Feasibility assessment of expansion options for a fish feed factory in Iceland

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Thesis of 30 ECTS credits submitted to the School of Science and Engineering
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Abstract

Fish farming in Iceland has been growing steadily since 2008. With better farming technologies it is becoming increasingly profitable and demand for feed is increasing. Domestic fish feed factories will not be capable of producing enough feed to supply the Icelandic market in the coming years if this trend continues. Old equipment also prevents optimal fat content in feed production. A new factory or upgrade is necessary for Laxá to stay competitive. This paper presents a feasibility model for comparison of a new 50.000 ton fish feed factory versus upgrading existing facilities at Laxá to supply increased demand. Risk analysis and inventory optimization are also presented for both options and optimal location is determined for a new factory. Both investment options are feasible at the end of the planning horizon. A new factory has 18% IRR and NPV of 725 M ISK. A factory upgrade returns 25% IRR and NPV of 231 M ISK. With no clear favorite the selection could ultimately depend on the risk attitude of Laxá executives and project investors.

Útdráttur

Fiskeldi á Íslandi hefur aukist jafnt og þétt síðan 2008. Tækniframfarir hafa leitt til þess að fiskeldi er orðið arðbærara en áður og því er horft í auknum mæli til þess. Samhliða auknu eldi þarf aukið magn fóðurs. Fiskifóðurs verksmiðjur innanlands munu ekki anna eftirspurn ef þessi þróun heldur áfram. Gamall tækjabúnaður gerir Laxá ekki kleift að framleiða fóður með ákjósanlegu fitumagni. Því er endurnýjun búnaðar eða ný verksmiðja nauðsynleg til að halda samkeppnishæfni. Framkvæmd er arðsemisgreining á 2 valmöguleikum fyrir Laxá. Bygging nýrrar 50.000 tonna verksmiðju eða endurnýjun búnaðar við núverandi verksmiðju fyrirtækisins. Áhættugreining og bestun á birgðahaldi fyrir báða valmöguleika er framkvæmd ásamt bestun á staðsetningu nýrrar verksmiðju á Vestfjörðum. Báðir fjárfestingar möguleikar eru arðbærir í lok áætlanargerðar. Núvirði nýrrar verksmiðju er 725 M ISK og innri vextir 18%. Endurnýjun nýrrar verksmiðju skilar núvirði upp á 231 M ISK og 25% innri vöxtum. Þar sem báðir möguleikar eru fýsilegir gæti lokaval á fjárfestingarkosti oltið á áhættusækni stjórnenda Laxár og fjárfesta.

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1. Introduction

Salmon, trout and arctic charr are all nutritious and healthy, and have in recent years become a increasingly popular delicacy. The demand for these species can not be satisfied in a sustainable way by regular fishing. This has lead to increased fish farming of those species as they are both high value and high demand. Another reason why aquaculture is increasing in popularity is the fact that farmed fish require low amounts of feed compared to other meat for growth. Farmed salmon requires 1.2 kg of feed while pork requires 3 kg and beef 8 kg for each 1 kg of product(Rúnarsson, 2014).

This has lead to fish farming growing increasingly popular in the world. Atlantic salmon production in the world has doubled over the last 10 years(FAO, 2015). Icelandic fish farmers want their share of the cake. The fish farming in Iceland has been rapidly growing since a collapse in 2008(Másson & Sigurðsson, 2012). Farming of Atlantic Salmon in Iceland has doubled over the last 5 years(Rúnarsson, 2014).

There are currently 2 factories which produce fish feed in Iceland. Laxá is located in Krossanes right beside Akureyri and Fóðurblandan which operates in Reykjavík. Laxá has maximum production capabilities of 12.000 tons if the factory is in constant production but currently produces around 8.000 tons per year. Fóðurblandan produces roughly 1.500 tons per year.

A recent trend in fishfarming which also proves a big incentive to construct a new factory is the demand for higher percentage of fats in fish feed. Neither factory in Iceland is able to produce fish feed with more than 32% of fat content in the fish feed due to equipment constraints. Higher fat content decreases raw material cost of production as proteins are more expensive than lipids(Nattabi, 2007). With raw material cost constituting of about 85% of product price this is a big factor. New equipment is expensive but necessary for Laxá to stay competitive. Current facilities at Laxá are over 20 years old and the factory is small with little room for expansion. Current production output makes factory upgrade a barely justifiable purchase.

Two expansion options for Laxá are considered and their feasibility analyzed. The options presented are upgrading equipment and warehouse at the existing factory to be competitive in the current market environment or constructing a new factory at a different location. Instead of renewing equipment and facilities at the old factory, it could be feasible to construct a new factory closer to the biggest fish farms in Iceland. At the recommendation of Laxá manager the main location focus for a new factory is on the Westfjords in Iceland. The main reasons behind this placement are that large fish farms are already operating there, most licenses held for farming and plans for new fish farms are well under way in the area.

A new or upgraded factory would be able to make a more diversified range of fish feed than factories can currently produce in Iceland. This is necessary to keep up with competition from foreign markets, namely in the Faroe Islands and Norway.

The focus in this project will be evaluating the feasibility of both options and deciding on the optimal actions for Laxá.

2. Theory

2.1 Financial feasibility studies

Feasibility studies can be used to analyze viability of proposed investments. Feasibility studies are commonly used to evaluate prospective projects before continuing with development and construction. A pre-feasibility study can save valuable time and resources by determining early if returns on the investment are acceptable. Projects that do not work can be cancelled and profitable ones analyzed further(Hofstrand & Holz-Clause, 2009). Feasibility studies are also helpful when reducing number of prospective investment options. It is quickly revealed which project alternatives are favorable and options for consideration can be decreased. The options remaining can be studied thoroughly. Determining financial conditions and operating performance of proposed projects by predicting future performance is the key purpose of financial feasibility analysis(Björnsdóttir, 2010).

Successful businesses do not start new projects without exploring the probability of project risks and profitability. There are various reasons for concluding financial feasibility studies. These include identifying opportunities and threats to prospective projects. It increases chance of project success by determining risky factors that can be mitigated early. It provides good information for decision making. A good feasibility report increases chances of funding from creditors and helps attracting equity investment(Hofstrand & Holz-Clause, 2009).

2.2 Project evaluation methods

There are various project evaluation techniques used to assess financial feasibility. These methods can be used to provide insightful vision of project operations. According to Remer & Nieto (1995) there is no single method prevalent when determining project feasibility. These methods are usually used in combination with each other to evaluate investment feasibility of projects. Remer & Nieto (1995) list up five basic types of methods which will be further discussed:

1. Net present value methods.
2. Rate of return methods.

3. Payback methods.
4. Ratio methods.
5. Accounting methods.

Evaluation methods benefit three groups. It is used by managers to improve firms operations. Creditors to determine risk of company being able to pay debt or liquidating. Shareholders and investors are interested in risk, return rates and company growth(Brigham & Houston, 2007). Potential limitations of ratio analysis include double effects, i.e. a high current ratio can both mean strong liquidity position of a project or excessive cash not reinvested. Financial statements can also be manipulated to look stronger than they are and if project ratios have a wide range from weak to strong it can be hard to determine overall success for the project(Brigham & Houston, 2007).

These limitations should be kept in mind when evaluating the feasibility report depending on the project sector.

For the project analysis the time base needs to be considered. There are three situations that need to be considered depending on the project(Remer & Nieto, 1995).

1. Project life equals the analysis period
2. Different projects having different analysis periods
3. Projects with infinite analysis periods.

It is important to regularly update the analysis to include the most recent information to verify the feasibility and validate the project on hand.

2.3 Minimum attractive rate of return

Minimum attractive rate of return (MARR) also known as hurdle rate is the discount rate which is used for evaluating projects. It is usually determined from 2 factors: cost of capital and risk associated with the investment. Raising capital costs money, with interest rates from borrowing money and issuing stock through equity(Park, 2007). The cost of capital is the benchmark MARR that a company can invest their money in safely elsewhere.

Another factor to consider when determining MARR is the risk factor associated with given investment. Riskier projects will have higher MARR as risk premium percentage is added to the cost of capital. This is done as a precaution as risky investments will need to yield higher returns than safe ones to be attractive to investors.

The case study presented has a 15 year planning horizon. A 15 year bond carries 6.5% interest rate(“Market Overview,” 2015). Estimated MARR for the fish feed factory with respect to this rate and similar investment projects is set at 12%. Since more risk is involved investing in a factory than government bonds the risk premium is 5.5%. Inflation is not taken into account.

2.4 Net present value

Net present value or NPV is a way to evaluate the feasibility of an investment. The formula for NPV can be seen in eq. 1.

$$NPV(i, N) = \sum_{t=0}^{N} \frac{R_t}{(1+i)^t} \quad (1)$$

Where i is the discount rate, R_t is the net cash flow at the end of period n and N the service life of the project(Park, 2007). According to Brealey, Myers, & Allen (2008) There are three rules to follow when applying NPV.

1. Only cash flow is relevant
2. Cash flows should always be estimated on incremental basis
3. Consistency in inflation treatment.

It is a common mistake to mix up cash flows with accounting income. Accounting income and cash flows are interrelated but different concepts. Accounting income equals total revenues minus total expenses, but capital expenditure is not deducted but instead depreciated over several years. This means that accounting income includes some cash flows but excludes other. Cash Flow is just the difference between cash received and paid out(Brealey et al., 2008).

To determine NPV an investor needs to decide on a minimum attractive rate of return. It is assumed that all cash flows received from a project can be reinvested at this rate and this rate is used to discount all future cash flows. Furthermore the service life and all cash inflows and outflows during project period need to be calculated(Park, 2007).

For single project evaluation the project should be accepted if NPV(*i*) > 0 as the discounted cash inflows are greater than outflows. If NPV(*i*) < 0 the project is rejected and if NPV(*i*) = 0 an investor remains indifferent to the investment(Park, 2007).

2.5 Weighted average cost of capital

The weighted average cost of capital (WACC) is the weighted average of the tax adjusted cost of equity and debt(Blake, 2000) defined as:

$$k = \frac{i_d c_d}{V} + \frac{i_e c_e}{V} \quad (2)$$

Where c_d is the total debt capital, c_e is the total equity capital, $V = c_d + c_e$, i_e is the average equity interest rate per period, i_d is the after tax borrowing interest rate and k the tax-adjusted weighted average cost of capital. WACC represents the cost of raising capital from both debt and equity(Park, 2007). Brigham & Houston (2007) describe factors affecting the WACC. Interest rates and tax rates affect the WACC directly and cannot be controlled by firms. Capital structure, dividend payout and budgeting decision rules also affect the WACC but can be directly controlled by the firm. Increasing debt ratio will lower the WACC as cost of debt is lower than the cost of equity, but this leads to higher investment risk.

2.6 Internal rate of return

IRR is another way often used to evaluate project feasibility. IRR is based on the return on invested capital in terms of project investment, and shows the return of the project. It is the return a company earns by investing in itself instead of investing elsewhere.

$$NPV(i,N) = \sum_{t=0}^{N} \frac{R_t}{(1+IRR)^t} \qquad (3)$$

IRR is found by setting the NPV function to 0. The project is accepted if IRR is bigger than the proposed minimum attractive rate of return, with investors redeeming acceptable profits of the investment(Park, 2007).

Brealey et al. (2008) discuss various drawbacks of the IRR method. IRR does not account for the investor lending or borrowing money. Another drawback to the IRR method is that it can yield multiple rates of return when dealing with multiple sign changes of net cash flows. This means that decisions are not unique and do not correctly depict non flat term structure of interest rates.

There are various ways to predict and deal with multiple IRR's. The upper limit of internal rates is determined by the maximum number of sign changes for investment periods. When dealing with multiple internal rates, Park (2007) suggests three ways to identify investment rate

1. Direct solution method.
2. Trial and error method.
3. Computer solution method.

Direct solution method is only applicable when dealing with an investment followed by a single payment in the future.

Trial and error method starts with an estimated guess at the IRR. The process is then iterated until PV(*i*) is close to zero. Linear interpolation is then used where PV(*i*) bounded by a positive and negative values. This method is slow and inconvenient and is thus not much used in practice.

The most common way to determine IRR is using a graphical method, where NPV is plotted up against the interest rate. The IRR is found from a point on the graph where NPV(*i*) = 0.

IRR is often preferred by large companies as comparison with cost of capital is easy(Jensen & Smith, 2000). The link between NPV and IRR means that when NPV is positive the IRR is also positive, signaling a preferable investment and vice versa when NPV is negative. When comparing mutually exclusive projects, a project can yield higher IRR but lower NPV than another similar investment. When comparing mutually exclusive projects it is necessary to use incremental analysis to determine the optimal decision(Brealey et al., 2008).

2.7 Modified Internal Rate of Return

External rate of return, also known as Modified internal rate of return (MIRR) is similar to the IRR but uses an external rate of return to determine financial attractiveness. This method is better suited to deal with periodic cash flows generated by investment between purchase and sale of project than IRR and NPV. Another big advantage using MIRR is that it returns a single percentage, it does not have multiple rates for complex cash flows like IRR(Brigham & Houston, 2007). MIRR enables investors to use a varying and more realistic reinvestment rate than the already proposed IRR method. MIRR is calculated in three steps(Kierulff, 2008):

1. Investment funds are discounted to the present using external rate of return determined by project risk and reinvestment rate.
2. Free cash flows are compounded forward at the external rate.
3. MIRR calculated

The MIRR method ranks projects in the same order as the NPV criterion does, but gives a percentage return which managers often favor over a NPV cash figure(Kierulff, 2008).

2.8 Financial ratios

Financial ratios are helpful when evaluating proposed projects. Financial ratios are calculated from the forecasted financial statements of planned projects. They are useful for managers and investors to anticipate performance of investments and for managers to execute adequate steps to improve future performance(Brigham & Houston, 2007). Projecting financial statements by forecasting entity costs and revenues gives a better overview of investment. Investments where there is little experience of project performance should however not be exclusively based on financial ratio analysis(Björnsdóttir, 2010).

Brigham & Houston (2007) divide financial ratios into five categories:

1. Liquidity Ratios
2. Asset Management Ratios

3. Debt Management Ratios
4. Profitability Ratios
5. Market Value Ratios

Liquidity ratios

Liquid assets are assets that can quickly be converted to cash should it be required. Liquidity ratios project how well firms are able to deal with paying short-term debts(Brigham & Houston, 2007). If the coverage is insufficient, firms ability to meet financial obligations is at risk(Saleem & Rehman, 2011).

$$Current\ Ratio = \frac{Current\ assets}{Current\ liabilities} \tag{4}$$

This ratio shows if liquid assets cover current liabilities and is an indicator to determine if a firm is able to pay off its short-term debts. Acceptable minimum of this ratio depends on the industry but a general rule is a ratio above 2(Park, 2007). This ratio can be used by firms for comparing with industry averages. Deviations far from industry average can indicate poor performance of firms(Brigham & Houston, 2007).

Quick ratio measures a firm‘s ability to pay short term debt without relying on inventory which can be hard to expedite to cash without suffering significant losses.

$$Quick\ Ratio = \frac{Current\ assets - Inventories}{Current\ liabilities} \tag{5}$$

The higher this ratio is, the better a firm is able to deal with its current obligations using liquid assets(Park, 2007).

Asset management ratios

These include Inventory Turnover ratio, Days sale outstanding, Fixed asset turnover and total asset turnover ratios(Brigham & Houston, 2007). These are not included in the project and will not be further discussed.

Debt management ratios

Creditors look to how much of a firms equity is supplied to manage investment risk. Debt management ratios give an overview of how a firm uses debt financing for project investment. Using debt leverage for investments can be beneficial for tax deductions, but increases investment risk(Brigham & Houston, 2007).

Debt ratio tells how big of a share creditors have supplied to the total financing of the project. Creditors may prefer to keep this ratio low to reduce investment risk in case of liquidation. High debt ratio can lead to creditors charging higher interest rates to account for this risk(Park, 2007).

$$Debt\ Ratio = \frac{Total\ Debt}{Total\ Assets} \tag{6}$$

Debt service coverage (DSCR) is the ratio of expected income of investment after tax to debt payments(Harris & Raviv, 1990). Creditors use it to determine if prospective project generates enough cash flow to cover debts in each annual period.

$$DSCR = \frac{Cash\ Flow\ After\ Tax}{Interest + Loan\ Principal} \tag{7}$$

Profitability ratios

Profitability ratios demonstrate all financing policies and operating results of the investment. These are reflected in operating results by the combined effects of liquidity, asset management and debt(Brigham & Houston, 2007). Liquidity and profitability ratios of investments are interrelated, when one decreases the other rises(Saleem & Rehman, 2011).

Return on common equity (ROE) is used by stockholders to determine their rate of return. It shows how much is earned by stockholders for their money invested in the project(Brigham & Houston, 2007).

$$ROE = \frac{Net\ Income}{Common\ Equity} \tag{8}$$

Return on investment is the ratio of after tax income to total liabilities. It measures the firms use of assets to earn profits(Park, 2007).Brealey et al. (2008) reject it as a capital investment criterion but state that it is used to determine performance of investment by comparing to the firms cost of capital.

$$ROI = \frac{EBIT}{Debt\ and\ Capital} \tag{9}$$

Market Value Ratios

Market value ratios link firms stock price to its cash flow, earnings and book value per share. If liquidity, asset and debt management along with profitability ratios show stable and promising results these ratios will yield high numbers. This results in solid stock price which in turn pays out dividends or can be sold for profit(Brigham & Houston, 2007). These ratios can be compared to industry averages to determine investment prospects and risks.

$$Internal\ Value\ of\ Shares = \frac{Equity}{Total\ Capital} \tag{10}$$

This ratio describes the projected value of shares in the company. For investors this is an indicator on returns of dividend or value of shares for capital invested.

2.9 Project selection risk

Hillson (2009) concludes that keeping risk out of projects is neither important or at all possible, but instead ensure that project risk is kept at acceptable levels and effectively managed. To ensure that projects succeed, risk needs to be proactively and effectively managed throughout the project. Failure to proactively manage risk can escalate current threats and lead to further previously unidentified problems which can have a big impact on project outcome(Project Management Institute, 2013). Risk that positively effects project outcome is identified as an opportunity and risk that has negative impact is called a threat.

Hull, (1980) states that a lot of investment information comes from speculation. The future is hard to predict and no major project investments are identical although experience from similar projects can be very valuable. There are various uncertain factors that require estimation for prediction in financial models. Factors like market share, production cost, equipment- and construction cost and sales price all require future prediction. These factors have a big impact on the objective of investments(Park, 2007). Reducing menaces that can turn into problems and minimizing effects of materialized problems are the benefits of effective risk management(Hillson, 2009).

Availability of data as well as time and budget constraints determine which risk methods are applicable for each project(Project Management Institute, 2013). Project risk is determined in three steps: Risk identification, risk analysis and risk response(Uher & Toakley, 1999). Fig. 1 shows the standard process for project risk prevention(Hillson, 2009).

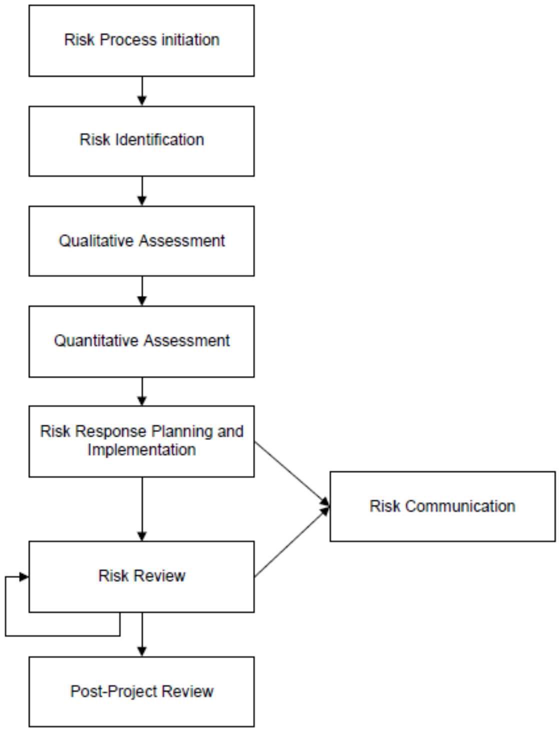

Figure 1 - Risk Process

2.9.1 Qualitative risk assessment methods

Identifying risk is the first step towards successful risk assessment. Risk identification can however produce a long list of risks which need be evaluated. Prioritizing risk for further consideration with respect to project impact on threats and opportunities is thus vital(Hillson, 2009). Qualitative risk methods address this issue individually.

Probability and Impact matrix prioritize risks for further consideration and analysis. Individual risk factors are assigned a probability of occurrence and impact factor based on current information. This can be used by firms to prioritize high impact risks which may require immediate attention. Probability and impact matrix can similarly be used to highlight investment opportunities where high impact factors with the greatest benefits can be targeted first(Project Management Institute, 2013).

2.9.2 Quantitative risk assessment methods

Quantitative risk methods use existing data and predictions to analyze project risk outcomes. Quantitative methods are useful for analyzing combined effects of risk exposure on projects. Both threats and opportunities should be observed when modeling quantitative risk. The biggest threat to quantitative risk assessment is data quality. Models with faulty data lead to incorrect risk assessments(Hillson, 2009). Common ways to assess quantitative risk include Sensitivity analysis, Monte Carlo simulation, three point estimate and decision trees.

Sensitivity analysis

Sensitivity analysis is useful when determining which factors have the biggest impact on project outcome. Sensitivity analysis measures percentage change in net present value for project relevant impact factors. It starts with a base case where previously determined expected values are used for each variable analyzed. Variables range is then deviated from its expected value by several percentages while keeping other variables constant and the effect on net present value is observed. Relative importance of variables can then be plotted separately and compared on a graph with the biggest factors having the steepest slopes(Brigham & Houston, 2007). Key parameters can then be further analyzed to map the risk and changes to parameters more precisely(Björnsdóttir, 2010).

Monte Carlo simulation

Monte Carlo simulation is a powerful approach to modelling risk. It can determine the probability of a project meeting the required financial criteria. It is also useful for determining the uncertainty of a project, i.e if the project outcome range is heavily dependent on some risky factors thus giving a wide margin of results.

Input variables are issued appropriate likelihood distributions. Input variables are randomly drawn based on these distributions for each iteration in the simulation. The expected project outcome usually follows the Normal distribution(Platon & Constantinescu, 2014). Selecting appropriate parameters and distributions is important for the outcome estimate to make sense. Two distributions are used for the Monte Carlo simulation in this paper.

Triangle distribution is a continuous probability distribution that is often used for managerial decision making, business simulations and finance(Bojadziev & Bojadziev, 2007). A lower limit a and upper limit b with 2 linear segments A^l and A^r joined at the peak of most likely outcome c seen in fig. 2.

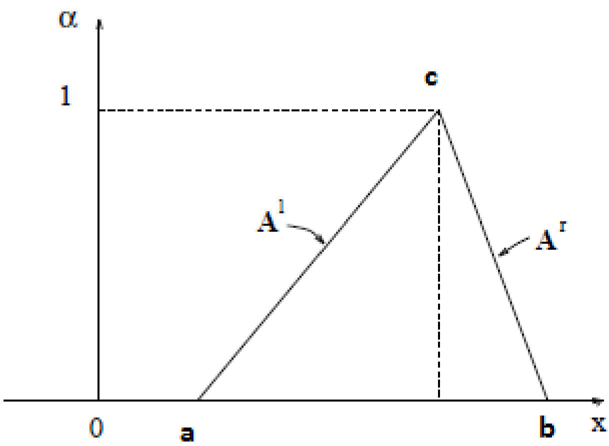

Figure 2 - Triangular distribution

The formula for the triangular probability density function is:

$$f(x|a,c,b) = \begin{cases} \frac{2(x-a)}{(b-a)(c-a)} & for\ a \le x \le c \\ \frac{2(b-x)}{(b-a)(b-c)} & for\ c \le x \le b \\ 0 & Otherwise \end{cases} \quad (11)$$

Pert distribution is a special form of the beta distribution, which similarly to the triangle distribution uses a minimum, maximum and most likely values which determine the shape parameter. When parameters of the distribution are skewed this distribution is generally preferred over triangular distribution as the smooth shape of the curve places less emphasis on direction of the skew(Hutchison & Dettore, 2011). Unlike triangle distribution, Pert has bell shaped curved segments instead of linear which increases probability of values in closer approximation to the most likely value, with bounds at the minimum and maximum values.

The probability density function for Pert distribution is:

$$f(x) = \frac{(x-\mathrm{a})^{\alpha_1-1}(b-x)^{\alpha_2-1}}{\beta(\alpha_1,\alpha_2)(b-a)^{\alpha_1+\alpha_2-1}} \quad (12)$$

Where β is the Beta function, $a = \text{min. value}, b = \text{max. value}, c = \text{most likely value}$. The mean is

$$\mu = \frac{a + 4 * c + b}{6} \quad (13)$$

With

$$\alpha_1 = 6\left\lfloor\frac{\mu - a}{b - a}\right\rfloor \quad (14)$$

and

$$\alpha_2 = 6\left\lfloor\frac{b - \mu}{b - a}\right\rfloor \quad (15)$$

Fig. 3 shows the PERT distribution for sales quantities in a new factory, with a pessimistic estimate of 35.000 tons, a most likely estimate of 45.000 tons and optimistic estimate of 50.000 tons.

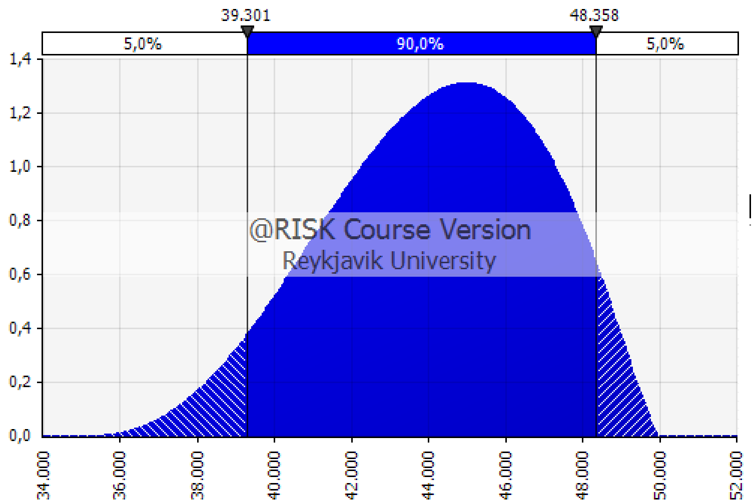

Figure 3 - Pert distribution for sales quantity of fish feed in tons per year

3 Financial Model

A financial model is built to forecast the feasibility of the proposed project. When analyzing the financial feasibility of a project various scenarios have to be considered. Investment projects are usually unique and as such the model has to be customized to fit each project accordingly. Björnsdóttir (2010) states that the best practice is to construct a model from modular components, where modules receive and deliver data from each other. This gives a clear vision of model development, makes resolving errors faster and enhances visualization of the model.

The model is built using Excel spreadsheets, which includes a lot of built-in financial functions that aid the model design. The model is split into modular components which present various functions of the model, making it robust and transparent. Whilst all modules are linked there is a main module with model assumption inputs and main results. This allows quickly adjusting parameters if the model assumptions change. Fig. 4 shows the modules of the model and how they interact with each other. Models used for the case study can be seen in Appendix.

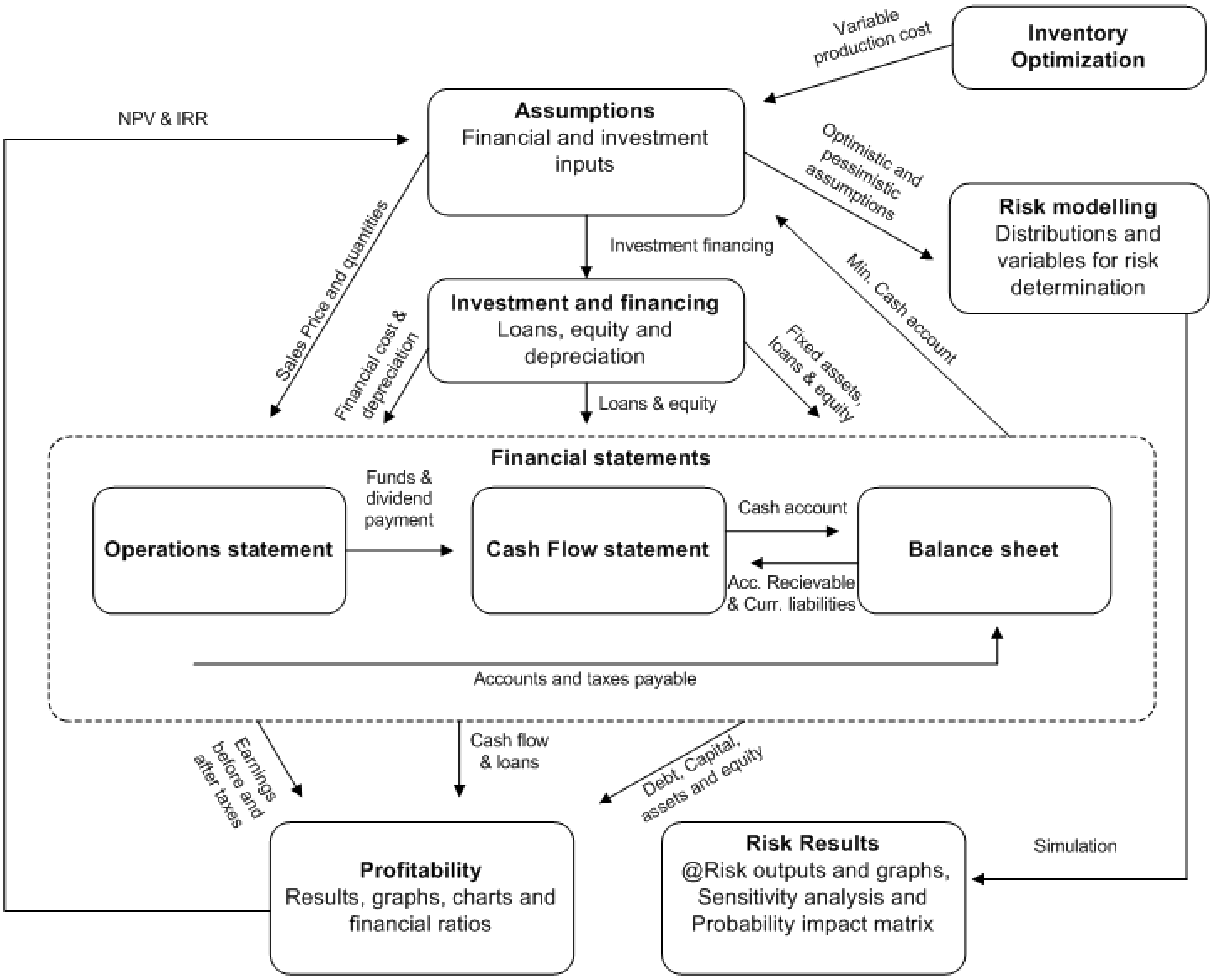

Figure 4 - Model setup and flow of data

3.1 Model components

3.1.1 Assumptions and results

This module contains all the main assumption inputs needed for the financial feasibility analysis. For transparency purposes all input cells are colored teal and are used for financial calculations in other modules. Yellow cells are calculations from modules and should not be tempered with.

Assumptions include input data of project investment and loan requirements, predicted sales price and quantities, along with fixed and variable costs of the project. This sheet also includes other financial assumptions such as MARR, taxes, fees, depreciation and dividend payments. The main investment determining factors NPV and IRR for both total capital and equity are displayed as results from the model in this sheet.

3.1.2 Investment and financing

Financial requirements of buildings, equipment and other project expenses are calculated in this module. Loan requirements are calculated from total investment and working capital requirements. Loan interest rates and repayments are calculated for further usage in other modules. Loans are split up for 3 years since construction and factory set up take a long time and thus the company does not require all the capital during the first year. A grace period of 1 year is set for loan repayments as the project revenue is delayed whilst under construction.

Investment costs and financing requirements of the Laxá project are inserted into the module. A solver method is then applied to the model to minimize the working capital required for the investment while keeping the minimum cash account above 200 M ISK.

The cash account is set to be above 200 M Isk from recommendation of Laxá manager because debtors in this business often pay bills late and having sufficient cash to cover expenses is important.

Depreciation of project equipment and buildings is calculated and used in the operation and income statements modules for tax deduction purposes according to regulations. A straight line method is used for depreciation, as it is the most common procedure in Iceland, and the practice that Laxá uses.

3.1.3 Operation statement

Operation statement also known as income statement calculates net profits/losses for each period of the investment project. This is done annually for the projected investment over 15 years. Operating revenue and expenses are used to calculate earnings before interest and taxes. Earnings before taxes are then calculated from EBITDA , depreciation and financial costs of the project.

Losses within first years of operations are transferred to next period for tax deduction purposes. The financial structure of firms can cause different firms with similar operations to report different net incomes based on debt and equity finance, i.e. companies with debt have interests to pay which are deducted from operating income(Brigham & Houston, 2007). Taxable profit is thus EBT with loss transfer deducted, with the income tax set at 20% which is the standard for Icelandic companies.

3.1.4 Cash flow statements

Cash flow is used in a variety of ways, including paying dividends, financing accounts receivable, retiring debt and buying back common stock. The main factors affecting a firms cash balance are: cash flow, changes in working capital, fixed assets and dividend payments(Brigham & Houston, 2007).

Projected cash flow of the project operation, as well as source and allocation of funds for each annual period is shown in the cash flow statement. This information is valuable to investors as they can determine the value of investment by the cash flow generated by it. Park (2007) states that investment decision should be made on the basis of cash flows rather than profits, as the value of investment depends on the cash flow it generates. Cash flow statements are divided into three categories. Operating activities include net change in operating cash flows from the operating statement, as well as changes in working capital. Investing activities include the buying/selling of fixed assets. Financing activities deal with cash raised by debt or stock, as well as dividend payments(Brigham & Houston, 2007).

Funds from annual operating activities are calculated from EBT and depreciation. Funds for allocation are then calculated from operation funds as well as invoices. Changes in net current assets is calculated as funds for investment, loan repayment, taxes and dividends is subtracted from funds for allocation.

3.1.5 Balance sheet

The balance sheet reports the financial position of the project at the end of each annual period. The three main components are assets, liabilities and stockholders equity(Park, 2007). Balance sheet items are usually listed by the order of liquidity and claims listed by the order of which they should be paid(Brigham & Houston, 2007). The liquid assets of cash, accounts receivable and inventory are listed first. Fixed assets are the buildings and equipment of the project which is depreciated over time and total assets calculated by adding liquid and fixed assets together. Liabilities which include short and long term debt, as well as taxes and accounts payable are calculated for each period. Total capital is calculated from stockholders equity, balance and accumulated dividend payments. Assets of the project should equal to total liabilities. An error check is calculated to verify that financial statements are correct.

3.1.6 Profitability results and graphs

Profitability measurements such as NPV, IRR and MIRR are calculated using built in Excel functions in the profitability results. These measurements are calculated for both equity and total cash flow & capital. Project relevant financial ratios are also calculated using figures from previously discussed excel modules. Cash flow, financial ratios and profitability criteria are then all plotted up for easy graphic visualization of project investment performance over the planning horizon of 15 years. This breakdown gives both investors and creditors good indicators for investment performance and increases credibility of the investment.

3.1.7 Risk module

All modules previously discussed use certain static figures for calculations of cash flow. Both input and output parameters thus report single figures for projection based on assumptions, i.e. a single project scenario is projected. The project scope is wide and there is uncertainty of exact values of some inputs. To grasp the uncertainty of investment and its effects on the project, a risk assessment is conducted. This module contains 3 methods of risk analysis. A sensitivity analysis, a probability and impact matrix and Monte Carlo simulation.

@Risk is a powerful add-in tool for risk analysis in excel. Key input variables are assigned values with probability distributions depending on their occurrence likelihood(Togo, 2004). It is used to perform risk analysis of uncertain factors using simulation. Probability distributions are used to objectively compute various different scenarios of changing parameters based on their likelihood. Each iteration takes in a new set of input values from the predetermined distributions. A probability distribution of the plausible NPV and IRR outcomes is generated from the completed simulation. A tornado graph that ranks inputs by the effect on output mean is also generated. This is useful when dealing with many input and output variables that affect the outcome of the feasibility analysis to see which factors have the biggest impacts on investment outcomes(Togo, 2004).

3.1.8 Inventory module

The inventory module calculates the optimal ordering quantities for three of the main ingredients used in fish feed. To determine the optimal ordering point economic order quantity (EOQ) also known as Wilson lot size is used. Shipping delivery costs for different routes are calculated. Raw material usage per year is calculated from factory production and ingredients of fish feed.

Delivery cost, holding cost and total cost for each raw material is plotted up to graph the optimal ordering point. This is also useful to determine the optimal size of silos required to store raw materials.

4 Laxá Case study

4.1 Project background

4.1.1 Ingredients of fish feed

Fish feed has to contain enough nutrients and energy to ensure maximum growth of fish at different stages of size. Fig. 5 shows the typical fish feed composition at Laxá. The main ingredients are:

- Fishmeal is the main protein provider. Fishmeal contains around 65% of protein and is the single biggest cost factor in producing fish feed. Fishmeal varies from 25% up to 60% of total ingredient in fish feed, depending on the proteins required for different stages of fish growth.
- Fish oil provides important lipids like omega for growth.
- Rapeseed oil and meal is used for its cost effectiveness and as a substitute for expensive fish oil and fishmeal.
- Wheat is used as a binder for fish feed.
- Corn and soya are used as a cheaper alternative to fishmeal due to lower cost for each protein unit.
- Wheat gluten is a high protein meal with 70% protein like fishmeal and used to replace it directly in small percentages when possible.
- Vitamins are added to ensure fish growth is sufficient and healthy
- Natural Color additive is added to salmon and trout fish feed for fillet appearance. It is around 1% of the total ingredients but makes up around 6% of the fish feed ingredient costs.

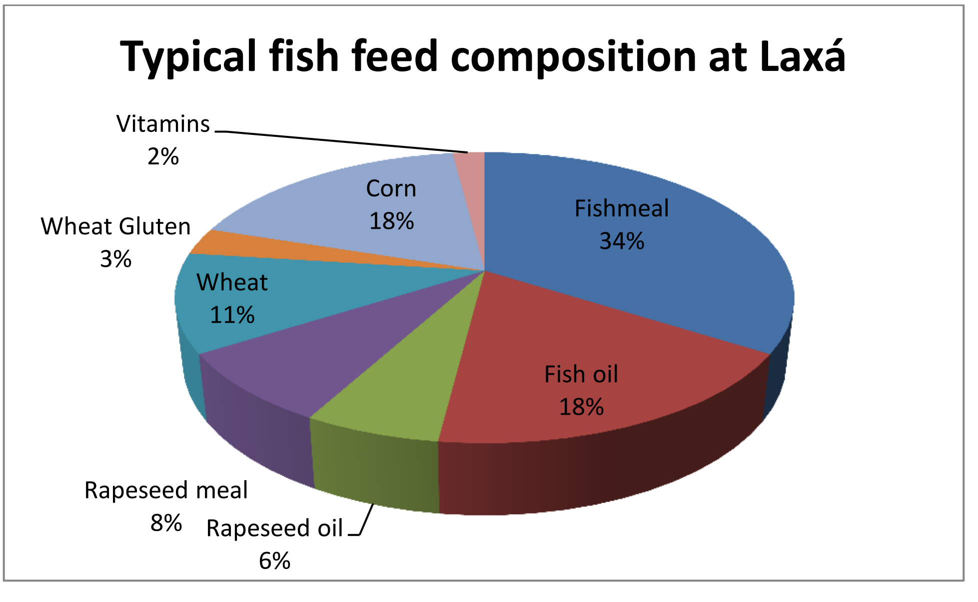

Figure 5 - Typical fish feed composition

4.1.2 Feed origin and transportation

Fishmeal and fish oil come from the parent company Síldarvinnslan (SVN) in Neskaupsstaður. Current procedure is transporting fishmeal daily to Akureyri in containers via road transport Specialized tank ships from Norway are used to fill Laxá‘s silos twice a year when fish oil is collected from SVN.

Wheat, rapeseed oil and rapeseed meal are shipped directly from Denmark using small bulk carriers.

Vitamins and plant meal, including wheat gluten, soya and corn are shipped from Rotterdam quarterly each year. Laxá uses bulk ships for delivery of meal sacks but as the current factory does not have large storage space and for inventory management purposes this ship is shared in collaboration with other companies shipping bulk to reduce transportation costs. Fig. 6 shows the main sail routes for import of raw materials.

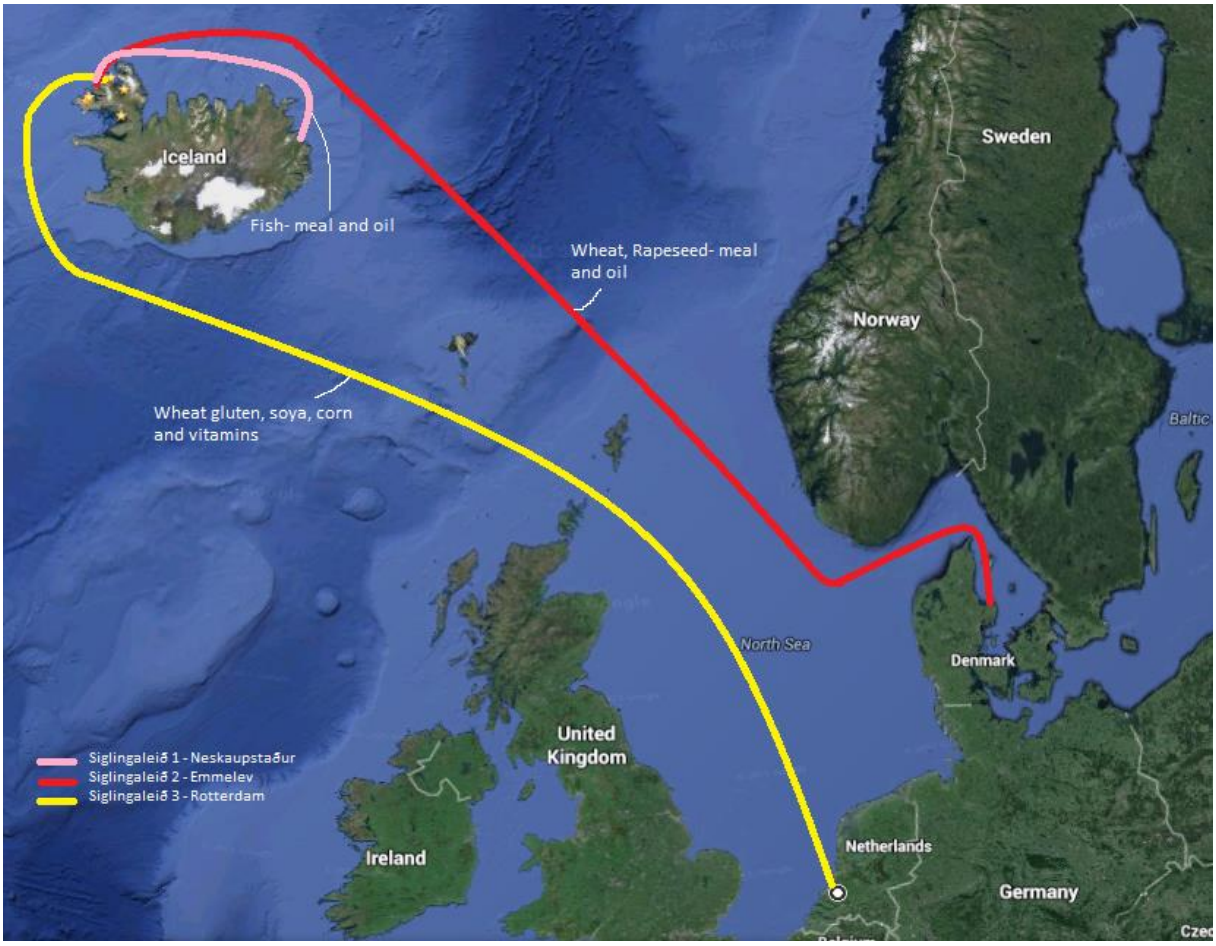

Figure 6 - Raw material sail routes

For a factory producing 50.000 tons a different procedure is required. A new factory requires 1350 tons of fishmeal every month. A bulk ship is needed for delivery of all raw materials. Raw materials are unloaded straight from the ship to conveyor belts and into silos for storage.

4.1.3 Fish feed production

The fish feed is currently made in batches of 2.5 tons, but a new factory with a more automated process is set to make batches of 20 tons. All ingredients except for vitamins and color are stored in silos. The factory operator gets a recipe which has been optimized by the factory manager to minimize cost whilst meeting all desired nutritional value criteria. Ingredients are automatically sent to a scale which weights correct amounts of each ingredient according to the recipe. Vitamins and color are then added by manual labor. Ingredients are mixed together and heated up. Water vapor is added for binding, ingredients put through an extruder and shaped into pellets. Pellets are dehydrated and coated with oils to get fat percent to an acceptable level. They are then cooled down, filtered and the end product put into sacks. Fig. 7 shows the manufacturing process at Laxá. To minimize raw material cost the deformed pellets filtered out as deposits in the process are reused.

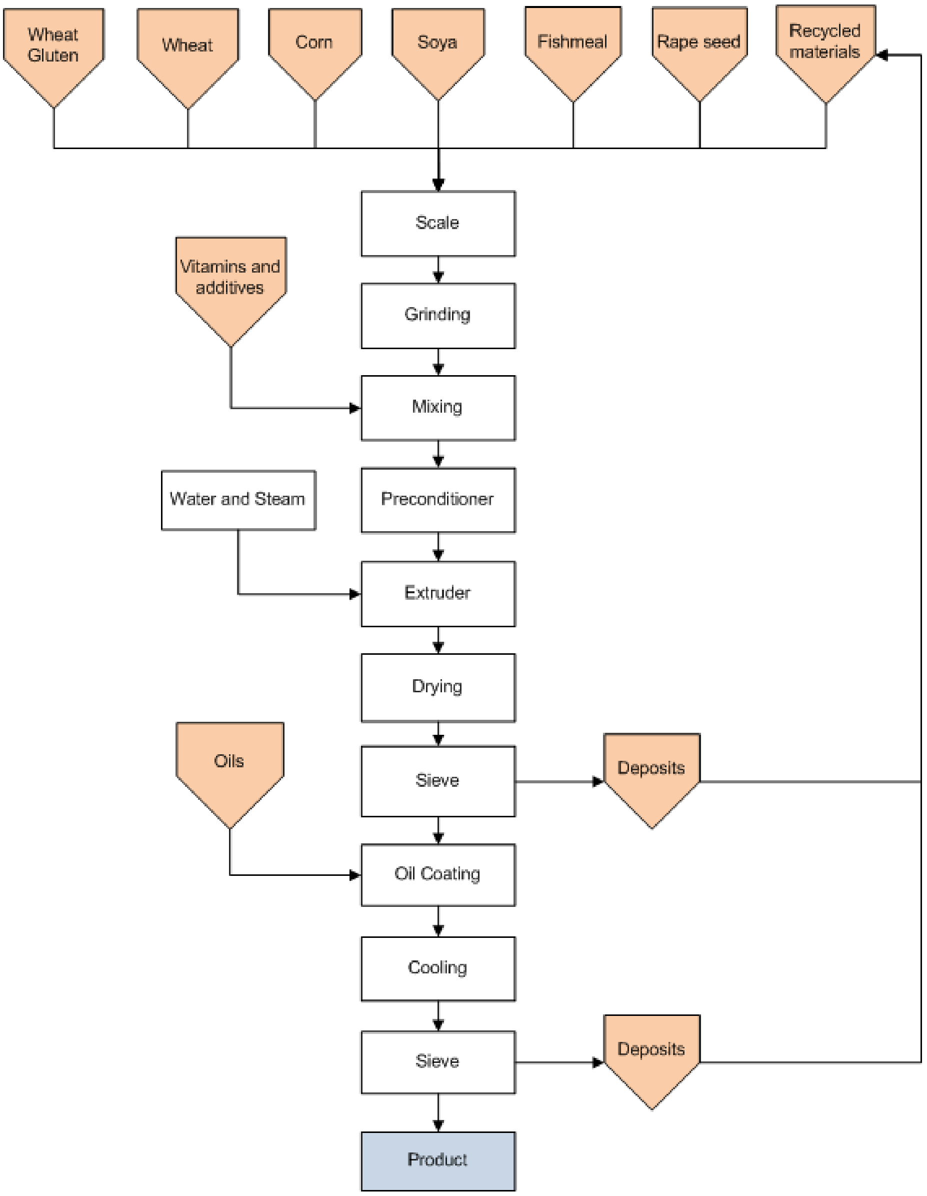

Figure 7 – Product manufacturing process for fish feed

4.1.4 Fish feed types

The factory produces many varieties of fish feed to account for different types and sizes of fish being farmed. Laxá is able to produce seven sizes of pills which range from 1.8 mm up to 12 mm. Laxá produces fish feed for 4 fish farming species: Arctic char, rainbow trout, salmon and cod.

During winter when sea temperatures decline the fish growth is reduced. This results in a change of diet. Rape oil proportions are increased to 60% of total fats in winter feed. Winter feed for salmon is produced in three pellet sizes from 4 mm to 9 mm. This demand for an extensive variety of products leads to the need for a large warehouse for storage of all product ranges.

4.2 Project incentive

To stay competitive in the market and to profit from the rapidly expanding fish feed market Laxá needs to either upgrade their existing facilities or construct a new factory. Fig. 8 shows the development of fish farming in Iceland the last 5 years, and 2015 projects almost threefold increase in tons slaughtered from 2010. Competitive advantage is to be gained by producing fatter fish feed than factories in Iceland are currently able to make. With increased optimization many investors are realizing that fish farming can be very profitable in Iceland. The long term goal is to be able to sell 50.000 tons of fish feed on the domestic market. Laxá currently controls around 60% of the market in Iceland and with a new factory the goal is to acquire a 20% increase on the domestic market.

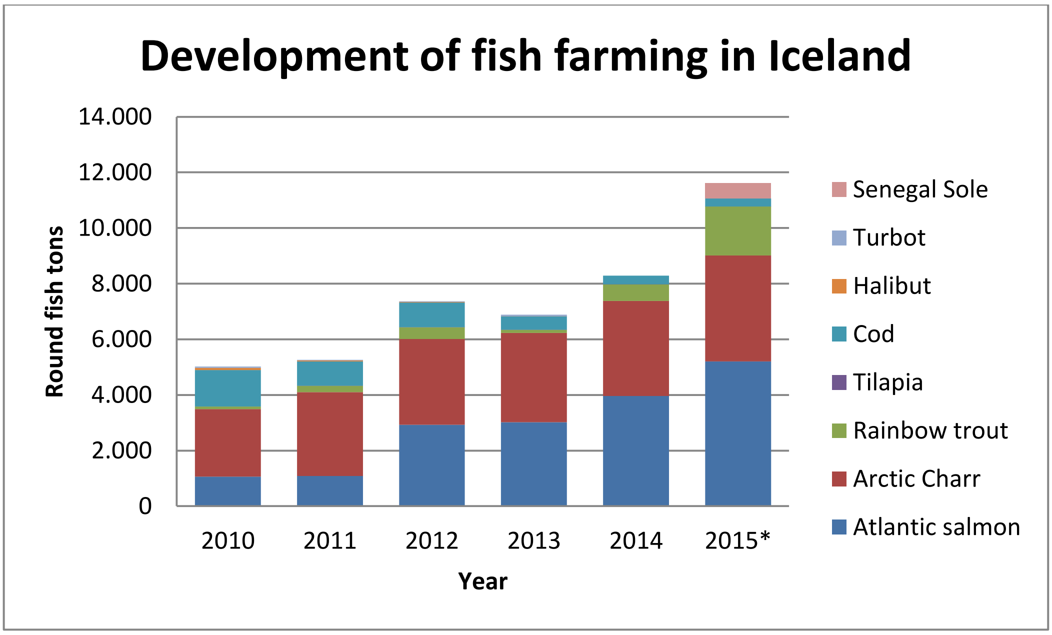

Figure 8 - Slaughtered fish from farms in tons per year(Jónsson, 2015)

The case of constructing a new factory, financial feasibility of the project as well as determination of location and risk involved are considered.

An alternative case of Upgrading current Laxá facilities at Akureyri to a more automated raw material handling with larger silos and equipment that produces fatter feed is also presented.

4.3 Competition analysis

Laxá sells their products to all of the biggest fish farms in Iceland except for Fjarðalax and Fiskeldi Austfjarða which buy their feed from a Faroese supplier due to their increased demand for 90 day imprest which Laxá could not agree to. Fóðurblandan has around 10% share of the market which mainly goes into supplying small fish farms on land. They are also considering building a new factory and are having plans sketched up of a new factory for them as well. Right now there is clearly not enough room for 2 large factories in Iceland to supply domestic fish farms so odds are that either competitor will prevail if both decide to construct factories at similar times. Laxá currently has low debts and their equity is very high so constructing a new factory might be easier for Laxá with higher capital than Fóðurblandan.

There is also competition from the international market, mainly the Faroe Islands and Norway which both have very large fish feed factories. Havsbrún in the Faroe Islands is owned by Bakkafrost which is a fish farming company. They have the advantage of producing their own fishmeal and fish oil at the same factory and thus can decrease their transport and fish feed production costs. Currently they mostly produce for the Faroese market and a small part of their production goes to Norway and Iceland.

Giant fish feed factories are also located in Norway. EWOS runs 3 plants which produce more than 200.000 tons of fish feed each and Skretting operates the largest fish feed factory in the world with a capacity of 450.000 tons, roughly 9 times bigger than the proposed Laxá project. Marine Harvest and Biomar also operate large factories. With the Icelandic fish farming market relatively small the international companies have not expressed much interest in selling their products there and thus the competition from these factories has not been a risky factor.

Over the recent years Laxá has lost some of its market share to foreign companies being able to produce fatter feed and give more slack in payback of products. With very competitive facilities and expansions in Icelandic fish farming, foreign fish feed companies might however turn their eyes to the Icelandic market in an increased manner.

4.4 Cost analysis

Cost analysis is used to assess the operating environment and to determine optimal operation parameters. The model is also used to shed light on investment risk and give a clear vision of all cost aspects. Acquiring a clear view of foundation costs is very important to determine if the project is profitable and should be invested in. A turnkey investment analysis has been made for the factory by a Danish company called Graintech A/S. Fish feed price was calculated from the annual financial statement of 2014 as 176 Kr/kg. Factory manager at Laxá confirmed that this was the average price of feed excluding VAT. Raw materials constitute of 85-86% of total feed cost, calculated at 149 Kr/kg.

4.5 Option 1 – Constructing a new factory

4.5.1 Housing

Laxá has 2 options for housing when constructing a new factory. The first option is to move the factory into an already existing empty factory space. The second option is to construct a new factory from scratch. The advantages of moving the factory into existing space is that it is considerably cheaper as empty industrial housing in the Westfjords is inexpensive. There is already an old empty capelin rendering at Bolungarvík harbor which might be feasible for the operation. The drawbacks of using existing factory space is that layout might not be optimal for fish feed production and thus require extensive renovations. Another problem is unexpected repair costs for old housing. This report will therefore focus on the construction of a new factory. It is assumed that the factory will get concession when finding a vacant lot due to future benefits for the municipality in which the factory is constructed in. The factory itself does not require a big area for operations but a warehouse to store all types of products is space consuming. From a turnkey solution made by Graintech A/S the cost of housing is estimated at 1.000 M ISK.

4.5.2 Equipment

Machinery in the factory is expensive. 8 large silos are needed to keep ingredients separated. Ingredients are pumped directly from ships via pipeline to the silos.

The main equipment in the factory is the following

- Conveyor belts from harbor to silos and silos to factory.
- 8 Silos able to store 4000 tons.
- A large scale to weigh raw materials for every batch of feed
- A mixer to blend all raw materials
- A compression extruder to shape pills out of mixed raw materials
- Dryer to extract all water moisture out of pellets.
- Vacuum compressor oil coater for coating of pellets.
- Forklifts for transportation of raw materials and products.

From a turnkey solution this cost is estimated to be 1.300 M ISK.

4.5.3 Other costs

Other costs include acquiring an environmental assessment and licenses estimated at 20 M.ISK, lot purchasing at 60 M.ISK and interior and exterior layout design of the factory and setup 120 M.ISK. This totals to 200 M.ISK and is depreciated over 5 years.

A new factory operates on shifts. Staffing requirements are 4 persons per shift with the factory running on 3 shifts 7 days a week and 4 managerial staff up to a total of 20 factory workers. Labor, electricity and maintenance are calculated as fixed costs, adding up to 240 M ISK per year.

4.6 Option 2 - Upgrading the old factory

The main reason for constructing a new factory is for Laxá to stay competitive in the business. Another option for considering is upgrading the old factory. Increasing raw material storage is important to minimize transportation costs of and take advantage of economies of scale. The addition of 8 silos storing 300 tons each is considered. Annual production of 20.000 tons requires 8.400 tons of plant meals yearly so a quarterly restocking of silos would be sufficient. The total setup cost of 8 silos and conveyor belts to and from silos and setup is 250 M ISK. Fig. 9 shows the proposed silo setup from Assentoft Silo A/S at current Laxá factory.

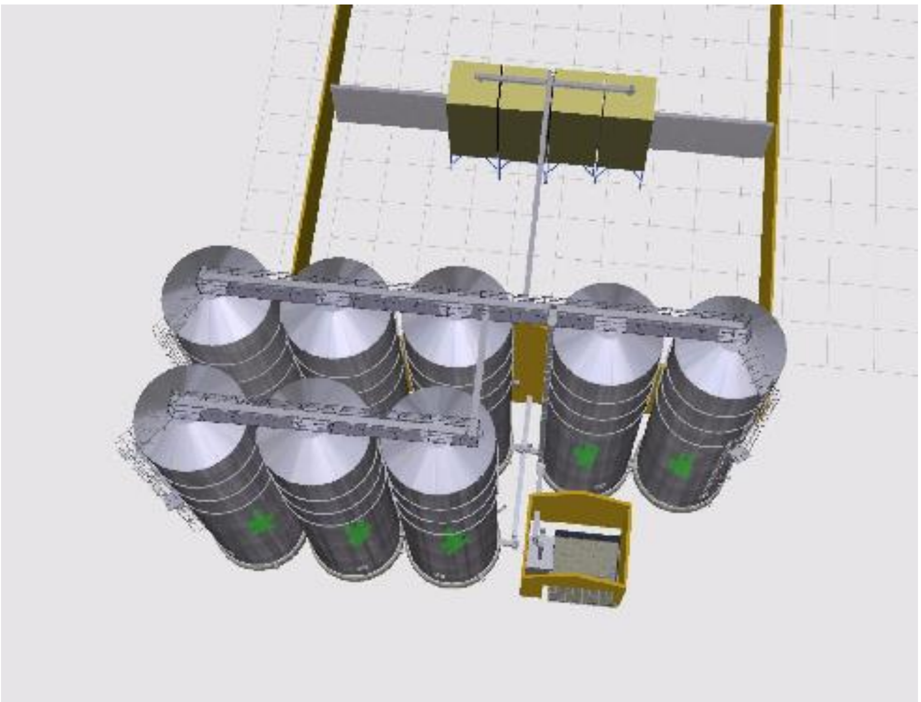

Figure 9 - Sketch of silo layout from Assentoft

Upgrading the factory extruder to be able to produce feed with higher fat content, as market demand is gradually increasing for fatter feed is also required. The cost of upgrading factory equipment is estimated to be 300 M ISK. A shed for delivery of raw materials and concrete foundations for silos are also required totaling up to 100 M ISK. The calculated total cost for a factory upgrade is 650 M ISK.

This requires a smaller capital investment from Laxá which can be financed with a bigger part of equity than building a new factory. The factory is currently able to produce 12.000

tons at full capacity. 8.000 tons is the overall added capacity that the upgraded factory will be able to produce.

The drawbacks to an upgrade is that the factory will not be able to produce more than 20.000 tons in full production, current factory requires more manual labor than a proposed new factory when comparing product output. Facilities are getting old and worn out. Fixed costs of running the old factory are higher compared to a new one as more maintenance is required with older equipment and the process requires more manual labor. Producing 20.000 tons requires 3 shifts for 7 days a week from June to December and 2 shifts otherwise. This requires 12 workers and 4 managerial staff for a total of 16 jobs. The total fixed costs of operating the upgraded factory is 192 M ISK up from 147 M ISK. Additional 45 M ISK are thus required to operate the factory at full capacity.

The fish farming market is currently expanding rapidly and the prospects look good, but past experience proves that the market is volatile. Chances are that 20.000 tons will be sufficient for the domestic market the next 5-10 years but if the growth continues and Laxá goes for the upgrade it might have to reconsider a new factory construction in the next decade.

5 Results

5.1 Inventory optimization

Optimizing the size of silos for raw material storage is important to keep the cost of raw materials used in production as low as possible. Demand of raw materials for production in the factory is reasonably stable throughout the year, i.e. there is little uncertainty concerning the level of demand for each production period. The size of silos required for three of the main ingredients at the factory are determined by the economic order quantity (EOQ). EOQ is determined by(Silver, Peterson, & Pyke, 1998):

$$EOQ = \sqrt{\frac{2AD}{vr}} \quad (16)$$

Where $A = fixed\ costs\ (transportation)$, $v = unit\ variable\ cost$, $D = demand$ and $r = carrying\ charge$

Fig. 10, 11 and 12 show economic order quantities for fishmeal, wheat and corn. This is based on the production of 50.000 tons of fish feed each year. From these figures it can be derived that optimal order quantity for fishmeal is 1285 tons, 3460 tons for wheat and 5110 tons for corn. Cost of renting a bulk ship domestically is calculated as 3000 EUR per day with daily oil costs of 600 USD. Sailing from Rotterdam to Ísafjörður takes 5 days cruising at 10 knots and thus a rent period of 10 days is used for wheat and corn, but 3 days for shipping fishmeal from Neskaupsstaður.

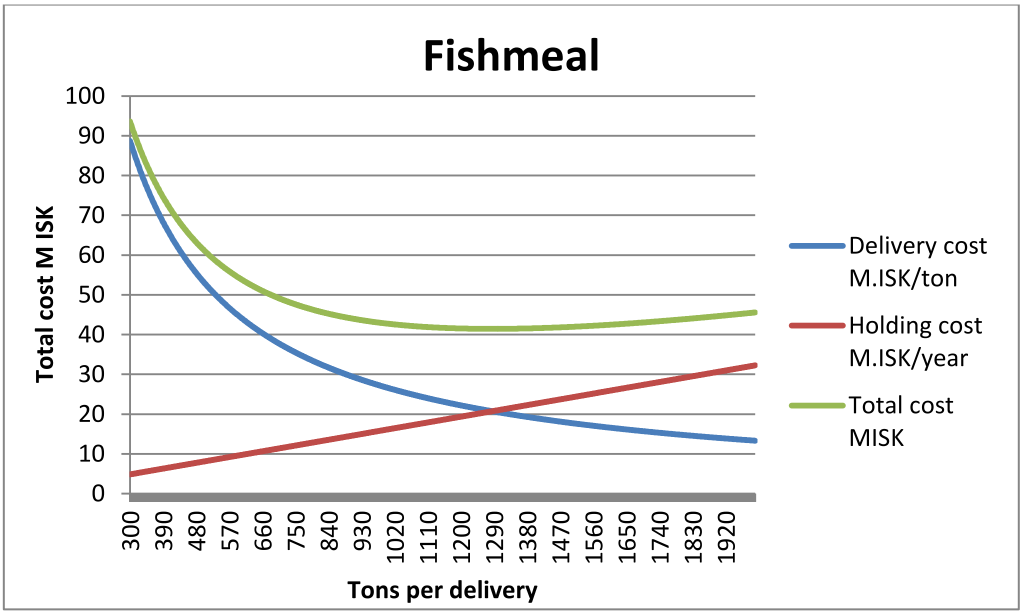

Figure 10 - EOQ for Fishmeal

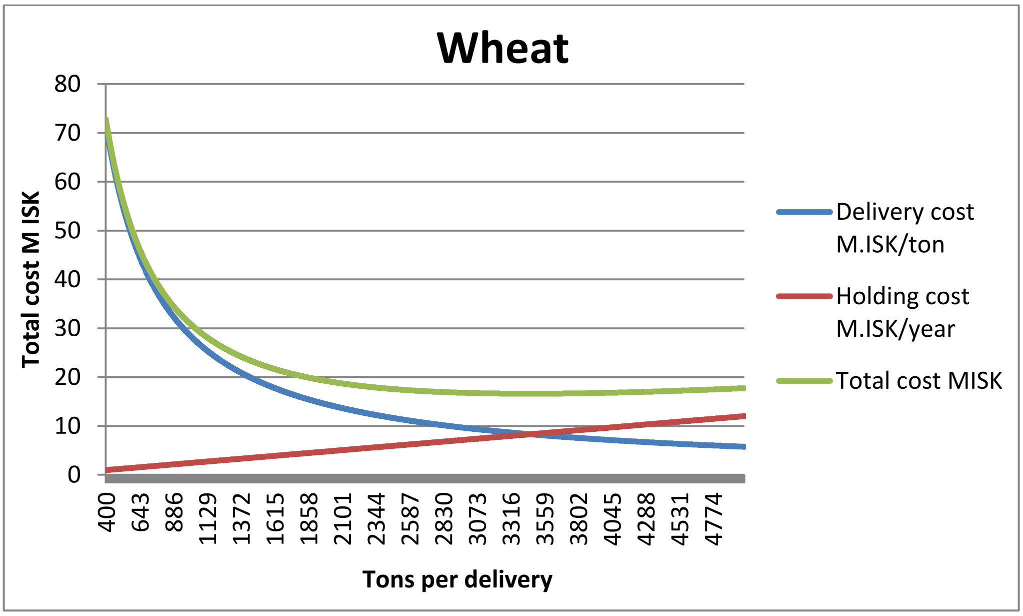

Figure 11 - EOQ for Wheat

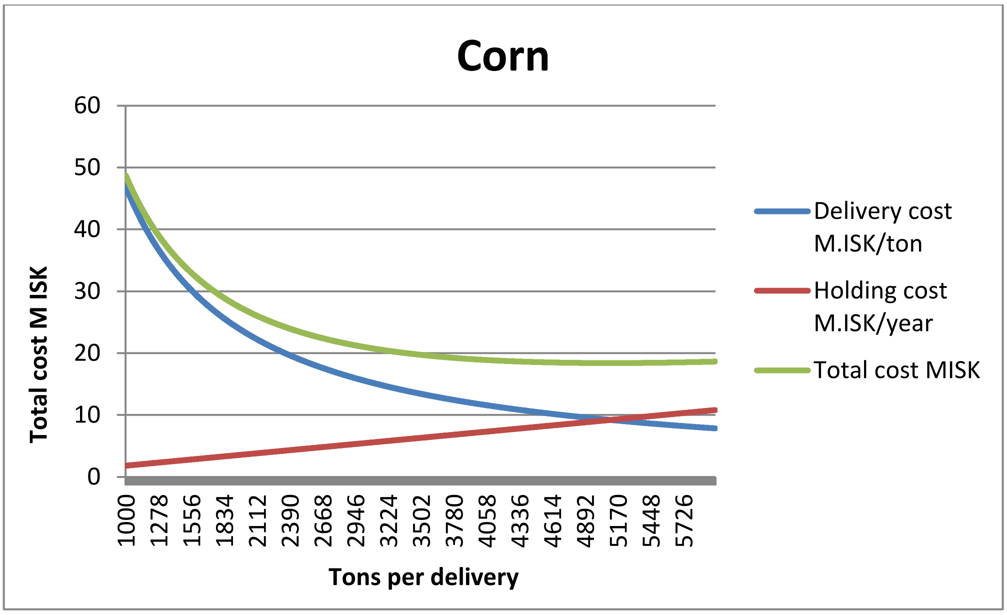

Figure 12 - EOQ for Corn

An upgraded old factory has the capacity for production of 20.000 tons each year. The EOQ for 20.000 ton production is found similarly. The EOQ for 20.000 ton annual production is 812 tons of fishmeal, 2187 tons of wheat and 3230 tons of corn.

By optimizing the delivery and holding costs of raw materials with larger silos it should be possible to reduce variable cost for new factory production by 1% down from 85% to 84% or 0,147 M ISK per ton. For a low margin commodity like fish feed this has a significant effect on project returns.

5.2 AHP location determination of a new factory

Analytic hierarchy process (AHP) is used in various areas of operations management. These include planning, resource allocation and selecting best alternatives(Subramanian & Ramanathan, 2012). Benefits of using AHP for determination of location is its ability to address complex, multi-attribute factors hierarchically(Liu & Hai, 2005). Each level of hierarchy is structured starting with the lowest level, to the highest level which is the general objective of the AHP.

For each hierarchy level the corresponding factors are estimated independently in a matrix. Weights of each factor are then determined by combining and normalizing the matrix. This yields the weights for the next hierarchy level. The ranking is then used to construct the next level of hierarchy until the process is complete and the general objective is realized. This produces integrated results for all project alternatives(Subramanian & Ramanathan, 2012).

Laxá is partially owned by Síldarvinnslan í Neskaupsstað (SVN) which produces all fishmeal and oil for Laxá which in turn means increased rationalization. The factories are however in different parts of Iceland and thus transport costs of fishmeal to Laxá are substantial. Transportation costs of fishmeal and fish oil could be reduced considerably if the factory would be placed in close proximity to Neskaupsstaður.

There are plans in the making for fish farms stationed in the Eastfjords. These plans are however still undergoing environmental impact assessment. Fish farming is well under way with fish farms already operating and more future growth predicted with current licenses in the Westfjords. Westfjords were selected as the basis for location determination. An analytic hierarchy process was conducted to figure out the most feasible location for a new factory located there. Weights were given to each factor, with access to a good harbor, labor and market proximity the most important aspects.

Factor	Weights
Harbor	**0,31**
Labor availability and proximity	**0,32**
Market proximity	**0,21**
Routes open	**0,12**
Existing available housing	**0,04**

Table 1 - AHP Contributing factor weights

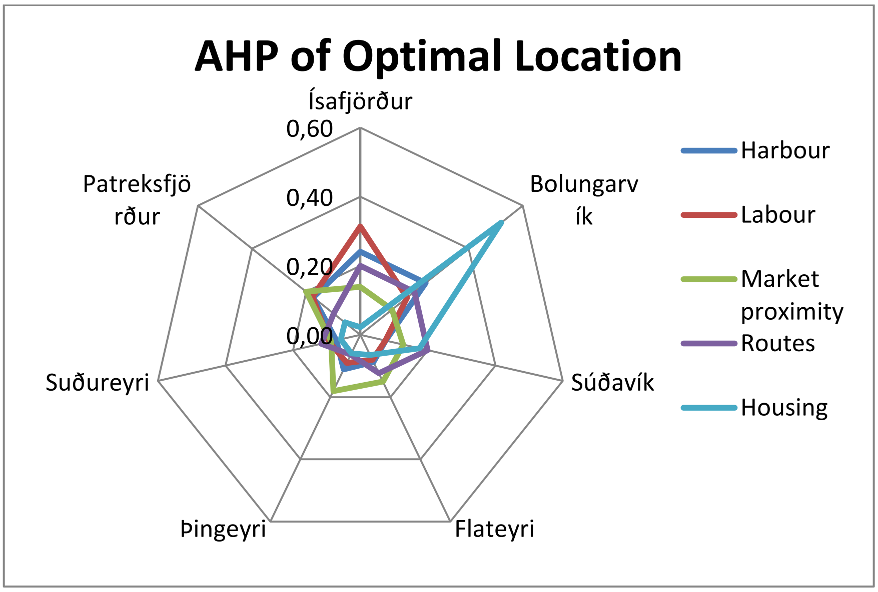

Figure 13 - AHP weights for all locations

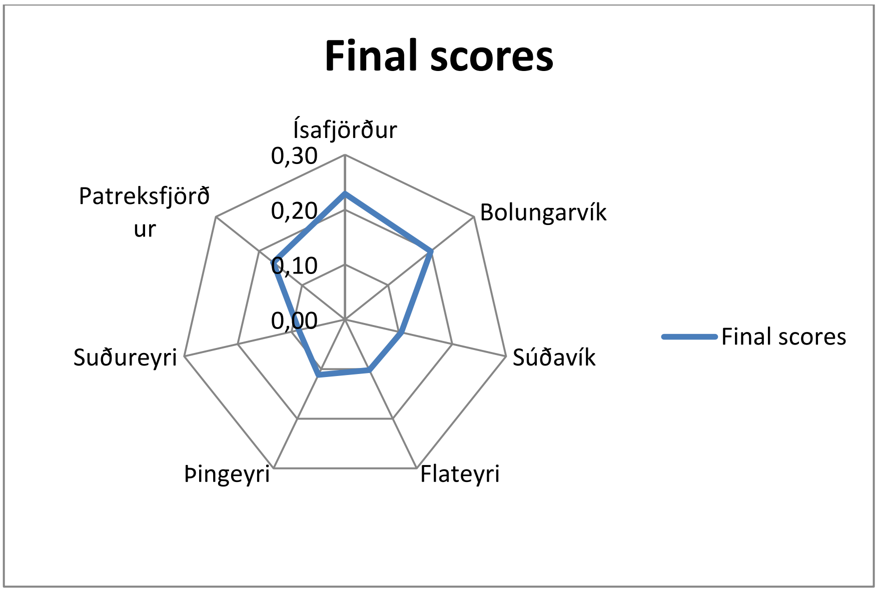

Figure 14 - AHP Final scores

Fig. 14 shows that Ísafjörður is the optimal location with Bolungarvík and Patreksfjörður finishing as runner ups. These towns all have a good access to a deep harbor in common(Landmælingar Íslands, 2012), but increased benefits of access to labor ranks Ísafjörður highest. Patreksfjörður is in closest proximity to current fish farms but there are a few plans of new fish farms located close to Ísafjörður and Bolungarvík. The three best options should be further examined and evaluated when determining final location placement of the factory.

5.3 Profitability results

The main results of profitability calculations based on projected investment cash flows for the planning horizon of 15 years for the 2 investment options can be seen in table 2. Screenshots of the financial statements model and the detailed investment evaluation can be seen in the Appendix.

Both project options yield positive NPV and IRR at the end of the planning horizon. Construction of a new factory has a positive NPV of net cash flow of 734 M ISK and the IRR of net cash flow of 18%. Similarly for a factory upgrade the NPV of net cash flow is 231 M. ISK and an IRR of 25%. Both projects surpass the MARR of 12% at the end of 15 years.

Summary of results			
Assumptions			
	Case 1 - New factory	**Case 2 - Factory Upgrade**	
MARR	12%	12%	
Total investment	2.500	650	M ISK
Working capital	1.220	267	M ISK
Total Equity	1116	275	M ISK
Total Loans	2604	642	M ISK
Variable Costs	0,147	0,149	M ISK/Ton
Fixed Costs	240	192	M ISK
Max. Production per year	50000	20000	Tons
Results			
NPV of Capital Investment	917	264	M ISK
NPV of Equity	734	231	M ISK
IRR of Capital Investment	17%	18%	
IRR of Equity	18%	25%	

Table 2 - Summary of results

Graphs and Charts

The projected cash flows for both investment options is presented in fig. 15 and 16. The graphs show cash flows for both capital investment and equity of the project. The first 4 years while a new factory is still under construction and starting up the cash flow is negative. Total cash flow turns positive in 2019.

The main cash outflow for a factory upgrade is in the first year as 650 M ISK are required for funding the improvements. The project takes 2 years to recover and cash flow turns positive in 2017. The cash flows for a new factory in full production are higher as there is more production output with a slightly higher profit margin of each ton produced than the additional production for upgraded factory.

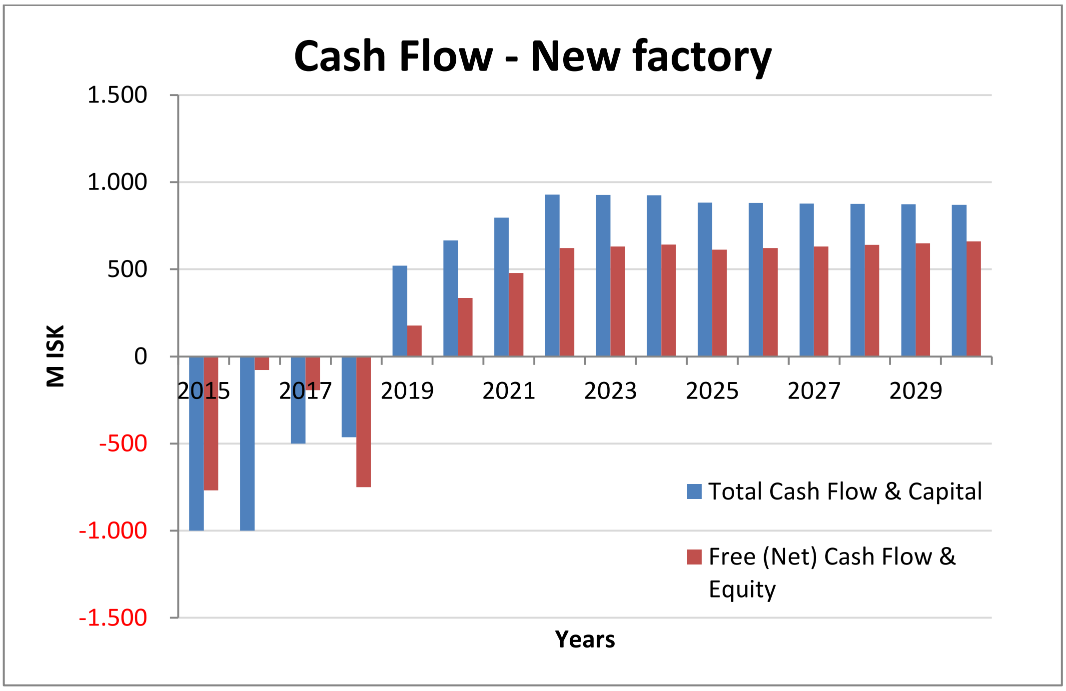

Figure 15 - Cash flow - New Factory

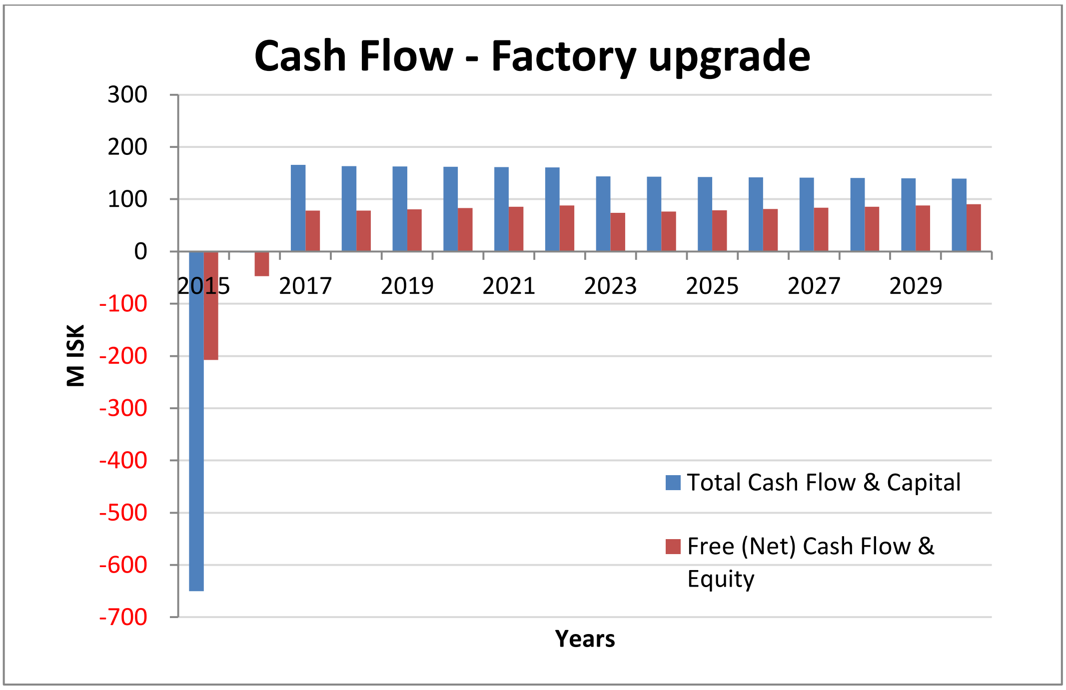

Figure 16 - Cash flow - Factory Upgrade

The accumulated NPV is illustrated in fig. 17. As seen from the graph the NPV of net cash flow for a new factory does not turn positive until 2025. This makes constructing a new factory a potentially risky investment. A steep gradient from 2018 when the factory goes into production however means that the project starts yielding returns quickly and after 15 years it has higher accumulated NPV than a factory upgrade. The NPV of net cash flow for a factory upgrade turns positive in 2020 making it a safer investment but a flatter gradient does not yield as high accumulated NPV at the end of the project lifetime. Both options have NPV>0 at the end of the project horizon and are therefore prospective options. A new factory is a riskier investment because of the longer period of negative NPV. The MARR might need to be raised in comparison with a factory upgrade, which in turn lowers the NPV of the project. Raising the MARR for a new factory to 14% reduces NPV to 437 M ISK which is similar to the NPV of a factory upgrade.

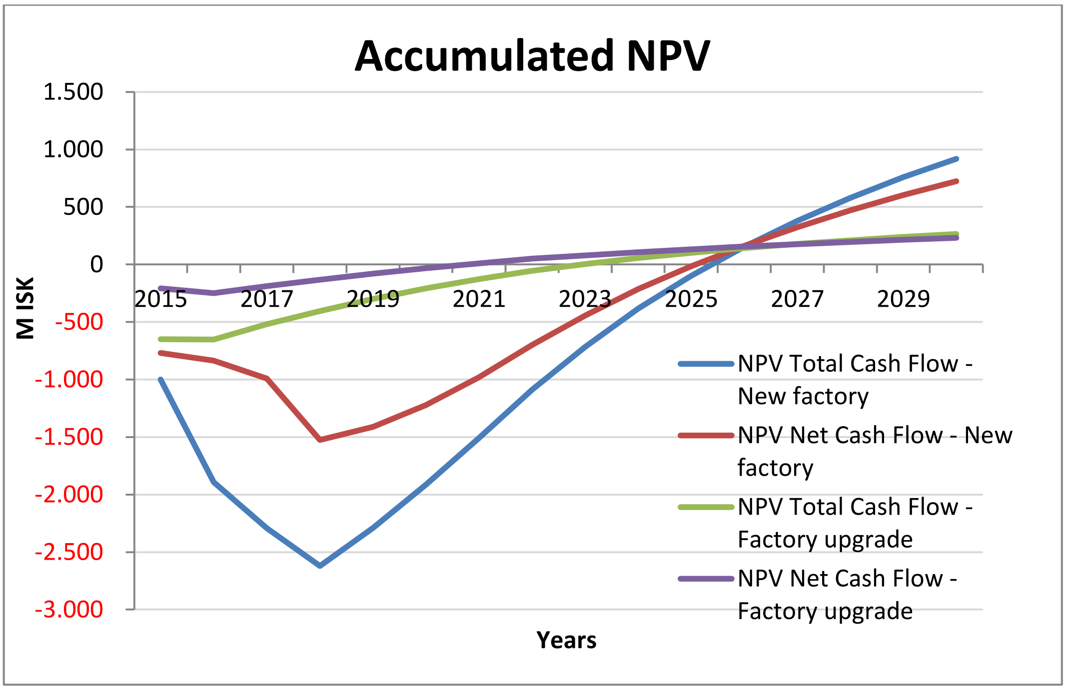

Figure 17 - Accumulated NPV

Fig. 18 suggests that the IRR of the factory upgrade climbs above the MARR of 12% in 2020 and for a new factory it goes above the discount rate in 2025, or at the same times as the projects turn positive NPV. At the end of the planning horizon the IRR for the factory upgrade is 25% and 18% for a new factory. Comparing the NPV and IRR of both options shows that both investment options have their merits. A new factory yields higher NPV while the factory upgrade has higher IRR.

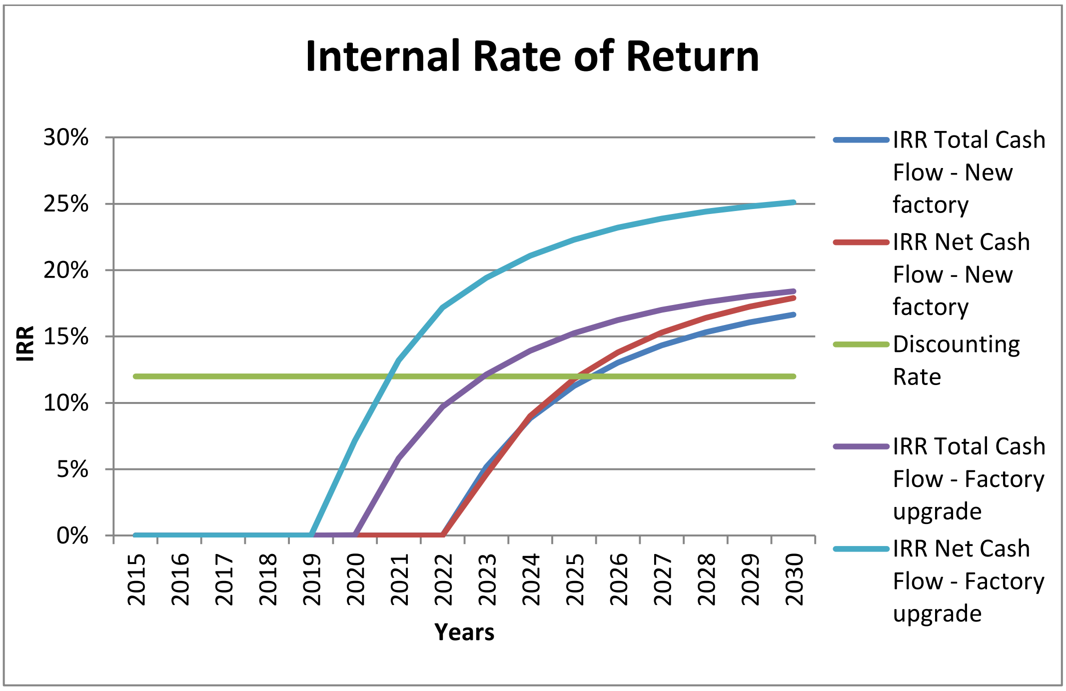

Figure 18 - Internal rate of return

Financial ratios are calculated from the profitability measurements plan. The ratios can be used to determine how the company project holds up for the investment period, as well as giving comparison with other similar companies.

Debt service coverage ratio is the indication of the company ability to pay debts with the cash flow from operations. From fig. 19 it can be seen that debt service coverage is acceptable from 2019 when a new factory goes into full production. The DSCR is below the acceptable minimum of 1.5 the first four years as no revenue is generated the first three years. For the first 4 years the extra cash from loans is used to cover debts. This could indicate that the company operations would be volatile the first few years and potential risk of the investment.

Fig. 19 illustrates that for a factory upgrade the DSCR drops below acceptable minimum the first year but quickly recovers as it is assumed that the factory will continue operations for a major part of the year while under renovations.

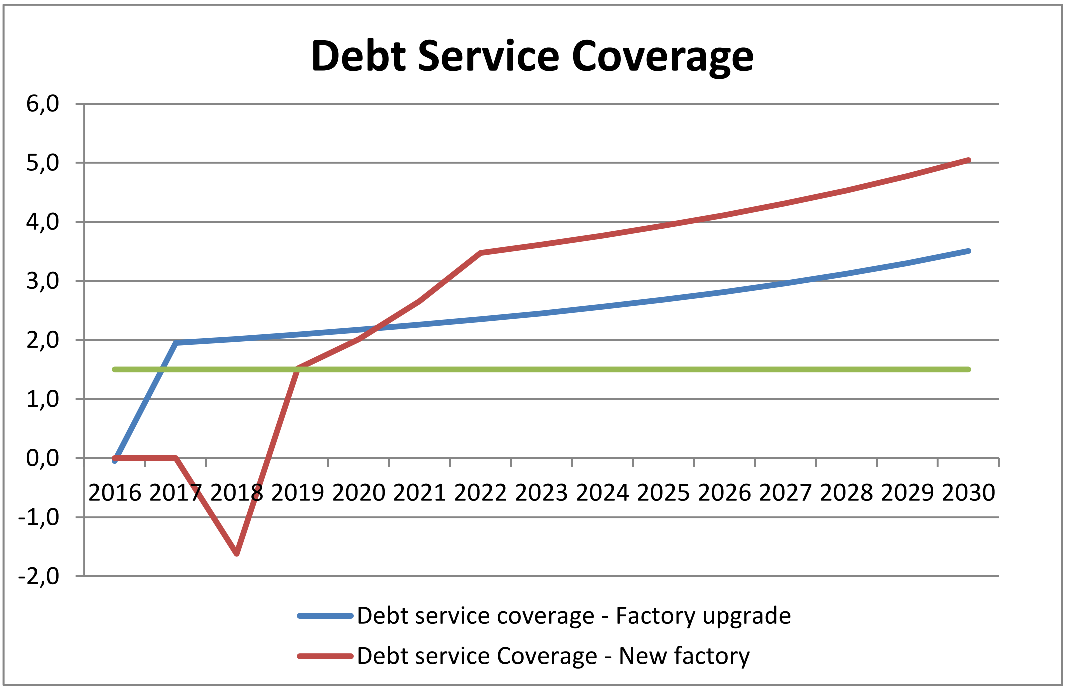

Figure 19 - Comparison of DSCR

Fig. 20 shows the liquidity ratios for both options. Current ratio evaluates company capability to pay down short term debts. The current ratio for a new factory drops quickly after the first three years when most of the firm's capital is used for construction, and production has not started, and hits 2.3 at 2018. This is still acceptable as it is recommended that current ratio is above 2. Quick ratio measures firm's ability to pay down short term debts without liquidating inventory. The quick ratio for a new factory drops to 1.8 which is below the benchmark rate as inventory builds up at the start of production, but quickly recovers. After 2018 the working capital is increasing faster than short term debt so the company should be able to pay its debts.

The current ratio for factory upgrade stays above the benchmark rate the entire planning horizon and gradually rises up to 5.7 at the end of the planning horizon. The current and quick ratio graphs for a factory upgrade are very similar as inventory build-up is neglible with already existing inventory.

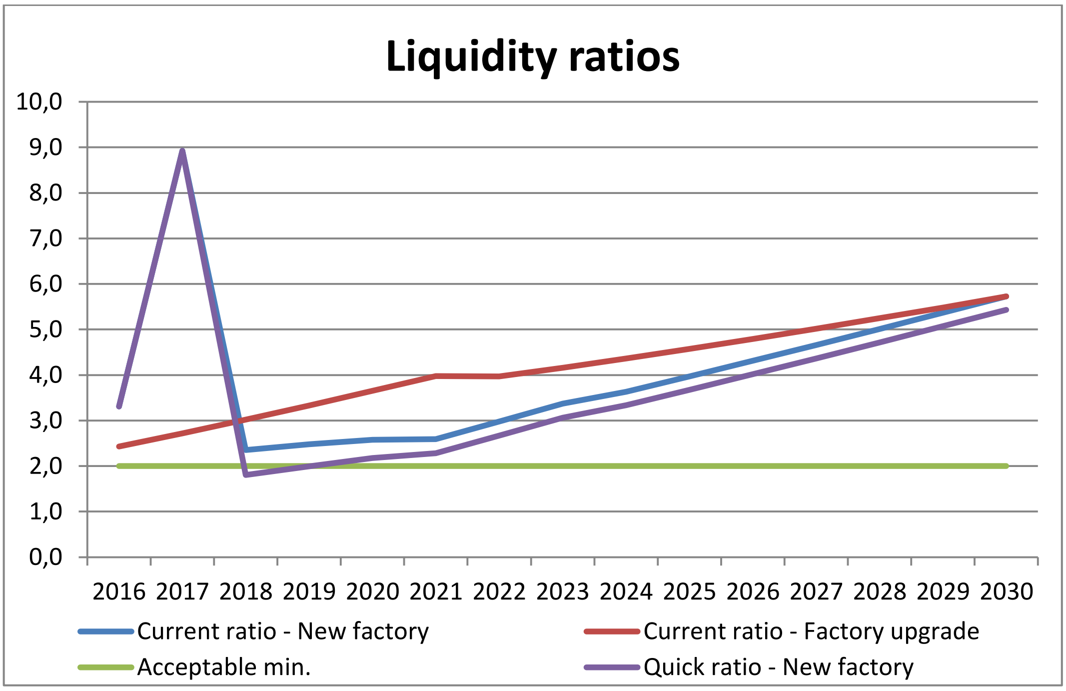

Figure 20 - Comparison of current ratios

Return on investment is the calculated return of the investment divided by total liabilities. When interpreting the ROI it must be considered that firm's capital increases as investment generates revenue over time, raising the denominator and thus decreasing ROI if the money is not reinvested. For the case of constructing a new factory, the return of investment quickly climbs from factory startup and then gradually declines again as company capital increases over time. Similarly for factory upgrade the ratio rises at the start of production and spikes in 2022 when equipment has been depreciated. The ROI declines slowly from 2022 as reinvestment of capital is not assumed.

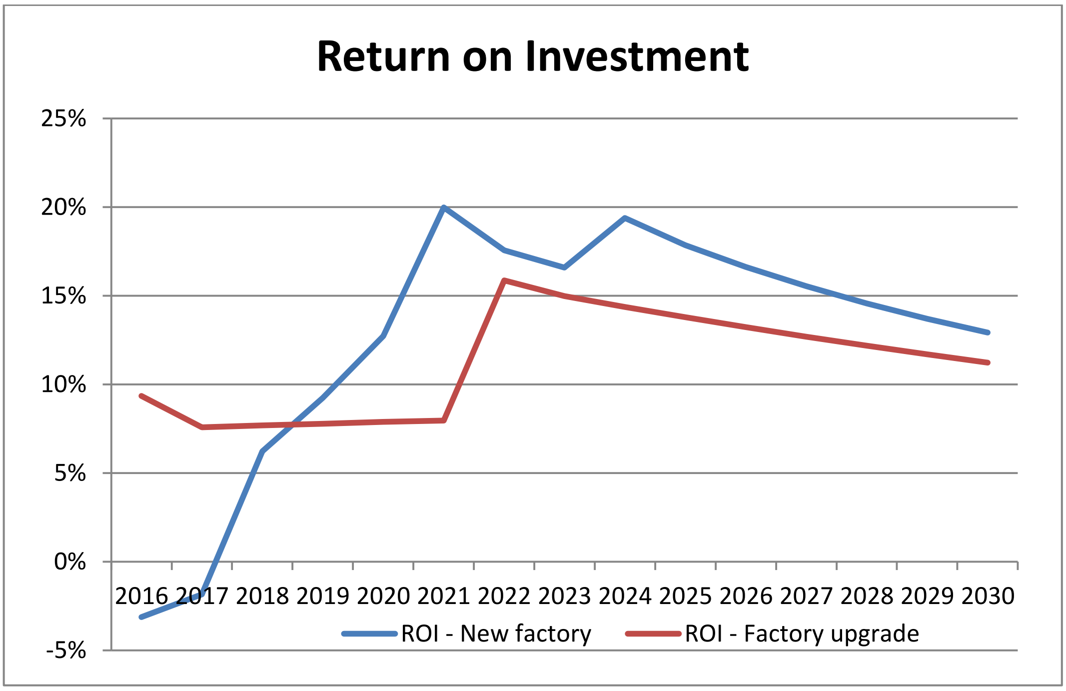

Figure 21 - Return on investment

Internal value of shares ratio is used to project value of shares in the company for each project. For investors this is an indicator on returns of dividend or value of shares for capital invested. Dividend payments of 20% for both projects means retained earnings increase every year. As fig. 22 shows this ratio for both projects climbs steadily throughout the planning period. The internal value of share for a new factory surpass factory upgrade in 2022. At the end of the planning horizon the internal value of shares is 6,1 for a new factory and 4,7 for factory upgrade. Fig. 22 illustrates that upgrading the factory is potentially a better short term investment option, as it is only in 2022 that the internal value of shares for a new factory exceed that of factory upgrade.

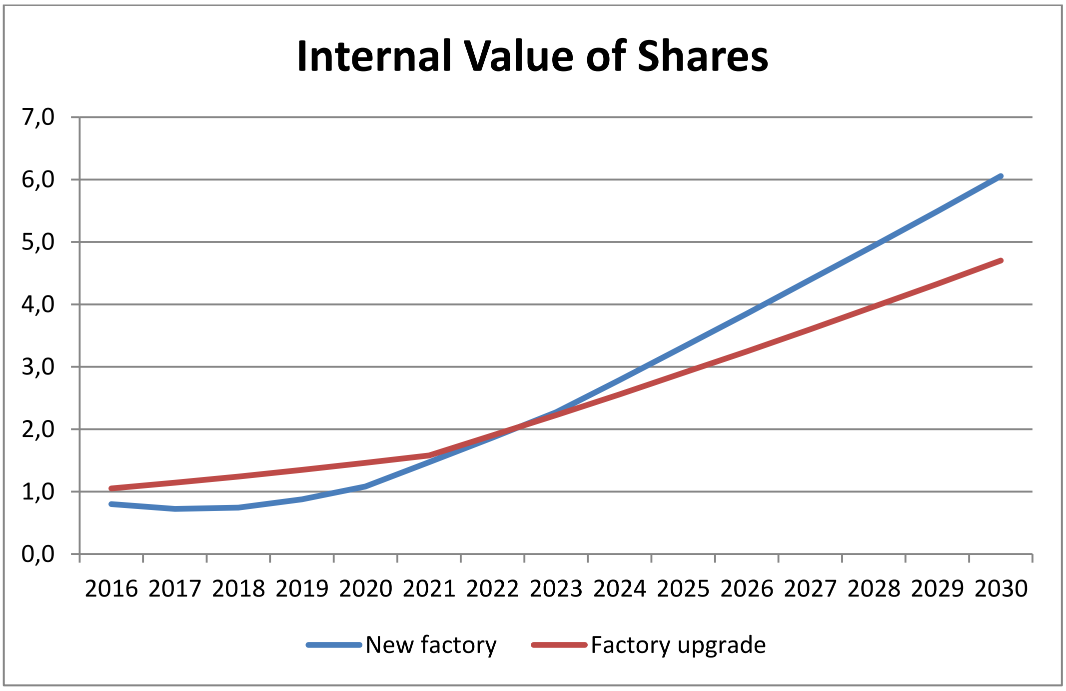

Figure 22 - Internal Value of Shares

6 Risk Assessment

Inputs and assumptions entered into the previously described model are all based on complete certainty in the data, and the results report a single estimate based on those inputs which assume correct data. The model presented has a planning horizon of 15 years. Predicting future behavior of the market is hard and input parameters are subject to change during course of the project.

Changes to input parameters can greatly affect project outcomes. A quantitative risk analysis can be used to map variability in project outcomes when input parameters change. Identifying which factors have the highest impact on investment outcome is important to manage risk. As the 2 options considered in the case study are both feasible investment options, their risk levels are compared to improve the investment decision.

Several methods of risk analysis are presented. A probability and impact matrix is presented to highlight threats and opportunities of a new factory. A sensitivity analysis was conducted for the construction of new factory. A Monte Carlo simulation to analyze the variability of financial feasibility for both options is also presented.

6.1 Probability and Impact matrix

Constructing a new factory is a large long term investment. Before undertaking a project of this magnitude it is vital to consider the main risk factors involved. A probability and impact matrix is constructed to prioritize which risks need to be considered. As illustrated in table 3, each risk is assigned a rating based on the probability of occurrence and the impact it has on project outcome. Risk factors marked red and yellow need to be monitored as they have a considerable impact on project should they occur.

Table 4 shows that market demand has the highest risk and needs further evaluation. There is a lot of uncertainty regarding demand for fish feed the next 10 years. If fish farming continues to grow like last year's demand will be sufficient. If demand is not sufficient Laxá cannot sell products leading to inventory piling up or the need to decrease production.

Risk of funding and permits can be decreased by securing all contracts for the project construction before starting. To counter competition from foreign feed products Laxá needs to be able to make their products with the right ingredients and supplements. Selling them at fair price is also necessary as buyers might look elsewhere if prices are not competitive.

	Impact on project goals									
Probability	0,05	0,1	0,2	0,4	0,8	0,8	0,4	0,2	0,1	0,05
	Very low	Low	Moderate	High	Very high	Very high	High	Moderate	Low	Very low
	Threats					Opportunities				
0,9	0,05	0,09	0,18	0,36	0,72	0,72	0,36	0,18	0,09	0,05
0,7	0,04	0,07	0,14	0,28	0,56	0,56	0,28	0,14	0,07	0,04
0,5	0,03	0,05	0,10	0,20	0,40	0,40	0,20	0,10	0,05	0,03
0,3	0,02	0,03	0,06	0,12	0,24	0,24	0,12	0,06	0,03	0,02
0,1	0,01	0,01	0,02	0,04	0,08	0,08	0,04	0,02	0,01	0,01

Table 3 - Probability and Impact matrix

Nr.	Risk factor	Impact	Probability	Risk figure	Proposed action
1	Permits	0,8	0,1	0,08	Prepare applications and environmental reports carefully
2	Market demand	0,4	0,7	0,28	More detailed forecast of demand
3	Funding	0,4	0,3	0,12	Secure all funding before starting construction
4	Incorrect feasibility analysis	0,2	0,5	0,1	Get an expert for second opinion
5	Delays in construction	0,2	0,3	0,06	Realistic and thorough time schedule
6	Increased construction costs	0,1	0,5	0,05	Reliable contractors
7	Increased operating costs	0,2	0,3	0,06	Automation in factory
8	Increase in Raw m. price	0,4	0,3	0,12	Ordering raw materials when seasonal demand is low
9	Inventory shortage	0,4	0,1	0,04	Keep safety stock - Monitor inventory level
10	Fish farming collapse	0,8	0,1	0,08	Look to international markets
11	Fish farming diseases	0,4	0,3	0,12	Decrease production periodically or sell product abroad
12	Foreign competition	0,2	0,5	0,1	Competitive prices and feed ingredients
13	Domestic competition	0,2	0,2	0,04	Be the first to expand
14	Natural disasters	0,4	0,1	0,04	No preventive measures

Table 4 - Impact analysis for a new factory

6.2 Sensitivity analysis

A sensitivity analysis was done to analyze which factors have the biggest impact on a new factory. The steeper the parameters are, the more vital they are to the project. 5 factors were analyzed and plotted into a sensitivity star and the scenarios for them analyzed. Fig. 23 shows the sensitivity analysis conducted for the case study. Input parameters that are likely to affect investment outcome are selected for the analysis.

The equipment and fixed costs have low impact on the project. The biggest factors affecting the project are the raw materials and sales price. The raw material price is usually around 85% of total production costs and the contribution margin around 5% when operating costs have been added to that. If this margin decreases it can be seen from the analysis that it has drastic effects on project outcome. A 6% decrease in sales price while raw materials price is stable drops the project IRR to 1,9% which is below acceptable investment levels. It must be noted though that these factors collaborate. If raw material price increases the sales price usually increases by a similar amount due to market conditions.

Sales quantity is the factor hardest to predict as the fish farming market has proven unpredictable the last 20 years. 6% reduction in sales causes the project IRR to drop by 2%. Since the fish farming market is still developing this is likely the most important factor as of right now it is not possible to sell all 50.000 tons domestically.

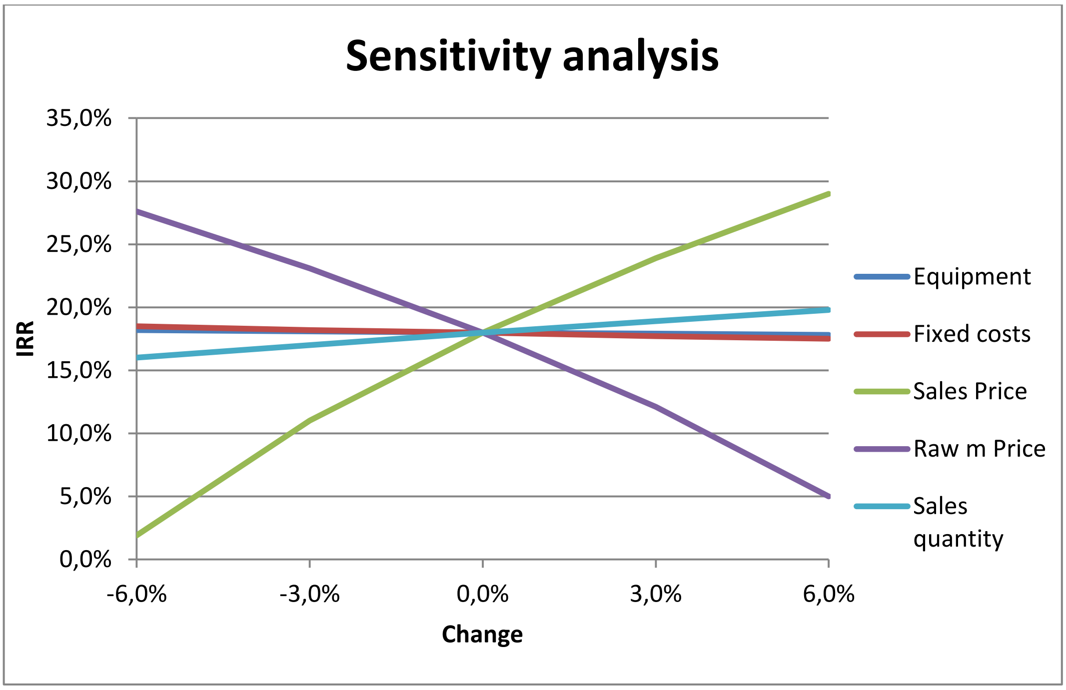

Figure 23 - Sensitivity analysis

6.3 Monte Carlo simulation

To simulate what happens if various parameters change during course of the project a Microsoft Excel add-in called @Risk was used. This tool offers a lot of parameter adjusting and adding likelihood with different distributions to those parameters to simulate results efficiently.

Tables 5 and 6 show the selection of parameters and distributions used for simulation. Distributions are based on assumed likelihood. It is crucial to consider the impact of uncertainty over decision making based on the model. Defining terms for occurrence probability of each input factor is important when starting simulation. Triangle distribution was chosen for sales price, variable and fixed costs. Pert distribution used for housing, equipment and sales quantity.

Equipment and housing variables are skewed to the right as costs of construction and equipment are likely to be higher if some unexpected problems occur. Sales quantity for years 2020-2030 are hard to predict as the fish farming market has been unpredictable but if all projects go according to plan a new factory should be able to sell 45.000 tons annually. Still this is a long way from now and plans for future fish farms might change so a conservative pert distribution skewed to the left of lower sales is used(Arunraj, Mandal, & Maiti, 2013).

Variable	Dist. Type	Optimistic	Base case	Pessimistic	Values
Variable cost	Triangle	0,144	0,147	0,152	M ISK/ton
Fixed cost	Triangle	220	240	270	M ISK/year
Sales Price	Triangle	0,18	0,176	0,17	M ISK/ton
Housing	Pert	900	1000	1300	M ISK
Equipment	Pert	1200	1300	1500	M ISK
Sales Quantity	Pert	50000	**45000**	35000	Tons/year

Table 5 - Risk parameter adjustment for a new factory

Variable	Dist. Type	Optimistic	Base case	Pessimistic	Values
Variable cost	Triangle	0,145	0,149	0,155	M ISK/ton
Fixed cost	Triangle	40	45	55	M ISK/year
Sales Price	Triangle	0,18	0,176	0,17	M ISK/ton
Housing	Pert	80	100	150	M ISK
Equipment	Pert	500	550	620	M ISK
Sales Quantity	Pert	9000	8000	7000	Tons/year

Table 6 - Risk parameter adjusting for factory upgrade

Figs. 24 and 25 show the internal rate of return for 500 iterations of probabilistic parameter adjustment. As seen from fig. 24 the probability of a new factory failing to achieve the minimum attractive rate of return is 19,2%. The probability of a factory upgrade not reaching its MARR is 8,6%. As NPV and IRR are correlated there is also 19,2% and 8,6% chance that the NPV at the end of the investment period will be negative for proposed projects. It can be concluded from these graphs that a factory upgrade is the less risky option in terms of meeting investment criteria.

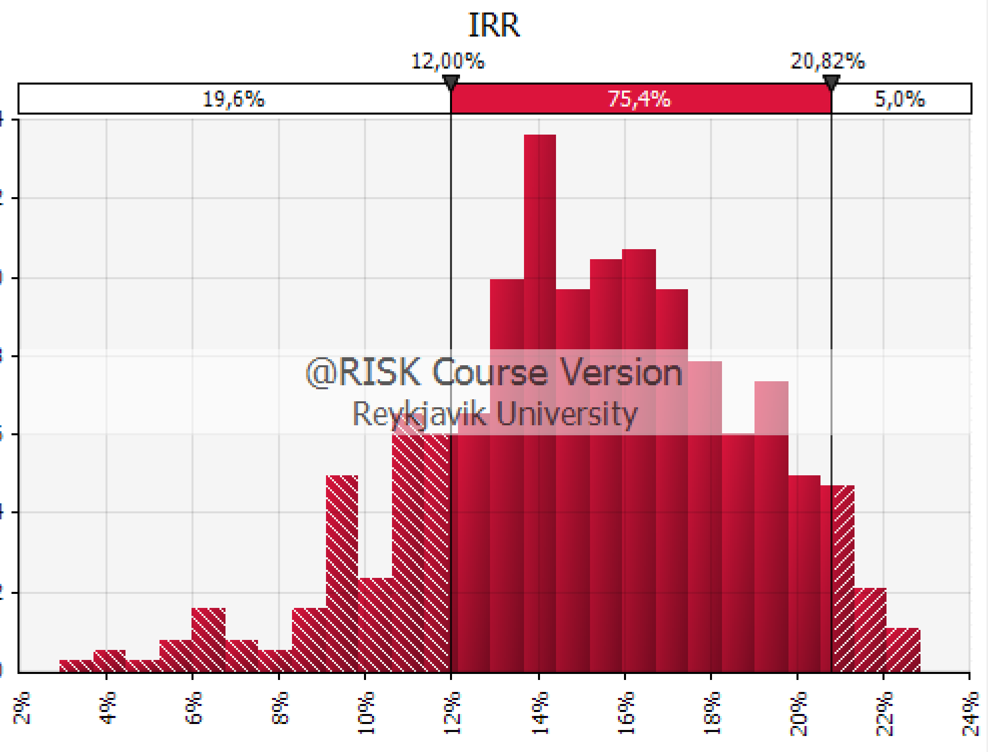

Figure 24 - Simulated IRR analysis for a new factory

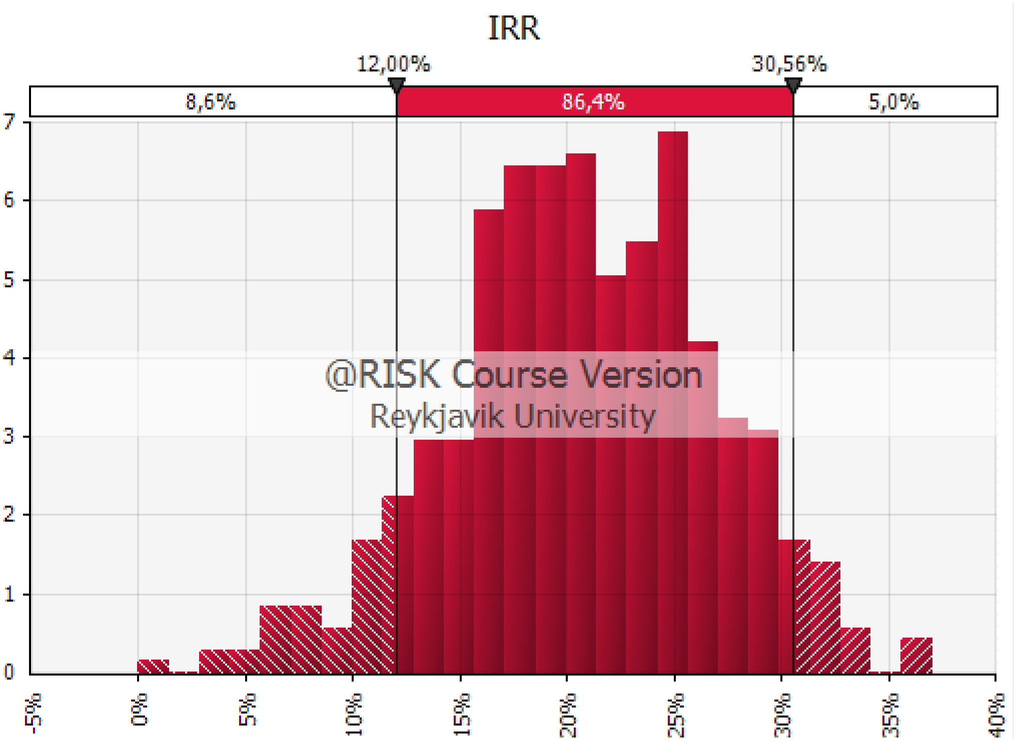

Figure 25 - Simulated IRR analysis for factory upgrade

From tornado graph in fig. 26 the biggest project impact factors can be seen. These results backup the results from sensitivity star created. Variable cost, which is the cost of raw materials, sales price and sales quantity are the biggest impact factors on the project. Fixed costs are relatively low due to automation in factory and do not have a very big impact.

Equipment and building costs also have a rather low impact so increased construction costs due to unexpected troubles would not be the end of the world for the company.

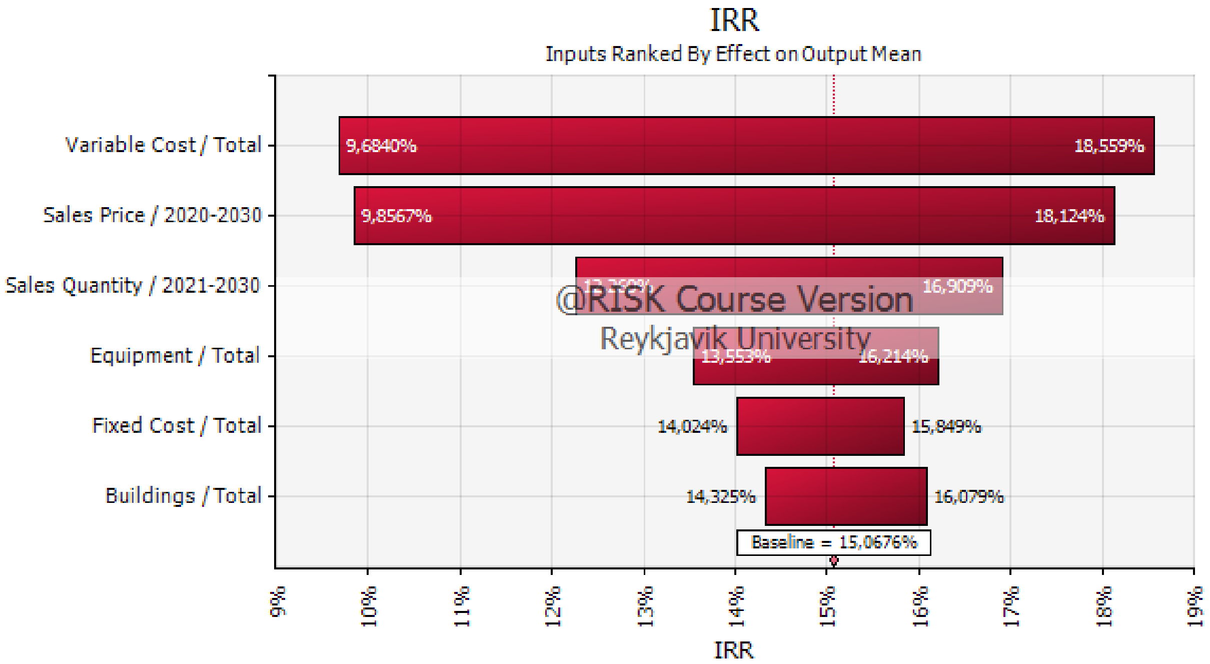

Figure 26 - Inputs effect on IRR

7 Conclusion & Discussion

The trigger for this project was the fact that the Icelandic fish farming market is expanding rapidly and Laxá want to take advantage of that. The goal of the project was making a feasibility analysis of the options which Laxá has for expanding.

The research question defined at the beginning is:

> *Which are the best possible options for Laxá to expand and profit from increased fish farming in Iceland?*

In order to answer this question methodologically a model was created. The feasibility assessment for both options can easily be updated if conditions change.

As the results describe a new factory is a risky investment, especially during the first 4 years when the factory is going into operation. Calculated IRR of 18% if everything goes according to plan is acceptable. Given experience from previous Laxá factory which is still in operation after 25 years it is very likely that a new factory will be in full usage for a while after those 15 years turning profits. It must also be considered that new equipment needs lower maintenance and there is less probability of malfunction than using old facilities. After 15 years given that the fish farming market does not suffer big a crisis, f.x from diseases the factory will be rendering high revenues for the company.

Upgrading the old factory is a less risky investment. Less liabilities are acquired compared to the construction of a new factory. It seems a more feasible option given the current feed demand in Iceland. IRR of 25% at the end of the planning horizon is well above the discount rate, and as the current capital of Laxá is high this seems a solid investment for the future of the company. If the fish farming market suffers another crash it is also easier for the company to downsize with less liabilities and smaller production output. This downsides include the location and facilities. Current location is far from both the biggest fish farming areas and the domestic raw material production. Factory closer to those areas reduces the cost of logistics considerably. The facilities are 25 years old and renovations are evident as both equipment and housing is worn out.

This report is based on Laxá being the only main fish feed manufacturer and if plans at Fóðurblandan go through constructing a factory as well, the business environment for Laxá changes drastically. It is clear that there is not room for 2 large fish feed factories selling all their product domestically, but on the other hand it is necessary to upgrade equipment in order to be competitive with international companies.

Technical know-how, facilities and accessibility make Iceland a desirable location for fish farming and all indicators point towards increased farming in the future. If the recent trend in fish farming continues a new factory is better suited as a long term investment. The planning horizon is long and there is a great deal of uncertainty looking that far ahead.

Upgrading the old factory has a more immediate impact and as there is currently not demand for more than 20.000 tons domestically this seems to be a more feasible option given current conditions. It is also less risky both in terms of the market environment and capital required to fund the project.

Laxá also has the third option which is simply not expanding. The current factory is profitable when producing over 4.000 tons per year as is with few liabilities. Laxá could continue to operate the Krossanes factory and re-evaluate the market conditions for expansion annually. Negative effects of selecting this option include less competitiveness as optimal nutrition for some feeds cannot be produced and the potential decrease of market share as a result.

As seen from feasibility analysis both investment options have their merits. The project selection could depend on the risk attitude of investors and Laxá board. There is no fish feed factory of comparable magnitude operating in Iceland. Before undertaking a project of this magnitude it might be practical to seek experience and knowledge from international fish feed operations.

Laxá sells a low price commodity with about 5% profit margin and as such is heavily reliant on selling large amounts of product. It might thus be feasible for Laxá to wait 2-3 years to see how the Icelandic fish farming market develops. On the other hand it, waiting could be a double edged sword. It might be too late to construct a new factory then if a different company has already started production.

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Appendix

Screenshots of the financial feasibility model for a new factory.

Assumptions and Results

		Total	2015	2016	2017	
Investment:			Year 1	Year 2	Year 3	
Buildings		**1.000**	800	200	0	M ISK
Equipment		**1.300**	0	800	500	M ISK
Other		**200**	200	0	0	M ISK
Total		**2.500**	**1.000**	**1.000**	**500**	M ISK
Financing:						
Working Capital		**1.245**	296	0	950	M ISK
Total Financing		**3.745**	**1.296**	**1.000**	**1.450**	M ISK
Equity	30%	**1.123,6**	389	300	435	M ISK
Loans	70%	**2.621,6**	907	700	1.015	M ISK
Loan Repayments		15	years			
Loan Interest		7%				

Discounting Rate	**12%**	**MARR**
Planning Horizon	**15**	**years**
	Total Cap.	**Equity**
NPV of Cash Flow	**918**	**725**
Internal Rate	**17%**	**18%**
Capital/Equity after 15 years	**6,1**	
Minimum Cash Account	**200**	

Operations:			2016	2017	2018	2019	2020	2021-2030	
Sales Quantity			0	0	25.000	30.000	35.000	45.000	Tons/year
Sales Price			0,176	0,176	0,176	0,176	0,176	0,176	MISK/ton
Variable Cost		0,147	MISK/ton						
Fixed Cost		240	MISK/year						
Inventory Build-up			**400** Tons						
Debtors	25%	of turnover							
Creditors	15%	of variable cost							
Dividend	20%	of profit							
Depreciation Buildings	4%								
Depreciation Equipm.	15%	down to 10%							
Depreciation Other	20%								
Loan Managem. Fees	2%								
Income Tax	20%								

Investment

		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Total
Investment and Financing			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Investment:																			
Buildings		800	1.000	1.000	960	920	880	840	800	760	720	680	640	600	560	520	480	440	
Equipment		0	800	1.300	1.105	910	715	520	325	130	130	130	130	130	130	130	130	130	
Other		200	160	120	80	40	0	0	0	0	0	0	0	0	0	0	0	0	
Booked Value		**1.000**	**1.960**	**2.420**	**2.145**	**1.870**	**1.595**	**1.360**	**1.125**	**890**	**850**	**810**	**770**	**730**	**690**	**650**	**610**	**570**	
Depreciation:																			
Depreciation Buildings	4%		0	0	40	40	40	40	40	40	40	40	40	40	40	40	40	40	**560**
Depreciation Equipm.	15%		0	0	195	195	195	195	195	195	0	0	0	0	0	0	0	0	**1.170**
Depreciation Other	20%		40	40	40	40	40	0	0	0	0	0	0	0	0	0	0	0	**200**
Total Depreciation			**40**	**40**	**275**	**275**	**275**	**235**	**235**	**235**	**40**	**40**	**40**	**40**	**40**	**40**	**40**	**40**	**1.930**
Financing:		**1.296**	**1.000**	**1.450**															
Equity	30%	389	300	435															
Loans	70%	907	700	1.015															
Repayment	15			60	107	171	171	171	171	171	171	171	171	171	171	171	171	171	**2.387**
Principal		907	1.607	2.561	2.454	2.283	2.113	1.942	1.771	1.600	1.430	1.259	1.088	917	747	576	405	234	
Interest	7%		63	112	179	172	160	148	136	124	112	100	88	76	64	52	40	28	**1.656**
Loan Managem. Fees	2%	18	14	20															**52**

Operations

		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Operations Statement																		
Sales in tons			0	0	25.000	30.000	35.000	45.000	45.000	45.000	45.000	45.000	45.000	45.000	45.000	45.000	45.000	
Price per ton			0,176	0,176	0,176	0,176	0,176	0,176	0,176	0,176	0,176	0,176	0,176	0,176	0,176	0,176	0,176	
Revenue in M ISK			**0**	**0**	**4.400**	**5.280**	**6.160**	**7.920**	**7.920**	**7.920**	**7.920**	**7.920**	**7.920**	**7.920**	**7.920**	**7.920**	**7.920**	**95.040**
																		0
Variable Cost	0,147		0	0	3.675	4.410	5.145	6.615	6.615	6.615	6.615	6.615	6.615	6.615	6.615	6.615	6.615	**79.380**
Fixed Cost	240		0	0	240	240	240	240	240	240	240	240	240	240	240	240	240	**3.120**
Diverse Taxes																		**0**
EBITDA (Operating Surplus)			**0**	**0**	**485**	**630**	**775**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**12.540**
																		0
Inventory Movement																		**0**
Depreciation			40	40	275	275	275	235	235	235	40	40	40	40	40	40	40	**1.890**
EBIT (Operating Gain/Loss)			**-40**	**-40**	**210**	**355**	**500**	**830**	**830**	**830**	**1.025**	**1.025**	**1.025**	**1.025**	**1.025**	**1.025**	**1.025**	**10.650**
																		0
Financial Costs (Int + LMF)		18	77	133	179	172	160	148	136	124	112	100	88	76	64	52	40	**1.662**
EBT (Profit before Tax)		**-18**	**-117**	**-173**	**31**	**183**	**340**	**682**	**694**	**706**	**913**	**925**	**937**	**949**	**961**	**973**	**985**	**8.988**
																		0
Loss Transfer	0	-18	-136	-308	-278	-94	0	0	0	0	0	0	0	0	0	0	0	**-816**
Taxable Profit		0	0	0	0	0	246	682	694	706	913	925	937	949	961	973	985	**8.970**
Income Tax	20%	0	0	0	0	0	49	136	139	141	183	185	187	190	192	195	197	**1.794**
Net Profit/Loss		**-18**	**-117**	**-173**	**31**	**183**	**291**	**546**	**555**	**565**	**730**	**740**	**750**	**759**	**769**	**778**	**788**	**7.194**

Cash Flow

		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Cash Flow																		
EBITDA (Operating Surplus)		**0**	**0**	**0**	**485**	**630**	**775**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**12.540**
Debtor Changes			0	0	1.100	220	220	440	0	0	0	0	0	0	0	0	0	**1.980**
Creditor Changes			0	0	551	110	110	221	0	0	0	0	0	0	0	0	0	**992**
Inventory Changes			0	0	400	0	0	0	0	0	0	0	0	0	0	0	0	**400**
Cash Flow before Tax		**0**	**0**	**0**	**-464**	**520**	**665**	**845**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**1.065**	**11.152**
Paid Taxes			**0**	**0**	**0**	**0**	**0**	**49**	**136**	**139**	**141**	**183**	**185**	**187**	**190**	**192**	**195**	**1.597**
Cash Flow after Tax		**0**	**0**	**0**	**-464**	**520**	**665**	**796**	**929**	**926**	**924**	**882**	**880**	**878**	**875**	**873**	**870**	**9.555**
Financial Cost (Interest+LMF)		**18**	**77**	**133**	**179**	**172**	**160**	**148**	**136**	**124**	**112**	**100**	**88**	**76**	**64**	**52**	**40**	**1.680**
Repayment		**0**	**0**	**60**	**107**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**2.217**
Net Cash Flow		**-18**	**-77**	**-193**	**-750**	**178**	**335**	**478**	**622**	**631**	**641**	**612**	**621**	**631**	**640**	**650**	**659**	**5.658**
Paid Dividend	20%	**0**	**0**	**0**	**6**	**37**	**58**	**109**	**111**	**113**	**146**	**148**	**150**	**152**	**154**	**156**	**158**	**1.497**
Financing - Expenditure		**296**	**0**	**950**														**1.245**
Cash Movement		**277**	**-77**	**756**	**-756**	**141**	**276**	**369**	**511**	**519**	**495**	**464**	**471**	**479**	**487**	**494**	**502**	**5.407**

Source and Allocation of Funds

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Source of Funds																	
Profit before Tax	-18	-117	-173	31	183	340	682	694	706	913	925	937	949	961	973	985	8.970
Depreciation	0	40	40	275	275	275	235	235	235	40	40	40	40	40	40	40	1.890
Funds from Operations	**-18**	**-77**	**-133**	**306**	**458**	**615**	**917**	**929**	**941**	**953**	**965**	**977**	**989**	**1.001**	**1.013**	**1.025**	**10.860**
Loan Drawdown	907	700	1.015														2.622
Equity Drawdown	389	300	435														1.124
Funds for allocation	**1.277**	**923**	**1.317**	**306**	**458**	**615**	**917**	**929**	**941**	**953**	**965**	**977**	**989**	**1.001**	**1.013**	**1.025**	**14.605**
Allection of Funds																	0
Investment	1.000	1.000	500														2.500
Repayment	0	0	60	107	171	171	171	171	171	171	171	171	171	171	171	171	2.217
Paid Taxes	0	0	0	0	0	0	49	136	139	141	183	185	187	190	192	195	1.597
Paid Dividend	0	0	0	6	37	58	109	111	113	146	148	150	152	154	156	158	1.497
Total allocation	**1.000**	**1.000**	**560**	**113**	**207**	**229**	**329**	**418**	**423**	**458**	**501**	**506**	**510**	**514**	**519**	**523**	7.810
																	0
Changes Net Curr. Assets	**277**	**-77**	**756**	**192**	**251**	**386**	**588**	**511**	**519**	**495**	**464**	**471**	**479**	**487**	**494**	**502**	6.795
Analysis of Changes																	
Current Assets																	
Cash at start of year	0	277	200	956	200	341	618	986	1.497	2.016	2.510	2.974	3.445	3.924	4.411	4.905	
Cash at end of year	277	200	956	200	341	618	986	1.497	2.016	2.510	2.974	3.445	3.924	4.411	4.905	5.407	
Changes in Cash	277	-77	756	-756	141	276	369	511	519	495	464	471	479	487	494	502	5.407
Debtor changes	0	0	0	1.100	220	220	440	0	0	0	0	0	0	0	0	0	1.980
Inventory changes	0	0	0	400	0	0	0	0	0	0	0	0	0	0	0	0	400
Changes in Current Assets	**277**	**-77**	**756**	**744**	**361**	**496**	**809**	**511**	**519**	**495**	**464**	**471**	**479**	**487**	**494**	**502**	7.787
Liabilities																	0
Creditor changes	0	0	0	551	110	110	221	0	0	0	0	0	0	0	0	0	992
Changes Net Curr. Assets	**277**	**-77**	**756**	**192**	**251**	**386**	**588**	**511**	**519**	**495**	**464**	**471**	**479**	**487**	**494**	**502**	6.795
Error check	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0

Balance

Balance Sheet

		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assets																	
Cash Account	0	277	200	956	200	341	618	986	1.497	2.016	2.510	2.974	3.445	3.924	4.411	4.905	5.407
Debtors (Acc recievable)	25%	0	0	0	1.100	1.320	1.540	1.980	1.980	1.980	1.980	1.980	1.980	1.980	1.980	1.980	1.980
Stock (inventory)	0	0	0	0	400	400	400	400	400	400	400	400	400	400	400	400	400
Current Assets		**277**	**200**	**956**	**1.700**	**2.061**	**2.558**	**3.366**	**3.877**	**4.396**	**4.890**	**5.354**	**5.825**	**6.304**	**6.791**	**7.285**	**7.787**
Fixed Assets		1.000	1.960	2.420	2.145	1.870	1.595	1.360	1.125	890	850	810	770	730	690	650	610
Total Assets		**1.277**	**2.160**	**3.376**	**3.845**	**3.931**	**4.153**	**4.726**	**5.002**	**5.286**	**5.740**	**6.164**	**6.595**	**7.034**	**7.481**	**7.935**	**8.397**
Debts																	
Taxes Payable		0	0	0	0	0	49	136	139	141	183	185	187	190	192	195	197
Creditors (Acc payable)	15%	0	0	0	551	662	772	992	992	992	992	992	992	992	992	992	992
Next Year Repayment		0	60	107	171	171	171	171	171	171	171	171	171	171	171	171	171
Current Liabilities		**0**	**60**	**107**	**722**	**832**	**992**	**1.299**	**1.302**	**1.304**	**1.346**	**1.348**	**1.350**	**1.353**	**1.355**	**1.358**	**1.360**
Long Term Loans		907	1.546	2.454	2.283	2.113	1.942	1.771	1.600	1.430	1.259	1.088	917	747	576	405	234
Total Debt		**907**	**1.607**	**2.561**	**3.005**	**2.945**	**2.933**	**3.070**	**2.902**	**2.734**	**2.604**	**2.436**	**2.268**	**2.099**	**1.931**	**1.763**	**1.594**
Equity		389	689	1.124	1.124	1.124	1.124	1.124	1.124	1.124	1.124	1.124	1.124	1.124	1.124	1.124	1.124
Profit & Loss Balance		-18	-136	-308	-278	-94	197	742	1.298	1.862	2.593	3.333	4.082	4.841	5.610	6.388	7.176
Accumulated dividend payments		0	0	0	6	43	101	210	321	434	580	728	878	1.030	1.184	1.339	1.497
Total Capital		**371**	**553**	**815**	**840**	**986**	**1.219**	**1.656**	**2.100**	**2.552**	**3.136**	**3.728**	**4.328**	**4.935**	**5.550**	**6.172**	**6.803**
Debts and Capital		**1.277**	**2.160**	**3.376**	**3.845**	**3.931**	**4.153**	**4.726**	**5.002**	**5.286**	**5.740**	**6.164**	**6.595**	**7.034**	**7.481**	**7.935**	**8.397**
Error Check		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Profitability - New factory

		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Profitability Measurements																		
NPV and IRR of Total Cash Flow																		
Cash Flow after Taxes		0	0	0	-464	520	665	796	929	926	924	882	880	878	875	873	870	9.555
Investment		-1.000	-1.000	-500														
Total Cash Flow & Capital		**-1.000**	**-1.000**	**-500**	**-464**	**520**	**665**	**796**	**929**	**926**	**924**	**882**	**880**	**878**	**875**	**873**	**870**	**9.555**
NPV Total Cash Flow - New factory	12%	-1.000	-1.893	-2.291	-2.622	-2.291	-1.913	-1.510	-1.090	-716	-383	-99	154	380	580	759	918	
IRR Total Cash Flow - New factory		0%	0%	0%	0%	0%	0%	0%	0%	5%	9%	11%	13%	14%	15%	16%	17%	
External rate of return		0%	0%	0%	0%	0%	0%	0%	4%	8%	10%	12%	13%	13%	14%	14%	14%	
NPV and IRR of Free (Net) Cash Flow																		
Free (Net) Cash Flow		-18	-77	-193	-750	178	335	478	622	631	641	612	621	631	640	650	659	5.658
Equity part of investment		-750																-750
Free (Net) Cash Flow & Equity		**-768**	**-77**	**-193**	**-750**	**178**	**335**	**478**	**622**	**631**	**641**	**612**	**621**	**631**	**640**	**650**	**659**	**4.908**
NPV Net Cash Flow - New factory	12%	-768	-837	-991	-1.525	-1.412	-1.222	-980	-699	-444	-213	-16	163	324	471	604	725	
IRR Net Cash Flow - New factory		0%	0%	0%	0%	0%	0%	0%	0%	5%	9%	12%	14%	15%	16%	17%	18%	
External rate of return(MIRR)		0%	0%	0%	0%	0%	0%	0%	3%	7%	10%	12%	13%	14%	14%	15%	15%	
Discount Rate		12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	

Financial Ratios	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ROI (Profit+Interest/Debt+Capital)	-3%	-2%	6%	9%	13%	20%	18%	17%	19%	18%	17%	16%	15%	14%	13%
ROE (Profit/Shareh. Capital)	-32%	-31%	4%	22%	30%	45%	34%	27%	29%	24%	20%	18%	16%	14%	13%
Turnover ratio (Revenue/Debt+Capital)	0%	0%	130%	137%	157%	191%	168%	158%	150%	138%	128%	120%	113%	106%	100%
Capital ratio (Capital/Debt+Capital)	26%	24%	22%	25%	29%	35%	42%	48%	55%	60%	66%	70%	74%	78%	81%
Net Current Ratio	3,3	8,9	2,4	2,5	2,6	2,6	3,0	3,4	3,6	4,0	4,3	4,7	5,0	5,4	5,7
Liquid Current Ratio	3,3	8,9	1,8	2,0	2,2	2,3	2,7	3,1	3,3	3,7	4,0	4,4	4,7	5,1	5,4
Internal value of shares(Total Capital/Equity)	0,8	0,7	0,7	0,9	1,1	1,5	1,9	2,3	2,8	3,3	3,9	4,4	4,9	5,5	6,1
Debt Service Coverage	0,0	0,0	-1,6	1,5	2,0	2,7	3,5	3,6	3,8	3,9	4,1	4,3	4,5	4,8	5,0
Acceptable minimum	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
Net quick ratio	3,3	8,9	1,8	2,0	2,2	2,3	2,7	3,1	3,3	3,7	4,0	4,4	4,7	5,1	5,4
Current ratio acc minimum	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Screenshots of the financial feasibility model for factory upgrade.

Assumptions and Results

		2015				
Investment:		M.ISK				
Buildings		100				
Equipment	100%	550				
Other		0				
Total		**650**				
Financing:						
Working Capital		267				
Total Financing		**917**				
Equity	100%	30%				
Loan Repayments	100%	15	years			
Loan Interest	100%	7%				

Discounting Rate	**12% MARR**
Planning Horizon	**15 years**

	Total Cap.	Equity
NPV of Cash Flow	**264**	**231**
Internal Rate	**18%**	**25%**

Capital/Equity after 15 years	**4,7**
Minimum Cash Account	**200**

Operations:			2016	2017	2018	2019	2020	2021-2030	
Sales Quantity	100%		8000	8000	8000	8000	8000	8000	Tonn/ári
Sales Price	100%		0,176	0,176	0,176	0,176	0,176	0,176	MISK/tonn
Variable Cost	100%	0,149	MISK/tonn						
Fixed Cost	100%	45	MISK						
Inventory Build-up			**0**						

Debtors	25%	of turnover
Creditors	15%	of variable cost
Dividend	20%	of profit
Depreciation Buildings	4%	
Depreciation Equipm.	15%	down to 10%
Depreciation Other	20%	
Loan Managem. Fees	2%	
Income Tax	20%	

Investment

Investment and Financing		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Total
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Investment:																			
Buildings		100	96	92	88	84	80	76	72	68	64	60	56	52	48	44	40	36	
Equipment		550	468	385	303	220	138	55	55	55	55	55	55	55	55	55	55	55	
Other		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Booked Value		**650**	**564**	**477**	**391**	**304**	**218**	**131**	**127**	**123**	**119**	**115**	**111**	**107**	**103**	**99**	**95**	**91**	
Depreciation:																			
Depreciation Buildings	4%		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	**64**
Depreciation Equipm.	15%		83	83	83	83	83	83	0	0	0	0	0	0	0	0	0	0	**495**
Depreciation Other	20%		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Total Depreciation			**87**	**87**	**87**	**87**	**87**	**87**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**559**
Financing:		**917**																	
Equity	30%	275																	
Loans	70%	642																	
Repayment	15			43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	**642**
Principal		642	642	599	556	513	471	428	385	342	299	257	214	171	128	86	43	0	
Interest	7%		45	45	42	39	36	33	30	27	24	21	18	15	12	9	6	3	**404**
Loan Managem. Fees	2%	13																	**13**

Operations

Operations Statement		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Sales			8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	
Price			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Revenue			**1.408**	**1.408**	**1.408**	**1.408**	**1.408**	**1.408**	**1.408**	**1.408**	**1.408**	**1.408**	**1.408**	**1.408**	**1.408**	**1.408**	**1.408**	**21.120**
																		0
Variable Cost	0,149		1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	1.192	**17.880**
Fixed Cost	45		45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	**675**
Diverse Taxes																		**0**
EBITDA (Operating Surplus)			**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**2.565**
																		0
Inventory Movement																		**0**
Depreciation			87	87	87	87	87	87	4	4	4	4	4	4	4	4	4	**555**
EBIT (Operating Gain/Loss)			**85**	**85**	**85**	**85**	**85**	**85**	**167**	**167**	**167**	**167**	**167**	**167**	**167**	**167**	**167**	**2.010**
																		0
Financial Costs (Int + LMF)		13	45	45	42	39	36	33	30	27	24	21	18	15	12	9	6	**401**
EBT (Profit before Tax)		**-13**	**40**	**40**	**43**	**46**	**49**	**52**	**137**	**140**	**143**	**146**	**149**	**152**	**155**	**158**	**161**	**1.609**
																		0
Loss Transfer	0	-13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Taxable Profit		0	27	40	43	46	49	52	137	140	143	146	149	152	155	158	161	**1.596**
Income Tax	20%	0	5	8	9	9	10	10	27	28	29	29	30	30	31	32	32	**319**
Net Profit/Loss		**-13**	**34**	**32**	**34**	**36**	**39**	**41**	**110**	**112**	**114**	**117**	**119**	**122**	**124**	**126**	**129**	**1.290**

Cash Flow

Cash Flow		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
EBITDA (Operating Surplus)		**0**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**1.710**
Debtor Changes			352	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**352**
Creditor Changes			179	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**179**
Inventory Changes			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Cash Flow before Tax		**0**	**-2**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**171**	**1.537**
Paid Taxes			0	5	8	9	9	10	10	27	28	29	29	30	30	31	32	**135**
Cash Flow after Tax		**0**	**-2**	**166**	**163**	**162**	**162**	**161**	**161**	**144**	**143**	**142**	**142**	**141**	**141**	**140**	**139**	**1.402**
Financial Cost (Interest+LMF)		13	45	45	42	39	36	33	30	27	24	21	18	15	12	9	6	**354**
Repayment		0	0	43	43	43	43	43	43	43	43	43	43	43	43	43	43	**385**
Net Cash Flow		**-13**	**-47**	**78**	**78**	**81**	**83**	**86**	**88**	**74**	**76**	**79**	**81**	**83**	**86**	**88**	**91**	**663**
Paid Dividend	20%	0	7	6	7	7	8	8	22	22	23	23	24	24	25	25	26	**134**
Financing - Expenditure		267																**267**
Cash Movement		**254**	**-54**	**72**	**72**	**73**	**75**	**77**	**66**	**51**	**53**	**55**	**57**	**59**	**61**	**63**	**65**	**795**

Source and Allocation of Funds

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Source of Funds																	
Profit before Tax	-13	40	40	43	46	49	52	137	140	143	146	149	152	155	158	161	1.596
Depreciation	0	87	87	87	87	87	87	4	4	4	4	4	4	4	4	4	555
Funds from Operations	**-13**	**126**	**126**	**129**	**132**	**135**	**138**	**141**	**144**	**147**	**150**	**153**	**156**	**159**	**162**	**165**	2.151
Loan Drawdown	642																642
Equity Drawdown	275																275
Funds for allocation	**904**	**126**	**126**	**129**	**132**	**135**	**138**	**141**	**144**	**147**	**150**	**153**	**156**	**159**	**162**	**165**	3.068
Alloction of Funds																	
Investment	650																650
Repayment	0	0	43	43	43	43	43	43	43	43	43	43	43	43	43	43	599
Paid Taxes	0	0	5	8	9	9	10	10	27	28	29	29	30	30	31	32	287
Paid Dividend	0	7	6	7	7	8	8	22	22	23	23	24	24	25	25	26	258
Total allocation	**650**	**7**	**54**	**58**	**59**	**60**	**61**	**75**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	1.794
Changes Net Curr. Assets	**254**	**119**	**72**	**72**	**73**	**75**	**77**	**66**	**51**	**53**	**55**	**57**	**59**	**61**	**63**	**65**	1.274
Analysis of Changes																	
Current Assets																	
Cash at start of year	0	254	200	272	343	417	492	569	635	687	740	795	853	912	973	1.036	9.178
Cash at end of year	254	200	272	343	417	492	569	635	687	740	795	853	912	973	1.036	1.101	10.278
Changes in Cash	254	-54	72	72	73	75	77	66	51	53	55	57	59	61	63	65	1.101
Debtor changes	0	352	0	0	0	0	0	0	0	0	0	0	0	0	0	0	352
Inventory changes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Changes in Current Assets	**254**	**298**	**72**	**72**	**73**	**75**	**77**	**66**	**51**	**53**	**55**	**57**	**59**	**61**	**63**	**65**	1.453
Liabilities																	
Creditor changes	0	179	0	0	0	0	0	0	0	0	0	0	0	0	0	0	179
Changes Net Curr. Assets	**254**	**119**	**72**	**72**	**73**	**75**	**77**	**66**	**51**	**53**	**55**	**57**	**59**	**61**	**63**	**65**	1.274
Error check	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0

Balance

Balance Sheet

		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Assets																	
Cash Account	0	254	200	272	343	417	492	569	635	687	740	795	853	912	973	1.036	1.101
Debtors (Acc recievable)	25%	0	352	352	352	352	352	352	352	352	352	352	352	352	352	352	352
Stock (inventory)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current Assets		**254**	**552**	**624**	**695**	**769**	**844**	**921**	**987**	**1.039**	**1.092**	**1.147**	**1.205**	**1.264**	**1.325**	**1.388**	**1.453**
Fixed Assets		650	564	477	391	304	218	131	127	123	119	115	111	107	103	99	95
Total Assets		**904**	**1.116**	**1.101**	**1.086**	**1.073**	**1.062**	**1.052**	**1.114**	**1.162**	**1.211**	**1.262**	**1.316**	**1.371**	**1.428**	**1.487**	**1.548**
Debts																	
Taxes Payable		0	5	8	9	9	10	10	27	28	29	29	30	30	31	32	32
Creditors (Acc payable)	15%	0	179	179	179	179	179	179	179	179	179	179	179	179	179	179	179
Next Year Repayment		0	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43
Current Liabilities		**0**	**227**	**229**	**230**	**231**	**231**	**232**	**249**	**250**	**250**	**251**	**251**	**252**	**253**	**253**	**254**
Long Term Loans		642	599	556	513	471	428	385	342	299	257	214	171	128	86	43	0
Total Debt		**642**	**826**	**786**	**744**	**701**	**659**	**617**	**591**	**549**	**507**	**465**	**423**	**380**	**338**	**296**	**254**
Equity		275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275
Profit & Loss Balance		-13	21	53	87	124	162	204	313	425	540	657	776	897	1.021	1.148	1.277
Accumulated dividend payments		0	7	13	20	27	35	43	65	88	111	134	158	182	207	232	258
Total Capital		**262**	**290**	**315**	**342**	**371**	**402**	**435**	**523**	**613**	**704**	**798**	**893**	**990**	**1.090**	**1.191**	**1.294**
Debts and Capital		**904**	**1.116**	**1.101**	**1.086**	**1.073**	**1.062**	**1.052**	**1.114**	**1.162**	**1.211**	**1.262**	**1.316**	**1.371**	**1.428**	**1.487**	**1.548**
Error Check		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Profitability - Factory upgrade

		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Profitability Measurements																		
NPV and IRR of Total Cash Flow																		
Cash Flow after Taxes		0	-2	166	163	162	162	161	161	144	143	142	142	141	141	140	139	2.105
Investment		-650																
Total Cash Flow & Capital		**-650**	**-2**	**166**	**163**	**162**	**162**	**161**	**161**	**144**	**143**	**142**	**142**	**141**	**141**	**140**	**139**	**2.105**
NPV Total Cash Flow	12%	-650	-652	-520	-404	-301	-209	-127	-54	4	55	101	142	178	210	239	264	
IRR Total Cash Flow		0%	0%	0%	0%	0%	0%	6%	10%	12%	14%	15%	16%	17%	18%	18%	18%	
External rate of return		0%	0%	0%	0%	0%	4%	8%	11%	12%	13%	14%	14%	14%	14%	15%	15%	
NPV and IRR of Free (Net) Cash Flow																		
Free (Net) Cash Flow		-13	-47	78	78	81	83	86	88	74	76	79	81	83	86	88	91	1.092
Equity part of investment		-195																-195
Free (Net) Cash Flow & Equity		**-208**	**-47**	**78**	**78**	**81**	**83**	**86**	**88**	**74**	**76**	**79**	**81**	**83**	**86**	**88**	**91**	**897**
NPV Net Cash Flow	12%	-208	-250	-188	-132	-81	-33	10	50	79	107	132	156	177	197	215	231	
IRR Net Cash Flow		0%	0%	0%	0%	0%	7%	13%	17%	19%	21%	22%	23%	24%	24%	25%	25%	
External rate of return		0%	0%	0%	0%	2%	9%	13%	15%	16%	17%	17%	17%	17%	17%	17%	17%	
Discount Rate		12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	
Financial Ratios																		
ROI (Profit+Interest/Debt+Capital)			9%	8%	8%	8%	8%	8%	16%	15%	14%	14%	13%	13%	12%	12%	11%	
ROE (Profit/Shareh. Capital)			13%	11%	11%	11%	10%	10%	25%	21%	19%	17%	15%	14%	13%	12%	11%	
Turnover ratio (Revenue/Debt+Capital)			156%	126%	128%	130%	131%	133%	134%	126%	121%	116%	112%	107%	103%	99%	95%	
Capital ratio (Capital/Debt+Capital)			26%	29%	32%	35%	38%	41%	47%	53%	58%	63%	68%	72%	76%	80%	84%	
Net Current Ratio			2,4	2,7	3,0	3,3	3,6	4,0	4,0	4,2	4,4	4,6	4,8	5,0	5,2	5,5	5,7	
Liquid Current Ratio			2,4	2,7	3,0	3,3	3,6	4,0	4,0	4,2	4,4	4,6	4,8	5,0	5,2	5,5	5,7	
Internal value of shares(Total Capital/Equity)			1,1	1,1	1,2	1,4	1,5	1,6	1,9	2,2	2,6	2,9	3,2	3,6	4,0	4,3	4,7	
Debt Service Coverage			0,0	1,9	2,0	2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,8	3,0	3,1	3,3	3,5	
Acceptable minimum			1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	
Net quick ratio			2,4	2,7	3,0	3,3	3,6	4,0	4,0	4,2	4,4	4,6	4,8	5,0	5,2	5,5	5,7	