunchy Cheeto™. It is not interchangeable with the other two product lines because it uses a unique type of extruder, known as a friction disk extruder. This extruder is capable of producing only one shape.

Data on equipment cost and utility usage was provided by an extrusion equipment manufacturer. Cost of ingredients for the three product categories was determined by first coming up with representative formulations. As the exact formulation of the starting product mix is not known and likely to change over time, information on typical formulations and ingredients was combined into representative formulas for each of the three basic product categories. The cost of each ingredient was based on Bunge's best understanding of ingredient costs at the plant's estimated volume. Volatility in the commodity market has created swings in ingredient costs, particularly in recent years. One of the four different scenarios that were considered looks at the impact of a rapidly increasing cost of ingredients while selling price increases at a slower rate.

A total of four alternate scenarios were run in addition to the base scenario, and NPV, IRR and payback time were calculated for each. The discount rate used for NPV and IRR was 6.9%. This figure was based on the expected return of alternative investments that were considered to be of comparable risk. Profits were calculated out over fifteen years, and although it is hoped that the investment would bring returns for longer than fifteen years, this period was considered reasonable and conservative. Financial results using the base model assumptions and the four alternatives were calculated and a weighted average of all alternatives was calculated in order to come up with the expected returns from the project. This information is summarized in Section 4.3 of Chapter 4.

CHAPTER IV: RESULTS

Chapter 4 looks at the results of our data analysis from Chapter 3. There are three sections in this chapter. Section 4.1 reviews the results of the conjoint analysis that was performed on the customer survey and considers how they might be interpreted to help focus the business. Section 4.2 looks at the influence of several location factors, including total cost of shipping, labor, and cost to build. Section 4.3 looks at the results of the financial analysis and evaluates under what circumstances the project is financially feasible.

4.1 Conjoint Analysis Survey Case Study

A conjoint analysis was performed on the survey answers provided by Customer "A", summarized in Table 4.1 and Figure 4.1. Based on the p-values of all the coefficients, all are considered significant at the 99% confidence level. The signs of all the coefficients are in the expected directions and their relative magnitudes were as expected. Thus, as expected, the high-priced producer is, *ceteris paribus*, less desirable than the fair-priced producer.

Table 4.1: Conjoint Analysis Coefficients for Customer "A"

Criteria	Attribute	Utility	P-value
Price	Low	0	-
	Fair	-1.21	0.00035
	High	-2.33	1.0E-07
Quality	Good	0	-
	Superb	0.67	0.00817
Lead Time	Long	0	-
	Average	1.11	0.0001
Strategic Partner	No	0	-
	Yes	2.39	3.4E-09

Table 4.1 may be re-presented in the regression equation format as follows:

$$D = 4.79 - 1.21P_f - 2.33P_h + 0.67Q + 1.11LT_a + 2.39ST$$

where D is the desirability of a manufacturer of extruded ingredients and inclusions to potential customers, P_f is fair price, P_h is high price, Q is superb quality, LT_a is average lead time and ST is strategic partner.

The two factors with the highest response coefficients are high price and strategic partner. The large negative coefficient for high price indicates that a high price manufacturer of extruded ingredients and inclusions is less desirable than a fair price or low price manufacturer. This result is perhaps intuitive; however, the magnitude of the coefficient gives an idea of the relative importance of this characteristic compared with others. For example, it helps us understand that high price is as undesirable as being a strategic partner is desirable in an almost equal but opposite sense (-2.33 for high price and +2.39 for strategic partner). Thus, if a company would position themselves as a high price supplier, they should consider positioning themselves as a strategic partner to offset high price. This means that things such as being a development partner, having great customer service, being flexible and willing to meet the customer's needs are components that should be built into the business to supply "Customer A". In interpreting the significance of these results it is important to remember that they are based on a case study of a single company with a particular profile. They currently have a low to intermediate market share in the extruded snack market and a strong desire to grow. Because they are trying to grow and do not have a large research group or a large line of established products, they may tend to rely more heavily on having key strategic partners than a large, established player which will have more of the necessary resources available in-house.

Bunge may also choose to focus on large nationally branded companies which will tend to deliver higher volumes but may have a steeper negative response to price. Additionally, it could consider other categories such private label business with grocery stores and club stores and pursue some small, regionally-branded companies in order to balance its overall customer portfolio and risk. When determining where to place the emphasis in this new business, it should be remembered that each customer is unique and will likely have different coefficients for each criteria depending on their individual business needs. Thus it may be beneficial for Bunge to survey more potential customers to get a well-rounded perspective.

4.2 Location Factors

Ultimately, the choice for the optimum location of a manufacturing plant will be a combination of several factors: shipping cost, cost to build, labor cost, and quality of labor should all be factored in. One way to make that choice is to take all of the important factors into consideration, weigh the impact of each of them appropriately and come to a clear and transparent decision.

The cost to ship ingredients to each of the three potential locations is summarized in Table 4.2. As the table indicates, Danville, Illinois has the lowest costs associated with ingredient shipping. This is because Danville has an insignificant cost to ship corn, the most widely used ingredient in the manufacture of the extruded products. The shipping costs are based on shipping full truckload quantities, 45,000 lbs/truck.

Table 4.2: Cost of Shipping Ingredients to Potential Locations

Ingredients – From	% Required	Brodhead	Indianapolis	Danville
Corn - Danville, IL	50%	$1,160.00	$540.00	NA
Rice - Woodland, CA	20%	$5,160.00	$4,100.00	$3,900.00
Miscellaneous – Chicago	30%	$1,220.00	$800.00	$600.00
Weighted Ingredient Freight Cost		$1,978.00	$1,330.00	$960.00
Weighted Ingredient Freight Cost/lb		**$0.0440**	**$0.0296**	**$0.0213**

Table 4.3 summarizes the average cost of shipping finished product to the consumer. It is a weighted value that takes into account the size of the ten metro areas selected to represent the population of the Midwest, South and Northeast as a whole as described in Section 3.3.2.4. Shipping prices were actual quoted values and as such they take into account not only the distance between locations, but also access to major highways and trucking routes in their calculation. Shipping cost is higher for finished product because the bulk density is lower, yielding trucks not filled to capacity. Finished product shipping cost/pound is based on shipping trucks with 20,000 lbs. vs. 45,000 pounds for a standard truck.

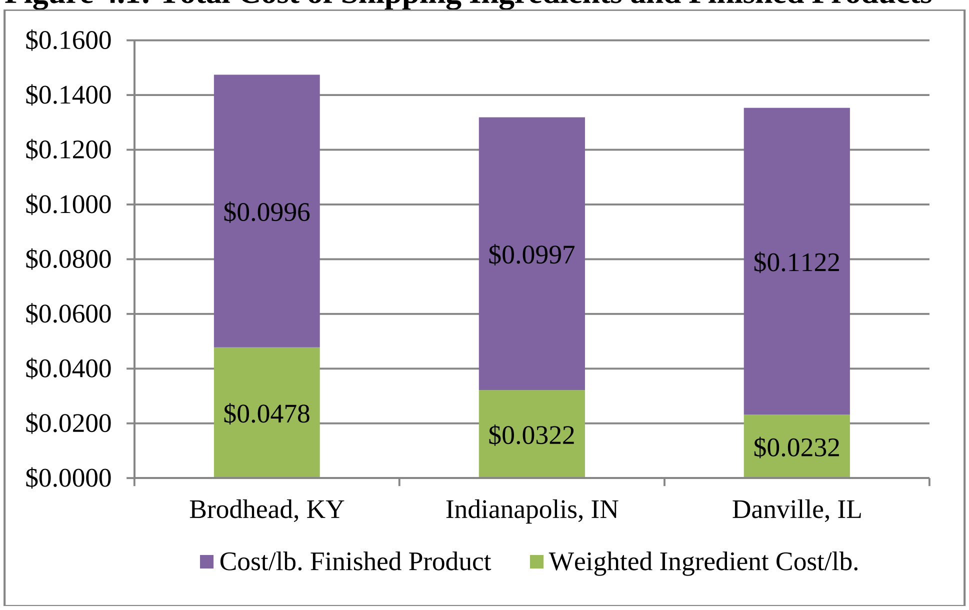
Although Brodhead is the most central location, Indianapolis has similar finished product shipping cost due to its access to major highways. This may be because in even though Brodhead is located near I-75, it is not next to any major Interstate networks. Danville has the cheapest shipping costs for ingredients, but it has the most expensive finished product shipping costs. This is because it is the least central location and is also the furthest from an Interstate.

Table 4.3: Cost of Shipping Finished Product to Ten Metro Areas

Metro Area	Weighted Shipping Cost per Truckload	Weighted Shipping Cost per Pound
Brodhead, Kentucky	$1,992.61	**$0.0996**
Indianapolis, Indiana	$1,993.50	**$0.0997**
Danville, Illinois	$2,243.10	**$0.1122**

Taking into account both the cost of shipping ingredients and finished products from Tables 4.2 and 4.3, Indianapolis and Danville become the locations with the lowest overall shipping costs. Although Brodhead was originally selected for consideration because it is the center of population for the Midwest, South and Northeast, it has the highest total shipping costs. This is summarized in Figure 4.1.

Figure 4.1: Total Cost of Shipping Ingredients and Finished Products



Shipping costs are just one factor to consider in the overall location decision. In order to find the best location we should also consider several other items: quantity, quality and cost of labor, cost to build the plant, and any savings from factors such as existing land. Labor in Indianapolis is available in both quantity and skill level but at a higher labor cost.

Brodhead is a small town with a population just over 1,000 in an isolated setting. This could make it difficult to find skilled labor, however, labor costs may be lower. Danville is mid-sized town with a population of around 35,000. This may make it harder to attract people for some of the more highly skilled positions to the area than Indianapolis. Labor costs may be higher for Danville than Brodhead but slightly lower than Indianapolis.

Building costs are likely to be somewhat higher in Danville compared with Brodhead and Indianapolis. This is something that Bunge has found to be consistently true about building projects there and may have something to do with higher taxes and unions. The building would be constructed on a site that is currently owned by Bunge, making land cost negligible. Danville could present a savings in overhead costs as some of the management functions could be shared with the corn mill. All these factors are summarized in Table 4.4.

Table 4.4: Location Market Analysis

Characteristic	Brodhead, Kentucky	Danville, Illinois	Indianapolis, Indiana
Labor Availability	-6	4	9
Labor Cost	7	3	4
Skilled Labor	-4	4	6
Transportation Costs	6	7	7
Cost to Build	5	7	5
Overhead Savings	0	5	0
average score	1.33	5.00	5.17
score basis Danville	**0.27**	**1.00**	**1.03**

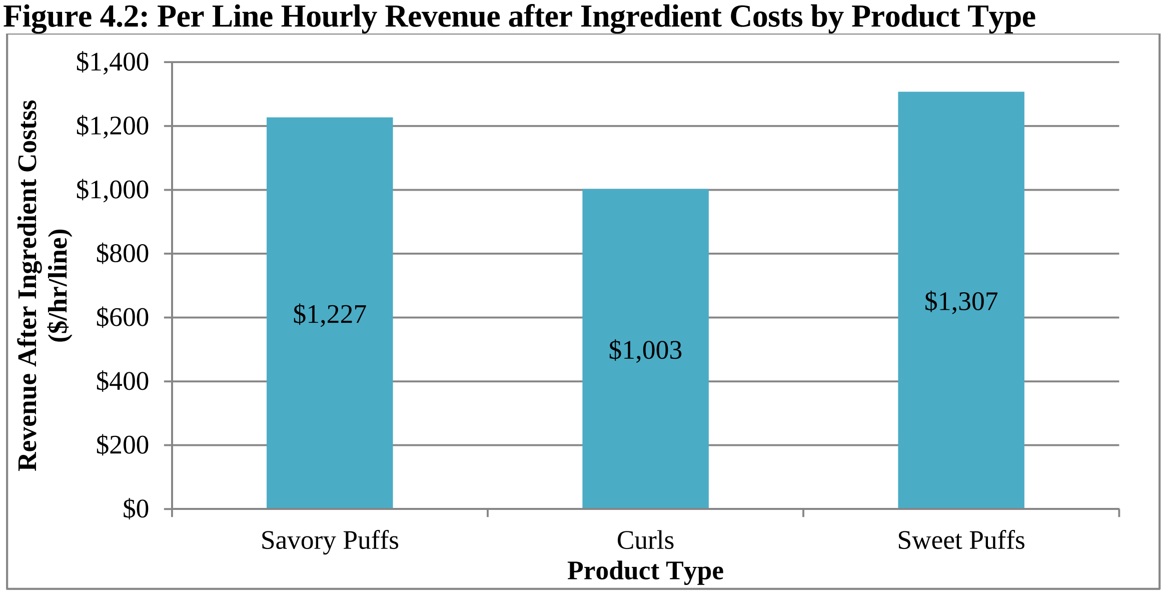
The scores assigned for each factor and even the locations themselves can always be modified as new information presents itself. The magnitude of each score is not important; rather what is important is that that they allow the locations to be ranked to help in decision making. Thus we can see that Brodhead is the least desirable location while

Danville and Indianapolis are fairly close to each other. They are so close in fact, that a small change in one of the factors for either of them could change the order of preference. This suggests that more input or other factors should be considered to help make the choice clearer.

4.3 Financial Analysis

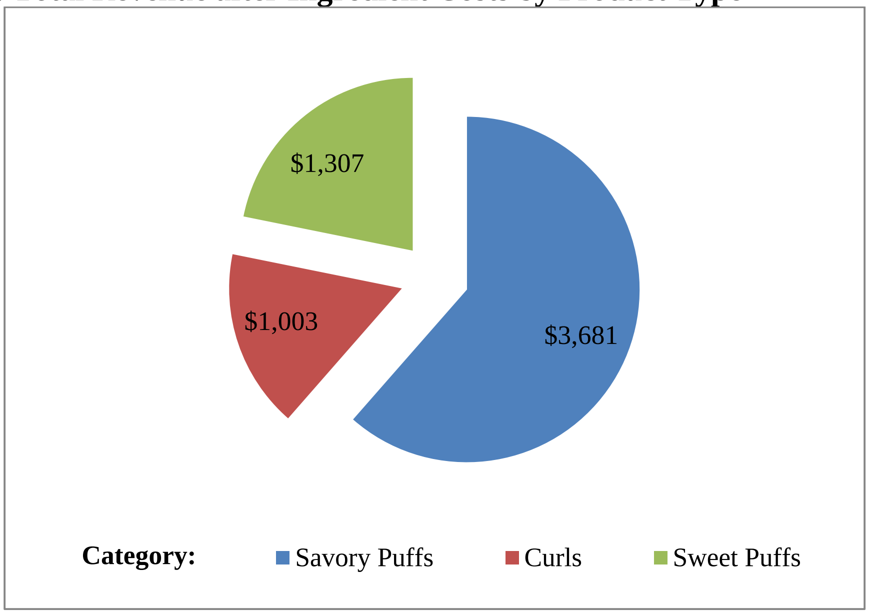
The base model for financial analysis was constructed with what we considered to be a conservative scenario for a number of factors: ingredient costs, revenue growth rates, and utility rate increases. Revenue per pound after ingredient costs for the three different extruded inclusions and ingredients produced (savory puffs, curls and sweet puffs) was similar. The major difference in revenue between the three products came when the capacity of the equipment was factored in to get the revenue per hour figure. Because the curls line runs at 1,000 lbs/hour vs.1,200 lbs/hour for the sweet and savory lines, this yields lower revenue over time, as shown in Figure 4.2. This factor could potentially be offset by including additional extruders in the design during the planning phase.

Figure 4.2: Per Line Hourly Revenue after Ingredient Costs by Product Type



In the base scenario, the plant will make product on three savory lines, one sweet line and one curls line based on predicted category demand. Because the three savory lines run in the base scenario, savory puffs contribute more to overall revenue. Total revenue coming from each of the categories is summarized in Figure 4.3.

Figure 4.3: Total Revenue after Ingredient Costs by Product Type



After calculating the base scenario, we ran four additional scenarios to look at what happens to the investment under different conditions. In the base scenario, we run five lines, 2 shifts per day, 6 days per week at full capacity. A production efficiency level of 85% was used. In this case, production efficiency refers to the amount of time during a shift when good finished product is being made and can be impacted by start up, shut down, clean up and unplanned downtime. In order to be conservative, we also planned for ingredient costs to rise at a rate of 5% per year while sales price only increases at 2%. Table 4.5 summarizes the key assumptions in the base scenario and also the alternate four scenarios. A description of the reasoning behind each of the four alternate scenarios is provided.

Table 4.5: Scenario Input Summary

	Base	Scenario 1	Scenario 2	Scenario 3	Scenario 3A
Number of Lines	5	5	5	3	3
Number of Shifts	2	3	2	2	2
Production Efficiency	85%	76.5%	85%	90%	90%
Ingredient Cost	+5%/year	+5%/year	+8%/year	+5%/year	+5%/year
Product Price	+2%/year	+2%/year	+3%/year	+1%/year	+2%/year

In Scenario 1, we considered an issue where demand for business is high and we must push capacity, moving from two shifts per day to three shifts per day, six days per week. Production efficiency drops to by 10% to 76.5% because there is less time available for clean-up and maintenance. Commodity prices have been volatile in recent years. Scenario 2 considers what would happen if commodity prices increased yearly at 8% instead of 5% and price was only allowed to increase at 3% instead of 2%. Scenarios 3 and 3A both look at what would happen if product demand goes down due to competitive pressure and we are forced to cut back from five lines to three lines. Scenario 3 looks at what happens if we are allowed to increase price by only 1% per year while scenario 3A keeps product price increases at 2% per year as in the base model. Table 4.6 shows the financial impact of each scenario.

Table 4.6: Scenario Results Summary (Currency in MM)

	Base	Scenario 1	Scenario 2	Scenario 3	Scenario 3A
Available Production Hours	58140	82850	58140	61560	61560
Savory Revenue	413.0	588.5	445.5	135.2	145.7
Curls Revenue	101.2	144.2	109.2	99.4	107.2
Sweet Revenue	137.7	196.2	148.5	135.2	145.7
Total Revenue	651.8	928.9	703.2	369.9	398.7
Ingredient Costs	292.2	416.4	370.4	162.6	162.6
Personnel and Utility Costs	117.3	162.4	117.3	80.8	80.8
Total Production Costs	409.6	578.8	487.7	243.4	243.4
Expenses and Depreciation	28.5	37.5	32.9	19.2	19.5
Total Costs	438.1	616.3	520.6	262.6	262.9
Net Income	**70.0**	**132.6**	**50.3**	**2.6**	**20.6**

Volume has the greatest impact on net income. As we increased volume by increasing the number of shifts in Scenario 1, we virtually doubled net income. As we reduced volume by halting production on two lines in Scenarios 3 and 3A, net income dropped significantly. The difference in net income between Scenario 3, when we allowed price to rise by 1% and Scenario 3A when we allowed it to rise by 2% made an approximately $18,000,000 difference in net income. Finally, Scenario 2 shows that the effect of a volatile commodity market on income reduces net income, although not as dramatically as the change in volume did.

Table 4.7 shows how each scenario effected NPV, IRR and payback period. The NPV of Scenario 1 more than tripled as net income doubled vs. the base scenario. This is because the rate of payback matters in NPV vs. net income due to the discount rate. IRR went from 11.2% to 18.8%. The rising commodity prices Scenario 2 had a lower, but positive NPV and an IRR of 9.4%. Both Scenarios 3 and 3A had negative NPV's and low IRR's.

Table 4.7: Financial Analysis of Scenarios

	Base	Scenario 1	Scenario 2	Scenario 3	Scenario 3A
Probability	70.0%	25.0%	2.0%	1.5%	1.5%
Net Income	70,024,510	132,563,504	50,271,371	2,595,926	20,633,119
NPV	18,036,371	56,103,218	9,111,983	(21,320,080)	(12,434,576)
IRR	11.2%	18.8%	9.4%	0.6%	3.8%
Payback Period	6.72	4.79	6.88	NA	NA

Finally each of the scenarios, including the base scenario, was giving a probability level. The yearly cash flows of each scenario were multiplied by this factor and the weighted average financial scenario was analyzed. These results are summarized in Table 4.8.

Table 4.8: Financial Analysis of Scenario Weighted Average

Metric	Result
NPV	$30,728,872
IRR	13.8%
Payback (years)	5.9

The weighted average of the investment was calculated to have a positive NPV and an IRR of 13.8%. Bunge's hurdle rate for this type of investment is 11.5%. The proposed project to build a plant to produce extruded ingredients and inclusions exceeds the hurdle rate by 2.3%.

CHAPTER V: SUMMARY AND CONCLUSIONS

This thesis evaluates the conditions under which building a plant for the contract manufacture of extruded ingredients and inclusions would make financial sense. Bunge's experience with a small scale production plant in Woodland, California will be helpful in determining accurate numbers for construction, manufacturing costs, and expected sales price. It also gives a background to draw on when selecting what scenarios might be encountered in this type of business.

By using a conjoint analysis survey on one potential customer, we are better able to understand how they make purchasing decisions. This not only allows Bunge to build its business in such a way as to meet its customer's needs, but also gives Bunge a sense of how much they would be willing to pay for building various factors in and where they may be more willing to sacrifice. It was found that being a strategic partner is important, but that at the same time Bunge cannot structure its business in such a way that it becomes a high cost provider of extruded ingredients and inclusions. The customer will not reward Bunge for high quality if it also comes at a high price. This indicates that Bunge should continue to focus on innovation and great customer service in order to meet the needs of this customer, but must make a simultaneous effort to provide a good product at a fair price.

When looking at location, there were several factors that were important to take into account. Not only how close the plant is located to the customer, but also shipping costs for ingredients and finished products, labor quality, quantity and cost, and any other savings associated with a particular location. Even though it might initially seem that the best location is the most centrally located to the end customer, that wasn't the finding of this study and it was determined that Indianapolis and Danville were about equally desirable.

The financial modeling showed that the investment should be profitable and clears the IRR hurdle rate of 11.5% with a weighted average IRR of 13.8%. By running the various scenarios we also see that factors such as commodity pricing can have a significant impact on profitability, but volume is critical. A 40% reduction in volume makes the project unsustainable. On the other hand, by building the project with more volume than it currently has planned in the Base Scenario, we would be able to make the project much more profitable assuming the volume could be filled.

5.1 Future Study

This thesis begins to explore whether an investment in a facility for the contract manufacture of extruded ingredients and inclusions is financially feasible. There are several additional topics that could be explored further to strengthen the conclusions. Because production volume has a significant impact on NPV and IRR, it would be helpful to do a market survey to determine demand so that Bunge does not under or overbuild. Although the intention is to create demand for new goods as well as forming some prediction of demand based on Bunge's experience in Woodland, California, a formal study of current demand and predicted growth could provide some useful insights.

The location determination decision tool came to a tie between Danville, Illinois and Indianapolis, Indiana as being most desirable. It would be good to get other input on the relative importance and rating for each factor, and there may be other additional factors that were not used in the rating. Although it appears pretty definite that Brodhead, Kentucky is not the optimum location, it would strengthen the results of this portion of the study if a clear choice would emerge between the other two locations.

Finally, and possibly most importantly, it would be a good idea to survey customers from the other three categories that were identified to get a more well-rounded view of the approach Bunge should take to building this business. This would involve interviewing decisions-makers from large nationally branded companies, club stores and some smaller regional players to find out their needs. Then, based on this feedback Bunge can structure its business in a way to meet their customer's needs, and at the same time build a strategy for which customers they would most want to pursue.

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APPENDIX 1: CUSTOMER SURVEY RESULTS

		Price		Quality	Lead Time	Strategic Partner	Desirability
Series #	Scenario #	Fair	High	Superb	Average	Yes	Index
1	1	0	0	0	0	0	5.67
1	2	1	0	0	0	0	4.33
1	3	0	1	0	0	0	3.00
2	4	0	0	0	0	1	7.00
2	5	1	0	0	0	1	6.00
2	6	0	1	0	0	1	5.00
3	7	0	0	0	1	1	8.33
3	8	1	0	0	1	1	7.00
3	9	0	1	0	1	1	6.00
4	10	0	0	0	1	0	5.33
4	11	1	0	0	1	0	4.00
4	12	0	1	0	1	0	2.67
5	13	0	0	1	1	0	6.67
5	14	1	0	1	1	0	5.67
5	15	0	1	1	1	0	4.33
6	16	0	0	1	0	0	5.33
6	17	1	0	1	0	0	4.00
6	18	0	1	1	0	0	3.00
7	19	0	0	1	0	1	7.33
7	20	1	0	1	0	1	6.00
7	21	0	1	1	0	1	5.00
8	22	0	0	1	1	1	9.33
8	23	1	0	1	1	1	8.33
8	24	0	1	1	1	1	7.33

APPENDIX 2: SURVEY REGRESSION ANALYSIS AND STATISTICS

Regression Statistics	
Multiple R	0.961261036
R Square	0.92402278
Adjusted R Square	0.902917997
Standard Error	0.549504079
Observations	24

ANOVA

	df	*SS*	*MS*	*F*
Regression	5	66.10185185	13.2203704	43.782624
Residual	18	5.435185185	0.30195473	
Total	23	71.53703704		

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	4.791666667	0.274752039	17.4399676	1.01E-12
Price: Fair	-1.20833333	0.274752039	-4.3979049	0.0003471
Price: High	-2.33333333	0.274752039	-8.492506	1.036E-07
Quality: Superb	0.666666667	0.224334101	2.97175804	0.0081717
Lead Time: Average	1.111111111	0.224334101	4.95293006	0.0001028
Strategic Partner: Yes	2.388888889	0.224334101	10.6487996	3.366E-09

APPENDIX 3: STATE CENTER OF POPULATIONS

	Census Data - State Population Centers			Calculations			
State or Territory	**Population (w)**	**Latitude (ϕ)**	**Longitude (λ)**	**cos(ϕ)**	**$\omega*\phi$**	**$\omega*\lambda*\cos(\phi)$**	**$\omega*\cos(\phi)$**
Alabama	4,779,736	33.008097	-86.756826	0.838593592	157,769,990	-347,743,567	4,008,256
Arkansas	2,915,918	35.142580	-92.655243	0.81772217	102,472,882	-220,928,162	2,384,411
Connecticut	3,574,097	41.497001	-72.870342	0.748990403	148,314,307	-195,071,308	2,676,964
Delaware	897,934	39.358946	-75.556835	0.773188177	35,341,736	-52,456,991	694,272
District of Columbia	601,723	38.910270	-77.014468	0.778130577	23,413,204	-36,059,642	468,219
Florida	18,801,310	27.822726	-81.634654	0.884395916	523,103,697	-1,357,404,846	16,627,802
Georgia	9,687,653	33.376825	-83.882712	0.835070453	323,343,099	-678,600,469	8,089,873
Illinois	12,830,632	41.286759	-88.390334	0.751416639	529,735,211	-852,184,502	9,641,150
Indiana	6,483,802	40.149246	-86.259514	0.764367491	260,319,762	-427,502,796	4,956,007
Iowa	3,046,355	41.946066	-93.036629	0.743774366	127,782,608	-210,802,465	2,265,801
Kansas	2,853,118	38.464949	-96.462812	0.782988837	109,745,038	-215,494,020	2,233,960
Kentucky	4,339,367	37.824499	-85.248467	0.789892868	164,134,383	-292,200,633	3,427,635
Louisiana	4,533,372	30.722814	-91.508833	0.859648916	139,277,945	-356,619,835	3,897,108
Maine	1,328,361	44.299950	-69.736482	0.715693343	58,846,326	-66,298,412	950,699
Maryland	5,773,552	39.140769	-76.797763	0.775597451	225,981,265	-343,896,713	4,477,952
Massachusetts	6,547,629	42.272291	-71.363370	0.739956486	276,783,278	-345,752,712	4,844,961
Michigan	9,883,640	42.873187	-84.203434	0.732861379	423,743,146	-609,913,937	7,243,338
Minnesota	5,303,925	45.203555	-93.571903	0.704590182	239,756,265	-349,686,949	3,737,093
Mississippi	2,967,297	32.590954	-89.579514	0.842537449	96,707,040	-223,954,056	2,500,059
Missouri	5,988,927	38.423798	-92.198469	0.783435394	230,117,321	-432,589,443	4,691,937
Nebraska	1,826,341	41.174300	-97.315578	0.752710288	75,198,312	-133,780,276	1,374,706
New Hampshire	1,316,470	43.154858	-71.461974	0.72950774	56,812,076	-68,630,297	960,375
New Jersey	8,791,894	40.431810	-74.432208	0.761178361	355,472,188	-498,115,183	6,692,199
New York	19,378,102	41.501299	-74.620909	0.748940698	804,216,405	-1,082,976,926	14,513,049
North Carolina	9,535,483	35.543075	-79.658232	0.813678716	338,920,387	-618,053,848	7,758,820
North Dakota	672,591	47.348468	-99.309504	0.677537744	31,846,153	-45,255,916	455,706
Ohio	11,536,504	40.455191	-82.773339	0.760913643	466,711,473	-726,607,819	8,778,283
Oklahoma	3,751,351	35.598464	-96.836786	0.813116366	133,542,334	-295,379,786	3,050,285
Pennsylvania	12,702,379	40.456756	-77.009680	0.76089592	513,897,048	-744,313,062	9,665,188
Rhode Island	1,052,567	41.753609	-71.450869	0.74601543	43,948,471	-56,105,453	785,231
South Carolina	4,625,364	34.025176	-81.011022	0.828791781	157,378,824	-310,552,809	3,833,464
South Dakota	814,180	44.014397	-99.002355	0.719165227	35,835,642	-57,968,843	585,530
Tennessee	6,346,105	35.808090	-86.359136	0.810981217	227,241,899	-444,453,507	5,146,572
Texas	25,145,561	30.905244	-97.365594	0.8580179	777,129,698	-2,100,695,936	21,575,341
Vermont	625,741	44.094874	-72.816417	0.718188555	27,591,971	-32,723,700	449,400
Virginia	8,001,024	37.810313	-77.811160	0.790044679	302,521,222	-491,857,293	6,321,166
West Virginia	1,852,994	38.795594	-80.731308	0.779386148	71,888,003	-116,591,982	1,444,198
Wisconsin	5,686,986	43.721933	-89.018997	0.722702621	248,646,021	-365,868,050	4,110,000
sum	**236,799,985**	**1480.908733**	**-3197.713672**	**29.454625124**	**8,865,486,628**	**-15,805,092,143**	**187,317,011**

Source: http://www.census.gov/geo/www/2010census/centerpop2010/CenPop2010_Mean_ST.txt

APPENDIX 4: METRO CENTER OF POPULATIONS

	Census Data - State Population Centers			Calculations			
State or Territory	**Population (w)**	**Latitude (ϕ)**	**Longitude (λ)**	**cos(ϕ)**	**ω*ϕ**	**ω*λ*cos(ϕ)**	**ω*cos(ϕ)**
New York	18,897,109	40.714353	-74.005973	0.757970957	769,383,567	-1,060,021,579	14,323,460
Chicago	9,461,105	41.878114	-87.629798	0.744566592	396,213,234	-617,301,339	7,044,423
Dallas/Fort Worth	6,371,773	32.802955	-96.769923	0.840538664	209,012,983	-518,272,763	5,355,722
Philadelphia	5,965,343	39.952335	-75.163789	0.76657892	238,329,382	-343,716,956	4,572,906
Houston	5,946,800	29.760193	-95.369390	0.868110523	176,977,916	-492,342,536	5,162,480
Washington, D.C.	5,582,170	38.895112	-77.036366	0.778296718	217,119,127	-334,691,009	4,344,585
Miami	5,564,635	25.788969	-80.226439	0.900402549	143,506,200	-401,967,475	5,010,412
Atlanta	5,268,860	33.748995	-84.387982	0.831479357	177,818,730	-369,699,388	4,380,948
Boston	4,552,402	42.358431	-71.059773	0.738944363	192,832,606	-239,043,072	3,363,972
Detroit	4,296,250	42.331427	-83.045754	0.739261833	181,866,393	-263,757,770	3,176,054
sum	**71,906,447**	**368.230884**	**-824.695187**	**7.966150478**	**2,703,060,137**	**-4,640,813,889**	**56,734,960**

Source: http://www.census.gov/compendia/statab/cats/population/estimates_and_projections--states_metropolitan_areas_cities.html

APPENDIX 5: SHIPPING COSTS TO METRO AREAS

Metro Area	New York	Chicago	Dallas/Fort Wortl	Philadelphia	Houston	Washington, D.C	Miami	Atlanta	Boston	Detroit
Population Weighting	26.28%	13.16%	8.86%	8.30%	8.27%	7.76%	7.74%	7.33%	6.33%	5.97%
Brodhead, Kentucky	$2,475	$1,025	$2,150	$2,345	$2,180	$1,760	$2,650	$875	$2,975	$800
Indianapolis, Indiana	$2,525	$650	$1,925	$2,000	$2,275	$1,875	$3,225	$1,225	$2,950	$805
Danville, Illinois	$2,900	$800	$2,260	$2,275	$2,250	$2,100	$3,500	$1,575	$3,050	$975

APPENDIX 6: TABLE OF BUILDING COSTS

Building Costs

Production Area

Cost/sq ft	$92.59
Extrusion	
Lines	5
Area/line	5,000
Total area	25,000
Receiving	
Area	10,000
Packaging	
Area	10,000
Shipping	
Area	5,000
Total area	50,000
Total cost	**$4,629,630**

Warehouse

Cost/sq ft	$55.56
Total area	100,000
Total cost	**$5,555,556**

Land / Utility prep

Land (20 ac)	$1,200,000
Utility Prep	$1,500,000
Total cost	**$2,700,000**

Land & Building Total: $12,885,185

APPENDIX 7: TABLE OF EQUIPMENT COSTS

Equipment Costs

Extrusion & Processing Equipment

Type	*Number*	*Cost/unit*	*Total*
Single Screw Line	3	$1,200,000	$3,600,000
Twin Screw Line	2	$2,500,000	$5,000,000
Grind/Sift/Blending Equipment			$1,200,000
		Total	**$9,800,000**

Storage and Packaging Equipment

6 Finished Product Bins w/ Pneumatics			$1,200,000
50 lb. bags	1	$850,000	$850,000
Tote Stations	2	$150,000	$300,000
Form & Fill	2	$1,500,000	$3,000,000
		Total	**$5,350,000**

Receiving, Warehousing & Shipping

Racking	1	$200,000	$200,000
Forklifts	5	$40,000	$200,000
		Total	**$400,000**

Utilities

Boiler	1	$300,000	$300,000
Compressor	1	$150,000	$150,000
Miscellaneous	1	$150,000	$350,000
		Total	**$800,000**

Equipment Total: $16,350,000

APPENDIX 8: TABLE OF MISCELLANEOUS COSTS

Installation and Miscellaneous Costs

***Base Cost* =** Land & Building - Warehouse - Land		
+ Equipment Cost	=	***$20,979,630***
	Factor	***Amount***
Electric Install Factor	40%	$8,391,852
Mech. Install Factor	60%	$12,587,778
Perm., Eng. & Env.	20%	$4,195,926
	Total	**$25,175,556**

Total Building, Equipment, Install & Misc. Costs

Total	**$54,410,741**
Contingency Factor	20%
Contingency	**$10,882,148**
Final Total	**$65,292,889**

APPENDIX 9: TABLE OF HUMAN RESOURCE COSTS

Plant Operations Employees - Variable				
Area	Employees/shift	Salary/person	Salary/shift	Total Cost/shift
Ingredient Receiving & Storage	4	$45,000	$180,000	$243,000
Extrusion	7	$60,000	$420,000	$567,000
Packaging	3	$45,000	$135,000	$182,250
QA Lab	2	$45,000	$90,000	$121,500
Shipping & Warehousing	4	$45,000	$180,000	$243,000
Maintenance	3	$65,000	$195,000	$263,250
Total/shift/year	23			**$1,620,000**

Office Staff - Fixed Cost			
Title	Number	Salary/person	Total Cost
Plant Manager	1	$110,000	$148,500
Operations Manager	1	$90,000	$121,500
Maintenance Manager	1	$70,000	$94,500
Safety & Environment Manager	1	$70,000	$94,500
QA Manager	1	$70,000	$94,500
Human Resources Manager	1	$70,000	$94,500
Purchasing Manager	1	$70,000	$94,500
Shipping Manager	1	$60,000	$81,000
Accountant	1	$70,000	$94,500
Sales Manager	1	$90,000	$121,500
General Admin Staff	3	$45,000	$182,250
Total cost/year	13		**$1,221,750**

Operations Employees Assumptions:	
Shifts/day	2
Hours/shift	8
Days/week	6
Hours/Week Adj. Factor	1.2
Weeks/year	50
Hours worked/year	**4800**
Benefits Assumptions:	
Benefits (% of Salary)	**35%**

Fixed Yearly H.R. Cost	**$1,221,750**
Variable Hourly H.R. Cost	**$810**
Total Hourly H.R. Cost	**$1,065**
Assumes: 2 - 8 Hr Shifts, 6 Days/Week	

APPENDIX 10: TABLE OF UTILITY COSTS

Electricity Usage		
Extrusion Lines Running		5
kWh Electricity/line		310
Total Production kWh		1550
Packaging Lines Running		3
kWh Electricity/line		150
Total Packaging kWh		450
Equipment kWh		2000
10% adder for Lights & Office		200
Total Electricity Usage kWh		2200
Electricity Rate ($/kWh)	$	0.10
Electricity Cost ($/hr)	**$**	**220.00**
Gas Usage		
Gas Ovens Running		3
Btu/Oven/hr		500,000
Equipment Btu/hr		1500000
5% adder for Building Heat		75000
Total (MM Btu/hr)		1.575
Cost of MM Btu Natural Gas	$	5.00
Gas Cost ($/hr)	**$**	**7.88**
Water Usage		
Pounds Production/hr:		5800.00
Water Addition Rate:		4%
Pounds Water/hr		232
Mixing Usage (gal/hr)		28
Cooling & Cleaning (gal/hr)		303
Cost of Water/gallon	$	0.004
Water Cost ($/hr)	**$**	**1.21**
Total Utilities		
Total Utilities Cost ($/hr)	**$**	**229.09**