Feasibility Study of Production of Steel (Billet) and Sponge Iron in Iran

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ABSTRACT

Nowadays, regarding the economic growth of developing countries the need for steel production has increased considerably. Iran as one of the big consumers of steel can be a good place for undertaking projects for Steel and Sponge Iron factories. As Iran has God-given relative advantage in this product, this research's aim is do a feasibility study on building a steel and sponge iron factories (raw material for steel). The research looks into to examining whether the financial viability of such investment would be profitable or not. The study tests the impact of establishing steel factories from investor's point of view. The thesis undertakes a financial analysis when NPV and IRR are conducted. In addition, the thesis measures the riskiness of the project through sensitivity analysis and risk analysis. The software which the paper employed in testing process is Excel and Crystal Ball which are common tools in feasibility study of projects. The paper tested investment criteria for one middle scale factory in order to give a better idea to different users of the result of the study. Bankers and owner perspectives being profitable project, means that project attracts investor to invest in this field of industry. Based on results, NPV and IRR were obtained 10,431,069 million Rial and 42.4%, respectively. The results of the analysis indicate that the investment can be a profitable project for both domestic as well as foreign investors. However, the research found that fluctuations in the prices of metal make this project to be a relatively high risky project.

Keywords: Billet, Sponge iron, Investment appraisal, Sensitivity analysis, Risk analysis

ÖZ

Günümüzde gelişmekte olan ülkelerin ekonomik büyümelerine bağlı olarak, çelik üretimine olan ihtiyaç ciddi miktarda yükselmiştir. İran'da çok yüksek miktarlarda çelik tüketimi bulunmaktadır ve yeni kurulacak çelik ve sünger çelik fabrikaları için iyi bir yatırım yeri olabilir. İran'daki çelik reservlerinin oldukça fazla olmasından dolayı bu çalışma yeni kurulacak çelik ve sünger çelik fabrikalarının uygun bir yatırım olup olmadığını test etmek amacı taşımaktadır. Bu araştırma ayrıca böyle bir yatırımın finansal anlamda karlı olup olmadığınıda test etmektedir. Araştırmada yatırımcının bakış açısından çelik fabrikası yatırımı incelenmektedir. Buna ek olarak, tezde risk ve hassaslık analizleri ile böyle bir yatırımın ne kadar riskli olduğunada bakılmıştır. Test sonuçları excell ve cristal ball bilgisayar programları kullanılarak elde edilmiştir. Tüm testler orta ölçekli bir şirketi baz alacak şekilde gerçekleştirilmiştir. Bankacılar ve yatırımcılar tarafından bakıldığında karlı bir yatırımdır ve birçok yatırımcıyı bu alana çekmektedir. Test sonuçlarına bağlı olarak NPV ve IRR 10,431,069, 42.4%'dur. Bu sonuçlarda böyle bir yatırımın hem yurtiçindeki hemde yabancı yatırımcılar için karlı bir yatırım olduğunu göstermektedir. Fakat, arastırma aynı zamanda sürekli değişen çelik fiyatlarına bağlı olarak da yatirimin riskli olduğunu ortaya koymaktadir.

Anahtar Kelimer: Çelik Çubuk, Sünger Çelik, Yatırım Değerlendirmesi, Hassaslık Analizi, Risk Analizi

To All of My Dears

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I would like to thank Assoc. Prof. Dr. M. Besim for his continuous support and guidance in the preparation of this study. Without his invaluable supervision, all my efforts could have been short-sighted.

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I owe quit a lot to my wife and my family who suffer difficulties that is resulted from my travel all the way from Iran to Cyprus and supported me all throughout my studies. I would like to dedicate this study to them as an indication of their significance in this study as well as in my life.

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LIST OF ABBREVIATIONS

ADSCR .....Debt Service Coverage Ratio

DR .....Discount Rate

CF..... Cash Flow

IR ..... Iran Rial

IRR..... Internal Rate of Return

Mt ..... Million ton

NCF.....Net Cash Flow

NPV .....Net Present Value

LLCR ..... Loan Life Coverage Ratio

WSA..... World Steel Association

Chapter 1

INTRODUCTION

1.1 Background

Steel is one of the modern structural materials in the present world. This metal has higher resistant to other commonly used materials. Today, more than twenty billion tons of steel used to form various products. The steel can be recycled indefinitely and enable new products seen over the life of the products, even without loss of strength, ductility, or provides any performance.

Since steel can be recycled without any restrictions, its environmental impact is minimized. Strength of Steel provides the opportunity for buildings designers to use less material in construction.

Steel also has a necessary role in energy production and energy transfer. These metals are used in Construction of offshore oil platforms and concrete.

Nowadays, regarding the relatively economic growth of developing countries need for steel production have increased considerably. On the other hand, developed countries do not like to invest in such industries because of many reasons. These reasons are listed due to their less willingness to expenditure in this field, governmental complicated regulations for environment, high cost of labor and tax. Since, they believe that this sector is overwork and energy consuming comparing high technological productions. Therefore, countries which have easy access to raw material, energy, labor, low wage,

good infrastructure and strategic situation are suitable place for producing in such industries.

Iran as one of the big consumer of such products in one hand, and having above-mentioned advantages on the other hand can be a good place for execution such plans for Steel (Billet) and Sponge Iron factories. In addition to domestic market, the country faces with high demand of many Gulf and Middle East countries such as UAE, Qatar, Iraq, Afghanistan and etc. Investment in such industry would be profitable for investors. It is quotable that even global crisis in the world, Iran has grown 12% in this industry while in countries like U.S shrunk 48% and EU with negative growth of 16% is the evidence of this claim.

1.2 Aim of Study

As Iran has God-given relative advantage in this product, this paper's aim is do a feasibility study on building a steel and sponge iron factories (raw material for steel). The research will look into to examining the financial viability of such investment. The study will test the impact of establishing such factories in macroeconomics and investor point of view. In fact, the paper will evaluate investor(s)' profitability and macroeconomic; therefore the thesis aims financial investment appraisal.

In addition this study aims to test the riskiness of the project for resistance against fluctuations of costs & revenues.

1.3 Data and Study Approach

1.3.1 Data Source

The required data for this thesis and the needed information has been taken from the world steel association (WSA) and Tadbir Sanat Iranian Consultancy.

In this study, data has been compiled from different sources including research article, books, net.

1.3.2 Study Approach

To perform Feasibility study of the projects, integrated financial appraisal analysis is a validate approach to indicate whether undertaking of the project would be profitable or not.

To determine NPV, financial analysis should be done. Calculation of sensitivity analysis is the second step to identity the risky variables. Third step is simulation of Monte Carlo that risky variables of the project are the inputs of Crystal Ball software to provide logical decision based on amount of riskiness of the project and which demonstrate resistance degree of the project facing change of risky variables.

Chapter 2

STEEL SECTOR

2.1 Steel Sector in the World

According reports of *Iron & Steel World Association* at the peak of the world economic crisis, year 2009, product of steel in the world experienced decrease of 16.3%, which for example The USA, EU & Russia respectively with decrease 47.2, 39.5 and 26.7 percent or even Japan and South Korea with decline 34 and 13.8 %, respectively stand in head of table.

In the meantime just China and India through 10 major producer steel had positive growth. But after that they could in addition compensated this collapse, reach to positive growth. Iran during this time consistently has had double-figure positive growth (about 12%), which is indicative potentials & investments in Iran. World crude steel production reached 1,527 megaton (Mt) for the year of 2011. This is an increase of 6.8% compared to 2010 and is a record for global crude steel production.

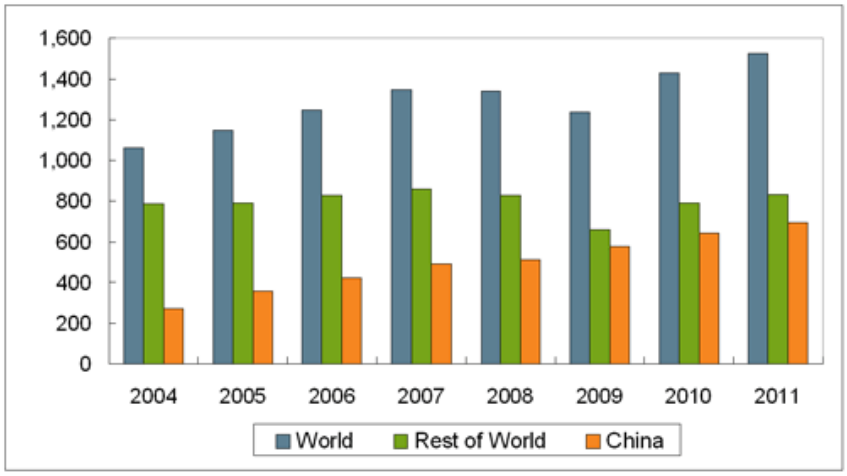

Figure 1: Annual Crude Steel Production (Mt) - *Source: World Steel Association (28.6.2012)*

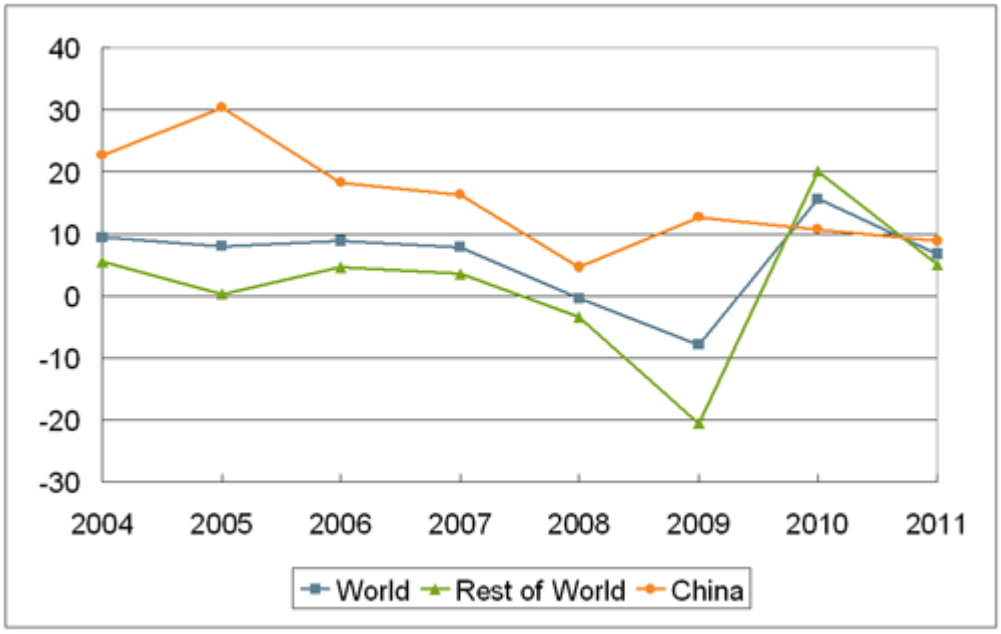

Figure 2: Crude Steel Production Annual Growth Trend (%)-*Source: WSA (28.6.2012)*

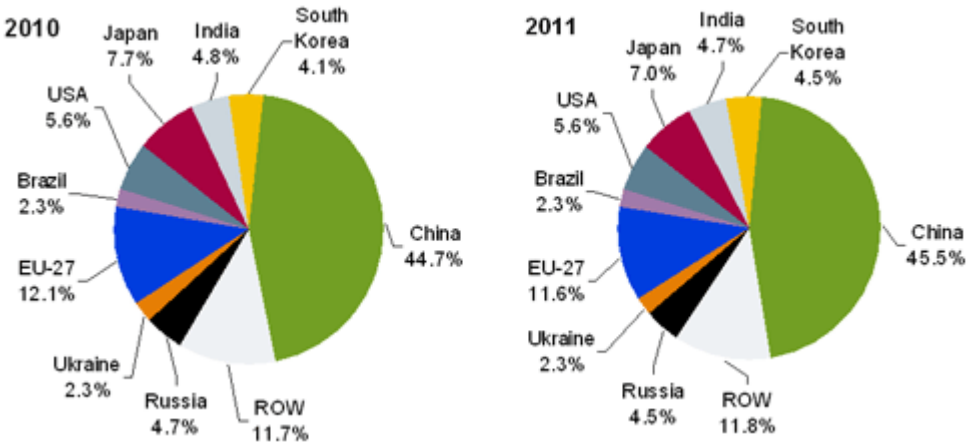

Figure 3: Share of world crude steel production 2011, 2010 - *Source: WSA (28.6.2012)*

Table 1: Ten Top steel-producing growths

Rank	Country	2011	2010	%2011/2010
1	China	695.5	638.7	8.9
2	Japan	107.6	109.6	-1.8
3	United States	86.2	80.5	7.1
4	India	72.2	68.3	5.7
5	Russia	68.7	66.9	2.7
6	South Korea	68.5	58.9	16.2
7	Germany	44.3	43.8	1.0
8	Ukraine	35.3	33.4	5.7
9	Brazil	35.2	32.9	6.8
10	Turkey	34.1	29.1	17.0

Source: World Steel Association (28.6.2012)

Notes:

- One of the largest and most dynamic industry associations in the world is *World Steel Association* (worldsteel). worldsteel represents approximately 170 steel producers (including 17 out of the world's 20 largest steel companies), national and regional steel industry associations, and steel research institutes. worldsteel members produce around 85% of the world's steel. (Source: WSA).

2.2 Steel Sector in the Iran

In Iran first steel factory was built in 1969 by Union of Soviet Socialist Republics (USSR) but with several times price, because before that time Iran had 6 unsuccessful try from year 1887, which was being faced with obstruction of the USA and UK, that even once the sheep carrier factory equipment which had been bought from Germany was sunk by UK.

Coming of this steel factory is one milestone in Iran for entry of new industry. After that, especially after Islamic revolution, has been built a lot of steel factory with various technologies in Iran.

Due to the increase of steel consumption in world, the consumption of Iran has increased in the past years. Consumption per capita over the past two decades, has reached 350 kg from about 170 kg.

Tadbir Sanat Consultant Co. who works in preparation of feasibility study for manifold business in Iran has done one feasibility study for a big holding company in Iran, the study consider a Discount rate of 25% and found that IRR can be as much 36%. (Tadbir Sanat Co, 2011).

The other research has been done in 1997 in Tehran University by Hossein Sadeghi which was published in the leading economic journal of Economic Research in Iran. According to this research, the steel industry is not a very attractive project for private sector. The same paper argues such project with macro view. The results show that a macro view, it can be considered as a major part after oil and petrochemical productions. Since the industry is managed by government, the productivity and efficiency in this sector is low regarding the high cost of operations.

However, today considering the execution of privatization plans in heavy and fundamental industry in Iran in recent years, and authorizing the private sector to enter in such fields, the role of governmental management has decreased remarkably.

To find out of importance of this sector, it should be noted that about 45 percent of the rail industry's freight revenue is from transporting steel products and its raw materials. (Ministry of road and instructor of Iran, 2010)

At present Iran by production of 13mt (WSA, 2011) is the biggest producer of Crude steel in Middle East in 2011 (in report of WSA, Turkey with 34mt is considered as a European country) and with near 5mt import, is a big importer in the world (Statistical Yearbook of Iran Customs, 2011).

Table 2: Three biggest steel (Slabs + Bloom + Billet) producers in the Middle East

Year / Region	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Iran	6,916	7,321	7,869	8,682	9,404	9,789	10,051	9,964	10,908	11,995	13,04
Saudi	3,413	3,570	3,944	3,902	4,186	3,974	4,644	4,667	4,690	5,015	5,275
Qatar	891	1,027	1,055	1,089	1,057	1,003	1,147	1,406	1,448	1,970	2,01
Middle East	**11,690**	**12,492**	**13,443**	**14,253**	**15,257**	**15,376**	**16,452**	**16,646**	**17,656**	**19,590**	**20,325**

Source: World Steel Association (28.6.2012)

According steel industry strategy of Iran for access 2% global export in year 2020 (about 10.5mt), construction of new factories or expansion of existent plants seem are necessary.

2.2.1 Supply

Because of the importance of supply and demand in each phase we consider separately,

2.2.1.1 Domestic Production

- **Sponge Iron**

As previously described, the main feed of EAF is *Sponge Iron*, therefore, from that time which this way of steel production in Iran has been popularized; supply of *Sponge Iron* has been favored. The main producers in the current conditions are in the below table.

Table 3: Main producers of *Sponge Iron* in Iran in 2011
Source: www.imidro.org (28.6.2012)

No	Plant	Nominal Capacity (Mt)	Performance (Mt)
1	Mobarake Steel	7	3.96
2	Khuzestan Steel	5.5	2.46
3	Esfahan Iron melting	0.25	0.19
4	Hormozgan Steel	1.6	1.1
5	Khorasan Steel	0.8	0.64
6	Ghadir Iranian Steel	0.8	0.6
7	Other	0.4	0.4
Total		16.35	9.35

According to statistics produced by the WSA Iran reached to more than 9.3mt (at the end of 2010), placed in second place after India (20,650mt) while was ranked third in the world after Venezuela in 2008.

Figure 4: Sponge Iron production

The following figure shows *sponge iron* production of Iran since 2000.

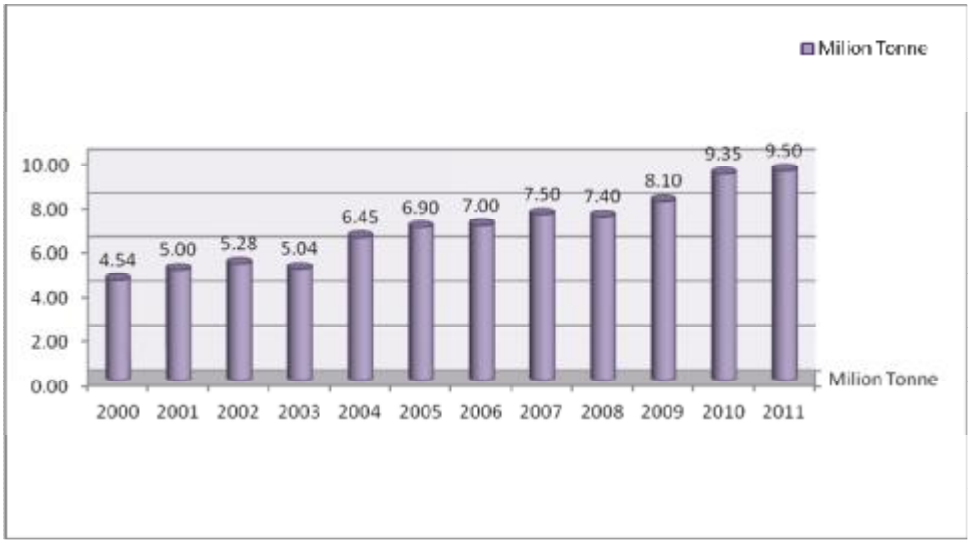

Figure 5: *Sponge iron* production in recent decade of Iran (2000-2011)
Source: www.imidro.org (28.6.2012)

- **Steel (Billet)**

In figure 6 Steel productions (Slabs + Bloom + Billet) in Iran from 2000 to 2011 has been shown.

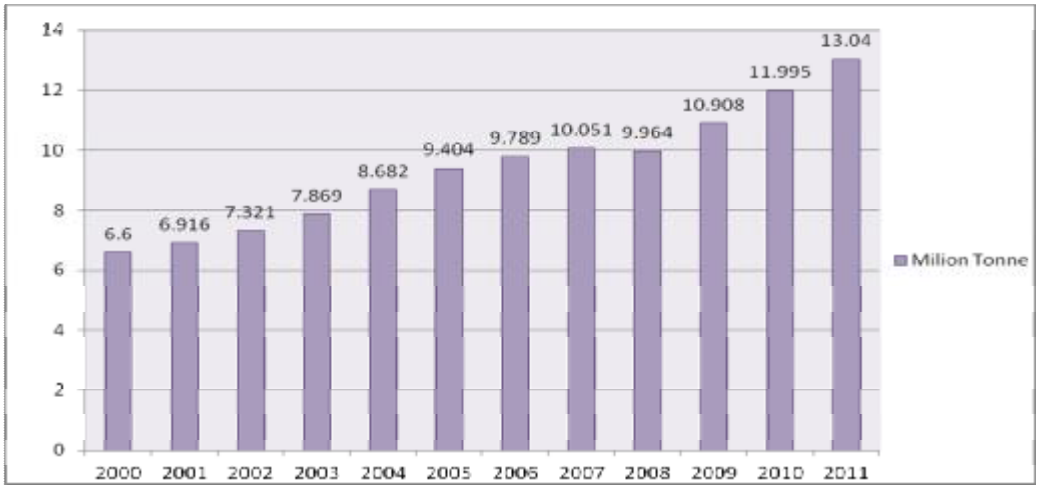

Figure 6: Billet production in Iran from 2000 to 2011

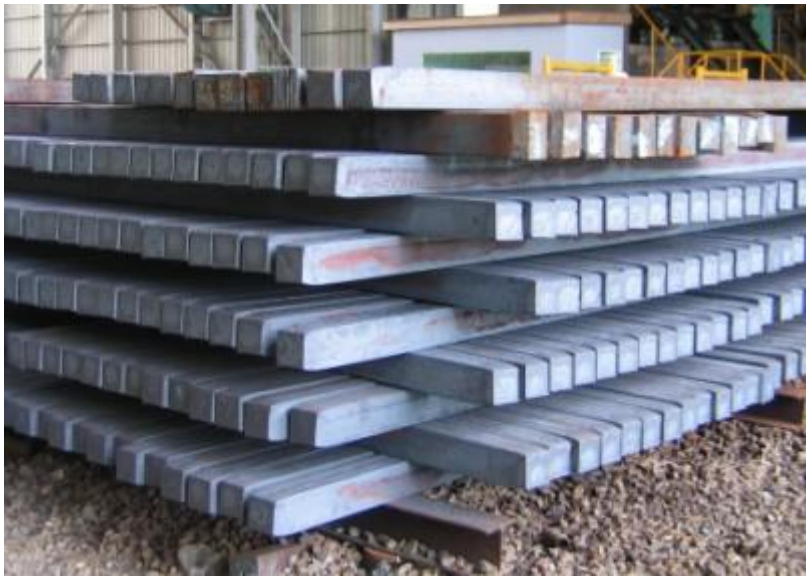

Figure 7: Billet production

2.2.1.2 Import

Sponge Iron: According to annual statistical report of Iran Customs, import of Sponge Iron is as follows:

Table 4: Volume of imported Sponge Iron in Iran from 2006 to 2011

Year	2006	2007	2008	2009	2010	2011
Volume	0.09mt	0.15mt	0.21mt	0.08mt	0.002mt	0.005mt

Source: Annual statistical report of Iran Customs

It can be clearly seen that import of this product because of self-sufficiency of domestic production is near zero. Amount of import decreased from 0.09 in 2006 to 0.005 in 2011 which demonstrate Iran reach to self efficiency in production of Sponge Iron.

Steel (Billet): According to Annual Statistical Report of Iran Customs, import of Sponge Iron is as follows:

Table 5: Volume of imported Billet in Iran from 2006 to 2011

Year	2006	2007	2008	2009	2010	2011
Volume	2.8mt	4.1mt	3.8mt	4.4mt	5mt	5.2 mt

Source: Annual statistical report of Iran Customs

Iran is big importer of crude steel (Billet) for rolling industry and this trend has been increased. It means growth of demand is more than production.

2.2.1.3 Inventory

Because of amount of inventory of Billet and Sponge Iron would not effective in supply sector in long term, the calculation of inventory in the analysis can be considered zero.

2.2.2 Demand

2.2.2.1 Domestic Demand

- **Sponge Iron**

As already mentioned main feed of EAF is the *Sponge Iron*. Therefore, there is requested to consider steel producers that are using this method in Iran.

Table 6: Units of steel production (electric arc furnace method)

No	**Company Name**	Performance of 2011(million ton)
1	Mobarake Steel	5.2
2	Khuzestan Steel	3.024
3	Boyer Sanaat	0.12
4	Iran Steel Group	1.13
5	Vian(Hamedan)	0.55
6	Other	1.25
Total		**11.06mt**

Source: Statistics and Information, Ministry of Industries and Mines

With total product of 11.06mt of steel, with the following assumptions, is calculated request *Sponge Iron*.

- Sponge iron consumed per ton is 1. 08 ton

- 25% of the volume of EAF is *Scrap*

1) × 11.06- 0. 25) = 8.295mt + 1/08 = 8.958 ≈ 9mt Use of sponge iron in 2011

Note: The number of sponge iron production is almost near 9.35 Mt in 2011 (Table 3)

- **Billet**

To find value of consumption of each product, following relation is practical:

(Domestic production + imports) - (Inventory + exports) = apparent consumption

(13.04 + 5.2) – (0 + 1.16) = 17.08

It is important to note that the main consumers of bullion are producers of Steel Sections. (Including of construction and industrial section), therefore if we want to estimate Billet intake, should consider total Producers capacity of steel sections. Total production capacities of steel sections are under below ISIC (International Standard Industrial Classification) code, which is allocated especial cod for each production.

Table 7: ISIC code of products (Billet is raw material of them)

Products	**ISIC code**
Angle steel	27101221
Angle iron	27101222
Steel Belt	27101223
Iron Belt	27101224
Shield	27101225
Channel	27101226
Bars and Rods	27101230-5

According to available statistics, the total nominal capacity of steel plants are over 140 industrial units (in appendix), near 19mt that if these units are operating with efficiency about 65% of its nominal capacity, 12.3mt will be produced. Because of Consumption ratio we need 12.3mt Billet which more than current production (7.1mt). This deficit will be offset by imports (according of the imports tables 5) If the current active plants want to reach their true capacity, they need raw materials (Billet) a lot.

If the actual consumption of ***steel sections*** to the raw materials needed (Billet), we should obtain their actual production. However, due to they are private units is not possible to obtain accurate statistics.

2.2.2.2 Foreign Demand (Exports)

- **Sponge Iron**

Table 8: The amount of *Sponge Iron* exports from 2007 until 2011 (million tone)

Year	2007	2008	2009	2010	2011
Volume	0.000064	0.000002	0.000055	0.0000025	0.000003

Source: Annual statistical report of Iran Customs

As you see, as a result of high domestic demand for ***Sponge Iron***, amount of export is near zero. Because of high demand of Sponge Iron for Electric Arc Furner who is producing Billet, almost entire domestic production of Sponge Iron are using in internal market of Iran

- **Billet**

Table9: The amount of ***Billet*** exports from 2007 until 2011

Year	2007	2008	2009	2010	2011
Volume	0.2mt	0.35mt	0.1mt	2.5mt	1.16mt

Source: Annual statistical report of Iran Customs

As you see, because of high domestic demand for ***Billet***, amount of export is very little. Then, staple amount of internal demand should be addressed by import of this production.

2.2.3 Supply Prediction

2.2.3.1 Domestic

- **Sponge Iron**

Iran's goal regarding **steel** production is to reach 25mt in 2013. Hence, development of project of *sponge iron* is highly regarded. At the following Table, *sponge iron* production projects begin construction and the their progress is more than 50%,

Table 10: *Sponge iron* production plan with physical progresses over 50%

No	**Company Name**	Capacity(million ton)	Development Rate
1	Production & Expansion metal Int.	0.8	80%
2	Khorasan Steel	0.8	95%
3	South Karoon	0.1	54%
4	South Iron melting	0.6	50%
5	Arfa Steel	0.8	73%
6	Ardakan Sponge Iron	0.2	73%
Total		3.3	-

Source: Ministry of Industries & Mines website

Is predicted if all the plans, timely financing, and reach to 60% their nominal capacity at the end of 2013, excess 11mt including the current production capacity, According to the following equation

Current demand + predicted growth = expected total domestic supply:

9.35+3.3(60%) =11.3mt

- **Billet**

At present 41 plans exist with capacity of over 50% with nominal capacity of 8.325mt that will be operated entirely by the end of 2013. (Source: Ministry of Industries & Mines website).

In overall if the units with development of over 50% be financed, and can reach 60% of its nominal capacity to produce, can be predicted, the end of 2013 the country's total steel production capacity of steel around 12.1mt. According to the following equation:

Active + project development and execution units = Domestic supply prediction in 2013

7.1+8.325(60%) =7.1+ 5=12.1mt

2.2.4 Demand Prediction

2.2.4.1 Domestic

- **Sponge Iron**

As growth rate of *Billet* production capacity is predicted be 5mt in 2013 (last page)

Sponge Iron is related to feedstock *Billet* under the assumptions of 25% *scrap iron* and factor of 1.08 to the consumption of *sponge iron.*

1) × 5- 1/08 × (0.25 ≈4 mt

Current + prediction = 9 + 4 =13 mt

Total demand in end of 2013 as noted in the internal supply facilities at the end of 2013 (11.3mt) that is lower than the forecast demand of *sponge iron*.

13 - 11.3 = 1.7

This shortage can be covered with imports like previous years.

- **Billet**

According to statistics published by the *Statistics and Information of Ministry of Industries and Mines*, 82 Steel Sections Producer (Billet consumers) with over 50% of physical progress and nominal capacity of 6.434mt has been constructing. If these plants would be able to complete at the end of 2013, in this section, add production capacity is of 4mt (it to be assumption with 60% of its nominal capacity), therefore, provide raw materials (Billet) for them is necessary.

Current demand + growth predicted = expected total domestic demand

12/3 +4 =16/3 domestic demand forecasting future and as noted in the internal supply facilities to the domestic supply of steel in 2013 will be 11.3mt.

16.3-11.3=5 shortage

This shortage can be covered with imports like previous years.

2.2.4.2 Foreign (exports)

- **Sponge Iron**

According to implemented EAF method steel production in the country and the lack *Sponge Iron* production plans on time due to lack of project financing, the export of this product at least until the year2014 is not possible. Under this condition, prediction of exported Sponge Iron is zero.

- **Billet**

According to steel industry strategy of Iran for access 2% global export in year 2020 (about 10.5mt), construction of new factories or expansion of existent plants seem are necessary, this means that about 4mt should have to be exported in 2014. Considering

defeat in establishing new firms and growth of demand of internal market, export of Billet would not possible.

All of all, high consumption of Billet for rolling industries of Iran is known as important consumer as well as net import by 4.04Mt (5.2 -1.16 = 4.04). This shortage (import) would be compensated by internal production or establishing of new plants; even considering relative performance of Iran and supporting by government, there is potential of export to external market.

Chapter 3

PROJECT DATA AND METHODOLOGY

3.1 Project Description

The third chapter is allocated to description of details of the project including input data and method that was used for project appraisal.

This project includes 2 phase as follows:

- First phase: 1.86 million tons of Sponge iron (nominal capacity)
- Second phase: 1.2 million tons of Billets (Ingot) (nominal capacity)

Both of them are expected to be launched after 5 year from start of the project (2013). If both work at full capacity, 70% of Sponge iron will be used to the second phase as well as selling rest.

Sponge iron as an intermediate product, as it feeds to the second phase of the project

In order to familiarize with each of the above items, we separately introduce each of the above products and their features.

3.1.1 First Phase: Sponge Iron

The sponge iron is known with ISIC No. 27101410 in and duty 4% for import (Iran).

Investigation of sponge iron role in the steel industry is necessary to mention methods used to produce steel.

1. Based on current crude steel production is performed in three ways
2. Blast Furnace (oxygen converter)

3.Open Heart

4.Electric Arc Furnace method (EAF)

For feeding Open Heart and Blast Furnace methods generally is used Fine and Lump (Form of iron ore), But in the EAF for steel production are used sponge iron (plus Iron Scrap). Each of these methods has their advantages and disadvantages which in this section are not possible, but as the production of crude steel, from method of blast furnace is changed to EAF, because of:

1.Shortage and expensive price of scrap

2.Lower energy consumption

3.Lower investment cost for production of crude steel

4.Flexibility for product of diverse type of steel

5.Utilization of Gas as source of energy instead of Coal fuels, especially for countries who rich in gas sources like Iran.

This project using EAF method, therefore the main feedstock is sponge iron which we initially discussed (as feedstock of Phase II for production of Billet); the image below is shown Product of Sponge Iron by MIDREX (direct reduction) method.

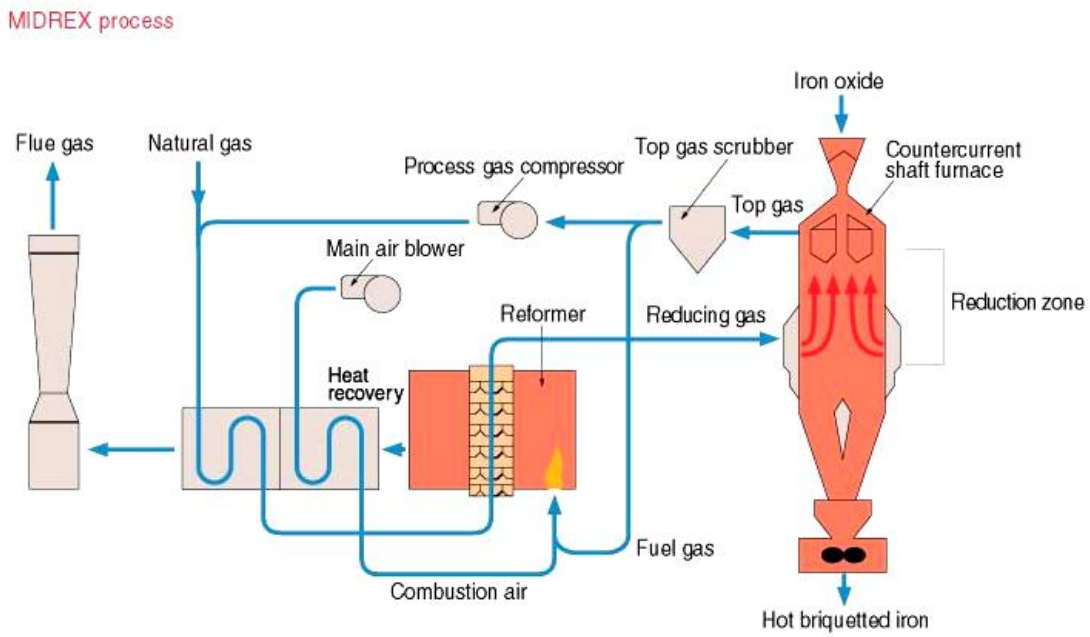

Figure8: Production procedure of Sponge Iron Source: www.jfe-21st-cf.or.jp (28.6.2012)

In Iran about 80% of crude steel produce by EAF and blast furnace method is 20%. Considering the need to increase crude steel in 2014 (up to 35mt), design and development of new sponge iron capacity to reach 20mt in the year 2014 is favored. Currently India with 15mt and Iran with 8mt respectively are in the first and second producers of Sponge Iron.

3.1.2 Phase II: Billet (Ingot)

In fact the main product of this project is the billet or ingot steel, which is in the second phase with an annual capacity of 1.2mt.

ISIC No of Steel billet Product is 27101121 and customs tariff is 4% (Iran). Ingot (billet) is a semi-finished product in the process of steel, which in later stages as feed are used for Factories producing steel sections.

Specification of product:

1-Product	Steel ingot (billet)
2- Billet size	× 130 130 – 150 × 150 and 180 × 180 mm
3- Length	6 to 12 m
4- Quality	Steel construction - carbon and alloy
5- Middle product	Sponge iron
6- Melting technology	Arc furnace (high power)
7- Metal melting furnace charging,	Scrap iron, sponge iron+ Down Alloys
8- Refining molten process	Melt furnace
9- Casting process	Continuous casting machine

Billet is main feed for all Production of steel sections and structural consumption such as Facing, channel, angle bars, round mill.

Therefore main consumers of billet are rolling and steel sections producers. This product is considered as an intermediate product, and in as much as all products of this firm is used for production of steel longitudinal sections. Consumption ratio is one to one (does not have waste)

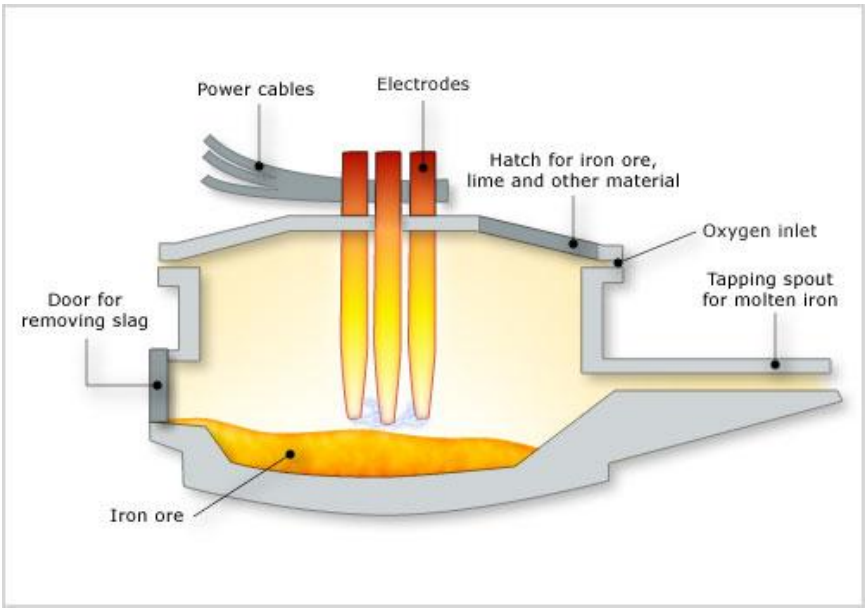

Figure 9: Electric arc Furner for Billet production *Source: www.teara.govt.nz (28.6.2012)*

3.2 Project Technology

For produce of sponge iron by direct reduction plant will be designed Midrex process and the license cost has been accounted.

Fortunately, in the *steel* sector and other parts of the factory, technical knowledge required is in the country and no payment for the license and the like, haven't been predicted.

3.3 Price and source of raw materials

The following table refers to changes in the world prices in the 2011

Table 11: Global Price of raw material in 2011 ($ /ton)

No	Month	Ironston	Gas m^3	Scrap
1	Jan	$104	$273	$345-335
2	Feb	$101	273	420-415
3	Mar	$101	273	440-435
4	April	107	300	420-415
5	May	107	283	320-325
6	Jun	105	290	320-325
7	July	102	305	355-350
8	Agust	96	308	400-395
9	Sep	102	305	385-380
10	Nov	104	311	395-390
11	Oct	105	313	405-400
12	Dec	123	314	405-400

It should be noted, since natural gas prices in Iran are not floating and a fixed price for each year of the succeeding, this analysis may not be very useful, but since the government wants to real and float the price of natural gas, may be used in future years. Now price per cubic meter of natural gas in Iran is 700 Rial.

Table12: Source and price of raw material to produce Billet in Iran

No	Martial	Source	Amount	Price
1	Sponge Iron	domestic	1.09	3500000R
2	Scrap Iron	import	0.0735	3638000R
3	Domestic Scrap	returnee	0.04	3393000R

Table13: Source and price of raw material to produce Sponge Iron in Iran

No	Material	Source	Amount	Price
1	Iron Oxide	domestic	1.45	1650000
2	Gas	domestic	-	700

3.4 Sales price

Metal prices in 2009 reached its lowest, but in 2010 were Took in the ascending again. Also will continue in 2011

Non-Declining demand in 2010 was owed economic growth in China that increase double-digit growth in demand for industrial metals.

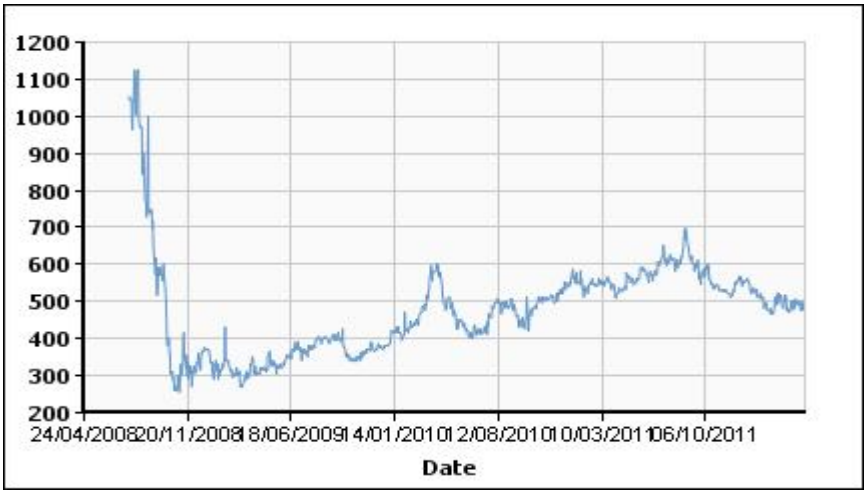

Figure 10: Billet Prices Graph from 2008 to2012
Source: London Metal Exchange & World steelprices.com

Figure11: Sponge Iron Prices Graph from March 2011to March 2012
Source: http://www.thehindubusinessline.com (28.6.2012)

3.4.1 Sales and Marketing Programs Aimed

For Billet product for the domestic market to 70% and 30 % is targeted for overseas markets, which in terms of market condition is changeable. Ranges of countries to foreign markets are Persian Gulf, India and South East Asia, but because of metals price is global, in our study we do not difference between domestic and foreign sale.

Table 15: *Sponge Iron* Forecast selling Program (Million ton)

Sponge Iron	2018-2052
Degree utilization	80%
Market sales	0.44
Phase II delivery	1.05
Total	1.5

Sponge Iron factory on schedule to be operational and is ready to sell their products in the 2017, and this product according the domestic market and Persian Gulf country

request, has feasibility sale, but as mentioned earlier in this project selling of surplus *Sponge iron* is not base of decision making and is one revenue side. In the following table Program of production, sales and market share in domestic and market is shown until 2052(35 year), however, in practice useful life of the plant is probably reach to 50 years.

Table 16: *Billet* Forecast selling Program (Million ton)

Billet	2018-2052
practical capacity	80%
Total production	0.96

3.5 Project Site Selection

3.5.1 Analysis Related to Access to the Raw Materials

Sponge iron as a domestic product of factory with using raw material *Iron ore pellet* will be produce which mainly will be provided from Gol Gohar *Iron ore pellet* in Located 55 km south West of the Sirjan city. Asphalt road connecting this region and *Bafgh - Bandar Abbas* two-band railway pass through from 8 km Gol Gohar which is connected by a split way. To the Located in proximity to the regional markets (such as Bahrain, Oman), supply of imported pellets is possible.

The sponge iron with Purchased *scrap metal* as a charge will be taken in EAF. Moreover, and surplus amount of *sponge iron* (97mt) will sales. *Down alloys* also be part of the metal charge, especially in the production of special alloy steels is desired.

Construction of two factories for production of *sponge iron* by *direct reduction* of annual capacity of 930 tons each predicted which has 94% purity.

Due to the high consumption of oxygen and nitrogen gas continuously, install oxygen (7000 cubic meters per hour) and nitrogen factory to provide domestic needs is essential.

Factories in special economic zone in the mining industry will be near Bandar Abbas and the legal benefits such as exemption from duties and income tax.

3.5.2 Analyzes Related to Consumption Market Access

Terminal loading and unloading facilities at Bandar Abbas, the largest facilities of in the Middle East in terms of capacity and is ranked eighth in the world.

And also adjacent to railways and roads provide facility to the internal distribution of products in different regions of the country,

Proximity to high seas provides exports to India, South East Asia and other regions of the world.

3.5.3 Other Factors Site Selection Project (including water supply, electricity, roads, communication and environmental issues)

Due to water shortage in the project region, install of a fresh water machine with capacity of 700 cubic meters is necessary

New natural gas transmission line from the "Sorkhun", the project is connected to the gas network, and because of the high consumption of natural gas in the *direct reduction* unit (*Sponge Iron*) will be construct gas decompression station with capacity of 42000 cubic meters per hour.

Electricity transmission line from the Hormozgan station to the *special economic zone* is as source of electricity energy, and considering the high consumption of electricity, will be established a specific electricity post with capacity of 245 MW.

3.6 Environment

Electric arc furnace (EAF) compared with Blast Furnace is cleaner, because of using natural gas instead of coke.

Because of steel recyclable potential and high durability possesses, it is very compatible with environment. Amount of energy to produce steel is lower than other materials. As a result of lightweight of steel productions such as car, contribute saving energy and other source of energy. In the last decades, steel industry has made effective efforts to decrease pollution. Energy consumption and carbon dioxide emissions have decreased to half of what they were in the 1960s. Dust emissions have been reduced by even more. (Source: World Steel Association)

-Recycle of Steel

As above mention, one the advantages of steel is recyclability from waste stream, which is result of unique magnetic properties of steel. It does not matter how many times steel is recycled, because its properties remain unchanged through electric arc furnace (EAF) method.

3.7 Total investment costs of projects

The components of the project are:
Land, Civil works (Landscaping & buildings), Machinery and equipment, Facility, Costs of pre-operation (Studies, Consultative, Appraisals).

Table 17: Investment Cost (Million Rial)

Year	0	1	2	3	4	5	Total
Land	300,609						300,609
Site Landscaping		9,322	77,800	113,040	80,000	120,000	400,162
Civil works & buildings		76,412	305,648	92,680	146,467	0	621,207
machinery & equipment		0	3,424,580	1,531,600	3,140,000	1,922,712	10,018,892
Auxiliary					536,508	220,200	756,708
Lab						184,104	184,104
Facility		233,000	168,000	540,000	1,800,000	800,000	3,541,000
Total(Nominal)	300,609	318,734	3,976,028	2,277,320	5,702,975	3,247,016	**15,822,682**

Source: Tadbir Sanat Co.

3.8 Operating and Maintenance Costs

Operating and maintenance costs are for 100 % of degree of utilization:

Table 18: Operating & Maintenance Costs (in 100% degree utilization) (Million Rial)

Raw materials(million Rial)	Cost	Year (0) ‘s Price
Sponge Iron	641,700	per year
Steel	5,415,120	per year
Labor Cost	105,980	per year
Facility Costs	2,478,700	per year
Maintenance	959,779	per year
Other costs	5%	above costs
Total	10,081,343	per year
Increase in real labor cost	0%	-
Oxide Iron	0.23	per ton

Source: Tadbir Sanat Co.

Operating and maintenance costs divide to fix and variable:

Table 19: Fixed and variable operating costs

Operating Costs	Fixed	Variable
Raw Material	0%	100%
Labor Casts	70%	30%
Facility Costs	20%	80%
Maintenance	20%	80%

3.8.1 Labor Cost

All the salaries declared bellow are in 0 year prices, and Include insurance and social security.

Table 20: Salaries declared in 0 year prices, and Include insurance and social security

Position	No. of Employees	Annual Salary
Managers	2	1,560
Production managers	8	3,900
Engineers & Technicians	40	15,600
Official employee	44	11,050
Skilled workers	94	20,800
Unskilled workers	375	45,500
% increase in real price	0%	-
Total(×1.3)	-	**98,410**

Source: Tadbir Sanat Co.

3.8.2Facility

Table 21: Facility Costs

1	Electricity	1064218
2	Water	619850
3	Gas	32050
4	Telecommunications	54382
Total		2,478,700

3.8.3Maintenance and Miscellaneous Cost

Table 22: Maintenance and Miscellaneous Cost

	Description	% of maintenance	Total
1	Civil works	2	589689
2	Machinery	2	240265
3	Facility	8	298296
4	Lab & workshop equipment	10	12887
Total		-	959,779

3.9 Project Financing

With respect of high inflation in Iran, especially after Revolution (1979), Iran has had average inflation at 25% (source: www.majles.com), therefore Interest Rate in Iran is very high, and time spam of loans are considered maximum 5 year.

For derive of loan in Iran, applicant should has 25% of investment cost of project, and must mortgage whole of project to repay of loan. When all is said and done achieve to a lean with suitable terms is not easy and needs to robust connections.

Because of special condition of Iran we cannot rely foreign loan and in the other hand, low percent of imported commodities in this industry (about 4%), our currency is only Rial and will not be converted to Dollar or Euro. Everything is nominal

- The total investment cost is 15,822,682million Rial; where 25% is portion of investor(s) and the rest is debt (75%).
- The payment of principal and interest accrued will start in terms of date of loan, initial loans repay in first and second years after start of project and rest loans refund after first or second year of start up. These loans will achieve from various sources such as banks, financial institute, and etc, but for simplification we account 4 loans in 4 separate years.
- By the end of year 12 (7 years after start of the project) the project is expected to pay its debt in full.
- The Opportunity Cost by investor on its share is equals Discount Rate (30%).

3.9 Selling of the Products

Metals market such as Gold, Iron and etc in Iran and most of countries, supply in Metals Exchanges and is cash transaction, although it includes the discount rate on credit sales, which is with more or less fluctuation. For simplification we assume that all of sales are cash and prices will increase with inflation, which from long term point of view is not unrealistic. Therefore we will not have any Accounts receivable, and because of high

inflation, credit purchases (Accounts payable) include discount rate, therefore leave it aside.

3.10 Methodology

In great projects detailed feasibility study is needed. Because amount of investment is huge and investors should be assure about the project financial viability. Effective variables of the project are analyzed and data is arranged in the so called “building block” which constitutes the foundation of different types of analysis. Financial and risk analysis was conducted.

3.11 Financial Analysis

Financial sustainability of the project is determined by Financial Analysis. According to Jenkins’s research in 2004; by identifying any financial deficits that are likely to occur during the investment and operating steps of the project, and thus by devising the essential means for meeting these deficits. Excel software is used for financial analysis. Important variables are selected to construct the parameters table as presented in tables of appendix.

There are two perspectives about cash flow statement that will follow the analysis

1. Banker perspective to examine incomes and costs to assure if the NCF is sufficient to cover principal and interest.
2. Investor(s) perspective, who are holder of whole of project, because if they cannot handle project costs and revenues they will be unsuccessful and will lose their capital and are responsible to bank(s).

The Net Present Value (NPV) is calculated as well as IRR. Based on calculation, if generates IRR and NPV higher than discount rate and zero, respectively, project is accepted.

3.12 Sensitivity Analysis

"What if" or Sensitivity analysis follows the project financial appraisal. As mentioned selection and test of the parameters is performed by excel, which are significant to the project outcome thus the variables that have a negative impact on NPV and IRR. Still, this approach is taking in consideration a change of only one variable, while taking all the other variables constant and cannot calculate the change of some variable at the same time. And any possible correlation between several risky variables is ignored during the process of analysis. Through Mont Carlo simulation, risky analysis is computed that recognizes all these facts.

3.13 Risk analysis

To determine risky variable analysis of risk is required. For this proposes sensitivity analysis is used. Once these variables are identified, and suitable probability distribution and likely range of values, according to either past data or to expert opinions, should be assigned to these risky variables. Monte Carlo simulation to generate a probability distribution of the project outcome is done by Using Crystal Ball. 10,000 trials conducting within this simulation to decrease the change of undertaking a fail project to accept a good one as well as going in profundity of risk source and help in deciding a convenient way of mitigating the likely risk of the project.

In the next chapter the study will used the data outlined and datelined in this chapter (chapter three). The data analysis and feasibility study of the study will be come out by using integrated investment appraisal followed by a risk analysis.

Chapter 4

FINANCIAL ANALISIS

Project viability is determined by contributing of financial appraisal. It means financial analysis help us to find out the success or failure of the project. As a result of this, investors are able to make decision based on information.

4.1 Parameter and Assumptions

- **Economic Life**

Economic life of this project is assumed 35 years

- **Capacity and the Degree of Utilization**

Capacity of the *Steel (Billet)* and *Sponge Iron* plant is 1.2 and 1.86 million ton and maximum degree of utilization is assumed to be 80%.

- **Program of Production**

Degree utilization of both of productions is 80% of nominal capacity.

- **Prices**

The fob prices in Persian Gulf for *Billet* and *Sponge Iron* these days are about $490 and $230 per ton, respectively. However, decrease of Dollar value and increase of product expenses, ought to we will have to increase the prices, but it be assumed their prices are fix and will increase just with domestic Iran inflation (24%). in other word, we assume that foreign inflation will not exist or domestic inflation is include foreign inflation.

- **Investment Cost**

Investment cost is calculated to be 15,822,682 million Rial and construction period is considered to take five years (from 2013 to 2017). The sources of funding will be provided by investor(s) (25%) and bank loan (75%). Opportunity cost and interest rate for investor share and bank loan is 30%, and repayment period of first and second loans are 2 first years of start of project and for 3rd and 4th loans are after a grace period of 1 and 2 year.

- **Operating Costs**

Based on analysis, annual operating cost in basic year is 10,081,343 (appendix table)

- **Working Capital**

As before mentioned in this study we do not have Accounts Receivable and Accounts Payable, but Cash Balance to be held stands at 1 month of operating costs.

- **Life of Assets and Residual Values**

The project has 15 year tax depreciation while its Economic life is 35 year, and residual value is zero, except land that its real value will be fixed.

- **Depreciation**

In this study depreciation is obtained by straight line method.

- **Inflation Rate**

The inflation rate used is the Iran inflation which is assigned to 24% and is assumed to be constant though out the project time, it should be noted that Iran average inflation during last 33 years (after Islamic Revolution) has been 24%, So it is assumed that it will be the same one the average for the project life.

- **Taxation**

In Iran, The corporate income tax rate is 25% on net annual income and is not paid for negative profit. We ignore VAT in cash flow, as until now Steel industry is exempt from VAT in Iran.

4.2 Financial Analysis Results

Tow important perspectives in implementation of the project are banker and owner point of view.

4.2.1 Banker Point of View

The NCF statement from point of view of the bank simply puts all the profits that create inflows into a project and all the costs that create outflows. The Real CF statement from this view is the NCF statement divided by the Price Index. The aim of the analysis is assessing the project capacity to service its debt. Two important ratios to determine capacity for debt repayment including:

1)Annual Dept Coverage Ratio (ADSCR)

ADSCR = Annual Real NCF /Annual Real Debt repayment

ADSCR starts from the beginning of the loan repayment until the last payment and it is year to year, and the project can to service its debt if it is more than one.

Table 23: ADSCR Financing Analysis

Year	NCF Before Financing (milling Rial)	Debt Repayment (million Rial)	**ADSCR**
6	3,927,848	5,222,317	0.75
7	8,855,551	13,632,728	0.65
8	9,096,825	8,016,507	1.13
9	10,873,968	8,016,507	1.36
10	13,077,626	8,016,507	1.63
11	15,810,161	8,016,507	1.97
12	18,328,011	2,892,876	6.34

As we can see ADSCR ratio is negative for year 6 (first start year), because the annual NCF generated is less than1.5 from 6^{th} to 9^{th} year (years of 1 to 4 of loan payback) and consequently not enough to serves its debt for these years and maybe it is not acceptable for financing by financial institution. Therefore we can use LLCR that it can make bridge financing among bad years (ADSCR less than 1.5) and good years.

2)Loan Life Coverage Ratio

LLCR = PV (Annual NCF) / PV (Annual Debt Repayment)

Table 24: LLCR result from Financing Analysis

Year	PV Net Cash Flow Before Financing (m Rial)	PV Debt Repayment (m Rial)	**LLCR**
6	33,706,114.11	29,666,584.76	1.14
7	38,711,745.59	31,777,548.4	1.22
8	38,813,052.65	23,588,266.58	1.65
9	38,631,095.39	20,243,286.82	1.91
10	36,084,265.05	15,894,813.12	2.27
11	29,908,631.08	10,241,797.32	2.92
12	45,424,522.14	2,892,876.774	15.70

As we can see in this way ability of project for debt repayment has improved especially for first year. In this method, future net cash flows of the project would be considered that are able to improve ratio of ADSCR in the first years. It means, there is a hopeful future for this project.

4.2.2 Owner's point of view

The investor(s) of the project is project owner(s), and receive NCF after paying all of the expenses.

Table 25: Cash flow statement: Owner's perspective

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2052	2053
	0	1	2	3	4	5	6	7	8	9	10	11	12	40	41
Price Index	1	1.24	1.54	1.91	2.36	2.93	3.64	4.51	5.59	6.93	8.59	10.66	13.21	5,455.91	6,765.33
Inflows															
Sale	0	0	0	0	0	0	37,426,081	46,408,340	57,546,341	71,357,463	88,483,255	109,719,236	136,051,852	56,170,933,768	0
Residual Value Of Assets															
Land															2033719583
Equipment															
Civil Works															
Change In A/R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Inflow	0	0	0	0	0	0	37,426,081	46,408,340	57,546,341	71,357,463	88,483,255	109,719,236	136,051,852	56,170,933,768	2,033,719,583
Total Inflow (Real)							10295424	10295424	10295424	10295424	10295424	10295424	10295424	10295424	300609
Outflow															
Investment Costs	300,609	318,734	3,976,028	2,277,320	5,702,975	3,247,016									
Equipment		233,000	3,592,580	2,071,600	5,476,508	3,127,016									
Building		85,734	383,448	205,720	226,467	120,000									
Land	300,609														
Operating Costs	0	0	0	0	0	0	30,339,512	37,620,995	46,650,034	57,846,042	71,729,092	88,944,074	110,290,652	45,535,057,254	0
Change In A/P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Change In C/B	0	0	0	0	0	0	2,578,859	618,926	767,468	951,661	1,180,059	1,463,273	1,814,459	749,125,135	-3,870,479,867
Income Tax	0	0	0	0	0	0	579,862	-687,132	1,032,014	1,685,793	2,496,478	3,501,728	5,618,730	2,658,969,129	0
Total Outflows	300,609	318,734	3,976,028	2,277,320	5,702,975	3,247,016	33,498,232	37,552,789	48,449,516	60,483,495	75,405,629	93,909,075	117,723,841	48,943,151,518	-3,870,479,867
Total Outflows (Real)	300,609	257,044	2,585,866	1,194,425	2,412,208	1,107,582	9,214,924	8,330,871	8,667,941	8,726,533	8,773,784	8,811,889	8,908,492	8,970,663	-572,105
NCF Before Financing	-300,609	-318,734	-3,976,028	-2,277,320	-5,702,975	-3,247,016	3,927,848	8,855,551	9,096,825	10,873,968	13,077,626	15,810,161	18,328,011	7,227,782,250	5,904,199,450
NCF Before Financing (Real)	-300,609	-257,044	-2,585,866	-1,194,425	-2,412,208	-1,107,582	1,080,500	1,964,553	1,627,483	1,568,891	1,521,640	1,483,535	1,386,932	1,324,761	872,714
Add Loan disbursement			850,000	2,130,000	5,680,000	3,207,011	2,528,293								
Less Loan Repayment							5,222,317	13,632,728	8,016,507	8,016,507	8,016,507	8,016,507	2,892,877		
NCF After Financing	-300,609	-318,734	-3,126,028	-147,320	-22,975	-40,005	1,233,824	-4,777,177	1,080,318	2,857,461	5,061,118	7,793,653	15,435,135	7,227,782,250	5,904,199,450
NCF After Financing (Real)	-300,609	-257,044	-2,033,057	-77,267	-9,718	-13,646	339,409	-1,059,789	193,276	412,273	588,884	731,312	1,168,020	1,324,761	872,714

NPV and IRR are best method for measuring profitability of projects. NPV is sum of all NCF in today price, and should be positive. IRR is output of project beside of Discount Rate and should be greater from that.

NPV = PV of Incomes - PV of Costs

In this project FNPV is 10,431,069 Million Rial and FIRR = 42.40%

4.3 Sensitivity Analysis

To identify to risky variables on net benefit of the project, sensitivity analysis is assessed. It is contribute in quantifying their influence extent, which compromises of testing the effects of variations after selecting the important project variables on IRR or NPV. Inflation, Billet price, change in Utilization Degree and Discount Rate are the variables tested.

- *Inflation*

The growth in inflation will have impact on NPV and IRR, because nominal net cash flow increase, but repayment of loan remains constant. Therefore inflation helps to refund of loans and improve ADSCR and LLCR ratios. Then, FNPV and FIRR will increase and vice versa. So there is a positive reaction between inflation and NPV.

Table 26: Result of sensitivity Analysis of Inflation

Inflation	**FNPV**	**FIRR**	**ADSCR**						
			1	**2**	**3**	**4**	**5**	**6**	**7**
10%	-3,691,011	17.7%	0.48	0.44	0.59	0.63	0.67	0.72	1.80
20%	3,061,444	35.3%	0.66	0.58	0.93	1.08	1.25	1.46	4.43
24%	**10,431,069**	**42.4%**	**0.75**	**0.65**	**1.13**	**1.36**	**1.63**	**1.97**	**6.34**
30%	39019710	52.9%	0.92	0.77	1.53	1.92	2.44	3.11	10.74
40%	325568628	69.8%	1.31	0.99	2.51	3.44	4.74	6.56	24.96
50%	3060733308	85.99%	1.87	1.23	4.10	6.05	8.99	13.40	55.25
60%	29490357754	101.73%	2.65	1.47	6.56	10.41	16.56	26.40	116.66

- *Billet Price*

Real increase or decrease in Billet price has direct effect in NCF and NPV. Therefore it is main risky variable.

Table 27: Result of sensitivity Analysis of Billet price

Price	FNPV	FIRR	ADSCR						
			1	2	3	4	5	6	7
400	-4,960,778	21.6%	-0.06	0.26	0.32	0.35	0.38	0.42	1.01
450	3,590,248	34.7%	0.39	0.48	0.77	0.91	1.08	1.28	3.97
490	**10,431,069**	**42.4%**	**0.75**	**0.65**	**1.13**	**1.36**	**1.63**	**1.97**	**6.34**
500	12,141,274	44.2%	0.84	0.69	1.23	1.47	1.77	2.14	6.93
550	20,692,300	52.3%	1.29	0.91	1.68	2.03	2.46	3.01	9.89

As we can see if Billet Price drops to 450 dollar, the NPV goes down to 6,840,821 million Rial and also IRR drops by 7.7%, and ADSCR falls significantly. And any price less than 450 dollar face with breakeven point (negative FNPV or FIIR lower of 30% (discount rate))

Table 28: Result of sensitivity Analysis of Sponge Iron Price

Price	FNPV	FIRR	ADSCR						
			1	2	3	4	5	6	7
275	4,940,008	36.2%	0.42	0.51	0.84	1.00	1.19	1.42	4.45
250	7,990,597	39.7%	0.61	0.58	1.01	1.20	1.43	1.73	5.50
230	**10,431,069**	**42.4%**	**0.75**	**0.65**	**1.13**	**1.36**	**1.63**	**1.97**	**6.34**
200	14,091,776	46.2%	0.97	0.75	1.33	1.60	1.93	2.34	7.60
170	17,752,483	49.8%	1.19	0.85	1.52	1.84	2.23	2.71	8.86

In the table of above, it can be clearly seen that, If Sponge Iron drops to 200 dollar, the NPV goes up by 3,660,707million Rial, and also IRR goes up by 4.2 % and ADSCR

increase significantly. For the reason behind the fact is that increase in new material (Billet) leads to increase in Sponge Iron price.

- *Degree of Utilization*

Degree of Utilization for this project, except first year is 80% nominal capacity. However due to technical or market conditions we force work to less capacity, therefore we consider NPV, IRR and ADSCR in less capacities.

Table 29: Result of Sensitivity Analysis of Billet Degree Utilization

BDU	**FNPV**	**FIRR**	**ADSCR**						
			1	**2**	**3**	**4**	**5**	**6**	**7**
30%	19580671	51.58%	1.39	0.95	1.62	1.95	2.37	2.89	9.46
40%	17750750	49.86%	1.26	0.88	1.52	1.84	2.22	2.71	8.84
50%	15920830	48.08%	1.14	0.82	1.43	1.72	2.08	2.52	8.21
60%	14090910	46.24%	1.01	0.76	1.33	1.60	1.93	2.34	7.59
70%	12260989	44.35%	0.88	0.70	1.23	1.48	1.78	2.16	6.96
80%	**10431069**	**42.40%**	**0.75**	**0.65**	**1.13**	**1.36**	**1.63**	**1.97**	**6.34**
90%	8601148	40.40%	0.62	0.60	1.04	1.24	1.48	1.79	5.71

It can be clearly seen that, by decrease of Billet degree utilization, FNPF, FIRR and ratios of ADSCR has been increased. Higher benefit of selling of Sponge Iron (first phase) in market is beneficial. Of course, regarding the limited market of Sponge Iron, may be selling of the production would be facing some difficulties. As it mentioned in the previous chapter, domestic production of Sponge Iron is enough for internal market, and owners should be focused on external markets.

Table 30: Result of sensitivity Analysis of Sponge Iron degree utilization

SIDU	FNPV	FIRR	ADSCR						
			1	2	3	4	5	6	7
55%	-3,973,205	23.6%	0.01	0.29	0.37	0.41	0.46	0.52	1.34
60%	-1,092,350	28.4%	0.16	0.36	0.53	0.60	0.69	0.81	2.34
70%	4,669,359	36.0%	0.46	0.51	0.83	0.98	1.16	1.39	4.34
80%	**10,431,069**	**42.4%**	**0.75**	**0.65**	**1.13**	**1.36**	**1.63**	**1.97**	**6.34**
90%	16,192,778	48.2%	1.05	0.79	1.44	1.73	2.10	2.55	8.33

Based on above table, degree utilization of sponge iron leads to decrease of FNPV, FIRR and ratios of ADSCR.

- *Investment Cost Overrun*

Table 31: Result of sensitivity Analysis of Investment Cost Overrun

ICO	FNPV	FIRR	ADSCR						
			1	2	3	4	5	6	7
30%	8636481	38.02%	0.79	0.66	1.16	1.38	1.65	1.99	6.40
20%	9230123	39.21%	0.77	0.66	1.15	1.37	1.65	1.99	6.37
10%	9828318	40.64%	0.76	0.65	1.14	1.36	1.64	1.98	6.35
0%	**10431069**	**42.40%**	**0.75**	**0.65**	**1.13**	**1.36**	**1.63**	**1.97**	**6.34**
-10%	11038373	44.64%	0.74	0.65	1.13	1.35	1.63	1.97	6.32
-20%	11650232	47.61%	0.73	0.64	1.12	1.34	1.62	1.96	6.30

Apparently, raise of cost overrun increases charge of investment.

- *Exchange Rate*

As Iran is an oil country, the government especially in times of high oil revenues, may be by injection of Dollar to market, keeps real Dollar exchange rate down and Dollar price does not grow with inflation. This subject in recent years has created problems for domestic productions because their costs increase with domestic inflation but competitor

imported commodities price do not grow as much. In fact, we face with decrease of our production real price; therefore we can consider this phenomenon as decrease of foreign goods prices. However, raw materials of domestic industries imported from abroad and increase of exchange rate has direct effect on cost of production and final price of commodities. Then increase of exchange rate is convenient for companies who have not high relatedness to foreign raw materials. One of those is steel firms and based on calculation, even 4% of raw material cost is related to imported goods. During last three decades growth of dollar rate is same as adjusted inflation (Iran inflation- US inflation). It means, if average inflation of Iran is around 24 % and US inflation 3.5% are assumed, dollar rate increase 21.5 % annually

Table 32: Result of sensitivity Analysis of Exchange Rate Relative increase rather than adjusted Inflation

XR	**FNPV**	**FIRR**	**ADSCR**						
			1	**2**	**3**	**4**	**5**	**6**	**7**
85%	-4853036	21.85%	-0.05	0.27	0.33	0.36	0.39	0.43	1.04
90%	241666	30.33%	0.21	0.39	0.60	0.69	0.80	0.95	2.81
95%	5336367	36.74%	0.48	0.52	0.87	1.02	1.22	1.46	4.57
100%	**10431069**	**42.40%**	**0.75**	**0.65**	**1.13**	**1.36**	**1.63**	**1.97**	**6.34**

It is clear that maximum resistance of this project facing increase of exchange rate rather than adjusted inflation is near 90%. It means if dollar rate cannot grow as such as adjusted inflation, Steel plants are not able to compete with foreign companies. Additionally, a result of assumption is calculated for long term. Maybe in the short term, change of exchange rate would be less or more of adjusted inflation

Sensitive analysis as a result of lack of variable as called probability cannot be useful for making decision. Because there is not any probability for occurrences of predicted

assumption scenario, then a method needed to calculate different probability for various scenarios.

In this step risk analysis is a practical approach to determine different probabilities of variables and presented logic result from the point of statistics aspect.

CHAPTER 5

RISK ANALYSIS

The main variables which are used in this financial analysis improbable are certain during the whole projects life. Therefore, NPV, IRR, ADSCR, LLCR of project will be uncertain.

Risk analysis based the Mont-Carlo method is a technique to encompassing the key variables on a predicting model to estimate the effect of risk on financial results. This approach is done to a number of simulation runs with computer by which a mathematical model and successive scenarios are built up that selected at random from multi-value probability distributions for main uncertain variables.

5.1 Selection of Probabilities and Risky Variables

Selection of the risky variables of the project is first step; the sensitive analysis conducted in previous chapter has already indentified risky variables. The selected risky variables are:

1. Inflation
2. Billet price
3. Sponge Iron price
4. Degree of utilization of Billet
5. Degree of utilization of Sponge Iron

6.Exchange rate

7.Cost over run

5.1.1 Probability Distribution Selection

The appropriate probability distribution (possible rage of values) can be defined by historical values or opinion of expert persons, which are presented blow:

- *Inflation*

Forecasting of inflation is complex and difficult and almost predict of inflation fluctuations is impossible. These inflation rates have been collected from last year's inflation that had been measured by independent institutes such as International Monetary Fund (IMF). It should be noted that the study assumed inflation rate is 24%. Should be reminded that with respect to interest rate 30% (24% inflation +6%) for financing, if the inflation rate is less than 24% in the period of loan repayment, as mentioned in previous chapter , has negative impact for ADSCR because its net cash flows cannot cover loan repayments, especially in first and second year of loan payment period.

Table 33: Frequencies and Probabilities of Iran Inflation

Range	Frequency	Probability
5% -15%	3	9.38%
15% -25%	14	43.75%
25% - 35%	11	34.38%
35% - 45%	3	9.38%
45% - 55%	1	3.13%
Total	32	100%

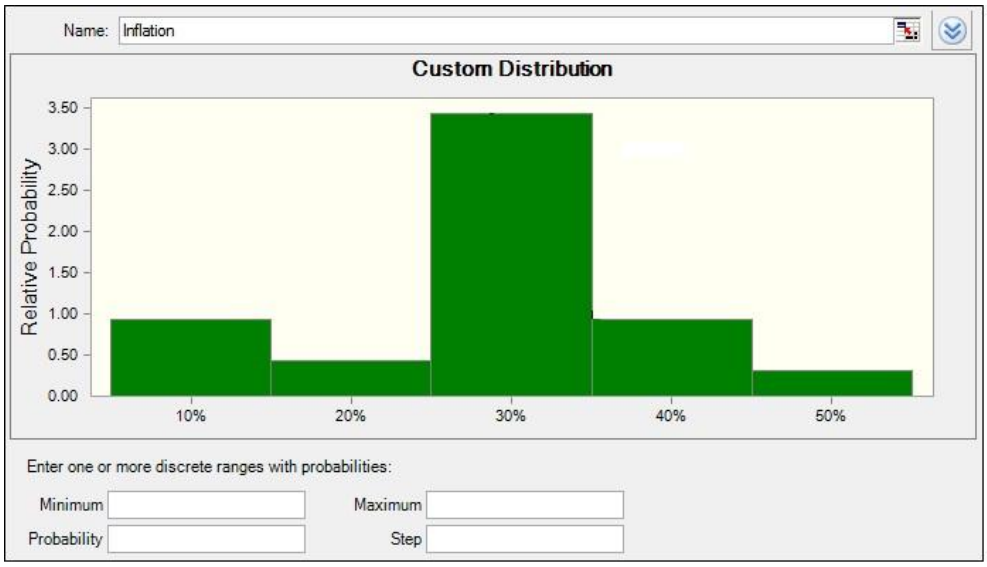

Figure 12: Step Distribution for Inflation

- <u>Billet and Sponge Iron Price</u>

Billet and Sponge Iron prices are defined in world markets and domestic inflation, but our mean is in real price, therefore we should consider just world prices net of world inflation especially the USA inflation. It should be noted that, we have assumed fix real price for Billet ($490 per ton).

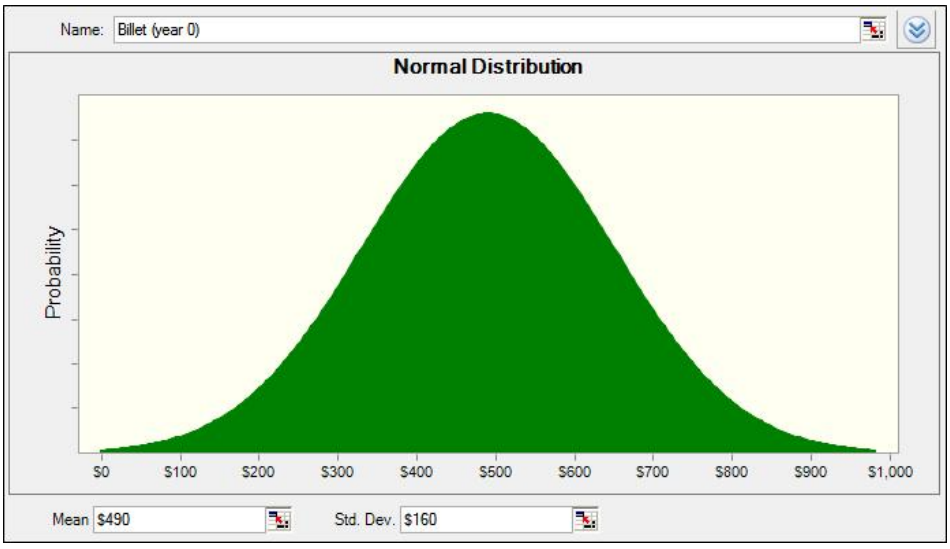

Figure13: Normal Distribution for Billet Price

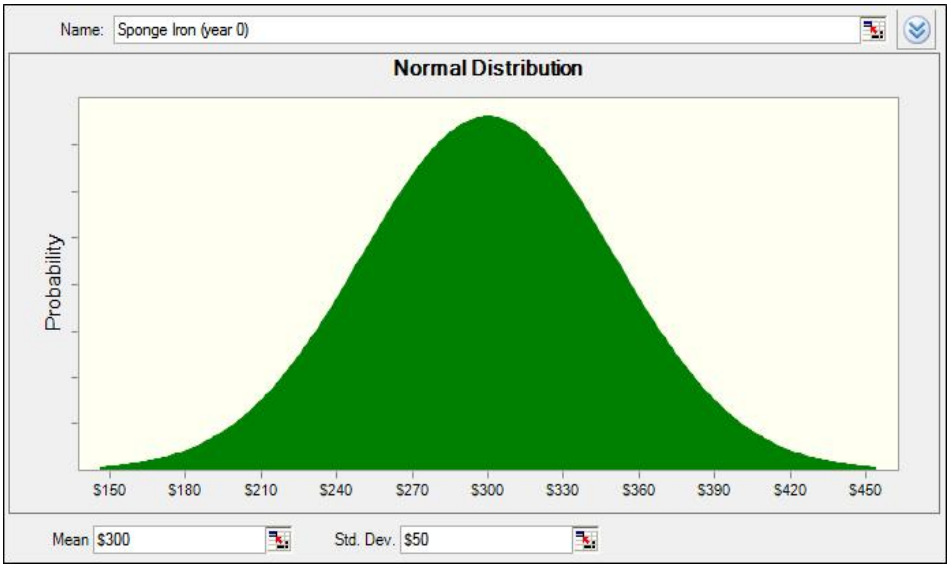

Figure14: Normal Distribution for Sponge Iron Price

- Degree of Utilization

To define of degree of utilization we should find of breakeven of it in the project that is 30%, which means project can continue to NPV near zero with this utilization degree.

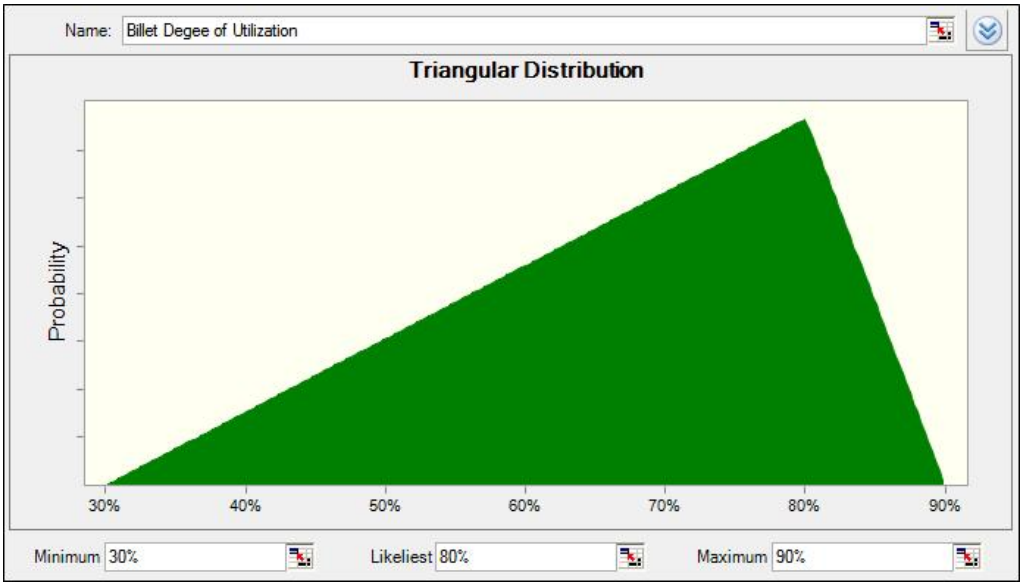

Figure15: Triangular Distribution for Utilization Degree of Billet

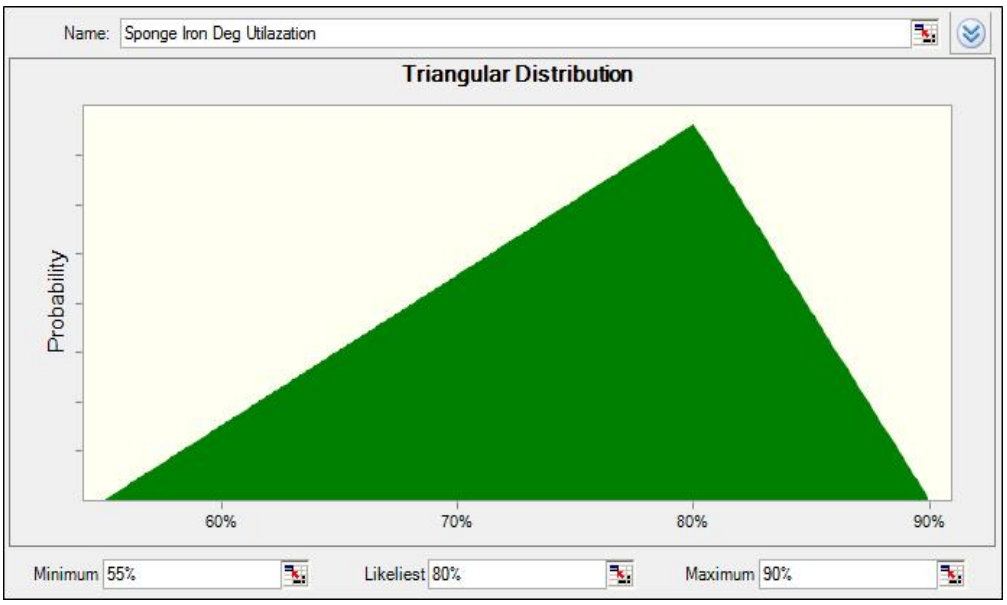

Figure16: Triangular Distribution for Utilization Degree of Sponge Iron

•Investment Cost Over run

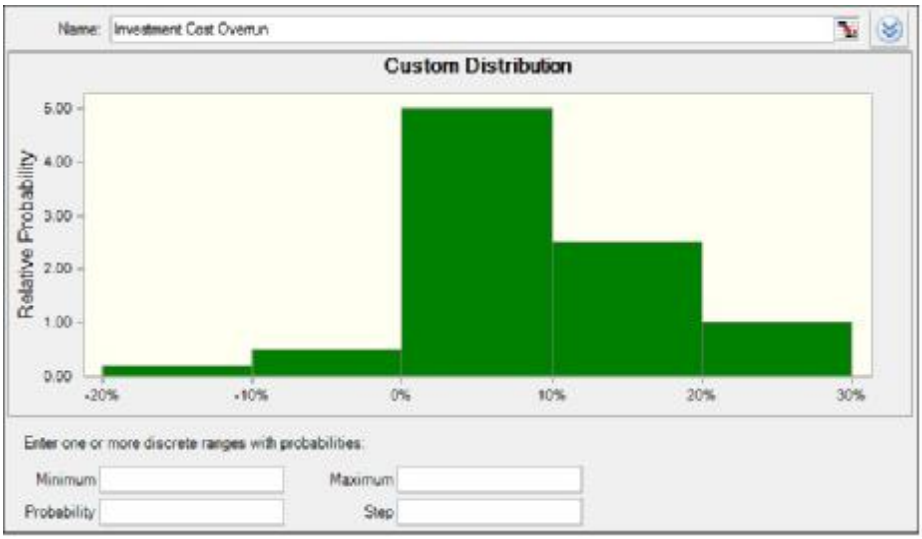

Figure17: Custom (Step) Distribution for Investment cost overrun

•Exchange Rate

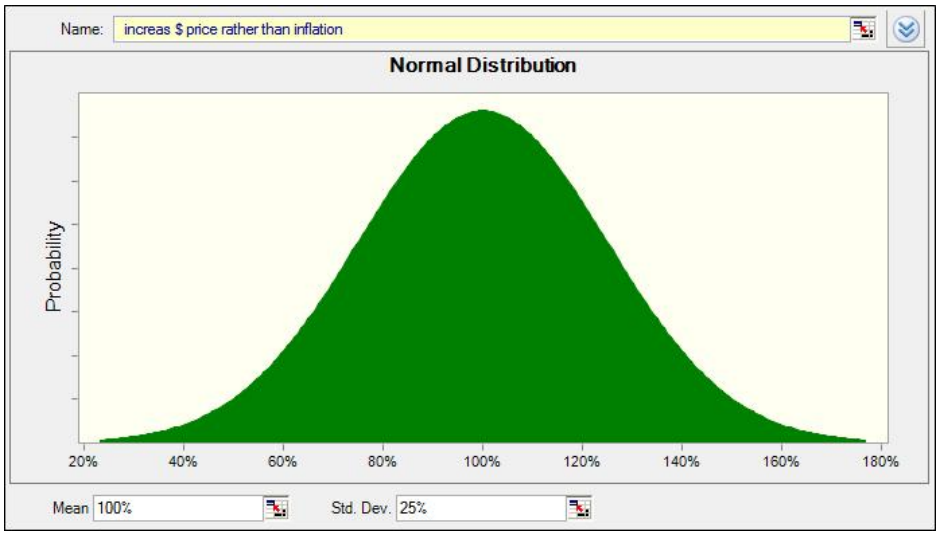

Figure18: Normal Distribution for Exchange Rate Relative increase rather than adjusted Inflation

5.2 Results of Risk Analysis

Next step is to define prediction of outcomes, which is selecting one variable to be tested to achieve results. In this analysis we will forecast these items:

1. NPV
2. IRR
3. 1st year of repayment (ADSCR 6)
4. 2ed year of repayment (ADSCR 7)
5. 3th year of repayment (ADSCR 8)
6. 4th year of repayment (ADSCR 9)
7. 1st year of repayment (LLCR 6)
8. 2nd year of repayment (LLCR 7)
9. 3th year of repayment (LLCR 8)
10. 4th year of repayment (LLCR 9)

10,000 trials of Mont Carlo simulation should be selected for running of Crystal Ball software, which the result for each predicts is:

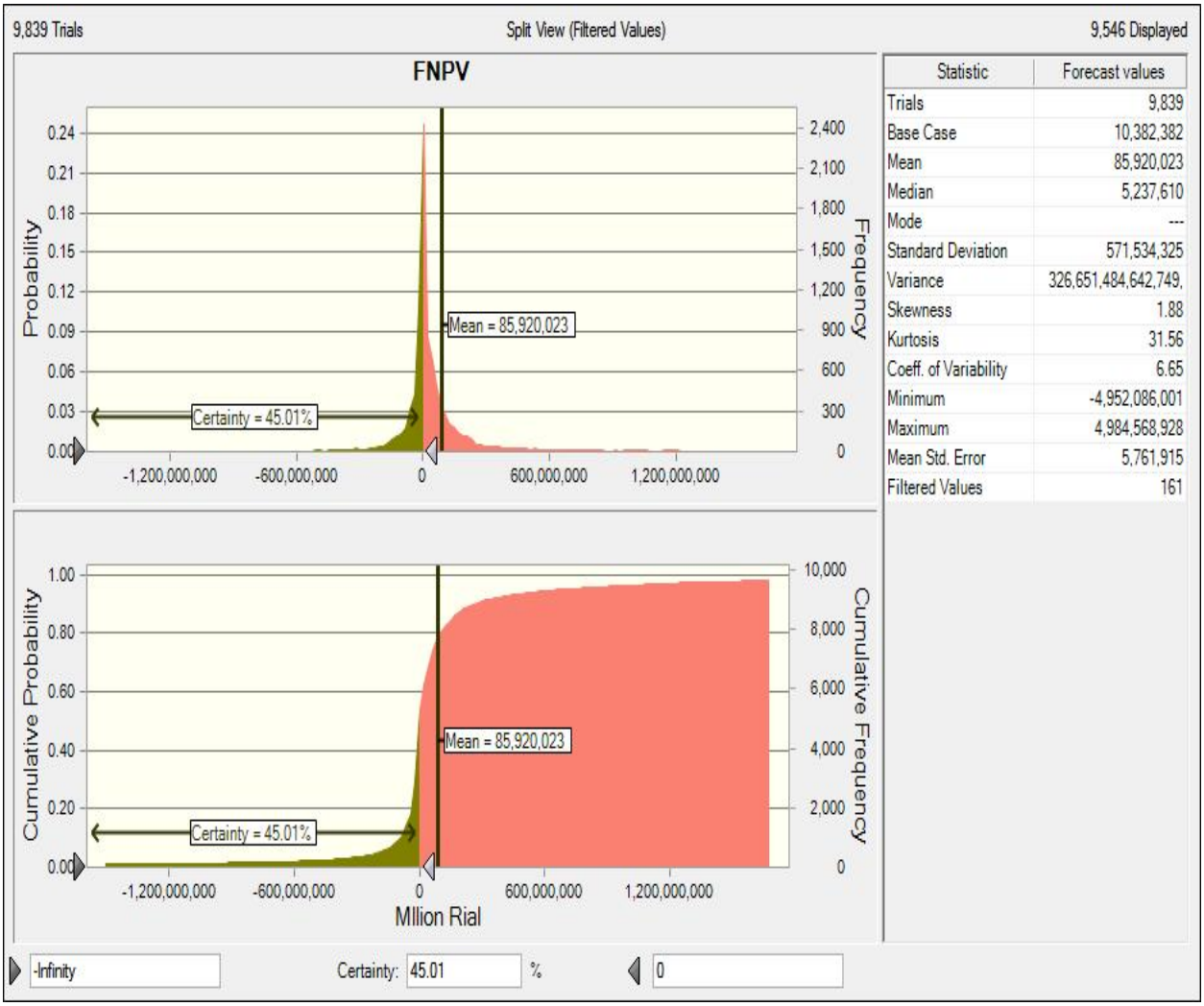

Figure 19: Forecast of NPV

As you can see mean of NPV is equal to 85,920,023 Million Rial with standard deviation of 571,534 Million Rial. The probability of negative NPV is of 45.01%. It means probability of success of the project is 55%. However, this demonstrates that the project is not very safe.

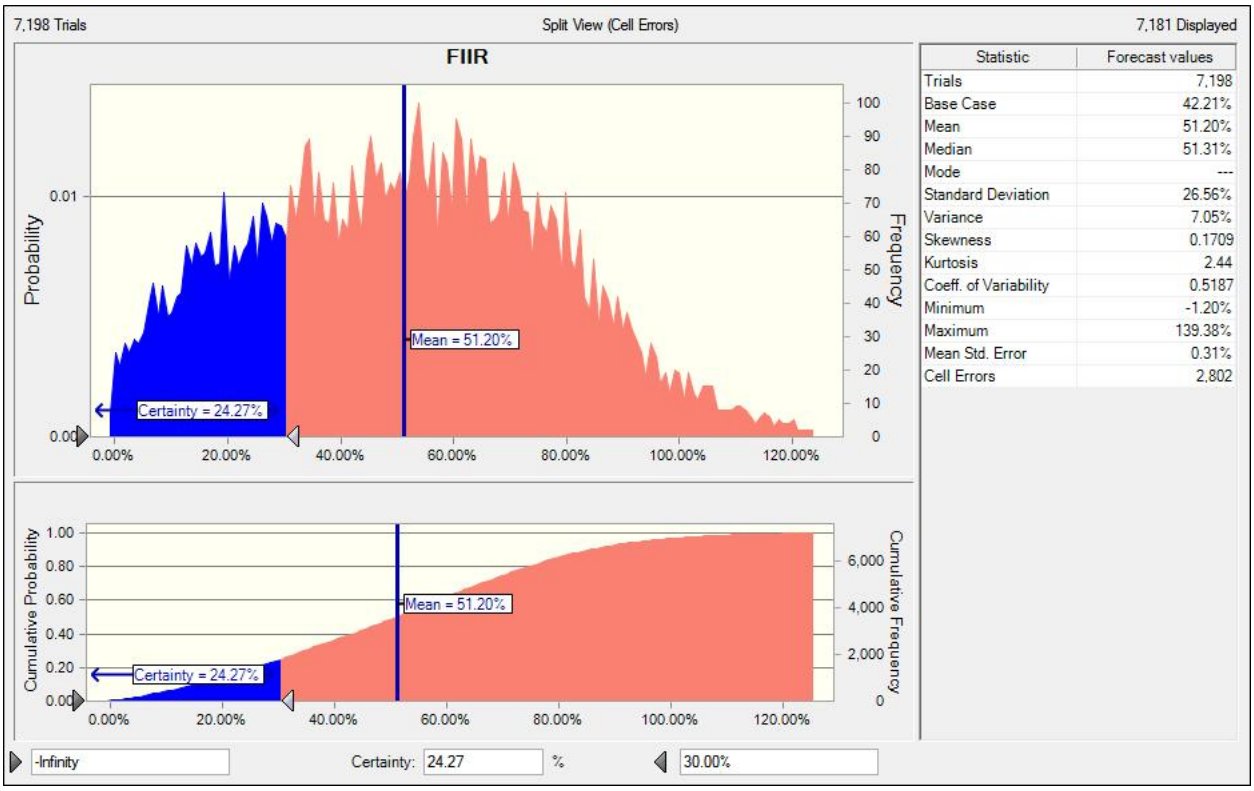

Figure 20: Forecast of IRR

The mean of IIR is 51.20% with standard deviation of 26.56% and the certainty level is 24.27 for going to below 30% (discount rate)

Certainty at 24.27% means that probability of having IRR higher than 30% is about 75%.

The following figures are the ADSCR prediction graphs for defined years.

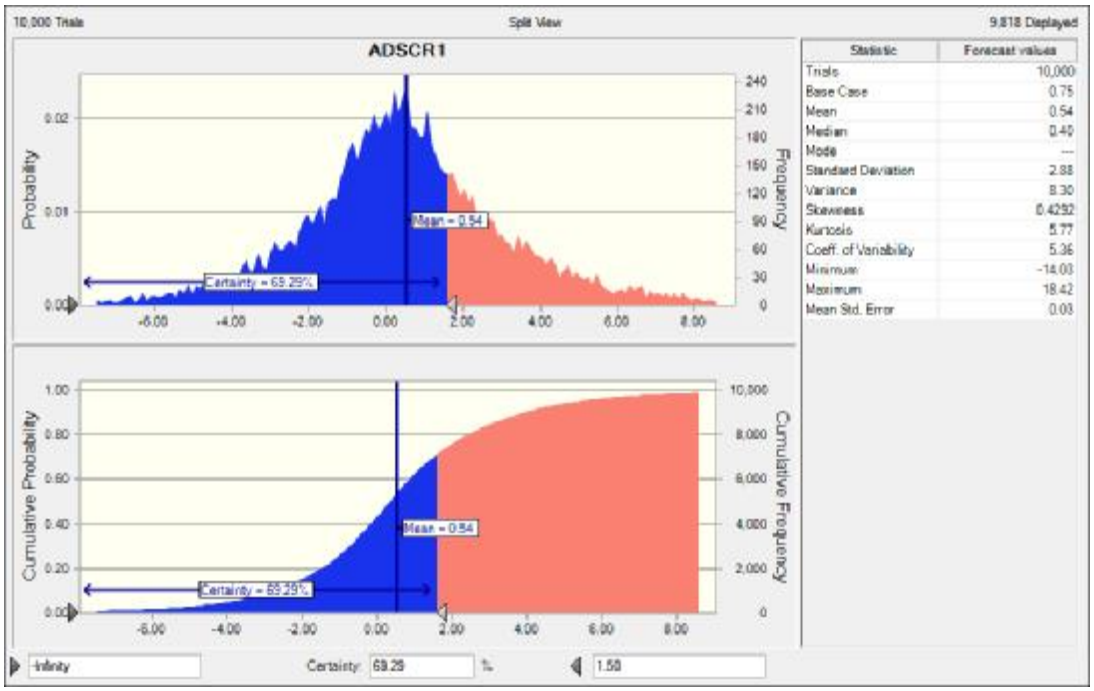

Figure 21: Forecast of ADSCR Year 6 (1st year of repayment)

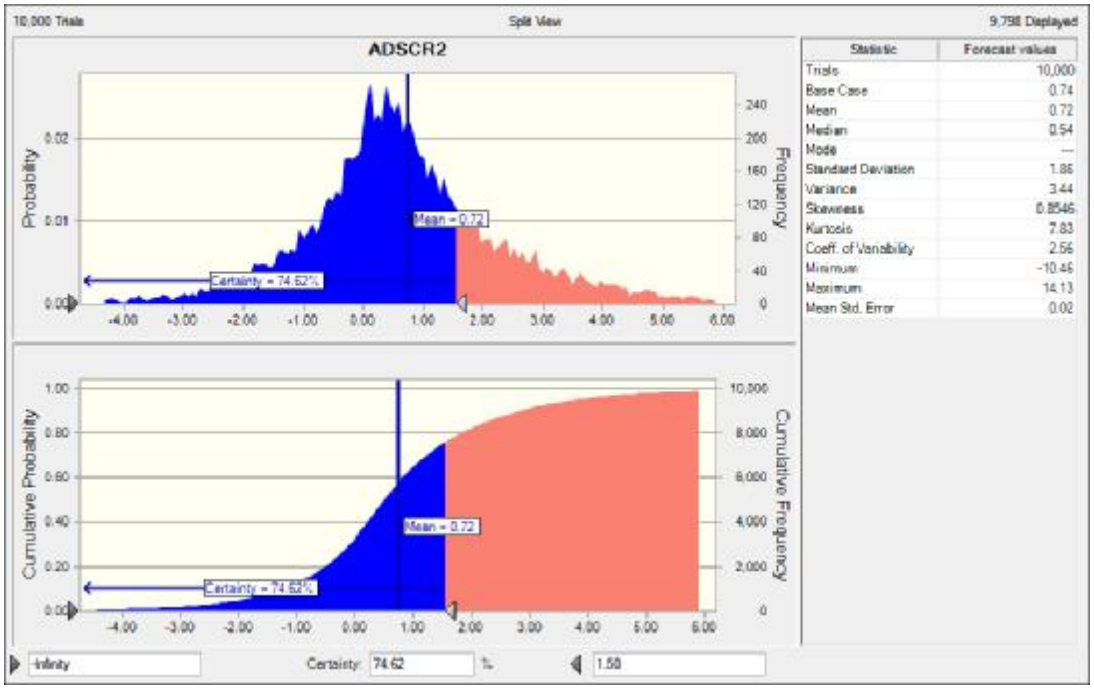

Figure 22: Forecast of ADSCR Year 7 (2nd year of repayment)

As it is clear from above figures and tables, the project has high probability to fail in its ability to service the debt in the first year of loan repayment, because it has a probability

of 61.34% of being less than one in this year, and is 63.98% for second year and others are same.

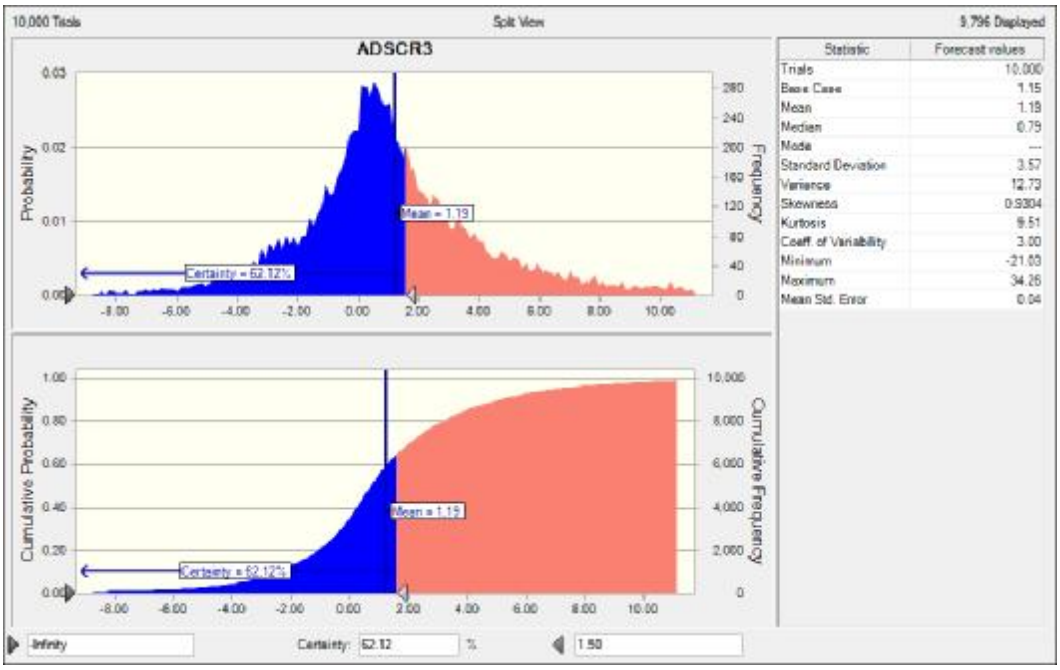

Figure 23: Forecast of ADSCR Year 8 (3th year of repayment)

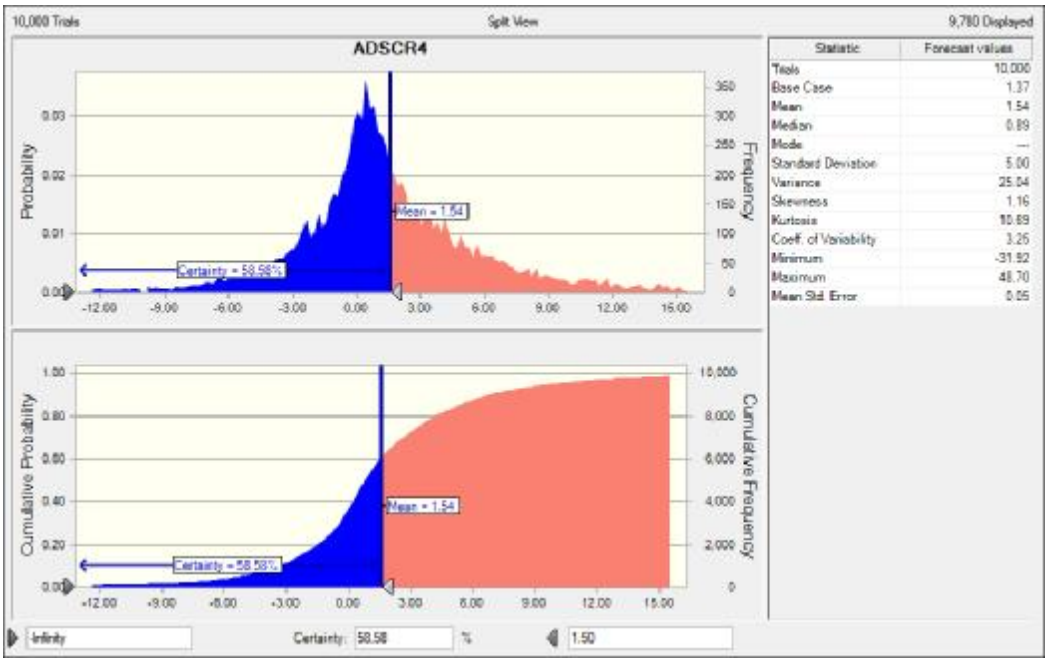

Figure 24: Forecast of ADSCR Year 9 (4th year of repayment)

The above figures show certainty of the left side of the figures demonstrated probability of defeat of the project and in contrast right side of chart shows border of minimum acceptance of ADSCR ratio for banker to trust and present loan.

The next figures are LLCR forecast graphs from 6 to 9 years after implementation of the project.

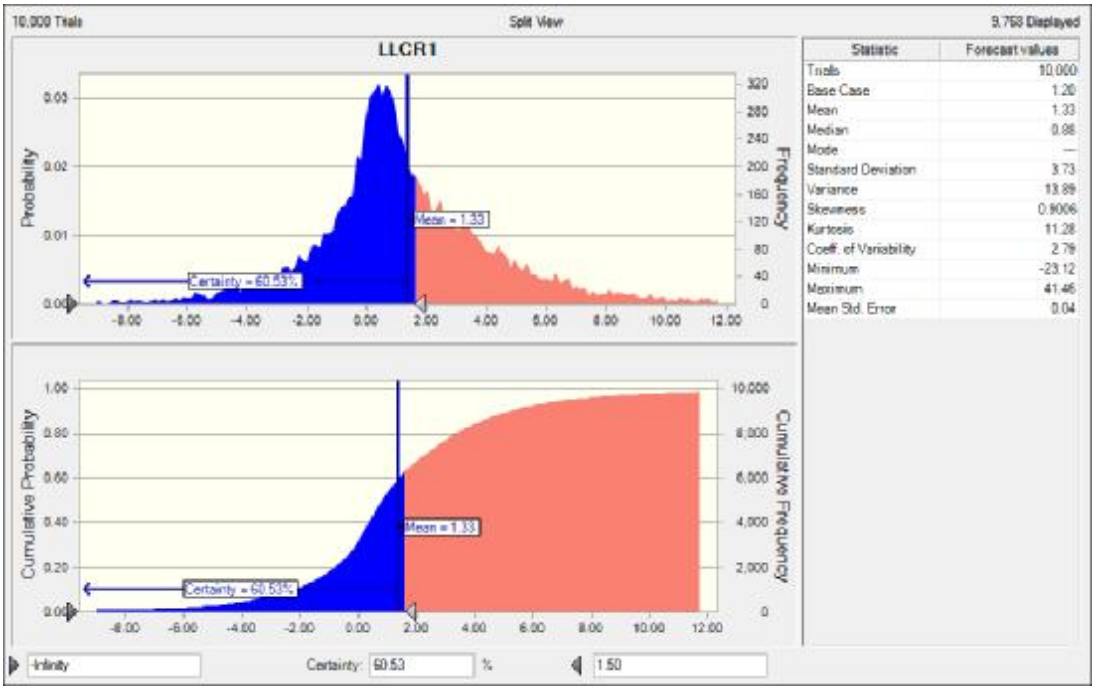

Figure 25: Forecast of LLCR 6 (1st year of repayment)

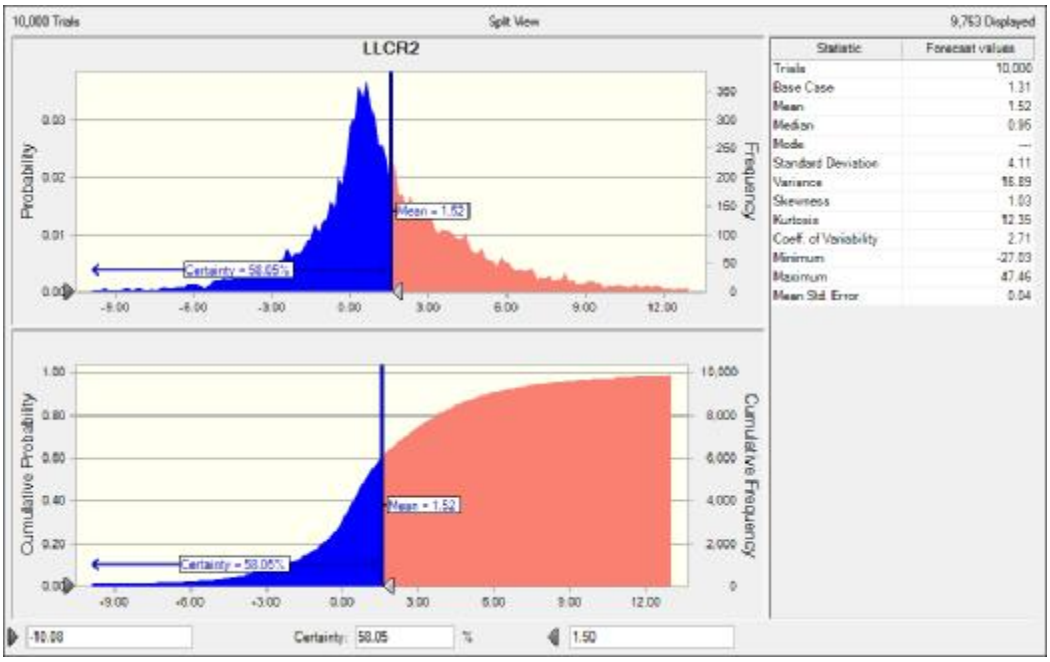

Figure 26: Forecast of LLCR 7 (2nd year of repayment)

According to above graphs, LLCR seems to have high probability of experiencing a value less than 1.5 for first year 52.5 % and for second year is 50.22% and other years are same.

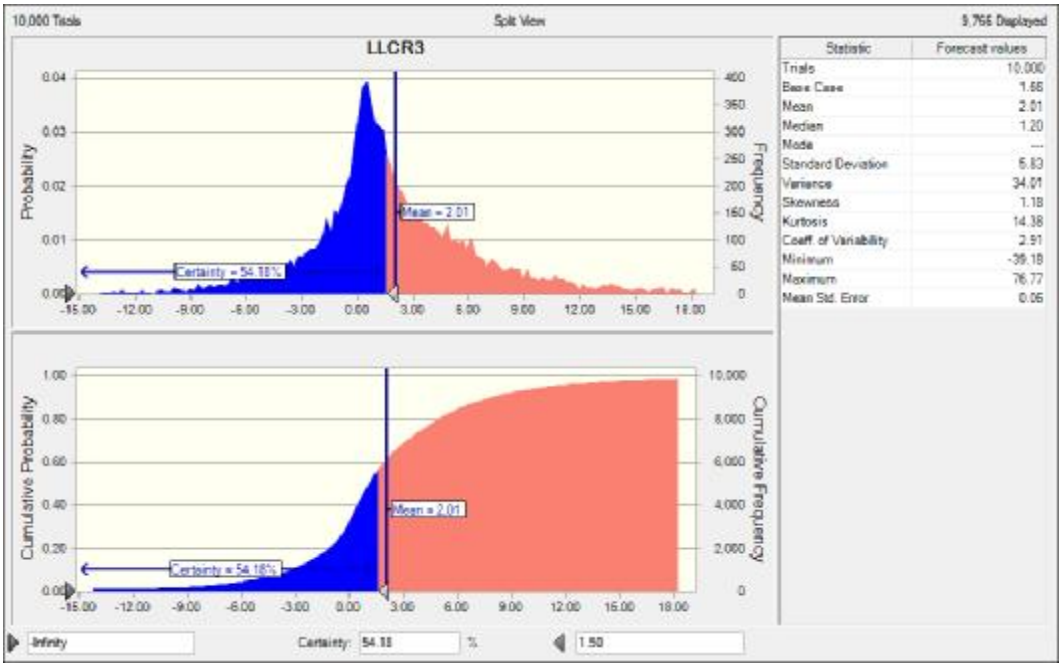

Figure 27: Forecast of LLCR 8 (3th year of repayment)

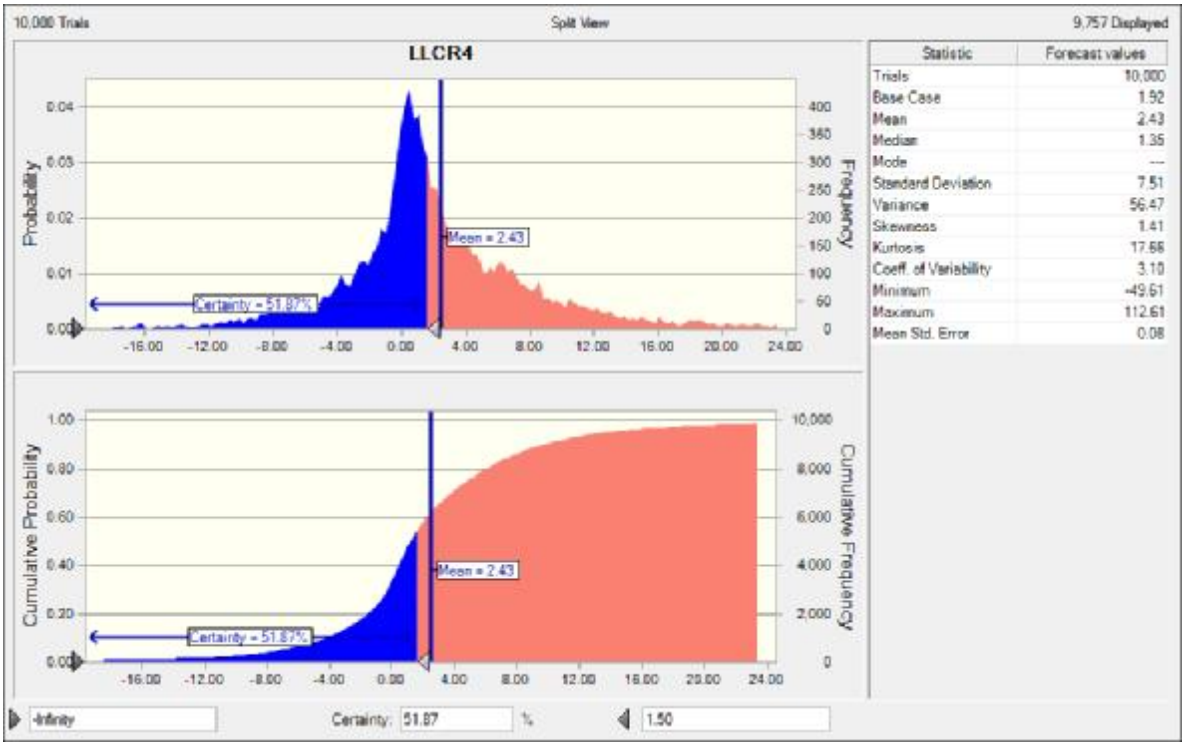

Figure 28: Forecast of LLCR 9 (4th year of repayment)

In this chapter results of risk analysis in various probabilities are presented and the next chapter is allocated to conclusion of the results.

Chapter 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

This feasibility study is about a Steel (Billet) plant as one sample for considering of the profitability of this industry in Iran, and a Sponge Iron production unit as feed of this project, which besides some output of it will sell in the market. The data was obtained from the competent institutions and practicing persons in this sector. The NPV and IRR were calculated as **10,431,069** and **42.40%** respectively

Part of this study was about the sensitivity analysis, that we considered some risky variables including inflation rate, Billet price and degree of utilization and their impact on the ADSCR and LLCR.

The study continued considering risk analysis of those risky variables by the Mont Carlo method and the riskiness was tested by using Crystal Ball software. To fine out the effect of the risky variables on them various variables were tested.

IRR, NPV, ADSCR Year 6 to 9 (from 1st to 4th year of repayment) and LLCR Years 6 and 9 (from 1st to 4th loan repayment year) are the tested variables.

The risk analysis results demonstrate that is a probability of the NPV to be negative by 45% and probability of IRR to go below 30% is 24.27%, this shows the project is relatively risky. It is derived from high fluctuated market of metal. Our main problem is

about dept repayment ratios (ADSCR and LLCR) in first and second years. The probabilities of inability to service debt in first and second year are 0.75 and 0.65 which are less than 1. Its LLCRs are also are 1.14 and 1.22 for first and second years which are not enough to cover its debt. But positive NPV of project improve these ratios for next years.

Some of the ways that can be used for improving these ratios and reduce the exposure to risk are:

1. Delaying in some of the first repayment of loan at later times.
2. Decreasing in the amount of debt and adding up more investors' share or equity.
3. Finding of cheaper loan seems to be not too practical for investors unless governmental fiscal sources can be employed.

The first case leads to higher interest cost regarding to high interest rate in Iran results to more cost in project and decreases amount of NPV.

In the second option, it is possible to decrease the amount of investment cost of the project received from banks and role of investor would be important. But, regarding official limitation and restrictions in issue of public stock, new companies would face problem in this field.

In the last choice which is to some extent compatible with the condition of Iran by accessibility of subsidies' loans for industry development, cannot be considered as the basis of making decision.

6.2 Recommendations

The ADSCR for the first and the second year is necessary to be improved in order to satisfy bankers' willingness to pay loan for this project.

In spite of valuable NPV and IRR, This project based on nature of its market is relatively risky project. Maybe most of risk-averse investors do not prefer to invest in this project.

It is recommended for future studies to carry out an economic analysis to define the project effects on the macroeconomic.

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APPENDICES

Appendix table 1: Technical Costs of, Production Operating

Table ? : Table of Parameters			
1st & 2ed phase :		Sponge Iron	Billet
Nominal capacity		1.86	1.2
Dgree of Utilization		80%	80%
Market Selling(mt)		0.45	0.96
Raw Materials (millon Rial)			
12000000			
Facility Costs			
900000			
Mainainance Cost			
Landscaping & building			5%
Machinery			5%
Facility			8%
Lab & workshop equipment			10%
Total	959779	millon Rial	
Wages & Salaries (annoual)			MillionRial
Managers		2	1200
Production magagers		8	3000
Engeeners & Technicians		40	12000
Official employee		44	8500
Skilled workers		94	16000
Unskilled workers		375	35000
% increase in real price		0%	
Total(×1.4)			**105980**
Working Capital			
A/R	0%	of Gross sales	
A/P	0%	of Operating cost	
C/B	8.5%	of Operating Costs	
Discount Rate			
IR for Time Account			30%

Financial

Investment Cost	million Rial						
Year	0	1	2	3	4	5	Total
Land	300609						300609
Site Landscaping		9322	77800	113040	80000	120000	400162
Civil works & buildings		76412	305648	92680	146467	0	621207
machinery & equipment		0	3424580	1531600	3140000	1922712	10018892
Auxiliary & service equipment					536508	220200	756708
Lab						184104	184104
Facility		233000	168000	540000	1800000	800000	3541000
Total(Nominal)	300609	318734	3976028	2277320	5702975	3247016	**15822682**
Financing							
Dept financing	75%			Owner(s)	25%		
million Rial	11867011			million Rial	3955670		
Nominal IR	30%						
No of Instalments	20 each 3 month(5year)						
Grace Period	1-2 year						
Tax Depreciation & Economic life							
		Tax.Deprc		Usful.Life			
landscaping & building		15	yrs	35			
Machinery and equipment		15	yrs	35			
laboratory and workshop		15	yrs	35			
facility		15	yrs	35			
Billet & Sponge Iron prices							
	$ per ton	**Exch.Rate**	**millon Rial per ton**				
Billet	490	18000	8.82				
Sponge Iron	230	18000	4.14				
Increase in the price	24%						
Inflation							
Iran 24%	U.s	3.5%	Increase in Exch.Rate		18.4%		
Taxation							
Corporate Income Tax Rate		25%					

Appendix table 2: SALES (million Rial)

	2018	2019	2020	2050	2051	2052	2053
Year	6	7	8	38	39	40	41
Pirce Index	3.64	4.51	5.59	3,548.33	4,399.93	5,455.91	6,765.33
Billet Price per ton ($)	$490	$490	$490	$490	$490	$490	
Exchange Rate	65434	81138	100611	63869945	79198732	98206427	
Billet Price per ton (Million Rial)	32	40	49	31296	38807	48121	
Deggre of Utilization	80%	80%	80%	80%	80%	80%	
Million ton per year	0.96	0.96	0.96	0.96	0.96	0.96	
Billet sale (Nominal)	30780093	38167315	47327471	30044422065	37255083361	46196303367	
Billet sale (Real)	8128512	8128512	8128512	8128512	8128512	8128512	
Sponge Iron Price per ton ($)	$230	$230	$230	$230	$230	$230	
Exchange Rate	65434	81138	100611	63869945	79198732	98206427	
Sponge Iron Price per ton (Million Rial)	15.05	18.66	23.14	14690.09	18215.71	22587.48	
Deggre of Utilization	80%	80%	80%	80%	80%	80%	
Million ton per year(for sell)	0.44	0.44	0.44	0.44	0.44	0.44	
Sponge Iron sale (Nominal)	6645987	8241024	10218870	6487142560	8044056775	9974630401	
Sponge Iron sale (Real)	1828224	1828224	1828224	1828224	1828224	1828224	
Total (Nominal)	37426081	46408340	57546341	36531564625	45299140135	56170933768	
Total (Real)	9956736	9956736	9956736	9956736	9956736	9956736	

Appendix table 3: OPERATING COSTS (million Rial)

	2018	2019	2020	2050	2051	2052	2053
Year	**6**	**7**	**8**	**38**	**39**	**40**	**41**
Raw Material	17,614,275	21,841,701	27,083,709	17,193,278,198	21,319,664,966	26,436,384,558	
Labor cost	362,144	449,059	556,833	353,488,920	438,326,260	543,524,563	
Facility Costs	7,568,910	9,385,449	11,637,957	7,388,006,843	9,161,128,485	11,359,799,321	
Maintenance	3349444	4153310	5150105	3269389147	4054042542	5027012752	
Other costs	1,444,739	1,791,476	2,221,430	1,410,208,155	1,748,658,113	2,168,336,060	
Total Operating Costs (Nominal)	**30339512**	**37620995**	**46650034**	**29614371263**	**36721820366**	**45535057254**	
Total Operating Costs (real)	8,346,002	8,346,002	8,346,002	8,346,002	8,346,002	8,346,002	

Appendix table 4: WORKING CAPITAL (million Rial) (Nominal)

Year	**2018**	**2019**	**2020**	**2050**	**2051**	**2052**	**2053**
	6	**7**	**8**	**38**	**39**	**40**	**41**
Accounts receivable	0	0	0	0	0	0	
Accounts payable	0	0	0	0	0	0	
Cash balance	2,578,859	3,197,785	3,965,253	2,517,221,557	3,121,354,731	3,870,479,867	
Change in A/R	0	0	0	0	0	0	0
Change in A/P	0	0	0	0	0	0	0
Change in C/B	2,578,859	618,926	767,468	487,204,172	604,133,174	749,125,135	-3,870,479,867

Appendix table 5: RESIDUAL VALUES (million Rial)

Year	**2012**	**2018**	**2019**	**2020**	**2050**	**2051**	**2052**	**2053**
	0	**6**	**7**	**8**	**38**	**39**	**40**	**41**
Land	300,609							2033719583
Value of Assets (excluding land)	15,522,073							
Annual depreciation		443,488	443,488	443,488	443,488	443,488	443,488	
Residual Value of Assets		15,078,585	14,635,097	14,191,609	886,976	443,488	0	0
Total								2,033,719,583

Appendix table 6: DEPRECIATION FOR TAX PURPOSES (million Rial)

Year	**2012**	**2018**	**2019**	**2020**	**2030**	**2031**	**2032**
	0	**6**	**7**	**8**	**18**	**19**	**20**
Value of Assets (excluding land)	15,522,073						
Annual Depreciation		1,034,805	1,034,805	1,034,805	1,034,805	1,034,805	1,034,805
Residual Value of Assets		14,487,268	13,452,463	12,417,658	2,069,610	1,034,805	0

Appendix table 7: LOAN SCHEDULE (million Rial)

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
Nominal Interest rate (Nominal)	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	
Nominal Interest rate (Real)	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	
Loan Disbursements			**850,000**	**2,130,000**	**5,680,000**	**3,207,011**	**2,528,293**							
Beginning debt & Interest accrued			850,000	3,235,000	9,885,500	16,058,161	23,403,902	25,202,756	19,130,855	16,853,603	13,893,177	10,044,623	5,041,502	
Interest accrued			255,000	970,500	2,965,650	4,817,448	7,021,171	7,560,827	5,739,256	5,056,081	4,167,953	3,013,387	1,512,451	
Principal Repayment							1,490,000	3,131,659	2,283,061	2,283,061	2,283,061	2,283,061	641,402	
Interest Paid							3,732,317	10,501,069	5,733,447	5,733,447	5,733,447	5,733,447	2,251,475	
Total Loan Repayment							5,222,317	13,632,728	8,016,507	8,016,507	8,016,507	8,016,507	2,892,877	
Ending debt & interest accrued			1,105,000	4,205,500	12,851,150	20,875,609	25,202,756	19,130,855	16,853,603	13,893,177	10,044,623	5,041,502	3,661,076	0
Debt Cash Inflow (Nominal)			850,000	2,130,000	5,680,000	3,207,011	2,528,293							
Total Loan Repayment as an Outflow (Nominal)							5,222,317	13,632,728	8,016,507	8,016,507	8,016,507	8,016,507	2,892,877	
Interest Paid (real)							1026711	2329602	1025752	827219	667112	537994	170375	
Debt Cash Inflow (Real)			552810	1117158	2402490	1093936	695500							
Total Loan Repayment as an Outflow(Real)							1436591	3024342	1434207	1156618	932757	752223	218912	