Financial Engineering and Risk Analysis of a Sunflower Oil Plant in Afghanistan

The journey of the Sunflower

1830 – Seeds arrive in Canada and US
1920s – Industrial processing begins
1980s – Exported to Europe to supply massive demand
Oil patent 1716
Arrives in Spain c 1510
Pre-history > 1500s

Peter the Great spots them in Holland – introduces them to Russia – c 1790
Cultivation begins

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THE FINANCIAL FEASIBILITY OF A SUNFLOWER OIL PLANT WITH APPLICATION OF CONSTRUCTION MANAGEMENT AND ENGINEERING THEORIES

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A Thesis

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ABSTRACT

Sunflower oil is a non-volatile oil pressed from sunflower (*Helianthus annuus*) seeds. Sunflower oil is commonly used in cooking as a frying oil and in cosmetic formulations as an emollient. The world's largest sunflower oil producers are Russia, Ukraine and Argentina.

This research focuses on a financial and risk analysis of sunflower oil production in Afghanistan. Due to the wars of the last thirty years, Afghanistan lacks industrialization and technological development. The country produces almost nothing and has to import its needs from international markets, especially from the neighboring countries due to its landlocked position.

Vegetable oil is a necessity and a basic cooking ingredient. The production technique is simple and requires limited investment (based on production capacity). The main vegetable oil in Afghanistan is sunflower oil. The country consumes over 200,000 tons of it per year. The market demand is generally imported from Russia and the United Arab Emirates, from which the oil travels through several countries to reach Afghan markets. Therefore, the availability and sales price constantly fluctuate and depend on political relationships between the neighboring countries.

This report will investigate the question of establishing a local sunflower oil production plant in Afghanistan through a financial and risk analysis. Various financial techniques will be applied to determine the profitability of this investment and to compare it with other opportunities available to the investors. The realization of the factory, the purchase of the required equipment, the employment of staff and all other expenses will be investigated, including expenses during the preparation phase and the start of the production. The results will be demonstrated by 3D sketches, execution planning, breakeven point and risk register to amplify and clarify the recommendations.
Chapter I - Introduction
This chapter starts with introduction of sunflower oil project in Afghanistan. Problem statement clarifies the safety issue, insecurities, lack of qualified staff and expropriation danger. Research objective and scope signifies research achievement. Research questions are directed on feasibility, current suppliers and market demand of sunflower oil.

Chapter II - Literature review
Under literature review relevant published and available studies and their similarity with this research is discussed. Idem feasibility and viability is clarified to evaluate and base the financial achievement of this report on it.

Chapter III - Project description
Chapter 3 summarizes sunflower oil history and production worldwide. Also distribution, demand, and consumption in Afghanistan is explained. Problem description signifies various future obstacles of sunflower oil project like huge variety of summer and winter temperature and local road conditions. An overview of the existing building is also presented.

Chapter IV - Methodology
The goal of this chapter is to develop a suitable methodology to execute this research with. Data collection techniques are discussed as well and the required information is identified.

Chapter V - Financial engineering
Financial engineering is subdivided in financial feasibility and financial analysis, which forms the core content of this research. F. feasibility is focused on product, market and competitive analysis, while F. analysis provides detailed calculation of the project cost and revenue. The outcome of this chapter will contribute to answer the research questions.

Chapter VI - Risk analysis
The outcomes of financial engineering is applied to determine the project and project environmental risk. The evaluation is focused on the project progress, investment, profit and losses. Idem a set of measurements are developed to avoid, mitigate, relocate or to accept the risk effects. Risk analysis is finalized with risk register.

Chapter VII - Conclusion & recommendation
• After gathering of sufficient information, accomplishment of different calculation and execution of risk analysis, the conclusion is finalizing this research with a suitable recommendation.
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LIST OF ABBREVIATIONS

DPP          discount payback period
GPD          gross domestic product
IIR          internal rate of return
LCC          lifecycle costing
MIIR         modified internal rate of return
NPV          net present value
PV           present value
PPP          public private partnership
ROI          return on investment
SROI         social return on investment
WAK Int.     WAK group of international companies
CAPEX        capital expenditures
OPEX         operational expenditures
1. Content of chapter I

Introduction

- The research starts with a short summary. The highlight of the project, the main stakeholders and project goal will be introduced.

Problem statement

- Problem statement will mainly point out the project achievement problems and the project environmental problems.

Research objective

- This part is emphasizing the main objective of this research and the theoretical knowledge to be achieved at the end of this research.

Scope of research

- Summarize the main tasks to be executed for evaluation of the financial feasibility and risk analysis.

Research questions

- Research questions will be substantiated to focus the content of the research on it. At the end of this research these questions must be answered.
Chapter I  INTRODUCTION

This thesis studies the financial feasibility of a sunflower oil plant located in Nangarhar province, Afghanistan. The currently abandoned olive oil factory was built in 1960 and was very profitable and successful in producing olive oil since the early 90’s (Rubin, July 2010). Due to war, the plant is not functioning well and the maintenance has been postponed until a suspension of the production process. During the war the machinery was plundered and sold to Pakistan as scrap metal.

After the invasion by NATO and the rebuilding of Afghanistan, foreign investment and natural resource exploration has increased, which caused great economic growth in Afghanistan in a very short period of time. This event created a new growth path and opened the opportunity for investors who dare to do business in a high risk area with high profits as a return. These events increased the economic growth, job opportunities, production capacity and demand for goods, which are linearly related to each other. To meet the local demand for human nutrition and to enlarge the employment opportunities, the Afghan government began to invest and stimulate the industrialization. Due to lack of governmental budget they used the public private partnership (PPP) methodology. Along with two other respected international firms, the WAK group of international companies (hereafter WAK Int.) has been invited by the representative of the Afghan government to participate in the PPP process. The government is offering to provide the existing plant building (which has to be renovated, modernized and enlarged to meet the capacity requirement), agriculture land and water for cultivation, security and all necessary clearances to whoever might operate in that area. The financial investment and operation strategy must be developed by the private partner. Although WAK Int. is very interested in this proposal, it wants to execute a financial feasibility research with rough factory design sketches and risk management plans.

The focus of this thesis is not only to serve the interest of WAK Int. and assess the financial feasibility of the sunflower oil project, but also to evaluate the application of construction management and engineering knowledge. This feasibility research will investigate the feasibility of the sunflower oil plant project. The focus of the research is not only on the financial investment, but also on threats that might harm the achievability of the goal, the construction work needed to restart production and an assessment regarding distributing the product in the region (CME).

Therefore, it is necessary to perform a risk analysis. To strengthen the research, project process management, stakeholder analysis and cross culture theory will be applied to understand the position of the stakeholders, their background and their cultural differences, which might influence the process for international companies operating in
foreign countries. Parallel to this, project management will be applied to describe the project structure and framework and determine the organizational strategy, the initial planning and the critical chain approach.

Although the Afghan government in this PPP agreement is generally responsible for providing of all required licenses, contracts and other official documents, a quick review and application of legal and governance theories will assess and explain the contract divisions. The table below provides an overview of the current contributions, obligations and shares in establishment of the sunflower oil factory.

**Table 1: PPP agreement and division**

<table>
<thead>
<tr>
<th>Contribution/obligation/share of the Government</th>
<th>Contribution/obligation/share of the private partner</th>
</tr>
</thead>
</table>
| Contribution | Contribution  
existing building of the olive oil factory, land and access to water for agricultural activity  
knowledge, experience, network, financial investment |
| Obligation | Obligation  
security at all time, dispense of licences, respect the agreement  
respect local law, prevent exploitation |
| Share | Share  
zero financial investment, income tax after 3 operation years, social benefits.  
100% investment of the required budget, 100% owner of the factory and neto earning. |
The role of the government in this project is to encourage (foreign) investors with experience and knowledge to establish, create and introduce industrialization in Afghanistan. The government provides land, security and licenses. In return, the government is counting on income taxes and social benefits for the country.
1.1 **OVERVIEW OF THE RESEARCH ORGANIZATION.**

<table>
<thead>
<tr>
<th><strong>Goal</strong></th>
<th>The main goal of this research is to evaluate the feasibility of sunflower oil plant establishment in Afghanistan. For achievement of this goal the below steps have to be executed.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Analysis</strong></td>
<td>First of all the product demand and consumption have to be identified. Subsequently current market suppliers, their prices and product availability should be determined.</td>
</tr>
<tr>
<td><strong>Local brand</strong></td>
<td>For such an investment in a such an area, it’s very important to evaluate, if there is demand for a new local brand. Also competitors advantages and strategy should be studied. A strong strategy should be developed on how to deal with existing suppliers and how to overpower the competitors.</td>
</tr>
<tr>
<td><strong>Production chain</strong></td>
<td>At this stage the required information to produce sunflower oil has to be complete, like; required sunflower seed per liter, required agriculture space for crops of one kg or ton sunflower seed, water supply for agriculture, required production capacity, required machinery, factory building measurement and requirement, plastic bottling machinery, transportation vehicles and more.</td>
</tr>
<tr>
<td><strong>Expenses</strong></td>
<td>To determine the project financial feasibility, the total project expenses, sale prices and the revenue have to be calculated. Also project financing strategy, payback period and bank loan interest should be clarified.</td>
</tr>
<tr>
<td><strong>Risk</strong></td>
<td>After accomplishment of the above steps, the project risk could be determined. This task must be executed after determination of the required project investment to evaluate the risk on project budget, duration, competitors strategy and market share.</td>
</tr>
<tr>
<td><strong>Strategy</strong></td>
<td>To start with execution of the mentioned steps and to focus on the direction of this research, initially the project achievement could be formulated as research questions. Than a suitable strategy and data collection technique could be selected for information collection.</td>
</tr>
</tbody>
</table>
1.2 Problem statement

Generally, the realization of a sunflower oil plant of a magnitude of around 200,000 tons/year is not a large problem. The general project and process management in combination with risk analysis and market research provides enough information to compose the financial plan. There is a general procedure to follow for evaluating such investments. The challenge that makes this research different from the routine financial analysis is its location in Afghanistan and the business partner of this project, the Afghan government. The lack of reliability and the continuous shifts in the political decision making of the partner, the market demand-supply chain (consumers, environment welfare, culture) and other large uncertainties define the project (political science). The central government is willing to execute this project in the context of a PPP-partnership. In the west, PPP-agreements are used to finance large infrastructure projects, such as highways and bridges. However, PPP application in Afghanistan is quite broad and popular due to lack of government budget. The key elements are trust, reciprocal understanding and benefit. In this project, the local government is continuously changing and the expropriation risk of foreign investors’ assets is not insignificant.

The main goals of this oil plant project for the local government, besides tax income, is to create employment opportunities, stabilize the currency and stimulate the economy and the growth of the gross domestic product (macro economy). Achieving these goals depends on several factors, such as an experienced and professional partner who could apply the best management and operational strategy and professional labor with experience and knowledge of the operation. Qualified industrial labor is hard to find in Afghanistan. Although the cooking oil consumption is quite high, its production and manufacturing in Afghanistan is negligible. The challenge is to design a proper management and risk plan within the context of a financial feasibility analysis to enlarge the production capacity, increase the efficiency of the plant and minimize the manufacturing costs required to take over the local market.

Large-scale production capacity and industrialization has never been introduced to Afghanistan due to the wars of the last 30 years (and even more wars before that). The market requirement has always been fulfilled by local and international traders (micro economy). Reliable and large statistics on import quantities or consumption are not available. The high project investment and large uncertainties do not permit basing the project on estimated statistics. Prior on the
execution of the financial calculation a survey is required to determine realistic consumption numbers.

1.3 RESEARCH OBJECTIVE

The main objective of this research is to apply the theoretical knowledge of construction management and engineering to a practical problem. Construction management and engineering has been developed to provide answers and expertise to large-scale projects, deal with uncertainties, and either prevent delays and risks or locate them in a department acquainted with the problem that can minimize the damage. Keeping operations within budget and achieving complimentary communication in the organization are skills of CME engineers.

Since TU-Delft is known as an excellent and successful knowledge center, it’s a great opportunity to execute research with so many uncertainties and unknowns, a large financial investment, environmental differences and management style to enlarge my operational area and knowledge. Execution of this financial analysis will also provide me with more expertise in evaluating financial investments and a clear view for operating later in Afghanistan as an independent entrepreneur.

1.4 SCOPE OF RESEARCH

The scope of this research is to evaluate the financial feasibility and risk analysis of a sunflower oil project in Afghanistan. Several aspects will be researched and discussed in this report, and the content will be divided into the following subparts for evaluation.

I. Analyzing the project and infrastructure, determining the stakeholders, clarifying the project management strategy and risk management plan.

II. Performing a financial analysis, which will include accumulating the necessary statistics and running a data analysis related to the consumption market and consumers. Furthermore, a purchase strategy will be put together and machinery prices will be quoted.

III. Project and environmental risk analysis

Phase one will contain a large study of the factors that might indirectly influence the project’s progress. This part will discuss the threat factors and the possible countermeasures (prevent, mitigate, transfer or accept) to minimize their detriment. At the same time, the positive uncertainties will be pointed out and all efforts will be made to take advantage of heir occurrence for a better project result.
Market research is necessary to complete the report. Due to lack of statistics, a random survey has to be executed to map the potential consumer base and their consumption to determine the production capacity. A purchase list and strategy will determine the machinery suppliers to be contacted for their prices to estimate the investment and to accomplish this financial analysis.

1.5 RESEARCH QUESTIONS

- Is there market demand that can support the establishment of local sunflower oil production in Afghanistan, and who are the current suppliers?
- What is the necessary project investment?
- How long does it take to reach the payback period?
- Is this project financially feasible and viable?
- What are the main project uncertainties and how to respond to them?
- What are the project environmental risks and how to mitigate them?
- Should the investor and the government accept or reject this investment proposal?
Chapter II  LITERATURE REVIEW

A literature review is an account of what has been published on a topic by accredited scholars and researchers. A review of the existing literature will generate directed information and policies. A literature review could provide specific information to a single topic or various techniques and tools with a wide range of application.

A survey of financial feasibility and risk analysis of a sunflower oil plant (related to the Middle East) confirmed the limitation of the literature in this area. However, various other related tools and terms for a financial and risk analysis are available and applicable. Their application area, technical advantages, disadvantages and limitations will be discussed later (Section 2.1).
2.1 LITERATURE REVIEW

First of all, the terms feasibility and viability and the financial analysis in the context of the sunflower oil project will be clarified.

A feasibility analysis determines the strengths and weaknesses of a new investment or existing business. The focus is to evaluate the proposed venture by considering the environmental opportunities. A feasibility analysis takes into account the resources, operational details, financial data and tax requirements together with its policies on management and marketing. The more details are available related to the product or service, the more reliable the financial analysis. A viability analysis determines the sustainability of an existing business or proposed
venture. The focus is to evaluate the existing strategy and the possibilities for innovation to enlarge the business opportunity. A viability investigation is required to determine whether the business proposal should be approved or not. This approval is mainly related to how long a business will last and the future growth. The forthcoming profit prediction of an existing business could be determined by analyzing the return of certain period. An approvable business could be expected to have a better chance at success in future ventures.

Financial investment in the sunflower oil plant is a long term commitment and therefore needs to be both feasible and viable. Although there have been several financial analyses executed in the past for different types of projects, every project has its own character, risks and environmental opportunities and threats. Therefore, it is important to execute a specific analysis for the sunflower oil plant based on available resources in Afghanistan. Relevant literature will be discussed to fortify the foundation and methodology of this research and to select appropriate calculation tools.

Construction management theory is suitable and applicable to a regular project in Europe or anywhere with western facilities and mentality. In this research the challenge is not only to determine the financial feasibility of the project, but also to determine how far western organizations could apply these theories in less developed and non-western countries with large uncertainties, cultural differences and limited technological facilities.

2.2 REVIEW OF FINANCIAL FEASIBILITY ANALYSIS

According Hofstrand and Holz-Claus (Hofstrand, 2006), a feasible project is one that could generate an adequate amount of cash flow (depending on the range of the project investment and the investors’ expectation) and profits, withstand the risks it will encounter, remain viable in the long-term and meet the goals of the business. The venture can be a start-up of a new business, the purchase of an existing business or the expansion of the current business.

Matson (Matson, 2000) confirms this theory by adding that “a financial feasibility study is an analysis of the viability of an idea. It describes a preliminary study undertaken to determine and document a project’s viability. The results of this analysis are used in making the decision about whether to proceed with the project. This analytical tool is used during the project planning phase and shows how a business would operate under a set of assumptions, such as the technology used, the facilities and equipment, the capital needs, and other financial aspects. The study is the first instance in a project development process that shows whether the project is technically and economically feasible. As the study requires a strong financial and technical background, outside consultants conduct most studies. This theory has been confirmed and explained by several other researchers in the literature.
To begin the determination of financial feasibility and viability of this research, several steps have to be taken. These steps provide the required information to both project developers and project investors on which to base their decision making. In this thesis a detailed comparison of cost and revenues will be evaluated to determine the feasibility of the project. Due to the financial and risk complicity of the sunflower cooking oil project, an enhanced research will be executed, taking into account project quality, operational issues, project construction risks, funding commitments and market assessments.

To determine and calculate the expenses, a proper and suitable methodology has to be evaluated to assess the feasibility of the project. The applied methodology will be supported by the theories of net present value, internal rate of return and the Du-Pont analysis. There are many other tools to be applied to determine the project’s feasibility, but this research will be limited to the above mentioned tools. Net present value will determine the profitability of the project, and the outcome of the internal rate of return will be applied to compare the sunflower oil project’s rate of return with other investment opportunities. Du-Pont analysis will decompose the return on investment in various components to understand the financial structure of the organization.
2.3 Capital expenditures and Operational expenditures (CAPEX & OPEX)

To calculate net present value, internal rate of return or any other measure used to determine the financial feasibility of this project, the required investment must be determined.

CAPEX, or capital expenditure, is a business investment incurred to create future benefit. CAPEX is required to begin establishing the project and involves tangible and intangible costs. For realization of the sunflower oil project, the cost of designing the factory, construction costs, and purchase of required sunflower squeezing machinery and other equipment constitutes the CAPEX. Once the capital expenditures of an investment are calculated, the cash flow to capital expenditures ratio will indicate whether the firm might asses over cash flow for the operation cost or have to finance it by depth. A great ratio is indicative of relative financial strength. The more an organization has the financial ability to invest in itself through capital expenditure, the easier it is for the business to grow.

Once the sunflower oil factory is established, various expenses are required for the day-to-day functioning of the business, such as wages, utilities, maintenance, and repairs. These costs fall under the category of OPEX, or operational expenditure. OPEX is the money the business spends in order to turn inventory into throughput. Operating expenses also include depreciation of buildings and machinery used in the production process.

![Figure 1: CAPEX, OPEX & revenue](image-url)
2.4 THE LACK OF CURRENT INFORMATION IN THE SUNFLOWER OIL TRADE

Although globalization and export by large producers makes it impossible for local manufacturers to compete in cooking oil production, there are countries where globalized trade is limited. Afghanistan is one of those countries, where international suppliers have limited access due to security reasons, infrastructure problems and the country’s landlocked location.

Like most other basic food ingredients, sunflower oil’s usage is quite high, especially in Asian countries where a warm meal cooked in oil is desired twice a day. Despite the increase in the number of manufacturers, there is no access to the production chain, financial data or information related to their area of distribution. The lack of information makes this financial and feasibility research quite hard to compare with the existing one. To execute this research and compare the purchase and market prices, the import size and transportation route with the current suppliers and the available production capacity of the neighboring countries and the suppliers must be determined. Furthermore, a general cost-benefit analysis will be applied to determine the required investment capital and expected rate of return and to develop a suitable management strategy.
2.5 Conclusion

This chapter was focused on a review of available literature and studies concerning the financial feasibility, viability and applied technique. Although production of sunflower oil is industrialized and has been growing since its manufacturing was industrialized in 1835, relevant financial information related to its production is hard to find due to competition.

A financial analysis is one of the most important preliminary steps in every investment. To generated information regarding the sunflower oil plant project, a comprehensive calculation is required. The outcome will be provided to WAK Int. to help compare this investment with its other investment opportunities. To compose this financial section of the research, the discussed calculation techniques could be applied. All techniques have their advantages, disadvantages and applications. Prior to applying the tools, the duration of the project based on the lifecycle of the machinery must be determined. With this information the present value of the future return could be calculated using a PV tool. Subsequently, the net present value of the project can be calculated with the NPV technique to investigate whether the project is profitable. To enable WAK Int. to compare investment opportunities, calculating the internal rate of return is very important. The IRR tool expresses the outcomes in percentage of the invested capital with the desired discount rate and is perfect in this type of study.

Application of the aforementioned tools are required to judge this investment. Further return on investment could be applied to signify the internal rate of return and to express the profit in percentage of the investment capital. Due to the nature of this PPP-project, it's desirable for the local government to express the social return on the investment (SROI) and the SROI tool makes this possible. The lifecycle cost tool (LCC), which studies the production life and the related costs of certain machinery, could be used to supplement the content, but it's not required. The LCC is also a time consuming technique, and is based on information provided by the machinery supplier, which in this case is of questionable reliability. All other discussed tools are suitable for this research and other calculation tools can be applied later to supplement and clarify this report.
Chapter III  PROJECT DESCRIPTION

This research is focused on a financial feasibility and viability analysis of a sunflower oil factory with large uncertainties and risk management in Afghanistan. Therefore, a suitable management strategy will be developed with a work plan controlled by a critical path method. First, a short summary of this chapter will be presented.

- **Content of chapter III**
  - Project description
    - A short description of various vegetable cooking oil is provided. Subsequently the consumption behavior and market demand of Afghanistan is analyzed with the main suppliers.
  - Problem description
    - Describes lack of production capacity, education and skills. Signifies the clash of tribes and corruption, causes disturbance of social order. Huge climate difference between winter and summer is studied with their impact on agriculture activities.
  - Location of the project
    - Emphasizes the unique location of the project area and great agriculture climate of it. The transportation route is idem underlined.
  - Factory building
    - Short description of the existing factory (olive oil plant) and the measurements.
  - Water resources & agriculture
    - Discusses the water resources of Afghanistan. Maps current water shortage and the effect of it on agriculture. Also the importance of agriculture in Afghanistan is summarized.
Cooking oil is a staple kitchen product. There are different kinds available in the market and new sorts are in development to improve human health and quality of life with minimum harm to nature. Since advent of new health threats caused by different type of cooking fat, the type of oil, its background and ingredients became an important issue. Since then, production of vegetable oil has been improved. Sunflower oil was produced industrially for the first time in the mid-eighteenth century in Russia. Due to globalization and increase in export, Ukraine, Russia and Argentina became the largest manufacturers of sunflower oil. At the same time local production of sunflower oil increased everywhere due to the simplicity of the manufacturing techniques and machinery. Still there are countries who prefer to import their cooking oil due to lack of land suitable to cultivate the sunflower plant or high labor costs.

Afghanistan is one of the countries that imports sunflower oil, but this is not due to production costs or lack of suitable agriculture land. It imports sunflower oil due to lack of industrialization and local production capacity. According to the latest statistics, the population of Afghanistan is around 33 million (W.Bank, 2014). The exact cooking oil consumption per capita per year is not available, but this number can be extrapolated from neighboring countries with the same cooking habits. In India, the consumption is around 14 liters per capita per year (Jha, 2014), the Pakistanis consume 14-15 liters per capita per year (Masood, 2010) and Iranian consumption is around 13 liters per capita per year. A random survey conducted in different provinces in Afghanistan among consumers with a variety of incomes leads to the conclusion that average cooking oil consumption in Afghanistan is between 11 and 13 liters per capita per year. Although the improvement of industrial manufacturing of cooking oil in Afghanistan has lately been subsidized, every attempt has failed due to lack of expertise and management capacity. Therefore, local (qualified) production capacity could be estimated between 1%–5% of the market demand. The remainder of the market demand is imported from Russia, Ukraine, Argentina, Malaysia and Jebel Ali (the UAE). Due to the conflict in Ukraine and Russia and better connection and accessibility for Afghan traders to the UAE, the majority of the current oil market demand is supplied from Jebel Ali. The main cooking oil used in Afghanistan is sunflower oil, followed by maize oil, and in the recent years olive oil has been becoming popular.

3.1 PROBLEM DESCRIPTION

The main problems in this project are the lack of sunflower oil production capacity, modern technology, and capable management to run the factory, sell the oil, and establish a trustable brand for further development and market inheritance. The existing factories have been subsidized enormously by the local government, the World Bank or western governments. All
these organizations were hoping to build Afghanistan’s industrial sector to reduce the amount of unemployment and indirectly preventing civilians from joining extremist groups for financial reasons. Unfortunately, none of those attempts has been successful, as the investments have always been executed through inexperienced mid-size entrepreneurs who lack management capacity. Their management strategy failed to analyze the supply and demand chain, the provision of raw materials during the entire year and transportation routes. They also failed to anticipate the market competition and the production costs prior to investment.

Beside lack of industrial knowledge, Afghanistan faces a large illiteracy problem. The majority of the residents have never been to school and cannot read or write. According to several scholars and analysts, this is a major cause of war and economic deterioration. Modernization and introduction of industrialization requires an open and knowledgeable society. Afghanistan is neither of these. Not only is the country landlocked and thus difficult for global trade to reach, but also the society, the religion and the culture are very conservative.

Tribal war is another consequence of lack of education. There are about 13 different tribes in Afghanistan. The majority of the population are Pashtuns (40%), followed by Tadjiks (36%), Hazaras (10%), Uzbeks (8%) and other small ethnic groups (Wikipedia, 2016). Although the ethnic groups are dispersed and mixed throughout the country, clashes between them are common. Tribal conflicts cost more than a hundred thousand innocent residents their lives between 1990 to 2001. Every attempt at peace and progress has failed up to 2001. After 9/11 and the invasion of the western coalition, a clear political power shift has been launched. This intervention also created greater access to Afghanistan and greater opportunities for Afghan traders to access the international market and participate in globalized trade. Establishment of a sunflower oil plant in Afghanistan may be easier now than ever before, but not in every province of Afghanistan.

Afghanistan is one of the most corrupt countries in the world (Index, 2015). Corruption could be assumed as the biggest threat for the safety, democracy, stability, business, and sustainability, or for that matter, any progress in society. Beside lack of education, lack of qualify staff and tribalism, corruption will also affect the success of a sunflower oil plant in Afghanistan. Corruption will not only affect the operation process, but also increase the production costs.
The surface area of Afghanistan (652,864 km$^2$) is about 16 times larger than the Netherlands (41,543 km$^2$), while the population is only 33 million people versus 16.9 million (W.Bank, 2014).

The spread of the Himalaya Mountains over a significant part of Afghanistan and the enormous contrast in the altitude between various provinces cause significant differences in climate between different parts of the country. This not only has a large impact on the agriculture, but also on the entire operation, production and transportation chain of any large scale production. These factors have been mostly neglected when planning large-scale projects in Afghanistan. In some provinces (Kunduz, Mazar-E-Sharif, Pule Khumri) the temperature reaches 45 degrees Celsius in the summer and -10 degrees Celsius in the winter with meters of snow (WeatherSpark, 2014). A favorable climate for sunflower cultivation is between 10 – 30 degree Celsius. Figure 2 shows the temperatures in areas with unfavorable agriculture climates.

The above project and problem description clarified the challenges and uncertainties, which will be elaborated further under risk analysis. Proper solutions and measurements must be taken into account to deal with these problems.
3.2 Location of the Project Plant

The existing olive oil factory plant is located in Nangarhar province, in the eastern part of Afghanistan, bordered by Torkham and Peshawar, Pakistan. The factory was built in the sixties by the Russian and former Afghan governments.

The location of the plant is very important in a country like Afghanistan with different elevations and different weather patterns. In this province, the average temperature is 35 degrees Celsius in the summer and 10 in the winter (WeatherSpark, 2014). Compared to other provinces, this climate is well-suited to allow agriculture and industry to maximize their production capacity year-round.

Nangarhar province is located on the main transportation route between the center of Afghanistan and Pakistan. Therefore, accessibility and road conditions are very good and the local roads are currently in use for transportation of goods between the two countries.
3.3 FACTORY

The existing olive oil factory was constructed in the early 1960’s by Russia. When the olive oil project began, there was no intention to build a factory for producing olive oil. The goal was to create a large olive and orange farm for local consumption and export to Russia. After a long period (approximately 12 years for olives and four years for oranges), when the entire farm was lucrative and productive, the crop was so high that Russia started to build a factory for production of olive oil for export. This came about when they realized that Afghans don’t like olives and that the olive consumption was very low (Rubbin, 2010).

The factory was built just outside the city to make it accessible for local workers and transportation of raw material to the factory and olive oil from the factory. The area around the factory was generally used for farming and housing the farmers. The main building in the plant was about 150 meters by 50 meters. The operating machinery and production processing system were Italian. The olive plant processed up to 8000 tons of olives in the high season (Ekhtyar, 2012).

Figure 5 – existing olive oil factory in Nangarhar, Afghanistan
3.4 WATER RESOURCES

Afghanistan is a landlocked country and about 75% is mountainous. The latest research and articles related to water availability in Afghanistan emphasize that “years of drought, armed conflict and a lack of good management have seriously affected Afghanistan’s water resources, cutting agriculture production and the supply of drinking water to such an extent that the country is facing a growing human tragedy” (IRIN, 2006).

Figure 6 – water resources in Afghanistan before and water resources in Afghanistan now

Lack of drinking water and water for agriculture due to rapid climate change and lack of water management is becoming a serious problem in Afghanistan. This problem was discussed and emphasized in 2012 at the South Asian Association for Regional Cooperation among the neighboring countries of Afghanistan. The Afghan representative of the ministry of water and energy said that Afghanistan has 57mn cubic meters of surface water and 18bn meters of ground water, but the country is only utilizing 31% of its water, while the rest flows into neighboring countries. This means that less than 50% of Afghanistan’s population has access to safe drinking water. Due to the continuous wars of the last 30 years, proper water supply infrastructure has been neglected or destroyed.

3.5 AGRICULTURE IN AFGHANISTAN

Agriculture was and is a very important driver of economic growth in Afghanistan. More than 60% of the employment relied on agriculture. In recent years Afghanistan has often been in the news in connection to the cultivation of drugs. Prior to the decades of conflict, Afghanistan’s agriculture products earned a global reputation for excellence. The most famous products of Afghanistan were pomegranates, pistachios, raisins and apricots. These agriculture products and many other important crops grown for local consumption constituted about 40% of Afghanistan’s gross domestic product (USAID, 2015). The current agriculture problems in Afghanistan are lack of water and the threat of drug cultivation, which mainly occurs in the western part of the country. Afghanistan also lacks modernization and large scale cultivation of good crops for local consumption and export.
Chapter IV  METHODOLOGY

A methodology is a system of broad principles or rules from which specific methods or procedures may be used to interpret or solve different problems within the scope of a particular discipline. Unlike an algorithm, a methodology is not a formula but a set of principles. For this report a variety of data is required to analyze the project demand and environmental criteria. Various methodologies have been used in the past by different organizations in Afghanistan to collect information. However, that information is not relevant for this research. Suitable milestones for this research are drafted in the following strategy chart. These steps

- **Product demand and consumption**
  - Determines the product demand and local consumption. Due to lack of data, the consumption could be determined based on random interviews and assumption.

- **Market suppliers & producers**
  - Market and product analysis should provide sufficient information to identify current suppliers and producers.

- **Product price and local distribution**
  - Identify the product distribution centers and suppliers to set local distribution. Quick market survey could provide product price.

- **Demand for establishment of local production**
  - Once product demand, quality, availability and price is determined, establishment of local brand could be evaluated. Local production is desired, when product price/quality/availability is better than existing one

- **Financial calculation and risk analysis**
  - After accomplishment of the above steps, financial calculation and risk analysis could be executed to determine the feasibility and viability of the project.
serve to guide the rest of this research.

4.1 Data collection techniques

To analyze the feasibility and viability of the sunflower oil plant, the number of consumers, their consumption behavior and the consequent market demand have to be determined. Furthermore, information on the supply chain, the local producers and their production capacity is required. To execute these task a suitable data collection technique is essential. A short summary of those techniques are mentioned in Table 2. The table will clarify how to identify various players, the market product price and the available techniques for information collection. Proper application and execution of the techniques mentioned in table 2 will provide more information.

The chart below is emphasizing once again the required information to be identified.
Required information | Source | Methodology
--- | --- | ---
1 Population/consumers | WPR (WPR, 2015) | Data and statistics related to the population of Afghanistan from before 2001 are hard to find. After the NATO invasion in 2001, NGO's and other organizations began registration and administration of the populations. Since then, several independent researches and reports have confirmed that there are about 33 million people currently living in Afghanistan.
2 Consumption/market demand | (Jha, 2014) (Masood, 2010) | Due to lack of local production capacity the exact consumption of cooking oil is unavailable. Since consumption is an important part of this analysis, a random survey was executed in several provinces of Afghanistan. The outcome was subsequently compared with the consumption behavior of the neighboring countries (India, Pakistan and Iran) with the same cooking and eating habits. To prevent any overly optimistic calculations, the consumption behavior is assumed lower than in the above mentioned neighboring countries. Application of this technique provided an oil consumption of 11 liters per capita per year for Afghans.
3 Suppliers/producers | Market analysis | The applied methodology for determining the supply chains was quite simple. The available cooking oil products in the market in the last two years have been analyzed and the manufacturing companies have been listed. These producers have their distributers or franchisers supplying the Afghan market. The main cooking oil suppliers are Alokozai, Momen, Noor and Shams.
4 Distribution center | Random survey | Due to large uncertainties in Afghanistan, only a few of the producers have their own distributer or franchiser in the capital city of Afghanistan. It's assumed that small Afghan importers and distributers provide distribution in the country.
5 Variety & price | Market analysis | Again by analyzing the availability of the cooking oil, the variety and prices are determined. This technique is applied over six large provinces of Afghanistan: Kabul, Herat, Mazar-E-Sharif, Kunduz, Nangarhar and Kandahar. There are four dominant brands and their prices are almost the same, around 105 Afghani (€1.8)

Table 2: Applied methodology on data collection
Chapter V  Financial Engineering

Financial engineering is the application of mathematical techniques to the solution of problems in finance. This covers the financial and feasibility analysis of a project and provides tools to calculate the required investment and the revenue of the project. Based on these calculations an organization could decide to approve or to reject an investment. Following is a short

- Content of chapter V is subdivided in two main parts, namely feasibility and financial analysis

- Part I product analysis

- Product analysis is subdivided and determines sunflower oil consumption and production in Afghanistan. Advantage of local production and alternative possibilities are also underlined.

- Market analysis

- The analysis is focused on main suppliers of sunflower oil market globally. The main suppliers of Afghan market and their shares are also identified. Further consumption of sunflower oil in Europe is discussed.

- Competitors analysis

- In this phase the main difference among local and foreign producers are clarified, their advantages disadvantages and limitations with their prices are discussed.

- Part II Sale forecast

- Identifies the consumption to determine the required production capacity and total sale forecast.

- CAPEX & OPEX

- In this stage the entire capital expenditures and operational expenditures are calculated to determine the required project investment. Idem project financing possibilities are evaluated.

- Market sales price

- WAK Int. produced sunflower oil price will be determined based on the current available (local and global) market product price. This price will determine the project revenue.

- Profit and revenue

- The main part of this chapter is to evaluate the financial feasibility of this project. This part is determining the project profitability and return on investment. Various calculation, tables and graphs are applied to visualizing the outcome.
summary of this chapter.
5.1 **Feasibility Analysis**

To assess the merit of the sunflower oil project plan, it's important to determine the current market suppliers and the product demand. Subsequently, the financial viability will be determined prior to starting the project. Based on this information, WAK Int. could decide whether this venture is worth the investment of money and time. In this feasibility analysis the following key components will be evaluated:

- product analysis
- market analysis
- competitive advantage analysis

5.1.1 **Product Analysis**

Sunflower cooking oil or any related substitute is a basic household necessity in Afghanistan. As mentioned earlier (2.4), most Asian countries prefer two warm meals per day, which are generally prepared in cooking oil. The demand for cooking oil is enormous and the average consumption per capita per year in Afghanistan is assumed around 11 liters per capita per year.

The local and central governments are willing to execute this project as a public-private partnership, with the main focus on long term demand in the Afghan market. To stimulate local production and industrialization and to create a platform for the investors, the local and central governments are willing to increase taxes on imported products in the long term. Tax increases will be applied when there are enough comparable local products available. A rough calculation of the market size could be determined once the exact number of consumers are defined.

\[
\text{Market size} = \text{Consumption per capita} \times \text{total consumers}
\]

The consumption per capita will be determined in the financial analysis and discounts will be applied to distinguish the consumption behavior of children in different age categories. Also, the total population will be discounted due to frequent emigration to neighboring countries. Currently, the total market demand is imported, mainly from Jebel Ali (the UAE) and Russia, and distributed by local Afghan entrepreneurs.

The main goal of this project is to take over the local market slowly by involving the existing oil distributors to prevent any competition or resistance. The long term goals are to establish manufacturing distributing agents across the country and evaluate and analyze the export market to the neighboring countries (mainly Pakistan, which currently imports sunflower oil from Malaysia and others).
The main advantage of the new product will be the price. Due to the fully local production of the sunflower oil, low labor costs, and lack of import or international transport fees and taxes, the sunflower oil can be produced and distributed at less than the current market price. At the same time, government strategies and popular enthusiasm for local production will encourage the residents to use local products. The product quality will be high due to the fresh sunflower seeds bought from local farmers. In comparison, the UAE is known as a desert area with no agriculture production and lack of water. It imports sunflower seeds and produces sunflower oil. It purchases the seeds from the international market, and the long distance traveled causes evaporation and reduces the quality of the seeds. Finally, manufacturing will be executed with the most modern machinery.

<table>
<thead>
<tr>
<th>Competitive advantages of the product</th>
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<tbody>
<tr>
<td>The main advantage of the new product will be the price. Due to the fully local production of the sunflower oil, low labor costs, and lack of import or international transport fees and taxes, the sunflower oil can be produced and distributed at less than the current market price. At the same time, government strategies and popular enthusiasm for local production will encourage the residents to use local products. The product quality will be high due to the fresh sunflower seeds bought from local farmers. In comparison, the UAE is known as a desert area with no agriculture production and lack of water. It imports sunflower seeds and produces sunflower oil. It purchases the seeds from the international market, and the long distance traveled causes evaporation and reduces the quality of the seeds. Finally, manufacturing will be executed with the most modern machinery.</td>
</tr>
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<table>
<thead>
<tr>
<th>Competition evaluation of the imported product vs local production</th>
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<tbody>
<tr>
<td><strong>Availability</strong></td>
</tr>
<tr>
<td>Imported product</td>
</tr>
<tr>
<td>Local production</td>
</tr>
</tbody>
</table>

*Table 3: local production vs imported product*

<table>
<thead>
<tr>
<th>Drawback and possible alternatives</th>
</tr>
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<tbody>
<tr>
<td>The main drawback of this project is the uncertainty and lack of safety in Afghanistan. Construction of the factory and purchase of new machines will require a large investment, which could be lost if current stable situation collapses. Also, initially the operation will be laborious due to lack of qualified and experienced staff. Although the stability and safety of Afghanistan can’t be guaranteed or predicted, with internal education the staff’s qualification and knowledge can be increased. Most machinery suppliers provide operation courses prior to the installation of their equipment. From the point of view of the government and the consumers there are no alternatives to reduce sunflower oil prices and increase its availability. Establishment of this project creates job opportunities and generates income for the residents as well for the government.</td>
</tr>
</tbody>
</table>
5.1.2 Market Analysis

At this stage the product analysis is completed and the necessity of cooking oil is determined. The outcome confirmed and clarified that there is great demand for local production of sunflower oil. With this information a market analysis could be composed.

Much has already been said about the demand for cooking oil. Cooking oil is a product consumed by all classes in societies around the world. The only difference is the variety, market availability and consumption quantity. The average worldwide oil consumption is 36 liters per capita per year (Statrica, vegetable oil worldwide, 2010). To prevent overestimation and high product demand, the consumption for Afghanistan is assumed to be 11 liters per capita per year. In comparison, Dutch citizens consume around 18 liters per capita per year (Statrica, vegetable oils, 2009).

![Table 4 - Vegetable oil consumption in kg per capita per year in Europe](image-url)
To meet the demand WAK Int. must have the ability to produce high quality vegetable oil. The oil quality should be at least equal to that of the current suppliers and the oil should be available in different package sizes for small, medium and large families. Furthermore, the product must be available and sufficient in the beginning at least in the nearest distribution centers and markets.

To take over the entire demand of the Afghan market, the supply chain must increase. This takeover must happen slowly to minimize the damage to competitors’ available market product and to prevent any kind of resistance. At the same time, advertisements and a clear product price difference must encourage the customers to choose this new product.

The current market supply is divided among different manufacturers. Although these manufacturers are not located and producing in Afghanistan, they have succeeded in meeting the demand for sunflower oil in Afghanistan. The main player in this supply chain is the Alkozay group, followed by Russian, Momin and Nurish. Alkozay group, Momin and Nurish are based in UAE and the others in Russia, purchasing their raw materials from the international market. However, there are also other brands available in the Afghan market, mainly focused on edible oil imported from Russia, Pakistan and Ukraine. Spinghar, the only Afghan semi-manufacturer, imports the edible oil and packages it inside Afghanistan with local subsidies and a local brand name.

Table 5 Sunflower oil market division among the main suppliers by percent
5.1.2.1 Marketing according to Philip Kotler & threats

To accomplish the market analysis of sunflower oil in Afghanistan, it’s also necessary to study and discuss the future threats and competitions due to development of new technology and other possible changes. Philip Kotler’s marketing management principles and his famous four P’s theory could be applied together with market threats. Kotler’s four P’s are discussed in his book *Marketing Management*, which is discussed and applied by various scholars in the literature (Kotler, 1960). The four P’s are:

- Price
- Promotion
- Product
- Place

**Price**

To introduce a new brand in the market the product price is very important. The price of existing sunflower oil brands in Afghanistan is quite high. The main reason for this is the large distance the product has to be transported across to reach the Afghan consumers. The existing suppliers are mainly located in the UAE and Russia. Since Afghanistan is a landlocked country, the long road transportation route together with border taxes determine the end price of imported products. Therefore, these suppliers cannot reduce their prices very much or for very long. However, the price of the local sunflower oil production will be significantly below the current sunflower oil product price (Table 25).

**Promotion**

Kotler’s objective was always to centralize and study the behaviors and desires of the customers in order to achieve successful marketing management. One of his strategies to reach the customer for better product marketing was promotion. WAK Int. and its governmental partner must take advantage of every opportunity to introduce the new local brand to the market and the customers. However, competitors could adjust their strategy as well by doing more advertisement to prevent the introduction of a new brand. Therefore, WAK Int. has to study the customer demand carefully and get their attention by supplying the product in various sizes, providing a high quality product at lower prices, and promoting the product based on market availability.
Product

Customers’ decision-making processes should be analyzed to develop a strategy for better operation and establishment of the product. The current suppliers and producers are focused on a large market and fulfill customers’ needs, not their desires. Alkozay and Momin operates from the UAE and Russian oil from Moscow, and these producers are primarily focused on their local customers. Most of their products doesn’t even have an information sticker in Dari or Pashto (Afghan languages).

![Image](image1)

**Figure 7: cooking oil packages for Afghan market, but with foreign language stickers**

WAK Int. could analyze all these marketing opportunities and competitor errors to develop a strong management strategy for establishing their new local product. Enlarging the distribution centers and providing better availability will also increase the product sale numbers.

Place

There is not a single factory in Afghanistan that produces sunflower oil for the local market. The production locations are far away from the Afghan market, which make customer access to production sites impossible. WAK Int. will establish the first local production of sunflower oil in Afghanistan. The factory will be accessible to the distributors, wholesalers, and customers during periodic open days. If the competitors decide to open a local manufacturing factory, they have to apply for permission. Due to the involvement of the government in this PPP-project, to make this investment successful the local government will not provide permission to any competitors for a new sunflower oil manufacturing business in Nangarhar province for the first 5 years after the start of production. Permission for other provinces will be granted, but without any further subsidies or government involvement. The agriculture situation, water supply and weather conditions of the other provinces were discussed at the beginning of this report, and are not favorable compared to Nangarhar province. Therefore, threats of local competition could be ignored.
Conclusion

Market competitors have no avenue to resist the manufacturing and introduction of the new product in the market. A local product, with the low labor costs, low transportation costs and no import taxation will cost at least 25% less than the existing market product.

5.1.3 COMPETITIVE ADVANTAGE ANALYSIS

Under this section the main differences and advantages between locally manufactured sunflower oil and existing sunflower oil products will be discussed. When producing a new version of an existing product, the manufacturers will be always confronted with the following questions:

- What are the main differences between the new product and the existing once?
- How will the business distinguish the new product from the existing one?
- Why would customers choose this product over the alternatives?

Difference with the existing products

The main differences with the existing market products will be the quality. As mentioned before, the existing products are manufactured in the UAE from imported sunflower seeds. Those seeds spend weeks in warehouses and containers before arriving in the UAE and entering the production chain. Also, seeds from different countries with different qualities are merged to create oil of an average quality, while Afghanistan and especially Nangarhar is famous on its crops due to high land availability and a perfect agriculture climate. The local seeds could be extracted within hours or days after the crops are harvested. The local temperatures and short transportation distance will prevent moisture evaporation and dehydration of the seeds, unlike in the operation chain of the UAE manufacturers.

How to distinguish from the existing products

The manufacturer of the local sunflower oil in Afghanistan could distinguish itself from the existing imported oil by the availability of their product in the market. Current market sunflower oil availability is dependent on the infrastructure and the state of the borders with neighboring countries. If there are conflicts with the neighboring countries (which is often the case with Pakistan), the borders are closed and nothing can go in or out of the country for weeks or months.

As an international firm, WAK Int. could play a major role in the marketing and in establishing several distributors to provide continuity, accessibility and transparency of its product to the consumers. Finally, by providing different sizes it could distinguish its product from the existing products.
Preference over the alternatives

Introduction of new product in the market is always a challenge. To familiarize the client with the new product and to get them to prefer a new product over existing alternatives requires a strong marketing strategy. The key factor of this strategy for sunflower oil will be the higher quality, lower prices and better accessibility of the product. WAK Int. and the local government are aware of these important factors.

It has been emphasized that local production with local crops will provide better quality. At the same time, for a complete takeover of the Afghan market a large production capacity is required. Therefore, the most modern equipment with large production capacity will be used to provide the consumers the best local production in different size and with frequent market availability.

The average income in Afghanistan is around 230 USD per month. To gain consumers’ preference over the existing alternatives, the lower price will be crucial. Since locally produced sunflower oil will have lower manufacturing costs, there will be a larger margin for reducing sales prices compared to competitors. These lower prices will encourage the consumers to choose this new product over the alternatives.

![Average income in Afghanistan](image)

*Figure 8: average income per month in Afghanistan*

5.2 **Financial analysis**

The product analysis and market analysis clarified the demand of local sunflower oil production and highlighted the avenues for distinguishing the new product: high quality and continuous market availability at lower prices. The challenge now is to determine the financial profitability...
of this project in the long and short term. The required investment and the rate of return must be determined to convince investors and possible shareholders to approve the project. For this reason, the financial analysis will be divided into subsections to investigate each aspect of the project.

5.2.1 Project sales forecast

The total project sales forecast for sunflower oil is related to the product demand and the number of consumers. The main idea behind this project is to supply the entire market demand for the long term. A rough consumption calculation for sunflower oil was already executed in the feasibility analysis. To prevent any overly optimistic calculation, different discounts will be applied to determine the minimum amount of sunflower oil consumption.

![Population division in 3 categories](image)

*Chart 1 – Potential consumers*

In Chart 1, the potential consumers are determined. The chart is based on three different categories: residents between the age of 0 – 14 years old, residents between the age of 15 – 64 years old and residents above the age of 64 years old (Afghanistan age structure, 2015). The consumption behavior of residents of different ages will not be the same. To simplify the calculation and to determine the minimum number of the real consumers, the residents between the age of 0-15 years old will be discounted 50%. This deduction is applied because this category will not consume as much as an adult consumers. The remaining 50% will be assumed as full consumers. As mentioned before, the total population of Afghanistan is, according several reliable references, around 33 million, of which 2 million have emigrated to neighboring countries. To be safe, 2,5 million will be deducted to prevent overestimation of the
consumption market. The table below demonstrates the total number of consumers after various deductions.

<table>
<thead>
<tr>
<th>No</th>
<th>Category</th>
<th>Population after age deduction in % of total population</th>
<th>Total pop. after deduction in mln</th>
<th>Consumers in mln</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Consumers age 0-14</td>
<td>21.2</td>
<td>30.5</td>
<td>6.5</td>
</tr>
<tr>
<td>2</td>
<td>Consumers age 15-64</td>
<td>55.3</td>
<td>30.5</td>
<td>16.9</td>
</tr>
<tr>
<td>3</td>
<td>Consumers age 64 +</td>
<td>2.4</td>
<td>30.5</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>Total consumers of vegetable oil</td>
<td></td>
<td>24.0</td>
<td></td>
</tr>
</tbody>
</table>

*Table 6 - Sunflower oil consumers*

This calculation set the minimum number of consumers at 24 million. To simplify the calculation and prevent overestimation, 15% of these consumers will be assumed as other vegetable oil consumers. Therefore, the potential consumers this research must be focused on number 20,800,000. The consumption of sunflower oil among Afghans was also discussed, compared with various nations and set at 11 liters per capita per year. Based on this information, the following algebraic expression determines the required amount of sunflower oil to take over the market step by step.

\[ \text{total consum} \rightarrow \lim_{n \to 20,8} Cn \]

*Where*

- \( C = 11 \) L oil consumption/capita/year
- \( n = 20.8 \) million consumers in Afghanistan

With the collected information, the total project sale forecast can be determined. The total consumption of sunflower oil in Afghanistan is 229,000 tons per year. WAK Int. could take over the entire market demand in 3 phases by producing 1/3 of the market demand in the first year and adding another 1/3 at the end of each year. Three years after the start of the production WAK Int. will supply the entire market demand and the government could if necessary start increasing taxes to prevent external import. As WAK Int. will be providing the market with sunflower oil at a 20% lower price, it may not be necessary to take any measures to stop the external import. The consumers might reject higher prices on their own.
Conclusion of sales forecast

By taking over the market in three stages, the risk will be decreased, the consumers will have more time to get familiar with this new project and WAK Int. will have more time to gain additional experience and educate the staff. The table below demonstrates the required amount of sunflower oil to be produced at the end of each year.

![Market supply by WAK](image)

**Chart 2 - WAK Int, market supply**

5.2.2 CAPEX (capital expenditure)

For realization of a sunflower oil factory, a large amount of capital is required. The exact amount of the investment depends on several elements:

- Required machinery for oil production, including installation
- Packaging equipment
- Factory construction based on the size of the machinery and warehouse
- Staff training
- Transportation, agriculture equipment and vehicles
- Agrarian projects

The total required investment capital will be investigated, divided into subgroups and discussed separately in detail. The local government will provide the existing factory, the required licenses and extra agriculture land for additional cultivation of sunflower seeds. The private partner will finance the other required investments.
5.2.2.1 Machinery cost

The production of sunflower oil is a long process and will require a variety of equipment. There are many manufacturing companies that supply these kinds of machinery as well as installation and staff training. Although the maximum production capacity of the sunflower oil plant is set at 76.3 $\times 10^3$ tons for the first year and 152.6$\times 10^3$ tons for the second year, the long term objective is to reach a minimum of 229$\times 10^3$ tons per year. With the growing population and market demand it’s better to have machinery with a higher production capacity than 229$\times 10^3$ tons per year. After an enhanced market research, WAK Int. selected three suppliers from China who will deliver the following machinery:

<table>
<thead>
<tr>
<th>Nr</th>
<th>Machinery type</th>
<th>Capacity</th>
<th>Delivery</th>
<th>Installation</th>
<th>price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cold &amp; hot vegetable oil processing machine</td>
<td>50-1000 ton / 12 hours</td>
<td>Ja, anywhere</td>
<td>Ja, included</td>
<td>3,100,000 USD</td>
</tr>
</tbody>
</table>

![Figure 9 - Sunflower oil machinery](image)

The selection criteria for the machinery are mainly based on the required capacity. The aforementioned equipment have a maximum production capacity of 365$\times 10^3$ ton of oil per year based on operating 12 hours per day and 365 days per year, while the market demand is 229$\times 10^3$ tons/year. To increase the production capacity in the future, the working hours per day could be increased up to a maximum of 24 hours a day with a maximum production capacity of 730$\times 10^3$ tons/year. The machinery is easy to clean and sorts the seeds by size and weight. The detailed specifications of the machinery are available and can be used to prepare the factory prior to transporting and installing the machinery.
5.2.2.2 Packaging and bottling costs

Packages and bottles are not only devices for transporting the oil from the plant to consumers’ kitchens, they are also important and attractive advertisement tools.

Figure 10 shows a selected number of the sunflower oil packages available in the Afghan market. The production of plastic bottles is quite easy and does not require heavy equipment. For this project a compact reliable manufacturing machine is selected to sustain the oil production capacity. The selected machine can produce various bottle sizes and shapes. For simplicity only two designs have been selected, which have a volume of 1 liter and 2,5 liters respectively.

<table>
<thead>
<tr>
<th>Nr</th>
<th>Machinery type</th>
<th>Capacity</th>
<th>Dimension in meters</th>
<th>Installation</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stretch molding blow</td>
<td>5000 pcs / hour</td>
<td>L<em>W</em>H, 3,4<em>1,6</em>1,9</td>
<td>Ja, inclusive staff training</td>
<td>50.000 USD</td>
</tr>
</tbody>
</table>

Figure 12: plastic bottle manufacturing machine

As demonstrated in Figure 12 and mentioned in the specifications, the machinery will not occupy considerable space and could be installed in the same area as the oil production machinery to avoid extra displacement.
5.2.2.3 Construction and renovation costs for the plant

Although the existing factory was already described and discussed, it’s important at this stage to analyze the plant from a new perspective. The existing building was built in the early 1970’s and does not fulfill the safety and functionality requirements of this project. The plant must be column free, there must be enough ventilation and daylight, the ceiling must be 6 to 9 meters high and the new machinery must be placed properly. The functionality should not be confined due to lack of space. The current division of the plant is shown below.

![Figure 12: current division of the plant](image)

A redesign of the plant is attached to this report. At this stage it’s important to determine the renovation and construction cost of the plant to finalize the financial analysis. Since WAK Int. originated as an engineering and construction company, it is well equipped to redesign and determine the required renovation and expansion of the factory.

<table>
<thead>
<tr>
<th>Activities</th>
<th>Renovation of the current factory</th>
<th>Expansion of the factory building</th>
<th>Construction of new storage and cooling</th>
<th>Construction of water reservoir &amp; pavement</th>
<th>Water, electricity, ventilation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total cost</strong></td>
<td>3.000.000 USD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 7: construction costs of the plant*

This price includes redesign and reconstruction of the entire plant, expansion and construction of a new storage area that includes cooling systems, and paving the entire area around the plant for transportation.
5.2.2.4 Staff training cost

Successful management is only possible with well qualified staff. Since industrialization has never been developed in Afghanistan, it’s important for any large organization operating in this country to train its local staff prior to the start of production. Although machinery suppliers provide short training courses to introduce their equipment to the recipients, it’s still important that at least the team leaders have some basic knowledge and experience with industrial production and large-scale systems. The table below shows the required investment for staff training.

<table>
<thead>
<tr>
<th>Flight to China</th>
<th>Accommodation</th>
<th>Reimbursement</th>
<th>Course fee</th>
<th>Total investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>8p* $ 950</td>
<td>8p*30days *$25</td>
<td>8p* $ 800</td>
<td>$ 10,000</td>
<td>$ 30,000</td>
</tr>
</tbody>
</table>

Table 8: staff training investment

The required investment is meant for 8 team leaders for 30 days and includes accommodation, course fee and staff reimbursement.

5.2.2.5 Transportation equipment cost

For a smooth operation it’s important to have 24-hour transportation available. Since the Afghan market does not operate 24 hours a day and most of the transportation vehicles are owned by entrepreneurs with only one vehicle, it’s important for the plant to have its own vehicles for transporting the seeds from the farm to the warehouse and plant. Besides provision of raw material to the plant, these vehicles could also be used to transport the sunflower oil from the factory to the local distribution centers.

<table>
<thead>
<tr>
<th>Trucks</th>
<th>Fork-lift trucks</th>
<th>Pallet trucks</th>
<th>Total investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>6pcs * $ 63500</td>
<td>4pcs * $ 8500</td>
<td>8pcs * $ 790</td>
<td>$ 422,760</td>
</tr>
</tbody>
</table>

Table 9: transportation equipment cost

Table 9: transportation equipment cost the required investment for the most basic and important transportation equipment. The trucks could operate between the warehouse, farms and the plant, while the fork-lift trucks are meant for the plant and the warehouse. The small pallet trucks are necessary for daily operation inside the factory for lifting pallets of sunflower oil after production and filling.

5.2.2.6 Agriculture & raw material cost

To supply the entire market demand of Afghanistan and even operate in the international market, a large amount of sunflower seed is required. To supply the local demand alone will require 229*10^3 tons of sunflower oil. Nearly 1,8 tons of sunflower seed is required to produce 1 ton of sunflower oil. To produce 229*10^3 tons of oil requires around 412,2*10^3 tons of sunflower seed. The average sunflower seed harvest is 0,6 to 3,0 tons per hectare. Assuming an
average harvest of 2,0 tons per hectare, almost 206.100 hectares of agriculture land is required (Department of Agriculture, March 2010).

<table>
<thead>
<tr>
<th>Amount of required oil</th>
<th>Required seed</th>
<th>Required agriculture land</th>
</tr>
</thead>
<tbody>
<tr>
<td>229*10³ tons sunflower oil</td>
<td>412,2*10³ tons</td>
<td>206.100 hectares</td>
</tr>
</tbody>
</table>

Table 10: oil, seed and land specifications

The total area of Nangarhar province is nearly 7.727 km² (772.700 hectare) with a total population of only 1,43 million. Most of the population of this province live and work in the capital city of Jalalabad. Only 38,5% of the land is in use, and only about 2% is used for agriculture. In comparison, in the Netherlands more than 63% of the total land area is used for agriculture (Ruimte, 2009). Nangarhar province’s location, availability of water and perfect agriculture temperature makes it possible to use 26,7% (2061 km²) of its land for cultivation of sunflower plants. It’s also possible to cultivate and harvest in other provinces of Afghanistan to prevent over-farming in this area.

With this information in hand, WAK Int., together with the local government, hopes to plant and harvest the required amount (412,2*10³ tons) of seed within 3 years after the start of the project. The local government is providing the required agriculture land and WAK Int. is willing to invest around 1.000.000 USD in agriculture equipment and a water supply system. Further agriculture management and investment possibilities to reduce the amount of required raw material fall under OPEX.

5.2.3 OPEX (OPERATING EXPENDITURE)

Having discussed the capital expenditures, the operating expenditure will now be clarified. The operational costs are all required expenditures during the operation of the plant. For such a large operation, it’s difficult to calculate all the expenditures; however, the important operating cost will be discussed and used to execute the financial analysis. These costs are:

- Staff salary
- Transportation cost
- Raw material cost
- Maintenance cost
- Available cash
5.2.3.1 Staff salary

Operating the factory requires staff. The required number of staff will differ over the years and depends on the required production capacity. This creates varying OPEX costs for the first three years. Once the maximum production capacity is reached, the OPEX costs will remain the same, barring uncertainties and damage. The staff are divided into various groups based on their expertise and area of operation. Fifty-eight staff members are required for the first year, consisting of four management team members to manage the project, eight team leaders to supervise and run the factory, 16 operation workers for production activities and 30 farmers for cultivation and crop activities.

<table>
<thead>
<tr>
<th>Year</th>
<th>Management team</th>
<th>Team leaders</th>
<th>Operation workers</th>
<th>Farmers</th>
<th>Total salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4<em>2500</em>12</td>
<td>8<em>600</em>12</td>
<td>16<em>350</em>12</td>
<td>30<em>400</em>12</td>
<td>$388,800</td>
</tr>
<tr>
<td></td>
<td>Staff<em>salary</em>month</td>
<td>St<em>Sa</em>Mo</td>
<td>St<em>Sa</em>Mo</td>
<td>St<em>Sa</em>Mo</td>
<td></td>
</tr>
</tbody>
</table>

Table 11: salaries for the first year of operation

For the second year of operation the same management team would be preserved and two well-performing operation workers could be promoted to support the team leaders. Six new operation workers and 15 new farmers will be hired to expand the operation’s capacity.

<table>
<thead>
<tr>
<th>Year</th>
<th>Management team</th>
<th>Team leaders</th>
<th>Operation workers</th>
<th>Farmers</th>
<th>Total salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4<em>2500</em>12</td>
<td>10<em>600</em>12</td>
<td>20<em>350</em>12</td>
<td>45<em>400</em>12</td>
<td>$492,000</td>
</tr>
<tr>
<td></td>
<td>Staff<em>Salary</em>Month</td>
<td>St<em>Sa</em>Mo</td>
<td>St<em>Sa</em>Mo</td>
<td>St<em>Sa</em>Mo</td>
<td></td>
</tr>
</tbody>
</table>

Table 12: salaries for the second year of operation

The maximum production capacity will be reached by the third year. For seamless execution of the operation, two new qualified staff members will be added to the management team. Two more operation workers would be promoted to support the team leaders and eight new production workers and 25 new farmers will be hired to prevent work overload.

<table>
<thead>
<tr>
<th>Year</th>
<th>Management team</th>
<th>Team leaders</th>
<th>Operation workers</th>
<th>Farmer</th>
<th>Total salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>3+</td>
<td>6<em>2500</em>12</td>
<td>12<em>600</em>12</td>
<td>28<em>350</em>12</td>
<td>70<em>400</em>12</td>
<td>$720,000</td>
</tr>
<tr>
<td></td>
<td>Staff<em>Salary</em>Month</td>
<td>St<em>Sa</em>Mo</td>
<td>St<em>Sa</em>Mo</td>
<td>St<em>Sa</em>Mo</td>
<td></td>
</tr>
</tbody>
</table>

Table 13: salaries for the third year of operation

Table 11-12 show the total salaries of the staff involved in the operation of the sunflower oil plant. These salaries are above the average income for workers in Afghanistan. The local government and WAK Int. are willing pay higher wages to stimulate the workers to execute their tasks carefully and with the required responsibility and honesty. Due to their high initial
salaries, inflation and raises for the first three years are neglected. However, the changes in salaries will not make a large difference to the total operational expenditures.

### 5.2.3.2 Transportation cost

The vehicle purchase costs have already been calculated under the CAPEX. The daily fuel consumption of the vehicles, drivers’ salaries and maintenance costs remain to be calculated. All transportation during the first three years will be executed by these trucks. However, by increasing the production capacity in three phases the number of drivers will change as well. The trucks will remain the same, but their operation hours and capacity will increase.

<table>
<thead>
<tr>
<th>Year</th>
<th>Fuel consumption</th>
<th>Drivers salary</th>
<th>Maintenance</th>
<th>Total OPEX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trucks<em>fuel</em>month</td>
<td>Drivers<em>salary</em>month</td>
<td>Trucks*maint. cost</td>
<td>Costs/year</td>
</tr>
<tr>
<td>1</td>
<td>6<em>700</em>12</td>
<td>6<em>400</em>12</td>
<td>6*750</td>
<td>$ 83.700</td>
</tr>
<tr>
<td>2</td>
<td>6<em>1.300</em>12</td>
<td>9<em>400</em>12</td>
<td>6*900</td>
<td>$ 126.900</td>
</tr>
<tr>
<td>3</td>
<td>6<em>2.000</em>12</td>
<td>12<em>400</em>12</td>
<td>6*1.150</td>
<td>$ 208.500</td>
</tr>
</tbody>
</table>

*Table 14: transportation costs*

### 5.2.3.3 Raw material cost

The entire production chain of sunflower oil, from cultivation to harvest, cleaning, transportation and squeezing is a complex task. To simplify this calculation only the main cost of the raw material will be calculated and an extra margin will be added per ton to account for the operational expenditures. The following tables provide the sunflower seed costs for agriculture production of sunflowers.

<table>
<thead>
<tr>
<th>Year</th>
<th>Agriculture area</th>
<th>Required seed</th>
<th>Cost</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(For 76.300 tons seed)</td>
<td>(area*required tons seed/ha)</td>
<td>(price seed/ton)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>68.700 ha</td>
<td>68.700 *0.03= 2.061 ton</td>
<td>$ 332</td>
<td>$ 684.252</td>
</tr>
</tbody>
</table>

*Table 15: sunflower seed cost for the first year of operation*

Table 15 shows the required seed cost for cultivation during the first year. As determined before, the required agriculture area to cultivate the maximum amount of sunflower seeds required is about 206.100 hectares. In the first year only 1/3 of this area will be needed, which is 68,7*10^3 hectares, and per hectare only 0,03 tons of sunflower seed is required to cultivate sunflower plants (Hofman, 2016). To prevent the cost of purchasing the seed from the open market for cultivation of the next year, it’s better to cultivate seeds for next years’ cultivation in addition to the seeds for this years’ oil production. It’s important to notice that the amount of required seed for cultivation will be increased as well and is about 4.122 tons for 137.400 hectares. Once the farms are running at full capacity and the sunflower plants are harvested, there will be no need to purchase sunflower seed for cultivation from the international market.
The entire process of cleaning, squeezing, carbonating, heating, filtering and bottling with nitrogen will require an additional operation investment. To simplify these calculations, an additional cost will be added to the production of each ton of oil to account for the application of raw materials and energy consumption.

<table>
<thead>
<tr>
<th>Operation expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Squeezing</td>
</tr>
<tr>
<td>Fuel/electricity consumption machinery</td>
</tr>
</tbody>
</table>

**Operational expenditures per ton** $300/ton  
*Table 16: operation cost/ton*

### 5.2.3.4 Maintenance cost

A separate budget has to be devoted for maintenance of the operational equipment. This budget will be determined at the beginning of each year after the yield of the harvest. Since all the production equipment comes with warranties, the maintenance cost will be assumed to be the same for the first three years.

<table>
<thead>
<tr>
<th>Year</th>
<th>Maintenance cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sunflower squeezing machine</td>
</tr>
<tr>
<td>1-3</td>
<td><strong>Total yearly budget</strong></td>
</tr>
</tbody>
</table>

*Table 17: maintenance costs years 1-3*

<table>
<thead>
<tr>
<th>Year</th>
<th>Maintenance cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sunflower squeezing machine</td>
</tr>
<tr>
<td>4-6</td>
<td><strong>Total yearly budget</strong></td>
</tr>
</tbody>
</table>

*Table 18: maintenance costs years 4-6*

The maintenance costs after 3 years will increase due to the end of the equipment warranty period, age, and wear and tear. These costs will increase until new equipment is bought.
### Year 7+

<table>
<thead>
<tr>
<th>Maintenance cost</th>
<th>$219,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunflower squeezing machine</td>
<td></td>
</tr>
<tr>
<td>Plastic bottling machine</td>
<td></td>
</tr>
<tr>
<td>Trucks</td>
<td></td>
</tr>
<tr>
<td>Agriculture equipment</td>
<td></td>
</tr>
<tr>
<td>Factory building</td>
<td></td>
</tr>
<tr>
<td>Advertisement &amp; others</td>
<td></td>
</tr>
</tbody>
</table>

*Table 19: maintenance costs after year six*

For simplicity’s sake it is assumed that maintenance costs will be the same for the first three years. Likewise, maintenance costs in the fourth to sixth year will be assumed to be the same, while the maintenance costs after the sixth year will increase yearly until the machinery is replaced.

### 5.2.3.5 Reserve budget

The purpose of the financial calculation is to define the expenditure costs and eliminate any surprises. However, not every expenditure of such a large project can be predicted at the beginning. To prevent cash flow shortage during the operation, an extra reserve budget will be separated for all other capital operational expenditures. The reserve budget investment cost is different than the unforeseen cost or project risk cost. Those costs will be discussed under risk management.

<table>
<thead>
<tr>
<th>Year</th>
<th>Reserve cash budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>Capital expenditures</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 20: reserve budget*

This budget could be kept in a savings account to prevent interest on a loan in case investment capital is borrowed.
5.2.4 Sunflower oil market sales price

After estimating and calculating the all the production costs and the sunflower market prices, the sunflower oil sales price could be determined. As mentioned previously, the sunflower oil market price in Afghanistan fluctuates frequently due to the unstable Afghan currency, transportation safety of imported oil and different national and international taxes. The market sales price of different key sunflower oil suppliers at their distribution centers are shown in the diagram below.

![Sunflower oil price in USD/liter](image)

*Figure 13: wholesale sunflower oil price in Afg.*

WAK Int. should fix its sales price based on the national and international sunflower oil market prices. Figure 13: wholesale sunflower oil price in Afg. shows that Momin provides cooking oil for the lowest price. Momin only distributes edible oil, therefore the lowest sunflower oil distributer is currently the Russian manufacturer at 1,26 USD per liter. The international market price of sunflower in December 2015 was 0,5 to 0,70 USD per liter (Indexmundi, 2016). To takeover the entire local market and to operate in the future in international trade market, the sunflower oil price of WAK Int. should be equal or below the international trade market, which will automatically be below the Afghan market.

5.2.5 Profitability Estimate and return on investment

Once the cost estimation is determined, the financial appliance could be submitted to calculate the net present value of the project, which would finalize the financial aspect of the investment. This calculation together with the risk analysis determines whether to accept or reject this investment. The following tools are applicable to this stage of the research:
The capital and operational expenditures were already discussed and determined. Before applying the tools, it’s important to review the CAPEX and OPEX costs in an accessible chart.

### CAPEX recapitulation chart

<table>
<thead>
<tr>
<th>Nr</th>
<th>Investment</th>
<th>Costs (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sunflower oil cleaning, squeezing and filtering machinery</td>
<td>3,100,000</td>
</tr>
<tr>
<td>2</td>
<td>Plastic bottle producing machine</td>
<td>50,000</td>
</tr>
<tr>
<td>3</td>
<td>Construction, renovation and expansion of the factory</td>
<td>3,000,000</td>
</tr>
<tr>
<td>4</td>
<td>Staff training and education costs</td>
<td>30,000</td>
</tr>
<tr>
<td>5</td>
<td>Transportation &amp; agriculture equipment</td>
<td>422,760</td>
</tr>
<tr>
<td></td>
<td><strong>Total CAPEX</strong></td>
<td><strong>6,602,760 USD</strong></td>
</tr>
</tbody>
</table>

*Table 21: CAPEX cost summary*

### OPEX recapitulation chart

<table>
<thead>
<tr>
<th>Nr</th>
<th>Operation costs</th>
<th>Year 1 (USD)</th>
<th>Year 2 (USD)</th>
<th>Years 3+ (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Staff salary including management team</td>
<td>388,800</td>
<td>492,000</td>
<td>720,000</td>
</tr>
<tr>
<td>2</td>
<td>Fuel consumption</td>
<td>83,700</td>
<td>126,900</td>
<td>208,500</td>
</tr>
<tr>
<td>3</td>
<td>Sunflower seeds for cultivation</td>
<td>684,252</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Maintenance costs</td>
<td>95,000</td>
<td>146,500</td>
<td>219,500</td>
</tr>
<tr>
<td>5</td>
<td>Corresponding production costs ($ 300/ton)</td>
<td>22,890,000</td>
<td>45,780,000</td>
<td>68,700,000</td>
</tr>
<tr>
<td></td>
<td><strong>Total OPEX/year</strong></td>
<td><strong>27,956,752</strong></td>
<td><strong>54,175,400</strong></td>
<td><strong>81,298,000</strong></td>
</tr>
</tbody>
</table>

*Table 22: OPEX cost summary*

The total required investment (CAPEX & OPEX) is summarized together with the sales prices. It’s now known how much it will cost WAK Int. to produce a liter of sunflower oil and what the minimum sales price should be to take over the market. Based on this information, the future value of this investment can be calculated by the application of present value.
The required cash outflow for capital expenditures is 6,602,760 USD and this amount will be invested in the first 3 years. In this period the plant will be constructed and the required machinery and transportation equipment will be purchased and transported to the operation’s location. The operational expenditures of 27,956,752 USD will be mainly spent to cover the production costs. Profit will be generated once the harvest is in, the production is started and the product is distributed to the market. Figure 14 outlines the current cash out- and inflow assumption for the project. A precise overview of the cost, profit and revenue will be provided later in this report.

\[ PV = I_t \times \sum_{t=t_0}^{t_0} (1 + r)^{t_0-t} \]

\( I_t = \text{cash flow at the beginning} \)

\( r = \text{rate of return based on investment opportunity} = 15\% \)

\( t_0 = \text{start of investment in years} \)

\( t = \text{end of investment in years} = 4 \text{ years} \)

\[ PV = 34,599,512 \times \sum_{t=4}^{0} (1 + 0,15)^{0-4} = 19,782,383 \text{USD} \]
Net present value could be applied to determine the profitability of this project. In Figure 13, the financial investment and the profit are visualized to clarify the future expectation of the project. Calculating the net present value will demonstrate the profits for this investment with the discounted future cash inflow.

\[ NPV = \sum_{t=t_0}^{t_e} I_t \times (1 + r)^{t_0 - t} \geq 0 \]

where:
- \( r \) = discount rate
- \( t \) = time in months or years

The entire required CAPEX cost will be invested in the first stage of the realization phase, while the OPEX cost will be divided over a long period. The OPEX cost will increase together with production costs and stabilize with production capacity. To determine the net present value of this project for the first 4 years, the discount rate is required. The government bond rate could be applied for private investors or small size entrepreneurs when there are no other investment opportunities. WAK Int. wants to apply a discount rate of 15%, which is reasonable compared with other investment opportunities it has.

\[ NPV = \sum_{t=t_0}^{t_e} I_t \times (1 + r)^{t_0 - t} \geq 0 \]

<table>
<thead>
<tr>
<th>Years</th>
<th>Cash outflow</th>
<th>Cash inflow</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-4.292.760</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>-2.310.000</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>-27.956.752</td>
<td>53.410.000</td>
<td>12.944.856</td>
</tr>
<tr>
<td>3</td>
<td>-54.175.400</td>
<td>106.820.000</td>
<td>47.559.535</td>
</tr>
<tr>
<td>4</td>
<td>-81.298.000</td>
<td>160.300.000</td>
<td>92.729.185</td>
</tr>
</tbody>
</table>

*Table 23: NPV calculation*
The applied discount rate for calculating the net present value was just an estimation of other project opportunities; however, the results did not provide sufficient information to compare different project opportunities with each other. Therefore, it is necessary to calculate the internal rate of return. As mentioned in the literature study section, internal rate of return uses the same formula as net present value. The only different is that internal rate of return generally operates by setting the outcome of NPV to zero. This could be achieved by manual trial-and-error for the discount rate or by software. There are also different formulas available for calculating the IRR. Below is the formula most often applied:

\[ IRR = \sum_{t=t_0}^{t_e} \frac{I_t}{(1+r)^{t-t_0}} = 0 \]

For reasons of simplicity and accuracy Microsoft Excel will be used to calculate the IRR and NPV of the sunflower oil project.

<table>
<thead>
<tr>
<th>Investment/return</th>
<th>Year</th>
<th>Cash outflow in USD</th>
<th>Cash inflow in USD</th>
<th>IRR in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPEX</td>
<td>0</td>
<td>-4.292.760</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CAPEX + OPEX</td>
<td>1</td>
<td>-2.310.000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Return – OPEX</td>
<td>2</td>
<td>-27.956.752</td>
<td>53.410.000</td>
<td>118 %</td>
</tr>
<tr>
<td>Return – OPEX</td>
<td>3</td>
<td>54.175.400</td>
<td>106.820.000</td>
<td>192 %</td>
</tr>
<tr>
<td>Return – OPEX</td>
<td>4</td>
<td>-81.298.000</td>
<td>160.300.000</td>
<td>216 %</td>
</tr>
</tbody>
</table>

Table 24: determination of NPV & IRR with Excel

![Investment & revenue graph](image1)

Table 24 and Figure 15: investment & revenue graph show the outcome of the NPV and IRR using Microsoft Excel. As expected, the net present value calculated by Excel is slightly different than the NPV determined manually. The software takes the investment and return time into
account, and is therefore more accurate than manual calculation. However, making a decision based only on this information is difficult, therefore it is important to also calculate the internal rate of return. The IRR of sunflower oil based on six years of operation is about 54%, which is a satisfactory for WAK Int. as well for the Afghan government. The latter was willing to accept the project with any IRR above 25%, not only because of profitable returns on the investment, but also due to the large social returns, such as job opportunities, increased number of tax payers, growth of GDP and introduction of large-scale industrial production to the country. However, the final decision making of this project is not only related to the IRR. The risk analysis will finalize the considerations for this investment.

Generally, establishing a production factory costs a lot of money at the beginning of the operation, while benefits will be generated at a later stage. Investors intend to make money on their investment, therefore they want to know when they will start to see a return. Once the CAPEX, the OPEX and the future expected profit are estimated, a breakeven analysis could be applied to estimate the economic growth of the project. With a payback period analysis, the required cost and profit behavior will be studied and the breakeven point could be determined. The breakeven point demonstrates the point when the total variable costs and the total fixed costs are equal to the total profit. This is could be very informative and important information for investors, as it will show them when they could expect profit generation from their investment. Microsoft Excel will be used to determine the payback period for the sunflower oil project.

<table>
<thead>
<tr>
<th>Nr</th>
<th>Payback period analysis based on production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sales price per ton in USD</td>
</tr>
<tr>
<td>2</td>
<td>Production per day in tons</td>
</tr>
<tr>
<td>3</td>
<td>Production in year 1 in tons</td>
</tr>
<tr>
<td>4</td>
<td>Working days per year</td>
</tr>
<tr>
<td>5</td>
<td>Sales (USD)</td>
</tr>
<tr>
<td>6</td>
<td>OPEX (USD)</td>
</tr>
<tr>
<td>7</td>
<td>CAPEX (USD)</td>
</tr>
<tr>
<td></td>
<td>Gross profit in USD</td>
</tr>
</tbody>
</table>

Table 25: breakeven point
Table 26a & b: breakeven point based on production capacity and period

Table 26a demonstrate the payback period based on production capacity. The entire investment will be earned back, after production of 43.921 ton sunflower oil. Table 26b is demonstrating the payback period in production days. This table signifies, that the entire investment will be earned within 210 production days, provided that the other parameters remain the same. Given the production is starting in the second year, the payback period will be reached 210 days and one year. This information provides the same answer in terms of different parameters, namely the required duration of the production in days and the production quantity. To emphasize the above calculation, the evolution of the expenses and profits are shown in the table and graphs below.
Table 27 provides information related to the production capacity, production cost and revenue. Based on this information, the payback period can be determined. Graph 1 shows the payback period of the project in terms of expenses and revenue. The payback period will be achieved about seventeen months after the start of the investment, after the production of 44.508 tons of sunflower oil. At that point the total cost will be equal to the revenue at about 26 million USD.
The entire investment budget has been determined and discussed from different perspectives. At this stage, the question arises regarding as to what the best option is to finance this investment. The following options are very plausible to finance this sort of project in this type of environment:

- Total financing with own capital
- Borrowing from a bank
- Selling shares

**Financing with own capital**

The simplest way to minimize the bureaucracy and the preparation phase for WAK Int. is to finance the entire project with their own equity. The project goal and the project environment create great challenges in convincing second and third parties to participate or invest in this project. While WAK Int. is willing to supply the required budget to finance the CAPEX and OPEX (6.602.760 USD + 24.141.752 USD) costs for the first operation year, it is willing to investigate other finance opportunities.

**Borrowing from a bank**

Generally, banks are willing to invest in projects with low risk. To be considered, WAK Int. must convince the banks of a satisfactory internal rate of return and limited project risk. WAK Int. is based in the Netherlands, and therefore it will be easier for them to apply for loans in the Netherlands. Afghan banks do not provide this amount of money to any investor. Despite the convenience of borrowing from Dutch banks, WAK Int. knows that it would have to pay high interest rates on such a loan due to the high risk, complexity and environment of the project.

**Selling shares**

The third opportunity for WAK Int. is to co-finance this investment by selling additional shares. However, this option is limited since WAK Int. is not traded on the international stock market. It could sell its shares on the Afghan market by convincing local investors to participate in this project temporarily against a very attractive interest rate or to operate as co-owners. The last option has to be accepted by the local government, which is the principle of this project.
In considering the scenarios of getting loans from banks or to selling shares, it’s important to provide more detailed information regarding the return on equity. Without determining the return on equity, the co-investors and even WAK Int. could not determine the exact profit margin. Application of Du-Pont analysis to decompose the ROI concept will clarify the situation.

The Du-Pont analysis consist of a three or more step calculation and demonstrates the exact division of profits. The formula below is a three step calculation of ROI based on the ratio of sale profits, sale assets and assets equity in state of single profit equity ratio. These ratios will provide enough information to shareholders and moneylenders to approve or pass on this project.

$$
ROE = \frac{Profit}{Sales} \times \frac{Sales}{Assets} \times \frac{Assets}{Equity} \times 100\%
$$

The return on equity is divided into three steps and provides more detailed information about the net profit margin and how efficiently the money is used to generate sales. The last ratio is about the leverage. The smaller the leverage, the better an organization’s investment and risk regulation. A high measure of leverage means that capital investment is for most part financed by debt and the operation could be very risky. As mentioned, WAK Int. has three options to finance the operation. The decomposition of the ROI is more applicable for understanding the investment structure when moneylenders or shareholders are involved. Since WAK Int. wants to consider all of its options, ROI will be applied to analyze the project evolution with shareholder equity and bank loans. For the remaining option (to finance the entire project with its own capital) the return on asset (ROA) technique will be applied. Below is the ROA formula, which is similar to the ROI formula, but without shareholder and moneylender contributions. ROA was invented by the Du-Pont organization in 1920 for its own use. With this tool an organization could study its operational efficiency without the involvement of second and third parties.

$$
ROA = \frac{Profit}{Sales} \times \frac{Sales}{Equity} \times 100\% 
$$

**Application and decomposition of ROI**
The local government is willing to cooperate with an international organization to successfully reopen the olive oil plant and produce sunflower oil in Afghanistan. Due to safety reasons and the isolated environment there are not many organizations willing to participate or invest in this project. Therefore, the government is quite humble, cooperative and flexible regarding the finance structure of this project. The government plans to assign the project to one organization as the main operator and not interfere in finance matters, such as involvement of shareholders or moneylenders. As mentioned before, the government is investing cash in the project.

At this stage of the analysis, WAK Int. wants to investigate the following three scenarios regarding the financial structuring of the project:

<table>
<thead>
<tr>
<th>Financial structure of the project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity</td>
</tr>
<tr>
<td>Scenario 1</td>
</tr>
<tr>
<td>WAK Int.</td>
</tr>
<tr>
<td>Shareholder equity</td>
</tr>
<tr>
<td>Debt</td>
</tr>
<tr>
<td>Total equity</td>
</tr>
</tbody>
</table>

Although WAK Int. is willing to provide the entire required investment capital, it wants to investigate these other scenarios to evaluate whether it could divide its assets on several projects at the same time to generate more profit and to divide the risk to its assets.

5.2.5.1 Financial structure of scenarios 1 and 2

In scenario 1, WAK Int. will finance 60% of the investment, 30% will be financed by the shareholders and the other 10% will be financed by the bank. The project profit and expenditures have already been determined and the ROI decomposition shows the following returns.

\[
ROI = \frac{Profit}{Sales} \times \frac{Sales}{Assets} \times \frac{Assets}{Equity} \times 100\%
\]

- Profit = 22,112,087 USD (total Income – total costs – debt interest)
- Sales = 53,410,000 USD
- Expenses = 30,744,512 USD (CAPEX+OPEX)
- Bank loan = 3,074,451 USD 1st year and 3,366,012 USD 2nd year (total payoff by 3rd year)
- Debt interest expenses = 553,401 USD (18% bank interest over its investment)
Shareholders = 9.223.354 USD (30% of the required investment)
WAK Int. = 18.446.707 USD (60% of the required investment)
Equity = 27.670.061 USD at the beginning
Tax = 10% after three years of operation

<table>
<thead>
<tr>
<th>Return on Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

Table 29: ROI calculation

The resulting ROI is, as expected, quite impressive. To increase the production capacity to reach the goal of supplying sunflower oil to the entire local market within three years, extra budget is required. Therefore, it’s prudent to reach an initial agreement with all involved investors not to claim any yield at the end of the first year and to invest all profits as equity to prevent further escalation of the bank loan and interest. This could lead to an increase of 27% for the second year and then the entire bank loan could be paid off with some yield to the shareholders.

Financial structure of scenario 3

In this scenario the involvement of the bank and shareholders will be eliminated, which means that extra capital investment will be required. WAK Int. will provide all the required capital. Therefore, an ROI calculation will not be applicable, but the return on asset could be determined.

\[
ROA = \frac{Profit}{Sales} \times \frac{Sales}{Assets}
\]

Profit = 22.112.087 USD (total Income – total costs – debt interest)
Sales = 53.410.000 USD
Assets = 53.148.160 USD (CAPEX+OPEX)
Tax = 10% after 3 operation years

<table>
<thead>
<tr>
<th>Return On Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>
The return on assets for the first two years of operation are satisfactory. Financing the entire investment with inherent capital is easy and profitable for WAK Int., since the interest on loans for projects in Afghanistan is not only high, but also not plausible due to the local tax system. In the west, generally an organization would like to supply a part of the capital through a bank loan, because the loan interest is fiscally deductible and the organization doesn’t have to provide all the money.
### Balance sheet of WAK International 2019

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities and Owner's Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Assets</strong></td>
<td><strong>Current Liabilities</strong></td>
</tr>
<tr>
<td>Cash</td>
<td>Accounts payable (operation costs)</td>
</tr>
<tr>
<td>Accounts receivable</td>
<td>Short-term loans</td>
</tr>
<tr>
<td>Inventory (produced sunflower oil)</td>
<td>Income taxes payable</td>
</tr>
<tr>
<td>Prepaid expenses (insurance)</td>
<td>Accrued salaries and wages</td>
</tr>
<tr>
<td>Short-term investments</td>
<td></td>
</tr>
<tr>
<td><strong>Fixed (Long-Term) Assets</strong></td>
<td><strong>Total current liabilities</strong></td>
</tr>
<tr>
<td>Long-term investments (SF seed)</td>
<td>Long-term debt</td>
</tr>
<tr>
<td>Property, plant, and equipment</td>
<td>Deferred income tax</td>
</tr>
<tr>
<td>(Less accumulated depreciation)</td>
<td>Other</td>
</tr>
<tr>
<td>Intangible assets (training)</td>
<td><strong>Total long-term liabilities</strong></td>
</tr>
<tr>
<td><strong>Total fixed assets</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Owner's Equity</strong></td>
<td></td>
</tr>
<tr>
<td>Deferred income tax</td>
<td>Investment capital</td>
</tr>
<tr>
<td>Other</td>
<td>Other</td>
</tr>
<tr>
<td><strong>Total Other Assets</strong></td>
<td><strong>Total owner's equity</strong></td>
</tr>
<tr>
<td><strong>Total Assets</strong></td>
<td><strong>Total Liabilities &amp; Equity</strong></td>
</tr>
</tbody>
</table>

**Table 31: balance sheet**
# Income statement of Sunflower Oil Project (31 December 2019)

<table>
<thead>
<tr>
<th>REVENUE</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sales</strong></td>
<td>$ 53.410.000</td>
<td></td>
</tr>
<tr>
<td><strong>Prepaid expenses</strong></td>
<td>$ 12.000</td>
<td></td>
</tr>
<tr>
<td><strong>Total revenue</strong></td>
<td>$ 53.422.000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cost of goods sold</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Factory labor salaries</td>
<td>$124.800</td>
<td></td>
</tr>
<tr>
<td>Sunflower seed (only 1st year)</td>
<td>$ 684.252</td>
<td></td>
</tr>
<tr>
<td>Production cost ($300/ton, Table 16)</td>
<td>$ 22.890.000</td>
<td></td>
</tr>
<tr>
<td><strong>Total cost of goods sold</strong></td>
<td>$ 23.699.052</td>
<td></td>
</tr>
</tbody>
</table>

| Gross profit | $ 29.722.948 | |

<table>
<thead>
<tr>
<th>EXPENSES</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Advertising and promotion</td>
<td>$ 9.500</td>
<td></td>
</tr>
<tr>
<td>Insurance</td>
<td>$ 12.000</td>
<td></td>
</tr>
<tr>
<td>Equipment /machinery</td>
<td>$ 3.572.760</td>
<td></td>
</tr>
<tr>
<td>Maintenance and repairs</td>
<td>$ 95.000</td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td>$ 83.700</td>
<td></td>
</tr>
<tr>
<td>Salaries (management, farmers etc)</td>
<td>$ 252.300</td>
<td></td>
</tr>
<tr>
<td>Education/training</td>
<td>$ 30.000</td>
<td></td>
</tr>
<tr>
<td>Office expenses</td>
<td>$ 12.000</td>
<td></td>
</tr>
<tr>
<td>Other expenses</td>
<td>$ 25.000</td>
<td></td>
</tr>
<tr>
<td>Interest</td>
<td>$ 0</td>
<td></td>
</tr>
<tr>
<td>Rent</td>
<td>$ 0</td>
<td></td>
</tr>
<tr>
<td><strong>Total expenses</strong></td>
<td>$ 4.092.260</td>
<td></td>
</tr>
</tbody>
</table>

| **Earnings before taxes** | $ 25.630.688 | |
| **Income tax** (starts after 3rd operation year) | $ 0 | |

| NET EARNING | $ 25.630.688 | |

*Table 32: income statement*
5.3 Conclusion

Financial engineering is the main topic of this research and is divided into two main parts, financial feasibility and financial analysis. These two parts were subsequently divided into several segments and the content was comprehensively analyzed, calculated and discussed.

**Feasibility analysis:** under a feasibility analysis the product specification and the total consumption of sunflower oil for Afghanistan is determined (11 liters per capita per year). Due to lack of statistics, the sunflower oil consumption was determined by a brief survey and by comparison with neighboring countries and compared with some European countries. Subsequently, the market analysis of sunflower oil and the product demand was discussed. All sunflower oil in Afghanistan is imported and customers are very dependent on limited market availability and the main suppliers’ prices. Due to the landlocked position of Afghanistan, its entire market supply is dependent on the neighboring countries and the political tensions between them. These tensions create an advantage for local production and allow a significant price difference.

**Financial analysis:** in this phase the project sales forecast was calculated based on prior consumption behavior. The total consumption was calculated using various discount factors to avoid any overestimation of the sales forecast. However, the large demand for the product is undeniable. To establish the outcome of the research and provide recommendations, different tables and graphs have been put together to demonstrate the financial aspect of the project. Applied financial tools, such as net present value, internal rate of return and Du-Pont analysis were used to demonstrate the financial feasibility of the project.

**Conclusion:** due to the lack of sunflower oil production in Afghanistan, the country is reliant on imports from the UAE and Russia. Afghanistan’s landlocked position and continual tension with neighboring countries not only affect the security of the country, but also the import market and local prices. The demand for sunflower oil is very high and there is no meaningful local production. The vast amount of available agriculture land and the agriculture orientation of the locals was shown in this research. These allow for large harvest potentials and make the success of local production likely. Based on financial calculations, this investment, with a ROI of 74% for first year and 101% for second year, is a very profitable project. At this stage of the research, the project could be recommended as highly profitable and successful investment. However, a risk analysis must still be conducted before a final recommendation can be made regarding whether to accept or pass on this proposal.
Chapter VI  RISK ANALYSIS

It has been recognized that besides the size of the return, the uncertainty of the return also plays an important role in assessing investment projects (Markowitz, 1952). The financial analysis showed a high return on investment, however, this investment includes risks. Risk analysis techniques will be applied to identify the project risks and to quantify their impact. Risks could have negative and positive impacts on the money or time required for the project or on the quality of the project. In this analysis, measures will be taken to enlarge the positive effect of the risks and to eliminate the negative impacts on the project. Due to the project’s location and the aforementioned safety concerns, a single project risk analysis is not sufficient, and therefore the risk analysis will be divided into two main parts.

I.  Project risk analysis
II.  Project environment risk analysis

Both parts will be executed separately, and together they will provide the risk analysis for sunflower oil project.

6.1  PROJECT RISK ANALYSIS

A project risk analysis is a short summary of possible threats that might affect the project results. These risks could be identified through various techniques, such as root cause analysis, checklist analysis, information gathering techniques, cause and effect diagram, interviewing, SWOT analysis, brainstorming, Delphi techniques and many more. After identifying the risks, their consequences and possible measures to prevent, compensate for, allocate against or mitigate the damage will be expressed in money and time.

To identify the possible risks for this project, a brainstorming technique will be applied. During the random survey to determine the sunflower oil consumption, interviews were also conducted to study the main cooking oil suppliers, their product prices and availability. The results of those interviews are mapped in a short list and could be used during this analysis to identify possible opportunities and threats regarding the establishment of the sunflower oil production plant. Once the risks are identified, qualitative and quantitative risk analyses could rank their impact on the project. To gain a better understanding of the risks and their total impact on the project, a Monte Carlo simulation will be applied to analyze the project’s risk of failure. A SWOT analysis will provide more inside information related to the project’s strengths, weaknesses, opportunities and threats. With this information, a risk treatment and operation strategy could be developed to create a risk register.
6.1.1 Brainstorming

The brainstorming technique is the most applied tool to identify risks (Trommsdorff, Feb. 2006). Although brainstorming is generally conducted in a group, several studies have proven that single brainstorming produces better results. Obviously a combination of both will be preferred and would be more productive.

To identify the project risk, the first step is to list all possible risks without any conditions or demarcation, allowing the mind to flow freely. However, not every analyzed risk will have the same impact or probability of occurrence. A rough brainstorming on the sunflower oil project will provide a list of possible future events that might harm the establishment or operation of the plant.

<table>
<thead>
<tr>
<th>Nr</th>
<th>Project risk</th>
<th>Occurrence period/cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Competition</td>
<td>Start – end</td>
</tr>
<tr>
<td>2</td>
<td>Lack of water</td>
<td>Start – end</td>
</tr>
<tr>
<td>3</td>
<td>Lack of electricity</td>
<td>Start – end</td>
</tr>
<tr>
<td>4</td>
<td>Loss of desired agriculture harvest</td>
<td>Start – end</td>
</tr>
<tr>
<td>5</td>
<td>Late delivery of sunflower seeds</td>
<td>Start – end</td>
</tr>
<tr>
<td>6</td>
<td>Lag in production capacity</td>
<td>Production phase</td>
</tr>
<tr>
<td>7</td>
<td>Extreme price fluctuations of sunflower seeds</td>
<td>Start – end</td>
</tr>
<tr>
<td>8</td>
<td>Worker strikes</td>
<td>Start – end</td>
</tr>
<tr>
<td>9</td>
<td>Accident and injuries</td>
<td>Start – end</td>
</tr>
<tr>
<td>10</td>
<td>Fire</td>
<td>Production phase</td>
</tr>
<tr>
<td>11</td>
<td>Loss of desired product quality</td>
<td>Production phase</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nr</th>
<th>Project environment risk list</th>
<th>Occurrence phase/cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Local safety</td>
<td>Start – end</td>
</tr>
<tr>
<td>2</td>
<td>Country-wide safety for further distribution</td>
<td>Start – end</td>
</tr>
<tr>
<td>3</td>
<td>Lack of paved infrastructure</td>
<td>Start – end</td>
</tr>
<tr>
<td>4</td>
<td>Lack of production experience</td>
<td>Production phase</td>
</tr>
<tr>
<td>5</td>
<td>Lack of maintenance workers</td>
<td>Production phase</td>
</tr>
<tr>
<td>6</td>
<td>Flooding</td>
<td>Start – end</td>
</tr>
<tr>
<td>7</td>
<td>Local warming</td>
<td>Production phase</td>
</tr>
<tr>
<td>8</td>
<td>Tribal conflicts</td>
<td>Start – end</td>
</tr>
<tr>
<td>9</td>
<td>Corruption</td>
<td>Start – end</td>
</tr>
<tr>
<td>10</td>
<td>Theft</td>
<td>Start – end</td>
</tr>
<tr>
<td>11</td>
<td>Expropriation</td>
<td>Start – end</td>
</tr>
</tbody>
</table>

Table 33: risk list
Table 332 lists various project risks and project environmental risks. The list was written after brainstorming and later reduced to the main possible threats. The incontestable risks are subdivided into two phases and each phase will be studied individually to determine the countermeasures. The main objective at this stage is only to identify the risks, however, an assumption of the occurrence period was given as well.

The goal of this brainstorm was to map the possible project and environmental risks with the highest occurrence possibilities. However, it's still possible that there are hidden risks not mentioned here that might harm the project establishment and progress. Table 332 also attempts to subdivide the risks by occurrence period per harvest and production cycles. However, this is based on assumptions. In reality, the exact occurrence period of the risks might differ from the analysis. However, when the risks are known and the countermeasures are developed, small differences in the occurrence period will not cause large problems or surprises unless several uncertainties come up at the same time.

To qualify and quantify the risk for further investigation, the risk list will be extended with quantitative and qualitative risk analyses. There are several techniques available to determine the probability and the impact of each risk, such as quantitative risk analysis, qualitative risk analysis, sensitivity risk analysis, decision tree, Monte Carlo simulation and many more. In this research the risks will be qualitatively and quantitatively measured and their effects on net present value will be demonstrated with a Monte Carlo simulation.

6.1.2 QUANTITATIVE RISK ANALYSIS

A quantitative risk analysis assigns a numerical or quantitative rating to the highest priority risks to develop a probabilistic analysis of the project. A quantitative risk analysis will provide the required statistics to run the Monte Carlo simulation and demonstrate the effect of the performed risk on the net present value of the sunflower oil project. A quantitative risk analysis will:

- quantify the possible outcomes for the project and assesses the probability of achieving specific project objectives
- provide a quantitative approach for decision making in areas of uncertainty
- create realistic and achievable targets for cost, schedule or scope

The quantitative risk analysis will use the data from the financial engineering calculations together with the risk list.

Quantifying the risk occurrence per year and the impact on the operation of the project is shown in Table 343. The probability column shows the chance of the risk occurrence per year and is numbered between 1 and 5. The effect of a certain risk on the project progress is listed
in the column under the impact and also numbered between 1 to 5. One represents a very low and five a very high probability or impact.

<table>
<thead>
<tr>
<th>Nr</th>
<th>Project risk</th>
<th>Probability 1 to 5</th>
<th>Impact 1 to 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Competition</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Lack of water</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Lack of electricity</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Loss of desired agriculture harvest</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Late delivery of sunflower seeds</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Lag in production capacity</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Extreme price fluctuation of sunflower seeds</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Worker strikes</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>Accident and injuries</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>Fire</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>11</td>
<td>Loss of desired product quality</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project environment risk list</th>
<th>Probability</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Local safety</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>2 Country-wide safety for further distribution</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3 Lack of paved infrastructure</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4 Lack of production experience</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5 Lack of maintenance workers</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>6 Flooding</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>7 Local warming</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>8 Tribal conflicts</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9 Corruption</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>10 Theft</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>11 Expropriation danger</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 34: quantitative risk analysis of the project

1. **Competition:** As discussed before, the chance of local production by competitors is quite low. The government will not provide license for the next 10 years to produce sunflower oil in the same district in order to minimize competition and stimulate private investment. Import has higher costs and therefore the probability and the impact could be almost neglected.

2. **Water:** Although water regulation for agriculture activity will be arranged ahead of time, the probability of its occurrence could not be neglected due to rapid climate change and frequent water shortages in Afghanistan. This risk could have a large impact the entire production chain.
3. **Electricity:** The required electricity for machinery will be provided by company-owned generators. However, technical problems could cause loss of electricity.

4. **Harvest:** The sunflower seed harvest determines the production capacity. If the harvest is low, the required production capacity might not be realized.

5. **Delivery:** The plant is located near the seed warehouse. Late delivery will not directly affect the production capacity.

6. **Delay:** Production capacity is an important parameter directly related to profit. Any matter that reduces production capacity will directly affect the revenue.

7. **Price:** Afghanistan’s landlocked position and political crises with the neighboring countries have been discussed. Apart from the international trade price fluctuation of the seed, these factors could also cause price fluctuation. Due to local cultivation of the seed, this risk will not have much negative influence on the project. However, price increases could provide opportunities to increase the oil’s sale price.

8. **Strike:** Worker strikes will likely reduce the production capacity and the profits. Due to high unemployment this risk will be limited, however, the effect would be very large.

9. **Accident:** Accidents create risks for staff, factory safety and public image. Although the production chain is quite simple and the effect of an accident would likely be small, it would delay the production and could cause worker injuries and equipment failure.

10. **Fire:** Fire presents a danger to human life, the plant’s safety reputation, the factory and the machinery. Although the design and division of the plant is very carefully executed, the possibility of fire could not be eliminated. If a large fire occurs inside the plant, all of the machinery will be destroyed.

11. **Quality:** Lack of experience in production and low quality seed can cause a drop in the desired product quality. However, the staff will be educated prior to production to minimize this risk. Due to Afghanistan’s economic problems, there are various types of oil available, from a high international standard to very low quality. A worker with a salary of only 200 USD per month will prefer product price above product quality. The goal is to produce a high quality product, and although a temporary drop in product quality will reduce the profits, it would not cause negative NPV.
6.1.3 **Monte Carlo Simulation**

The Monte Carlo simulation (or Monte Carlo method) can be used to describe any technique that approximates solutions to quantitative problems through statistical sampling. The Monte Carlo simulation is used here to describe a method for propagating uncertainties in model inputs into uncertainties in model outputs. Hence, it is a type of simulation that explicitly and quantitatively represents uncertainties. A Monte Carlo simulation relies on the process of explicitly representing uncertainties by specifying inputs as probability distributions. If the inputs describing a system are uncertain, the prediction of future performance is necessarily uncertain. That is, the result of any analysis based on inputs represented by probability distributions is itself a probability distribution (Stan Ulam, 1987).

A large number of risks are identified and mapped in the risk list table, and subsequently their probability and impact were quantified. At this stage risks that affect the same parameter of the NPV will be mapped together. Once all risks are categorized, their impact will be demonstrated by applying a Monte Carlo simulation.

<table>
<thead>
<tr>
<th>Nr</th>
<th>Risk parameter</th>
<th>Risk impact on the NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unit price</td>
<td>Unit price multiplied by production capacity equals profit. The following risks directly affect the unit price or production capacity: loss of desired product quality (decreases the unit price), worker strikes, fire, lack of electricity, flooding and local safety (increases the unit price and decreases the production capacity).</td>
</tr>
<tr>
<td>2</td>
<td>Unit cost</td>
<td>Occurrence of the following events requires additional measures, which might increase the unit production cost. Country-wide safety (leads to difficult and expensive distribution), lack of water (must pump underground water), lack of paved roads (increase transportation expenses), lack of worker experience (slows production and cause frequent mistakes), local warming (cause less harvest), tribal conflicts (means no workers, destruction), lack of maintenance workers (leads to apply foreign experts and work guidelines).</td>
</tr>
<tr>
<td>3</td>
<td>First year production</td>
<td>Loss of harvest (decrease in production capacity), infrastructure (failure in distribution).</td>
</tr>
<tr>
<td>4</td>
<td>Initial demand</td>
<td>Local economic growth (increase in demand), safety for further distribution, country-wide safety (population growth), product quality.</td>
</tr>
<tr>
<td>5</td>
<td>Growth</td>
<td>Experience (increase of production efficiency)</td>
</tr>
<tr>
<td>6</td>
<td>Business share</td>
<td>Competition (when local competitors establish and divide the market supply chain).</td>
</tr>
<tr>
<td>7</td>
<td>Development cost</td>
<td>Extreme price fluctuation of sunflower seeds, corruption, theft, expropriation (extremely dangerous, very low probability).</td>
</tr>
</tbody>
</table>

*Table 35: Monte Carlo simulation parameter and risk impact on NPV*
The risks are divided by risk parameters and each parameter represents the probability and impact of a certain risk occurrence. To analyze the influence of the risk impact on the project, the parameters will be simulated. Due to high profits, rate of return and net present value a single risk will not significantly affect the outcome. The objective is to analyze the worst scenario and its effect on the NPV. Therefore, all risks will be applied at the same time and their influence will be demonstrated by a Monte Carlo simulation.

Figure 16: tornado demonstration of the parameters' effect on project

In Figure 16, a Monte Carlo simulation demonstrates the tornado effect of the risk parameters. The tornado effect ranks the parameters based on their effect on the NPV and provides numbers to analyze the results. Different risk scenarios are assumed to occur and their probabilities and effects are described in the table below. This table will be used to analyze the impact of various risk scenarios on the NPV.

<table>
<thead>
<tr>
<th>Uncertain inputs</th>
<th>Actual</th>
<th>Min</th>
<th>Most likely</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development cost</td>
<td>$684.252</td>
<td>-10</td>
<td>$684.252</td>
<td>10</td>
</tr>
<tr>
<td>Year first produced</td>
<td>3,0</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Duration of production (years)</td>
<td>8,0</td>
<td>6</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Initial unit cost</td>
<td>$315,00</td>
<td>-10%</td>
<td>$300</td>
<td>40%</td>
</tr>
<tr>
<td>Initial unit price</td>
<td>$653,33</td>
<td>-50%</td>
<td>$700</td>
<td>10%</td>
</tr>
<tr>
<td>Initial demand</td>
<td>$70.578</td>
<td>-50%</td>
<td>76300</td>
<td>5%</td>
</tr>
<tr>
<td>Yearly growth percentage</td>
<td>31.17%</td>
<td>20%</td>
<td>33%</td>
<td>35%</td>
</tr>
<tr>
<td>Early annual demand growth</td>
<td>35.00%</td>
<td>30%</td>
<td>35%</td>
<td>40%</td>
</tr>
<tr>
<td>Business share of demand</td>
<td>32.83%</td>
<td>30%</td>
<td>33%</td>
<td>35%</td>
</tr>
</tbody>
</table>

Table 36: risk scenarios
**Initial unit price:** Due to the simplicity of the production, the initial price of the product is the most significant parameter. The large production capacity and product sales price cover the costs, determine the profit and affect the NPV. In Table 365 different risk scenarios are assumed to occur and decrease the unit price to 653 USD per ton.

**Initial unit cost:** The initial unit production cost of the product is also very important and could affect the outcome significantly. Various risk scenarios are applied to affect the unit cost and increase it up to 315 USD per ton. The same scenarios are assumed for other parameters and their final result are demonstrated as a probability density and cumulative ascending.

![Figure 17: cumulative ascending](image_url)
Despite maximizing the extreme risk scenarios, the normal deviation provided by the Monte Carlo simulation finds a probability of only 4% for negative net present value. This 4% is caused by expropriation, definitive work standstills and lack of raw material. In all other scenario the project will be profitable and possible to realize.

6.1.4 Qualitative Risk Analysis

A qualitative risk analysis analyzes project risks, the impact these will have on the project and the probability of these risks occurring. Qualitative risk analysis does not rely on data and statistics to base a model on, instead the probability of occurrence and the impact after attending will be expressed by low, medium and high parameters.

<table>
<thead>
<tr>
<th>Nr</th>
<th>Project risk</th>
<th>Probability</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Competition</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>2</td>
<td>Lack of water</td>
<td>low</td>
<td>High</td>
</tr>
<tr>
<td>3</td>
<td>Lack of electricity</td>
<td>low</td>
<td>High</td>
</tr>
<tr>
<td>4</td>
<td>Loss of desired agriculture harvest</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>5</td>
<td>Late delivery of sunflower seeds</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>6</td>
<td>Lag in production capacity</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>7</td>
<td>Extreme price fluctuation of sunflower seeds</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>8</td>
<td>Worker strikes</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>9</td>
<td>Accident and injuries</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>10</td>
<td>Fire</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>11</td>
<td>Loss of desired product quality</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 37: qualitative risk analysis

Table 36 estimated the risks and their occurrence period and Table 37 showed the probability and impact of the risks on the project. The probability column shows the possibility that a certain risk will occur during the life of the project. Subsequently, the impact of the attended risk is expressed so that appropriate strategies and measures can be developed to secure the execution.

These risks can influence all stages of the project, but they don’t always have to be negative. The negative result of each risk is undesired and the management team will undertake any countermeasures to prevent them, but there are also positive results of risks and present opportunities. There are several scenarios for the sunflower oil plant that could bring new opportunities. For example, higher than average snow or rain in the nearest mountains could produce reserve water for agriculture activities.
6.1.5 Risk Treatment Plan

A risk treatment plan or assessment plan will identify how to avoid, transfer, mitigate, or accept risks. The risk treatment plan will be used to create a risk register. Three of the four risk identification steps have already been executed (risk identification, risk analysis and risk evaluation). Risk treatment is the last step required to complete the risk analysis. The following responses could be applied in dealing with identified risks:

- Prevent or avoid
- Mitigate or compensate
- Transfer
- Accept
- Exploit

1. Risk: Competition with existing market suppliers and establishment of new local producers.

Response: The probability and impact of this risk is quite low. International suppliers could not match the local price and new establishment is omitted. The best response will be fast growth and market take over with affordable prices and high quality. The remaining risk could be accepted.

2. Risk: Water shortage will affect the agriculture activities. Although water irrigation systems will be installed prior to the plant’s operation, this risk could not be eliminated.

Response: The best treatment is to transfer the responsibility to the local government.

3. Risk: Electricity is required to operate the machinery. Regulation of electricity and electrical capacity in Afghanistan is not sufficient to guarantee operation of the machinery.

Response: Relying on local electricity might cause production losses and delays. Therefore, electrical generators should be purchased to ensure sufficient electrical generation. The investment should be accepted and factored into the development costs.

4. Risk: Failure of sunflower harvest

Response: The impact of this risk could vary from low to very high and the best response will be prevention. Measures such as ensuring staff education, water supply and chemical sustenance for the land have to be provided to minimize this risk.
5. Risk: Late delivery of sunflower seeds for production.
Response: The plant includes a warehouse for storing seeds. To prevent interdependency and loss of production capacity, the management team should enlarge the plant’s storage capacity. That way late deliveries will not directly affect the production chain.

6. Risk: Loss of production capacity
Response: This risk has a major impact on the project revenue and NPV. Therefore, several responses should be taken to prevent and mitigate its consequences. Possible responses include hiring extra workers or paying existing workers overtime to make up for the loss, having extra generators, and producing more than is currently needed to provide a surplus that can continue to supply the market demand.

Response: This risk can harm the project only in the first year. After that, sunflower seeds for cultivation will no longer be imported from the international market. The impact of this risk is small, but it could not be totally eliminated. Therefore, the risk of price fluctuation will be accepted.

8. Risk: Worker strikes will reduce production capacity and total profit.
Response: Due to high unemployment in Afghanistan, the workers will not strike frequently for fear of losing their jobs. However, a worker strike would have a large impact on production capacity. Therefore, this risk must be prevented by regular internal discussion and salary agreements.

9. Risk: Worker accidents cause worker injury and equipment failure, endanger factory safety, create a negative image and delay production.
Response: The modern and functional factory design is developed to minimize the risk of accident. The risk is more to the project’s reputation than to its profits. However, this risk could be reduced and mitigated by safety boards and regulations, safety alarms and provision of on-site first aid equipment.

10. Risk: Fire could cause loss of human life, harm to the project’s reputation and destroy the factory and the machinery.
Response: This is a very serious risk with a large impact on the production chain, reputation and responsibility of the company. Although the risk could not be
fully eliminated, therefore several responses, such as *mitigating* and *transferring* the responsibility and *accepting* the damage should be applied to this risk. The chance and consequence of a fire can be reduced by appointing and educating a fire team from among the workers and equipping the building with emergency exit doors, fire extinguishers, exit labels and fire delay covering material.

**Risk:** Desired product quality might not be generated at the beginning of the operation.

**Response:** Lack of experience and low quality seeds could cause the product to initially be of lower than desired quality. However, the staff will be educated prior to production to minimize this risk.

The two main responses to this risk will be *mitigation* and *expectance*. The impact could be minimized by initially bringing in foreign experts to assist and educate the local workers in addition to the planned training for the selected workers. Additionally, clear guidelines for the production method could help avoid mistakes. The remainder of the risk must be *accepted*. 
6.2 Project Environment Risk Analysis

The financial analysis of the sunflower oil project and the application of various tools predicted high net present value and rate of return. An investor would likely approve such a project in a western country, however, Afghanistan is in no way a western country. The financial analysis, the risk analysis and especially the environmental risk analysis of this project are decisive to the decision to accept or reject it.

Afghanistan is notorious since 9/11 due to Al-Qaida attacks and the Taliban’s violence towards all people, and especially women. The country is 16 time larger than the Netherlands, with a population of 32 million. It is landlocked between Pakistan, Iran, Tajikistan, Uzbekistan, Turkmenistan and small border with China in the north. The Soviet Union attempted to make Afghanistan its 15th state, but instead the war contributed to the Soviet Union’s collapse. Afghanistan has always been always known as a war zone between empires, but in the last decade it also became a war zone between several tribes inside the country. Although 99% of the country has the same religion and the population density is low, clashes between the 13 different tribes are common. Afghanistan was divided into 28 provinces until 2009, but now recognizes 34 provinces, and the subdivision continues due to tribal conflicts. The largest segment are Pashtuns (36%) followed by Tadjiks (26%), Hazaras (13%), and Uzbaks (6%), with Turkmen and other small tribes rounding out the population. Seventy-five percent of the country is mountainous, and it possess significant minerals, gas and oil.

Despite being one of the poorest nations in the world, Afghanistan may be sitting on one of the richest troves of minerals in the world, valued at nearly 1 trillion USD, according to U.S. scientists (Charles, 2014).

Several mines (copper, oil, gas and lithium) have been contracted to China, India and others for exploration (OLIVER, 2012). However, the progress is often interrupted due to lack of security, tribal conflicts, corruption and lack of governmental authority. Due to long wars, the education in Afghanistan is disorganized and the majority are illiterate. Most of its current problems could be also caused by lack of education. The people who can read are mostly the religious leaders (Mullahs) and they are also the ones behind the interruptions and against every type of progress, modernization, wealth and success. However, the country is changing since the NATO invasion and is beginning to modernize. The young generation is fed up with war, and globalization and access to the internet is driving them to achieve better lives. Due to a lack of modernization and production capacity, the country imports almost everything. Despite its cheap labor cost, perfect weather conditions and large land area, without industrialization little can be done. Afghanistan presents a great opportunity for investors to start carefully chosen operation in select areas.
The Afghan government has developed several attractive measures to stimulate foreign and local investors and to increase industrialization. Anyone with positive intentions is welcome to invest in Afghanistan without any conditions. Regulation and governmental taxes are waived for a certain period and the government provides land and license for industrial or agriculture purposes. The climate is suitable for production and agriculture, unlike in Pakistan, the UAE or Saudi Arabia.

6.2.1 Qualitative risk analysis of project environment risk

The sunflower oil project is located in Jalalabad, the capital city of Nangarhar province, where the Pashtun are the majority. Tribal war has always been minimal here. The province is located close to the border with Pakistan. It sits on an important transportation route between Pakistan and the capital city of Kabul as well as the rest of Afghanistan. The area is very lush and has clean and healthy water from snowmelt off the nearest mountains, with streams running year-round. Agriculture is the main activity, and the majority of the locals are farmers who cultivate maize, grain, rice, sunflowers and more. However, their activities and capacities are very limited in relation to the available area. Therefore, the local government is willing to reestablish the old olive oil factory to generate employment, wealth and safety.

With the given agriculture and industrial information, a brainstorm can be performed to identify the local risks and determine their probability and impact.

<table>
<thead>
<tr>
<th>Qualitative risk analysis of project environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project environment risk list</td>
</tr>
<tr>
<td>1 Local safety</td>
</tr>
<tr>
<td>2 Country-wide safety for further distribution</td>
</tr>
<tr>
<td>3 Lack of paved infrastructure</td>
</tr>
<tr>
<td>4 Lack of production experience</td>
</tr>
<tr>
<td>5 Lack of maintenance workers</td>
</tr>
<tr>
<td>6 Flooding</td>
</tr>
<tr>
<td>7 Local warming</td>
</tr>
<tr>
<td>8 Tribal conflicts</td>
</tr>
<tr>
<td>9 Corruption</td>
</tr>
<tr>
<td>10 Theft</td>
</tr>
<tr>
<td>11 Expropriation</td>
</tr>
</tbody>
</table>

Table 38: qualitative risk analysis of project environment

Prior to a risk treatment of the project environment, SWOT analyses on the project and WAK Int. will be performed to understand their strengths, weaknesses, opportunities and threats in order to better develop a strategy and risk response for the sunflower oil project.
6.2.2 SWOT analysis

The SWOT analysis was created by Albert S Humphrey in the 1960s and the tool is as useful now as it was then. A SWOT analysis is a technique to understand a project or company’s strengths and weaknesses and identify the opportunities and threats the project or company might face. A SWOT analysis takes the information from an environmental analysis and separate it into internal (strengths and weaknesses) and external (opportunities and threats) issues. Once this is completed, the SWOT analysis determines what may assist the firm in accomplishing its objectives and what obstacles must be overcome or minimized to achieve the desired results. In the figure below a SWOT analysis is executed for WAK Int. in the context of operation in Afghanistan.

![SWOT analysis of WAK Int.](Image)

Figure 18: SWOT analysis of WAK Int.
Prior to a detailed clarification of the SWOT analysis drafted for WAK Int., it’s necessary to execute a SWOT analysis for the sunflower oil project. These two SWOT analysis will be studied and combined to prepare actions and outline an appropriate strategy.

The SWOT analysis for sunflower oil project will not only focus on project operation, but also on project environment and all other direct and indirect aspects that might affect the project’s progress.

**Figure 19: SWOT analysis of sunflower oil project**
The sunflower oil project has bright future and will provide new opportunities to WAK Int. for further exploration and expansion. However, there also weakness and threats included in this project. Therefore, the SWOT analyses were applied to study the consequence of each action and to develop new strategies and measures to prevent, mitigate, accept or transfer individual events. The information provided by the SWOT analyses will be used to create risk responses by bundling the strengths of the project and organization to compensate for the weaknesses and minimize the threats in order to achieve the new opportunities.

6.2.3 Risk treatment plan of project environment
The same methodology used in the risk treatment plan will be used for the project environment risk and the following responses will be utilized:

- Prevent
- Mitigate
- Transfer
- Accept

1. Risk: **Local safety** is a major risk. When the area is not safe, workers cannot come to work, agriculture and production activities will halt and distribution will be dangerous.

   **Response:** Jalalabad is one the safest cities in Afghanistan. The residents are also very keen on avoiding the war and compromising with the winning party. The locals prefer not to choose a side and want to carry on their daily activities in peace. Although the local government has promised to ensure security and supply a special security force in and around the plant, no other response to avoid this risk is available. Therefore, the remainder of risk must be accepted.

2. Risk: **Country-wide safety for further distribution**

   **Response:** Safety in all parts of the country is difficult to guarantee. However, the impact on the project’s operation is limited. The best response to this risk is to outsource the country-wide distribution of sunflower oil. The risk will then be transferred to local suppliers.

3. Risk: **Lack of paved infrastructure** decreases accessibility to the customers and increases the distribution cost.

   **Response:** Outsourcing the distribution will also transfer the risk from lack of paved infrastructure to the local suppliers. The current distribution is done by small
entrepreneurs. Additionally, the main highways between the provinces and cities are well maintained by NATO and western organizations.

4. Risk: **Lack of production experience** could delay production capacity, reduce product quality and increase production cost.

Response: By organizing extra educational courses and bringing in foreign experts to temporarily assist the local workers, this risk could be prevented or at least minimized.

5. Risk: **Lack of maintenance workers** due to lack of industrialization and machine production. In case of machinery failure the entire production system will be halted or delayed.

Response: Although all the machinery will be new and guaranteed by the seller, technical problems can never be neglected. Therefore, a selected group of mechanics should take a workshop under the machinery provider’s supervision, which will assist them to prevent any failures. This could be an expensive response, but not in relation to the potential lost production of around 439,000 USD per day.

6. Risk: **Flooding** could damage the plant and the sunflower crops.

Response: From past experience the probability of this risk is quite low. However, as demonstrated in the SWOT analysis WAK Int. has the engineering knowledge and expertise to design flood-proof buildings. The flooding risk for agriculture activities could be mitigated by building dikes in the most flood-sensitive areas, and the remainder risk could be accepted.

7. Risk: **Local warming** could affect the sunflower crops.

Response: Although sunflower plants can handle some temperature fluctuation, extremely hot weather in the final stage will harm the crops. The most economic response for this risk is to cultivate more seeds each year than is required for production, thus providing an inventory to compensate and mitigate poor harvests.

8. Risk: **Tribal conflict** will affect the entire operation system.

Response: WAK Int. might be able to prevent or mitigate escalation of tribal conflicts with its resources mentioned under the SWOT analysis (money, network and background). A well-known way to solve tribal conflicts is gathering the representatives of each tribe, known as the Loya Jirga (Bezhan, 2013), to work
out the best solution. Since the local government is also involved in this project, they will support WAK Int. in preventing escalation of tribal conflicts.

9. Risk: **Corruption** could have varying effects on the project at all stages and is generally figured into the production cost.

Response: Until to the late 1980’s corruption was unknown in Afghanistan. After emigrating to the neighboring countries due to several wars in the nineties, Afghans became familiarized with corruption and are currently ranked as the 11th most corrupt country in the world (Transparency, 2010). There is no way to avoid this risk, the only option is to **accept** the corruption and add it into the investment and production costs.

10. Risk: **Theft** will be subdivided in different classes and will always increase the cost.

Response: The best response will be to equip the plant with alarms, build fences or walls around the factory and engage a suitable insurance company to **transfer** the risk.

11. Risk: **Expropriation danger**

Response: Expropriation has never happened in Afghanistan, however, such a large investment with the involvement of an international organization and large-scale production has also never happened in Afghanistan. This risk together with the safety issue will form the biggest dilemma of this investment. The investors willing to operate in Afghanistan have to **accept** the consequence of these two risks, knowing that the probability of their occurrence is low.
6.3 **Risk Register**

All possible project and environmental risks have been identified and analyzed both quantitatively and qualitatively to develop a risk treatment. SWOT analyses demonstrated the strengths, weaknesses, opportunities and threats for the project and WAK Int. At this stage a risk register will be created based on the accumulated information and condensed into one table.
## Risk register of the sunflower oil project

<table>
<thead>
<tr>
<th>Nr</th>
<th>Risk</th>
<th>Probability</th>
<th>Impact</th>
<th>Cost ($/y)</th>
<th>Allocation</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Competition</td>
<td>Low</td>
<td>Low</td>
<td>-</td>
<td>Managemen t team</td>
<td>Fast market takeover, efficient production, low prices and good quality</td>
</tr>
<tr>
<td>2</td>
<td>Lack of water</td>
<td>low</td>
<td>High</td>
<td>$2*10^5$</td>
<td>Manag. team</td>
<td>Pumping of underground water</td>
</tr>
<tr>
<td>3</td>
<td>Lack of electricity</td>
<td>low</td>
<td>High</td>
<td>$3*10^5$</td>
<td>Manag. team</td>
<td>Production by generators, purchase of extra generators</td>
</tr>
<tr>
<td>4</td>
<td>Loss of desired agriculture harvest</td>
<td>Medium</td>
<td>High</td>
<td>$3*10^5$</td>
<td>Operat. team</td>
<td>Training the staff prior to operation and providing external assistance</td>
</tr>
<tr>
<td>5</td>
<td>Late delivery of SF seeds</td>
<td>Medium</td>
<td>Low</td>
<td>-</td>
<td>Manag. team</td>
<td>Advance storage of seed for production</td>
</tr>
<tr>
<td>6</td>
<td>Lag in production capacity</td>
<td>Medium</td>
<td>High</td>
<td>$50.000$</td>
<td>Operat. team</td>
<td>Overtime</td>
</tr>
<tr>
<td>7</td>
<td>Extreme price fluctuation of SF seeds</td>
<td>Medium</td>
<td>Medium</td>
<td>$1*25.000$</td>
<td>Manag. team</td>
<td>Accept</td>
</tr>
<tr>
<td>8</td>
<td>Worker strike</td>
<td>Low</td>
<td>Medium</td>
<td>$15.000$</td>
<td>Manag. team</td>
<td>Increasing salaries and bonuses</td>
</tr>
<tr>
<td>9</td>
<td>Accident and injuries</td>
<td>Low</td>
<td>Low</td>
<td>$25.000$</td>
<td>M+O team</td>
<td>Supplying first aid facilities, regulation</td>
</tr>
<tr>
<td>10</td>
<td>Fire</td>
<td>Low</td>
<td>High</td>
<td>$20.000$</td>
<td>Operat. team</td>
<td>Safety board, exit doors, training and supplying fire extinguishers</td>
</tr>
<tr>
<td>11</td>
<td>Loss of desired product quality</td>
<td>Low</td>
<td>High</td>
<td>$45.000$</td>
<td>M+O team</td>
<td>Staff training</td>
</tr>
<tr>
<td>12</td>
<td>Local safety</td>
<td>Low</td>
<td>High</td>
<td>-</td>
<td>Government</td>
<td>Transfer + accept</td>
</tr>
<tr>
<td>13</td>
<td>Country-wide safety</td>
<td>High</td>
<td>Medium</td>
<td>-</td>
<td>Manag. team</td>
<td>Outsourcing distribution to local suppliers</td>
</tr>
<tr>
<td>14</td>
<td>Lack of paved infrastructure</td>
<td>High</td>
<td>Medium</td>
<td>-</td>
<td>Manag. team</td>
<td>Outsourcing to local suppliers</td>
</tr>
<tr>
<td>15</td>
<td>Lack of production experience</td>
<td>High</td>
<td>Medium</td>
<td>-</td>
<td>Operat. team</td>
<td>Training</td>
</tr>
<tr>
<td>16</td>
<td>Lack of maintenance workers</td>
<td>High</td>
<td>High</td>
<td>$1<em>3</em>10^5$</td>
<td>Operat. team</td>
<td>Training + assistance by foreign expert</td>
</tr>
<tr>
<td>17</td>
<td>Flooding</td>
<td>Low</td>
<td>High</td>
<td>$1*10^5$</td>
<td>Manag. team</td>
<td>Dikes, accept the remaining risk</td>
</tr>
<tr>
<td>18</td>
<td>Local warming</td>
<td>Low</td>
<td>Low</td>
<td>-</td>
<td>Manag. team</td>
<td>Accept</td>
</tr>
<tr>
<td>19</td>
<td>Tribal conflict</td>
<td>Low</td>
<td>Medium</td>
<td>-</td>
<td>Manag. team</td>
<td>Use network to find compromises</td>
</tr>
<tr>
<td>20</td>
<td>Corruption</td>
<td>High</td>
<td>Medium</td>
<td>-</td>
<td>M+O team</td>
<td>Accept</td>
</tr>
<tr>
<td>21</td>
<td>Theft</td>
<td>Low</td>
<td>High</td>
<td>$10.000$</td>
<td>M+O team</td>
<td>Alarm, fence, insurance</td>
</tr>
<tr>
<td>22</td>
<td>Expropriation danger</td>
<td>Low</td>
<td>High</td>
<td>-</td>
<td>Manag. team</td>
<td>Accept</td>
</tr>
</tbody>
</table>
Table 39: risk register table
Chapter VII  CONCLUSION

The financial feasibility and risk analysis of a sunflower oil project in Afghanistan was very carefully and extensively executed. The market and product demand, current market suppliers and consumption were evaluated. The application of various financial engineering techniques provided satisfactory net present values, internal rate of return and decompensation. A Du-Pont analysis divided the profit over sale, asset and equity. The return on asset tool was applied to compare the outcome with the return on equity. The results were numerically calculated and shown in graphs and diagrams. The high return on investment is undeniable and very attractive. However, a single financial analysis was not enough to assess the project approval, and therefore risk analysis was indispensable.

The risk analysis was divided into two main parts, the project risk and the project environmental risk. A risk analysis alone was not sufficient to evaluate and advise WAK Int. and the local government about the uncertainties. Therefore, the environmental effects and risks were evaluated. The main project risk was lack of experienced and qualified staff to operate the plant, while the main environmental risks were the lack of safety, tribal conflict and failure of water supplies. The risk treatment plan has been executed to prevent, mitigate, transfer or allocate the risk to the right department for effective remedy. However, risks can never be completely eliminated and WAK Int. will have to accept some risks if it pursues this investment.

Based on the financial analysis, WAK Int. could approve this investment. The high internal rate of return and high net present value are excellent reasons to accept the project. However, there are some large risks that could not be eliminated, mitigated or accepted. These risks are the expropriation, tribal war and country-wide safety. There are no available countermeasures to mitigate or prevent expropriation or tribal war. These risks are beyond the power of a single entrepreneur. In case WAK Int. accepts these risks, it could approve the project. The final decision is up to the investor.
Chapter VIII  Recommendations

The content of this research was carefully and thoroughly executed to provide a proper and suitable recommendation to the principles. Due to complexity of the project environment, a unique solution or recommendation is not applicable. The principle might accept the project environmental risks identified in this research or it might pass on the project. However, it can be recommended that the operation be initially confined to the Nangarhar province. The focus of that preliminary project must be on small-scale production with a low budget. Although the environmental and expropriation risks will remain the same, the financial losses will be minimized. Since the consumption behavior, the market demand and the suppliers are already known, the investigation should be focused on how to reduce costs and increase profits.

Sunflower oil production could be realized with basic manual equipment (as Indian farmers do) or in large-scale production with modern machinery. It is recommended to find a middle ground between these two options to reduce the investment cost and the risks. Once the initial production is successful and 10% of the country is supplied, the operation and production capacity could be enlarged. The new investment will be partially financed from the profits and the rest by the investor. By doing this the investor will prevent total investment loss and reduce the necessary capital investment. Additionally, various unknown risks will be identified during the operation for future consideration and investment.
Chapter IX  REFERENCES


This picture is provided by Bill Podlich, an American professor who visited Afghanistan in 1967. He was representing UNESCO in Kabul during the establishment of a new university for postgraduate teacher training.