# Feasibility Study for a Shrimp Processing Line

## *Final Report – Excerpts for Public Distribution*

NC STATE UNIVERSITY

**MBA 549 Supply Chain Management Practicum Project**

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NC GROWING TOGETHER
*Connecting Local Foods to Mainstream Markets*

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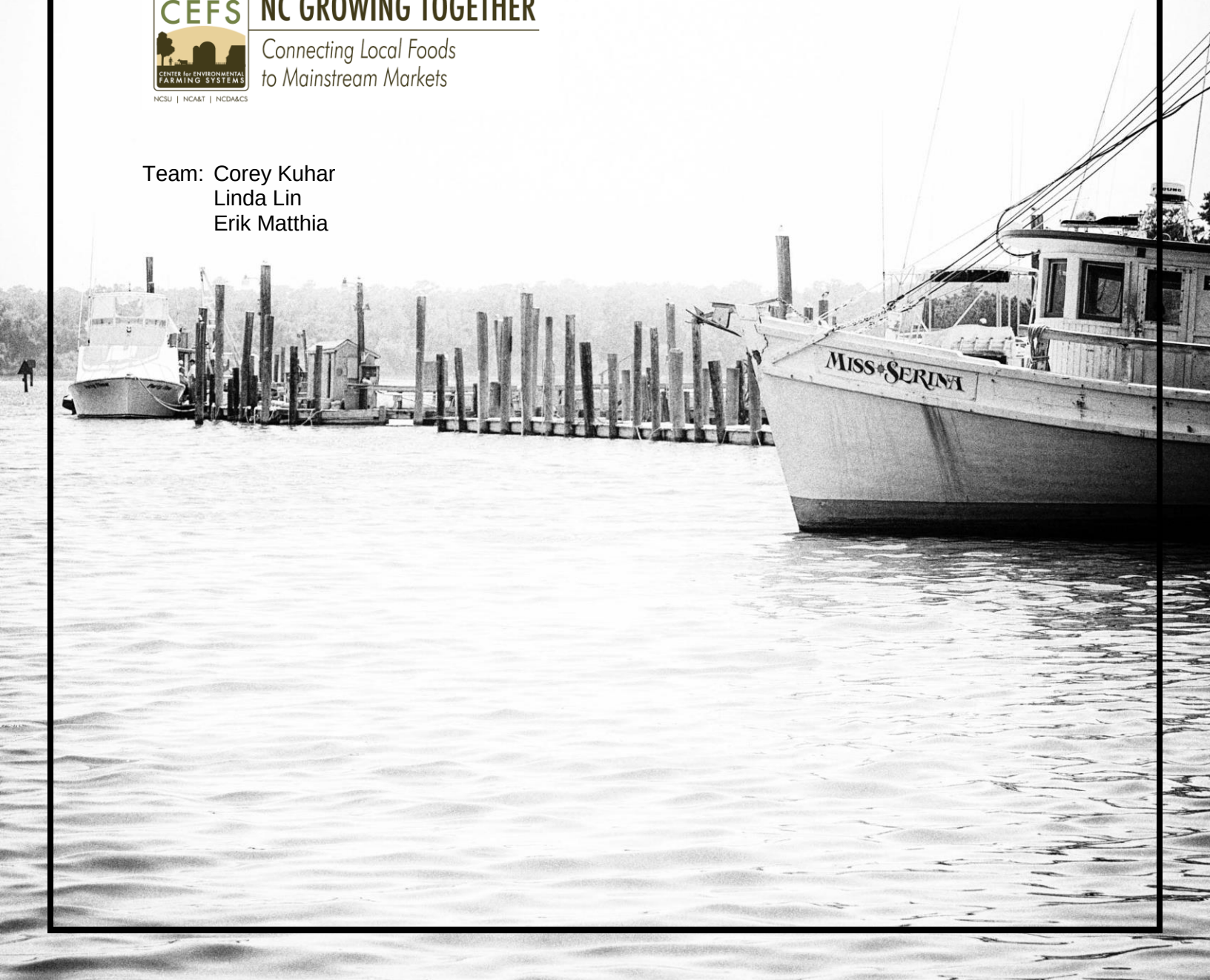

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**NOTE: This document consists of excerpts from the original report "Feasibility Study for a Shrimp Processing Line" by Corey Kuhar, Linda Lin, and Erik Matthia. Some text and tables have removed or modified to eliminate the inclusion of proprietary information.**

## A. Executive Summary

This study was conducted by students of North Carolina State University's Supply Chain Resource Cooperative for the North Carolina Growing Together project, a 5-year (2013-2017) funded initiative to connect small/mid-scale "local" producers to "mainstream" (larger-scale) grocery and food service markets. Infrastructure such as processing facilities are a key link in creating cross-scale collaboration to bring raw product to market. This study evaluates the viability of a shrimp peeling and deveining line installed at an existing seafood processing company. In this report, we refer to this entity as the "processor".

Currently, North Carolina shrimp fishers harvest about 5 million lbs. of shrimp per year off of the eastern coast of North Carolina. Most of this shrimp is transported to large processing facilities in the U.S. Gulf Region because there is no robust and automated shrimp processing capacity located within North Carolina borders. This leads to the following concerns:

- Supply chain inefficiencies due to increased transportation costs.
- Quality concerns due to preservatives that must be used to maintain shrimp freshness during the prolonged transportation and processing cycle. In addition, high-quality NC shrimp may be mixed with imported shrimp and thus the value of the NC shrimp is diminished.
- Loss of opportunity to create jobs within North Carolina.

In addition, the viability of shrimp fishing in NC has decreased in recent years due to pricing pressure created by shrimp imported from countries such as India, Thailand, and Indonesia. Due to lower cost of labor, taxes, and regulations in these countries, NC shrimpers are forced to lower their selling prices and decrease their profit margins as a result.

Previous studies have found that availability of shrimp processing capacity in NC could create new efficiencies that increase the viability of shrimp fishing in NC.

Our project involves a feasibility study for adding a shrimp peeling and deveining line to an existing processing operation at the following annual throughput levels: 50,000 lbs, 100,000 lbs, and 200,000 lbs, 803,420 lbs[1], 1,339,034 lbs and 2,678,068 lbs.

The study also considers two different business models: (1) Option 1: buying the raw product and processing and selling the finished product or (2) Option 2: processing shrimp for a fee as a service.

Our analysis focuses on three distinct areas: (1) the market, (2) the technology required, and (3) the financial costs and benefits to the processor.

[1] These throughput levels are based on 15%, 25% and 50% of 5-year average (YR 2010-2014) of NC shrimp landings (5,356,37 lbs) as recorded by NCDENR.

Since a feasibility study considers future events and opportunities, certain assumptions must be made to allow for detailed analysis. In particular, our team made the following assumptions:

- The processor will be able to generate a 15% profit margin with both Option 1 and Option 2.
- The processor will procure shrimp at the prices listed in the financial analysis section.
- The processor will sell all shrimp processed before it expires.
- An act of God or natural disaster will not interfere with the processor's regular business operations or impact the availability of NC shrimp.
- The shrimp that the processor procures will already be headless. Thus, the processor will not be required to remove the heads of the shrimp as part of the process.

For our financial analysis, we use the discounted cash flow valuation method. This method allows future cash flow projections that are discounted by a discount rate to account for uncertainty and risk. The specific tools that we use are described below:

- Net Present Value (NPV): A positive NPV indicates future financial benefits to the firm.
- Internal Rate of Return (IRR): The higher the IRR, the more benefit is realized.
- Profitability Index: A PI of more than 1 implies that the value earned by the investment is greater than the investment itself.

Our analysis shows that, based on the assumptions stated above, the project has profit potential. The NPV is positive, the IRR is high, and the PI is greater than 1 for all throughput levels and for both business models that we investigate.

In summary, the project passes the initial financial viability check. However, our team strongly recommends that further research should be conducted before proceeding with this investment. Specifically, two areas of consideration are outside of the scope of this project but should be investigated:

1. Consideration of the impact that the new shrimp processing line will have on other operations. For example, there is a possibility that the new processing capacity will affect sales of unprocessed shrimp as customers replace their unprocessed shrimp with processed shrimp.

2. Develop a better understanding of the market and possible distribution strategies. Further research is required to define the target market, acceptable prices, potential demand, and the optimal distribution strategy based on the target market. We recommend customer segmentation studies, price sensitivity analysis, and an analysis of distribution channels as they apply to these new markets.

If the aforementioned analysis tools show potential for market demand and minimal impact on existing operations, we recommend proceeding with investment in the shrimp peeling and deveining line.

## B. Introduction

For the third year in a row, the National Restaurant Association's annual survey of chefs placed "locally sourced meats and seafood" as the #1 Top Food Trend in the U.S. North Carolina fishermen are in a good position to take advantage of this trend, as the NC coast is home to numerous fish species that could be retained within the state for sale to consumers. Shrimp, in particular, present an appealing prospect because of their popularity among consumers. Shrimp is the most popular seafood in the U.S., representing over 25 percent of the nation's annual per capita seafood consumption. The missing piece of the supply chain that links NC shrimpers to NC consumers is processing: there are no automated shrimp processing (peeling, deveining, packing, freezing) facilities within the state. As a result, NC shrimpers ship this perishable product to out of state processors, and the value-add that results from processing is captured by these out-of-state entities. The majority of these out-of-state processors are located in the Gulf region, and they process shrimp on a very large scale. It's not uncommon for NC shrimp to be mixed in with Gulf region shrimp, so the origin of the processed shrimp shipped back to NC can be questionable.

With ample storage and freezing capacity, a processor is in prime position to capitalize on this missing link in the infrastructure and capture new markets, as these are two critical segments to any shrimp processing line. The critical piece to the puzzle is the shrimp peeling and deveining machinery. Currently, there are no medium to large sized processors with mechanized processing capabilities in North Carolina. A processor in this position would have the opportunity to become a leading provider of chemical-free, fresh caught, locally harvested NC shrimp to NC consumers. This processing line would support the NC shrimp fishing industry by creating a sustainable operation and new job opportunities in the community.

## C. Project Description, Scope, and Methodology

### C.1. Description and Scope

The scope of this project is to examine the business case for investment and operation of a shrimp processing operation for a seafood processor at an existing facility. In particular, our study is concentrated on generating a detailed feasibility study for adding a shrimp peeling and deveining line to a company's existing operations. This feasibility study considers the following:

1. Six different throughput levels: 50,000 lbs, 100,000 lbs, and 200,000 lbs, 803,420 lbs, 1,339,034 lbs and 2,678,068 lbs of shrimp annually. (The latter three volumes are based on 15%, 25% and 50% of 5-year average (YR 2010-2014) of NC shrimp landings (5,356,37 lbs) as recorded by NCDENR).

2. Two types of operation:

    a. Buying the raw product and processing and selling the finished product as outlined in Figure 1 below; and

    b. Processing the product for a fee as outlined in Figure 2 below. Note that Option 2 does not require any shrimp procurement.

Figure 1
Buying the raw product and processing and selling the finished product

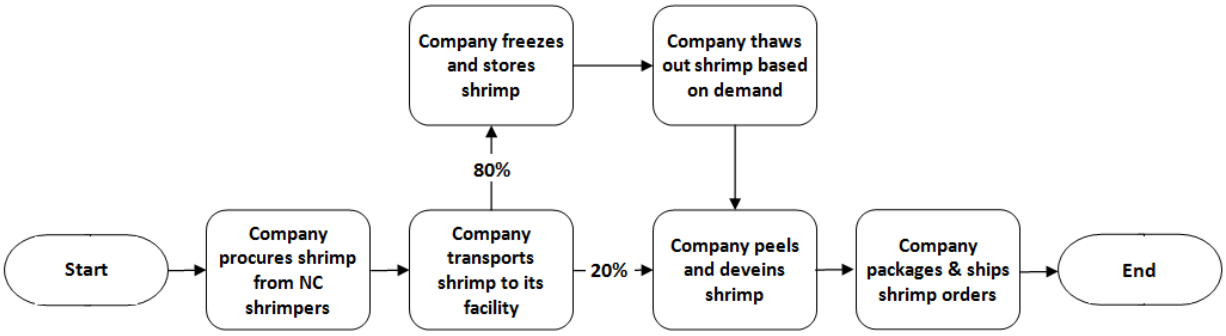



Figure 2
Processing the product for a fee


Given the scope of the project, our study assumes the following:

1. Shrimp processing includes the following: (a) peeling, (b) deveining, (c) packing, and/or (d) freezing.

2. The study only considers wild caught shrimp by NC licensed fishermen as the source of shrimp supply and did not consider farm-raised shrimp as a source of supply.

3. With respect to the acquisition of the shrimp processing equipment, the team considers both equipment purchase and leasing options based on a vendor's offering.

4. The feasibility study does not consider the following:

    - Corporate capital expenditure and/or investment thresholds
    - Further support of the processor’s operations beyond the scope of project
    - Feasibility study for shrimp processing facility in another state or country
    - Analysis of any processes besides shrimp processing
    - Analysis of impact on a processor’s other business units
    - Analysis of impact on the national seafood industry
    - Competitive implications of the new facility

## C.2. Methodology

To better understand the shrimp processing industry, our research approach centered around three distinct areas: market analysis, technology analysis and financial analysis. Basic market analysis is essential to understanding the cost of raw shrimp input and potential profit margins in value-add activities. Market research included supply and demand for shrimp, shrimp landing patterns in NC, ex-vessel prices of shrimp landings in NC, major participants in the shrimp industry and potential customer segments.

Technology analysis is necessary to determine the capital and operating costs involved in the proposed shrimp processing operation. Aspects of technology research included determining the steps in a shrimp processing operation, determining the types of equipment needed, locating and evaluating shrimp processing equipment vendors and obtaining quotes on equipment from those vendor(s) determined to be a potential fit.

The last area of research is the financial and profitability analysis. Our study uses a discounted cash flow analysis to evaluate the profitability of each of the two previously mentioned business models.

# D. Industry and Market Research and Analysis

The U.S. shrimp processing industry has been met with some economic challenges. Crucial to the feasibility study is an understanding of these challenges, their potential impact on the industry and the implications for a seafood processor in its consideration to add a shrimp processing line to its existing operations. In this section, we examine the literature on (1) current trends in the shrimp processing industry; (2) the impact on the pricing of shrimp and potential margins in value-added activities along the shrimp processing chain; and (3) some of the industry participants.

## D.1. Recent Trends in the Shrimp Processing Industry

***Competition from Imports***

Much of the literature on shrimp fishery and shrimp processing industries have cited imports as a major factor in the changes and challenges that have occurred over the course of the last several decades. According to W. Keithly and P. Poudel, the U.S. market has long dominated the shrimp imports market (2008, p.463). In general, both U.S. and Japan combined make up 50% of world shrimp imports (by value) (Keithly & Poudel, 2008, p.464; NMFS, 2004, p.30). The more alarming trend for the processing sector is the change in the composition of the imports over the last decade. Specifically, the growth in peeled products since the 1990s is described by Keithly and Poudel as "explosive" (2008, p.466). Since 1980, peeled products represent 50% of the total import base, equaling to 447 million pounds in 2002 (NMFS, 2004, p.32). There are also signs that there is a rapid increase in the import of breaded products, which have been mostly "negligible" at about 10 million pounds in 2002 (NMFS, 2004, p.32). The increasing amount of imported processed shrimp products is negatively impacting domestic shrimp processors' businesses.

***Industry Consolidation and Narrowing Margins***

The processing sector generally welcomes unprocessed shrimp imports as they represent a source of raw material in domestic processing activities (Keithly & Poudel, 2008, p.469). In fact, since 1995, the annual import usage as a percentage of total processing activities was approximately 40% (NMFS, 2004, p.37). However, the increase in imports of processed shrimp products has brought several consequences. For purposes of our study, these consequences are narrowly focused on the Southeast processing sector. First, much of the data on firms and production activity since 1980 reflects a general consolidation in the Southeast shrimp processing sector (NMFS, 2004, p.36). While the quantity of shrimp processed remains relatively stable since the mid-1980s, the number of shrimp processing firms in the South Atlantic region fell from 49 to 17 between the period of 1991 through 2001 (NMFS, 2004, p.36). In North Carolina, according to a study conducted by the North Carolina Division of Marine Fishers between 2000 and 2005, of 117 local fish houses, 39% of those firms went out of business due to pressure from cheaper imported products (Handfield and Kunjithapatham, 2009).

Second, the impact of this industry consolidation is that the economic returns are decreasing and reducing margins. According to the results of a survey conducted by the National Marine Fisheries Service, Office of Science and Technology, Fisheries Statistics Division ("NOAA") in 2012, the U.S. domestic shrimp processing sector is highly concentrated in the Gulf of Mexico or the South Atlantic, accounting for 78% of the total shrimp processed in 2012 (SSA, 2014). A brief review of the members of the American Shrimp Processors Association (ASPA) and their processing capacities reveals the economies of scale required to operate a shrimp processing establishment. Specifically, ASPA members process between 2.6 million to 52.4 million pounds of shrimp annually, with an average of 18.5 million pounds. These large economies of scale reflect a coping mechanism for narrowing margins by the shrimp processing firms (NMFS, 2004, p.38).

Moreover, in comparing the difference between the cost of raw shrimp material and the price of processed shrimp products, NOAA has found that the per-unit profitability has fallen since 1980, supporting the rationale for the consolidation experienced by the shrimp processing industry (NMFS, 2004, p.38). In fact, in an interview with Dr. David Veal, President of ASPA, he estimated that the average profit margin for current shrimp processors ranges from 1% to 2%. His experience cautions potential firms that are considering entering into the industry.

## D.2. Current Participants in the Processing Sector: American Shrimp Processors Association

The American Shrimp Processors Association (ASPA) is the premier association for shrimp processors in the United States of America. The organization advocates the sale and consumption of "Wild American Shrimp" due to its safety, traceability, and health advantages over imported and/or farm-raised shrimp.

To achieve growth in the domestic shrimp industry, the ASPA provides support for American shrimp fishers, processors, and retailers. It also provides educational tools and industry news on its website at www.americanshrimp.com.

The organization is composed of 31 shrimp processor members and 14 associate members. Below is a listing of all shrimp processor members and some key data points regarding each of those member companies.

The capacity of ASPA members ranges from approximately 2,600,000 lbs. per year to 78,600,000 lbs. per year. Table 1 below summarizes the capacity of ASPA members.

**Table 1**
**Capacity of ASPA Members**

| Shrimp Processor | State | # Employees (peak) | Facility size (sq. ft.) | Annual Capacity (lbs.) |
|---|---|---|---|---|
| Dean Blanchard Seafood | LA | 50 | 15,000 | 78,600,000 |
| Gulf Crown Seafood Company | LA | 63 | 40,000 | 52,400,000 |
| C.F. Gollott and Son | MS | 75 | 14,000 | 39,300,000 |
| Bayou Shrimp Processors | LA | 100 | 40,000 | 39,300,000 |
| JBS Packing Company | TX | 100 | 50,000 | 32,750,000 |
| Biloxi Freezing & Processing | MS | 100 | 20,000 | 32,750,000 |
| Carson & Company | AL | 120 | 80,000 | 28,820,000 |
| Paul Piazza & Son | LA | 85 | 50,000 | 26,200,000 |
| Seabrook Seafood | TX | 50 | 38,000 | 20,960,000 |
| R A Lesso Seafood | MS | 40 | 22,000 | 17,030,000 |
| **Shrimp Processor** | **State** | **# Employees (peak)** | **Facility size (sq. ft.)** | **Annual Capacity (lbs.)** |
| Gulf Island Shrimp & Seafood | LA | 100 | 15,000 | 17,030,000 |
| Dominick's Seafood | AL | 40 | 20,000 | 15,720,000 |
| Sea Pearl Seafood Company | AL | 80 | N/A | 15,720,000 |

| | | | | |
|---|---|---|---|---|
| Hi Seas of Dulac | LA | 55 | 100,000 | 14,410,000 |
| Pamlico Packing Company | NC | 24 | 20,000 | 14,410,000 |
| Gulf Pride Enterprises | MS | 55 | N/A | 13,100,000 |
| Smith & Sons Seafood | GA | 30 | 20,000 | 10,480,000 |
| Wood's Fisheries | FL | 90 | 30,000 | 7,860,000 |
| Gulf Fish | AL | 22 | 24,000 | 7,860,000 |
| Indian Ridge Shrimp Company | LA | 40 | 40,000 | 7,860,000 |
| Ocean Springs Seafood | MS | 6 | 22,000 | 5,895,000 |
| Fisherman's Reef Shrimp | TX | 50 | 15,000 | 5,240,000 |
| Tommy's Seafood | LA | 30 | 20,000 | 5,240,000 |
| Tidelands Seafood Company | LA | 14 | 11,000 | 2,882,000 |
| Al's Shrimp Company | LA | 10 | 18,000 | 2,620,000 |
| Leonard & Sons Shrimp | SC | N/A | N/A | N/A |
| Lafitte Frozen Foods | LA | 100 | 100,000 | N/A |
| Graham Shrimp Company | AL | N/A | N/A | N/A |
| David Chauvin's Seafood | LA | 40 | N/A | N/A |
| Vincent Piazza, Jr. & Sons | LA | N/A | N/A | N/A |

One note on the table above: Dean Blanchard Seafood is not an actual processor, though they are a Processor Member in the ASPA. Dean Seafood receives, sorts by size and stores shrimp overnight, but there is no peeling equipment onsite. Dean Seafood buys shrimp directly from the shrimp fishers and operates as a wholesale business that distributes shrimp to other processors along the Gulf Coast.

## D.3. Shrimp Pricing

Instrumental to a seafood processor's consideration in adding a shrimp processing line to its existing operations is an understanding of the cost of the raw shrimp material, particularly if the processor decides to operate under Option 1. Given that raw shrimp material will serve as the primary input into a shrimp processing operation, it is important to understand the factors

which affect shrimp pricings and potential operating margins based on the shrimp processing industry's experience.

***Factors which Influence Shrimp Pricing***

There are several factors which may influence shrimp dockside price (i.e. ex-vessel prices or payment received by the vessel). From a broader, market and economic perspective, these factors include volume of shrimp landings, market price, and species composition of the landings (NMFS, 2004, p.16). Like all commodities, shrimp is not immune to the economic theory of the law of supply and demand. Specifically, when the supply of shrimp is abundant and outweighs the demand, the price of shrimp falls. Given that shrimp landings vary year to year and that demand is a function of consumer preferences and disposable income, prices fluctuate accordingly.

Furthermore, as previously mentioned, the influx of imported raw shrimp and shrimp products also impacts the market prices of shrimp. For the most part, imported products force domestic shrimp fishermen and processors to sell at prices that would be either as competitive as, if not cheaper than, the imported products. In fact, according to W. Keithly and P. Poudel, "the Southeast U.S.A. deflated dockside shrimp price...closely mirrors the import price" during the 1980s, the 1990s and post 2000 (2008, p.466). The woes of deflated shrimp prices caused by imports have been the source of anti-dumping lawsuits brought on by the Southern Shrimp Alliance, a coalition of southern U.S. shrimp processors.

"Species composition" refers to the composition of the landings. The species composition along the Gulf of Mexico and the South Atlantic coast is largely divided into three types: brown, pink and white. Depending upon the region and the landings, price per pound would vary among the different species. For example, in the Gulf of Mexico, the 20-year average (during the period of 1982-2001) nominal price of brown shrimp, which accounted for 58% of the Gulf of Mexico landings, was $2.11 per pound, while white shrimp, which represented 34% of the Gulf of Mexico landings, was $2.09 (NMFS, 2005, p.17). The nominal price for pink shrimp, which made up of 8% of the landings, for the 20-year period was $2.19 (NMFS, 2005, p.17).

The other two factors that must be taken into account with respect to shrimp pricing are shrimp condition and shrimp count. Shrimp condition refers to the form of the shrimp in which it is purchased. The most common forms of shrimp are: (1) head on, shell on, (2) headless, shell on, (3) peeled and deveined, tail on, (4) peeled and deveined, tailed off. Shrimp count or shrimp size refers to the number of individual shrimp that make up 1 pound. Shrimp count generally ranges from less than 15 through 70/80. The larger the shrimp count, the higher the dockside price per pound.

Finally, it is also important to note the differences among the regional prices of shrimp. For example, the price per pound for shrimp landed in the South Atlantic region is generally higher than the price per pound of shrimp landed from the Gulf of Mexico (NMFS, 2005, p.17).

***NC Shrimp Dockside Prices***

The Division of Marine Fisheries of the North Carolina Department of Environment and Natural Resources captures statistics on recreational and commercial harvests of finfish, shellfish and crustaceans landed in North Carolina. Through the aid of the License and Statistics Division, our team obtained data on the commercial landings and ex-vessel value of shrimp by species, size and condition for the period 2010 to 2014. Given that head on, shell on and headless, shell on shrimp are the primary forms of input for the shrimp processing operation, these forms of dockside prices are the central focus of our feasibility study. Table 2 below is a summary of the dockside vessel prices of the NC shrimp landings over the period of 2010-2014.

**Table 2**
**Summary of Shrimp Ex-Vessel Prices**
**by Size and Condition for 2010-2014**

**Source**: NC Dept. of Environmental and Natural Resources, Division of Marine Fisheries
***Denotes unavailable data

| Year | Size | Heads On Price/LB | Heads Off Price/LB |
|---|---|---|---|
| **2010** | 80+ | $0.97 | $0.71 |
| | 0/15 | $2.72 | $4.49 |
| | 16/20 | $2.26 | $4.38 |
| | 21/25 | $1.79 | $3.82 |
| | 26/30 | $1.74 | $3.36 |
| | 31/35 | $1.50 | $2.44 |
| | 36/40 | $1.27 | $2.03 |
| | 41/45 | $1.34 | $1.70 |
| | 46/50 | $1.06 | $1.59 |
| | 51/55 | $0.98 | $1.28 |
| | 56/60 | $1.00 | $1.15 |
| | 60/70 | $1.12 | $1.03 |
| | 70/80 | $0.62 | $0.80 |
| | MIXED | $1.85 | $2.05 |

| Year | Size | Heads On Price/LB | Heads Off Price/LB |
|---|---|---|---|
| **2011** | 80+ | $1.04 | *** |
| | 0/15 | $3.11 | $6.29 |
| | 16/20 | $2.33 | $4.44 |
| | 21/25 | $2.12 | $4.26 |
| | 26/30 | $1.91 | $3.64 |
| | 31/35 | $1.67 | $2.79 |
| | 36/40 | $1.43 | $2.48 |
| | 41/45 | $1.21 | $1.96 |
| | 46/50 | $1.15 | $1.86 |
| | 51/55 | $0.76 | $1.28 |
| | 56/60 | $0.85 | $1.46 |
| | 60/70 | $0.77 | $1.01 |
| | 70/80 | $0.85 | $0.93 |
| | MIXED | $2.30 | $3.83 |
| **2012** | 80+ | $0.74 | *** |
| | 0/15 | *** | *** |
| | 0/15 | $3.01 | $5.04 |
| | 16/20 | $2.54 | $4.49 |
| | 21/25 | $2.31 | $4.11 |
| | 26/30 | $1.90 | $3.75 |
| | 31/35 | $1.66 | $2.98 |
| | 36/40 | $1.45 | $2.51 |
| | 41/45 | $1.25 | $1.99 |
| | 46/50 | $1.52 | $1.90 |
| | 51/55 | $1.10 | $1.45 |
| | 56/60 | $1.03 | $1.50 |
| | 60/70 | $0.89 | $1.14 |
| | 70/80 | $0.64 | $0.64 |
| | MIXED | $2.37 | $3.20 |
| **2013** | 80+ | $0.76 | $1.29 |
| | 0/15 | $3.76 | $7.14 |
| | 16/20 | $3.14 | $6.39 |
| | 21/25 | $2.63 | $5.77 |
| | 26/30 | $2.34 | $5.02 |
| | 31/35 | $2.04 | $4.27 |
| | 36/40 | $1.72 | $3.53 |
| | 41/45 | $1.42 | $2.80 |
| | 46/50 | $1.37 | $2.79 |
| | 51/55 | $1.15 | $1.98 |
| | 56/60 | $1.14 | $2.10 |
| | 60/70 | $0.95 | $1.72 |
| | 70/80 | $0.85 | $1.21 |
| | MIXED | $3.07 | $3.65 |

| Year | Size | Heads On Price/LB | Heads Off Price/LB |
|---|---|---|---|
| **2014** | 80+ | $0.73 | $1.54 |
| | 0/15 | $3.42 | $4.62 |
| | 16/20 | $3.57 | $7.01 |
| | 21/25 | $3.03 | $6.61 |
| | 26/30 | $2.62 | $5.85 |
| | 31/35 | $2.26 | $4.81 |
| | 36/40 | $2.05 | $4.29 |
| | 41/45 | $1.76 | $3.43 |
| | 46/50 | $1.98 | $3.57 |
| | 51/55 | $1.63 | $2.39 |
| | 56/60 | $1.55 | $2.48 |
| | 60/70 | $1.37 | $1.88 |
| | 70/80 | $0.90 | $2.02 |
| | MIXED | $3.10 | $2.46 |

## D.4. Shrimp Demand

Despite the economic woes experienced by the domestic shrimp processing industry due to competition from imported products, there are opportunities. We will now review the specific factors that may influence shrimp demand as well as certain characteristics regarding consumer preferences.

***Influencing Factors***

Several key factors influence the demand for shrimp, such as the size of the population, exchange rates, and disposable income. According to the IBIS World Industry Report from 2014, “demand for all [seafood] product segments is projected to increase during the next five years on the back of population growth, recovering disposable incomes and strong export demand” (Harris, 2014).

In recent years, health awareness among consumers has increased, causing a positive impact on the seafood industry in general. Several research studies have shown the advantages of fish fats, proteins, and omega-3 oils as opposed to red meats (Harris, 2014).

Americans view seafood as a premium food product. This is an advantage during times of prosperity and economic growth, but can just as easily become a disadvantage during economic stagnation or an economic downturn. As the following graph shows, per capita seafood consumption decreased sharply after the 2009 economic crisis and is now on a slow rise again due to overall economic improvement (Harris, 2014).

**Figure 3**


***U.S. Shrimp Demand***

The average American consumes around 4.1 lbs. of shrimp per year (American Shrimp Processors Association, 2015), ranking it number one in volume of all types of seafood consumed in the U.S. In fact, according to Consumer Reports, "Americans eat about three times more shrimp than we did 35 years ago."

Between 92-94% of the American demand for shrimp is satisfied through imports. The largest exporters to the U.S. are India, Thailand, and Indonesia. (Dr. David Veal). In 2014, India accounted for 18.6% of total U.S. shrimp imports. About 46% of Indian shrimp was already peeled when it was imported. The supply of peeled shrimp from Indonesia and Ecuador also increased from 2013 (FAO GLOBEFISH, 2015).

***NC Consumer Preferences***

Though research on consumer preferences was not part of the project scope, our interview with Barry Nash, Seafood Technology & Marketing Specialist with NC Sea Grant, revealed some helpful information on the preferences of NC seafood consumers.

Mr. Nash has conducted research in the area of NC consumer preferences and has discovered the following:

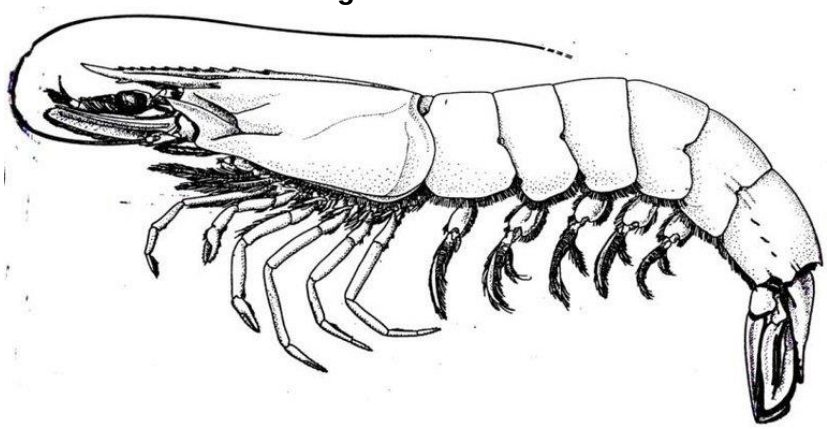
- NC consumers prefer local, wild-caught seafood due to a perception of higher food safety compared to farm-raised seafood.
- NC consumers prefer seafood that is easy and quick to prepare. In the example of shrimp, they prefer a 1 lb. package in IQF or P&D format.
- Restaurants prefer 2-5 lbs. blocks of shrimp that are ready to cook.

According to Mr. Nash, there is a market for peeled & deveined shrimp in NC, but more research is necessary to determine the exact size and composition of that market.

## E. Technology Research and Analysis

This section details the technology required for a shrimp processing operation. As these technology needs can only be determined by understanding the steps in shrimp processing, we will begin with a brief review of the steps involved in shrimp processing.

**Figure 4**



Source: (Typical Shrimp Depiction)

A study conducted by Mississippi State University on the costs of processing and hauling freshwater shrimp in Mississippi has provided a very comprehensive overview of the steps in shrimp processing. As part of their study, W. Waits and J. Dillard provided a detail list of the capital investment requirements in building a shrimp processing operation from the ground up. While the study relates to the processing of freshwater shrimp, the steps are nevertheless the same. First, let's review the steps in a shrimp processing operation. Figure 5 below shows the phases of a shrimp processing operation.

**Figure 5**
**Phases of a Shrimp Processing Operation**


(Waits and Dillard, 1987)

1. **Receiving**: shrimp is delivered to and received by the shrimp processor plant in wooden crates aboard refrigerated trucks. Shrimp is removed by hand from the crates into an automated wash receiving tank. Shrimp is washed and transferred to a conveyor belt to the breaking table.

2. **Breaking**: shrimp head is removed. Removal of the head is most often a manual process that can be performed either by the shrimp fisher/farmer or by the processor that procures the shrimp.

3. **Grading**: shrimp is sorted according to a preset size category and deposited down side shoots into perforated plastic baskets.

4. **Peeling & Deveining**: legs, shell and vein are removed by using automated machinery.

5. **Packing**: separated and sized shrimp are weighted according to size and packaged in either 1 pound bags or 5 pound boxes in accordance to end customers' preferences. Packaged shrimp product are placed onto a master carton and loaded onto freezer carts. Packaging is generally done by hand labor.

6. **Blast Freezing**: processed shrimp is kept overnight in a Freon-activated blast freezer, where as many as 22,000 lbs of shrimp can be exposed to -40F temperature. Freezing can occur at different points of the processing cycle to help reduce spoilage. For example, if the shrimp will undergo a long journey to arrive at the processor's plant, it makes sense to freeze the shrimp beforehand. On the other hand, in order to meet demand during off-season, shrimp is often bought, frozen, and stored prior to processing. Frozen shrimp is then thawed as demand required during the off-season.

7. **Glazing**: frozen shrimp is removed from the blast freezer and coated with a thin layer of water, which is immediately turned into a moisture sealing gaze.

8. **Storing**: Frozen and glazed shrimp is stored for temporary or long term storage to prevent premature thawing.

(Waits and Dillard, 1987)

## E.1. Capital Investment Requirements

Given the aforementioned steps in shrimp processing, we can now determine the equipment requirements. Table 3 below summarizes the equipment needed at each stage of processing.

**Table 3**
**Summary of Equipment Requirements at Each Stage of Shrimp Processing**
Source: Waits and Dillard, 1987

| Process Step | Labor/Equipment Requirement |
|---|---|
| **Receiving** | • Forklift for crate transfer from trucks to loading docks<br>• Automated wash receiving tank |
| **Breaking** | • "32 experienced head breakers could break on average 1,500 lbs of shrimp per hour" (p.4)<br>• Flume breaking table |
| **Grading** | • Grading machine or sorters |
| **Peeling & Deveining** | • Peeling & deveining equipment |
| **Packing** | • Packing tables<br>• Electronic scales<br>• Packing boxes<br>• Packing cartons<br>• Freezer carts |
| **Blast Freezing** | • Blast freezer |
| **Glazing** | • Glazer (includes conveyor belt, nozzle and strapping system) |
| **Storage** | • Storage freezer |

**For purposes of our study, it is important to note that the initial start-up operation is to simply add a shrimp peeling and deveining line into an existing operation.** As a result, the capital investment requirement is reduced to acquiring peeling and deveining machine(s). Additionally, since it is assumed that only headless, shell-on shrimp will be procured and sorted in accordance to shrimp count, the breaking and grading phases of the processing operation are eliminated as well as any associated equipment requirements. Furthermore, since, for purposes of this study, it is assumed there is already a seafood processing operation in place, then the company has already invested in the equipment for packaging, freezer, and storing. In consequence, our team will provide recommendations for the procurement of the peeling and deveining equipment in the following section.

## E.2. Overview of Equipment Vendors

Initial research into the shrimp processing equipment vendor market revealed five (5) potential manufacturers: Tomra, Innotec-Systems, Prawnto Shrimp Machine Co. of Texas, Laitram Machinery, and Gregor Jonsson. We reached out to the sales department of each company in an effort to gather information used to determine which vendor(s) were a fit .

Tomra is a leader in sensor-based sorting machines. However, it was determined that they do not offer peeling and deveining machines, so we eliminated them from consideration.

Innotec-Systems is a company based in Holland that specializes in food processing lines. They offer comprehensive shrimp processing lines, however their machines do not have the ability to peel and devein, so we eliminated them from consideration.

Prawnto Shrimp Machine Co. of Texas sells shrimp processing machines that cut and devein, however they cannot peel. For this reason we determined that they are not a good fit ..

Laitram Machinery is a leading manufacturer of seafood processing equipment based in Louisiana. They offer shrimp processing lines that are capable of peeling and deveining. Further conversations with their sales department revealed that their machines are designed to process large volumes of shrimp, and they recommended a minimum of 4M lbs of shrimp processed annually to achieve a return on investment. Since the highest throughput level we looked at for this study was approximately 2.6M lbs, they were eliminated from consideration.

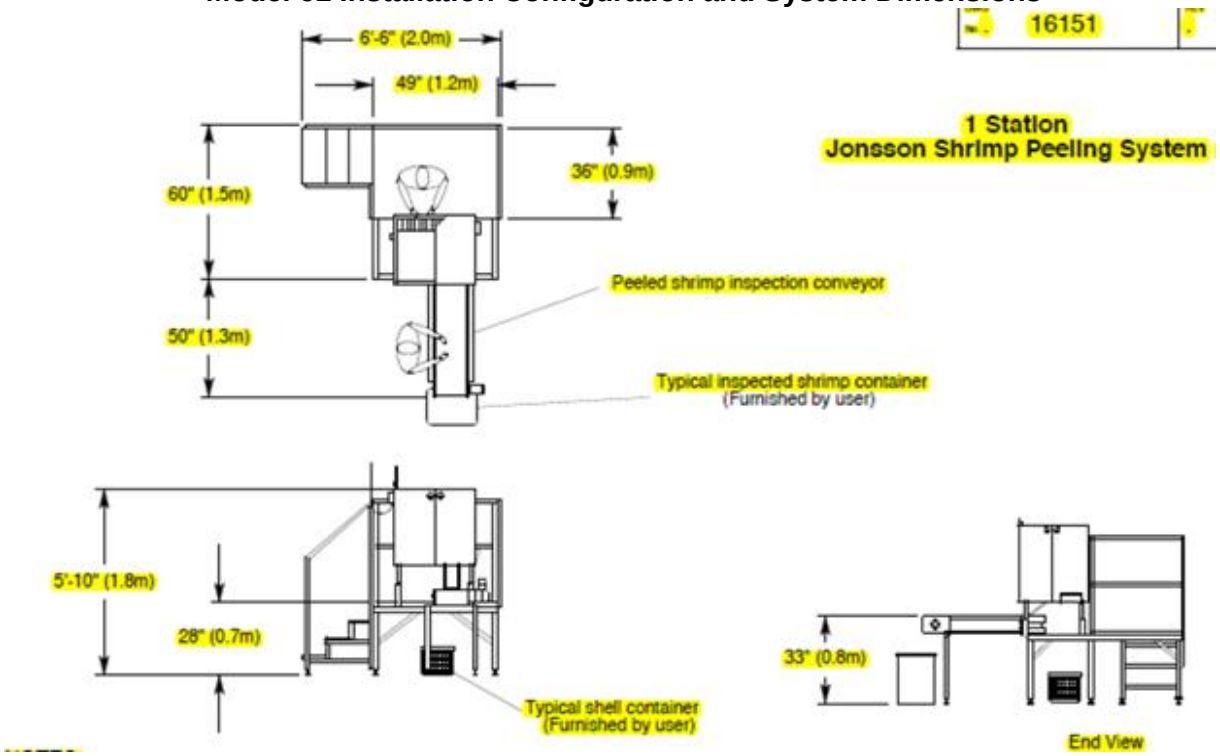
Gregor Jonsson is located in Illinois and specializes in shrimp processing machinery. Their sales staff was extremely helpful and provided information and literature in response to our initial inquiry. They offer shrimp peeling and deveining machines and appear to be a great fit for purposes of this study. We will discuss their equipment options further in the following section.

## E.3. Gregor Jonsson, Inc.

Gregor Jonsson offers a variety of shrimp peeling systems. Based on the purposes of this study, Gregor Jonsson recommended the Model 61 system. The Model 61 system can peel in the following styles: tail-on butterfly, tail-on round, E-Z peel, tail-on gradual cut, completely peeled and deveined, and peeled and deveined split. A Model 61 single machine system can

process 280 lbs of 16/20 count shrimp per hour, 220 lbs of 21/25 count shrimp per hour, and 180 lbs of 26/30 count shrimp per hour, averaging across three shrimp counts to 227 lbs per hour. The machine requires two operators, one at the shrimp peeling station and the other at the peeled shrimp inspection conveyor. Figure 6 below is a blueprint of the machine and provides the installation configuration and system dimensions.

**Figure 6**
**Model 61 Installation Configuration and System Dimensions**




All machines from Gregor Jonsson meet the USDA standards for food handling and are only available for lease in the U.S. Gregor Jonsson provided us a quote on the Model 61 one-machine system, which was valid for 30 days. The quote consisted of an initial charge of $4,070.00 with a monthly lease cost of $1,420.00. Shipping could only be estimated, but the freight charges are passed along from Gregor Jonsson and would range from $500.00-$800.00. The machine could be shipped within 10 days of receiving the initial payment and signed lease.

Some of the services provided in the service level agreement include:

- Unlimited phone/video/Skype/email support
- Hands-on training at the processor's facility by a Gregor Jonsson rep
- Maintenance schedule and spare parts included
- System replacement with a new machine after 5 years at no additional charge
- No minimum lease term

Outside of a 1-year warranty on the motor, Gregor Jonsson machines do not come with a warranty. Per the assurance of the Gregor Jonsson sales representative, as long as the customer follows the maintenance schedule and replaces the parts (such as the blade, which is included) as recommended, they will rarely experience an issue. In the event of an issue that

cannot be resolved via phone/video/etc., a Gregor Jonsson technician needs to physically fix the machine. In this case, the customer is responsible for the cost of repair. Charges include $60 per hour for travel time, $75 per hour for labor, overnight expenses of $150 per night, ½ of the airfare cost, all service transportation costs (rental car, etc.), and local mileage reimbursement.

Based on the shrimp sizes 16/20, 21/25, and 26/30, and assuming one 8-hour shift per day, five days per week, the Model 61 single-machine system is capable of processing 471,000 lbs of shrimp per year. As a result, the Model 61 single-machine system meets the lower three (3) throughput levels (50K, 100K, 200K) being investigated in our study, but does not meet the upper three (3) throughput levels (803K, 1.34M, 2.68M). For the upper three throughput levels, additional machines are required. Since Gregor Jonsson machines are modular, it is possible to add additional machines as demand increases. The machines can also be configured in different manners, so it is possible to have a ratio of machines to conveyor belts that is greater than 1:1.

For each of the upper three throughput levels, Gregor Jonsson recommends the following machine configurations:

- 803K lbs throughput level: Model 61 two-machine system
- 1.34M lbs throughput level: Model 61 three-machine system
- 2.68M lbs throughput level: Model 61 six-machine system

Table 4 below summarizes the installation configuration and the quotes received for each throughput level.

**Table 4**
**Gregor Jonsson Quotes**

| | Throughput Level | Initial Charge | Mo. Lease | Freight |
|---|---|---|---|---|
| 1 Machine System | 50,000 lbs<br>100,000 lbs<br>200,000 lbs | $ 4,070.00 | $1,420.00 | $ 650.00 |
| 2 Machine System | 803,420 lbs | $ 7,140.00 | $2,570.00 | $1,300.00 |
| 3 Machine System | 1,339,034 lbs | $11,350.00 | $4,020.00 | $1,950.00 |
| 6 Machine System | 2,678,068 lbs | $20,540.00 | $7,460.00 | $3,900.00 |

## E.4. Mobilization, Start-Up and Transportation Recommendations

This section from the original report was removed due to its proprietary nature.

# F. Financial and Profitability Analysis

A major component of our feasibility study is to determine whether the investment in peeling and deveining machine(s) would yield a profitable shrimp processing line to an existing

seafood processing operation. As previously stated, the two business scenarios which our study is exploring are:

- **Option 1**: buying raw shrimp material, processing the same and selling processed shrimp products; and
- **Option 2**: processing raw shrimp material for customers for a fee.

In this section, we will expound on our research methodology, provide an overview of the underlying assumptions regarding our calculations, and provide the financial results of our analysis for each of the aforementioned options.

## F.1. Methodology - Discounted Cash Flow Analysis

In estimating the attractiveness of an investment, discounted cash flow (DCF) analysis is a widely-used valuation method. Under this valuation method, projections about the future cash inflows generated by sales revenue and future cash outflows generated by the cost of investing in the project are used to determine the future free cash flows of the project. Free cash flows, in this instance, is free cash that is not needed for working capital or fixed asset investments and therefore, is cash not needed to support current or future operations. Following the determination of future free cash, such future cash flows are then discounted, usually at the weighted average cost of capital, to arrive a present value.

To evaluate the project's future cash flows, we employ the aid of three decision-making tools to determine whether to accept or reject the project: net present value (NPV), internal rate of return (IRR), and profitability index (PI). By definition, net present value is the difference between the sum of the present values of the project's future cash flows and the costs of the project. If the NPV is greater than zero, NPV represents an increase in the value of the firm from the project. Therefore, the project can be accepted. If the NPV is less than zero, NPV represents a decrease in the value of the firm from the project and should be rejected.

Internal rate of return is an annualized effective compounded return rate. It is a rate that is "intrinsic to the project" and does not "depend on [the interest rate prevailing in the capital market] except the cash flows of the project" (Ross, Westerfield, and Jaffe, 2013). In evaluating the merits of a project, if the IRR is greater than the discount rate, accept the project. If the IRR is less than the discount rate, reject the project.

By definition, profitability index (PI) is the ratio of the present value of the future expected cash flows after initial investment divided by the amount of the initial investment. It is a ratio which tells you the amount of benefits generated per dollar invested. When the PI is greater than 1, accept the project. When the PI is less than 1, reject the project.

DCF analysis is a powerful tool which allows one to estimate the money one would receive from an investment while taking into account the time value of money. Moreover, "the concept of DCF valuation is based on the principle that the value of a business or asset is inherently based on its ability to generate cash flows for the providers of capital. To that extent, the DCF relies more on the fundamental expectations of the business than on public market factors or historical precedents..." (Macabacus, 2015). As a result, DCF is an ideal valuation method for our feasibility study as the project relates to the launching of a new shrimp product in a market that is not yet well-defined. The execution by the processor based on all of its available resources would be crucial to the success of this project.

For purposes of our study, it should be noted that the time horizon of our project is restricted to five years. With respect to the discount rate, we analyzed the project cash flows at a range of discount rates, ranging from 2% to 26%, increasing at 2% increments. Lastly, we analyzed Options 1 and 2 as mutually exclusive projects.

## F.2. Analysis

As previously mentioned, DCF analysis is predicated on estimations about future cash flows. More specifically, only relevant cash flows or cash flows incremental to the project are considered. Incremental cash inflows and outflows represent the changes in the firm's cash flows that occur as a direct consequence of accepting the project (Ross, Westerfield, and Jaffe, 2013). For that reason, this section examines the specific cash inflows and outflows that are incremental to the project, while highlighting the assumptions of our calculations.

Prior to examining our projections about future cash inflows and outflows, some premises must be noted. Per the project scope, our analysis investigates six throughput levels: 50,000 lbs, 100,000 lbs, 200,000 lbs, 803,420 lbs, 1,339,034 lbs and 2,678,068 lbs of processed shrimp sold annually. We incorporated these throughput levels as the number of pounds of *processed* shrimp product the processor will be selling.

We begin by estimating the incremental future cash inflows as a result of accepting the shrimp peeling and deveining line.

***Projections about Future Cash Inflows***

Cash inflows are generated from the revenue earned as a result of the sale of shrimp. We determine the sales revenue by estimating that year to year unit sales would equate to our desired throughput level. For purposes of our calculations, each throughput level is investigated and analyzed individually.

For the selling price per pound of shrimp, we established a 15% profit margin as the target. Therefore, the selling price is comprised of said margin and the operating cost per pound. Table 5 below provides a summary of the projected cash inflows for Options 1 and 2.

**Table 5**
**Summary of Sales Revenue for Options 1 & 2**
**(at 15% Profit Margin)**

| | lbs of shrimp sold | **50,000** | **100,000** | **200,000** | **803,420** | **1,339,034** | **2,678,068** |
|---|---|---|---|---|---|---|---|
| **Option 1** | Selling price per lb | $10.50 | $10.63 | $10.29 | $10.09 | $10.11 | $10.08 |
| | **Sales Revenue** | **$524,812.52** | **$1,063,193.28** | **$2,057,601.86** | **$8,107,319.24** | **$13,544,032.92** | **$26,990,824.92** |
| **Option 2** | Selling price per lb | $0.94 | $1.07 | $0.73 | $0.53 | $0.55 | $0.52 |
| | **Sales Revenue** | **$46,752.90** | **$46,752.90** | **$46,752.90** | **$425,665.90** | **$741,270.97** | **$741,270.97** |

As outlined in our Project Scope Document, our study does not take into account the impact of a shrimp peeling and deveining operation on a processor's other business units or operations. As a result, our calculation of cash inflows does not take into account any side effects such as revenue erosion or revenue generated from the synergy of adding this new operation to existing operations. Furthermore, since our study does not take into account the competitive implications of the new shrimp peeling and deveining operation, our financial model does not incorporate an annual growth rate of the unit sales of shrimp.

***Projections about Future Cash Outflows***

Cash outflows are generated from the costs of investing in the project. In order to gain a comprehensive understanding of the costs associated with shrimp processing operation, our team reviewed available literature on the cost of operating a shrimp processing facility. Table 6 reveals the different costs common across our literature review.

**Table 6**
**Costs Associated with Operating Shrimp Processing Facility**
Source: Waits and Dillard, 1987, p.7-9.

**CAPITAL INVESTMENTS**

- Land
- Building
- Breaking equipment
- Grading equipment
- Weighing & packing equipment
- Blast freezing equipment
- Glazing & strapping equipment
- Icemaking equipment
- Forklift
- Storage freezer
- Truck
- Office Equipment
- Miscellaneous: minor items of equipment, licenses, permits, and hookup for utilities

**CATEGORIES OF COST OF OWNERSHIP**

- Equipment and building depreciation
- Insurance
- Interest on investment
- Taxes (county, municipal, state, and federal)

**OPERATING COSTS**

- Labor
- Utilities: electricity, water, telephone
- Waste disposal: charges for hauling away solid wastes collected daily in dumpsters and the monthly rent on dumpsters
- Interest on operating capital
- Repairs and maintenance
- Supplies and services: packaging (boxes, cartons, and straps)transporting (wooden pallets, collecting baskets), wash down equipment (hoses, nozzles)j, & miscellaneous (brooms, shovels, hand brushes, cleanser, chlorine, paper towels, rakes, and general overhead such as postage)
- Truck: labor, electricity, water, repairs, fuel and supplies (wooden crates)

Given the two business scenarios that our study is undertaking and the fact that a processor would simply be adding a peeling and deveining operation to its existing business, we have determined three core cost components: material cost, operating cost and one-time capital investment cost. Some clarification should be made between Options 1 and 2. Since the processor is only processing for a fee under Option 2, the core components of cost associated with that scenario are operating cost and one-time capital investment cost. We will now consider each of these core components in detail, beginning with the material cost.

1. *Material Cost*

One element of the material cost is the procurement cost of raw shrimp material. In figuring such cost, we used a weighted average based on the percentage breakdown of the three types of shrimp count: 16/20 (50%), 21/25 (15%), and 26/30 (35%). The weighted average cost of raw shrimp material is $6.49 per pound.

Another element of the material cost is the number of pounds of shrimp that has to be procured, which is a function of the yield at various stages of processing. Our research on shrimp yield revealed that the yields of meat from whole shrimp range from 20-40%, with factors such as shrimp size, condition and processing machines accounting for the differences within the range (FAO, 2001). On average, the head of the shrimp constitutes approximately 37% of the whole shrimp weight while the legs and shell constitute another 11-13% of the whole shrimp weight (E. Willis, personal communication, July 7, 2015). For purposes of our calculation, it was determined that an 18.22% yield loss from headless, shell-on form to peeled and deveined form is a reasonable percentage within the range observed in our research.

Based on the yield loss, the processor will need to procure a number of pounds of shrimp that is greater than the actual throughput level. Table 7 below summarizes the pounds of procured shrimp required for each throughput.

**Table 7**
**Pounds of Shrimp to Procure under Option 1**

| **Throughput Level (lbs)** | **50,000** | **100,000** | **200,000** | **803,420** | **1,339,034** | **2,678,068** |
|---|---|---|---|---|---|---|
| **lbs of shrimp to procure** | 61,140 | 122,279 | 244,559 | 982,416 | 1,637,361 | 3,274,722 |

2. *Operating Cost*

The incremental operating cost as a consequence to accepting the shrimp peeling and deveining project includes:

- Management payroll
- Labor wage
- Equipment lease
- Utilities
- Seafood house building lease
- Freezing, packaging and storing costs associated with the processing line
- Advertising

For each of the aforementioned costs, Table 8 below lists the operating costs used for purposes of this study. **NOTE: The actual costs from the original report have been removed due to their proprietary nature.**

| **Table 8**<br>**Operating Cost per Unit** | |
|---|---|
| **Category** | **Cost** |
| **Supervisor** | |
| **Advertising** | |
| **Seafood House Lease**<br>(includes rent, waste & utilities) | |
| **Storage** | |
| **Freezing** | |
| **Freezing Labor** | |
| **Packaging** | |
| **Avg. Labor Cost** | |

Given that different throughputs will require different investment of resources, we will briefly examine some of the adjustments made in our calculations, particularly those costs associated with management payroll, labor, utilities, and the freezing, storing and packaging costs associated with processing.

a. Management Payroll

In the original report, the number of salaried supervisors needed to oversee the established throughput levels was estimated based on proprietary information, therefore those estimates have been removed. Table 9 below indicated the number of supervisors required by each throughput level in the original report,

| **Table 9**<br>**Number of Supervisors per Throughput Level** | |
|---|---|
| **Throughput Level (lbs)** | **# of Supervisors** |
| 50,000 lbs | |
| 100,000 lbs | |
| 200,000 lbs | |
| 803,420 lbs | |
| 1,339,034 lbs | |
| 2,678,068 lbs | |

b. P&D Equipment Lease

Regarding the lease for the peeling and deveining equipment, our group obtained quotes for 1, 2, 3, and 6 machine configurations from Gregor Jonsson. Table 4 above summarizes the cost of the lease for each configuration.

c. P&D Machine Operators and Utilities

With respect to the cost of the peeling and deveining (P&D) machine operators and utilities for operating the P&D machine, adjustments were made in accordance to (1) the specification of the machine configuration for each throughput level and (2) the number of machine operating hours required to process the raw shrimp material to yield the desired throughput level. In figuring the cost of utilities, our study incorporated the municipal rates for water and waste consumption in a major city in North Carolina and the average price per kilowatt-hour in the state of North Carolina. Table 10 captures the machine operating details for each throughput level.

**Table 10**
**P&D Machine Operating Details**

| Throughput Level (lbs) | lbs of shrimp to process | # of P&D Machine Required | # of P&D Operators | Total Machine Operating Hrs | Total KW Usage | Total $H_2O$ Usage |
|---|---|---|---|---|---|---|
| **50,000** | 61,140 | 1 | 2 | 269 | 185 | 17,238 |
| **100,000** | 122,279 | 1 | 2 | 539 | 369 | 34,475 |
| **200,000** | 244,559 | 1 | 2 | 1,077 | 738 | 68,950 |
| **803,420** | 982,416 | 2 | 3 | 2,164 | 1,483 | 408,979 |
| **1,339,034** | 1,637,361 | 3 | 6 | 2,404 | 1,648 | 454,422 |
| **2,678,068** | 3,274,722 | 6 | 9 | 2,404 | 1,648 | 1,370,479 |

d. Freezing, Freezing Labor, Packaging, and Storing

As previously outlined in Figures 1 and 2 above, given that Options 1 and 2 follow different processes, adjustments have to be made to the freezing, freezing labor, packaging and storing costs. For Option 1, we adjusted the cost of freezing, freezing labor, and storing to reflect that 80% of the procured shrimp will be frozen and stored. For Option 2, since all of the shrimp will be processed in the fresh form and then frozen and packaged, 100% of the processed shrimp will be frozen and packaged. There is no storage cost associated with Option 2 since the final product will be shipped to customers.

e. Seafood House Lease

Our treatment of the seafood house lease takes into account an opportunity cost should the peeling and deveining operation be accepted. While the seafood house lease exists whether or not an existing processor accepts the shrimp peeling and deveining project, the space which would be housing the shrimp peeling and deveining operation could be used for other purposes such as expanding other seafood processing operations. As a result, we incorporated 30.15% of the annual seafood house lease to our cost analysis. The 30.15% represents the proportion of the square footage of the shrimp processing room to the total square footage of the seafood house.

3. *One-Time Capital Investment Cost*

Given that the scope of this study only considers adding a shrimp peeling and deveining line to an existing operation, the only capital investment required is for the peeling and deveining equipment alone. However, since Gregor Jonsson only leases equipment in the U.S., that equipment lease is integrated into the Operating Cost component. The costs which are taken into account in this category are the initial charge and freight cost associated with the Gregor Jonsson lease. Table 4 above encapsulates those charges for each machine configuration.

4. *Estimating Investment in Working Capital*

While working capital is not listed as a line item in our total cost analysis, it is nevertheless a cost contributing to cash outflows. Investment in working capital is necessary for several reasons. The processor will need to purchase raw materials before production and sale, giving rise to an investment in inventory. The processor will also require cash as a buffer against unforeseen expenditures. Finally, should the processor deal with credit sales, cash will not be generated until payment is made at a later date.

The Food and Agriculture Organization of the United Nations (FAO) published a technical paper, "Economic Engineering Applied to the Fishery Industry," in which A. Zugarramurdi, M. Parin, and H. Lupin compared and contrasted different technological alternatives for investment applied to both personal and commercial investments in the fishery industry. Within this technical report, the authors provided three ways to estimate working capital, which are:

1. "Take it as 10-20% of fixed investment. Generally, 10% is used as an acceptable approximate estimate for fish industries when data are lacking.

2. Take it as 10% of annual sales.

3. Calculate the inventory costs for one month's capacity of raw material, plus two months' capacity of finished products. Add the accounts receivable calculated on one month's sales."

(Zugarramurdi, Parin, and Lupin, 1995).

For the purposes of our calculations, we incorporated 10% of annual sales for the investment in working capital.

***Summary***

Taking the example of the 50,000 lbs throughput level, Tables 11 and 12 below sum up the assumptions underlying our calculations outlined in the previous paragraphs. All throughput levels for both Options 1 and 2 follow the same formula. **NOTE: Proprietary operating costs have been redacted.**

# Table 11
# Detailed Explanation of Financial Analysis for Option 1
# NOTE: PORTIONS OF THIS TABLE HAVE BEEN REDACTED TO PROTECT PROPRIETARY INFORMATION

**Option 1**
**Financial Analysis**

| Year | 0 | 1 | 2 | 3 | 4 | 5 | Assumptions |
|---|---|---|---|---|---|---|---|
| **Project Data** | | | | | | | |
| lbs of shrimp sold | | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | -assume the same every year; no growth model at this point |
| % of Yield Loss due to Processing | | 18.22% | 18.22% | 18.22% | 18.22% | 18.22% | -See "Data" Tab, Note "6. Shrimp Yield Calculation" |
| lbs of shrimp to procure | | 61,140 | 61,140 | 61,140 | 61,140 | 61,140 | |
| Desired Margin % | | 15% | 15% | 15% | 15% | 15% | - |
| $ Selling price per lb | | $10.50 | $10.50 | $10.50 | $10.50 | $10.50 | |
| $ of var. op. cost per lb | | | | | | | |

| Year | 0 | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|---|
| MACRS Depreciation % (7-year life class) | | 0.143 | 0.245 | 0.175 | 0.125 | 0.089 | |
| Depreciation -- Equipment | | 0 | 0 | 0 | 0 | 0 | -N/A since leasing from Gregor Jonnson |
| Depreciation -- Building | | 0 | 0 | 0 | 0 | 0 | -N/A since Fish House is leased |
| **Total Depreciation** | | 0 | 0 | 0 | 0 | 0 | |

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **Pro Forma Income Statement ($)** | | | | | | |
| Sales | | $524,812.52 | $524,812.52 | $524,812.52 | $524,812.52 | $524,812.52 |
| – Costs (excl. Depreciation) | | | | | | |
| – Total Depreciation | | | | | | |
| =EBIT | | | | | | |
| – Tax (35%) | | | | | | |
| **= Net Income** | | | | | | |

| Year | 0 | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|---|
| **Pro Forma Balance Sheet -- Asset side ($)** | | | | | | | |
| Net Working Capital | $52,481.25 | $52,481.25 | $52,481.25 | $52,481.25 | $52,481.25 | $0.00 | -According to FAO, there are several methods for estimating working capital, one of which is to take it as 10% of annual sales. Source: http://www.fao.org/3/a-v8490e/v8490e05.htm -In the final year of the project, net working capital will decline to zero as the project is wound down. In other words, the investment in working capital is to be completely recovered by the end of the project's life. |
| Net Fixed Assets - Equipment | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | -N/A since leasing from Gregor Jonnson |
| Net Fixed Assets - Building | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | -N/A since Fish House is leased |
| | | | | | | | |
| **Memo: After-tax Cash Flow = MV – (MV – BV)T** | | | | | | | |
| | Year | MV | BV | T | ATCF | | -N/A since there is no Capital Investments |
| Equipment | 5 | | $0.00 | 0.35 | $0.00 | | |
| Building | 0 | | | 0.35 | $0.00 | | |
| Building | 5 | | $0.00 | 0.35 | $0.00 | | |
| | | | | Total | $0.00 | | |

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **Project Cash Flow ($)** | | | | | | |
| EBIT | | | | | | |
| + Depreciation | | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| – Taxes | | -$27,552.66 | -$27,552.66 | -$27,552.66 | -$27,552.66 | -$27,552.66 |
| = OCF | | $51,169.22 | $51,169.22 | $51,169.22 | $51,169.22 | $51,169.22 |
| – inc Net Working Capital | -$52,481.25 | $0.00 | $0.00 | $0.00 | $0.00 | $52,481.25 |
| – Net Capital Spending | | | | | | |
| Equipment One Time Charges | -$4,720.00 | | | | | $0.00 |
| Building | $0.00 | | | | | $0.00 |
| **Project After-tax Cash Flow** | | | | | | |

# Table 12
# Detailed Explanation of Financial Analysis for Option 2
# NOTE: PORTIONS OF THIS TABLE HAVE BEEN REDACTED TO PROTECT PROPRIETARY INFORMATION

**Option 2**
**Financial Analysis**

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **Project Data** | | | | | | |
| lbs of shrimp sold | | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 |
| % of Yield Loss due to Processing | | 18.22% | 18.22% | 18.22% | 18.22% | 18.22% |
| lbs of shrimp to process | | 61,140 | 61,140 | 61,140 | 61,140 | 61,140 |
| Desired Margin % | | 15% | 15% | 15% | 15% | 15% |
| $ Selling price per lb | | $0.94 | $0.94 | $0.94 | $0.94 | $0.94 |
| $ of var. op. cost per lb | | | | | | |

**Assumptions**

-assume the same every year; no growth model at this point
-See "Data" Tab, Note "6. Shrimp Yield Calculation"

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| MACRS Depreciation % (7-year life class) | | 0.143 | 0.245 | 0.175 | 0.125 | 0.089 |
| Depreciation -- Equipment | | 0 | 0 | 0 | 0 | 0 |
| Depreciation -- Building | | 0 | 0 | 0 | 0 | 0 |
| **Total Depreciation** | | 0 | 0 | 0 | 0 | 0 |

-N/A since leasing from Gregor Jonnson
-N/A since Fish House is leased

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **Pro Forma Income Statement ($)** | | | | | | |
| Sales | | $46,752.90 | $46,752.90 | $46,752.90 | $46,752.90 | $46,752.90 |
| – Costs (excl. Depreciation) | | | | | | |
| – Total Depreciation | | | | | | |
| =EBIT | | | | | | |
| – Tax (35%) | | | | | | |
| **= Net Income** | | | | | | |

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **Pro Forma Balance Sheet -- Asset side ($)** | | | | | | |
| Net Working Capital | $4,675.29 | $4,675.29 | $4,675.29 | $4,675.29 | $4,675.29 | $0.00 |
| Net Fixed Assets - Equipment | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| Net Fixed Assets - Building | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |

-According to FAO, there are several methods for estimating working capital, one of which is to take it as 10% of annual sales. Source: http://www.fao.org/3/a-v8490e/v8490e05.htm#3.7 Working Capital (Iw)
-In the final year of the project, net working capital will decline to zero as the project is wound down. In other words, the investment in working capital is to be completely recovered by the end of the project's life.
-N/A since leasing from Gregor Jonnson
-N/A since Fish House is leased

**Memo: After-tax Cash Flow = MV – (MV – BV)T**

| | Year | MV | BV | T | ATCF | |
|---|---|---|---|---|---|---|
| Equipment | 5 | | $0.00 | 0.35 | $0.00 | |
| Building | 0 | | | 0.35 | $0.00 | |
| Building | 5 | | $0.00 | 0.35 | $0.00 | |
| | | | | Total | $0.00 | |

-N/A since there is no Capital Investments

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **Project Cash Flow ($)** | | | | | | |
| EBIT | | | | | | |
| + Depreciation | | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| – Taxes | | -$2,454.53 | -$2,454.53 | -$2,454.53 | -$2,454.53 | -$2,454.53 |
| = OCF | | $4,558.41 | $4,558.41 | $4,558.41 | $4,558.41 | $4,558.41 |
| – inc Net Working Capital | -$4,675.29 | $0.00 | $0.00 | $0.00 | $0.00 | $4,675.29 |
| – Net Capital Spending | | | | | | |
| Equipment One Time Charges | -$4,720.00 | | | | | $0.00 |
| Building | $0.00 | | | | | $0.00 |
| **Project After-tax Cash Flow** | | | | | | |

## F.3. Option 1 Results

### NOTE: PORTIONS OF THE BELOW TEXT HAVE BEEN REDACTED TO PROTECT PROPRIETARY INFORMATION

Based on the data discussed above, Table 13 presents the results of the Total Cost Analysis for each throughput level under Option 1.

**Table 13**
**NOTE: PORTIONS OF THIS TABLE HAVE BEEN REDACTED TO PROTECT PROPRIETARY INFORMATION**

| Option 1<br>Total Cost Analysis - Detailed Summary | | | | | | |
|---|---|---|---|---|---|---|
| **Throughput Level** | **50,000** | **100,000** | **200,000** | **803,420** | **1,339,034** | **2,678,068** |
| **Material Cost** | | | | | | |
| **Total lbs of Shrimp** | 61,140 | 122,279 | 244,559 | 982,416 | 1,637,361 | 3,274,722 |
| **Cost of headless, shell-on shrimp** | $6.49 | $6.49 | $6.49 | $6.49 | $6.49 | $6.49 |
| **Total cost of shrimp** | **$396,643.43** | **$793,286.87** | **$1,586,573.73** | **$6,373,425.35** | **$10,622,380.87** | **$21,244,761.74** |
| **Operational Cost** | | | | | | |
| **Management Payroll** | | | | | | |
| **Labor** | | | | | | |
| P&D Operators | | | | | | |
| Freezing Labor | | | | | | |
| **P&D Equipment Rental (Lease)** | | | | | | |
| **Utilities** | | | | | | |
| Electricity | | | | | | |
| Water | | | | | | |
| **Building Rent, Waste & Utilities** | | | | | | |
| **Storage Cost** | | | | | | |
| **Freezing Cost** | | | | | | |
| **Packaging** | | | | | | |
| **Advertising** | | | | | | |
| **Total Operational Cost** | $ | | | | | |
| **One-Time Capital Investments** | **50,000** | **100,000** | **200,000** | **803,420** | **1,339,034** | **2,678,068** |
| **P&D Machinery One-Time Charges** | | | | | | |
| Initial Freight Charge | $650.00 | $650.00 | $650.00 | $1,300.00 | $1,950.00 | $3,900.00 |
| Initial Charge | $4,070.00 | $4,070.00 | $4,070.00 | $7,140.00 | $11,350.00 | $20,540.00 |
| **Total Investment Cost** | **$4,720.00** | **$4,720.00** | **$4,720.00** | **$8,440.00** | **$13,300.00** | **$24,440.00** |
| **Total Operational Cost** (Excl. investment) | | | | | | |
| **Total Cost** (incl. material, operational, investment) | | | | | | |

As the results show, the material cost ranges from approximately $397,000 to $21.2 million (depending upon throughput level). The operating cost ranges from approximately [redacted]. Lastly, the range for one-time investment cost is from $4,720.00 to $24,400.00. The total cost under Option 1, depending upon the throughput level, ranges from approximately [redacted].

A couple of trends can be observed from the results of the Total Cost Analysis. First, as the throughput level increases, total cost increases as well. Second, of the three cost components, material cost of shrimp makes up the bulk of the total cost. In fact, the material cost of shrimp is about [redacted] of the total cost of the 50,000 lbs throughput level and as much as [redacted] of the total cost of the 2.68 million throughput level.

**Table 14**
**NOTE: PORTIONS OF THIS TABLE HAVE BEEN REDACTED TO PROTECT PROPRIETARY INFORMATION**

| Option 1<br>Financial Analysis - Detailed Summary | | | | | | |
|---|---|---|---|---|---|---|
| Throughput Level (lbs) | 50,000 | 100,000 | 200,000 | 803,420 | 1,339,034 | 2,678,068 |
| lbs of shrimp to procure | 61,140 | 122,279 | 244,559 | 982,416 | 1,637,361 | 3,274,722 |
| Desired Margin % | 15% | 15% | 15% | 15% | 15% | 15% |
| $ Selling price per lb | | | | | | |
| $ of var. op. cost per lb | | | | | | |
| Annual Sales Revenue | | | | | | |
| Annual Cost | | | | | | |
| EBIT | $78,721.88 | $159,478.99 | $308,640.28 | $1,216,097.89 | $2,037,781.41 | $4,048,623.74 |
| Net Income | | | | | | |

Table 14 shows the summary of, among other things, cost per pound, selling price per pound and potential net income for Option 1. Based on our analysis, the variable cost per pound ranges from [redacted]. Assuming the processor's desired profit margin of 15%, the potential selling price per pound ranges from $[redacted]. Given the 15% profit margin, the projected net income would range from approximately $[redacted].

**Table 15**
**NOTE: PORTIONS OF THIS TABLE HAVE BEEN REDACTED TO PROTECT PROPRIETARY INFORMATION**

| Option 1 - Financial Analysis<br>Projected Annual Cash Flows, IRR, NPV & PI | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Through-put Level (lbs) | YR 0 | YR 1 | YR 2 | YR 3 | YR 4 | YR 5 | IRR | NPV | | PI | |
| | | | | | | | | @ 26% Discount | @ 2% Discount | @ 26% Discount | @ 2% Discount |
| 50,000 | | | | | | | | | | | |
| 100,000 | | | | | | | | | | | |
| 200,000 | | | | | | | | | | | |
| 803,420 | | | | | | | | | | | |
| 1,339,034 | | | | | | | | | | | |
| 2,678,068 | | | | | | | | | | | |

Table 15 is a summary of the projected free cash flows and the results of the evaluation tools we employed for analyzing such cash flows under Option 1. With respect to the Project Cash Flows, year 0 reflects the initial cash outflow that a processor must make for each throughput under consideration. Year 5, which is the terminal year of the project, represents not only the annual free cash but also any after-tax free cash from potential asset sale and the recovery of the investment in working capital which is made during the life of the project. Since there were no capital investments made in this project, the difference in the cash flow from year 4 to year 5 represents the recapturing of the investment in working capital.

As far as the results of the NPV, IRR and PI, it is clear that the shrimp peeling and deveining project has earning potential. In fact, based on the NPV and depending on the discount rate, that earning potential could range from approximately [redacted] should the processor undertake the project at the 50,000 lb throughput level or as high of a range of approximately [redacted] when looking at the results for the 2.68 million pound throughput level. Moreover, with IRR ranging from approximately [redacted] and PI ratios of greater than 1, it is evident that the processor could see more than one dollar generated per dollar invested.

## F.4. Option 2 Results

**NOTE: PORTIONS OF THE BELOW TEXT HAVE BEEN REDACTED TO PROTECT PROPRIETARY INFORMATION**

Table 16 presents the results of the Total Cost Analysis of each throughput level under Option 2.

**Table 16**
**NOTE: PORTIONS OF THIS TABLE HAVE BEEN REDACTED TO PROTECT PROPRIETARY INFORMATION**

| Option 2<br>Total Cost Analysis - Detailed Summary | | | | | | |
|---|---|---|---|---|---|---|
| **Throughput Level** | **50,000** | **100,000** | **200,000** | **803,420** | **1,339,034** | **2,678,068** |
| **Operational Cost** | | | | | | |
| **Management Payroll** | | | | | | |
| **Labor** | | | | | | |
| P&D Operators | | | | | | |
| Freezing Labor | | | | | | |
| **P&D Equipment Rental (Lease)** | | | | | | |
| **Utilities** | | | | | | |
| Electricity | | | | | | |
| Water | | | | | | |
| **Building Rent, Waste & Utilities** | | | | | | |
| **Storage Cost** | | | | | | |
| **Freezing Cost** | | | | | | |
| **Packaging** | | | | | | |
| **Advertising** | | | | | | |
| **Total Operational Cost** | | | | | | |
| **One-Time Capital Investments** | | | | | | |
| **P&D Machinery One-Time Charges** | | | | | | |
| Initial Freight Charge | $650.00 | $650.00 | $650.00 | $1,300.00 | $1,950.00 | $3,900.00 |
| Initial Charge | $4,070.00 | $4,070.00 | $4,070.00 | $7,140.00 | $11,350.00 | $20,540.00 |
| **Total Investment Cost** | **$4,720.00** | **$4,720.00** | **$4,720.00** | **$8,440.00** | **$13,300.00** | **$24,440.00** |
| **Total Operational Cost** (Excl. investment) | | | | | | |
| **Total Cost** (incl. material, operational, investment) | | | | | | |

As the results show, depending upon the throughput level, the annual operating cost ranges from approximately [redacted]. The range for the one-time investment cost does not change from Option 1 as these calculations are dependent on the machine configuration for each throughput. The total cost under Option 2, depending upon the throughput level, ranges from approximately [redacted].

Option 2 reflects similar trends to those observed in the results of the Total Cost Analysis for Option 1. Again, as the throughput level increases, total cost increases as well. As material cost does not apply to Option 2, it makes sense that the operating cost would make up the bulk of the total cost for each throughput.

**Table 17**
**NOTE: PORTIONS OF THIS TABLE HAVE BEEN REDACTED TO PROTECT PROPRIETARY INFORMATION**

| Option 2<br>Financial Analysis - Detailed Summary | | | | | | |
|---|---|---|---|---|---|---|
| Throughput Level (lbs) | 50,000 | 100,000 | 200,000 | 803,420 | 1,339,034 | 2,678,068 |
| Desired Margin % | 15% | 15% | 15% | 15% | 15% | 15% |
| $ Selling price per lb | | | | | | |
| $ of var. op. cost per lb | | | | | | |
| Annual Sales Revenue | | | | | | |
| Annual Cost | | | | | | |
| EBIT | | | | | | |
| Net Income | | | | | | |

Table 17 shows the summary of, among other things, cost per pound, selling price per pound and potential net income for Option 2. The variable cost per pound ranges from [redacted] Assuming a profit margin of 15%, the potential selling price per pound ranges from [redacted]. Given the 15% profit margin, the projected net income would range from approximately [redacted].

**Table 18**
**NOTE: PORTIONS OF THIS TABLE HAVE BEEN REDACTED TO PROTECT PROPRIETARY INFORMATION**

| Option 2 - Financial Analysis<br>Projected Annual Cash Flows, IRR, NPV & PI | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Throughput Level (lbs) | YR 0 | YR 1 | YR 2 | YR 3 | YR 4 | YR 5 | IRR | NPV @ 26% Discount | NPV @ 2% Discount | PI @ 26% Discount | PI @ 2% Discount |
| 50,000 | -$ | | | | | | | | | | |
| 100,000 | -$ | | | | | | | | | | |
| 200,000 | -$ | | | | | | | | | | |
| 803,420 | -$ | | | | | | | | | | |
| 1,339,034 | -$ | | | | | | | | | | |
| 2,678,068 | -$ | | | | | | | | | | |

Table 18 is a summary of the projected free cash flows and the results of the evaluation tools we employed for analyzing such cash flows under Option 2. IRR, NPV and PI results all reflect a very profitable scenario if a processor should choose to operate under Option 2. All of the IRR are much higher than any of discount rates considered in our analysis. Moreover, the earnings potential could range from approximately [redacted] should a processor undertake the project at the 50,000 lb throughput level or as high of a range of approximately [redacted] when looking at the results for the 2.68 million pound throughput level.

## G. Conclusion, Considerations and Recommendations

The addition of a shrimp processing line to a seafood processing company's existing operations passes the initial viability check. The NPV, IRR, and PI all show that the project has the potential to be profitable. However, we recommend taking the following considerations into account:

1. **What impact will the peeling and deveining operation have on other operations?** Specifically, will the new peeling and deveining operation erode the sale of shell-on shrimp? If so, how much? It is our recommendation that an existing company considering adding a shrimp processing line conduct an internal impact study to understand the effects of the sale of peeling and deveining products on its shell-on products.

2. **What is the targeted market and customer segment for fresh, wild-caught, peeled and deveined shrimp products?** What are the acceptable prices, which such market and/or customer segments are willing to pay? What is the potential demand of such market? What is an optimal distribution strategy? Our model takes into account a profit margin of 15%. However, the real question remains as to the reasonableness of such margin. It is understood that marketing fresh, local NC peeled and deveined shrimp products is a brand new product with little known about the target markets. Prices and profit margins can only be determined by customer demand, which are influenced by customer preferences. The only way to determine customer preferences is by conducting in-depth field market research. As a result, it is our recommendation that customer and market segmentation studies be completed. Pricing sensitivity analysis will provide valuable information on what targeted customers are willing to pay as well as understanding how changes in price may affect revenue. Moreover, once those new markets are defined, distribution channels will need to be matched to the market.

In summary, we tested the feasibility of adding a shrimp processing line and the operation passes the initial tests for profitability. However, we recommend that these considerations be researched in detail to determine the market impact on the operation.

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