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Market Study: Creating a Cooperative Biodiesel Business in Worcester, Ma

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Abstract

The goal of this project was to create a market study on the availability of waste vegetable oil in the Worcester area, in helping a non-profit organization create a cooperative business. This business aimed to convert waste vegetable oil into biodiesel fuel, which in turn creates jobs and helps the environment. An in depth look at the supply chain was required, as well as a look into various methods of data collection, including surveys and interviews. Our results showed that 'Sit-down' restaurants were the best option for small-scale producers overall, and Seafood restaurants had the highest volumetric production of small-scale suppliers.

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Executive Summary

This project, consisting of two groups of students from Worcester Polytechnic Institute (WPI) and Ex-Prisoners and Prisoners Organizing for Community Advancement (EPOCA), examined the biodiesel manufacturing process, as well as the necessities in creating a cooperative business with the purpose of converting waste vegetable oil into biodiesel fuel. Our group focused primarily on the marketing aspects of the project while another focused on production. Knowledge of the supply chain, and supply chain management was essential when determining what suppliers of waste vegetable oil, such as local restaurants or manufacturers like Wachusett Potato Chip Co, look for in contracts and in dealing with renders or other removal agencies. Though our results showed minimal variation in terms of different restaurant types holding certain characteristics, such as reliability or flexibility, above any others, it was necessary to determine on average which types of restaurants may be easiest to work with contractually, and which types produce and dispose of the most waste vegetable oil (WVO). Before data collection and analysis could begin however, a proper understanding of biodiesel fuel and the supply chain was necessary.

Biodiesel fuel is an alternative fuel source made from renewable resources such as vegetable oils, or animal fats, combined with alcohol and a hydroxide base. When burned in home heating applications or diesel engines biodiesel emits less carbon dioxide than petroleum or petro-diesel, as well as sulfur dioxide emissions and air toxins. Though biodiesel has in the past been created using virgin oil from crops such as corn, the damages this caused to the food industry as well as the high price of vegetable oil led to biodiesel being highly priced and seldom used in comparison with petroleum. The realization that waste vegetable oil could be used in place of corn and soy oil has renewed interest in biodiesel as an alternative fuel source. Using WVO in the biodiesel process also has the added benefit of recycling the waste oils from restaurants that would otherwise be destroyed. EPOCA understood that a business could be created utilizing this process, as well as the jobs it could create. In order to create a truly turn-key operation, understanding the supply chain would become necessary.

Supply chains incorporate the acquisition of a raw material, the manufacture of said material into a finished product, and the distribution of the finished product to the consumer base. This part of the project focused on acquiring the material, because EMPOWER, the

business EPOCA created, was looking to create a push system where they created the fuel predicting that the demand will present itself. For this to work, the WVO needed to be acquired so EMPOWER could begin producing the biodiesel. In order to acquire WVO, EMPOWER would need to enter into business with the suppliers. Before this could be accomplished, the two main types of business relationships were analyzed. The first, arms-length relationships, was straight business deals, with can include frequent bidding wars and switching of suppliers. For EMPOWER, the contract would be their only focus, with no emphasis on pursuing relationships with their suppliers. The opposing method, collaborative business relationships, begins like arms-length, with contracts created with suppliers but the emphasis is on maintaining good relations with the suppliers by forming trust, which can in turn lead to reduced prices on material, and continued business in the future. Research into the two topics, by means of examining the automobile industry showed that while collaborative businesses are more successful now, such as the Japanese car industry, for EMPOWER the time and money involved in forming these trusting relationships outweighed the gains that could be achieved. For large industries, such as the automobile, with many raw materials and suppliers it may be important to use collaborative relationships, but for small businesses such as EMPOWER, arms-length relationships are more practical and more beneficial. Once the supply chain had been researched and examined, methods for collecting the necessary data had to be determined.

Before data could be collected, a method for amassing the information needed to be determined. After researching various methods of data collection, we decided on creating a survey for small scale suppliers of WVO, and interviews for large scale manufacturers. The survey included questions on waste oil produced; patrons served each week, as well as Likert scales to determine what restaurants require when working with renderers and what they look for in a contract. The surveys were distributed by hand, though an online survey using Qualtrics, an online survey database, was incorporated midway through distribution, unsuccessfully. For large scale manufacturers, which we took to include local companies such as Frito Lay, Wachusett Potato, and Gorton's Seafood, we conducted phone interviews to determine quantity of available waste oil, as well as the method for disposing, as well as any interest they may have in donating or selling their WVO to a company creating biodiesel from it. With the methods of data collection in place, we set about collecting our data and analyzing it for trends and any conclusions that could be made.

Once survey distribution was completed and the phone interviews with large scale manufacturers concluded, we began to analyze our data. The large scale manufacturers did not relay enough information to perform any analytical tests, so we drew conclusions based on what was said. For instance, we found that the potato chip companies such as Frito Lay and Wachusett did not produce any more WVO than small scale suppliers, though Gorton's seafood did produce sufficient quantities of waste vegetable oil to warrant further investigation. We found that Gorton's was selling their WVO to anyone willing to take it, though they were willing to waive the price in order to enter into a contractual agreement with a company such as EMPOWER who is looking to benefit the lives of others. The small scale suppliers provided 30 surveys with which to analyze using t-tests and ANOVA (Analysis of Variance) tests through SPSS software. The 30 surveys were broken up by restaurant type into 5 categories: Mediterranean (Italian, Greek etc.), Chinese, Seafood, 'Take-out' (sub-shops, fast-food), and 'Sit-down' (steakhouses, American food) restaurants. Through our t-test, four conclusions were made: First, Seafood restaurants produce the most waste vegetable oil. Second, 'Take-out' restaurants have the lowest expectations when working with renderers. Third, 'Sit-down' restaurants have the lowest expectations from contracts. Finally, Seafood restaurants have the highest number of patrons served, followed by "Sit-down'. These conclusions can be used to help EMPOWER target specific restaurants to enter into business with. For example, Though Seafood restaurants produce the most waste vegetable oil; they may not be easy to enter into a contract with. In contrast however, 'Sit-down' restaurants produced the next highest quantity of WVO while also having the lowest expectations from their contracts with disposal companies. Our results suggest that 'Sit-down' restaurants may be the most beneficial restaurants to target, however seafood and 'take-out' restaurants are likely also very strong candidates.

The conclusion of this project showed not only the availability of waste vegetable oil in the Worcester area, but the primary places to target, as well as the providing an understanding of the necessary steps to take when creating a business. Also, during the course of our data collection, interest was raised in the area with regards to biodiesel through our survey distribution and phone interviews. Using the information that was researched on biodiesel and the supply chain, as well as the contacts made during data collection, EPOCA has all the tools necessary in creating their successful and self-sustaining biodiesel plant, EMPOWER.

1.0 Introduction

Ex-Prisoners Organizing for Community Advancement (or EPOCA) is an organization devoted to the betterment of the lives of current ex-prisoners and focuses energy on social activism and pursuing revised laws in the state of Massachusetts. Since law revision is an arduous task, it is difficult for ex-prisoners to seek employment under the current statutes. Criminal Record Offender Information (CORI) has become accessible to more employers than it was ever intended to be accessible to, and many jobs are becoming unavailable to people with any offense at all on their CORIs. EPOCA has set out to create cooperative businesses that will employ ex-prisoners and people with CORI forms equally and fairly. One such cooperative business will focus on the production and distribution of biodiesel, a clean burning alternative fuel.

Biofuels are made from renewable resources, such as corn and soybean products. With fuel costs currently on the rise and non-renewable petroleum resources dwindling, alternative fuels will play an important role in future resources and critical energy concerns. For this reason it may be feasible as well as lucrative to start a company that will produce biofuels at this point in time. There are two processes to produce biodiesel, one of which is from raw corn, soy, and other crops less common to the U.S. such as hemp, tallow, and sunflower seed oil; the other being from restaurant waste or animal fats in the form of waste oils (Canakci, 2007). Before moving ahead with this project, it was important to consider what actions would be appropriate from a business standpoint in starting a biodiesel manufacturing plant. This chapter will discuss in detail the critical role of the elements of the supply chain that were considered and incorporated before this project could begin.

Creating a business requires a proper understanding of the product supply chain. Only by examining the many methods associated with the supply chain can a business truly succeed. An understanding of the supply chain helps a start up business become competitive and successful by understanding the market. Though there are many different methods when discussing business methods and buyer supplier relationships, such as push and pull techniques, arms-length or collaborative relationships, the end goal remains the same: Creating a self sustaining and profitable business, that converts waste vegetable oil into a clean and renewable alternative fuel, biodiesel.

Then we will focus primarily on three methods of primary source data collection; the survey study for small-scale suppliers, questionnaires for large-scale suppliers, and a pre-production cost analysis. Each of these methods was devised from our necessity to answer our primary research questions. For example, the small-scale supplier survey study estimated the amount of waste vegetable oil currently available to supplement the notion that the process will not be feasible if there is not a sizeable volume of waste vegetable oil. Likewise, the large-scale questionnaires determined the feasibility of contact and involvement for EMPOWER with large-scale vegetable oil suppliers. Lastly, the pre-production cost analysis was an examination of the costs required before production could begin at their facility. This analysis will take the form of a linear flowchart to be completed and compiled with production costs by EPOCA in order to do a cost/benefit analysis. The cost/benefit analysis will be an effective tool for EMPOWER to use for price-point setting and feasibility of the process.

After the data from our surveys and interviews were gathered, they needed to be statistically analyzed in order for their findings to become apparent and make sense. The survey data were analyzed using statistical analysis software and conclusions were drawn from the interviews by hand. Our initial intentions were to determine the availability of waste oil from each type of restaurant in the Worcester area as well as the contractual and service components that waste oil producers are looking for in order to derive a strategic acquisition plan for EMPOWER. Due to constraints in survey collection, however, it was not possible to have many different types of restaurants examined statistically. We needed to interpret our data in larger and broader groups than we had initially intended, consolidating several alike types of restaurants into one larger group. Because of our findings from our large scale producer interviews, we did not have enough data to make statistical analysis possible for them, so we analyzed our data qualitatively. To return to our survey analysis, the first objective we had was to sort our data into a database that could be easily analyzed and imported into statistical analysis software. We used our research questions as a base to describe the type of findings we would make. That being said, we wanted to find what the availability of waste vegetable oil was and the contractual and service components.

2.0 A Background Study and Literature Review

2.1 Why Biodiesel?

Biodiesel is produced from waste oils that are composed of monoalkyl esters that are useful as fuels in diesel engines as well as home heating applications. Since biodiesel is produced from renewable resources such as vegetable oils and animals fats, combined with alcohol and a hydroxide base, it is nontoxic and cleaner-burning that traditional petrodiesel (Canakci, 2007). Biodiesel fuels also have a higher lubricity than petrodiesel. Higher lubricity leads to decreased friction of engine components (beachbionic.com). Biodiesel that is processed from waste vegetable oil sources is a highly efficient means for producing a petroleum fuel alternative, as waste that would otherwise serve as a pollutant is turned into a useful, clean burning, and low emission recycled fuel.

2.1.1 Environmental Benefits

Biodiesel has many environmental benefits, especially those related to air pollution. Hydrocarbon emissions, sulfur dioxide, carbon dioxide, and air toxins are lower in biodiesel than conventional fuels. Biodiesel blends, which are biodiesel mixed with petroleum diesel in different concentrations, also have lower emissions nearly proportionate to their percentage of biodiesel (Hinerfield, 2005). In B100, a 100% blend of biodiesel, the sulfur dioxide emissions are reduced 100%, air toxins are reduced 60-90%, and hydrocarbons are reduced approximately 56%. In B20, a common biodiesel blend containing 20% biodiesel fuels, sulfur dioxide is reduced 20%, air toxins 12-20%, and hydrocarbons by 11%. Additional decreased emission components include particulate matter, nitrogen oxides, and mutagenicity over straight petrodiesel (Hinerfield, 2005). Instances of biodiesel usage can already be seen in over 20 National Parks across the U.S., and as a key part in the boating industry in preventing fines from oil spills due to the degradability of biodiesel. Also, the underground mining market is incorporating biodiesel to prevent health risks because of the lower emissions (Gerpen, 2004). Despite lower emissions, the high cetane and high lubricity results in little to no performance degradation. The components to create this environmentally friendly fuel are also highly available as the crops to produce biodiesel are more renewable than petroleum sourcing.

However, creating biodiesel from virgin sources requires oil to cultivate the crops. In contrast, waste vegetable oil is a byproduct of the majority of restaurants and food production industries in the U.S, and has the added environmental benefit of recycling otherwise waste product. The availability of waste vegetable oil all throughout the U.S. due to the food industry makes this source easily attainable.

2.1.2 Availability

Waste vegetable oil can be easy to obtain, as it is produced in massive quantities all throughout the U.S. (Zhang, 2003). Table 1, displayed in appendix one, represents the amount of waste vegetable oil, WVO, available in several cities throughout the U.S. Using data from that table we determined a quantity of yellow grease and trap grease created per restaurant in given cities and applied that to an estimated number of restaurants in Worcester given the population.

We used these processes do determine the amount of biofuels available in Worcester. Based on population figures and restaurants our initial estimate is 7,055 gallons on average, of usable (yellow) grease annually. Trap grease that is unusable for our purpose of biodiesel conversion will not be accounted for in these calculations. Taking data from the Massachusetts Advanced Biofuels Task Force Final Report for spring of 2008, we were able to use figures for restaurant-generated waste oil per citizen annually to produce a figure of 9 lbs per person annually, which can be used to confirm our data extrapolations from the chart below in Table 1 (MABTF, 2008). Taking our data calculated from the Biofuels Report, we can estimate that Worcester produces 1.57 million pounds annually, and from our data we determined a calculation of 1.43 million pounds (Canakci, 2007). This number was obtained by multiplying the median yellow grease output of Worcester by the number of restaurants in the city. It is reasonable to consider that Worcester's annual waste oil production figure will fall between 1.43 million and 1.57 million pounds. This produces an 8.9% error, within range to assume our data is reasonable. Once the waste oil is obtained, biodiesel synthesis can begin.

2.1.3 Synthesis

Biodiesel processing is simple, and when using waste vegetable oils, very cost effective (Zhang, 2003). There are three main components to biodiesel synthesis, including vegetable oil, methanol or ethanol, and a hydroxide catalyst (Hinerfield, 2005). The main component, vegetable oil, can be obtained from waste grease as well as fresh raw vegetable or soy oil produced for biodiesel synthesis. The main components that are produced are biodiesel fuel and glycerol. Essentially, all that is needed to contain processing are storage chambers for each component, a reaction chamber, and storage containers for final products. However, filtration is a key component when using waste vegetable oil to produce commercial quality biodiesel. Furthermore, a closed loop system where the glycerol is converted to methanol for the synthesis of more biodiesel fuels will increase efficiency, as there will be no hazardous byproduct (G.D.O. (2007)*U.S. Patent No. 7,388,034*. Elk River, MN, US. Patent and Trademark Office). By adding intricate processing techniques to the basic biodiesel synthesis model and with the incorporation of waste vegetable oils rather than virgin oils, biodiesel production can be an even more cost effective and environmentally and economically sensitive process. We describe the financial viability of biodiesel production below.

2.1.4 Financial Viability

According to an Economic Assessment and Sensitivity analysis study conducted in the Chemical Engineering department at the University of Ottawa, biodiesel when being produced from waste oil sources shows promise of financial viability (Zhang, 2003). The study examined two sources of oil, virgin and waste oil, and two methods of production, an alkali-catalyzed process and an acid-catalyzed process. Alkali-catalyzed processes are the most common commercial means for production of biodiesel, where a product such as methanol and a hydroxide are used as a catalyst for synthesis. Acid-catalyzed processes use an acid, most commonly sulfuric acid, as the catalyst for reaction (Han, Yi, Wu, Liu, Hong, Wang, 2008; Zhang, 2003). The most financially viable process is the acid-catalyzed process while using waste oil. This was due largely to a lower break-even price, and a more attractive after-tax rate of return. Using the acid-catalyzed processes with waste oil could lead to a break-even price between 160 to 220 dollars cheaper per ton than the alkali-catalyzed process using virgin oil (Zhang, 2003, Han et al, 2008). These studies determined that even though alkali-catalyzed processes required less expensive processing equipment and materials, it had a high manufacturing cost offsetting economic advantage in terms of return or break-even price (Zhang, 2003). The after-tax rate of return referred to above with regard to waste oil production involves a very common occurrence of government-mandated financial assistance and tax incentives for producers of biodiesel and biodiesel blenders.

Biodiesel production may be a financially sound endeavor for individuals interested, and there is financial assistance available to those interested in production from waste oils. Certain tax incentives, federal grants, and subsidies may be available to those willing to pursue production and use of biodiesel fuels (Gerpen, 2004). Some of the tax incentives include the Volumetric 'Blender' Tax Credit, and the Alternative Fuel Refueling Infrastructure Tax Credit. The latter provides a tax credit for those that are producing and dispensing biodiesel fuels of blends B20 or higher. The former must be completed by all biodiesel producers and blenders, which entitles them to refunds on excise tax as well as other benefits. Currently, tax credits for waste vegetable oil biodiesel equate to fifty cents per gallon which was set to expire Dec 31, 2008, but was extended another year through December 31, 2009 (Austin, 2008). Although there are further tax credits on the horizon, one can never be sure when they will run out as politics plays a large part in their establishment, and these credits often only are effective on a temporary basis before needing renewal.

Federal subsidies are available not only to farmers who grow corn and soy crops for cultivating biodiesel, but also to manufacturers of biodiesel from waste oils. Subsidies are a topic of debate, and are as such varying drastically in their availability and quantity over time. Despite inconsistent availability of tax incentives, federal grants, and subsidies of biodiesel production as a whole; biodiesel production specifically from waste oils has promise of being a lucrative and alluring alternative fuel source. That said, there are some risks associated with starting a biodiesel company, as there are with starting any type of business venture.

2.1.5 Associated Risks

This section outlines the risks associated with investment in biodiesel. Some of the risks involved in starting a biodiesel venture include a decrease in the price of petroleum diesel, leading to a decrease in interest in biofuels. Another problem could be lack of market for fuel in this area, that case would likely be caused by the relatively high temperature at which biodiesel fuel clouds and becomes incombustible, around 60 degrees Fahrenheit (Hinerfield, 2005). This requires users to keep their systems over 60 degrees in order to maintain functioning, often requiring substantial modifications depending on what they wish to fuel. Several other risks involved with starting a biodiesel production facility at this point include a lack of sources due to contracts formed between longer standing biodiesel refiners and producers. These could lead to barriers to entry such as a need for investment. A lack of operating history, financial position, and high straight vegetable oil costs due to heavy competition add to the risk of investment in biodiesel (Thompson, 2008). Perhaps the largest concern is the currently limited customer base for biodiesel. Currently, the biofuels movement is a grassroots group of people united around a common goal, and as such the customer base is rather small. In fact, only 25 million gallons of biodiesel were sold in the United States in 2004, making it less than 1 percent of the fuel market (AP, 2005). All of these factors combined could make investment in the biodiesel field a risky endeavor. Despite risks associated with investment in biodiesel, there are marked benefits to entering the biodiesel market.

2.1.6 Benefits of Investment in Biodiesel from Waste Oil

Creating biodiesel from raw corn and soy sources has been a relatively common practice over the last decade. One issue occurs when comparing this to biodiesel created from waste oil. The price of biodiesel fuel from soy and corn products is fluctuating around $6 per gallon (Rubens, 2008). Being so much higher than the price of petroleum and even petrodiesel, the question becomes from a financial standpoint, "Why use biodiesel?" The price of biodiesel is made especially high because of the price that farmers demand for their soy and corn products. In addition, the growing of corn for ethanol and soy for diesel has caused a food shortage (Rubens, 2008). With this in mind, the market is ripe for the emergence of a new, cheaper supplier for the raw biodiesel components.

Currently, there exists an industry that gathers waste oil from restaurant chains and large dining establishments and then transports it for disposal. EPOCA has an opportunity to approach suppliers of waste vegetable oil and convince them that giving the oil to a biodiesel company is a smarter alternative than having it hauled off by a disposal company. These companies may then be willing to sell EPOCA their excess waste oil, and in turn coordinate how to purchase the refined fuel from EPOCA to use to run their businesses. The money saved using this cyclical method will lower the overall cost required to profit from the biodiesel, and create a local market for refined waste oil that will reflect the national trend for increased use of biodiesel.

With matters as they currently are, there is promise that the biodiesel market will grow. There are a combination of factors supporting this market, the core of which being mandated government use of biodiesel blends, high costs of petroleum, and government incentive. In fact, the US government has passed into law that renewable fuels must account for 35 billion gallons of US consumption by 2017 (University of Illinois, 2008). This is a staggering amount in a country currently dominated by fossil fuels. In addition, this room for growth has lead many banks to give favorable loan terms to emerging biodiesel companies, because of the high likelihood for them to be able to pay it off with relative ease (Alcala, 2007). Because of this, many individuals and organizations have decided to initiate their own biodiesel production programs. That said, once the decision has been made to start a biodiesel production company, there are still many factors that need to be considered before a startup can possibly succeed. One such factor in the creation of a biodiesel distributor is the regulation put in place by the local, state, and federal government.

2.1.7 Regulatory Measures in Place

Some things that must be considered before anything can get started are the governing regulatory measures. All businesses and organizations have regulations by which they must abide, ranging from how they can secure funding to how they can distribute their end product. Adherence to governing regulations can make or break a fledgling company such as EPOCA's biodiesel cooperative project, so understanding the regulatory structure is of the utmost importance.

There are certain sets of federal, state, and local regulations that must be adhered to in order to procure waste oils, manufacture and distribute biodiesel, and handle its byproducts. The US Environmental Protection Agency (EPA) oversees federal regulations, as disposal of waste oil is considered a matter of environmental concern. This concern is due to the fact that waste oil, by definition, is a waste product produced as a result of cooking operations, and as such must be handled and treated as a waste up until it is processed and turned into clean biofuel.

In addition to adhering to federal regulations, government at the state and local level can addend laws to make stricter handling policies. These local and state regulations can be found on the Massachusetts Government Department of Energy and Environmental Affairs website. Regulatory measures for biodiesel cover a large breadth of topics, ranging from the containers in which the waste and final products are kept, and the volume of material one can transport in one trip (Boeckman, 2007). In part, this is because the byproduct of transesterization, glycerol, is a hazardous material.

This, as well as the other products involved in collection and synthesis, must be properly contained to insure that the EPOCA manufacturing plant will meet the requirements at the federal, state, and local levels. Another instance of a company that was designed to start a larger scale biodiesel production facility in the state of Massachusetts stated that it had to take the following legal actions to comply with regulations:

The project requires a National Pollutant Discharge Elimination System (NPDES) Construction General Permit and an Industrial NPDES Permit from the U.S. Environmental Protection Agency (EPA); a Sewer Connection Permit, Comprehensive Plan Approval and Waste Oil Generator Registration from the Department of Environmental Protection (MassDEP); Tank Registrations with the MA Board of Fire Prevention; Orders of Conditions from the Pittsfield and Dalton Conservation Commissions; a Sewer Connection Permit from the Pittsfield Department of Public Works and Utilities; Special Review from the Pittsfield Department of Community Development; and a Storage Tank License from the City of Pittsfield (Energy and Environmental Affairs, 2007)

Though this project was completed on a larger scale, similar provisions will exist for EPOCA in their North Grafton location. In "An Act Furthering the Biofuels Clean Energy Sector," proposed by Massachusetts State Legislatures to the House of Representatives in 2007, a BQ-9000 national biodiesel accreditation program from producers and marketers was proposed. This accreditation would be a necessary fixture for all producers and distributors of biofuels, and as such would be a necessary step for EPOCA to follow (Massachusetts Commonwealth, 2007). Additionally, several forms found on IRS.gov, including the "Volumetric Blender Tax Credit Registration Application" are required by the Internal Revenue Service (IRS) for all producers and blenders of biofuels, making it a quite lengthy task to become a registered entity.

Biodiesel is a feasible alternative fuel source when synthesized from recycled waste vegetable oil. It is cleaner burning than traditional petroleum-derived diesel fuels, lowering CO_2 emissions and particulate matter. It is easily adaptable to diesel vehicles and oil-heated homes. When produced from waste vegetable oil, biodiesel synthesis is a simple process that yields efficiently recycled fuels from otherwise landfill-bound waste. Because of the capacity biodiesel synthesis yields to benefit the environment, as well as produce jobs and increase community efficiency, it was quickly decided this could be a mechanism to be used by an organization such as EPOCA.

2.2 A Deeper look into EPOCA

EPOCA, Ex-Prisoners and Prisoners Organizing for Community Advancement, is a non-profit organization dedicated to the improvement of lives for ex-prisoners (exprisoners.org). EPOCA runs many different programs that are designed for the benefit of the community, but also focuses on helping prisoners recover after their sentences have been served. Many ex-prisoners find it hard to reenter the work force once their sentences are served, because of negative stigma from employers and members of outside society. There are also many laws enacted with regard to criminal offenders that limit their abilities after their sentences are served, specifically in the state of Massachusetts in which EPOCA was founded. One such bill is the Criminal Offender Record Information Act. EPOCA has been working hard to reform CORI because these documents are a large part of the reason ex-prisoners cannot find work. Any minor crime committed will appear on a CORI form, even those served time for, or even been acquitted of. EPOCA finds this system unjust, and has set out to resolve it. A cooperative business program is a main goal of EPOCA because of the potential it has to improve the lives of ex-prisoners now while CORI reforms have not yet come to fruition (exprisoners.org). The worker-owner scenario that forms from members proving themselves to the organization will be a positive force for the business.

2.2.1 EPOCA's Plan for a Biodiesel Business

Rather than wait for social change to come about, EPOCA is looking to create it on their own, by having ex-prisoners working alongside experienced professionals. This business, a biodiesel plant named EMPOWER, will provide training and jobs to ex-prisoners, and help EPOCA members gain some financial independence. They will gain experience in running a cooperative business in the process, and skills involved in social networking with companies involved in the waste oil collection process. Also, the ex-prisoners who will be trained for work at the plant will finally have satisfactory revenue and a skill set that will help them secure jobs in the future. The fuel itself is more ecologically friendly then regular gasoline or petrodiesel, so the project will also help the environment. EPOCA is about community advancement, and the biodiesel project incorporates many of the ideas they stand for. In order to profess their ideals and accomplish their goals, EPOCA is going to need sufficient start up funding to focus on the project.

2.2.2 Funding

Funding will be a crucial part in this process. Though EPOCA is hoping to create financial independence for the EMPOWER project, they realize that no business can start without some initial funds. The starting funds they have accrued to date are around $12,500. Though only a starting point, there are ways in which EPOCA can earn more money, and thus afford what is necessary to start a biodiesel plant. Certain programs, such as the Business and Industrial Loan Guarantee Program, will provide loans to start up companies to businesses located in rural areas, which North Grafton falls into (Gerpen, 2004). EPOCA plans to launch EMPOWER as one of their cooperative businesses. This type of business combines the need to turn profit with the benefit of sharing a common goal amongst its members.

2.2.3 The Cooperative Business Model

EPOCA has determined a Cooperative business model to be advantageous to their cause. EPOCA believes in this because owner-members feel more connected with the progress of the company and the personal rewards that will come from company progress. In a cooperative business, members are paid wages, then when a profit is attained, certain amounts of the money are divided and the dividends are distributed throughout the work force based on the time each individual invested (ncba.coop/abcoop.cfm).

Cooperatives exist to meet the needs of their members, which is appropriate for a company such as EMPOWER. Members will need to achieve certain attributes for them to be involved in the decision-making. Self-help, democracy, equality, and solidarity are all characteristics a cooperative business adheres to. Since each member has an equal voice in decisions, it is important that all members are well educated with regard to the goals of the cooperative and trained in decision-making (ncba.coop/abcoop.cfm). Members will be trained in processes throughout the whole company, rather than in one specific area, making them more knowledgeable to the company as a whole than an unskilled worker (ncba.coop/abcoop.cfm).

The relationship between a business, and its suppliers and consumers is important to analyze in order to create a successful business. Below we introduce the supply chain, which will explain this concept. In this section of the document, we focus primarily on the relationship between EMPOWER and suppliers of waste oil.

2.3 The Supply Chain

In order for EPOCA to build an effective, self-sustaining business, they will need to understand the importance of the supply chain and supply chain management. “A supply chain is defined as a set of three or more companies directly linked by one or more of the upstream and downstream flows of products, services, finances, and information from a source to a customer”(Mentzer, 2001). Put simply, a supply chain is a group of organizations dedicated to the supplying, manufacturing, and distributing of a product. The supply chain pipeline is the stream of material that passes from one element of the supply chain to the next, becoming more refined at each level (Bhaskaran, 1998). The supplying pipeline focuses on providing a raw, unrefined material to a manufacturer. The manufacturer converts this raw material to a finished product, which is then distributed to consumers through networks of distributors, warehouses, and retailers. In our application, the suppliers are producers of waste vegetable oil, such as restaurants and cafeterias, EMPOWER is the manufacturer, and the end consumer will be the customers that purchase the refined biodiesel for use in their homes, businesses, or automobiles.

2.3.1 Supply Chain Analysis

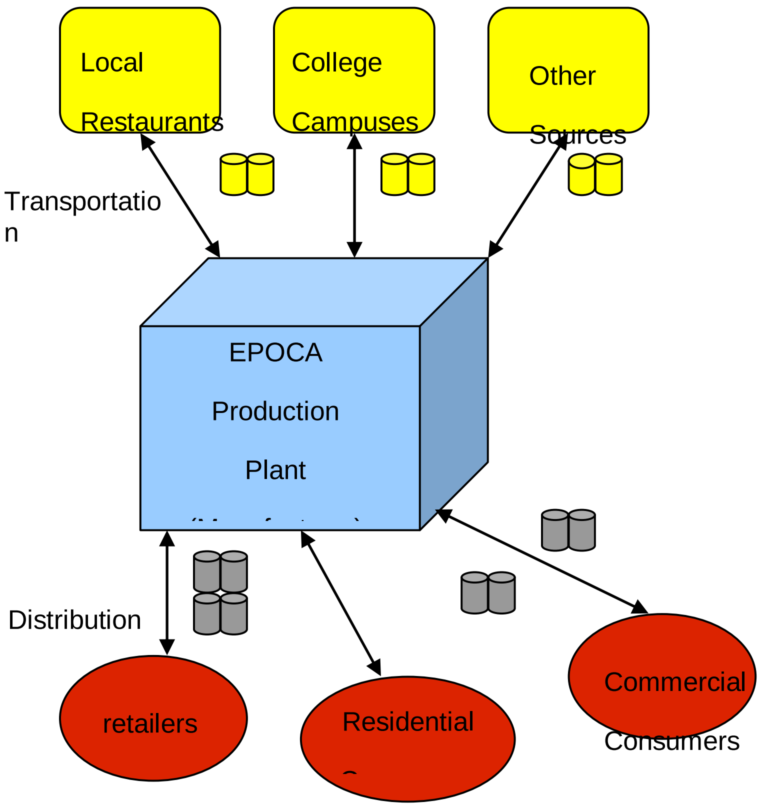

Figure 1 Illustrates the elements of the supply chain specific to EPOCA's biodiesel company.

Beamon (2000; p.2) states that "At its highest level, a supply chain is comprised of two basic integrated processes: (1) the Production planning and Inventory Control Process, and (2) the Distribution and Logistics Process." The focus of this section is on the first process, specifically production planning and inventory control. The production planning aspect of the two processes is essential because it entails coordinating the acquisition of raw materials and streamlining production (Beamon, 2000; Gerpen, 2004). Finding suppliers is a crucial first step when examining the supply chain. Before any finished product can be created, a raw material needs to be acquired for use in the production process (Beamon, 2000; Bhaskaran, 1998). Once a raw material is acquired, it must be transported to a production facility for further processing, and eventual distribution (Gerpen, 2004; Bhaskaran, 1998).

A supply chain is important in regard to the biodiesel project because EPOCA will need a detailed analysis of suppliers and consumers in order to help create a turn-key operation. EPOCA is concerned with producing biodiesel fuel from waste oil, so therefore a supply chain analysis will provide EPOCA information with regard to contacts with different suppliers, consumers, and channels of distributors. In this analysis, we will specifically be targeting suppliers. Contacts will be vital if EPOCA hopes to create a self-sustaining business. Potential suppliers of waste vegetable oil could consist of institutions such as WPI, Clark University, Holy Cross, local area restaurants, or large scale manufacturing companies, potentially including Frito-Lay, and Wachusett Potato Chip Co. Once communication is established with contacts at places such as these and a means for analysis is implemented, we can learn how many gallons of waste oil can be sold or donated to EPOCA. Also, having estimates of the amount of waste oil available will allow for an analysis of the long-term scope of this project and helps to line up supply and demand.

Once the waste oil is refined into biodiesel fuel, EPOCA will then distribute the fuel to their customers. One important aspect of this project is presenting the idea of a reiterative cycle to potential suppliers. Showing suppliers that selling their excess waste oil to EPOCA is not the only way they can benefit from this business, but in fact they can be a consumer of the product made from what they have just recently disposed of. By examining the interest producers of waste vegetable oil have in repurchasing of biodiesel fuel, a consumer base can be determined. To understand how to perform analysis, several elementary supply chain concepts were examined and adapted to fit the needs of this project.

2.3.2 Push/Pull Supply Chain Dynamics

In deciding how to effectively model the supply chain to fit the needs of the company, two techniques stand out: the push method and the pull method. The choice of method is important because different strategies may prompt different production levels or different levels of raw material acquisition. A pull system is defined as a system where production meets the needs of demand (Karmarkar, 1991). This means that production meets the demand of consumers. A major risk facing companies that focus on the pull method of business revolves around the idea of change and uncertainty (Karmarkar, 1991). This means that in the event that consumer demand far exceeds the expectations of production suddenly, the system will be essentially caught off guard. Conversely, pull systems have less worry in terms of over-production creating too costly of an endeavor. In order to illustrate the push and pull methods and their respective uses, we will use a vastly different but very often studied model for supply chain dynamics, the automotive industry.

An example of a pull system is the Kanban model instated by General Motors automotive division, in which “demand is communicated by replenishment signals sent by a customer to a supplier when the customer consumes a container of material” (Bhaskaran, 1998). The Kanban model, which is designed to exist between and within manufacturing plants, is replenishment-based (Bhaskaran, 1998). This means that the production and distribution between plants is driven by demand of the consuming plant. This prevents overproduction and over-distribution of manufactured goods. If EMPOWER were to implement the pull method by understanding the demand for biodiesel, and designing their production processes to meet that need, the process would involve understanding a consumer base. The potential risk in this method for EMPOWER would be a limitation in the production capacity should the demand for biodiesel become greater than what was initially assumed. Another risk of this project is the current price fluctuations of petroleum fuels that may increase or decrease the demand for biodiesel in rapid, unpredictable intervals. Yet another risk comes from the threat of the minimal amount of consumer research, meaning that the consumer base could be strongly overestimated or underestimated and there are no established customers.

The push method states that production can begin before the full extent of demand is realized (Karmarkar, 1991). This method can otherwise be described as forecasting (Bhaskaran, 1998). Driving the demand by creating the product initially can help hasten the deliverable from manufacturer to consumer. A Materials Requirement Planning system, or MRP, is a prime example of a push method. According to Karmarkar (1991), "an MRP system, in principle at least, attempts to offset production in time by the exact lead time needed to produce the order" (348). For instance, General Motors uses a similar model to control the 'customer' end of the supply chain. That is, they use the push method of production to forecast the demand for consumer-end products. They then produce end products in a manner most befitting the forecast prediction (Bhaskaran, 1998). This model, however, is made successful by forecast generation mathematics that enable General Motors to forecast the demand and scheduling instabilities (Bhaskaran, 1998). Software that incorporates forecast generation mathematics also creates an absolute forecast error, thereby theoretically protecting General Motors and related suppliers from dangerous overproduction when demand is not properly forecasted (Bhaskaran, 1998). By producing before the demand is fully understood, any orders that arise will be quickly fulfilled. Somewhat similar to GM, for EMPOWER this would mean developing contacts with their suppliers before they have investigated the customer base. Unlike for GM, forecast mathematics software is not available for EMPOWER. However, oil heat is an inelastic good, unlike a new luxury automobile, and therefore the demand for oil heat is likely to remain reasonably constant despite economic downturn. A potential risk of this assumption is that biodiesel will have the same inelasticity as home heating oil, which would not be the case if home heating oil's prices were to plummet. This could potentially draw consumers from biodiesel back to traditional home heating oil. Another potential risk in this method may be an improperly predicted demand for biodiesel; however as stated this is likely not to be the case, as it is being assumed that the consumer base will exceed the supply of biodiesel for the purposes of this study. Based on the research above, EMPOWER intends to employ the push method in order to meet a large consumer demand.

2.3.3 Creating Buyer Supplier Relationships

When it comes to forming a business, one must pay close attention to all aspects of the supply chain. However, in the early stages it is important to secure a reliable supply, especially if the push method is to be incorporated. There are multiple methods of going about this vital step, and the procedure one should follow is directly related to the type of relationship one wants to have with their suppliers. The two main types of buyer-supplier relationships that we will focus on are arm's length, in which businesses interact on a strictly business level only, and collaborative businesses, in which businesses form long term relationships based on trust and social institutions. Both of these relationships have associated benefits and drawbacks (Hoyt, 2000; Mudambi, Helper, 1998). In determining the benefits and risks of both methods, we will again examine the automobile industry. In particular we will cross-examine the US and UK auto industry with the Japanese auto industry, which tend to follow an arm's length and collaborative approach, respectively.

2.3.3.1 Arm's Length Relationships

An arm's length model of supply chain management is defined as lessening the dependence on the suppliers in order to strengthen bargaining power. By keeping suppliers at an "arm's length", any lasting relationships or commitments that may hurt a company's purchasing strategies can be avoided (Dyer, Cho, Chu, 1998; Hoyt, 2000). The American car industry is known to incorporate an arm's length approach, with leaders such as General Motors (GM) citing that they use that very model (Dyer, Cho, Chu, 1998). The benefits of arm's length relationships can be seen by examining the ways companies such as GM, or other US automakers, conduct their business.

One of the main benefits to using an arm's length relationship is the ability to create a demand for services rendered, essentially creating a bidding war among suppliers. Having multiple suppliers looking to remain in business creates a market that allows for the lowest possible price in acquiring the raw material you need. General Motors incorporated this strategy and saved more than three billion dollars. GM's managers renegotiated contracts to create a bidding war amongst the suppliers whom GM bought from, which resulted in reduced prices for the goods and a large amount of money saved by GM (Dyer, Cho, Chu, 1998). If EPOCA can secure the initial supply necessary to began production, they can then create a demand of service from future suppliers looking to sell or donate their waste vegetable oil to a reputable source.

Another benefit to using an arm's length relationship is the low levels of trust and information sharing allow the company to switch to a supplier with comparable quality and lower prices without damaging the relationship (Dyer, Cho, Chu, 1998; Mudambi, Helper, 1998). In the US auto industry in particular, suppliers have realized that if a more competitive supplier presents itself, their customers, the automakers, will be more inclined to switch business in order to cut costs (Mudambi, Helper, 1998). This understanding does not damage the relationship because the expectations were low to begin with. The lack of trust, though seemingly a negative, turns out to be a positive force by creating a demand from the suppliers to maintain business with the manufacturer.

When creating a business, keeping the costs low to start will help in further development. An arm's length approach uses short-term contracts and frequent rebidding in order to ensure low short-term costs. Also, low levels of trust, investments and information sharing allow for changing of suppliers when necessary, without fear of damaging any relationships, and preventing further business between companies from taking place (Dyer, Cho, Chu, 1998). Low short-term costs can be very beneficial to a start-up company by helping to maximize profits, which early on can be very scarce.

There are some risks associated with using a predominantly arm's length approach when creating buyer-supplier relationships. The lack of trust and information sharing may result in suppliers feeling mistreated, and ultimately wanting to take their business to another customer. Also, bidding wars can hurt supplier relationships and result in a loss of business (Dyer, Cho, Chu, 1998; Mudambi, Helper, 1998). Learning how to balance the arm's length relationships, while maintaining some levels of trust is becoming a prevalent theme in the auto industry today (Dyer, Cho, Chu, 1998; Mudambi, Helper, 1998). An initial venture into arm's length relationships will allow for EPOCA to focus on low initial costs, and more time and resources dedicated to their business, as opposed to forming a long term relationship with their suppliers. However, there are certain situations where the balance between arm's length and business collaborative becomes necessary in order to ensure a continued business.

2.3.3.2 Collaborative Business

The opposing method to developing arm's length relationships is developing collaborative relationships. These relationships generally exhibit a longer duration and increased stability over arm's length relationships (Cusumano, Takeishi, 1991). "Supply chain partnerships that exhibit trust and cooperation will remain intact during periods of extended economic recession"(Hoyt, 2000, p760). As the article suggests, a strong collaboration with trust between two companies should help hinder the urge to break deals to meet short term economic needs or gain short term benefits (Hoyt, 2000). One example of a collaborative business model is the relationship between Japanese automakers and their respective suppliers. Whereas the American automotive industry has traditionally held annual bidding wars between suppliers of parts to find the least expensive parts that they could, Japanese automakers have traditionally only held bidding wars every two to four years, and often rate their suppliers and continue their engagement longer than the initial contract states (Cusumano, Takeishi, 1991). Japanese automakers also use fewer suppliers for their parts than American automakers traditionally have, and the suppliers whom Japanese automakers have purchased from have their own set of suppliers, which creates pyramid integration (Cusumano, Takeishi, 1991). This means that, rather than buying from many suppliers of low-level components like the American automakers do, Japanese automakers have a closer relationship with each of their suppliers, and fewer suppliers as well. These suppliers are more likely to produce parts developed specifically for the Japanese automakers for ease of integration into their systems, rather than creating their own proprietary parts that are not built to supplier specifications (Cusumano, Takeishi, 1991). The close relationship of Japanese automakers to their suppliers also led to a more rapid increase in technological advances, as the suppliers were pushed to create more advanced components to maintain the relationship. This close relationship also led to a dramatic decrease in pricing, as Japanese automakers worked closely with their suppliers to help them refine their components and manufacturing processes in order to hit 'target pricing' that the automakers would set (Cusumano, Takeishi, 1991). With regard to EMPOWER, collaborative business relationships would entail close relationships with their individual suppliers that could result in a long term involvement and a reliable and mutually beneficial agreement.

Another representation of collaborative business is explained in "The 'Close but Adversarial' Model of Supplier Relations in the U.S. Auto Industry," written by Ram Mudambi and Susan Helper. Arm's length and Collaborative business, which they refer to as formal and informal commitment respectively, are differentiated and explained in context of each of their practical applications. Formal commitments, comparable to arm's length relationships, are enforceable by legal means. Informal commitments, comparable to collaborative relationships, are closely based on trust (Mudambi, Helper, 1998). Like collaboratives, informal commitments require implementation of a social institution as opposed to simply a legal institution and cannot occur spontaneously (Mudambi, Helper, 1998). This article also notes that Japanese automakers have tended to use informal commitments which have led to a decrease in changing of parent companies, as well as a decrease in the pricing of supplier goods and increase in supplier good technology (Mudambi, Helper, 1998). This article however, stresses the need for supplemental formal mechanisms to decrease the vulnerability associated with weakness of modern social institutions (Mudambi, Helper, 1998). This example, coupled with the former example, should serve to illustrate collaborative business methods, their strengths, weaknesses, and applications. For EMPOWER, the collaborative may result in a decrease in the price of the oil they are buying, or a set price that can withstand economical downturn or other unforeseen events in the future. There are certain other factors involved that will decide how well either one of these business relationship models will work. These factors are discussed in detail below.

2.3.3.3 Creating a Successful Business Relationship

For producers of waste vegetable oil to be willing to enter business with a biodiesel manufacturer or any company that acquires waste vegetable oil, certain factors must be considered to convince the supplier that the business opportunity is worthwhile. When entering into a formal contract, the quality of service is a deciding factor in whether or not an agreement can be reached. The factors that influence service quality positively or negatively include price, professionalism, responsiveness, availability, timeliness, and completeness (Hayes, 1992; Zeithaml, Parasuraman, Berry, 1990). Understanding how these factors can improve the quality of service, and ultimately the business relationship, are important tasks. We will consider EMPOWER to be delivering a service of removal to the producers of waste vegetable oil. This is a simplified model, but can be used to describe the necessary actions EMPOWER will need to take when compared with the service industry. These requirements will be more stringent for the service industry, as they are being paid to provide their service. EMPOWER is collecting the waste oil for their own benefit and likely not being paid to do it, however following the obligations which bind members of the service industry may help EMPOWER to compete in the market of waste oil collection.

a. Importance of Price

One of the first parameters to forming a relationship between two businesses is the price of service from one company to the next. By examining the prices competitors are using when dealing with suppliers, a competing price point will be established that meets not only the needs of the target suppliers, but ensures the companies' expenses will be met (Zeithaml et al., 1990). All of this pertains to EMPOWER in that they will need to agree upon prices to acquire waste oil from suppliers that are competitive with other persons wanting to acquire waste oil, and at the same time set the price low enough that it will be cost effective to run their business. Having a price point established so that EMPOWER can understand what price it will need to acquire waste oil at in order to profit from finished biodiesel will then allow EMPOWER to focus on other necessary aspects of the agreements, such as availability and responsiveness.

b. Availability and Responsiveness of Support

Having support readily available to face any situation that arises is an important factor when forming a business relationship. If a supplier can quickly contact their service provider, and there is trained staff available to help them, they will be more inclined to enter into a business arrangement (Hayes, 1992). Open lines of communication will be beneficial to the supplier by allowing for support when necessary. Also, the service provider strengthens the relationship with the supplier, which can increase future business. It is important that each party's objectives are met and each party is satisfied by the relationship, which is established by proper communication (Cannon, 2001; Carr, 1999). Also, a quick response to the needs of the supplier is a very effective way to strengthen the relationship between the two parties. Immediate help or delivery of service can be a deciding factor when forming a business relationship (Hayes, 1992; Zeithaml et al., 1990). In the case of EMPOWER and its relationships, it may be important to both parties to be able to reach each other quickly in the event of an out of schedule pick up or other occurrence.

c. Professionalism, Complete Removal and Timeliness

Professionalism, completeness (doing a complete job), and timeliness are important in a successful business relationship. These traits are common aspects of customer satisfaction associated with the service industry (Hayes, 1992). The staff of a service company is expected to act in a professional manner, including but not limited to courtesy, attentiveness, and respect for the clients of the customer or company requiring service, and this will be the same for

EMPOWER (Hayes, 1992; Zeithaml et. al, 1990). Completeness, or (in this case) the complete removal of all of the contractually-required grease, is another important aspect of customer satisfaction associated with the service industry. Staff of a service company that are complete in their service will be sure to have completed everything promised by their representative company, and the servicing company will be sure that every aspect of the service is completed. Completeness, in this sense, is critically important with regard to overall customer satisfaction as the job will be incapable of meeting the customer's expectations if the entirety of the service is not completed. Timeliness, defined as "the degree to which the job is accomplished within the customer's stated time frame and / or within the negotiated time frame,"(Hayes, 1992, p. 8) pertains in the service industry to the completion of a service within a given time, the meeting of deadlines, and the completion of all associated responsibilities within their given time frame (Hayes, 1992).

Adapted to EMPOWER, there is little change in the definitions of professionalism, completeness, or timeliness. Wherein this case EMPOWER would be representative of the service company and the suppliers of waste vegetable oil would represent the customers, EMPOWER would still need to have the actions of its employees represent professionalism. In this case, it will be observed in greater detail the necessity for completeness of service in the methodology chapter of this document. Timeliness will also need to be discussed further in the methodology chapter of this document to determine the actual degree of importance in this particular instance.

2.4 Conclusion

EPOCA is a non-profit organization that is dedicated to improving the lives of ex-prisoners. They strive for social justice and policy changes in their community, and the resultant betterment of the lives of their members and other ex-prisoners. They have organized a project to start a cooperative business that will collect waste oils of little or no use, and turn them into a clean-burning fuel known as biodiesel.

Biodiesel is a fuel made from renewable resources that is cleaner-burning than traditional petroleum diesel and non-toxic. It is made by combining a virgin or waste vegetable oil or an animal fat with an alkali such as methanol and a hydroxide base. Not only does biodiesel lower carbon emissions, but it reduces dependence on foreign oil and reduces the damage done by domestic and foreign drilling. EPOCA plans to create a biodiesel production facility not only to better the lives of its members, but also to improve the local economy and reduce stress on the environment. This project is a testament to their dedication to community and social change.

In order to be successful in this endeavor, EPOCA has to resolve a variety of issues. Firstly, EPOCA has to establish a network of suppliers of oil so they have raw material to work with. Secondly, a facility has to be established in which biodiesel production can actually commence. Finally, EPOCA has to raise awareness as to the benefits of biodiesel and create a customer base to whom they will sell their biodiesel. As the marketing group, our responsibility is to aid in the implementation of the supply chain model through which EPOCA will receive the raw oil.

There are several different means by which business is conducted in modern economies. The push and pull methods are two different means to determine production and assume demand. The push method assumes the demand will be met and produces to meet the predicted demand. The pull method produces to meet the demand that has been determined by initial studies or previous demand. With regard to professional relationships, two methods can be observed for conducting oneself as a business. Arm's Length relationships and collaborative relationships are two different means to approaching business relationships. Though the former is founded in contracts and legal obligations, and the latter is founded in social obligation, trust, and close-knit relationships, the two methods can complement each other in a combinational manner, an example of which can be seen in the prosperous Japanese Automotive Industry. Regardless of the type of relationship which is formed, there are several factors which must be carefully observed. These were adopted from customer satisfaction parameters in the service industry. Several factors which must be carefully observed include professionalism, completeness, timeliness, availability and responsiveness of support. EMPOWER can use these lessons to understand the means for most properly forecasting and accounting for the demand. EMPOWER can also use these lessons to create a business that functions to meet their needs in terms of relationships with other businesses, and the means by which their employees and business as a whole conduct themselves in a professional setting. We decided to investigate these requirements, as well as contractual requirements that waste oil suppliers might have in the methodology section of our report.

3.0 Methodology

In the Background and Literature Review chapter we discussed key supply chain elements of the biodiesel project. Our research for this project focused on determining the availability of a supply of waste vegetable oil (WVO) in the Worcester and North Grafton area. This is important in that it helps determine whether there is a large enough supply of WVO for our sponsors to support a business of this type on a scale consistent with their needs. The following chapter described the methods used to further initial research and gather information that would confirm the suppositions from restaurant extrapolation discussed in the background chapter.

This Chapter will focus primarily on three methods of primary source data collection; the survey study for small-scale suppliers, questionnaires for large-scale suppliers, and a pre-production cost analysis. Each of these methods was devised from our necessity to answer our primary research questions. For example, the small-scale supplier survey study estimated the amount of waste vegetable oil currently available to supplement the notion that the process will not be feasible if there is not a sizeable volume of waste vegetable oil. Likewise, the large-scale questionnaires determined the feasibility of contact and involvement for EMPOWER with large-scale vegetable oil suppliers. Lastly, the pre-production cost analysis was an examination of the costs required before production could begin at their facility. This analysis will take the form of a linear flowchart to be completed and compiled with production costs by EPOCA in order to do a cost/benefit analysis. The cost/benefit analysis will be an effective tool for EMPOWER to use for price-point setting and feasibility of the process. To start our primary source research, we began by developing a set of survey questions to be distributed to local producers of waste vegetable oil.

3.1 Survey/Demographic Study with Statistical Analysis for Small-Scale Suppliers

3.1.1 Rationale and Justifications for Surveying

Research with no direction is a daunting and ineffective task. It was necessary for us to determine the most efficient and befitting means for the research task. To start, we wanted to gather information from small-scale waste vegetable oil suppliers with regard to the availability of oil and interests of suppliers, which we planned to interpret by type of restaurant. We decided that the use of survey questionnaires would be the most appropriate method of reaching a large sample as it would be less time consuming than doing individual case studies, observation, historical analysis, or interviewing.

3.1.1.1 Alternative Means for Data Acquisition

Each of the potential alternatives that we assessed had, in some way, a critical flaw that made them inappropriate for our needs. We needed to collect information from many different small-scale suppliers in order to procure an appropriate sample in a very short time period. In order to answer our one of our research questions, the desires of waste oil suppliers in contractual obligations, we needed information with regard to their interests in negotiating a contract with a company that is obtaining their waste oil, as well as the amount of waste oil they had and other general information pertaining to their waste oil disposal regiment. Case studies would not be as useful as the results of these types of studies cannot be generalized beyond the case in which they were examined (Yin, 1994). Observation of many different small-scale suppliers would be far too time consuming and breech upon each subject's right to privacy, and may not get the necessary information with regard to suppliers' desires in contracts. Historical Analysis, or the assessment of change and continuity over time using any existing records (Interdisciplinary and Global Studies Division [IGSD], 2006), could have potentially answered some of our questions with regard to different size restaurants and their output of waste oil as well as their needs and desires in a contract. However, even if these records did exist they would be time consuming to research and validate and there is always the possibility that they would not be as accurate or as up to date as our method of surveying local businesses. Interviewing was another possibility; however the time and cost associated with the hiring, training, and compensation of professional interviewers to avoid potential problems associated with this method far exceeded the benefits of this design (Frey, Mertens Oishi, 1995). The professional interviewers would be required for small-scale producers of waste oil because of the difficulty we would have in meeting the time constraints to interview each small-scale producer, whereas this method would be feasible if the sample size was much smaller such as the case of the large scale suppliers. After careful evaluation of each methodological alternative, we concluded that writing a survey questionnaire to distribute to many small-scale producers of biodiesel would be the most efficient means of data collection in regard to said producers.

3.1.2 Design of Survey Questionnaire

The survey questionnaire needed to be carefully developed following guidelines that would help us create questions that would be useful to our analysis, as well as maximize the number of responses that we could achieve from our target sample. In order to create survey questions that would be useful for our analysis, we needed to first consider what the resultant goals of the survey would be (National EMSC Data Analysis Resource Center [NEDARC], 2006). By deciding what we hoped to accomplish by the administration of this survey questionnaire, we could more easily create the questions that would get us that answer.

We decided that the use of this survey would be to collect information by restaurant type. This would help us determine the availability of waste oil by type of restaurant, as well as the interests of waste oil producers with regard to contracts, scheduling, pick up frequency, and related factors. Analyzing data by this method would allow EMPOWER to have a general understanding of availability by restaurant type so they could narrow their focus during initial source acquisition and extrapolate these data over a broader spectrum should they expand their range of source collection in the future. For this reason, it was necessary to create questions that would allow us to know the traffic each restaurant in our sample had, as well as their typical volumetric production of waste oil over a given duration and the type of oil the restaurant uses. We also chose to write questions that would make clear what each restaurant in the sample would look for in dealing with a collector of waste oil, their current situation and willingness to provide waste oil to a company making biofuels, as well as their interest in repurchasing their waste oil in the completed form of biodiesel.

The survey then needed to be assessed for brevity, leading questions, clarity and specificity of the questions, and proper formatting. Brevity will increase the number of responses by making the respondents more inclined to answer the questions because the survey will require less effort (Buckingham, Saunders, 2004; Frey, Mertens Oishi, 1995). The questions had to be worded in an unbiased manner to eliminate the risk of leading the respondent and be clear and specific enough that the respondent did not misunderstand and give a false response (Frey, Mertens and Oishi, 1995). The questions needed to be formatted clearly so the respondent could easily answer. That is, a question phrased simply "What is your current situation for waste oil disposal?" could refer to frequency of pick up, location of pick up, or containers currently used for pick up. More specific answers will be more useful to us as a comparison mechanism. As an example of a formatting method used to develop clear and easily analyzed questions, many of the questions used a Likert Scale, which allowed the respondent to select his or her most prominent likes, dislikes, interests, or inclinations relative to comparable variables with a clear scale typically ranging from one to five (Buckingham, Saunders, 2004; Frey, Mertens and Oishi, 1995). Other questions, wherever possible, were answered simply with a yes or no response for ease of analysis, or multiple-choice responses using ranges when questions involved numbers (Buckingham, Saunders, 2004).

Once the survey questionnaire was complete, it was necessary to test and implement the survey. In order to test the survey, we submitted drafts to friends and family members to read and check for coherence. We then took a small number of surveys and submitted them to local restaurants to test them for any potential problems with understanding or length of the survey. We found that a three-page survey was discouraging to most of our initial respondents. We then made pages one and two front and back, conserving paper and making the survey appear shorter. The survey design process required developing a sample size and location. As the project would be based in North Grafton and was designed to benefit the Worcester community, it was reasonably clear that the data would be most useful if obtained by surveying the Worcester community. In the following section, we will discuss specifically how we set about developing an appropriate sample in terms of size and location.

3.1.3 Survey Sampling

To determine our sample size we sought to determine what would represent our target population. The representation of a target population is dependent on many things. The main areas focused on were the sample frame and sample size (Fowler, 2002; Buckingham, Saunders, 2004). By carefully determining the size and frame needed to reach the population we were targeting, we would be able to increase the precision of our results. This allowed us to extrapolate our results to the full population we were targeting, which is small-scale suppliers of waste vegetable oil (Fowler, 2002). By breaking this information down, we will demonstrate why sample frame and size are important.

3.1.3.1 Determining Target Population for Sample Frame

In determining the sample frame we used, we first had to investigate the target population we were trying to reach. For the purpose of this survey, our target population happened to be small-scale suppliers of waste vegetable oil. Examples of suppliers would be restaurants or institutions such as WPI. The reasoning behind this sample frame is the need for accurate responses from people who deal with removal of waste vegetable oil first hand. Though not complicated, the questions relied on knowledge of removal of waste vegetable oil, and the business associated with companies hired to dispose of it. Sample sets can be defined as, "…a set of people who go somewhere or do something that enables them to be sampled" (Fowler, 2002, p.12). This implies that a supplier of waste vegetable oil is more apt to answer questions related to the removal of WVO as opposed to someone with no experience in the process. Having selected our sample frame, the next task we faced was choosing the size of our sample.

3.1.3.2 Determining Sample Size

While attempting to keep our target demographic confined to the Worcester and North Grafton areas, we used the Yellow Pages to find that the quantity of restaurants available for us to choose from would be in the 300 to 350 range. With a population this small, typically a small sample would suffice, but for us this was not the case. By splitting our sample up into types of restaurants, we aimed to pinpoint the type of restaurant that would be most appropriate for EMPOWER to target as a source of WVO. Depending on the outcome of the results, we aimed to have 5 different categories of restaurants to analyze. These 5 categories were Chinese, Seafood, ‘Mediterranean’, ‘take-out’, and ‘sit-down’ restaurants. We made the assumption that a Chinese restaurant would have different waste vegetable oil production quantities than a Seafood restaurant, for example. We also assumed that a ‘take-out’ restaurant, such as a McDonald’s, would serve a much higher population than a ‘Mediterranean’ restaurant, which we chose to define as Italian, Greek, or other similar restaurants. We hoped to conclude that a higher number patrons served would result in more WVO produced. To establish these categories we decided to investigate a heterogeneous population instead of a homogeneous. A homogeneous population, which would include a similar population, such as people around the same age, allows for smaller samples. However, a heterogeneous population does the exact opposite and requires a larger sample to procure accurate results (Fowler, 2002; Buckingham, Saunders, 2004). In order to determine the sample size, we started with the assumption that there were approximately 336 restaurants (including cafeterias) in the city of Worcester and 14 restaurants in North Grafton, with the data from North Grafton being taken from a Super-pages database. This figure, totaling 350 restaurants and cafeterias could be used in determining our sample size. From this, we would have to factor that we will be stratifying this data by restaurant type. Following the assumption that we will be able to collect nearly as many questionnaires from each type of restaurant and college campus demographic, we had to divide this total by five to represent our stratification. Using a formula for determining sample sizes, outlined in Figure 1 in Appendix 1 of this document, we concluded that it would be necessary to gather information from 12 restaurants for each restaurant type. This figure resulted from assuming a 95% confidence level, a 9% margin of error, and an estimated convergence of data of 85%. We determined from this an approximate total sample size of 60, and making the assumption that there were roughly the same number of restaurants of each type in the population size; we concluded that there should be 12 restaurants in each category in the sample set.

3.1.4 Obstacles in Data Collection

There were many obstacles to overcome before the data could be collected and analyzed. When conducting research that involves human subjects, as surveys do, it was necessary to get approval or exemption in order to proceed with the questioning. For us, this involved approval from the WPI Institutional Review Board (IRB) in compliance with the National Institute of

Health's (NIH) regulations and guidelines. In order to gain exemption from review, and be able to conduct our research, we needed to submit our final draft of our survey, as well as an application for exemption. Upon receiving exemption, we began distributing the survey.

As the survey distribution progressed, we found it difficult to obtain completed surveys from local area restaurants. We attributed this in part to a lack of qualified persons on site. In addition to this, lack of interest, lack of time, and length of survey all posed potential issues for our respondents. Because of this, surveys took a significant amount of time to collect and our response rate was lower than we had anticipated. More than ninety surveys were distributed by hand, with only 30 usable surveys collected. The survey administration took more than 100 hours. In order to supplement the low number of survey responses, we administered an electronic version of the survey, using Qualtrics, and distributed it to approximately thirty local area restaurants via email. The email addresses were gathered by viewing online listings for local area restaurants and pulling from the contacts given, which proved to be an unreliable source. Online survey distribution yielded no usable results and a number of the emails were classified as undeliverable, either due to an incorrect email address or because of spam filters. Beyond issues with response rate, there were issues with how to effectively distribute the survey while adhering to the constraints of location, human resources, and confidentiality.

3.1.4.1 Obstacles in Determining Sample Location

In order to gather the most accurate results to fit the demographics we were targeting, we needed to distribute and collect a large amount of surveys. Though our area was confined to Worcester and North Grafton, the travel required would take far longer than the project deadlines would allow for. To compensate for the time constraints we faced, we opted to increase the amount of human resources at our disposable. Rather than have the primary project members be accountable for the fifty or so observations we strived to collect, we elected to recruit the help of our sponsoring organization, Ex Prisoners Organized for Community Advancement (EPOCA), to collaborate with us in the process.

3.1.4.2 Obstacles in Training of Survey Administrators

Because of the validity of the data would be at risk if a survey administrator were to answer a respondent's question in leading way or direct a respondent's opinion, training of the

EMPOWER members was necessary in order to ensure the proper guidelines were met, and the surveys received optimal results. As survey administrators, we would all be responsible for locating and gaining the cooperation of respondents, as well as answering questions they may have, and probing them to complete answers they may be unsure about (Fowler, 2002). Because of the potential complications that could arise from having many different people with minimal training administering the surveys vocally, we opted to have the survey questionnaire be issued on paper and read by the respondents. Because studies have found that only one meeting often provides for ineffective administrators, and thus inaccurate results (Fowler, 2002), an additional meeting was scheduled to allow for discussion and ways to improve, before the full scale distribution of the survey occurred. Due to time constraints, the survey was conducted entirely by our group and the secondary meeting was not scheduled for several weeks. An important aspect of the survey that needed to be discussed in the second meeting with the sponsor was the conflict of interest between the need to identify potential suppliers, and the requirement of keeping confidentiality.

3.1.4.3 Issues of Confidentiality

In order to get a review exemption from the Institutional Review Board, (IRB), we agreed to keep the identity of the respondent, the person who is completing the survey, confidential. Unfortunately, confidentiality would hinder the ability to identify those interested in selling or donating their waste vegetable oil to EMPOWER, our sponsor. In order to resolve the situation, we allowed for a voluntary release of personal contact information that would be separated from the survey severing any link between the respondent and their answers. What this release would do for EMPOWER is provide contacts of people interested in either biodiesel, or receiving of the survey results. For people interested in biodiesel, EMPOWER can then correspond with them over the project they are undertaking, and the possibility of business between the two companies forming. Targeting restaurants that do not provide contact information will still be possible however. For those who do not provide any contact information, we can still use the data collected to stratify the results by the type of restaurant. By stratifying the data by types of restaurant and observing the mean values for each type, we can make observations that will allow us to predict the overall qualities of each type of restaurant. This method of data analysis will help EMPOWER to target restaurants by type as opposed to individual restaurants, but will still narrow their search for available waste vegetable oil. Looking at availability by restaurant type allows EMPOWER to pursue contracts with restaurants which will likely have more WVO available than going after leads with little potential.

There were several obstacles that presented themselves from early on in the process of data collection using our survey. It was necessary to protect the respondents and their confidentiality, as well as train survey administrators to not put the respondents in a situation where they may have been forced to breech their confidentiality. Despite this obvious risk, it was necessary to deploy survey administrators to deal with the time constraints and our inability to cover enough ground to effectively distribute enough surveys to obtain the desired number of responses. After the obstacles of the data collection had been overcome, and the data was collected, analysis of the data could begin.

3.1.5 Analysis of Data, Stratification of Sample

After data had been collected it had to be analyzed in order to achieve meaningful information. Due to the nature of the survey three main methods of analysis come into play. These methods will be used to draw conclusions based on how much oil restaurants use and how much they may have available for EMPOWER to pick up. From this information, EMPOWER will be able to focus their efforts on particular restaurant types in order to maximize the efficiency of their efforts.

The first analytical procedure is to find the means and standard deviations of the relevant response data. The mean, which is an average of a set of data, is needed to discover the total volume of oil one could expect from a certain type of restaurant (Petruccelli, 1999). The standard deviation value will illustrate how far from the described mean the endpoints of the data set strayed, thereby confirming or refuting that the mean is an appropriate representation. Taking this information into consideration will greatly streamline the efforts of individuals when they go out to restaurants and ask for waste vegetable oil. This will help EMPOWER focus their efforts on types of restaurants which go through large volumes of oil, rather than waste time pursuing smaller volumes at greater distances. The means of the data sets are more useful to the study than other descriptive measurements, such as median or mode, because the mean shows the average result, not just the most prevalent or the middle value in the data set.

After means had been established, the next step was to see if quantitative differences were statistically different. This was accomplished through the use of an independent two sample T-test, a statistical test that can be used to determine whether two samples of an assumed equal variation are statistically different. In short, a T-test is the comparison of two full sets of data in order to discover how different the sets actually are from one another. The two samples can be of the same size or different sizes, but must be of equal variance in order for the two sample unpaired t-test to work. A small sample size or an outlier in one or more of the samples may cause the data to become skewed. As such, it is necessary to create a graph to plot the data, preferably a box plot to visually assess spread of responses or the presence of an outlier. We ran our t-tests using SPSS statistical analysis software.

First, we ran a series of two-tailed independent sample t-tests in SPSS. We used these because they were capable of determining if two sets of data are statistically indifferent (the null hypothesis), or statistically different. Using this test we could determine if there was any statistical difference between the types of restaurants that we grouped our data into. Secondly, we had designed to check our pre-established groupings using a K-means cluster analysis. This type of test takes data, and groups it into clusters. We intended to use the plot it produced to visually determine whether or not our clusters (or types of restaurants) were accurate. We found that in practice, this method was impractical because of the small sample sizes, a high level of variance for each type of restaurant, and a high standard deviation.

The two-tailed independent sample t-test function in SPSS also provides the user with two sets of means for the samples being compared, as well as a standard deviation value. Because these were included, we did not need to run separate commands to find them. The mean and standard deviation could then be used for each group to determine the overall impression that each group had for each question. We can analyze these by hand, against each other, to determine the best type or types of restaurants for EMPOWER to pursue. Through SPSS, we determined which variables ended up being statistically different when comparing different restaurant types.

The process of survey distribution was deemed most appropriate for outreach to small-scale suppliers in our project. In order to begin our survey distribution, we needed to assess the alternative means for data collection to determine that a survey was the most appropriate means to reach our large target audience; which we deemed it was. We encountered several obstacles in the course of administering our survey, most noticeably a lack of interest from the local area restaurants. . We collected our data for analysis by restaurant type. After the data was stratified and assessed, it could be used by EMPOWER to target restaurants by type and narrow their search for WVO. While we were compiling information from small-scale suppliers, we were simultaneously collecting information from large-scale suppliers as well.

3.2 Interviewing of Large-Scale Suppliers

3.2.1 Rationale and Justifications for Interviewing

3.2.1.1 Why Choose Interviewing over Alternative Methods

While surveys may be adequate for reaching out to a large breadth of demographics, another data gathering method must be applied when one wants to get complete and detailed information from a specific source. . In cases like these, one can hold a personal interview with the target population in order to maximize responses and increase the usefulness of the data. The presence of large-scale manufacturers in Massachusetts means that there was a potential for large volumes of waste vegetable oil in concentrated locations. Several of the large-scale manufacturers that we made contact with included Frito Lay Potato Chip Company, Wachusett Potato Chip Company, Cape Cod Potato Chip Company and Gorton's Seafood. It was extremely important to include these sources within the data collection process, but the general survey aimed at restaurants was incapable of sufficiently probing the possibilities (Ipathia, INC, 2008). Because of time and travel constraints, we opted to conduct our interviews over telephone rather than scheduling in person interviews, discussed in greater detail in the obstacles section below. These phone interviews were shortened versions of our survey for small scale suppliers, with more emphasis on quantity, current contracts, and price of raw oil. These changes to the survey were included because of the differences between small and large-scale producers, outlined in greater detail below.

3.2.1.2 Alternative Means for Data Acquisition

Restaurants and large-scale production companies are extremely different entities, and what works for gathering information from one may not work for the other. All data collection methods have inherent strengths and weaknesses, relative to the requirements of the study. For example, while there were hundreds of restaurants in the city of Worcester alone, there were only a handful of large scale production companies in the state. We identified several companies that operated locally, and made contact with them. It was because of the small number of large-scale producers that while surveys are adequate for the vast number of restaurants, there simply were not enough respondents to make a survey beneficial, in terms of statistical analysis, when presented to a large-scale production company. However, in this case the personal interview becomes a strong alternative for data collection. While inefficient and impractical for someone to hold a personal interview with every restaurant manager, it became far easier for one to get meaningful information when presented with a handful of targets. In addition, the information needed from restaurants and large-scale producers was inherently different. Large scale manufacturers have a completely different business plan than local restaurants, with different goals and procedures. We did not need to acquire information about how long they've been in business, or how many patrons they have. As such, the nature of the question changed to how willing a company is to part with their oil and the requirements they had for doing so. Personal interviews allowed for a much more individualized response, tailored specifically to the relevant data on a case by case basis (Bailey, 2007; Interdisciplinary and Global Studies Division [IGSD], 2006).

3.2.2 Obstacles in Data Collection

Although there were many benefits to utilizing interviews for large-scale production companies, there were also a variety of obstacles that may hamper data collection. The largest obstacle was time, in that large production companies tend to have their calendars scheduled far in advance. In order to hold an interview, we must first had to identify the individual within the company we needed to contact, actually contact the individual and then schedule a mutually acceptable time for the interview to take place. In addition, there would be time needed to actually travel to the site, hold the interview, and then leave. The respondent has to schedule off a block of time they usually have available for whatever use they need. This could potentially become a problem if an interview runs longer than previously anticipated, forcing the said interviewer to rush or leaving the interview incomplete. Phone interviews were also a possibility, but there still remained the issue of having to schedule a mutually acceptable time for the interviewer to contact the respondent. As a whole, the personal interview process takes far longer per individual response than a survey would, but it was necessitated by circumstances. Aside from time constraints, personal interviews are also troubled by interviewer bias. Everything the interviewer says and does can affect the respondent's answers, potentially changing results. As such, it is imperative that the interviewer remains as unbiased as possible when carrying out the interview. Lastly, personal interviews lose the main benefit surveys have, their anonymity. The nature of an interview makes it impossible for the respondent to remain confidential, potentially affecting how they respond when questioned (Bailey, 2007).

Because of these issues, particularly time and travel constraints, we found it more convenient to conduct phone interviews with our large-scale supplier contacts. This method of contact allowed us to save time driving to large-scale suppliers, saved us from having to schedule appointments at said facilities, and appeared to have given the impression to the respondent that the interview would be less time consuming than if we had scheduled an appointment. Another key issue encountered is what defines a large scale supplier. Of the companies originally considered large scale, the volume of waste vegetable oil produced on a weekly basis could be described as nothing but small. While companies such as Frito-Lay put out large volume of product, the waste oil they produce is actually extremely small when compared to the production of food from restaurants. These large-scale producers typically were able to recycle a vast majority of the oil used in their processes, leaving very little available for pickup.

3.2.3 Stratification of Sample and Analysis of Data

Due to the nature of the interviews, with a small sample size of individual responses, statistical analysis will be impossible to incorporate. There is no real need to draw overarching conclusions based on the averages for waste vegetable production by drawing in the means of the quantitative data because generalizations cannot be made. The analysis one has to do is simple comparisons between the responses in order to understand the differences between the large-scale production companies. These comparisons included the availability of WVO that each supplier had, as well as qualitative data such as their willingness to work with a biodiesel producer such as EMPOWER.

3.3 Cost Analysis

The cost benefit analysis was used to determine the overall benefit and risks associated with the EMPOWER project. Essentially, it provided EMPOWER with a view of the initial startup costs, and the costs which will keep arising. There were several important questions to ask when deciding if the EMPOWER project is one that is worth pursuing. Put simply, will it make money? This could be done by means of price-point setting. Price-point setting factors in all the pre-production costs, production costs, including the price to acquire raw waste oil, and the volumetric capacity of the plant; and determines what price the product will need to be sold in order to profit. To start, it needed to be determined the availability of waste oil, the price of the available waste oil, and the cost to obtain it. The availability needed to be assessed first in order to determine if acquiring waste vegetable oil is cost effective or even feasible.

3.3.1 Using Survey and Interviewing to Determine Waste Vegetable Oil Availability

The goal of our survey, and the interviews we are conducting with large-scale manufacturers, was to determine the availability of waste vegetable oil in the Worcester and North Grafton areas, so that we could better aid EMPOWER in their pursuit of suppliers. Though the survey and questionnaire for interviews are similar, the information we are seeking to collect from them have some key differences. Excluding the amount of waste vegetable oil produced, and the preferences in regards to contracts, the strengths of both the survey study and questionnaire differ. First, the survey aimed to provide valuable information regarding restaurant type in regards to waste oil availability. In contrast, the interviews purpose was to determine the possible interest large scale manufacturers may have had in working with a biodiesel company, as well as a heavier concentration on the contractual necessities they may have required in order to enter into a contractual agreement.

Analysis of the survey involved a stratification of our responses in order to effectively compare the data we receive. Having chosen to break our sample into five categories based on the restaurant type and the assumptions we have made on the amount and type of oil they will use; we used the data to determine the availability by type of restaurant. For instance, if we received 10 responses from 'sit-down' dining establishments; we then compared the amount of waste vegetable oil each restaurant claims to dispose of in reference to the amount of patrons they served each week. A breakdown by this means provided an estimate of the amount of WVO certain restaurants disposed of, to better aid EMPOWER in their search for suppliers. Also, the survey helped in determining if certain restaurants were already in business with disposers of waste vegetable oil. By asking the amount restaurants are paying, or being paid, to dispose of their WVO, we determined a potential target price for acquisition. If the price point we receive is similar across many samples then a price for waste oil product had already been set in this market. Knowledge of a price point for acquisition of WVO would help in determining the amount that can be spent on certain production processes while maintaining a profit.

3.3.2 Compilation of Pre-Production Cost Analysis

In order for a price point to ultimately be set, it was necessary to determine the pre-production costs incurred, the production costs incurred, and the total saleable output of the system. Once each of these was obtained, a price point could be set and the profit margin could be determined. However, in this document we focused on the gathering and compiling of the pre-production costs.

Pre-production costs consisted of one-time expenses as well as recurring expenses. Additionally, these expenses could be fixed or variable depending upon what quantity the project produces or consumes over a given time period. In order to organize these pre-production costs we created a pre-production cost flowchart which had many different expenses associated with the pre-production aspect of the EMPOWER collaborative (see Figure 2). For instance, costs such as registration and inspection of the vehicle to transport waste oil will be a fixed recurring cost, while the gasoline and diesel fuel required to transport the oil to the plant will be a variable recurring cost. Additionally, rent for the facility in which production will be housed, security system monitoring fees, and permits will be a fixed recurring cost. Insurance will be a variable recurring cost, because the amount which is produced will be capable of driving the materials handling insurance into higher brackets requiring more costly coverage. Other variable recurring costs include the cost associated with purchasing waste vegetable oil, money for maintenance to the truck and pay the employees of EMPOWER, health insurance for employees, and utilities. Examples of one-time expenses are lawyer, notary, and accountant fees that have been tabulated during the incorporation process and establishment of the cooperative business. Other one-time pre-production expenses that will be incurred are the cost of the truck, the storage tanks for post-production materials, the property tax, and installation of a security system.

Once all of the pre-production costs were obtained and the cost of recurring and variable fees was estimated, these figures can be compiled with projected production costs. Production costs will include any and all expenses specifically pertaining to the production aspect of biodiesel. An example of such costs may be the recurring costs of a hydroxide base with which to mix the waste vegetable oil, or the Phenolphthalein indicator that is also used in the process. These costs will be taken by EMPOWER from the production team working on the aspects of this project involving the actual production process of biodiesel. The next step will be to project the initial output level at which EMPOWER will plan to produce biodiesel. Once the production and pre-production costs are compiled and projected for a varying range of theoretical output levels, a minimum price-point can be established and the revenue range will be projected. The price-point will be affected after the fact by the cost of substitute goods, as EMPOWER will be incapable of selling their biodiesel fuel at a price that is competitive in the market. This will represent the ultimate goal in the installment of this project, creating a biodiesel business that is capable of providing a living wage to its employed individuals, as well as produce a clean burning and financially viable alternative fuel.

3.3.3 Obstacles in Pre-Production Cost Analysis

We encountered a large number of obstacles when it came time to formulate a reliable pre-production cost. First of all, variable costs depend greatly on market fluctuations. For example, the price of gas has changed from $4.00 a gallon, to $1.79 during the course of this project. Variable costs change too rapidly to put together a meaningful value, so one has to know they are there and make adjustments as one goes. Another issue encountered lies with the gathering of fixed costs from EPOCA. Many of the fixed costs for pre production rely on what the finalized process will be, something which as of yet is not determined. Without knowing these very important startup costs, it is impossible to present meaningful pre-production costs.

4.0 Data Analysis

4.1 Introduction to Data Analysis

After the data from our surveys and interviews were gathered, they needed to be statistically analyzed in order for their findings to become apparent and make sense. The survey data were analyzed using statistical analysis software and conclusions were drawn from the interviews by hand. Our initial intentions were to determine the availability of waste oil from each type of restaurant in the Worcester area as well as the contractual and service components that waste oil producers are looking for in order to derive a strategic acquisition plan for EMPOWER. Due to constraints in survey collection, however, it was not possible to have many different types of restaurants examined statistically. We needed to interpret our data in larger and broader groups than we had initially intended, consolidating several alike types of restaurants into one larger group. Because of our findings from our large scale producer interviews, we did not have enough data to make statistical analysis possible for them, so we analyzed our data qualitatively. To return to our survey analysis, the first objective we had was to sort our data into a database that could be easily analyzed and imported into statistical analysis software. We used our research questions as a base to describe the type of findings we would make. That being said, we wanted to find what the availability of waste vegetable oil was and the contractual and service components, and analyzed these data relative to five different types of restaurants. We decided to group our restaurants into five categories; Chinese food, ‘take-out,’ ‘sit-down,’ Seafood, and ‘Mediterranean.’ Mediterranean restaurants, by our definition, would encompass restaurants serving food from any country near the Meditteranean Sea, including Italy. Our findings were as followed.

4.1.1 Seafood Restaurants have the highest production of Waste Vegetable Oil

From our data, we intended to interpret which of the five restaurant types would be most appropriate for EMPOWER to pursue connections with. This necessitated understanding what would make a restaurant type an appropriate target. After concluding that there were differences in the amount of oil each type of restaurant used using an Analysis of Variance test (ANOVA), we decided to determine where specifically the statistical differences were and which type of restaurant had the highest amount of available waste oil. From the t-tests we ran, we determined there were three statistically different values. Namely, the ‘Mediterranean’-Chinese (t= 9,Sig=0.002), ‘Mediterranean’-Seafood (t= 8, Sig=0.001), and Chinese-Seafood (t=-2.664, Sig=0.026) tests revealed statistically-different data with regard to amount available. We determined from the t-tests that Chinese and Seafood restaurants had a higher amount of waste vegetable oil available than ‘Mediterranean’ (mean = 5-15 gal/month) restaurants, and that Seafood restaurants (mean = 40-50+ gal/month) had a higher amount of WVO available than Chinese (mean = 15-50 gal/month). We used our data table of mean data to infer which of these restaurants had the highest output of waste vegetable oil (Figure 4.1). We determined that seafood restaurants did in fact have the highest WVO output. From that determination we comfortably inferred that Seafood restaurants would have the highest WVO output of any of the restaurant types we compared. Using this information, EMPOWER could seek out contracts with seafood restaurants for a high volume account. Though we determined, as will be outlined below, that seafood restaurants may not be the easiest type of restaurant to work with in regard to service and contract requirements, their high yield and strong interest in working with an alternative fuel source manufacturer make them a good candidate for a large-volume contact.

Figure 4.1 Comparison of Volumetric WVO Production

Question	Medit	Chinese	Seafood	Take-out	Sit-down
Years	1.0-10	1.0-10	7.5-10+	7.5-10+	5.0-10
Patrons	830	875	2810	2136	2180
Disposal	Cubies/SDWOL	Cubies/SDWOL	Steel Drums	Cubies/SDWOL	Steel Drums
Location	outside	outside	mostly outside	mostly inside	mostly outside
Oil Type	Veg/Canola	Canola	mostly canola	mostly veg	canola
Frequency	bi-weekly	bi-weekly	monthly	bi-weekly	monthly
Punctuality	3.75	3.33	3.2	1	1.75
Complete	4.5	3.33	3.6	3.66	4.25
Flexibilty	2.75	3.16	3.8	1.33	2
Reliabilty	4.25	3.83	4.8	2.33	4.25
Contact	3.5	3.16	2.6	2	3.25
Price	4.75	4.83	4.6	4	3.5
Labor	4	3.33	3	3	2.25
Terms Serv	3.25	3.33	2.2	2	1.25
Firm Liability	4	4	3.2	3.25	2.25
Rest Liability	4.25	4.33	3.6	3	2.25
Escape Clause	2.5	2.5	2	1.75	1.5
Insurance	3.75	3.16	3.8	1.75	2.25
Donate WVO	4.5	3.16	4.2	4.4	3.3
WVO Prod	5-15 gal/month	15-50 gal/month	40-50+gal/mon	10-50 gal/mon	20-50 gal/mon
Pay to dispose	1.5	1.66	1.6	1.57	1.16
Interest in Bio	2.75	1.8	2.2	2.33	3.2

Note: means collected for Service and Contract component section had a range of 1-5. Five meant that component was very important and one meant that that component was not important. Questions involving interest in donation and interest in biodiesel followed the same scale. For the 'Pay to dispose' question, an answer of one indicated that the company was paying to dispose of their oil, an answer of two indicated they were not.

4.1.2 Take-out restaurants have the lowest service expectations when working with waste renderers

Next, we determined that of all of the restaurants, 'take-out' restaurants had the lowest service expectations when working with waste oil renderers (Figure 4.2). To start, we ran a series of t-tests for the five main factors we surveyed on with regard to working with a renderer. These were punctuality, completeness, flexibility, reliability, and ease of contact. For punctuality, we found that there were two instances of statistically different data by restaurant type. Both 'Mediterranean' and Seafood restaurants had higher expectations with regard to punctuality than 'take-out' restaurants. For completeness, there were no instances of statistical difference. For flexibility, the two instances of statistical difference yielded the results that both 'Mediterranean' and Seafood restaurants had higher expectations than 'take-out' restaurants. Our data regarding reliability suggested that both Chinese and Seafood restaurants had higher expectations that 'take-out' restaurants, and our ease of contact data provided no statistically different data. All of these conclusions helped answer the research question regarding the service requirements component when working with a waste oil supplier. We found that 'take-out' restaurants were the easiest to work with in regard to service requirements. As 'take-out' restaurants share a 50 gallon per week cap with any of the other types of restaurants, this means that EMPOWER could investigate high yield 'take-out' restaurants and expect them to have fewer service requirements than another type of restaurant producing the same amount of oil.

Figure 4.2 Comparison of Expectation When Working with a Waste Oil Renderer

Question	Medit	Chinese	Seafood	Take-out	Sit-down
Years	1.0-10	1.0-10	7.5-10+	7.5-10+	5.0-10
Patrons	830	875	2810	2136	2180
Disposal	Cubies/SDWOL	Cubies/SDWOL	Steel Drums	Cubies/SDWOL	Steel Drums
Location	outside	outside	mostly outside	mostly inside	mostly outside
Oil Type	Veg/Canola	Canola	mostly canola	mostly veg	canola
Frequency	bi-weekly	bi-weekly	monthly	bi-weekly	monthly
Punctuality	3.75	3.33	3.2	1	1.75
Complete	4.5	3.33	3.6	3.66	4.25
Flexibilty	2.75	3.16	3.8	1.33	2
Reliabilty	4.25	3.83	4.8	2.33	4.25
Contact	3.5	3.16	2.6	2	3.25
Price	4.75	4.83	4.6	4	3.5
Labor	4	3.33	3	3	2.25
Terms Serv	3.25	3.33	2.2	2	1.25
Firm Liability	4	4	3.2	3.25	2.25
Rest Liability	4.25	4.33	3.6	3	2.25
Escape Clause	2.5	2.5	2	1.75	1.5
Insurance	3.75	3.16	3.8	1.75	2.25
Donate WVO	4.5	3.16	4.2	4.4	3.3
WVO Prod	5-15 gal/month	15-50 gal/month	40-50+gal/mon	10-50 gal/mon	20-50 gal/mon
Pay to dispose	1.5	1.66	1.6	1.57	1.16
Interest in Bio	2.75	1.8	2.2	2.33	3.2

4.1.3 'Sit-down' restaurants have the lowest expectations from contracts.

Third, we evaluated the mean data we obtained from our contract requirements question. Using t-tests, we determined that there were instances of statistical difference in both the term of service and firm liability data. We determined that with regard to term of service (meaning, a predetermined amount of time for collaboration of companies is applied to the removal contract) both 'Mediterranean' and Chinese restaurants felt that a set term of service was more important than 'sit-down' restaurants did. From our firm liability question we gathered that Chinese restaurants felt that removal firm liability was more important than 'sit-down' restaurants felt that it was. No other statistically different data points existed in our contract data. From the analysis of this data we determined that 'sit-down' restaurants have the lowest expectations in contracts, illustrated graphically in Figure 4.3. From this data we gathered that 'sit-down' restaurants will require the least in terms of contractual obligations. This means that EMPOWER could create relationships with many different 'sit-down' restaurants and not be limited by impediments such as a set term of service, or needing to be well-insured. As 'sit-down' restaurants have the second highest average output of waste oil, this could mean that 'sit-down' restaurants are an extremely viable source for waste oil.

Figure 4.3 Expectations in Contracts

Question	Medit	Chinese	Seafood	Take-out	Sit-down
Years	1.0-10	1.0-10	7.5-10+	7.5-10+	5.0-10
Patrons	830	875	2810	2136	2180
Disposal	Cubies/SDWOL	Cubies/SDWOL	Steel Drums	Cubies/SDWOL	Steel Drums
Location	outside	outside	mostly outside	mostly inside	mostly outside
Oil Type	Veg/Canola	Canola	mostly canola	mostly veg	canola
Frequency	bi-weekly	bi-weekly	monthly	bi-weekly	monthly
Punctuality	3.75	3.33	3.2	1	1.75
Complete	4.5	3.33	3.6	3.66	4.25
Flexibilty	2.75	3.16	3.8	1.33	2
Reliabilty	4.25	3.83	4.8	2.33	4.25
Contact	3.5	3.16	2.6	2	3.25
Price	4.75	4.83	4.6	4	3.5
Labor	4	3.33	3	3	2.25
Terms Serv	3.25	3.33	2.2	2	1.25
Firm Liability	4	4	3.2	3.25	2.25
Rest Liability	4.25	4.33	3.6	3	2.25
Escape Clause	2.5	2.5	2	1.75	1.5
Insurance	3.75	3.16	3.8	1.75	2.25
Donate WVO	4.5	3.16	4.2	4.4	3.3
WVO Prod	5-15 gal/month	15-50 gal/month	40-50+gal/mon	10-50 gal/mon	20-50 gal/mon
Pay to dispose	1.5	1.66	1.6	1.57	1.16
Interest in Bio	2.75	1.8	2.2	2.33	3.2

4.1.4 Seafood Restaurants have the highest number of patrons served, followed by 'sit-down' restaurants

Our data from the question relating to how many questions each establishment served suggested that Seafood restaurants served more patrons than any other type of restaurant. The t-tests confirmed that there was a statistical difference in the data from 'Mediterranean' and Chinese restaurants. These t-tests also confirmed that there was a statistical difference between the data for Chinese and 'sit-down' restaurants, illustrating that 'sit-down' restaurants served more patrons weekly than Chinese restaurants did. There was no statistical difference between the data for comparisons between Seafood and 'take-out' and 'sit-down' restaurants, however, so it cannot be inferred that these three types of restaurants will likely serve a different number of patrons weekly. From our measures of central tendency, we determined that in our sample seafood restaurants served the greatest number of patrons. Despite this, it cannot be determined that 'take-out' or 'sit-down' restaurants would be less appropriate candidates, as illustrated in Figure 4.4. Using this information, the proportionality between the number of occupants served and amount of waste oil produced could be assessed. We found that there did appear to be some correlation between number of occupants served and output of waste vegetable oil, however there are likely other factors involved that affect this proportionality such as type of food produced. This is a sensible conclusion, because different types of food require more vegetable oil to be produced than others (i.e. fried fish versus spaghetti). We found it was unnecessary to investigate this any further as there was some degree of correlation between output and number of patrons, and since most other factors that could attribute to the skewed correlation can be easily inferred using a basic knowledge of the production of food.

Figure 4.4 Comparison of Number of Patrons Served

Question	Medit	Chinese	Seafood	Take-out	Sit-down
Years	1.0-10	1.0-10	7.5-10+	7.5-10+	5.0-10
Patrons	830	875	2810	2136	2180
Disposal	Cubies/SDWOL	Cubies/SDWOL	Steel Drums	Cubies/SDWOL	Steel Drums
Location	outside	outside	mostly outside	mostly inside	mostly outside
Oil Type	Veg/Canola	Canola	mostly canola	mostly veg	canola
Frequency	bi-weekly	bi-weekly	monthly	bi-weekly	monthly
Punctuality	3.75	3.33	3.2	1	1.75
Complete	4.5	3.33	3.6	3.66	4.25
Flexibilty	2.75	3.16	3.8	1.33	2
Reliabilty	4.25	3.83	4.8	2.33	4.25
Contact	3.5	3.16	2.6	2	3.25
Price	4.75	4.83	4.6	4	3.5
Labor	4	3.33	3	3	2.25
Terms Serv	3.25	3.33	2.2	2	1.25
Firm Liability	4	4	3.2	3.25	2.25
Rest Liability	4.25	4.33	3.6	3	2.25
Escape Clause	2.5	2.5	2	1.75	1.5
Insurance	3.75	3.16	3.8	1.75	2.25
Donate WVO	4.5	3.16	4.2	4.4	3.3
WVO Prod	5-15 gal/month	15-50 gal/month	40-50+gal/mon	10-50 gal/mon	20-50 gal/mon
Pay to dispose	1.5	1.66	1.6	1.57	1.16
Interest in Bio	2.75	1.8	2.2	2.33	3.2

4.1.5 Conclusion of Statistical Analyses

The Statistical Analyses of the data revealed several interesting points from our survey responses. We found that Seafood restaurants had the highest volumetric output of waste oil, and that 'take-out' restaurants have the lowest expectations when working with waste oil renderers. Also, we found that 'sit-down' restaurants had the lowest expectations with regard to contracts. We also found that even though Seafood restaurants had the highest number of patrons weekly, we could not determine that this was statistically different from the data we collected from 'take-out' and 'sit-down' restaurants, and as such could not definitively say that seafood restaurants would always have the highest number of patrons. We also could not definitively say that the number of patrons would correspond directly to the amount of waste oil produced, though there did appear to be some correlation. After we had completed our statistical analyses, we proceeded to do a qualitative analysis of our large-scale supplier interview data.

4.2 Qualitative Analysis for Large-Scale Suppliers

When we tried to contact our target large-scale suppliers, we found that often times it was more convenient to simply conduct an over-the-phone interview as opposed to scheduling an in-person interview with each supplier. From our discussions with contacts at Frito Lay Potato Chips, Cape Cod Potato Chips, Gorton's Seafood, and Wachusett Potato Chips, we learned that potato chip companies do not, in fact, output waste vegetable oil on a large scale, but instead reuse and recycle it. Cape Cod Potato Chips was most accommodating of the potato chip companies, with figures estimating that they produce 75-100 gallons/wk. This firm sells their waste oil to a group of customers in a database each time their reserve tank fills. Each customer needs to have liability insurance in order to enter the database, which is first come first serve only. They sell their waste oil at market price. Wachusett Potato Chip Company had pre-existing contracts with a waste oil renderer whom they paid to pick up their waste oil. They expressed that there was very little waste oil byproduct from their manufacturing process. A branch of Frito Lay Potato Chips located in Wilmington, MA expressed that there was negligible production of waste oil byproduct from their manufacturing process.

When we contacted Gorton's Seafood in Gloucester, MA, we found that the manufacture of frozen seafood products does produce a large amount of waste vegetable oil. Gorton's Seafood claimed that they produced 'a few thousand pounds per month.' Currently, they were selling this oil for $0.22/gal, and our contact said that they were receiving roughly $600 dollars/month from their waste oil sales. From this we estimated that Gorton's had a monthly production of approximately 2,700 gallons of waste oil. They have no contracts and this oil is open for anyone wishing to purchase it. This oil is less useful for 'grease-car aficionados' wishing to run waste vegetable oil that has simply been filtered in their vehicles, as it is quite dirty from the frying process. This does not hold true for producers of biodiesel, however, because of the high level of purification and chemical reactions necessary to produce biodiesel. Most interestingly, our contact at Gorton's Seafood suggested that he may be willing to wave the $0.22/gallon fee for any oil EMPOWER is willing to take, in order to benefit their cause.

The qualitative analysis of large-scale producers of waste vegetable oil, and the interview process that preceded it, proved to be useful and informative. The data collected from the interviews conducted suggested a more focused approach could be taken when deciding on which type of large-scale waste oil producers should be contacted. This data disproved our assumption that potato chip manufacturers would be a valuable source of large quantities of waste vegetable oil, but opened a potential channel with a large-scale producer in the business of seafood manufacturing.

4.3 Chapter Conclusion

Our data analysis was compiled using SPSS statistical analysis software. Survey data was entered into a database that could be easily analyzed with this software. T-tests were run in order to compare each type of restaurant to all of the other types of restaurants that we intended to observe. We found that Seafood restaurants had the highest volumetric output of waste oil, and that 'take-out' restaurants have the lowest expectations when working with waste oil renderers. Also, we found that 'sit-down' restaurants had the lowest expectations with regard to contracts. We found that seafood restaurants had the highest number of patrons served weekly, but this data was not differentiable from that of 'sit-down' and 'take-out' restaurants. From the large-scale producer sample was too small to analyze quantitatively, and so we described each case specifically and made the assumption that our sample was the entire population of large-scale producers in the area. From this data we gathered that producers of potato chips are not large-scale waste vegetable oil producers at all, and in fact produced very small amounts of waste vegetable oil due to an efficient manufacturing process. Our other large-scale producer contact, Gorton's Seafood, who produces frozen seafood dinners, produced a large volume of openly available waste vegetable oil at a competitive price.

5.0 Conclusion and Recommendations

The purpose of this project was to do a market study for a non-profit organization planning to produce biodiesel fuels in the Worcester area. Our primary research intent was to determine the availability of waste oil and the required components of contracts and service with producers of waste vegetable oil. This project facilitated the understanding of the basic biodiesel process as well as basic supply chain components. The research goals were addressed by means of a survey and interview questionnaire which was circulated among small-scale waste vegetable oil producers as well as several proposed large-scale producers. The findings associated with these results are intended to be used as potential guidelines for the most efficient acquisition of waste vegetable oil by our sponsor. We have made several recommendations, among them being:

- Seafood restaurants in the Worcester Area produced the highest volume of waste oil.

- 'Take-out' restaurants have a lower median volume, however they expect the least from the waste oil collectors overall.

- 'Sit-down' restaurants have the lowest expectations from contracts and the second highest median volumetric output of waste vegetable oil, making them the most attractive restaurant type overall.

- Seafood restaurants have the highest number of patrons served, and there is some correlation between number of patrons served and amount of waste oil output. There is not a definitive proportionality, however, and other factors are incorporated into this correlation.

- Potato Chip manufacturers are not worthwhile sources of waste vegetable oil, as they have efficient production processes that severely limit the amount of waste vegetable oil they output.

- Gorton's Seafood of Gloucester may be a worthwhile contact as a large-scale producer of waste vegetable oil.

After these conclusions were drawn from out data analysis, we drew recommendations for further research with regard to this project. These recommendations included:

- Detailed price-point setting using detailed pre-production cost and production cost analyses.

- Cost-Benefit analysis using the set price-point and the observed market price of waste vegetable oil.

- Detailed study of contract components that should be included in the agreements between EMPOWER and producers of waste vegetable oil.

To conclude our project, we would like to thank our advisors, Professors Robert Krueger and Fabienne Miller for their assistance in our report compilation and conceptualization of supply chain and business knowledge that was previously unbeknownst to us. We would also like to thank EPOCA for allowing us to assist with their venerable efforts to improve the lives of those who have not always been treated fairly. Lastly, we would like to thank the Worcester area restaurants that completed our surveys, as well as Frito Lay Potato Chips, Cape Cod Potato Chips, Wachusett Potato Chips, and Gorton's Seafood. We hope that any future reader of this report will be able to view the greater impacts that our work has had and gain valuable insight into the social aspects that underlie this report.

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Appendix

Table 1 Grease production by Major Cities shows the grease produced for a number of cities, given their populations and number of restaurants. Note that yellow grease is used in biodiesel production.

Cities	State	Population	# Restaurants	Yellow Gr.	Trap Gr.	Total Grease
Olympia	WA	161,238	240	1,080,000	1,200,000	2,280,000
Bloomington	IL	129,180	200	500,000	2,300,000	2,800,000
Battlecreek	MI	135,982	211	1,500,000	1,500,000	3,000,000
Decator	AL	131,556	245	1,300,000	2,400,000	3,700,000
Bryan	TX	121,862	198	1,200,000	2,000,000	3,200,000
Provo	UT	263,590	400	4,380,000	7,000,000	11,380,000
Lincoln	NE	213,641	350	4,500,000	2,600,000	7,100,000
Macon	GA	281,103	348	2,800,000	5,900,000	8,700,000
Bradenton	FL	211,707	360	2,100,000	3,000,000	5,100,000
Fayetville	NC	274,566	384	2,700,000	2,100,000	4,800,000

Table 2 Grease Production by Worcester shows the average grease outputs per restaurant and uses the median data to provide information for Worcester.

Averages			Grease	Per Restaurant	Per Year
Worcester	# Restaurants	Population	Yellow Grease	Trap Grease	Total Grease
Smaller than	219	135,964	5,160	6,960	12,120
Larger than	368	248,921	8,950	11,140	20,090
Worcester	336*	175,898	8,136	10,242	18,378

Figure 2. Pre-Production Cost Breakdown Analysis

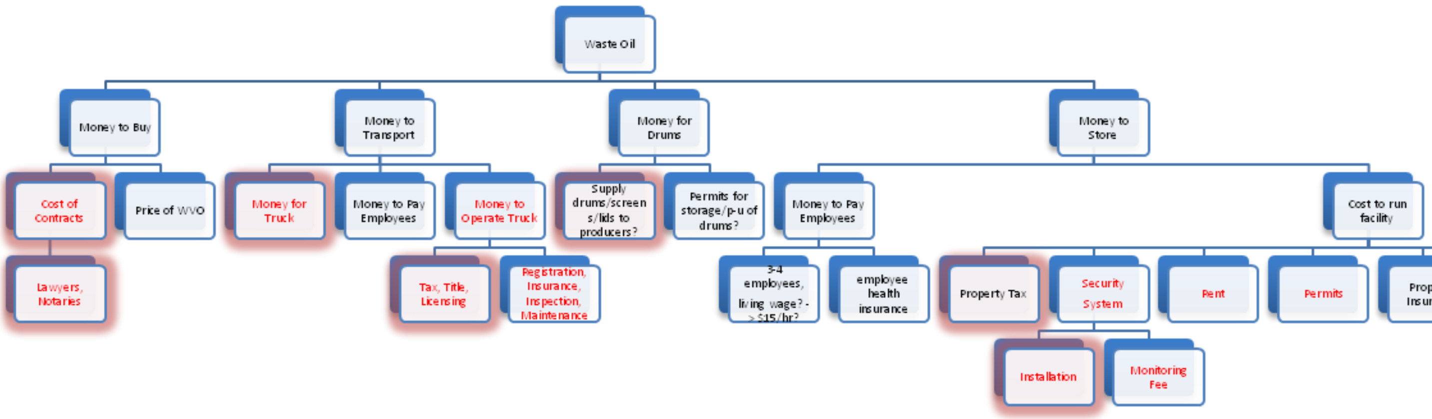

Figure 3: Small-Scale Supplier Survey

The purpose of this survey is to collect information on the availability and collection practices of waste vegetable oil in the Worcester region. The information from this survey will be used to assess the feasibility of producing clean burning biodiesel fuel from waste oil for distribution to local homes and businesses as a substitute for home heating oil and diesel fuel. This survey is intended to be answered by employees with experience in removal of waste vegetable oil.

Your participation is confidential and voluntary. Your responses will help create green jobs and provide environmentally-friendly heating alternatives for the community. We value your time and appreciate your participation in this study. Please note that you many end your participation at any time and are not required to answer every question. If you have any questions or comments about this study, please feel free to contact:

Kevin Goggins
Worcester Polytechnic Institute, Biomedical Engineering '10
biodiesel_marketing@yahoo.com

1.) How many years have you worked at this business?

a.) > 1 year **b.) 1-5 years**

c.) 5-10 years **d.) 10+ years**

2.) On average, how many patrons does your establishment serve in one week?

____

3.) What is your current method for disposing of waste vegetable oil? (i.e. Steel Drums with or without lids, cubies, etc)

4.) When disposing of waste vegetable oil for collection, do you leave it outside or inside, for pickup during work hours?

Which way would you prefer?

5.) What type of oil do you primarily use for cooking/frying?
a.) Vegetable Oil **b.) Canola Oil**

c.) Soy Oil

d.) Other/Mix ___________________.
(Please State Which in the Line above)

6.) What is your most preferred frequency of oil collection? On a scale of 1-5, with <u>1 being least</u> preferred and <u>5 being most</u> preferred.

Daily ________

Weekly ________

Bi-weekly ________

Monthly _________

As needed _________

7.) When working with a renderer or waste disposal company, rate each of the following factors on a scale of 1-5, with 1 being not important and 5 being very important.

	1 (Not Important)	2	3	4	5 (Very Important)
Punctuality	__________	_________	__________	__________	_________
Completeness (Removal of Trap and Yellow Grease)	__________	_________	__________	__________	_________
Flexibility	__________	_________	__________	__________	_________
Reliability	__________	_________	__________	_________	_________
Ease of contact with removal company	________	_________	__________	_________	_________

8.) When entering a contract with a removal service, rate each of the following on a scale of 1-5, with 1 being not important and 5 being very important.

	1 (Not Important)	2	3	4	5 (Very Important)
Price	__________	_________	__________	__________	_________
Labor (Establishment workers or removal employees moving and loading oil)	__________	_________	__________	__________	_________
Term of Service	__________	_________	__________	__________	_________
Removal Firm Liability	_________	_________	__________	_________	_________

Restaurant Liability	________	________	________	________	________
Escape Clause	________	________	________	________	________
Insurance	________	________	________	________	________

9.) Would you be more inclined to donate your waste vegetable oil to a company creating alternative fuels from it instead of to a waste disposal company?

1 (Not at all inclined)	2	3	4	5 (Very inclined)
________	________	________	________	________

10.) How much waste vegetable oil does your establishment produce monthly (approximately)?

a.) 1-5 gallons **b.) 5-10 gallons**

c.) 10-20 gallons **d.) 20-50 gallons**

e.) 50+ gallons

11.) Do you pay to dispose of your waste oil? If so, how much do you pay monthly?

[Yes] $________ **[No]**

12.) Biodiesel fuels are produced from waste oils and can be used to power diesel vehicles and as an alternative to home heating oil. How interested would you be in purchasing alternative fuels produced from your waste vegetable oil?

1 (Not at all interested)	2	3	4	5 (Very interested)
________	________	________	________	________

If you're interested in learning more about biodiesel, you may include your contact info below

13.) If you use oil heat at your current establishment, how many gallons do you use in the winter months?

(Please Tear on the above line if the respondent wishes to give personal contact information)

Thank you for your time and cooperation in completing this survey. If you would like to see the results of the survey, or you are interested in learning more about biodiesel, you may leave your email address or phone number below, as well as check off what you would like us to send you.

E-mail________________________________ **Information on Biodiesel [ ]**

Phone Number__________________________ **Results of survey [ ]**

Table 3. Chinese-Seafood Mean Statistics

Group Statistics

	V5	N	Mean	Std. Deviation	Std. Error Mean
Q1	2.00	6	2.8333	.40825	.16667
	3.00	5	3.6000	.54772	.24495
Q2	2.00	6	875.0000	362.97383	148.18344
	3.00	5	2810.0000	1305.94793	584.03767
Q3a	2.00	6	2.5000	.83666	.34157
	3.00	5	1.8000	1.30384	.58310
Q4a	2.00	6	1.0000	.00000	.00000
	3.00	5	1.2000	.44721	.20000
Q5a	2.00	6	2.0000	.89443	.36515
	3.00	5	1.8000	1.30384	.58310
Q6	2.00	6	3.5000	1.76068	.71880
	3.00	5	4.0000	1.00000	.44721
Q7a	2.00	6	3.3333	1.36626	.55777
	3.00	5	3.2000	1.64317	.73485
Q7b	2.00	6	3.3333	1.21106	.49441
	3.00	5	3.6000	1.51658	.67823
Q7c	2.00	6	3.1667	.98319	.40139
	3.00	5	3.8000	1.30384	.58310
Q7d	2.00	6	3.8333	1.60208	.65405
	3.00	5	4.8000	.44721	.20000
Q7e	2.00	6	3.1667	1.16905	.47726
	3.00	5	2.6000	1.14018	.50990
Q8a	2.00	6	4.8333	.40825	.16667
	3.00	5	4.6000	.89443	.40000

Q8b	2.00	6	3.3333	1.63299	.66667
	3.00	5	3.0000	1.58114	.70711
Q8c	2.00	6	3.3333	1.03280	.42164
	3.00	5	2.2000	1.09545	.48990
Q8d	2.00	6	4.0000	.89443	.36515
	3.00	5	3.2000	1.64317	.73485
Q8e	2.00	6	4.3333	.81650	.33333
	3.00	5	3.6000	1.67332	.74833
Q8f	2.00	6	2.5000	1.04881	.42817
	3.00	5	2.0000	1.22474	.54772
Q8g	2.00	6	3.1667	1.16905	.47726
	3.00	5	3.8000	1.64317	.73485
Q9	2.00	6	3.1667	1.47196	.60093
	3.00	5	4.2000	.83666	.37417
Q10	2.00	6	3.8333	.40825	.16667
	3.00	5	4.6000	.54772	.24495
Q11	2.00	6	1.6667	.51640	.21082
	3.00	5	1.6000	.54772	.24495
Q121	2.00	5	1.8000	.83666	.37417
	3.00	5	2.2000	1.78885	.80000

Table 4. Chinese-'Sit-down' Mean Statistics

Group Statistics

	V5	N	Mean	Std. Deviation	Std. Error Mean
Q1	2.00	6	2.8333	.40825	.16667
	5.00	6	3.0000	.89443	.36515
Q2	2.00	6	875.0000	362.97383	148.18344
	5.00	5	2180.0000	697.85385	312.08973
Q3a	2.00	6	2.5000	.83666	.34157
	5.00	6	2.0000	1.54919	.63246

Q4a	2.00	6	1.0000	.00000	.00000
	5.00	6	1.1667	.40825	.16667
Q5a	2.00	6	2.0000	.89443	.36515
	5.00	6	1.6667	.81650	.33333
Q6	2.00	6	3.5000	1.76068	.71880
	5.00	6	4.1667	.98319	.40139
Q7a	2.00	6	3.3333	1.36626	.55777
	5.00	4	1.7500	1.50000	.75000
Q7b	2.00	6	3.3333	1.21106	.49441
	5.00	4	4.2500	.95743	.47871
Q7c	2.00	6	3.1667	.98319	.40139
	5.00	4	2.0000	1.15470	.57735
Q7d	2.00	6	3.8333	1.60208	.65405
	5.00	4	4.2500	.95743	.47871
Q7e	2.00	6	3.1667	1.16905	.47726
	5.00	4	3.2500	2.06155	1.03078
Q8a	2.00	6	4.8333	.40825	.16667
	5.00	4	3.5000	1.91485	.95743
Q8b	2.00	6	3.3333	1.63299	.66667
	5.00	4	2.2500	1.50000	.75000
Q8c	2.00	6	3.3333	1.03280	.42164
	5.00	4	1.2500	.50000	.25000
Q8d	2.00	6	4.0000	.89443	.36515
	5.00	4	2.2500	1.50000	.75000
Q8e	2.00	6	4.3333	.81650	.33333
	5.00	4	2.2500	1.50000	.75000
Q8f	2.00	6	2.5000	1.04881	.42817
	5.00	4	1.5000	1.00000	.50000
Q8g	2.00	6	3.1667	1.16905	.47726
	5.00	4	2.2500	1.50000	.75000
Q9	2.00	6	3.1667	1.47196	.60093
	5.00	6	3.3333	1.36626	.55777

Q10	2.00	6	3.8333	.40825	.16667
	5.00	6	3.8333	1.60208	.65405
Q11	2.00	6	1.6667	.51640	.21082
	5.00	6	1.1667	.40825	.16667
Q121	2.00	5	1.8000	.83666	.37417
	5.00	5	3.2000	1.48324	.66332

Table 5. Chinese-'Take-out' Mean Statistics

Group Statistics

	V5	N	Mean	Std. Deviation	Std. Error Mean
Q1	2.00	6	2.8333	.40825	.16667
	4.00	7	3.5714	.78680	.29738
Q2	2.00	6	875.0000	362.97383	148.18344
	4.00	6	2136.6667	3865.10888	1577.92409
Q3a	2.00	6	2.5000	.83666	.34157
	4.00	7	2.8571	.89974	.34007
Q4a	2.00	6	1.0000	.00000	.00000
	4.00	6	1.6667	.81650	.33333
Q5a	2.00	6	2.0000	.89443	.36515
	4.00	7	1.2857	.48795	.18443
Q6	2.00	6	3.5000	1.76068	.71880
	4.00	6	3.5000	1.04881	.42817
Q7a	2.00	6	3.3333	1.36626	.55777
	4.00	3	1.0000	.00000	.00000
Q7b	2.00	6	3.3333	1.21106	.49441
	4.00	3	3.6667	2.30940	1.33333
Q7c	2.00	6	3.1667	.98319	.40139
	4.00	3	1.3333	.57735	.33333
Q7d	2.00	6	3.8333	1.60208	.65405
	4.00	3	2.3333	1.52753	.88192
Q7e	2.00	6	3.1667	1.16905	.47726
	4.00	3	2.0000	1.00000	.57735

Q8a	2.00	6	4.8333	.40825	.16667
	4.00	4	4.0000	2.00000	1.00000
Q8b	2.00	6	3.3333	1.63299	.66667
	4.00	4	3.0000	1.63299	.81650
Q8c	2.00	6	3.3333	1.03280	.42164
	4.00	4	2.0000	1.15470	.57735
Q8d	2.00	6	4.0000	.89443	.36515
	4.00	4	3.2500	1.70783	.85391
Q8e	2.00	6	4.3333	.81650	.33333
	4.00	3	3.0000	2.00000	1.15470
Q8f	2.00	6	2.5000	1.04881	.42817
	4.00	4	1.7500	.95743	.47871
Q8g	2.00	6	3.1667	1.16905	.47726
	4.00	4	1.7500	1.50000	.75000
Q9	2.00	6	3.1667	1.47196	.60093
	4.00	5	4.4000	.89443	.40000
Q10	2.00	6	3.8333	.40825	.16667
	4.00	7	3.4286	1.13389	.42857
Q11	2.00	6	1.6667	.51640	.21082
	4.00	7	1.5714	.53452	.20203
Q121	2.00	5	1.8000	.83666	.37417
	4.00	3	2.3333	2.30940	1.33333

Table 6. Seafood-‘Sit-down’ Mean Statistics

Group Statistics

	V5	N	Mean	Std. Deviation	Std. Error Mean
Q1	3.00	5	3.6000	.54772	.24495
	5.00	6	3.0000	.89443	.36515
Q2	3.00	5	2810.0000	1305.94793	584.03767
	5.00	5	2180.0000	697.85385	312.08973
Q3a	3.00	5	1.8000	1.30384	.58310
	5.00	6	2.0000	1.54919	.63246

Q4a	3.00	5	1.2000	.44721	.20000
	5.00	6	1.1667	.40825	.16667
Q5a	3.00	5	1.8000	1.30384	.58310
	5.00	6	1.6667	.81650	.33333
Q6	3.00	5	4.0000	1.00000	.44721
	5.00	6	4.1667	.98319	.40139
Q7a	3.00	5	3.2000	1.64317	.73485
	5.00	4	1.7500	1.50000	.75000
Q7b	3.00	5	3.6000	1.51658	.67823
	5.00	4	4.2500	.95743	.47871
Q7c	3.00	5	3.8000	1.30384	.58310
	5.00	4	2.0000	1.15470	.57735
Q7d	3.00	5	4.8000	.44721	.20000
	5.00	4	4.2500	.95743	.47871
Q7e	3.00	5	2.6000	1.14018	.50990
	5.00	4	3.2500	2.06155	1.03078
Q8a	3.00	5	4.6000	.89443	.40000
	5.00	4	3.5000	1.91485	.95743
Q8b	3.00	5	3.0000	1.58114	.70711
	5.00	4	2.2500	1.50000	.75000
Q8c	3.00	5	2.2000	1.09545	.48990
	5.00	4	1.2500	.50000	.25000
Q8d	3.00	5	3.2000	1.64317	.73485
	5.00	4	2.2500	1.50000	.75000
Q8e	3.00	5	3.6000	1.67332	.74833
	5.00	4	2.2500	1.50000	.75000
Q8f	3.00	5	2.0000	1.22474	.54772
	5.00	4	1.5000	1.00000	.50000
Q8g	3.00	5	3.8000	1.64317	.73485
	5.00	4	2.2500	1.50000	.75000
Q9	3.00	5	4.2000	.83666	.37417
	5.00	6	3.3333	1.36626	.55777

Q10	3.00	5	4.6000	.54772	.24495
	5.00	6	3.8333	1.60208	.65405
Q11	3.00	5	1.6000	.54772	.24495
	5.00	6	1.1667	.40825	.16667
Q121	3.00	5	2.2000	1.78885	.80000
	5.00	5	3.2000	1.48324	.66332

Table 7. Seafood-'Take-out' Mean Statistics

Group Statistics

	V5	N	Mean	Std. Deviation	Std. Error Mean
Q1	3.00	5	3.6000	.54772	.24495
	4.00	7	3.5714	.78680	.29738
Q2	3.00	5	2810.0000	1305.94793	584.03767
	4.00	6	2136.6667	3865.10888	1577.92409
Q3a	3.00	5	1.8000	1.30384	.58310
	4.00	7	2.8571	.89974	.34007
Q4a	3.00	5	1.2000	.44721	.20000
	4.00	6	1.6667	.81650	.33333
Q5a	3.00	5	1.8000	1.30384	.58310
	4.00	7	1.2857	.48795	.18443
Q6	3.00	5	4.0000	1.00000	.44721
	4.00	6	3.5000	1.04881	.42817
Q7a	3.00	5	3.2000	1.64317	.73485
	4.00	3	1.0000	.00000	.00000
Q7b	3.00	5	3.6000	1.51658	.67823
	4.00	3	3.6667	2.30940	1.33333
Q7c	3.00	5	3.8000	1.30384	.58310
	4.00	3	1.3333	.57735	.33333
Q7d	3.00	5	4.8000	.44721	.20000
	4.00	3	2.3333	1.52753	.88192
Q7e	3.00	5	2.6000	1.14018	.50990

	4.00	3	2.0000	1.00000	.57735
Q8a	3.00	5	4.6000	.89443	.40000
	4.00	4	4.0000	2.00000	1.00000
Q8b	3.00	5	3.0000	1.58114	.70711
	4.00	4	3.0000	1.63299	.81650
Q8c	3.00	5	2.2000	1.09545	.48990
	4.00	4	2.0000	1.15470	.57735
Q8d	3.00	5	3.2000	1.64317	.73485
	4.00	4	3.2500	1.70783	.85391
Q8e	3.00	5	3.6000	1.67332	.74833
	4.00	3	3.0000	2.00000	1.15470
Q8f	3.00	5	2.0000	1.22474	.54772
	4.00	4	1.7500	.95743	.47871
Q8g	3.00	5	3.8000	1.64317	.73485
	4.00	4	1.7500	1.50000	.75000
Q9	3.00	5	4.2000	.83666	.37417
	4.00	5	4.4000	.89443	.40000
Q10	3.00	5	4.6000	.54772	.24495
	4.00	7	3.4286	1.13389	.42857
Q11	3.00	5	1.6000	.54772	.24495
	4.00	7	1.5714	.53452	.20203
Q121	3.00	5	2.2000	1.78885	.80000
	4.00	3	2.3333	2.30940	1.33333

Table 8. ‘Mediterranean’-Chinese Mean Statistics

Group Statistics

	V5	N	Mean	Std. Deviation	Std. Error Mean
Q1	1.00	5	2.8000	1.09545	.48990
	2.00	6	2.8333	.40825	.16667
Q2	1.00	5	830.0000	939.14855	420.00000
	2.00	6	875.0000	362.97383	148.18344
Q3a	1.00	5	2.6000	1.34164	.60000
	2.00	6	2.5000	.83666	.34157
Q4a	1.00	5	2.0000	1.00000	.44721
	2.00	6	1.0000	.00000	.00000
Q5a	1.00	5	1.6000	.54772	.24495
	2.00	6	2.0000	.89443	.36515
Q6	1.00	5	2.8000	.83666	.37417
	2.00	6	3.5000	1.76068	.71880
Q7a	1.00	4	3.7500	1.25831	.62915
	2.00	6	3.3333	1.36626	.55777
Q7b	1.00	4	4.5000	.57735	.28868
	2.00	6	3.3333	1.21106	.49441
Q7c	1.00	4	2.7500	.50000	.25000
	2.00	6	3.1667	.98319	.40139
Q7d	1.00	4	4.2500	.50000	.25000
	2.00	6	3.8333	1.60208	.65405
Q7e	1.00	4	3.5000	.57735	.28868
	2.00	6	3.1667	1.16905	.47726
Q8a	1.00	4	4.7500	.50000	.25000
	2.00	6	4.8333	.40825	.16667
Q8b	1.00	4	4.0000	1.41421	.70711
	2.00	6	3.3333	1.63299	.66667
Q8c	1.00	4	3.2500	.95743	.47871
	2.00	6	3.3333	1.03280	.42164

Q8d	1.00	4	4.0000	1.15470	.57735
	2.00	6	4.0000	.89443	.36515
Q8e	1.00	4	4.2500	.95743	.47871
	2.00	6	4.3333	.81650	.33333
Q8f	1.00	4	2.5000	1.29099	.64550
	2.00	6	2.5000	1.04881	.42817
Q8g	1.00	4	3.7500	1.25831	.62915
	2.00	6	3.1667	1.16905	.47726
Q9	1.00	4	4.5000	.57735	.28868
	2.00	6	3.1667	1.47196	.60093
Q10	1.00	5	2.2000	.83666	.37417
	2.00	6	3.8333	.40825	.16667
Q11	1.00	4	1.5000	.57735	.28868
	2.00	6	1.6667	.51640	.21082
Q121	1.00	4	2.7500	2.06155	1.03078
	2.00	5	1.8000	.83666	.37417

Table 9. 'Mediterranean'-Seafood Mean Statistics

Group Statistics

	V5	N	Mean	Std. Deviation	Std. Error Mean
Q1	1.00	5	2.8000	1.09545	.48990
	3.00	5	3.6000	.54772	.24495
Q2	1.00	5	830.0000	939.14855	420.00000
	3.00	5	2810.0000	1305.94793	584.03767
Q3a	1.00	5	2.6000	1.34164	.60000
	3.00	5	1.8000	1.30384	.58310
Q4a	1.00	5	2.0000	1.00000	.44721
	3.00	5	1.2000	.44721	.20000
Q5a	1.00	5	1.6000	.54772	.24495
	3.00	5	1.8000	1.30384	.58310
Q6	1.00	5	2.8000	.83666	.37417

	3.00	5	4.0000	1.00000	.44721
Q7a	1.00	4	3.7500	1.25831	.62915
	3.00	5	3.2000	1.64317	.73485
Q7b	1.00	4	4.5000	.57735	.28868
	3.00	5	3.6000	1.51658	.67823
Q7c	1.00	4	2.7500	.50000	.25000
	3.00	5	3.8000	1.30384	.58310
Q7d	1.00	4	4.2500	.50000	.25000
	3.00	5	4.8000	.44721	.20000
Q7e	1.00	4	3.5000	.57735	.28868
	3.00	5	2.6000	1.14018	.50990
Q8a	1.00	4	4.7500	.50000	.25000
	3.00	5	4.6000	.89443	.40000
Q8b	1.00	4	4.0000	1.41421	.70711
	3.00	5	3.0000	1.58114	.70711
Q8c	1.00	4	3.2500	.95743	.47871
	3.00	5	2.2000	1.09545	.48990
Q8d	1.00	4	4.0000	1.15470	.57735
	3.00	5	3.2000	1.64317	.73485
Q8e	1.00	4	4.2500	.95743	.47871
	3.00	5	3.6000	1.67332	.74833
Q8f	1.00	4	2.5000	1.29099	.64550
	3.00	5	2.0000	1.22474	.54772
Q8g	1.00	4	3.7500	1.25831	.62915
	3.00	5	3.8000	1.64317	.73485
Q9	1.00	4	4.5000	.57735	.28868
	3.00	5	4.2000	.83666	.37417
Q10	1.00	5	2.2000	.83666	.37417
	3.00	5	4.6000	.54772	.24495
Q11	1.00	4	1.5000	.57735	.28868
	3.00	5	1.6000	.54772	.24495
Q121	1.00	4	2.7500	2.06155	1.03078

	3.00	5	2.2000	1.78885	.80000

Table 10. 'Mediterranean'-'Sit-down' Mean Statistics

Group Statistics

	V5	N	Mean	Std. Deviation	Std. Error Mean
Q1	1.00	5	2.8000	1.09545	.48990
	5.00	6	3.0000	.89443	.36515
Q2	1.00	5	830.0000	939.14855	420.00000
	5.00	5	2180.0000	697.85385	312.08973
Q3a	1.00	5	2.6000	1.34164	.60000
	5.00	6	2.0000	1.54919	.63246
Q4a	1.00	5	2.0000	1.00000	.44721
	5.00	6	1.1667	.40825	.16667
Q5a	1.00	5	1.6000	.54772	.24495
	5.00	6	1.6667	.81650	.33333
Q6	1.00	5	2.8000	.83666	.37417
	5.00	6	4.1667	.98319	.40139
Q7a	1.00	4	3.7500	1.25831	.62915
	5.00	4	1.7500	1.50000	.75000
Q7b	1.00	4	4.5000	.57735	.28868
	5.00	4	4.2500	.95743	.47871
Q7c	1.00	4	2.7500	.50000	.25000
	5.00	4	2.0000	1.15470	.57735
Q7d	1.00	4	4.2500	.50000	.25000
	5.00	4	4.2500	.95743	.47871
Q7e	1.00	4	3.5000	.57735	.28868
	5.00	4	3.2500	2.06155	1.03078
Q8a	1.00	4	4.7500	.50000	.25000
	5.00	4	3.5000	1.91485	.95743

Q8b	1.00	4	4.0000	1.41421	.70711
	5.00	4	2.2500	1.50000	.75000
Q8c	1.00	4	3.2500	.95743	.47871
	5.00	4	1.2500	.50000	.25000
Q8d	1.00	4	4.0000	1.15470	.57735
	5.00	4	2.2500	1.50000	.75000
Q8e	1.00	4	4.2500	.95743	.47871
	5.00	4	2.2500	1.50000	.75000
Q8f	1.00	4	2.5000	1.29099	.64550
	5.00	4	1.5000	1.00000	.50000
Q8g	1.00	4	3.7500	1.25831	.62915
	5.00	4	2.2500	1.50000	.75000
Q9	1.00	4	4.5000	.57735	.28868
	5.00	6	3.3333	1.36626	.55777
Q10	1.00	5	2.2000	.83666	.37417
	5.00	6	3.8333	1.60208	.65405
Q11	1.00	4	1.5000	.57735	.28868
	5.00	6	1.1667	.40825	.16667
Q121	1.00	4	2.7500	2.06155	1.03078
	5.00	5	3.2000	1.48324	.66332

Table 11. ‘Mediterranean’-‘Take-out’ Mean Statistics

Group Statistics

	V5	N	Mean	Std. Deviation	Std. Error Mean
Q1	1.00	5	2.8000	1.09545	.48990
	4.00	7	3.5714	.78680	.29738
Q2	1.00	5	830.0000	939.14855	420.00000
	4.00	6	2136.6667	3865.10888	1577.92409
Q3a	1.00	5	2.6000	1.34164	.60000
	4.00	7	2.8571	.89974	.34007
Q4a	1.00	5	2.0000	1.00000	.44721

	4.00	6	1.6667	.81650	.33333
Q5a	1.00	5	1.6000	.54772	.24495
	4.00	7	1.2857	.48795	.18443
Q6	1.00	5	2.8000	.83666	.37417
	4.00	6	3.5000	1.04881	.42817
Q7a	1.00	4	3.7500	1.25831	.62915
	4.00	3	1.0000	.00000	.00000
Q7b	1.00	4	4.5000	.57735	.28868
	4.00	3	3.6667	2.30940	1.33333
Q7c	1.00	4	2.7500	.50000	.25000
	4.00	3	1.3333	.57735	.33333
Q7d	1.00	4	4.2500	.50000	.25000
	4.00	3	2.3333	1.52753	.88192
Q7e	1.00	4	3.5000	.57735	.28868
	4.00	3	2.0000	1.00000	.57735
Q8a	1.00	4	4.7500	.50000	.25000
	4.00	4	4.0000	2.00000	1.00000
Q8b	1.00	4	4.0000	1.41421	.70711
	4.00	4	3.0000	1.63299	.81650
Q8c	1.00	4	3.2500	.95743	.47871
	4.00	4	2.0000	1.15470	.57735
Q8d	1.00	4	4.0000	1.15470	.57735
	4.00	4	3.2500	1.70783	.85391
Q8e	1.00	4	4.2500	.95743	.47871
	4.00	3	3.0000	2.00000	1.15470
Q8f	1.00	4	2.5000	1.29099	.64550
	4.00	4	1.7500	.95743	.47871
Q8g	1.00	4	3.7500	1.25831	.62915
	4.00	4	1.7500	1.50000	.75000
Q9	1.00	4	4.5000	.57735	.28868
	4.00	5	4.4000	.89443	.40000
Q10	1.00	5	2.2000	.83666	.37417

	4.00	7	3.4286	1.13389	.42857
Q11	1.00	4	1.5000	.57735	.28868
	4.00	7	1.5714	.53452	.20203
Q121	1.00	4	2.7500	2.06155	1.03078
	4.00	3	2.3333	2.30940	1.33333

Table 12. 'Take-out'-'Sit-down' Mean Statistics

Group Statistics

	V5	N	Mean	Std. Deviation	Std. Error Mean
Q1	4.00	7	3.5714	.78680	.29738
	5.00	6	3.0000	.89443	.36515
Q2	4.00	6	2136.6667	3865.10888	1577.92409
	5.00	5	2180.0000	697.85385	312.08973
Q3a	4.00	7	2.8571	.89974	.34007
	5.00	6	2.0000	1.54919	.63246
Q4a	4.00	6	1.6667	.81650	.33333
	5.00	6	1.1667	.40825	.16667
Q5a	4.00	7	1.2857	.48795	.18443
	5.00	6	1.6667	.81650	.33333
Q6	4.00	6	3.5000	1.04881	.42817
	5.00	6	4.1667	.98319	.40139
Q7a	4.00	3	1.0000	.00000	.00000
	5.00	4	1.7500	1.50000	.75000
Q7b	4.00	3	3.6667	2.30940	1.33333
	5.00	4	4.2500	.95743	.47871
Q7c	4.00	3	1.3333	.57735	.33333
	5.00	4	2.0000	1.15470	.57735
Q7d	4.00	3	2.3333	1.52753	.88192
	5.00	4	4.2500	.95743	.47871

Q7e	4.00	3	2.0000	1.00000	.57735
	5.00	4	3.2500	2.06155	1.03078
Q8a	4.00	4	4.0000	2.00000	1.00000
	5.00	4	3.5000	1.91485	.95743
Q8b	4.00	4	3.0000	1.63299	.81650
	5.00	4	2.2500	1.50000	.75000
Q8c	4.00	4	2.0000	1.15470	.57735
	5.00	4	1.2500	.50000	.25000
Q8d	4.00	4	3.2500	1.70783	.85391
	5.00	4	2.2500	1.50000	.75000
Q8e	4.00	3	3.0000	2.00000	1.15470
	5.00	4	2.2500	1.50000	.75000
Q8f	4.00	4	1.7500	.95743	.47871
	5.00	4	1.5000	1.00000	.50000
Q8g	4.00	4	1.7500	1.50000	.75000
	5.00	4	2.2500	1.50000	.75000
Q9	4.00	5	4.4000	.89443	.40000
	5.00	6	3.3333	1.36626	.55777
Q10	4.00	7	3.4286	1.13389	.42857
	5.00	6	3.8333	1.60208	.65405
Q11	4.00	7	1.5714	.53452	.20203
	5.00	6	1.1667	.40825	.16667
Q121	4.00	3	2.3333	2.30940	1.33333
	5.00	5	3.2000	1.48324	.66332

Table 13. Significance Table (p-values)

	Med-Chin	Med-Fish	Med-Takeout	Med-Sitdown	Chin-Fish	Chin-Takeout	Chin-Sitdown	Fish-Takeout	Fish-Sitdown	Takeout-Sitdown
Q1	0.95	0.18	0.18	0.75	0.03	0.06	0.69	0.95	0.23	0.25
Q2	0.92	0.03	0.48	0.03	0.01	0.44	0	0.72	0.37	0.98
Q3a	0.88	0.37	0.7	0.52	0.31	0.46	0.5	0.13	0.82	0.24
Q4a	0.09	0.14	0.56	0.09	0.37	0.48	0.34	0.29	0.9	0.21
Q5a	0.41	0.76	0.32	0.88	0.77	0.07	0.52	0.36	0.84	0.32
Q6	0.44	0.07	0.26	0.04	0.59	0.1	0.44	0.44	0.79	0.28
Q7a	0.64	0.6	0.01	0.09	0.89	1	0.12	0.04	0.21	0.44
b	0.12	0.3	0.51	0.67	0.75	0.02	0.24	0.96	0.48	0.66
c	0.46	0.18	0.02	0.28	0.38	0.77	0.12	0.02	0.07	0.41
d	0.63	0.13	0.06	1	0.23	0.02	0.66	0.01	0.29	0.09
e	0.62	0.2	0.05	0.82	0.44	0.22	0.94	0.48	0.56	0.38
Q8a	0.78	0.78	0.49	0.25	0.58	0.19	0.13	0.56	0.29	0.73
b	0.53	0.36	0.39	0.14	0.74	0.34	0.32	1	0.49	0.52
c	0.9	0.18	0.15	0.01	0.11	0.76	0.01	0.8	0.16	0.28
d	1	0.44	0.49	0.11	0.33	0.09	0.05	0.97	0.4	0.41
e	0.89	0.52	0.32	0.07	0.37	0.38	0.06	0.66	0.25	0.59
f	1	0.57	0.39	0.27	0.48	0.18	0.17	0.75	0.53	0.73
g	0.47	0.96	0.09	0.18	0.47	0.29	0.31	0.1	0.19	0.65
Q9	0.13	0.56	0.85	0.15	0.18	0.13	0.84	0.72	0.25	0.17
Q10	0	0	0.07	0.07	0.03	0.14	1	0.06	0.34	0.61
Q11	0.65	0.8	0.84	0.31	0.84	0.43	0.09	0.93	0.17	0.16
Q12	0.37	0.68	0.81	0.71	0.66	0.64	0.1	0.93	0.36	0.53