ECONOMIC FEASIBILITY OF PROCESSING ALTERNATIVES FOR SMALL-SCALE PROCESSORS OF FRUITS AND VEGETABLES IN OKLAHOMA

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CHAPTER I

INTRODUCTION

Background

Feasibility Studies

A feasibility study is a detailed investigation and analysis of a proposed development project to determine whether it is technically and economically viable. This analytical tool, used during the project planning process, shows how a business would operate under a set of assumptions about the technology used (the facilities, equipment, and production process) and the financial aspects (capital needs, volume, cost of goods, wages, etc). The study is the initial step in a project development process that allows for the projection and assessment of production cost, volume of product, labor requirements, demand for the product, and sustainability of the project. The feasibility study also takes into consideration risk factors such as seasonality of raw materials, business failure and flexibility of the business in times of hardship.

The portable processing unit investigated in this thesis is a new concept here in Oklahoma and perhaps in the United States and therefore the analysis and conclusions will be of great interest. The following questions will be answered by the feasibility study:

- Is there a demand for the product?

- Who are current competitors providing similar products?
- What is the cost of producing the product?
- What is the profitability?

Oklahoma Horticultural Production and Mobile Processing

Oklahoma's fruit and vegetable production is currently limited to about thirty different produce items most of which are distributed through direct market outlets (Barron and Henneberry 2005). These direct market outlets include, but are not limited to, pick-your-own farms/orchards, roadside stands, and farmers markets which are held on a weekly basis depending on the availability of products for sale. Most of the fruits and vegetables produced in Oklahoma are of low monetary value (Henneberry 2005) and therefore there is low monetary incentive for farmers to grow and supply them. The main drawback for direct sales is that the producers are limited to producing what they are able to sell easily and therefore limit their potential for making more money via mass production. A mobile processing unit will be able to utilize the excess produce and thereby ensure that the farmer does not incur unnecessary losses due to limited market outlets.

The mobile processing unit described and modeled in this thesis will afford the farmer huge savings in both transportation cost and reduced produce damage since the processing will be done on site. The savings realized increase the profitability of the business which will allow for expansion and production of high quality products.

As the name suggests, the mobile processing unit can be moved with ease from one farm to another which means that the farmer may delay harvesting until a few days before the arrival of the processing equipment, thereby reducing the costs and losses associated with storage of highly perishable farm produce like tomatoes.

The value-adding objective of the mobile processing unit may encourage numerous farmers to cultivate and produce the seemingly low-monetary value produce.

Due to limited information on Oklahoma-based fruit and vegetable processing, it was deemed necessary to identify a commonly produced food item where information related to multiple processing alternatives could be collected. Oklahoma farmers produce an estimated 600 acres of fresh market tomatoes annually valued at $2.25 million (Schatzer 2004). This means that the region has sufficient supply of raw tomatoes to support a variety of tomato-based sauces and salsas.

The feasibility project in this thesis compares the costs of processing high-acid hot-packed foods such as barbecue sauce in the following settings: co-packer, mobile processing unit and own-facility system. More emphasis will be laid on the mobile processing unit since it can easily reach those farmers who have limited access to commercial processors of fruits and vegetables.

Objectives

General Objective

The overall objective of the research is to determine the economic feasibility of the portable processing unit and conditions that are necessary to adopt it. The mobile processing unit may be utilized for manufacturing a variety of products, but for the purposes of making comparisons with processing alternatives, a commonly manufactured product was needed. Barbecue sauces are common throughout the U.S., and several sauces are manufactured in Oklahoma by existing Oklahoma companies of varying sizes.

<u>Specific Objectives:</u>

To achieve the general objective, several specific objectives must be addressed. For this endeavor, identified objectives were to:

- Determine the costs of utilizing the portable modular processing unit given different energy sources.
- Determine the cost of building and equipping a small, fixed facility.
- Assess the costs associated with engaging the services of a Copacker in the processing of the some range of products
- Compare the cost per unit of product of each of these three processing alternatives under different production scenarios.

Portable Processing Unit Data

I. Portable modular equipment, capacity and utility requirements from Dr. Tim Bowser and Dr. William Mc Glynn of the Food and Agricultural Products Center, Oklahoma State University

II. Fixed facility estimates using equipment line specified by Dr. Tim Bowser and using the Kenkel/Holcomb feasibility template

III. Copacker rates determined by statewide survey of processors willing to process fruits and vegetables at contracted rates.

Conceptual framework

To accomplish the first objective, costs for using natural gas and electricity are determined and factored into the overall cost analysis of the project in order to establish the energy source that is most efficient to use. A given production level is assumed and from this, the gas and electricity costs are extracted. The second objective is achieved by establishing the estimated cost of building a fixed facility from estimates developed for and used by clients of the Food and Agricultural Products Center of Oklahoma State University. Part of the second objective and the entire third objective is achieved by sending out surveys and questionnaires to copackers and own-facility operators in the industry and then analyzing these cost estimates in order to come up with an industry average.

For the fourth objective, the Simulation for Excel to Analyze Risk (SIMETAR©), an add-in program for Microsoft Excel®, was used to determine the different scenarios of operation that various units of the project will be operating under to establish whether the portable processing unit is a viable option for processors. The number of iterations (making repetitions) in the analysis is 500. The system automatically calculates the appropriate production cost for a given production volume and this process is randomly repeated five hundred times. The data generated will then be sorted in an ascending order so as to generate a smooth average cost curve for each system of processing.

CHAPTER II

LITERATURE REVIEW

History of Barbecue Sauce

Barbecue sauce is a spicy sweet and sour sauce usually based on catsup or chili sauce. The sauces can be simmered, chunky, smooth, hot, spicy, mild, smoky, sweet, thick, and peppery or thin however they're spiced and stirred and are an important accompaniment to Oklahoma barbecue (Jones 2004).

Barbecuing began in the late 1800s during cattle drives out west. While on the trail, there wasn't much to eat and what the cowboys did get was usually the lower quality cuts of beef. The cattle barons of the times were more concerned with profits than feeding hands and thus cowhands were fed the disposable beef. The main choice for this was brisket, which is a very tough and hard piece of meat. However, the cowboys learned that if you left this brisket to cook for a long period of time (3-7hours) (Beaston 2004) at a very low temperature, what was once a disposable cut of beef become a tasty treat. During this time the cooks started to experiment with sauces to put on the barbecued beef to make an even tastier piece of beef.

According to Food Product Design Magazine, new evidence shows that royalty and the rich as far back as 700 B.C enjoyed barbecued meats. The first scientifically documented proof of barbecued meat consumption comes from the tomb of King Midas

(730 to 700 B.C.), ruler of an empire that stretched from today's northern Iraq to central Turkey. In the king's tomb, pottery food jars were found to contain food residues. These residues were found to be barbecued goat or lamb. Tracing the history of barbecue sauces in America is difficult because there are very few barbecue sauce recipes to be found in early cookbooks. Commercial barbecue sauces were not found nationally on grocers' shelves until 1948, when Heinz Company put a barbecue sauce in the market. Open pit barbecue soon followed, then Kraft Foods with its brand.

Prepared Food Magazine reports that barbecuing originated in the New World. Upon their arrival in the Americas, Spanish explorers observed Native American (Cherokees and Creek Indians of the Carolinas) using crude wooden racks to smoke or dry fish, birds and meats. Later, the Spanish brought over cattle and pigs, which were also barbecued. "Barbecue" is an English word adaptation from either the Spanish word "barbacoa" or the word "barabicoa" from the Taino Native American tribe of the Caribbean and Florida regions (ADS 2005).

Manufacturing Barbecue Sauces

The processing alternatives that are of interest for this study include a copacker, mobile processing unit and own-facility unit. Copackers manufacture and package foods for other companies to sell and they can provide entrepreneurs with a variety of services in addition to manufacturing and packing products. Copackers often help in the formulation of the product depending on the owner's specifications. Some of the advantages afforded to the owner by the copacker include reduced startup costs for the food entrepreneur and greater accuracy in predicting overhead costs due to manufacturing. Finally, a copacker assists in the reduction of lead-time in getting a product to the market. With an established business, the copacker will usually have the proper regulatory certifications, lines of credit for purchasing supplies and ingredients, product liability insurance, food industry contacts and sources for the job to be efficiently done (Rushing 2005).

The Portable Unit

The mobile processing unit is a complete, modular system for heating, commercially sterilizing, and packaging small batches of high acid, hot packed, pump-able food products in rigid containers. The portable modules will be placed in containers and transported directly to the producer/processor for on-site batching and processing of high-acid food consistent with field conditions in Oklahoma. The purpose of the system is to add value to rural agricultural products where transport cost to the standard permanent and localized processing plant may be prohibitive. The prototype mobile processing unit is highly versatile and adaptable to various processing conditions depending on the demand by the manufacturer or processor for food materials.

Features and Requirements of the Portable Unit

- Production rate: 1.0 gallons per minute (gal/min) or a 15-gallon batch
- Products: high-acid, pumpable foods with particulates up to 0.2 inch (for pumped products)
- Portable with clearance for standard 32” wide doorway

- Clean-In-Place (CIP) system, self-draining (i.e., no disassembly required for cleaning)
- Modular, consisting of the following components:
    1. Batch module
    2. Process module
    3. Fill module
    4. Utility module
- Batch module:

The batch module consists of the following: steam-jacketed, 15-gallon batch tank with cover and a thermometer; 24x30" horizontal workspace to batch tank with under-shelf storage; 110V, Ground Fault Interruption (GFI), covered equipment outlet located near the work space; product pump (positive displacement) with variable speed drive from 0 to 2 gal/min; valve and piping from kettle to pump, including provision for re-circulation back to kettle; manual pump control station; and hot-water wash-down hose station;

- Process module:

Continuous heat and hold process with heat exchanger using steam or hot water as the heating medium. Sized to heat tomato paste from 70^0 F to 195^0 F at 1.0 gal/min; thirty-second hold tube with automatic divert valve that directs product back to the batch tank (sized for 1.0 gal/min); system control package with PC and Ethernet interface and circular chart (or equivalent) temperature recorder (for product temperature in kettle or hold tube) with 25% open space in electrical enclosure; three compartment sink with faucet and drain boards. Minimum compartment size is 10 x 14 x 10". Minimum drain board length, 12"

- Fill module:

Heated, insulated, covered surge tank for product storage; piston filler for 2 oz. to 1 gallon product sizes (adjustable fill height); pneumatic cap fastener suspended on telescoping support structure; work table for filling, 24 x 24" minimum size; temperature sensor for surge tank; hot-water wash-down hose station; electronic bench scale for net weight determination

- Utility module:

Source of steam, hot water, compressed air and other utilities required to operate the modules; State of Oklahoma Chief Boiler Inspector provided leniency for portable boiler installations under 15 psig operating pressure; all site utilities will be connected through the utility module and transferred to other modules as required.

Functional Properties of the Modules

The connections between modules consist of flexible piping and wiring, featuring wash-down, quick-connect, and reusable fittings with a foolproof connection plan. The layout of the modules should be ergonomic as possible, with work surfaces at 32 to 34" high. Openings for all product and utility piping should be seal-able using quick-connect fittings for transportation and storage. The drains for the sinks will terminate in a common pipe with a 2" ID flexible hose connection. 3-A Standard (one of the primary food equipment organizations: www.3-a.org) finishes and materials were used for food-contact surfaces.

Some of the site utilities may include: LP gas, electricity (single phase 110v, with one 20 amp circuit max) via generator, potable water at 60^0 to 70^0 F and 60 psi (via garden hose), and jerry-can container quantities for small motors (e.g. compressor).

CHAPTER III

BUSINESS ANALYSIS

Small Scale Business Structure

The Small Business Act established The Small Business Administration (SBA) to protect the interests of small businesses and to help ensure that a fair and representative share of government contracts is placed with small businesses (SBA-Small Business Administration 2005).

The law defines a small business concern as "one that is independently owned and operated and which is not dominant in its field of operation". The law also states that in determining what constitute a small business, the definition will vary from industry to industry in order to establish eligibility for SBA's programs. This numerical definition is the "size standard" and is always stated as number of employees or average annual receipts.

Small businesses make a significant contribution to the U.S. economy, and in 2003, they were the engines of Oklahoma's economic performance. Nationally, small firms generate half of U.S. non-farm private output and employ 500 or fewer employees. In Oklahoma, small business owners who include women, minorities, and home- based individuals were leaders in the state's economy in 2003.

Table 1 Number of U.S. Businesses by Number of Employees.

Number of Employees	Number of firms	Number of employees	Percent (%) all Employer firms	Percent (%)of total employment
<5	3,389,161	5,606,302	60.4	5.1
5-9	1,012,954	6,652,370	18.1	6.0
10-19	605,693	8,129,615	10.8	7.3
20-99	501,848	19,703,162	8.9	17.8
100-499	81,347	15,637,643	1.5	14.1
> 500	16,740	54.976,569	.3	49.7
All employer firms	5,607,743	110,705,661	100.0	100.0

Source: www.bizstats.com, 2005

Table 1 shows the number of firms in the US and the number of employees of those firms. Firms with fewer than 20 employees, considered to be small-scale, makeup about 90% of the total number of firms.

The Oklahoma State Labor Force Market Trend

The estimated total number of businesses in Oklahoma in 2003 was 295,300. Employer firms (firms with at least 5 employees) accounted for 75,486 firms in 2003 and 97.4 % or an estimated 73,500 were small-scale firms. The estimated number of businesses that employed some people rose by 0.3 percent in 2003. The most recent data available also show that family run businesses numbered 221,777 in 2001. Self-employment increased by 4.8% from 149,695 in 2002 to 156,890 in 2003 (U.S.DOL 2003). This trend shows that the self-employment sector of the labor force is growing by about 15 times that of the employer-businesses. The trend also indicates that more people will require tools that will assist them in running their own operations, which are more than likely small-scale.

Small firms typically use commercial bank lenders and rely on local bank services. Over the last five years there has been a gradual decline in the number of banks in Oklahoma. This trend means that fewer banks are offering services to small businesses and hence the likelihood that the cost of services will increase as supply declines and demand increases.

Food and Drug Administration Requirements for Food Processing

The Food and Drug Administration's requirements for registration, manufacturing, and processing of low acid canned foods (LACF) and acidified foods (AF) in hermetically sealed containers are codified in Title 21, Code of Federal Regulations, Parts 108, 113 and 114.

The purpose of 21 CFR 108, 113, and 114 is to ensure safety from harmful bacteria or their toxins, especially the deadly Clostridium Botulinum (C Botulinum). Adequate processing, controls, and appropriate processing methods, such as cooking the food at the proper temperature for sufficient times, adequately acidifying the food, or controlling water activity, can only accomplish this. C. Botulinum is a living organism, which is almost universally present. Under certain conditions, C. Botulinum can grow in foods and produce a powerful neurotoxin, which affects the nervous system. C. Botulinum will only grow in foods, which are packaged in the absence of oxygen, have a "favorable" pH and temperature, and contain water and nutrients necessary for its growth (FDA, CFSAN 1997). The pathogens can be destroyed by heating the food at 176^0 F for 10 minutes and/or such a heat-time combination that would result in their destruction.

Financial Ratio Analysis

As with most manufacturing sectors, food processing is generally observed to be a highly capital-intensive, low per-unit margin industry. Profitability is significantly impacted by small changes in throughput, input costs, and efficiency.

On the financial front, there is need for the development of a strong banking relationship that allows tailor-made solutions and timely financing when it is needed. Understanding the causes of low profits, such as inadequate expense control, high interest rates and low sales volume is vital for success. The business owner needs to accurately assess financial needs caused by growth and therefore understand the impact of such growth on corporate operation.

Financial ratios are widely used in analyzing financial statements. The computation of ratios is a mechanical process; ratios do not explain the causes of relationships between numbers. They serve as a benchmark and are a quick reference in determining the profitability and operational performance of a firm (Sihler 2004).

The type of information each provides can be grouped into the four major ratio categories:

1. Profitability: measures that relate earnings to sales or assets
2. Liquidity: measures that suggest ability to pay current bills over the short run without undue stress. Consequently, these ratios focus on current assets and current liabilities.
3. Asset management ratios: measures how effectively a firm is managing its assets. The question it attempts to answer is whether

the total amount of each type of asset as reported in the balance sheet seems reasonable, too high, or too low in view of current and projected sales levels.

4. Debt Management Ratios: measures that show how an enterprise finances its business

Profitability:

Several ratios are available to help measure the ability of a business to make a profit. Sales growth is the percentage increase or decrease in sales between two time periods. The formula for sales growth is: (current year's sales – Last year's sales)/last year's sales. If overall costs and inflation are rising, then one should watch for a related increase in sales, if not, then this is an indicator that prices are not keeping up with costs.

Gross profit margin is an indicator of how much profit is earned on products sold, without consideration to selling and administration costs. The formula for gross profit margin is: Gross Profit/Total Sales

Return on equity determines the rate of return on capital invested in the business and shows whether the business is providing enough compensation for the risk of being in business. The formula for return on equity is: Net Profit/Equity. The analyst should compare the ratio to other businesses in the same or similar industry.

Liquidity:

Financial ratios in this category measure the company's capacity to pay its debts as they become due. Current Ratio is the ratio between all current assets and all current liabilities. The formula for current ratio is: Current Assets/Current Liabilities.

A ratio of 1:1 means that the assets available can cover the possible liabilities but a ratio close to 2:1 is desirable. Since current assets and current liabilities are, in principle, converted to cash over the following 12 months, the current ratio is a measure of short-term liquidity. To the firm, a high current ratio indicates liquidity, but also it may indicate an inefficient use of cash and other short-term assets (Ross et al 2004).

Quick Ratio is the ratio between all assets quickly convertible into cash and all current liabilities. It specifically excludes inventory. The formula for quick ratio is: (Cash +Accounts Receivable)/Current Liabilities. This ratio indicates the extent to which the business could pay current liabilities without relying on the sale of inventory. Generally, a ratio of 1:1 is good and indicates that one does not have to rely on the sale of inventory to pay bills.

Debt to Equity Ratio shows the relationship between capital invested by the owners and the funds provided by lenders. The formula for debt equity ratio is: Debt/Equity. This ratio compares how much the business was financed through debt and how much was financed through equity. For this calculation it is common practice to include loans from owners in equity rather than in debt. A desirable debt to equity ratio is in the range of 1:1 to 4:1. Most lenders have credit guidelines and limits for the debt to equity ratio; 2:1 is a commonly used limit for small business loans.

Debt Coverage Ratio indicates how well a firm's cash flow covers its debt and the capacity of the business to take on additional debt. The formula for debt coverage ratio is: (Net Profit + Non-Cash Expenses)/Debt. This ratio shows how much of a firm's cash profits are available to repay debt.

Asset Management Ratios

Inventory Turnover Ratio indicates how fast goods are being sold and can be directly correlated to profits since high turnover usually is a result of higher sales and hence profits. The formula for inventory turnover ratio is: Sales/Inventories.

Days Sales Outstanding Ratio is used to appraise accounts receivable and it represents the average length of time that the firm must wait after making a sale before receiving cash, which is the average collection period. The formula for Days Sales Outstanding is: Receivables/Average Sales per Day

Fixed Assets Turnover Ratio measures how effectively a firm uses its plant and equipment. The formula for this ratio is Sales/Net Fixed Assets. A potential drawback for this ratio is when an old firm is compared to a new one. Due to inflation, old equipment is valued at a much higher discount than new equipment, so an old plant is likely to have a higher fixed asset turnover ratio.

Similarly, Total Asset Turnover Ratio measures the turnover of all firms' assets. Its formula is: Sales/Total Assets.

Debt Management Ratios

Debt Ratio measures the percentage of funds provided by sources other than equity. Creditors prefer low debt ratios (Brigham and Ehrhardt 2005) because the lower the ratio, the greater the cushion against creditor's losses in the event of liquidation. Stockholders, on the other hand, may want more leverage because it magnifies expected earnings. The formula for this ratio is: Total Liabilities/Total Assets

Times-Interest-Earned Ratio is obtained by dividing earnings before interest and taxes by interest charges. The TIE ratio measures the extent by which operation income can decline before the firm is unable to meet its annual interest costs. Failure to meet this obligation can bring legal action by the firm's creditors, possibly resulting in bankruptcy. Since interest is paid using pre-tax dollars, the firm's ability to pay is not affected by taxes. The above-mentioned ratios should be within the industry's average or better for the firm to be considered viable both in the short and the long term. The formula for this ratio is: EBIT/Interest Charges

Table 2 Comparison of Net Incomes for Food Processors and all other Manufacturers in the U.S.

Corporation with net income (as % of Revenue)	Food Products %	All Manufacturers %
Total revenue	100	100
Total expenses	94.8	92.3
Net income	5.2	7.7
Details of expenses**:**		
Cost of goods sold	72.4	67.2
Officers compensation	1.4	3.1
Salaries and wages	6.2	7.0
Repair	0.5	0.5
Rent	1.1	1.2
Taxes	1.3	2.0
Interest	0.8	0.9
Depreciation	1.9	2.3
Advertising	1.9	1.0
Retirement plans	0.4	0.5
Employee benefits	0.8	1.0
Other expenses	6.2	5.6

Source: www.bizstats.com, 2005

Table 2 shows the expected revenue and related expenses in the food industry as compared to all other manufacturing concerns. It shows the net income for food and general industry in the ranges of 5% and 7% respectively. This will act as a guide or reference for the small-scale business in order for them to determine whether they are making money or not. The financial figures are expected to differ from one industry to another but they should have a similar general trend for one to be able predict performance. Operating expenses require up to 92-95% of all the revenue generated and this measure is closely scrutinized by most manufacturers due to competition and limited avenues to innovate and come up with new products.

Table 3 Typical Financial Ratios in Small-Scale Food and Related Products Industries in the U.S.

Industry	Food and related products
Current ratio	1.1
Debt to equity ratio	1.3
Cash	1.8%
Notes and accounts receivable	19.9%
Inventories	7.2%
Other current assets	4%
Loans to stockholders	0.4%
Mortgage and real estate loans	0.2%
Other investments	35.5%
Depreciable assets (net)	16.4%
Intangible assets (net)	8.5%
Other assets	5.9%
Total assets	100.0%
Accounts payable	15.2
Mortgage, bonds and notes due within 1yr	7.0%
Other liabilities	7.5%
Loans from stock holders	0.9%
Mortgages, notes and bonds dues beyond 1yr	18.9%
Other liabilities	6.8%
Net equity	43.7%
Total Debt and equity	100.0%

Source: www.bizstats.com, 2005

The most relevant figures in Table 3 are current ratio, debt to equity ratio, depreciable assets, and accounts payable and net equity. The current ratio shows how well the current assets are able to cover the current liabilities and therefore the firm may not fall into bankruptcy. Management of assets is crucial in the determination of sustainability of a business entity and therefore the more the depreciable the assets, the less the salvage value obtainable at the end of the useful life of the asset. Inventory control and regulation will also play an important role in the determination of profitability since high inventory levels as compared to sales means that there is too much money tied down.

Factors that Cause Business Failure

The chance of a new business surviving for five years from inception is between 30 to 50 percent (Reilly and Millikin 1996). Business failure is not only common with new start-ups but also with businesses that have been in operation for some time regardless of how successful they are. Although business failure happens to businesses of all sizes, small businesses are more vulnerable because they simply do not have the back-up finance and resources that most larger companies possess: and also because of their poor ability to ensure finance from banking institutions.

Business failure occurs when a business has reached a point (commonly insolvent) where it can no longer continue trading without the risk of encountering further problems. These problems may offer no feasible solutions and by continuing to trade, the business gets into deeper trouble. Such problems may be caused by a poor market survey prior to the onset of trading leading to unmatched planning efforts and the market eventually overwhelms the business. An example of this is when the growth of the market or demand is so great that the business is forced to grow and typically go into unsustainable debt.

On the contrary, successful organizations are those that best adopt to fit the opportunities provided and the constraints imposed by their environment (Kalleberg et al, 1991). Such adaptation depends a great deal on the choices and actions an organization's leaders make. Leaders differ in the extent to which they have the psychological traits, experience and skills needed to accomplish the entrepreneurial and managerial tasks necessary for organizational growth and survival. The following business owner traits weigh heavily on his ability to successfully run a business:

Traits of a Successful Entrepreneur

In the business world, certain people succeed while others do not and this is due to a variety of reasons and circumstances. Today's businesses require patience and multitasking abilities on the part of the business owner since there is cut-throat competition as a result of target customers constantly changing their demand. Information technology and the use of computers and cellular phones have reduced the lag-time previously slowing down the flow of information from one area to the next (DeFiore 2005). The small-scale business ventures are especially vulnerable because their success depends on the efforts of the few workers who are stakeholders/owners of the business. The following are some the traits that a successful entrepreneur typically possesses:

- Decisive decision maker which means that they are able to rely on their own judgment and often make decisions based on incomplete information
- Enjoy taking charge and able to take-on and follow through to the successful completion of a project
- Want to be master of their own financial destiny which means that they have less desire to be rich but want to "do their own thing" and prove that they are right
- Organized, independent and self-confident which means that they must perform well in all areas of the business
- They work hard to ensure that the business succeeds with the knowledge that there is no fall-back position

- Should be able to take criticism and rejection on a straight face and still be able to move on
- They typically have specialized skills for the business either from education or experience
- Determined and persistent which means that they are not brought down by a few draw backs along the way

Another very important factor that affects the survival of an organization is its age and performance. Young organizations and organizational forms suffer liabilities of newness involving both internal processes, such as coordinating and defining roles and developing trust and loyalty among employees, and external problems such as acquiring resources and stabilizing supplier and customer relationships.

Some of the causes of business failure include but are not limited to: lack of skills, sales problems, financial control, and lack of funds, high finance cost, insolvent customers, overtrading, marketing issues and red tape.

The business owner should ensure that he has all the required skills for the business or should hire some help from a person with the required skills. Time should be spent on learning all the basics that go into making the business venture successful before actually starting the operations.

Demand for newly introduced products into the market is usually low and does not easily respond to marketing gimmicks until the customers are aware and understand the benefits of the product or service. The competitors may have the market saturated with the product in question and this causes another problem of market penetration, which is usually very expensive. To avoid such a bottleneck in the future of the small business, vigorous market research should be carried out before commencement of business.

Accounting skills are vital for the small business and the owner should hire a competent accountant in order to keep watch over the financial position of the business in order to maintain a healthy cash flow position for the business.

Lack of funds is a very common cause of business failure especially in the first three years of small business operations. It can lead to excessive borrowing and consequently, businesses become insolvent because their liabilities are higher than their assets. Entering a highly competitive market may force the small business to offer competitive prices so as to penetrate the market but the downside of this strategy is that the profits generated might not be sufficient to support other activities of the firm.

High cost of finance usually ultimately affect the performance of a small business because the owners commit themselves to taking any source of finance available to them with total disregard of the high interest rates and unfavorable repayment schedules. The common source of finance that owners turn to is the credit card since they are easy to access but have very high interest rates, some as high as 20%. The safest and best short term funding for small business startup, is family and friends though this avenue is usually abused by non-payment.

The issue of the customer becoming insolvent can seriously affect the operations of the business especially if this is a major customer, accounting for a substantial amount of money owed to the small business. This will result in the non-payment of the money owed since the priority system of debt settlement is used with tax and employee salary and wages taking the first priority.

Overtrading as a result of sudden increase in the demand for goods and services can cause insolvency in that the firm is forced to borrow more in the short run in order to cater for these new orders. The customers purchase by credit under normal circumstances resulting in cash flow problems due to limited inflow of cash to support the production operations.

The small businesses that go through the initial start-up hurdles still have other challenges that they must overcome in order to get established and become competitive enough in the market place. Each stage needs a different approach and so it is important to change the business plane in order be strategic and resourceful.

Marketing is another area of business that is critical to success but often disregarded by small business owners for various reasons. The entrepreneurs are limited in the knowledge of how to handle the marketing endeavors in order to obtain maximum benefit from such an effort. Most business owners believe that marketing is all about gaining new customers but they forget that it is also an effort to maintain the already existing customers so that they are not taken by competition.

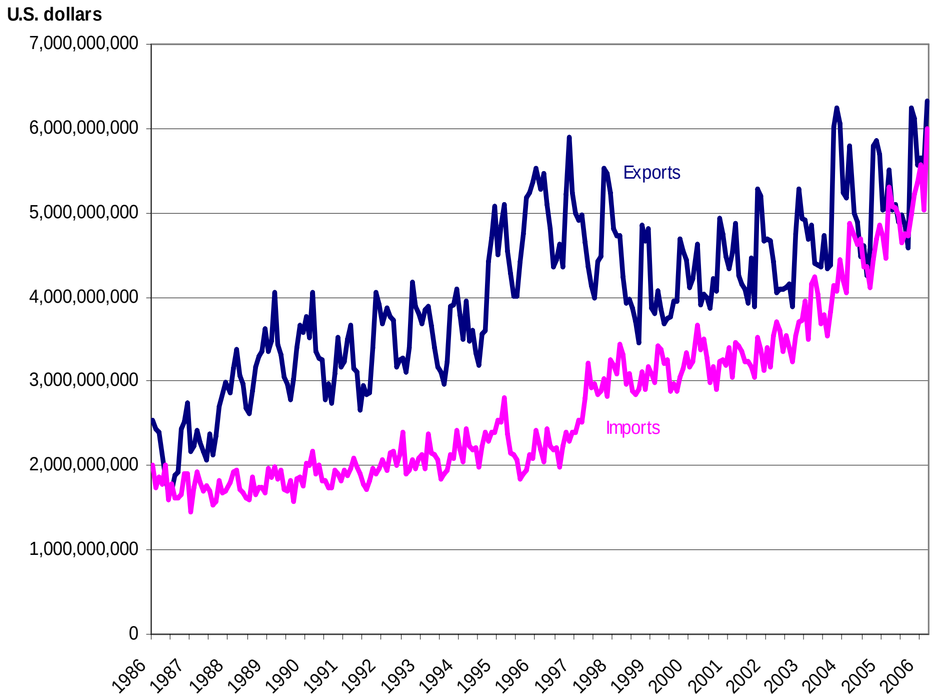
The Fruit and Vegetable Situation in the U.S

The United States is importing more food, especially horticultural crops. Tomatoes from Mexico, grapes from Chile and bananas from the Dominican Republic are standard fare on the American table today. Hennessy (1996) reports that in the 1960 to 1990 period, vertical coordination for fresh vegetables increased from 45% to 65% while that of processed vegetables increased from 75% to 95%. There are two main reasons behind this phenomenon. The first reason is that the modern consumer is demanding more processed foods due to time constraints caused by duo-careers in the family. Secondly, the food industry has acquired advanced technology that enables it to provide highly processed foods to the consumer. This can only be achieved through a qualitatively homogenous supply of raw materials. According to Wilkins (2004), about 85% of all vegetables destined for freezing and canning are grown under contract, with processors dictating variety, quality, quantity, delivery date and even price.

An alternative to the highly concentrated food processor industry is to establish community-based food systems that include many small-scale farmers and a diversity of products. The farmers would then be encouraged to add-value to their produce at the farm level and that is where the mobile processing unit really becomes handy because the farmer incurs minimal transportation costs and the risks therein.

The US food export and import trade has fluctuated over the past few decades with most years having a trading surplus. The US has traditionally exported more food than it imported mainly due to favorable weather conditions and access to new technology in farming and management of business. Figure I illustrate the actual trade situation in the last two decades. According to the U.S. Department of Agriculture, U.S. agricultural trade surplus in 2005 continued to decline from $577 million in February to $198 million in March. In March 2005, the United States exported $5.5 billion in agricultural products and imported $5.3 billion. U.S. exports for October 2004 through March 2005, (first half of federal fiscal year 2005) totaled $32.9 billion, a 5-percent decline from that in fiscal year 2004. Imports for those months in fiscal year 2005 totaled $23.5 billion, a10-percent increase over 2004. The United States is pursuing liberalization with many developed and developing countries. Having access to growing foreign agriculture markets is essential to U.S. farmers who produce far more than the domestic buyers can consume.

Figure 1 United States Agricultural Trade Value, by Month and Calendar Year



Source: Economic Research Service, U.S. Department of Agriculture and Bureau of Census, U.S. Department of Commerce, 2006.

Figure 1 show that trade deficit was experienced several times in the past three decades. A trade deficit was experienced in May 1986, June 2004, September 2005 and April 2006 in the approximate amounts of $147 M, $200 M, $150 M, and $146 M respectively. In the late 1990s, the value of export agricultural produce was increasing while that for the import market was declining until early 2000 when the gap narrowed down. According to Krugman and Baldwin (1987), some of the reasons for trade deficit include: substantial lags in the adjustment of both prices and quantities to exchange rates, probably representing a tendency of firms to commit themselves to supplies for extended periods of time; failure of foreign demand to grow as rapidly as US demand due primarily to the growth rate of the economy and the associated purchasing power; the final reason is the underlying strength of the dollar which makes American goods and services more expensive for foreign buyers.

Feasibility Assessment Template

Dr. Phil Kenkel and Dr. Rodney Holcomb, professors in the Agricultural Economics Department of Oklahoma State University, first developed the feasibility assessment template for the Agricultural Marketing Resource Center. The template is designed to assist the user in determining the economic viability of a project by entering relevant figures in the input cells and the output is automatically generated. The input cells include expectations for market projection, loan amortization, personnel expenses, fixed and variable expense projections, operations summary and depreciation of equipment. Profits or losses are estimated for a period of ten years based off user identified cost inflation rates and market growth rates. The template enables one to quickly examine the impact of changes in yield, fixed and variable costs, loan term, wage rate, and production levels.

SIMETAR: Simulation for Excel to Analyze Risk

The financial analysis of the mobile processing unit, copacker and own-fixed facility were conducted using a simulation tool known as Simetar©. Simetar is a simulation language written for risk analysts to provide a transparent method for analyzing data, simulating the effects of risk, presenting the results in a user friendly manner of Microsoft® Excel. A common theme with Simetar is that all the functions are dynamic; so if changes are made to the original data, almost all parameters, hypothesis tests, regression models, and risk ranking strategies are automatically updated. This dynamic feature makes Simetar a superior tool especially during development, validation, verification and application of stochastic parameters. Simetar was used to:

- Evaluate the financial performance of the mobile processing unit
- Estimate the risk inherent in the production of a given volume of product
- Determine at what production level the mobile processing unit is a better alternative
- Determine the minimum production level for each alternative required for profitability

Table 4 Assumptions Made for the Mobile Processing Unit.

Variables	Unit measurements & Cost
Number of production days per year	240
Production rate of equipment	1 gal/min.
BTU (British thermal units) used for production	576,000
BTU used for cleaning	108,375
Number of cleaning cycles	2
Cost of electricity	$0.08/Kwh
Cost of natural gas	$4.50/ft^3
BTU/lb	1000
Gallons of production per day	480
Water used per gallon of product	0.5 gal
Cost of water/ 1000gal	$1.68
Sewarage/1000 gal	$1.35
Fluid Ounce per bottle	16
Bottles per case	12
Ingredients	$4.94/gal
Jars	$2.80/gal
Lids	$0.4/gal
Heat-seal wraps	$0.008/gal
Labels	$0.008/gal
Insurance	$0.069/gal
Utilities	$0.052/gal
Capital borrowed (%)	50
Interest rate (%)	7.50
Loan term (yrs)	10

Table 4 shows various assumptions made for the mobile unit. For the purpose of this analysis, the equipment was assumed to be operational about 40 hours a week with the mobile unit having a production rate of 1 gallon per minute and that of the fixed facility being varied. The electricity and natural gas estimates represent what commercial users pay to the City of Stillwater in Oklahoma for 2005. The insurance quoted here gives the mobile unit liability coverage of up to three million dollars. The unit is fifty percent financed at a rate of seven and a half percent for a ten year life period. The packaging material used for the mobile unit was on average more expensive because of the following reasons:

- Storage space for the mobile unit is limited and hence only small orders of packaging materials can be made
- Since only small orders are made, the mobile unit cost per unit is still high as compared to the fixed facility, where it is possible to negotiate quantity discounts. The fixed facility has large warehouses and can be able to make large orders of various ingredients and materials.

The mobile unit can, however, get a lower per unit price of ingredients and packaging materials by partnering with other small-scale processors in the region for collective purchasing. Such cooperative purchasing arrangements are common in the food industry, and several small manufacturers of bottled products in Oklahoma pool their purchases of bottles and lids to receive volume discounts. The main drawbacks to this strategy might be bottle design, demand cycles being different, and cutthroat competition between processors who make the same products.

Table 5 Survey Results Detailing the Cost of Operating a Fixed Facility

Variables	Cost/Unit
Ingredients	$3.20/Gal
Utilities cost (gas, elec. water)	$0.04/Gal
Water used per gallon of product	0.5/Gal
Fluid Ounce per bottle	16
Bottles per case	12
Glass/Lids	$0.50/Gal
Labels	$0.1/Gal
Insurance	$0.1/Gal

The table 5 shows packaging and ingredient costs associated with the fixed facility being substantially lower than that of the mobile unit. This is possible through bulk order purchases made by the processor since storage space is available at the facility and large volumes of product are made at any one time.

Table 6 Process Modules Preliminary Price Estimates for Mobile Processing Unit

Module 1 Batch	Cost ($)	Module 4 Fill	Cost ($)
Steam Kettle, self contained	8,000	Filler, piston	8,000
Particulate pump and drive	8,000	Surge tank, insulated and heated	2,500
3-way manual drive	1,200	Pneumatic cap fastener	500
Frame and castors	2,500	Sanitary piping	1,500
Work table	300	Piping	500
Wash-down hose	300	Temperature sensor (surge)	400
Temperature sensor (kettle)	400	Work table	300
Sanitary piping	2,500	Wash down hose	300
Electrical	500	Frame and castors	2,500
Total	23,700	Electrical balance	1,500
		Total	18,000
Module 2 Process		Options	
Concentric tube heat exchanger	3,000	Hardened computer	2,500
Diversion valve	1,400	Wood-fired hot water heater	7,000
Holding tube	1,500	Air compressor (gasoline power)	1,500
Frame and castors	2,500	Generator (20 amp)	1,500
Electrical controls	4,000	Water filtration system (cartridge)	300
Insulation	500	Non-jacketed batch tank (deduct)	-5,000
Three compartment sink	1,200	CIP pump and piping	6,000
Temperature sensor (product)	400	Concentric tube regenerator	2,500
Back pressure valve	750		
Circular chart recorder	750		
Sanitary piping	2,500	Module total	72,950
Electrical	500	Custom Trailer	15,000
Total	19,000	GRAND TOTAL	87,950
Module 3 Utilities			
Hot-water boiler (LP gas)	6,000		
Hot-water pump	500		
Frame and castors	2,500		
Piping and fittings	2,500		
Electrical	750		
Total	12,250		
Debt Assumptions			
Capital borrowed (%)			50
Interest (%)			7.5
Loan Term (yrs)			10

Source: FAPC, Oklahoma State University, 2006

Table 6 shows different components and associated costs of the mobile processing unit. The modules consist of the fill, process, batch, utilities, and options that can be modified depending on the location of the equipment. The costs listed in the table are estimates and are bound to go up during the implementation or operation of the equipment. The modules will be hooked up in a custom-made trailer that meets the food safety standards as spelled out by the USDA. The trailer can be hauled from one point to the next by a powerful pick-up track.

Table 7 Cost Estimates for Building a Standard Own-Fixed Facility

Facility	Size in Sq ft	Cost/sq ft ($)	Specific description of components	Total cost ($)
Warehouse	9,000	50		$450,000
Process	3,000	85		$255,000
Office/welfare	1,500	75		$112,500
Totals	13,500	210		$817,500
Equipment				$
Process			Kettles, pumps, piping	$85,000.00
Fill			Filler	$55,000.00
Package			Labeler, taper, conveyor	$20,000.00
Warehouse			Racks, pallet jack, Minimal storage	$25,000.00
Sanitation			Hose stations, COP, Foamer, chemical storage	$10,000.00
Laboratory			Instruments, millwork	$20,000.00
Utility			Boiler, compressed air	$45,000.00
Shop			Basic tools, and Workbench	$12,000.00
Office			Furniture, computers, Fax, printer	$15,000.00
Grounds				
Lighting				$5,000.00
Improvement				$15,000.00
Total				$307,000.00
Grand Total				$1,124,500.00
Debt Assumptions				
Capital borrowed (%)				50
Interest (%)				7.5
Loan Term (yrs)				10

Source: FAPC, Oklahoma State University, 2006

The cost estimates are based on 2006 dollars and therefore represent what it would actually cost to build such a facility in that year. The cost may vary up or down from this estimate depending on the location of the facility due to land rates and availability of building materials. The design of the building and quality of materials may either increase or decrease the cost associated with construction.

After analyzing the survey responses and simulating production runs under mobile, fixed and copacker forms of production, three average cost curves were generated which were unique to each situation.

Figure 2 Average Cost Curves for Barbecue Sauce Produced under Different Production Systems (Year 3 of production)

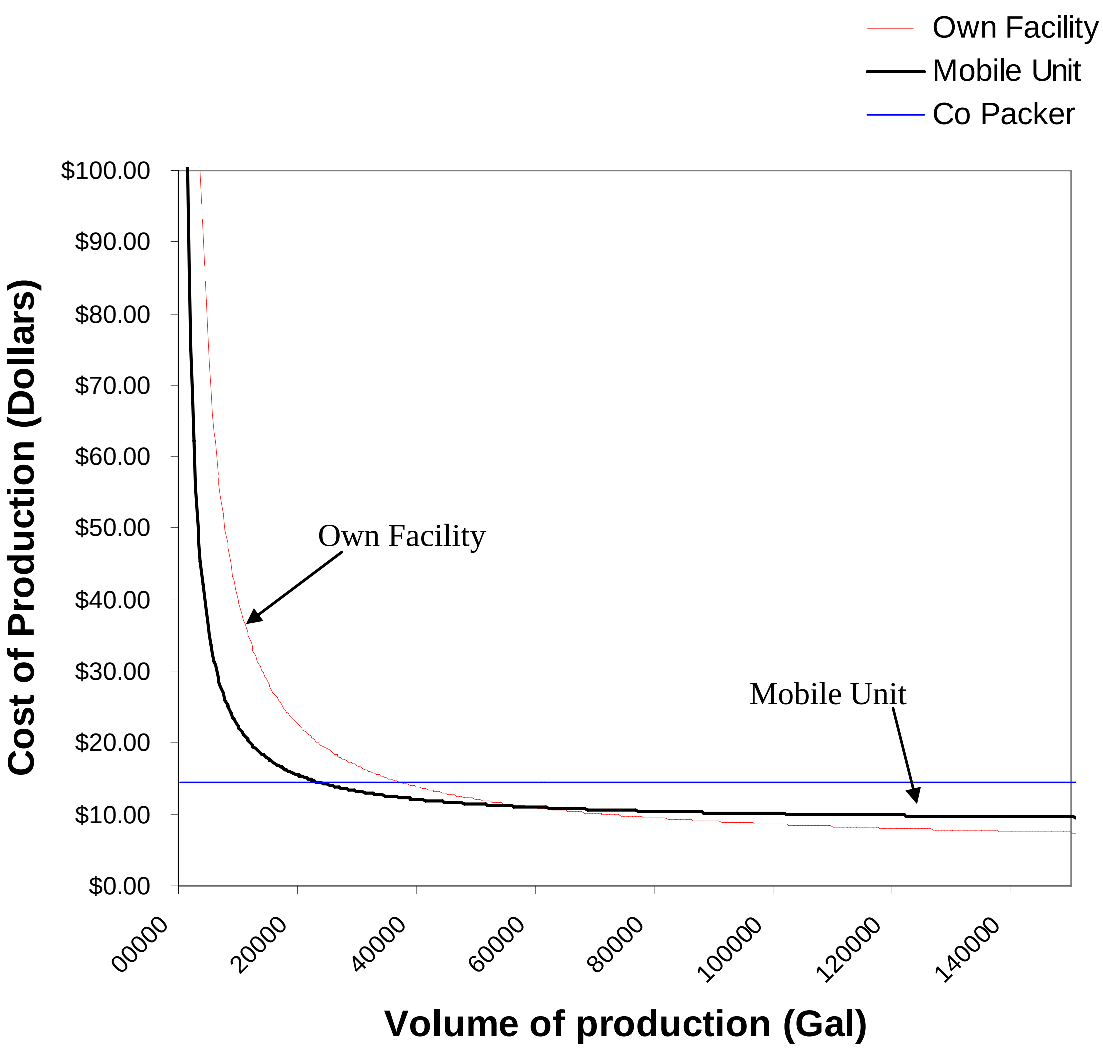


Figure 2 shows that at a production volume of about 6,000 gallons of barbecue sauce, the breakeven production cost for the mobile unit and fixed facility is approximately $30.00 and $62.00 respectively. The system of choice at this level is the copacker, which is able to maintain a constant cost irrespective of the volume. The figure reflects the fact that the fixed facility has much more capital invested and therefore requires a guaranteed production minimum in order to cover all the costs and be competitive. The production level considered here of 6,000 gallons represents a point on the curve where it is prohibitively expensive to produce sauce. Further details of the results are available in Chapter V.

CHAPTER IV

RISK IDENTIFICATION AND EVALUATION

Ownership Risk Issues in Food Processing

Many food-processing firms constantly face the possibility of losing business due to uncontrollable internal and external circumstances. A large majority of food processors have fixed facilities and are therefore limited by geographical location, raw material sourcing, and access to markets, labor, transportation, and utilities. Depending on the actual location of the processing facility, the owner may be faced with higher operational costs and regulations that eventually slow down business activities and negatively affect the bottom line. The fixed facility can almost never be moved without the possibility of structural damage and prohibitive cost in the event of business failure in its current location.

The mobile processing unit under consideration in this study is very versatile and can be hauled from one geographical location to the next with the aim of maximizing profits by ensuring that the equipment does not lie idle. The equipment movement is essentially guided by the availability of raw materials in the region of operation. For example, the southern part of the US generally has fruit and vegetables ready early in the season, followed by the mid regions and eventually the northern states such as Minnesota and Michigan. The portable nature of the mobile processing unit can ensure that the equipment is in use year-round and that the producers have a secondary outlet for their raw commodities without having to incur major transportation costs.

Ownership Risk in the Barbecue Sauce Example

Using the barbecue sauce example from the previous chapter, one could draw a simple comparison to illustrate ownership risk. For example, assume the possibility of business shutdown at the end of year 3 for both the mobile unit and the fixed facility. The shutdown could be due to external circumstances such as market share loss, competition, lack of raw materials, state or local regulations and restrictions. The business loan advanced to the projects is considered delinquent since the business ceases to generate money that would go into servicing the loans. The outstanding loan balance at the end of year 3 is $433,855 for the fixed facility and $33,933 for the mobile processing unit.

To recover the outstanding loan balance and some portion of the equity tied up in the mobile unit, the unit as a whole can almost immediately be sold and transported to another region/location for continued operations. Continued operations will generate income that can be used to service the outstanding loan balance and thereby eliminating the risk of bankruptcy on the previous owners of the equipment.

On the other hand, when the fixed facility is offered for sale, it will most likely remain in the market for a long time and attract stiff penalties from lenders due to non-payment of loans. The owners may be forced to sell some equipment at discounted prices to make their scheduled debt repayments, since the whole facility cannot easily be moved to a different location. The removal of key equipment or the entire product line may also detract from the value of the building, since it was designed for a specific purpose but has been diminished to a shell facility.

Cooperative Ownership Possibilities for the Mobile Unit

A cooperative is a business or service organization that is owned and democratically controlled by the people who use its services and receive the benefits (services and earning allocation), which are distributed on the basis of utilization. As a self-help business form, agricultural cooperatives were designed to move produce to market, buy inputs and influence price and other terms of trade, while providing fair treatment and other benefits to the members. The main advantage of being a cooperative member is that the risk of owning and operating a business is evenly distributed among the members.

The mobile processing unit can be owned by a cooperative entity that deals in one commodity and is located in a small geographical region. The cooperative members would be encouraged to produce enough raw materials for the mobile unit since they would be assured of an outlet for their produce and limited transportation expenses.

The unit may also be used for multiple commodities, e.g., tomatoes, peaches, mangoes, papayas and guavas, and in a much broader geographic region. The different commodities would require slight modification in the processing set up and packaging, but overall, the equipment would be used over a longer period of time due to varied maturation times of the different commodities.

When the mobile unit is engaged in multiple commodities in multiple states, careful scheduling is necessary in order to ensure a smooth transition from one area to the next. Since different fruits and vegetables ripen and mature at different times in different regions, it is necessary to have a chart that shows their expected maturation dates, amount and quality, and market conditions. When the equipment is utilized over more seasons (spring, summer, and fall), overhead costs (fixed costs) are allocated to each respective product, which significantly reduces per unit cost to the equipment owner.

Peach Puree Processing Example

The mobile processing unit can be used to process a variety of fruit and vegetables depending on season, market forces, and availability of raw materials. For the purpose of providing an example of processing operations and risks, a peach puree activity has been assumed. The example was developed from an extension fact sheet released by Michigan State University (Long 2005), in which the estimated annual losses for the state's peach crop were provided and the potential for puree production discussed.

According to Long (2005), Michigan produces more than 25 million pounds of fresh market peaches annually worth $8.25 million, but little market exists for culled fresh-market peaches. The article continues to note that between 5 and 15 percent of fresh market peaches produced in Michigan are discarded annually during the packing process. The mobile processing unit can be strategically positioned at the source of the cull peaches to process them into a puree that can be used as filler in pies or fermented and used to make wine or utilized as a topping on desserts or pastries (Andrews 1989)

For this example, it was assumed that a large orchard owner or multiple smaller but neighboring orchard owners utilized a cooperatively owned mobile processing unit for ten days, either as members of the cooperative owning the unit or through a rental arrangement. Using the Kenkel and Holcomb feasibility template, the orchard owner(s) was assigned an overhead charge equivalent to 1/24th (assumed use of 10 days out of 240 days per year operation) of the average fixed costs associated with owning, operating, and maintaining the mobile unit. It was also assumed that it takes 15 lbs. of whole peaches to make 1 gallon of puree, after accounting for weight losses associated with peeling, pitting, and the removal of stem/leaf litter. It is further assumed that $0.25/lb is allocated to the value of cull/discarded peaches to cover the orchard costs of handling the peaches that would otherwise be thrown away or left in the field.

Table 8 Assumptions Made for the Processing of Peaches

Variables	Unit Cost
Number of production days per year	10
Overhead costs for mobile unit	$72.42
Production rate of equipment	1 gal/min.
Number of cleaning cycles	2
Cost of electricity	$0.08/Kwh
Cost of natural gas	$4.50/ft^3
Gallons of production per day	480
Water used per gallon of product	4.0 gal
Cost of water/ 1000gal	$1.68
Sewage/1000 gal	$1.35
Peaches	$3.75/gal
Sugar	$0.04/gal
Ascorbic acid	$0.20/gal
Plastic jug	$1.00/gal
Box/case (4 gal/case)	$0.25
Label	$0.10/gal
Insurance	$0.026/gal
Utilities cost	$0.06/gal
Puree selling price	$7.00/gal

Table 8 shows the specific assumptions made in order to utilize the cooperatively owned mobile unit in processing of cull peaches into puree. The equipment is utilized for a total of ten days in a year for peach processing, and four gallons of water are used per gallon of product since processing peaches involve a lot of washing. The puree is packed in one-gallon plastic jugs that are then packed in a carton box each holding four jugs. The carton boxes help protect the plastic jugs and improve handling especially during transportation and distribution of the product to the market.

Puree Production Risk

Risk is defined as the possibility that an outcome will not meet expectation. Some of the major sources of risk in agriculture are production and yield risks, market and price risks, business and financial risks, technology, casualty risk, human resource risk, and legal risk (Hewitt, Sticker, and Muraro 2000).

For the peach-processing project, the major risk involves the production schedule set up for the mobile processing unit. Since the equipment is set up to rely on cull peaches, raw material supply may not be constant or very reliable, resulting in unnecessary stoppages. Quality of raw materials may occasionally not be of the required standard due to varied storage and handling conditions during the packing of the fresh market peaches. To resolve these issues, careful scheduling of production cycles should be considered to minimize unnecessary movement of the equipment, and more importantly, ensure sufficient raw material supply for continuity of production.

Figure 3 Probability Density Function of Pre-Tax Earnings from Peach Processing

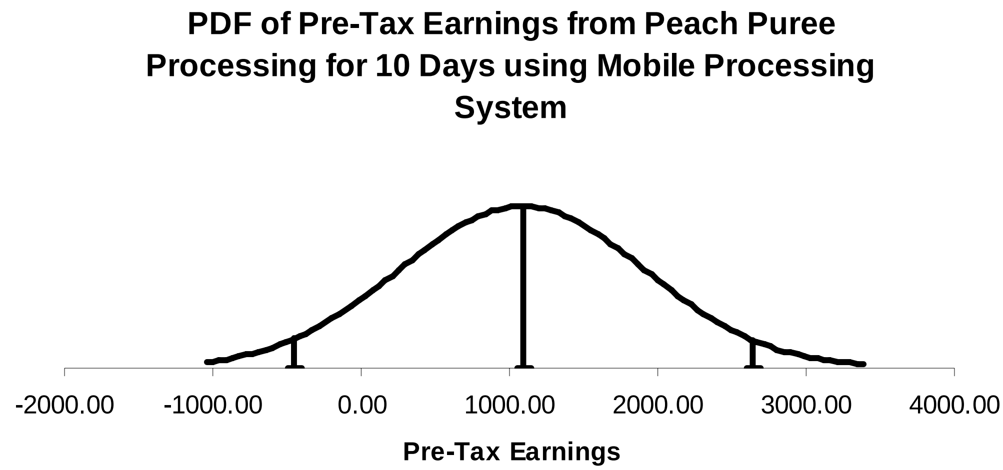


Figure 3 show that 90% of the distribution of pre-tax profits lies between $30.00 and $2,600 for the ten-day period under consideration. This means that the probability of making a loss is very small and is evaluated at 8.6% (figure 4). In this example, it was assumed that in the simulation the production capacity averages 0.9gal/min with a standard deviation of 0.1. This assumption implies that the equipment can process slightly more or less peach puree per minute depending on the prevailing circumstances such as raw material availability, quality, size and ripeness of peaches.

CHAPTER V

RESULTS, DISCUSSION AND IMPLICATIONS

Results

Barbecue Sauce Analysis

The analysis was based on the cost of production of barbecue sauce as opposed to profitability since marketing costs are highly variable due to their wide variability between processors and also the quantities of product being considered. The marketing mix for the barbecue sauce producers includes brokerage fees, distribution cost, warehousing fees, and the marketing program used. The above-mentioned fees and costs greatly vary depending on the size of operation, whether the facility is owner-operated or rented, time of the year, and location of the facility. The mobile processing unit, contracted production using a copacker and the own-facility systems were all analyzed for cost of production. Cost curves were generated for each case (Figure 2). The cost curves indicated the average total cost for each gallon of sauce manufactured at various volume levels. The copacker's charge per gallon of product was determined through surveys and an average cost was established from their responses.

It was assumed that as production levels increase a firm may have to contract production with more than one copacker, as each copacker has limited production capacity for manufacturing another firm's product. Further, it was assumed that even if multiple copackers were needed to meet the production goals that the average price per gallon would be maintained.

The model for each of the processing alternatives was run for the third year of operation since it was assumed that by this time stabilization of production processes would have taken place. This would include experience of the production staff, stability in the market place, generated revenue sufficient to cover loan servicing, and efficient sourcing of the raw materials.

The models are highly dynamic and this means that various inputs such as capital, labor cost, input costs, and other operating cost can be changed and an infinite number of production scenarios can be produced. For the purposes of this study, only production levels were varied.

For very high product volumes, the system shows that the own-facility has the lowest average cost per gallon of production followed by the mobile unit and finally the copacker. For low product volume, the copacker is the least-cost option, as the mobile unit and the own facility have significantly higher overhead costs (own facility having the highest). It is evident that to justify investment in either the mobile processing unit or the own-facility required a guaranteed minimum amount of production is necessary to be cost competitive.

At a production level of 25,000 gallons shown in figure 2, the breakeven cost for both the copacker and the mobile unit is \$14.48 per gallon. The breakeven cost for the fixed facility is \$18.73. This tremendous drop in the cost of production reflects the fact that increased volume kicks in the effect of economies of scale. At this production level, the system of choice would either be the mobile unit or the copacker.

At higher levels of production, the copacker's cost of production remains constant but average costs for the mobile unit and own-facility decrease. The fixed costs are spread across a larger production volume for the mobile and the fixed facilities, and the dedication of equipment to one's own products is a benefit over the limited production availability of the copacker.

At about 71,000 gallons, the breakeven cost for both the mobile unit and the fixed facility is $10.73 and one is indifferent as to which equipment to use since both costs the same. Further increase in volume results in a decrease in the average cost of production for the fixed facility.

For the mobile unit, the cost of production will start to increase at about 150,000 gallons per year because more labor and equipment would be required to run a second or third shift. Additional modules may have to be purchased to further increase the production volume. Since the mobile unit is primarily targeted for the rural areas and therefore small-scale processing, it has an obvious advantage over both the copacker and the fixed facility. It can utilize raw materials located in different areas, minimizing travel time/mileage and minimizing spoilage of the horticultural inputs.

Another advantage of the mobile unit is that it can utilize both natural gas and electricity or run on either of the two energy sources depending on availability. The ease of assembly and operation makes the equipment very handy and training personnel therefore becomes easy and fast.

Peach Puree Analysis

The peach puree processing example adopted from the Michigan State University extension fact sheet shows the benefits an entrepreneur accrues from utilizing the mobile processing unit as opposed to a fixed facility. This example shows how adversely profitability is affected by small changes in fixed and raw material cost. The results indicate that when these costs are controlled for the ten-day period, the mobile unit returns considerable pre-tax profits while the fixed facility must be utilized for many more days just to cover fixed costs.

Figure 4 Probability of Pre-Tax Earnings from Peach Puree processing being Less Than $0 and Greater Than $1,000

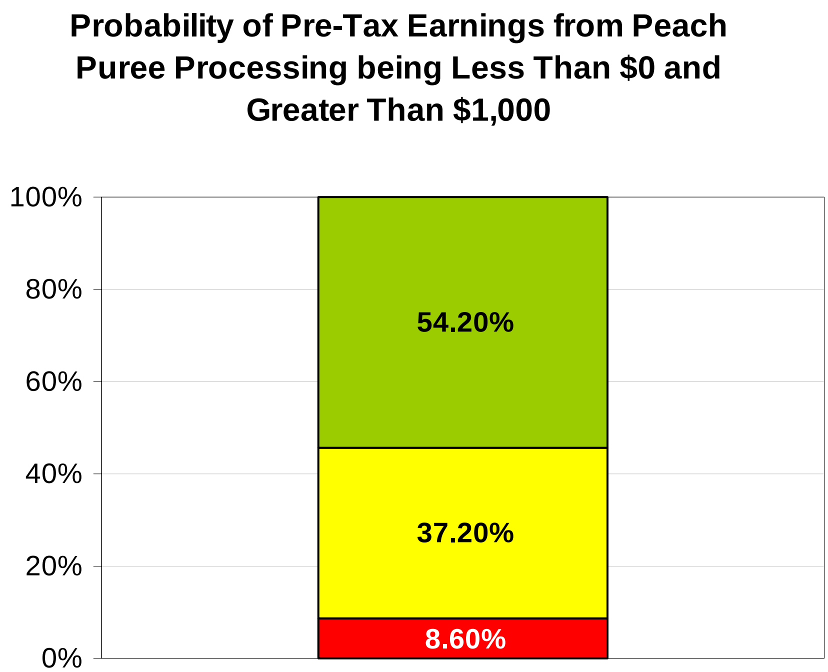


Figure 4 shows that there is an 8.6% chance of losing money, 37.20% chance of making a maximum of $1,000 and 54.20% chance of making above $1,000 over the ten-day period. Overall, there is over a 90% chance of the unit generating profits, given the assumptions made in this example.

Figure 5 Effects of Daily Fixed Cost Changes on Pre-Tax Profit

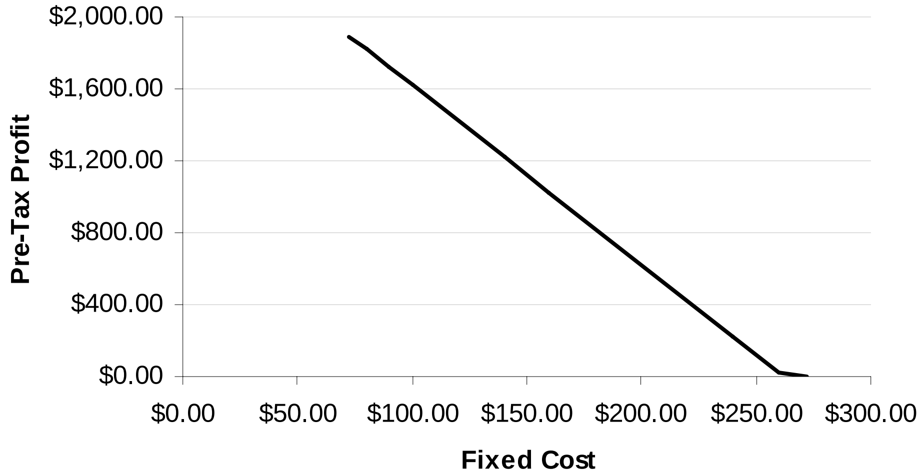


Figure 5 shows that an increase in fixed cost from $75 to $250 results in an almost complete erosion of any pretax profit in the peach-processing example. If the fixed cost increases to about $271, the pretax profit becomes zero and the business would have to rely on credit to survive. The assumed production capacity of about 480 gallons per day of peach puree is sufficient to generate profits but further increases in the number of production days result in more produce that minimizes fixed cost allocated to each unit volume of product. Decreasing the allocated fixed cost per unit product will result in an increase of the pretax profits as shown on figure 5.

A fixed facility owned by the peach orchard will have an installed minimum production capacity that must be met in order to generate profits. Since the peach example assumes a ten-day production cycle, the fixed costs allocated to each unit volume of product would be so high that profits would be impossible to generate

Figure 6 Effects of Peach Handling Cost on Pre-Tax Profit

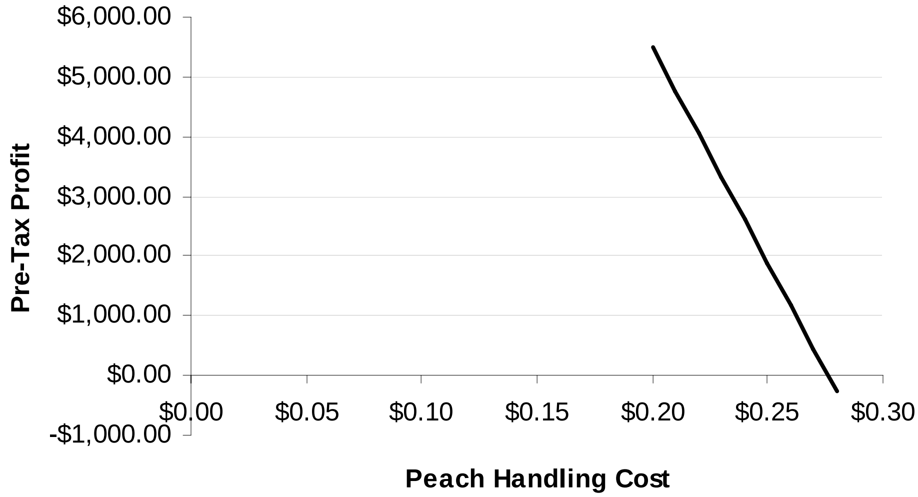


Figure 6 shows the responsiveness of pre-tax profit to very small changes in cost of handling a pound of cull peaches. When the peach handling cost decreases by one cent per pound, there is a $720 increase in pre-tax profit for the 4,800 gallons of peach puree produced in the ten-day period. It is therefore possible to increase profitability of the mobile processing unit by avoiding transportation and handling fees.

When the cull peaches are transported to a fixed facility, the handling cost increases tremendously and negates any processing profitability. Exposure of peaches to various handling conditions during shipment to a fixed facility will result in quality deterioration and higher rejection rates of the raw materials at the factory. Since transportation expense for both the quality rejects and good quality peaches is a sunk cost, unit cost for the good peaches goes up significantly.

Summary of Peach Processing Example

Ingredients were a significant factor in determining the production cost for peach processing as well as packaging materials cost. The cull peaches can be sourced at discounted prices from large-scale farmers since they are most likely to have more culls due to high volume of produce. The reduced cost of raw material will serve to lower production cost and improve the profitability of the mobile unit as shown in figure 5.

The peach-processing venture considered in this example has a 90% chance of making a pre-tax profit in the ten-day window and hence it is more than likely that the equipment will continue to be profitable when used for more days.

The fixed cost for the mobile unit is considerably lower when high volume of produce is processed in the system. This is because cost allocation is spread out resulting in higher profitability.

The mobile processing unit can be easily transported to the raw material site(s), which become available at different geographical locations and process them on site into finished products ready for the market. The agility of the mobile processing unit makes it possible to utilize most material that would have otherwise been considered post harvest loss. In the event that raw materials are suddenly depleted in the current location before the ten-day period, the mobile unit can be transported to another region where continued processing would take place

Implications of Research to the Food Industry

The mobile processing unit is an alternative for entrepreneurs who, for one reason or another, are unable to use a copacker or a fixed facility. The mobile processing unit can be co-operatively owned thus resulting in a further reduction in cost and associated risk for each member of the co-operative.

The system can be used for a wide range of food products with minimal adjustments in the processing equipment. Due to the mobile nature of the equipment, it can be transported from one region to the next depending on the availability of raw materials. This is particularly important in those regions with poor road networks and lack utilities necessary to run a fixed facility.

The mobile system has the potential to be exported to less developed regions of the world such as South America and Africa. For example, post-harvest losses in Kenya are in the range of 20-30 % (Oniang'o and Mutuku, 2001) of the harvested crops mainly due to lack of processing and preservation facilities. The mobile unit requires minimal utility connections and about three members of staff to run production. Since labor is readily available and cheap, it is possible to have more workers for the same amount of money allocated for labor in the US. Food safety issues have to be guaranteed in the area in which the system would operate so as to have superior quality products that would favorably compete in the market place.

Consideration for Further Research

The analysis of the mobile processing unit was limited by the fact that the information used for analysis was derived from surveys carried out for barbecue sauce processors. The ideal situation would have been to have the equipment have several production runs and determine the associated costs for each production level. These actual numbers would give a much clearer picture of the input prices, associated risk, real value savings on bottles and lids as the volume goes up. It was not possible to capture these savings from the surveys and therefore their effect on the bottom line was not known.

In this study, the production level was varied and all other inputs were held constant. Several other scenarios can be generated where inputs cost, labor cost, loan interest rates, utility costs, and marketing costs can be varied and analyzed.

Since the mobile unit moves to the raw material source, it is important to know what quantity of raw materials warrants the shipment of the equipment to a given site and for how long it will be in operation. This information is important for logistics and other regulatory purposes such as the laws that govern the production and processing of food products in a given area.

The mobile unit has the capacity to use different energy sources such as firewood, charcoal, kerosene, natural gas and electricity. Since these energy sources have different costs and are readily available in some areas and not others, it would add value to the project to investigate the best energy source in a given location.

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APPENDIXES

APPENDIX A

INSTITUTIONAL REVIEW BOARD (IRB) FORM

TELEPHONE SURVEY REQUEST

Hello. This is ________________ from Oklahoma State University's Food & Agricultural Products Center. I was wondering if you might be willing to meet with me to discuss the production practices and costs associated with manufacturing your BBQ sauces. I'd also like to take the time to provide you with information on a small-scale, portable processing unit we at OSU have developed to manufacture BBQ sauces and similar food products.

Would you be willing to schedule a time when I could visit you at your facility?

[if no] Thank you. If I can help you in any way or if you change your mind, please feel free to call me at _____________.

[if yes] Great. What day(s) and time(s) in the next week(s) would be best for you?

APPENDIX B

INSTITUTIONAL REVIEW BOARD (IRB) FORM

Oklahoma State University Institutional Review Board

Date:	Tuesday, January 31, 2006
IRB Application No	AG0620
Proposal Title:	Compare Economic Feasibility of Processing Alternatives for Small Scale Producers of Fruits and Vegetables in Oklahoma
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 1/30/2007

Principal Investigator(s

Rodney Holcomb
114 FAPC
Stillwater, OK 74078

Robert Karaya
415 Ag Hall
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Beth McTernan in 415 Whitehurst (phone: 405-744-5700, beth.mcternan@okstate.edu).

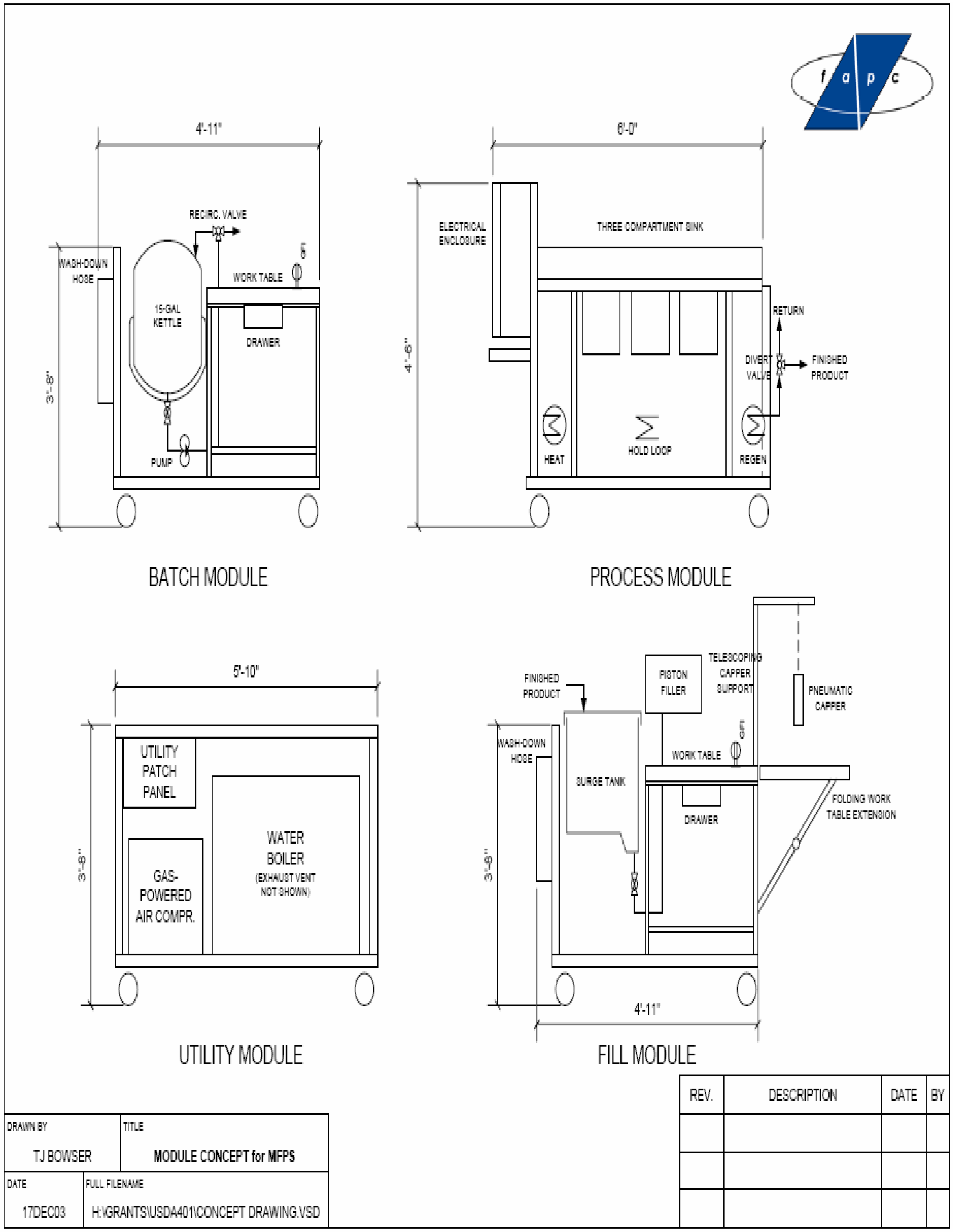
Sincerely,

Sue C. Jacobs

Sue C. Jacobs, Chair
Institutional Review Board

APPENDIX C

CONCEPT DRAWINGS FOR THE MOBILE PROCESSING UNIT


4'-11"
RECIRC. VALVE
WASH-DOWN HOSE
WORK TABLE
15-GAL KETTLE
DRAWER
3'-8"
PUMP
BATCH MODULE
6'-0"
ELECTRICAL ENCLOSURE
THREE COMPARTMENT SINK
4'-6"
RETURN
DIVERT VALVE
FINISHED PRODUCT
HEAT
HOLD LOOP
REGEN
PROCESS MODULE
5'-10"
UTILITY PATCH PANEL
WATER BOILER
(EXHAUST VENT NOT SHOWN)
GAS-POWERED AIR COMPR.
3'-8"
UTILITY MODULE
TELESCOPING CAPPER SUPPORT
PISTON FILLER
FINISHED PRODUCT
PNEUMATIC CAPPER
WASH-DOWN HOSE
WORK TABLE
SURGE TANK
DRAWER
FOLDING WORK TABLE EXTENSION
3'-8"
4'-11"
FILL MODULE
REV.
DESCRIPTION
DATE
BY
DRAWN BY
TJ BOWSER
TITLE
MODULE CONCEPT for MFPS
DATE
17DEC03
FULL FILENAME
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APPENDIX D

THE EXPENSE PROJECTION FOR MOBILE PROCESSING UNIT

AND OWN FACILLITY AT A PRODCUTION LEVEL

OF 105,011 AND 78,687 GALLONS

PER YEAR RESPECTIVELY.

MOBILE UNIT

Sheet summaries expenses for the mobile unit. The only input is for "supplies and miscellaneous" expenses.

Production level 105,011 gal/yr

Labor	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Salaries		81435.92	81435.92	81435.92	81435.92	81435.92	81435.92	81435.92	81435.92	81435.92	81435.92
Benefits		24430.78	24430.78	24430.78	24430.78	24430.78	24430.78	24430.78	24430.78	24430.78	24430.78
Overtime		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Labor	**0**	**105866.70**	**105866.70**	**105866.70**	**105866.70**	**105866.70**	**105866.70**	**105866.70**	**105866.70**	**105866.70**	**105866.70**
Production Expenses		690533.26	697438.59	704412.97	711457.10	718571.68	725757.39	733014.97	740345.12	747748.57	755226.05
Utilities		3822.95	3937.64	4055.76	4177.44	4302.76	4431.84	4564.80	4701.74	4842.80	4988.08
Total Variable	**0**	**800222.90**	**807242.92**	**814335.44**	**821501.24**	**828741.13**	**836055.93**	**843446.46**	**850913.56**	**858458.06**	**866080.83**
Fixed											
Maintenance		2638.50	2717.66	2799.18	2883.16	2969.65	3058.74	3150.51	3245.02	3342.37	3442.64
Insurance		1759.00	1811.77	1866.12	1922.11	1979.77	2039.16	2100.34	2163.35	2228.25	2295.10
Property Tax		439.75	452.94	466.53	480.53	494.94	509.79	525.08	540.84	557.06	573.77
Depreciation		13424.56	22665.46	15638.96	10839.46	8242.44	7371.14	6514.44	3253.57	0.00	0.00
Interest		4098.13	3864.99	3614.38	3344.97	3055.35	2744.01	2409.32	2049.53	1662.75	1246.97
Total Fixed	**0**	**22359.93**	**31512.82**	**24385.17**	**19470.21**	**16742.15**	**15722.85**	**14699.68**	**11252.31**	**7790.44**	**7558.48**
Other											
Supplies	5000	5000.00	5150.00	5304.50	5463.64	5627.54	5796.37	5970.26	6149.37	6333.85	6523.87
Miscellaneous*	5000	5000.00	5150.00	5304.50	5463.64	5627.54	5796.37	5970.26	6149.37	6333.85	6523.87
Total Other	**10000**	**10000.00**	**10300.00**	**10609.00**	**10927.27**	**11255.09**	**11592.74**	**11940.52**	**12298.74**	**12667.70**	**13047.73**
Total Expenses	**10000**	**832582.83**	**849055.74**	**849329.61**	**851898.72**	**856738.37**	**863371.52**	**870086.67**	**874464.60**	**878916.20**	**886687.04**

* Year 0 miscellaneous expenses may include legal fees, licenses, permits and other organizational expenses.

Avg. Cost /gal		**9.93**	**10.03**	**9.93**	**9.86**	**9.82**	**9.80**	**9.78**	**9.73**	**9.68**	**9.67**

OWN-FACILITY

Sheet shows a summary of expenses for the own-fixed facility. The only input is for "supplies and miscellaneous" expenses.

Production level 78,687 gal/yr

Labor	**Year0**	**Year1**	**Year2**	**Year3**	**Year4**	**Year5**	**Year6**	**Year7**	**Year8**	**Year9**	**Year10**
Salaries		119,000	119,000	119,000	119,000	119,000	119,000	119,000	119,000	119,000	119,000
Benefits		35,700	35,700	35,700	35,700	35,700	35,700	35,700	35,700	35,700	35,700
Overtime		-	-	-	-	-	-	-	-	-	-
Total Labor	**-**	**154,700**	**154,700**	**154,700**	**154,700**	**154,700**	**154,700**	**154,700**	**154,700**	**154,700**	**154,700**
Production Expenses		403,352	407,385	411,459	415,574	419,729	423,927	428,166	432,448	436,772	441,140
Utilities		0	0	0	0	0	0	0	0	0	0
Total Variable	**-**	**558,052**	**562,085**	**566,159**	**570,274**	**574,429**	**578,627**	**582,866**	**587,148**	**591,472**	**595,840**
Fixed											
Maintenance		33,735	34,747	35,789	36,863	37,969	39,108	40,281	41,490	42,734	44,017
Insurance		22,490	23,165	23,860	24,575	25,313	26,072	26,854	27,660	28,490	29,344
Property Tax		5,623	5,791	5,965	6,144	6,328	6,518	6,714	6,915	7,122	7,336
Depreciation		64,832	96,146	74,656	59,306	48,377	48,346	48,377	34,654	20,962	20,962
Interest		50,169	47,188	43,984	40,539	36,836	32,855	28,576	23,976	19,031	13,715
Total Fixed	**-**	**176,848**	**207,037**	**184,254**	**167,427**	**154,823**	**152,900**	**150,802**	**134,694**	**118,339**	**115,373**
Other											
Supplies	5,000	5,000	5,150	5,305	5,464	5,628	5,796	5,970	6,149	6,334	6,524
Miscellaneous*	5,000	5,000	5,150	5,305	5,464	5,628	5,796	5,970	6,149	6,334	6,524
Total Other	**10,000**	**10,000**	**10,300**	**10,609**	**10,927**	**11,255**	**11,593**	**11,941**	**12,299**	**12,668**	**13,048**
Total Expenses	**10,000**	**744,900**	**779,422**	**761,022**	**748,628**	**740,507**	**743,119**	**745,608**	**734,141**	**722,479**	**724,261**

* Year 0 miscellaneous expenses may include legal fees, licenses, permits and other organizational expenses.

Avg. Cost/gal	**9.47**	**9.81**	**9.48**	**9.23**	**9.04**	**8.99**	**8.93**	**8.70**	**8.48**	**8.42**

VITA

ROBERT KARAYA

Candidate for the Degree of

MASTER OF SCIENCE

Thesis: ECONOMIC FEASIBILITY OF PROCESSING ALTERNATIVES FOR SMALL-SCALE PROCESSORS OF FRUITS AND VEGETABLES IN OKLAHOMA

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Nairobi, Kenya on August 10 1974. The Son of Mr. & Mrs. Charles Muriuki Karaya.

Education: Graduated from Kanunga High School Nairobi, Kenya in December 1993. Graduated from Jomo Kenyatta University of Agriculture and Technology with Diploma in Food Technology in December 1997 Graduated from Jomo Kenyatta University of Agriculture and Technology with B.S in Food Science and Technology in December 2000

Experience: Factory manager in a soft drink company based in Nairobi, Kenya from January 2002 to February 2003. Graduate Research Assistant, Department of Agricultural Economics at Oklahoma State University from August 2004 to August 2006.