# Integrated Investment Appraisal and Risk Analysis of an Undeveloped Oil Field Project in Libya

**Mohammed Ibrahim Y Mriheel**

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Approval of the Institute of Graduate Studies and Research

Prof. Dr. Ali Hakan Ulusoy
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science in Banking and Finance.

Prof. Dr. Nesrin Ozatac
Chair, Department of Banking and Finance

We certify that we have read this thesis and that in our opinion it is fully adequate in scope and quality as a thesis for the degree of Master of Science in Banking and Finance.

Prof. Dr. Mustafa Besim
Supervisor

Examining Committee

1. Prof. Dr. Mustafa Besim

2. Assoc. Prof. Dr. Hasan Ulas Altiok

3. Asst. Prof. Dr. Aleksandr Zabolotnov

# ABSTRACT

The Murzug region in Libya has an immense potential for oil production. As a result of the perishable nature of raw materials, it imposes a huge effect on the economy. The oil production plant will process high profit and help to the growth of the region.

The aim of this study is to evaluate the economic potential of an undeveloped oil field in the Murzug Basin, south of Libya. The thesis aims to provide a financial model to serve as a guide for the future investment in oil field development program in remote area, the southern desert region of Libya. This thesis presents financial analysis study involving financial and sensitivity analyses. The study utilises a financial analysis approach to the problem of identifying and investigating the factors that control and effect the finances of the studied project. Thus, the study uses a financial and sensitivity analyses and draws on data obtained from an existing exploration activity and using it as an adjacent or an analogue to NC101 oil field and development project. This oil field is located south of Libya in the Murzug basin and is called the Al Shararah Field. I have personally made a site visit to the AL Shararah field and have interviewed several geologists, engineers and managers in order to collect accurate information and use them as reference to my thesis.

The oil production will generate a positive NPV of 313 million usd dollars and an IRR of 17%, which means the project will generate enough profit from the owner's perspective. The study also shows that the project will generate enough cash flow to pay its debt obligation. From the cash flow we can observe that the project will

generate enough cash to cover its debts as the ADSCR and LLCR average ratio are 3.06 and 3.45 respectively.

As for the sensitivity analysis we have identified six risky varaibles which are oil price, foreign inflation (USA) , tariffs per barrell , investment cost overrun, discount rate and the proportion of oil exported . The project was most sensitive to oil price, tariffs per barrel and foreign inflation. As for investment cost overrun the project was not sensitive towards it at all.

The project's risks were evaluated using a Monte-Carlo simulation. The distribution of probability is used to show the uncertainty related to the key project variables. The simulation of Monte Carlo analysis was taken for oil prices, tarrif per barrel and foreign inflation .

**Keywords:** Financial Analysis, Risk Analysis, Oil Field Project, Murzug, South of Libya.

# ÖZ

Libya'daki murzug bölgesi, petrol üretimi için muazzam bir potansiyele sahiptir. Hammaddelerin çabuk bozulan doğasının bir sonucu olarak, ekonomi üzerinde büyük bir etki yaratır. Petrol üretim tesisi yüksek kar işleyecek ve bölgenin büyümesine yardımcı olacak.

Bu çalışmanın amacı, Libya'nın güneyindeki Murzug Havzası'ndaki gelişmemiş bir petrol sahasının ekonomik potansiyelini değerlendirmek ve güneydeki uzak bölgede petrol sahası geliştirme programına gelecekteki yatırımlar için bir rehber olarak hizmet edecek bir finansal model sağlamaktır. Libya'nın çöl bölgesi. Bu tez, finansal ve duyarlılık analizlerini içeren finansal analiz çalışmasını sunmaktadır. Çalışma, incelenen projenin gelirini kontrol eden ve etkileyen faktörlerin belirlenmesi ve araştırılması sorununa bir finansal analiz yaklaşımı kullanmaktadır. Bu nedenle, çalışma bir finansal ve duyarlılık analizi kullanır ve mevcut bir arama faaliyetinden elde edilen verilerden yararlanır ve bunu NC101 petrol sahası ve geliştirme projesine bitişik veya analog olarak kullanır. Bu petrol sahası Libya'nın güneyinde Murzug havzasında bulunur ve Al Shararah Sahası olarak adlandırılır. AL shararah alanına şahsen bir saha ziyareti yaptım ve doğru bilgileri toplamak ve bunları tezimde referans olarak kullanmak için birkaç jeolog, mühendis ve yöneticiyle görüştüm.

Petrol üretimi pozitif bir NPV üretecek, bu da projenin sahibinin bakış açısına göre yeterli kar üreteceği anlamına geliyor. Çalışma aynı zamanda projenin borç yükümlülüğünü ödemek için yeterli nakit akışı yaratacağını da gösteriyor.

**Anahtar Kelimeler:** Mali Analiz, Risk Analizi, Petrol Sahası Projesi, Murzug, Libya'nın Güneyi.

# DEDICATION

This thesis is dedicated to my family who have supported me and believed in me at all times.

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Foremost, all praise to God for his unconditional love, guidance, support, and wisdom throughout my thesis program.

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# Chapter 1

# INTRODUCTION

## 1.1 Purpose and Scope

Financial analysis of petroleum projects is an important research discipline, applied in international oil companies to make decisions on whether to invest their money in such projects or save the companies budget to other financially viable projects. In other words, financial analysis of any project is a crucially important step to rank projects, reduce risks, and make profit for any company. The objective of financial analysis is to reduce risk and make the desired profit by a better integration of fiscal terms and technical data. Financial software generally runs these models and aim to reconstruct the timing of projects and predict the outcome of how to tackle the projects development. Other important outcomes include the possibility of reconstructing cash flow in and out during the whole life cycle of the project. As such, constructing cash flow has many crucially important applications in the financial analysis of projects. In Libya, petroleum is the backbone economy of the country. Petroleum explorations started in the late fifties and giant oil fields have been discovered in the country. The importance of the southern desert region for the petroleum industry has been demonstrated by the economic success achieved in the discovery of the largest oil field in the Murzug Basin, and the Al Shararah Oil field. The ultimate result is a huge loss of the ‘hard currency’, which could be invested in other promising projects. Academically, hitherto, no attempt has been made to answer crucial questions about the causes of delaying development of already explored oil fields in the above

mentioned areas and what are the lessons which should be learned from previous investment projects. The lack of financial analysis, as well as sensitivity analysis for the proposed NC101 undeveloped oil field has created ambiguity and prevents establishment of clear-cut investment strategy in the southern desert of Libya. Thus, conducting financial and sensitivity analysis provide a guide to the decision makers about investments values and grant the economic success and growth for countries. It is suggested that unless an accurate financial model is available to company management no clear investment strategy can be established. Therefore, it has been proposed that a financial analysis research project is desperately needed to overcome the problems and reduce risk in NC101 undeveloped oil field.

## 1.2 Purpose of Study

The purpose of this study is to assess the economic potential of an underutilized oil resource in the Murzug Basin, Libya, and to offer a financial model to act as a guide for future investments in programs to develop untapped oil fields in distant areas, such as the southern desert region of Libya.

## 1.3 Layout of Thesis

The study project is divided into six chapters and categorized as follows:

A brief introduction to crude oil and a description of the procedure for processing and extracting crude oil for the NC101 project are provided in Chapter 2 opening paragraphs. This section continues to discuss the projected NC101 project and its significance to the Libyan economy while providing an outline of crude oil.

The investment evaluation technique is covered in detail in Chapter 3. The project's financial model and risk analysis are both included in this evaluation technique. The method aids in assessing the project's potential overall from several angles.

The project's sustainability and financial feasibility are examined in Chapter 4. First provided are the input parameters utilized to construct the financial model. It also measures the effect of the oil field project on the different project for stakeholders.

Chapter 5 discusses the project's sensitivity and risk analysis on the financial levels.

The NC101 oil field should be accepted or rejected based on the findings and outcomes of performing the investment appraisal, according to the research's conclusion in Chapter 6.

# Chapter 2

# STUDY OVERVIEW

## 2.1 Background

This thesis presents financial analysis study involving financial and sensitivity analyses. The study utilises a financial analysis approach to the problem of identifying and investigating the factors that control and effecting the revenue of the studied project. Thus, the study uses a financial and sensitivity analyses and draws on data obtained from an existing exploration activity and using it as an adjacent or an analogue to NC101 oil field and development project. This oil field is located south of Libya in the Murzug basin and is called the Al Shararah Field. I have personally made a site visit to the AL shararah field and have interviewed several geologists, engineers and managers in order to collect accurate information and use them as reference to my thesis. I will be mentioning most of them as my reference in this chapter.

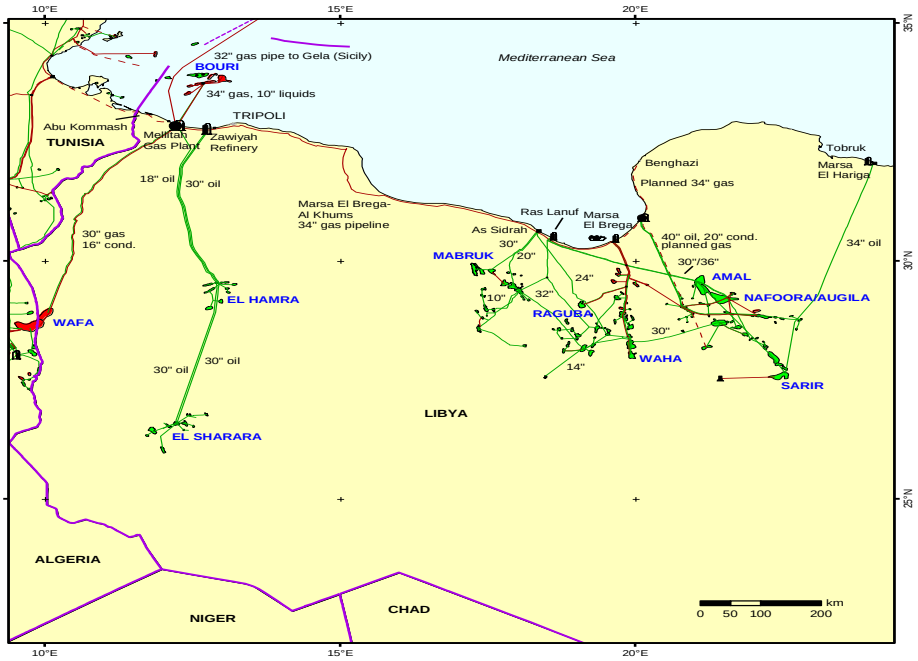
The financial analysis of the NC101 project within the Murzug Basin was carried out to unravel the economic potential of the field and provide decision makers with financial indicators that can be used as a guide line to develop the field and future similar opportunity in the country.

In order to investigate the potential of NC101 oil field project, The method simply involves building a cash flow model using assumptions selected with careful consideration of adjacent developed oil field and by field visit to see the Capital costs

and operating costs on ground in order to adopt a similar scenario or to be used as an analogue to the field under investigation. Thus, it was possible to interpret the development costs and to build production profile, which was used to construct the cash flow model of the NC101 oil field.

### 2.1.1 Location of the Study Area

The NC101 oil field is in the Murzug Basin, which is situated on the southwestern part Libya (Fig.1). The investigated NC101 Field is bounded by longitudes 130.00`E to 140.00`E and latitudes 250.40`N to 260.00`N.




The NC101 oil field in Murzug Basin

### 2.1.2 Crude Oil

Oil is a liquid fuel source that may be discovered below the earth. Drilling is used to obtain oil. Plastics, petroleum products, and transportation all use it. Oil contains between 50% and 97% hydrocarbons. Nitrogen, oxygen, and sulfur make up between 6% and 10% of it. Metals like iron, copper, nickel, vanadium, and less than 1%. (Rahasaco, 2022).

Because of its origins, oil is referred to as a fossil fuel, it was formed. After combining with mud, it was buried by sedimentary layers. Over millions of years, the extreme pressure heated the remains. After further pressure and heat, the oil melted. It is a nonrenewable resource as a result. When this supply is out, it would take millions of years for fresh oil to be produced. (Amadeo. K, 2022).

## 2.2 Crude Oil Production Process

### 2.2.1 Locating the Oil Field

Seismic surveys are used by geologists and geophysicists to look for potential oil resources in the form of geological formations. The "traditional" approach is creating a subterranean explosion close by and monitoring the seismic reaction, which discloses details about the subsurface geological features. But there are other "passive" techniques that employ seismic waves that naturally occur to gather data (Mriheel, 2018).

Petroleum is also sought after using other tools like magnetometers and gravimeters. The first step of extracting oil from the reservoir is to drill the well. A geologist (referred to on the rig as the "mudlogger") will record the presence of an oil well when it has been tapped (Mriheel, 2018).

Joint wells are frequently drilled into the same reservoir in order to achieve an economically viable extraction rate. Water, steam, acids, or other gas mixes may be pumped into the reservoir by some wells (secondary wells) in order to increase the rate of economic extraction (Mriheel, 2018, July).

### 2.2.2 Drilling Oil Well

An oil rig digs a deep hole into the soil to establish the oil well. To give the newly drilled well bore structural stability, a steel pipe (casing) is inserted into the hole. The well's foundation is then modified with holes to allow oil to enter the bore. Finally, a "Christmas tree" of valves that control flow and adjust pressures is attached to the top (Alhnaish, A. S, 2020).

### 2.2.3 Primary Recovery

An oil rig digs a deep hole into the soil to establish the oil well. To give the newly drilled well bore structural stability, a steel pipe (casing) is inserted into the hole. The well's foundation is then modified with holes to allow oil to enter the bore. Finally, a "Christmas tree" of valves that control flow and adjust pressures is attached to the top (Alhnaish, A. S, 2020 ).

> When the pressure of the oil reservoir is sufficient to force the oil and some associated gas to the surface, all that is necessary to attach the well to a pipeline network for storage and processing is to place a complex arrangement of valves (the Christmas tree) on the well head. (Mriheel, I. Y, 2021).

### 2.2.4 Secondary recovery

> The pressure decreases during the course of a well's life. At some point, the pressure beneath the earth becomes too low to drive the oil to the surface. Secondary recovery techniques are used once the natural reservoir drive has diminished. These rely on infusing fluids into the reservoir to raise the pressure, which increases or substitutes an artificial drive for the natural reservoir drive. The reservoir's pressure is raised using secondary recovery methods using gas lift, gas reinjection, and water injection. (Mriheel,I. Y, 2021).

> After the oil is extracted from the well, the fluid enters the separator, encounters an inlet diverter, and abruptly changes momentum (initial separation). Gravity causes the liquid droplets in the gas stream to descend to the tank's bottom, where they are collected. For the entrained gas to exit the oil, climb to the vapour space, and reach equilibrium, the liquid Collection Section provides the requisite retention time. The liquid discharges from the container through the liquid dump valve. Using a level controller, the liquid dump valve is regulated. Above the liquid, gas, and oil mist flow, via the input diverter, and then horizontally through the gravity setting section. (Mriheel,I. Y, 2021).

A Pressure Controller installed on the gas exit controls the pressure in the separator. The pressure controller delivers a signal to either open or close the pressure control valve in response to variations in pressure in the separator.

> The pressure inside the vessel is kept constant by regulating the rate at which gas departs its vapor space. Following the separation of the three fluids—oil, water, and gas—the oil is then transported through pipelines to tanks for

storage before being transported directly through the main pipeline, which is situated south of Libya, to the country's northern shores where it will be gathered by oil carrier vessels for export. (Mriheel,I. Y, 2021).

# Chapter 3

# METHOD FOR INVESTMENT APPRAISAL

## 3.1 Introduction to Method

Project appraisal consists of financial and economic analyses. The integrated investment evaluation technique will serve as the foundation for the study's methodology. In the year 2002 Jenkins and Harberger developed the appraisal method (Jenkins, Kuo, & Harberger, 2013). This method evaluates projects investments and takes into consideration the stakeholder, economic, financial and risk analysis so that it can give an overall assessment of the investment over is lifespan.

The demand module of comprehensive appraisal method differentiates the domestically and internationally traded goods and services and recognizes the sources of demand. Along with assessing the market's features, anticipated prices, and production levels, it also takes into consideration how real prices have changed throughout the life of the project. In addition to using secondary data for the analysis, the module also uses original data in the form of interviews with potential users and receivers.

The technical module looks at several available technologies to see if the project investment and operation are technically possible. It assesses the expenses related to the required inputs (such as the kind of input, such as machinery, raw material sources equipment, and other pertinent materials).

## 3.2 Financial Analysis

While making a financial assessment of an investment it is critical to determine the project's financial feasibility and sustainability throughout its projected life expectancy. The cost and quantity of project inputs, outputs, and other deliverables are taken into consideration while developing a financial model, and the table of parameters has a detailed list of all the assumptions. In this study the cash inflows and outflows are all going to be in foreign US dollars.

Sales income for the project should only be divided into export sales in terms of cash inflows. While it is important to distinguish between costs for the NC 101 production line, equipment, land, building, pipeline, fuel, and other components depending on where they are incurred.

A project's financial feasibility can only be determined by carefully evaluating the facts available on project finance. A suitable rate of return should be chosen and used when evaluating the project's profitability from the owner's perspective. It's crucial to remember that land's residual value does not increase or decrease in value while calculating it. Land's value would only alter if the NC 101 project's execution led to an increase or decrease in that land's value. Any change that occurs after operations cease must be evaluated and properly taken into account in the residual value.

The financial model's creation is made possible by the facts. The financial assessment aids equity investors in determining if the project is financially viable. The bankers' (total investment) and owners' (equity holders') perspectives are used to construct the cash flow statement for the financial model as nominal terms but then reverted again into real terms.

Net cash flows collected from the perspective of the whole investment shows whether the project is capable of satisfying its debt commitments, including principle and interest during the term of the loan or not. Important ratios including (ADSCR) and (LLCR) will be used to evaluate the project's capacity to repay its debt. Significant information about the project's overall performance and financial feasibility may be gleaned from these measures. It helps determine if the project operation generated adequate annual net cash flows to pay down the loan on an annual basis. The ratio determines whether future years' net cash flows will be sufficient to qualify for bridge finance when specific years' net cash flows are insufficient.

Having a positive NPV means that From the owner's perspective, the project's financial viability shows that equity holders will have a higher rate of return than 10%. If NPV is zero this means that owners will have equal rate of return to the opportunity cost of funds if it were to be invested elsewhere.

## 3.3 Risk Analysis

Risk Analysis Based on a 100% likelihood of occurrence, the deterministic estimates of the project outcomes are generated from financial analysis. However, given the enormous degree of uncertainty surrounding any estimates or forecasts made regarding future market values, this is not a realistic depiction of reality. The sensitivity analysis approach is therefore executed on the project results of the model to evaluate the degree of uncertainty and determine risky variables of the project. Then using this identified risky variable a risk analysis is conducted using Monte-Carlo approach.

# Chapter 4

# FINANCIAL ANALYSIS

## 4.1 Parameters and Assumptions

A collection of presumptions and factors form the foundation of the financial model for the NC 101 production. The essential assumptions included in the parameter table are used to derive all deterministic results.

## 4.2 Duration of Nc101 Project

NC 101 involves five-year building phase and a 22-year project assessment phase that starts in 2020. Operations for the project are anticipated to start in 2024 and terminate in 2046, respectively. After operations are stopped in 2046, it is believed that all project assets would be properly liquidated.

## 4.3 Investment Cost

The NC 101 project's overall investment cost is (US$1159.6 mil). Drilling wells and injectors will cost (US$500 million), which will make up 43% of the entire investment. Plant and equipment will cost (US$450 million), which will make up 39% of the total investment, and the pipeline will cost (US$200 million), which will make up 17% of the whole investment. Finally, the proportion of buildings and civil works/land is just 1% and 1%, respectively. This is because the machinery is pricey and highly advanced. The equipment has special qualities that speed up the extraction of oil from the southern Libyan desert and guarantee the production of high-quality oil devoid of any contaminants. The central procurement sector is one of the plants and pieces of equipment used in the processing of oil.

| The Investment Cost | Unit | Amount |
|---|---|---|
| Land/Civil work | US$ | 4,600,000 |
| Building | US$ | 5,000,000 |
| Plant & Equipment | US$ | 450,000,000 |
| Well drilling &work overs | US$ | 500,000,000 |
| Pipeline | US$ | 200,000,000 |
| **Total** | US$ | **1159.600.000** |
| The Investment cost over-run factor | % | 0% |

## 4.4 Project Financing

Oil production NC 101 project's total investment cost is financed by equity and debt. Loans account for 70% of the overall project cost, with the IOC, the equity holder, financing the remaining 30%. The Libyan Development Bank will offer the loan, which has an 8-year term and a nominal interest rate of 10%. From 2025 through 2031, there will be 7 payments for loan repayment. One disbursement of the total loan amount is made in 2020's first year.

| **Financing of the project** | | |
|---|---|---|
| Loan repayment profile | | Equal Principal Repayment |
| Choice | | 1 |
| Loan disbursement | | 2020 |
| Loan tenor | year | 8 |
| Grace period | year | |
| Number of installments | year | |
| Real interest rate | | 10% |
| Risk premium | | 0% |
| Loan repayment start date | | 2025 |
| Loan repayment end date | | 2031 |

## 4.5 The Sources and Funds of NC 101

Sources and funds for the NC 101 project comprise a loan of 811.7 mil US$ given by LDB and the initial investment cost of US$ 347.8 contributed by equity holders. To address any unanticipated increases in investment costs throughout the project's investment phase, cash has been set aside for cost overruns. The capital raised will be utilized to fund an investment of US$ 1.159.6 billion, including investment cost overruns. The table below displays the sources and funds for the NC 101 project.

| **Item** | **US$ million** |
|---|---|
| **Sources of funds** | |
| Debt (loan) | 811.7 |
| ***Equity contribution*** | |
| Initial investment cost | 347.8 |
| Investment cost over-run funding | - |
| **Total sources of funds** | **1159.6** |
| | |
| **Uses of funds** | |
| Investment cost | 1159.6 |
| Investment cost over-run | - |
| **Total uses of funds** | **1159.6** |
| **Check** | **-** |

## 4.6 Production and Sales of NC 101 Project

At the start of production, the NC 101 project is using all of its available production capacity. It is predicted that 10.8 million barrels of the production capacity will be utilized in the first year and that this number would increase by 33% in the following year. Third-year output growth will climb by 30%, resulting in 18.72 million barrels. For four more years, oil output will stay constant. After that, it will gradually decrease until it reaches 14.4 million barrels, a 23% decrease, commencing in the ninth year of production. twenty years, starting in 2021 and ending in 2035. The NC 101 project's output capacity varies; for example, production may begin at 10.8 million barrels per

year and subsequently fall to 1 million barrels annually towards the conclusion of the project time. It is predicted that production would reach a minimum of 1 million barrels and a maximum of 18.72 million barrels in 2025 and 2035, respectively. 10% of the entire amount of production each year is made up of output inventory.

| **Production** | **Unit** | **Amount** |
|---|---|---|
| NC 101 production | Barrel /year | 200 Million |
| Production capacity utilization during the construction period | % | 0% |
| Initial production capacity utilization | % | 100% |
| Production capacity utilization growth rate | % / year | |
| Growth of capacity utilization beginning year | Year | 2024 |
| Production capacity utilization growing period | Year | 5 |
| Growth of capacity utilization ending year | Year | 2046 |
| Production capacity utilization | % | |
| The proportion of output exported | % | 100% |
| Proportion of output traded domestically | % | 0% |

The parties will each supply their own equipment and raw materials. It is estimated that NOC AND IOC will be adequate to guarantee sustained production for the duration of the project's operating life. The risk analysis will go into depth on the effects of raw material shortages on the project's viability.

## 4.7 Inventory Valuation

It is presumed that 15% of the annual total production amount is made up of output inventory. The first in-first-out (FIFO) approach is used to value the project's output inventory. The amount of oil sold during the first year is (10.8 million barrels) is multiplied by the current crude oil price of US $50 in 2025 to appraise the expense of products regarding the crude oil produced in that year.

## 4.8 The Operation Expense

Variable and fixed costs make up the project's operational expenses. The oil fields variable cost, depend on how much of the production capacity is being used and fluctuate as that percentage changes. However, because they are not reliant on how much of the production capacity is being used, fixed costs like fixed power usage and general and administrative expenditures continue to exist no matter how much that capacity varies. Average variable and fixed expenses are $2.38 and $2.69 per barrel, respectively., in the United States. Consequently, the average total cost of producing a barrel of crude oil is (US$ 5.07).

## 4.9 Labor

Direct and indirect skilled work, as well as direct unskilled labor, are all required for the NC 101 project. The production manager, engineers, geologists, agronomists, the director of finance & accounting, and technicians are examples of direct skilled labor on the one hand. While administrative personnel, which includes human resources, quality control, procurement, accounting, security, and other departments, makes up indirect skilled labor. On the other hand, manual laborers and housekeepers are included in direct unskilled labor. The oil field plant requires a total of 100 employees to run. The annual labor expense is (US$ 2.4 million), which is roughly 0.24% of the overall operating expense.

## 4.10 Price of Crude Oil

The nations that make up OPEC include Saudi Arabia, Iran, Gabon, Algeria, Iraq, Kuwait, Libya, Nigeria, Republic of the Congo, Angola, United Arab Emirates, Venezuela, and Equatorial Guinea. Oil prices hit $130 per barrel in 2020, the highest level since 2008, and OPEC and its partners, collectively known as OPEC+, decided to maintain stable output.

In order to maintain the oil market's stability and ensure that petroleum supplies are delivered to the market in an effective and reasonable manner, OPEC was established in 1960 with the initial membership of five oil-producing nations. OPEC has had the greatest effect on oil supply and prices since its founding.

## 4.11 Foreign Inflation

Inflation in the United States and abroad are 2% and 7.5%, respectively. The whole project review period is predicated on the assumption that inflation rates won't change. As of 2020, the actual exchange rate was 4.5 Libyan dinars (lyd) per US dollar. The risk analysis will cover the effects of changing inflation rates and actual forex appreciation/depreciation.

## 4.12 The NC 101 Working Capital

The part of sales income that the project has not yet received is known as account receivables. The cash flow statement, on the other hand, monitors changes in account receivables, which highlight the differences between those at the beginning and end of the month. The project's net cash flow is decreased by an increase in accounts receivable. When receivables go down, the opposite is true. It is anticipated that throughout the course of the project's working life, accounts receivable will account for 20% of sales revenue.

Input purchases made by the project for which money has not yet been received are shown in account payables. The amount of real net cash flow, however, changes according to the number of account payables. 15% of total operating expenses, excluding staff costs, over the project's operational life will be projected for the accounts payable. How much cash has been set aside to pay the project's ongoing

expenses may be seen in the cash balance. An estimated 10% of the annual sales revenue will be held in cash for daily use.

## 4.13 NC 101 Depreciation

The building and plant and equipment expenditures are depreciated using the straight-line approach by allocating a certain fixed percentage throughout the asset's economic life. The buildings and plant & equipment's economic lives in this project are 20 and 10 years, respectively (PWC, PricewaterhouseCoopers, December 2013).

The asset's residual value is calculated by multiplying the asset's cost by the entire depreciable amount throughout the course of the project's operational life. In 2035, the assets would be liquidated, and the cash flow statement would reflect the remaining value. Since it is predicted that the project's operations won't have any impact on the property, the land's initial value will remain unchanged when the project is finished.

**Residual Values**

| **Asset** | **Residual value** |
|---|---|
| Land | 0 |
| Building | 0.23 million usd |
| Plant & equipment | 20.45million usd |
| Pipeline | 9.09 million usd |
| Drilling of wells and injectors | 22.73 million usd |
| **Total residual value`** | **52.5 million usd** |

## 4.14 Tax Depreciation

Because it generates a tax shelter, it is used to calculate the depreciation expenditure that is deducted from taxable income, It will lower the project's income tax burden. For tax purposes, both the building and the machinery and equipment have a useful economic life that may be depreciated by 5% throughout the course of the project. We will be using the straight-line approach. The regulations of the Libyan National oil company state that the economic service life of the building to be 20 years and 10 years for the plant and equipment , Although in reality as I have witnessed during my site visit to the oil field , the plant and equipment are not replaced by the end of ten years ,instead they are only maintained .Therefore in the cashflow at ten years of the project , the plant and equipment replacement are not recorded .

| **DEPRECIATION** | | |
|---|---|---|
| ***Economic service life*** | | |
| Building | Years | 20 |
| Plant & Equipment | Years | 10 |
| ***Economic service life for tax purposes*** | | |
| Building | % | 5% |
| Plant & Equipment | % | 5% |

## 4.15 Tax

In accordance with the tax legislation of Libya, 65% of the project's activities' revenue is subject to government tax, which must be paid. As previously stated, all of the generated crude oil will be exported. The percentage of sales earnings from IOC, which accounts for 20% of crude oil output is free from taxation under Libyan law. Any crude oil project in Libya is required to pay a 17% royalty, according the country's tax legislation.

## 4.16 Required Rate of Return

Investors in the project's equity anticipate a real rate of return of 12.5 %. Based on the opportunity cost of capital for investments in alternative capital markets, this rate is genrally required from the central bank of Libya to most of the oil and energy sectors there fore we have decided to work with the same rate .

## 4.17 The Banker’s View

The banker's view of the financial cash flow statement in the financial analysis aids the banker in determining the NC101 project's capacity for repaying its loan obligations. It will help the Libyan Development Bank (LDB) determine if the NC 101 project's activities would provide enough income to pay for the investment cost, operating costs, loan repayments, and enough returns for equity investors.

## 4.18 The ADSCR Ratio and LLCR

To acquire appropriate project finance from any bank, the NC 101 project's ratios must satisfy the banker. The standard ratio of 1.5 has been developed by LDB, a financier of the crude oil project who is responsible for 51.5% of the project's total finance, is mainly worried about the project's capacity to pay back its loan or whether it is bankable. Therefore, LDB would only look at what is best for them which is done by evaluating two important indicators which are ADSCR & LLCR. The ADSCR ratio is used to determine if the project can generate enough net cash flows to meet its annual principal and interest payments. The LLCR, helps in deciding if a project will be able to make sufficient net cashflows in the coming years to meet the requirements for bridge financing, even if certain years may not generate enough cash flow to pay off the loan.

**Debt Service Coverage Ratios**

| YEAR | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|---|---|
| Net Cash Flows Available for Debt Financing (NCFADF) | (40) | 616 | 879 | 1,125 | 1,378 | 1,659 | 1,952 |
| Total Debt Service (TDS) | 219.45 | 204.67 | 189.88 | 175.10 | 160.31 | 145.53 | 130.74 |
| Present Value of (NCFADF) | 3,559 | 4,189 | 4,269 | 4,081 | 3,633 | 2,859 | 1,674 |
| Present Value of (TDS) | 915.21 | 784.47 | 653.72 | 522.98 | 392.23 | 261.49 | 130.74 |
| **ADSCR** | 1.76 | 2.39 | 2.93 | 3.18 | 3.48 | 3.84 | 3.87 |
| **LLCR** | 2.78 | 3.10 | 3.35 | 3.53 | 3.70 | 3.85 | 3.87 |

**Minimum and Average ADSCR and LLCR**

| | Minimum | Average |
|---|---|---|
| **ADSCR** | **1.76** | **3.06** |
| **LLCR** | **2.78** | **3.45** |

As show from the results we know that the NC 101 project can produce adequate net cash flows to settle its annual debt. 10.8 million barrels ($581.52 million) in gross sales during the project's first year of operation enabling it to pay off its yearly debt. Both the lowest ADSCR of 1.76 and the average ADSCR of 3.06 times indicate a higher possibility of debt collection, which is advantageous to LDB. This is caused by a rise in production capacity utilization of 30% each year and an increase in ADSCR results from 1.76 to 3.87 in 2025 and 2031, respectively. Since the project's ADSCR results have become better over time, this suggests that it is bankable. According to the LLCR indicators the project will have sufficient net cash flow to be eligible for finance bridging for the coming years.

LDB will consider this project to be a sound investment and approve the project finance request for the NC 101 when it is a bank that accepts small risks. This is as a result of LDB's belief in the NC 101 project's long-term financial sustainability. The objective of achieving financial closure will thus be accomplished.

## 4.19 Owner Perspective

The equity holder's and the banker's perspectives are similarly derived. Financing is the sole difference between the aforementioned cash flow figures. Both cash flow statements are similar to the determination of NCFBF, however it is calculated in nominal terms and then adjusted for real terms. As for the equity holders perspective any loan or debt is edited as cash outflow, while any cash inflows are to be on the cash flow statement as cash. Therefore, the loan taken for the NC 101 oil field project is audited as cashflow, as for the total loan repayment such as principal or interest are recorded as cash outflows.

As seen from the table below the construction period starts from year 1 the same year the loan was disbursed 811.7 million usd . the construction involves installing a pipeline, plant & equipment of the central procurement as well as drilling the wells and injectors . The operation then starts at year four that is when the production and sales starts. A sales of 643 million usd was made during the first year of production, as the years go on the sales will increase due to the increase in oil production . the project starts paying of its loan by the first year of production and will finish paying its last installment at year eleven. from the cash flow statement an NPV of 313 million usd was found and an IRR of 17%. this means that the project is highly feasible as the investors will have a higher rate of return than their opportunity cost, same thing

applies for the bankers the cash flow statement shows that the project is able to pay of its debt.

| | *Year 1* | *Year 2* | *Year 3* | *Year 4* | *Year 5* | *Year 6* | *Year 8* | *Year 9* | *Year 10* | *Year 11* | *Year 21* | *Year 23* | *Year 24* | *Year 25* | *Year 26* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gross sales | 0 | 0 | 0 | 643 | 909 | 1253 | 1407 | 1492 | 1581 | 1289 | 321 | 180 | 0 | 0 | 0 |
| Change in Account Receivable | 0 | 0 | 0 | -129 | -53 | -69 | -16 | -17 | -18 | 58 | 27 | -2 | 36 | 0 | 0 |
| **Liquidtation Value** | | | | | | | | | | | | | | | |
| Building | | | | | | | | | | | | | | | 0 |
| Plant & Equipment | | | | | | | | | | | | | | | 20 |
| Pipeline | | | | | | | | | | | | | | | 9 |
| Drilling of Wells & Injectors | | | | | | | | | | | | | | | 23 |
| **TOTAL CASH INFLOW (+)** | **0** | **0** | **0** | **515** | **856** | **1184** | **1391** | **1475** | **1563** | **1348** | **347** | **178** | **36** | **0** | **53** |
| **Investment** | | | | | | | | | | | | | | | |
| Land /Civil Work | 1 | 1 | 1 | 1 | | | | | | | | | | | |
| Building | 0 | 0 | 5 | 0 | | | | | | | | | | | |
| Plant & Equipment | 120 | 250 | 80 | 0 | | | | | | | | | | | |
| Pipeline | 0 | 100 | 100 | 0 | | | | | | | | | | | |
| Drillingo Wells & Injectors | 0 | 300 | 150 | 50 | | | | | | | | | | | |
| **Operating Cost** | | | | | | | | | | | | | | | |
| Variable Costs | 0 | 0 | 0 | 26 | 36 | 50 | 56 | 60 | 63 | 52 | 13 | 7 | 0 | 0 | 0 |
| **Fixed Cost** | | | | | | | | | | | | | | | |
| Labor | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maintenance | 0 | 0 | 0 | 6 | 9 | 13 | 14 | 15 | 16 | 13 | 3 | 2 | 0 | 0 | 0 |
| Well Workovers | 0 | 0 | 0 | 7 | 8 | 8 | 9 | 10 | 10 | 11 | 19 | 22 | 23 | 24 | 0 |
| Tariff | 0 | 0 | 0 | 15 | 22 | 30 | 34 | 36 | 38 | 31 | 8 | 4 | 0 | 0 | 0 |
| Total Fixed Cost | **0** | **0** | **0** | **29** | **39** | **51** | **57** | **60** | **64** | **55** | **30** | **28** | **23** | **24** | **0** |
| **Working Capital** | | | | | | | | | | | | | | | |
| Changes in Accounts Payable | 0 | 0 | 0 | -8 | -3 | -4 | -1 | -1 | -1 | 3 | 1 | 0 | 2 | 0 | 4 |
| Changes in Cash Balance | 0 | 0 | 0 | 64 | 27 | 34 | 8 | 8 | 9 | -29 | -13 | 1 | -18 | 0 | 0 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TOTAL CASH OUTFLOW (-)** | **121** | **651** | **336** | **162** | **98** | **131** | **120** | **127** | **135** | **80** | **31** | **36** | **7** | **24** | **4** |
| **NCFBF** | **-121** | **-651** | **-336** | **352** | **757** | **1053** | **1271** | **1348** | **1428** | **1268** | **316** | **142** | **29** | **-24** | **49** |
| Income Taxes | 0 | 0 | 0 | 278 | 282 | 446 | 544 | 596 | 651 | 541 | 138 | 78 | 0 | 0 | 0 |
| **NCFBF** | **-121** | **-651** | **-336** | **75** | **476** | **607** | **727** | **751** | **778** | **727** | **178** | **65** | **29** | **-24** | **49** |
| **Financing of the Project** | | | | | | | | | | | | | | | |
| Loan Disbursement | 812 | | | | | | | | | | | | | | |
| Loan Repayment Schedule | 0 | 0 | 0 | 0 | 286 | 262 | 213 | 189 | 165 | 140 | 0 | 0 | 0 | 0 | 0 |
| **NCFAF (NOMINAL)** | **-121** | **-651** | **-336** | **75** | **189** | **345** | **514** | **562** | **613** | **587** | **178** | **65** | **29** | **-24** | **49** |
| **NCFAF (REAL)** | **91** | **-614** | **-299** | **63** | **150** | **258** | **342** | **353** | **363** | **328** | **55** | **18** | **8** | **-6** | **11** |

| | |
|---|---|
| **DISCOUNT RATE** | |
| 12.5% | |
| **FNPV REAL** | **313** |
| **FIRR REAL** | **17%** |

# Chapter 5

# SENSITIVITY AND RISK ANALYSIS

## 5.1 Risk Analysis

In evaluating a project's investment, risk analysis is crucial. It will be irrational to believe that the variables utilized in the research and the results generated will not change if the oil field project field project goes on. A risk analysis is performed to examine potential variations in the project's financial results. Detailed sensitivity analysis and the Monte-Carlo risk simulation make up the risk analysis carried out in this work.

## 5.2 Sensitivity Analysis

As a first step, to identify the risky variables a sensitivity analysis is conducted. Sensitivity analysis evaluates how sensitive a project's outcome is to small shifts in each parameter's value. It is frequently called "what if" analysis. It aids in defining the hazardous variables and illustrates how they relate to the project's output parameters. A sensitivity analysis can also be performed to determine how the project's outcome will alter. It is a crucial risk-reduction strategy because of unanticipated potential unpredictability. The NC101 oil project's sensitivity analysis was conducted using a few key parameters. The investment cost overrun, currency rate, oil price, real interest rate, per-barrel tariffs, percentage of production exported, and foreign inflation in the USA are a few examples of these parameters.

## 5.3 Discount Rate

The baseline scenario's discount rate is 12.5%, according to the assumption. The tested range for the adjustment in the discount rate is 6.5% to 15.5%. The effect of the discount rate on the project's financial result is depicted in the table below. With regards to the discount rate, our FPV decreases as it rises. As for the other components of FRATE OF RETURN, ADSCR, AND LLCR, they have stayed consistent despite the fluctuation in the discount rate**.**

| 12.50% | % |
|---|---|

| | FNPV | FRATE OF RETURN | min. ADSCR | min. LLCR |
|---|---|---|---|---|
| | 524.40 | 20% | 1.76 | 2.78 |
| 15.50% | 253.12 | 20% | 1.76 | 2.78 |
| 14.50% | 333.84 | 20% | 1.76 | 2.78 |
| 13.50% | 423.86 | 20% | 1.76 | 2.78 |
| 12.50% | 524.40 | 20% | 1.76 | 2.78 |
| 11.50% | 636.89 | 20% | 1.76 | 2.78 |
| 10.50% | 762.97 | 20% | 1.76 | 2.78 |
| 9.50% | 904.56 | 20% | 1.76 | 2.78 |
| 8.5% | 1063.88 | 20% | 1.76 | 2.78 |
| 7.5% | 1243.53 | 20% | 1.76 | 2.78 |
| 6.5% | 1446.58 | 20% | 1.76 | 2.78 |

## 5.4 Change in Foreign Inflation – USA

It is estimated that inflation will be 6% on the average in the base case. The range of the tested change in foreign inflation is from 1% to 10%. The NPV, RATE OF RETURN, ADSCR, and LLCR all increase when foreign inflation rises. The sensitivity of foriegn inflation on the project's financial results is displayed in the table below. The baseline scenario's interest rate is expected to be 6 percent.

| | |
|---|---|
| 6.00% | % |

| | FNPV | FRATE OF RETURN | min. ADSCR | min. LLCR |
|---|---|---|---|---|
| | 524.40 | 20% | 1.76 | 2.78 |
| 1.00% | 382.05 | 18% | 1.71 | 2.63 |
| 1.50% | 451.78 | 19% | 1.74 | 2.70 |
| 2.00% | 524.40 | 20% | 1.76 | 2.78 |
| 2.50% | 600.06 | 20% | 1.79 | 2.86 |
| 3.00% | 678.90 | 21% | 1.81 | 2.94 |
| 4.00% | 846.71 | 23% | 1.86 | 3.11 |
| 5.00% | 1029.12 | 25% | 1.92 | 3.29 |
| 6.00% | 1227.55 | 26% | 1.97 | 3.48 |
| 7.00% | 1443.59 | 28% | 2.03 | 3.68 |
| 8.00% | 1678.97 | 29% | 2.08 | 3.89 |
| 9.00% | 1935.64 | 31% | 2.14 | 4.11 |
| 10.00% | 2215.73 | 33% | 2.20 | 4.35 |

## 5.5 Investment Cost Overrun

The oil field project's investment cost overrun is predicated on a base scenario of 0%. The tested variation of the cost overrun's change ranged from 0% to 50%. The table below illustrates how sensitive the investment cost overrun is to the project's FNPV, RATE OF RETURN, minimum ADSCR, average ADSCR, and minimum LLCR:

| | |
|---|---|
| 0.00% | % |

| | FNPV | FRATE OF RETURN | min. ADSCR | min. LLCR |
|---|---|---|---|---|
| | 524.40 | 20% | 1.76 | 2.78 |
| 50.00% | 524.32 | 20% | 1.76 | 2.78 |
| 40.00% | 524.33 | 20% | 1.76 | 2.78 |
| 45.00% | 524.33 | 20% | 1.76 | 2.78 |
| 40.00% | 524.33 | 20% | 1.76 | 2.78 |
| 35.00% | 524.34 | 20% | 1.76 | 2.78 |
| 30.00% | 524.35 | 20% | 1.76 | 2.78 |
| 25.00% | 524.36 | 20% | 1.76 | 2.78 |
| 20.00% | 524.37 | 20% | 1.76 | 2.78 |
| 15.00% | 524.38 | 20% | 1.76 | 2.78 |
| 10.00% | 524.38 | 20% | 1.76 | 2.78 |

| | | | | |
|---|---|---|---|---|
| 5.00% | 524.39 | 20% | 1.76 | 2.78 |
| 0.00% | 524.40 | 20% | 1.76 | 2.78 |

The project outcome and investment cost have a poor correlation, as seen in the above table. The FNPV, RATE OF RETURN, DSCR, and LLCR decrease as the investment overrun rises. It is believed that the default case is 0. Still, the project will have a good financial PV and rate of return.

## 5.6 World Oil Price

The project's starting price per barrel will be $50 US. Since all of the project's production will be exported, the export price is a crucial variable to take into account in the sensitivity analysis of this project. As we know that Fifty is the base price , a range of an export price changes ranged from 10 to 135 USD. The table below illustrates how export prices are affected by the project's financial analysis's findings:

50 *USD/Barrel*

| | FNPV | FRATE OF RETURN | min. ADSCR | min. LLCR |
|---|---|---|---|---|
| | 524.40 | 20% | 1.76 | 2.78 |
| 135 | 4507.35 | 55% | 4.71 | 7.85 |
| 125 | 4038.77 | 52% | 4.37 | 7.25 |
| 115 | 3570.19 | 48% | 4.02 | 6.65 |
| 105 | 3101.61 | 45% | 3.67 | 6.06 |
| 100 | 2867.31 | 43% | 3.50 | 5.76 |
| 90 | 2398.73 | 39% | 3.15 | 5.16 |
| 80 | 1930.15 | 35% | 2.80 | 4.57 |
| 70 | 1461.57 | 30% | 2.46 | 3.97 |
| 60 | 992.98 | 25% | 2.11 | 3.38 |
| 50 | 524.40 | 20% | 1.76 | 2.78 |
| 40 | 55.82 | 13% | 1.41 | 2.18 |
| 30 | -412.76 | 6% | 1.07 | 1.59 |
| 20 | -881.35 | -3% | 0.72 | 0.99 |
| 10 | -1349.93 | -16% | 0.37 | 0.37 |

## 5.7 Tariffs Per Barrel

Tariffs is also another important variable that can determine the success of the oil field project. The base case scenario is US$ 1.2 per barrel a range from US $0.2 to US $ 2.00. As shown in the table below an increase in tariffs has a negative relationship with the four factors of FPV, frate of return, min ADSCR, and min LLCR.

| 1.20 | *USD/Barrel* |
|---|---|

| | FNPV | FRATE OF RETURN | min. ADSCR | min. LLCR |
|---|---|---|---|---|
| | 524.40 | 20% | 1.76 | 2.78 |
| 2.00 | 455.51 | 19% | 1.71 | 2.69 |
| 1.90 | 464.12 | 19% | 1.71 | 2.70 |
| 1.80 | 472.73 | 19% | 1.72 | 2.72 |
| 1.75 | 477.04 | 19% | 1.72 | 2.72 |
| 1.70 | 481.34 | 19% | 1.73 | 2.73 |
| 1.60 | 489.96 | 19% | 1.73 | 2.74 |
| 1.55 | 494.26 | 19% | 1.74 | 2.74 |
| 1.45 | 502.87 | 19% | 1.74 | 2.75 |
| 1.35 | 511.48 | 19% | 1.75 | 2.76 |
| 1.20 | 524.40 | 20% | 1.76 | 2.78 |
| 1.00 | 541.62 | 20% | 1.77 | 2.80 |
| 0.8 | 558.85 | 20% | 1.79 | 2.82 |
| 0.6 | 576.07 | 20% | 1.80 | 2.84 |
| 0.4 | 593.29 | 20% | 1.82 | 2.87 |
| 0.2 | 610.52 | 21% | 1.83 | 2.89 |

## 5.8 Proportion of Out Exported 200 Million Barrel

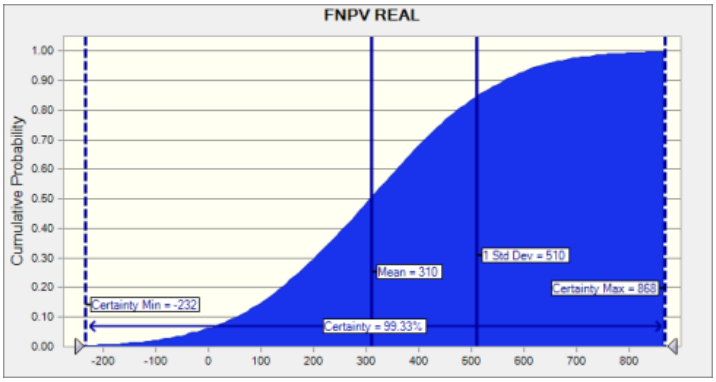
| | FNPV | FRATE OF RETURN | min. ADSCR | min. LLCR |
|---|---|---|---|---|
| 100.00% | 524.40 | 20% | 1.76 | 2.78 |
| 90.00% | 471.96 | 18% | 1.58 | 2.50 |
| 80.00% | 419.52 | 16% | 1.41 | 2.25 |
| 70.00% | 367.08 | 14% | 1.23 | 2.03 |
| 60.00% | 314.64 | 12% | 1.06 | 1.82 |
| 50.00% | 262.20 | 10% | 0.88 | 1.64 |

| | | | | |
|---|---|---|---|---|
| 40.00% | 209.76 | 8% | 0.70 | 1.48 |
| 30.00% | 157.32 | 6% | 0.53 | 1.33 |
| 20.00% | 104.88 | 4% | 0.35 | 1.20 |
| 10.00% | 52.44 | 2% | 0.18 | 1.08 |
| 0.00% | 0.00 | 0% | 0.00 | 0.97 |

As we see above the project is highly sensitive towards proportion of output exported. the base case is 100% to be exported, a range from 0% to 100% was taken. the lower the proportion of export the higher the negative impact is on FNPV, IRR, ADSCR, LLCR.

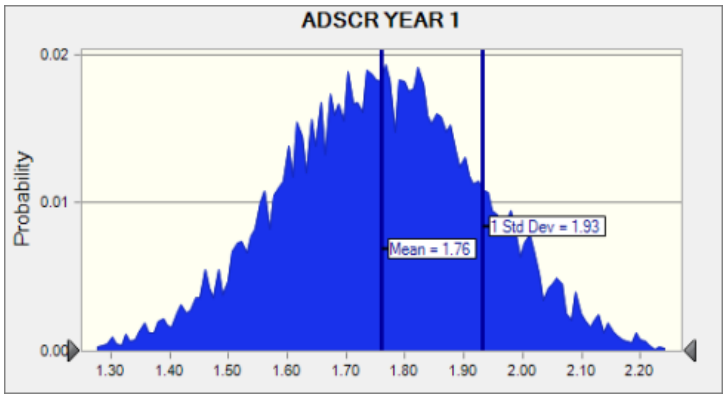
## 5.9 Risk Analysis of FNPV

Nevertheless, the oil field project's FNPV is 313. The risk simulation demonstrates that the predicted value of the FNPV will be 313 given the risk factors. From the figure below we can see that there is a 90% chance that the FNPV would be positive or equal to zero.



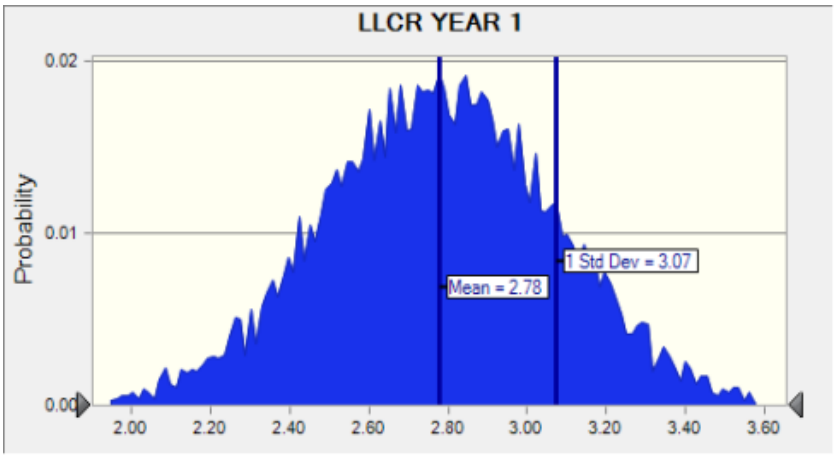

## 5.10 Risk Analysis of ADSCR

As for ADSCR the risk simulation was ran for the first three years , the base case for ADSCR was 1.76 with that been the same value for the mean when the simulation was done for the first year of ADSCR .




## 5.11 Risk Analysis for LLCR

A risk simulation was also done for the first three years to LLCR , the base for LLCR was 2.78 having the same value of mean for the first year of LLCR.



# Chapter 6

# CONCLUSION

The major export from Libya is crude oil, which serves as both the country's principal export and a significant source of money for the economy. The oil field project will help the region flourish while boosting the local economy. Furthermore, it will result in the development of jobs in southern Libya. According to the financial analysis of this study, the NC 101 oil field project will have a PV of 313 million USD and a IRR of 17%, which is higher than the estimated opportunity cost of capital. The project will also have sufficient amount of cash to pay off its debt or for upcoming bridge financing if needed. The fall out between Russia and Ukraine has affected the world in various ways especially the energy sector, we have witnessed a relatively high appreciation of oil prices which has led to economic instability worldwide. Fortunately, Libya is one of few countries who could benefit from this conflict if it were to take the right approach. Earlier predictions made in February and March suggested that rising oil prices would result in a trade surplus of $12.5 billion. However, LPFM amended the predictions to account for changes in Libya's oil production and exports following the blockades of the Al-Feel and Sharara oil fields as well as the Zueitina and Brega oil ports in April. According to the findings, the trade surplus will be much smaller than it was last year as a result of the blockades, but it will still be positive at $4.9 billion—a little bit more than the returns of $4.2 billion from the previous year. The only barrier facing Libya is to unite all parties to sort the conflicts in the country. The biggest threat to any project is the shutdown of its

production, which would prevent enough oil from being exported. This is because criminals and war lords will be able to use our resources for their own benefit due to the ease of access to weaponry.

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