P.O. Box 1390, Skulagata 4
120 Reykjavik, Iceland

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PROFITABILITY ANALYSIS OF THE INVESTMENT IN BEAM TRAWLERS FOR CUBAN SHRIMP FISHERIES.

Yosbely Argudin Soto
Empresa Pesquera Industrial de Cienfuegos, EPICIEN
Carretera a O'Bourke, Cienfuegos, Cuba.
yosbely06@yahoo.es

Supervisor
Páll Jensson
University of Iceland
pall@hi.is

ABSTRACT

Since the fishing technology and vessels used nowadays for shrimp catching in Cuba are very old, maximising efficiency and effectiveness in the operation is difficult. Therefore, the main objective of this project is to carry out an overall analysis of the worthiness of purchasing new shrimp vessels in Cuban companies. The results of this research provide the decision makers with tools that form a broad basis on which to make the final decision, that is, whether to invest in the new vessels or not. In order to achieve this objective a profitability model is built to analyse all the data. The model is good for calculating the results and performing sensitivity analysis and risk assessment. In addition, the Analytic Hierarchy Process method was used to support the results, mainly comparing the ships in terms of effectiveness, environmental and social subjects. The results of the case study in Cuba showed that this investment is very attractive. However, sensitivity analysis and Monte Carlo simulation indicated that high risks could be involved regarding mainly a variation in the sales price.

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1 INTRODUCTION

1.1 Cuba general background

Cuba, officially the Republic of Cuba, consists of the island of Cuba (the largest of the Greater Antilles), the Isle of Youth and adjacent small islands. It is located in the northern Caribbean at the confluence of the Caribbean Sea, the Gulf of Mexico and the Atlantic Ocean (Figure 1).

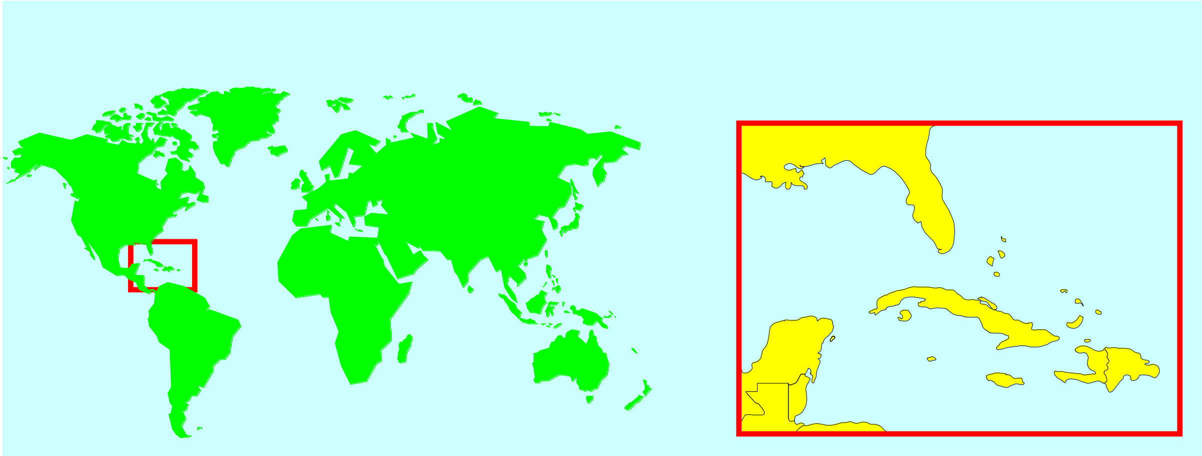

Figure 1: Cuba, geographical position

The total surface of Cuban Archipelago is 106 760 square kilometres and the temperature average fluctuates between 21ºC in winter to 27ºC in summer. The average rainfall is 1300 millimetres annually, with a great difference between the rainy and dry seasons. The total population is more than 11 000 000 inhabitants and it is not distributed equitably throughout the country, 75% live in urban zones. Social aspects such as life expectancy, infant mortality rates and education levels in Cuba have been comparable to the most developed countries in the world.

The Cuban GDP in 2003 was 24 million EUR, 2140 EUR/capita and its major exports were nickel, citrus, tobacco, fish, medical products, sugar, coffee and skilled labour; imports included food, fuel, clothing, and machinery (Ministry of Economy and Planning, personal communication).

1.2 Cuban fisheries

Cuba has experienced a growth in its main economic activities during the past few years. In this development, fisheries play a vital role as an essential source of foreign currency. Therefore, production and exportation of seafood products are key factors in the Cuban economy. Despite the well-known importance of this activity, some issues prevent the Cuban companies from taking maximum advantage of the stock. The main problems are the old technology and the lack of spare parts, which leads to an underutilisation of the natural resources.

Aquaculture is 1/3 of the total fisheries, it is carried out in 30 artificial or natural ponds, which cover about 160 thousands hectares. The fingerlings are produced in 30 hatcheries all over the country and the main species are whiteleg shrimp, cyprinid, tilapia and catfish.

Marine fisheries are approximately 60% of the total fisheries in Cuba and there are over 20 fishing ports all over the island (Figure 2). Several species are caught such as crustaceans (lobster and shrimp) and fishes (skipjack tuna, snappers, groupers, mackerels, jacks, grunts and mullets) (Ministry of Fisheries, personal communication).

Figure 2: Location of fishing ports in Cuba.

Shrimp fisheries are one of the most important in Cuban fisheries. It is carried out all over the country. Over the years, so far the catch has decreased and so has the shrimp catch but the lately it has been stable (Figures 3 and 4).

Figures for 2004 are 37 325 tons for marine fisheries and 27 562 tons for aquaculture, in total 64 887 tons. The stability in shrimp is mainly due to a longer closed season, which allows the shrimp to breed in better environmental conditions and reach bigger sizes.

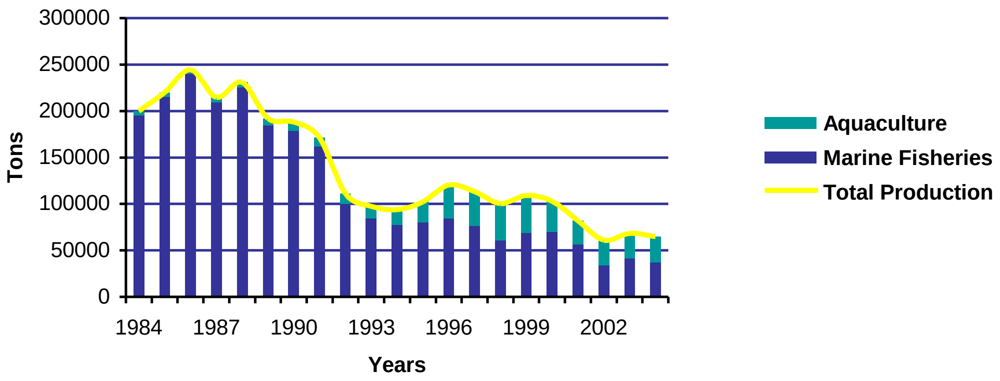

Figure 3: Total Cuban fisheries production 1984-2004 (FAO 2006)

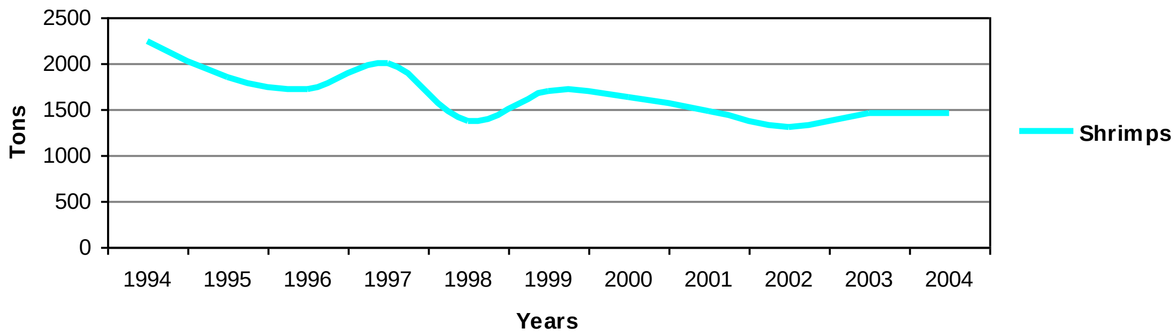

Figure 4: Cuba, shrimp catch 1994-2004.

The shrimp fishing fleet is composed of 50 beam trawlers, 23 meters in length and 100 to 150 GRT. They are mainly based in four fishing ports in the south coast of the island, Cienfuegos, Júcaro, Santa Cruz del Sur and Manzanillo. All the ships are equipped with GPS and require a fishing license to operate. Companies are allocated defined fishing areas for their vessels. The crew consists of six or nine men, who are responsible for the catching and delivering to one of the two processing ships. The shrimp is frozen either at high seas or in the land-based industries in Santa Cruz del Sur and Manzanillo. Since this species has nocturnal habits, the fishing is done at night, also taking advantage of the lower temperature and sun absence at that time. The shrimp is then collected at the process industry and it is classified according its quality features and size.

The vessel's crew sells the landings to the company. Prices are fixed taking into account quality and size of the pieces. Each vessel's trip expenses (i.e., ice, bait, tackle, etc.) are then covered with the revenues earned from the trip. Major repairs to the hull and deck equipment are paid by the company. Then it returns the difference between total revenue and trip costs (referred to as "margin") to the individual vessels. Each vessel's captain distributes the margin for that trip to the crew via a predetermined share system. The captain uses his discretion to determine the share each crew member receives. Thus, the crew has an incentive to minimise costs so that the net income to be divided up among the crew is maximised. Because the margin is the main source of income to the crew, a strong motivation exists to operate the vessels as efficiently as possible. In addition, the price received by the vessel can be a function of quality. Therefore, a high premium is placed on handling the catch in such a way that quality is preserved (Adams *et al*. 2000).

The main destination market for shrimp is Spain and its demand is not fully met. The shrimp, which is not good for export, because of melanosis or is damaged, is sold for domestic consumption but mainly to the tourism sector in hotels and other facilities. The price (based on the Spanish market) ranges from 10 to 18 EUR per kilo and it has been quite stable in the last years. Maybe in the near future, the production values could not experience a great increase, since the Cuban government is very concerned to avoid over fishing the stocks. Therefore, the main challenge is to make the catches more profitable by carrying out more efficient and effective fisheries, in order to take advantage of the strong and demanding market for this product.

1.3 Objective and goals

Since the technology used now is very old, it is not possible to maximise the effectiveness and efficiency of the catch with present vessels. New trawlers are available in the international market and therefore the main objective of this project is to carry out an overall analysis to find out the economic benefits from the purchase of new vessels in fisheries companies in Cuba. Very often investment projects and new processing introductions in Cuba are carried out without taking into consideration important questions about the implicit risk associated with the business. The decision makers generally do not have the tools and information needed to appreciate and evaluate the uncertainty of the factors involved. Important decisions taken without analysing the possibilities of success or failure can sometimes lead to serious mistakes and great losses in both financial and production terms (Massino 2004)

Some questions were raised, during the research work, for instance: Are there any other kind of ships, which can be used for shrimp catching under Cuban conditions that would produce more benefits? According to the Cuban experience, beam trawlers are the most appropriate vessels to carry out those fisheries. Stern trawlers for example are not suitable because that activity is carried out at seas from 10 to 15 meters deep for small amounts of shrimp. Usually stern trawlers are devised for deeper waters and larger catches. It is also believed that beam trawlers are more manoeuvrable and therefore, it is easier for the crew to collect the shrimp from the fishing gears. The study should take into account the increase of the catch and the increased expenses in addition to the environmental and social issues. It is also necessary to mention the high cost of maintenance of the current boats, due to the old technology and the lack of spare parts. Thus, sooner than later the replacement of these vessels will become an urgent issue.

The main objective can be broken down into a number of goals to achieve the final results.

Goals:

- Analysis of profitability in order to determine if the new trawler would be more profitable than the old one, considering possible risk elements.
- Comparison of environmental topics, such as safety for oil spilling, caring of the sea bottom etc.
- Comparison of social topics, such as salary, crew, number of jobs and living on board etc.
- Comparison of effectiveness, taking into account mainly the proportion of catch and by catch.
- Development of a project general enough to be used in Cuban fishing companies, under different circumstances.

2 THEORETICAL AND PRACTICAL BACKGROUND

Profitability is, in general, the efficiency of a company or industry at generating earnings. Some concepts related to this topic will be reviewed in this chapter but not much can be found in the literature about profitability of fishing vessels specifically.

Many authors agree that it is necessaryto invest to make a business profitable no matter what kind of business. It also seems reasonable that current profitability is related to future investment and that current investment is related to future profitability (Sloan 1996, Fairfield *et al*. 2002 and 2003, Richardson *et al*. 2004 and 2005).

Previous work also shows that dividend-paying firms tend to be more profitable although they grow more slowly (Fama and French 2001). In Cuba, due to the socialist system of government, most of the dividends are collected by the state in order to support some other areas, which are not as profitable or even those, which do not yield almost any revenues at all, like educational or health organisations.

Literature shows that accruals result in transitory variation in earnings (Sloan 1996). This statement is consistent with other investigations (Collins and Hribar 2000, Chan *et al*. 2006) that accruals predict returns on the investment.

Fairfield *et al*. 1996 have examined the role of particular financial statement components and ratios in forecasting the profitability of a certain investment or business in general. This ratio analysis was also used in determining the advisability of investing in the project.

Getting into the particular case of calculating profitability of fishing vessels, two computation models, Kalkyle and Minikalkyle, were put forward by Digernes (1981). The study was carried out to develop a tool to assist fisheries stakeholders in considering alternative investment opportunities for fishing vessels. According to vessel owners and financing institutions if the project works in the first years, then the inflation rate helps to manage responsibilities later on. That is the reason why only results from one-year operations are analysed.

Both models are complementary and operate under similar bases. The difference lies mainly in the way they present the results.

- Kalkyle provides the user with a complete detailed result of the operation. The report can be presented to a third party and also runs a sensitivity analysis, shown both in table and diagram form.
- Minikalkyle is a less complicated model. It is mainly used in the development stage of the design of a vessel project. The users can experiment with some input changes and several alternatives come up. The accuracy of the information at this point is limited but it is enough to get a general idea of the expected results.

The similarities between models are:

- The operation of the vessels is the factor that produces the revenues. It takes into account effective fishing time, amount of fishing gear used per fishing day, catch per unit gear used and fish price.

- The cost components are related to the factor that produces it, for instance, fuel cost is expressed as a function of the engine power and operating time.

The main results produced by the models are:
- Owners' net profit, before tax
- Crew income, annual and per working day
- Cash flow balance before tax
- Break-even revenue and catch rates with corresponding crew income
- Parameter sensitivity analysis

The model proposed in this paper is related in some ways to those outlined above. The need for large computers for Kalkyle or programmable calculators for Minikalkyle, which was a disadvantage at that time they were first proposed, seems to have been overcome now with relatively easy access to computers. Microsoft Excel is a powerful tool which is able to perform the calculations and present the results, both in table and graph form. Another difference is that in the present study, the time value of money was taken into account and the planning horizon is 10 years, instead of the only one. In Digernes' document, the ship is used in various seasons to fish different kinds of species and using diverse fishing gears. The results for every season are stated as well as a final summary. For Cuban shrimp trawlers it is not possible to utilise the vessels for a different activity since trawling for fish is banned and the revenues of using the vessels for other tasks do not cover the costs incurred. In general terms, the model presented in this project can be seen as achieving similar objectives to Digernes' but taking advantage of the development of computer technology, adapted to Cuban conditions and using some additional techniques and methods as well.

3 METHODS

The main analytical tool in this project is a profitability assessment model designed for Microsoft Excel. Since other aspects than economical were studied, in addition to that model, the Analytical Hierarchy Process method was applied to support the results. This is a well-known technique for solving multi criteria decision-making problems.

3.1 Profitability assessment model

The model is based on one workbook with several sheets, one for each component (Figure 5).

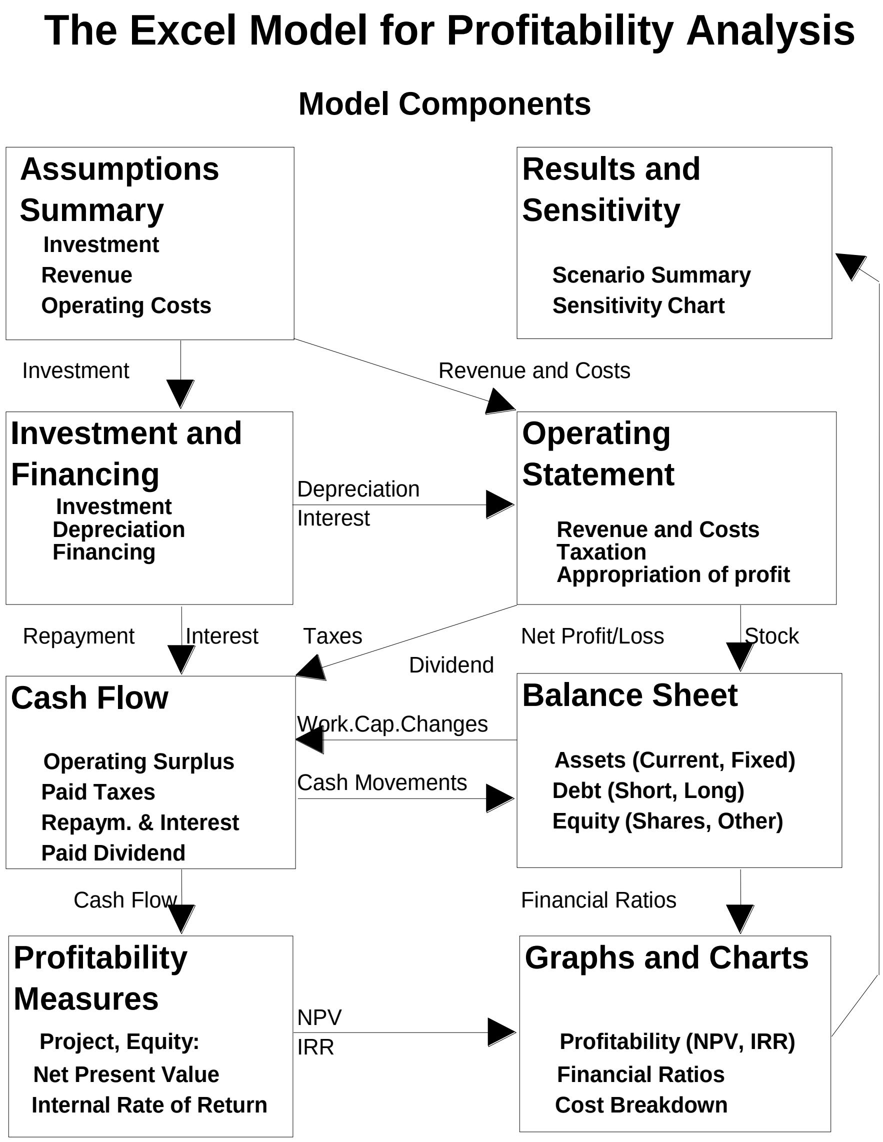

Figure 5: Profitability assessment model, with its main components.

Assumptions and results

This component of the model is for the input of the assumptions for the calculations to follow. In addition, the main results of the profitability analysis are shown here. If needed, additional assumption sheets can be inserted before this sheet for details such as a breakdown of the investment costs and of operational costs.

Investments and financing

This sheet includes the assumed breakdown of the investment cost related to the project, i.e. ship costs, equipment and other investment (engineering and diverse start-up costs).

Operating statement

This component has the purpose of calculating the revenue and costs year by year, the income tax and other taxes, and the appropriation of profit.

Balance sheet

The balance sheet gives a more complete picture to be able to follow the forecasted development. Also, financial ratios can be calculated. Finally, the balance sheet is used in the model as a verification tool as many logical errors may result in a difference between total assets on one hand and total debt and capital on the other hand.

Cash flow

The cash flow calculation begins with the operating surplus from the operating statement. Debtor and creditor changes are calculated on the basis of the debtors and creditors on the balance sheet, giving cash flow before taxes.

Profitability calculations

This component of the model calculates the profitability of the investment. Two measures are used in the model: The net present value (NPV) with a discounting factor and the internal rate of return (IRR).

Sensitivity analysis

Sensitivity analysis for exploring and better understanding the effects of uncertainties can be done in many different ways. Impact analysis deals with only one uncertain item at the time, for example sales price, sales quantity or cost of ship. Scenario analysis deals with simultaneous changes in more than one uncertain item. Excel scenario manager is used for this purpose. The changing cells are selected and their values for each scenario. Finally, the Monte Carlo method is used to assess the impact of the most critical risk element, simulating normally distributed random numbers and studying the effect on the internal rate of return.

3.2 Analytic Hierarchy Process

The Analytic Hierarchy Process provides a proven, effective means to deal with complex decision making and can assist in identifying and weighting selection criteria, analysing the data collected for the criteria and expediting the decision-making process. It helps to capture both subjective and objective evaluation measures, providing a useful mechanism for checking the consistency of the evaluation measures and alternatives suggested by the team thus reducing bias in decision making. The method is especially suitable for complex decisions which involve a comparison of decision elements, which are difficult to quantify. It is based on the assumption that when faced with a complex decision the natural human reaction is to cluster the decision elements according to their common characteristics.

In the Analytic Hierarchy Process, pairwise comparisons are performed by the decision-maker and then the pairwise comparison matrix and the eigenvector are derived to specify the weights of each parameter in the problem. The weights guide the decision-maker in choosing the superior alternative (Ghazinoory 2006). This method was first used by Saaty who not only introduced it (Saaty 1980), but also utilised it in planning and anticipating for the first time (Saaty 1990). He employed forward and backward processes to determine logical future outcomes and then found promising control policies to attain the desired future. In the other words, Saaty's approach attempted to reduce the gap between logical future and desired future by choosing the appropriate strategies.

The process facilitates the rational evaluation of these pros and cons. It supports the pursuit of an optimal solution in a transparent manner, via:

- Qualitative and quantitative decision analysis
- Simple evaluation and representation of solutions through the Hierarchical Model
- Logic arguments and clearing emotions
- Checking the quality of the decision
- Little need of time
- High acceptance

The Analytic Hierarchy Process has been applied by decision makers in countless areas, including accounting, finance, marketing, energy resource planning, microcomputer selection, sociology, architecture and political science (Winston 1994). Ramanathan and Ganesh (1995) employ Analytic Hierarchy for a resource allocation problem. In that paper, the weight of each decision variable gained by Analytic Hierarchy is used as a coefficient of that variable in the objective function. In the present project, it was used to assess the effectiveness, environmental and social issues involved.

4 MODEL AND DATA ANALYSIS

4.1 Data and assumptions

The profitability odel is built up using Microsoft Excel in a way that all the data can be inserted and changed adapting it to the characteristics of the company or business analysed. The template for the data and assumptions is shown in Appendix 1. First, in the model, there is a work sheet, named Startup, where the main data and assumptions are stated. All the entries are linked automatically to the sheets in which they are going to be used, so different results can be experienced by changing the values of the entry cells.

As mentioned previously due to the lack of some real data and the convenience of having some inputs that could be changed by the user, a number of assumptions had to be made. In this case, the assumptions are in italics (Figure 6). The information will be presented in table form, so the user can more easily understand all the costs involved in the profitability analysis. For further information, the Excel sheet, named Assumptions and Results is Appendix 2.

4.1.1 Investments costs

The investment costs were broken down into several items. Since those expenses are the most important in this activity, it is assumed that the real investment cost is almost fully covered (Table 1).

Table 1: Breakdown of investment costs (in 1000 euros).

Breakdown of investment costs		
Ship:		*200.0*
	Ship total	***200.0***
Equipment:		
	Spare fishing gears	10.0
	Medical stuff	5.0
	Contingency	5.0
	Equipment total	**20.0**
Other investment:		
	Design	*12.0*
	Training	3.0
	Special clothes	2.0
	Contingency	3.0
	Other total	**20.0**
Total investment cost		**240.0**

In this case, the ship cost was assumed, because there is usually a variation in price, depending on the vessel builder. That happens with the design of the ship, as well. Training costs is the amount used for training the crew in using the new technology. For the other articles the regular costs were used, which are currently being applied for Cuban boats. The Excel sheet corresponding to this module is in Appendix 3.

4.1.2 Operating costs

A similar procedure was followed to deal with operation costs. First, data were stated (Table 2) for calculating the costs and results, for instance, fuel costs and sales per year.

Table 2: General data of fishing operations.

	Value	**Unit**
1 fishing season	60	days
Number of fishing seasons per year	3	
Fuel consumption	1 000	l/day
Fuel consumption per year	180 000	l
Fuel price	0.6	€/l
Fuel cost per year	111 600	€/year
Catch	300	kg/day
Catch per year	54 000	kg/year
Sales price	10	€/kg
Sales per year	540 000	€/year

Some elements are unknown, such as the maintenance, insurance and sales costs, so they had to be estimated, taking into account the data from actual vessels. On the other hand, the figures used in salary, supplies, food and fuel are real costs in operating vessels, although they may vary a bit. The fuel costs and the costs of insurance are the highest items in the operations (Table 3) and the Excel sheet on operation is in Appendix 4.

Table 3: Breakdown of operation costs

Breakdown of operation costs			
Variable costs:			
	Salary	3 300	€/ton
	Supplies	1 000	€/ton
	Total variable costs	**4 300**	**€/ton**
Fixed costs:			
	Maintenance	*25 000*	*€/year*
	Food	15 000	€/year
	Fuel	111 600	€/year
	Insurance	*50 000*	*€/year*
	Sales	*10 000*	*€/year*
	Total fixed costs	**211 600**	**€/year**

4.1.3 Breakeven analysis

One of the most common tools used in evaluating the economic feasibility of a new enterprise or product is the breakeven analysis. The breakeven point is the point at which revenue is exactly equal to costs. At this point, no profit is made and no losses are incurred. It can be expressed in terms of unit sales or money sales. That is, the breakeven units indicate the level of production that is required to cover costs. Sales above that number result in profit and sales below that number result in a loss. The breakeven sales indicate the money coming from revenues required to breakeven. The breakeven point in this case is about 48 tons, which yield approximately 480 000 euros (Table 4 and Figure 6).

Table 4: Data and results of the breakeven analysis

Variable costs:		
Salary	3 300	€/ton
Supplies	1 000	€/ton
Variable cost total	4 300	€/ton
Fixed costs:		
Maintenance	25 000	€/year
Food	15 000	€/year
Fuel	111 600	€/year
Insurance	50 000	€/year
Sales	10 000	€/year
Fixed costs total	**211 600**	**€/year**
Sales price:	10 000	€/ton
Net profit contribution	5 700	€/ton
Break even analysis without investment costs:		
Sales price:	10 000	€/ton
Net profit contribution	5 700	€/ton
Break Even Quantity	37.1	tons/year
Break even analysis with investment costs:		
Annuity of loans	57 887.7	€/year
Fixed costs including annuity	269 487.7	€/year
Break even including annuity	**47.3**	**tons/year**

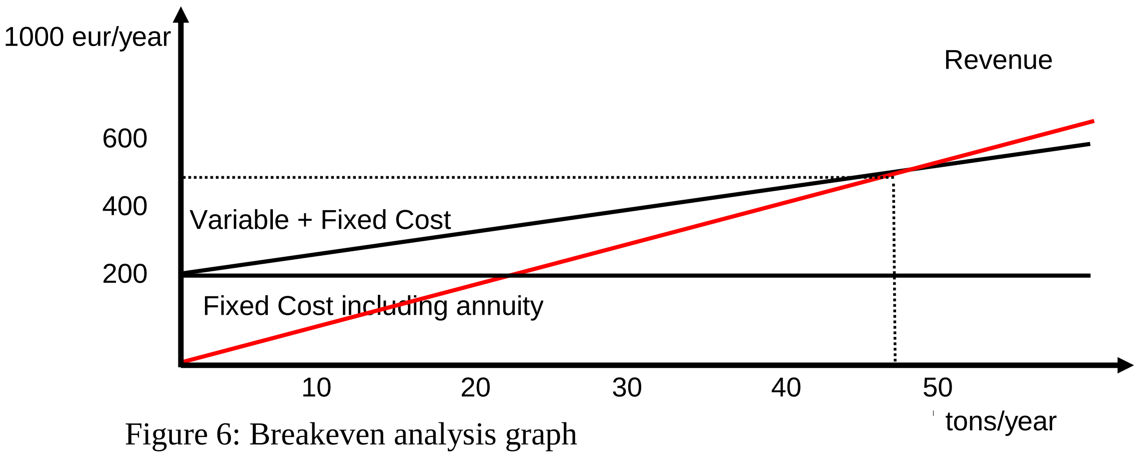

Figure 6: Breakeven analysis graph

4.2 Cash flow analysis

In this analysis, two main elements were studied. Total cash flow and capital, which shows a positive value throughout all the years, except for the first one, when the starting financing is deducted. The net cash flow and equity, is below zero in the first two years, mainly because debtors are very high, but after that period, there is an increasing trend. Both flows are presented in Figure 7 (Appendixes 5 to 7).

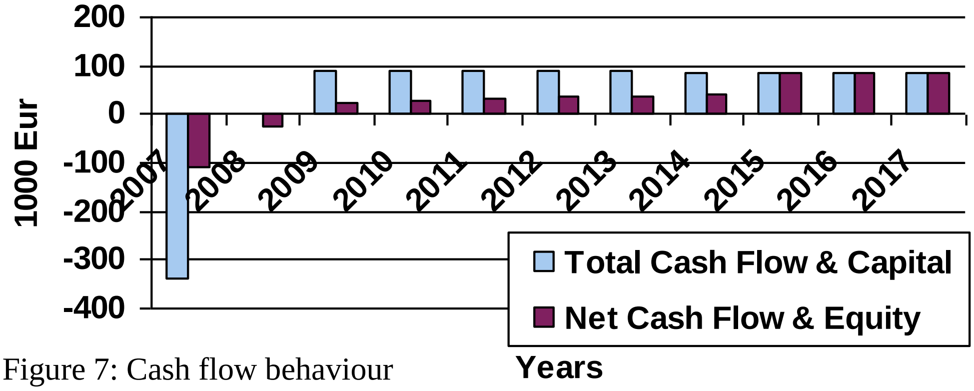

Figure 7: Cash flow behaviour

4.3 Profitability analysis

In this analysis the internal rate of return and the net present value were evaluated as well as the most important financial ratios, some other ratios are presented in Appendix 6.

The Internal rate of return is a capital budgeting method used by firms to decide whether they should make long-term investments. It is the return rate, which can be earned on the invested capital, i.e. the yield on the investment. A project is a good investment proposition if its internal rate of return is greater than the rate of interest that could be earned by alternative investments (investing in other projects, buying bonds, even putting the money in a bank account). Mathematically it is defined as any discount rate that results in a net present value of zero of a series of cash flows. In this project, the internal rate of return of equity is 21%, after 10 years (Figure 8).

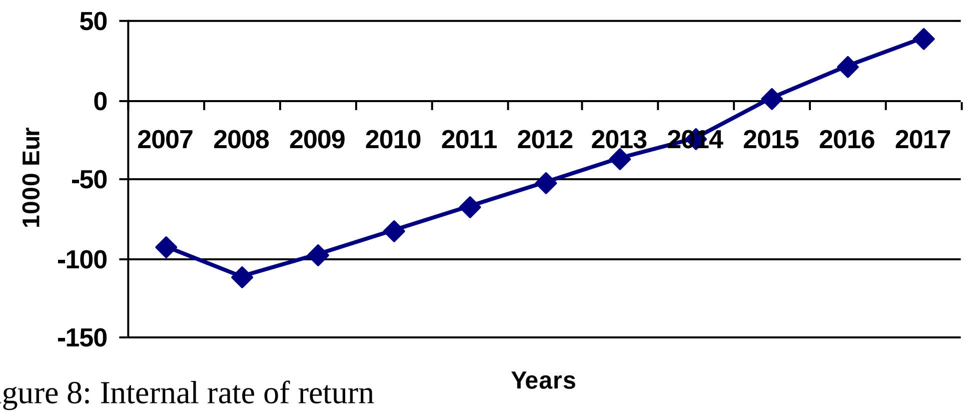

Figure 8: Internal rate of return

The net present value of a project or investment is defined as the sum of the present values of the annual cash flows minus the initial investment. The annual cash flows are the net benefits (revenues minus costs) generated from the investment during its lifetime. These cash flows are discounted or adjusted by incorporating the uncertainty and time value of money. It is one of the most robust financial evaluation tools to estimate the value of an investment. If a project has a positive net present value, then it is generating more cash than is needed to service its debt and provide the required return to shareholders (Brigham and Houston 2004). So the study investment, with net present value equals 39 000 euros acceptable, but the discounted payback period is too long, eight years (Figure 9).

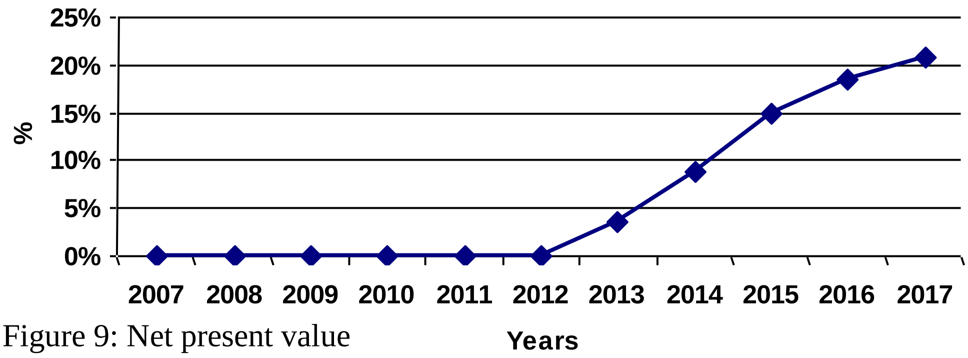

Figure 9: Net present value

The Net current ratio is a comparison of a firm's current assets to its current liabilities. It is an indication of a firm's market liquidity and ability to meet short-term debt obligations. If current liabilities exceed current assets (the current ratio is below one), then the company may have problems meeting its short-term obligations. It does not happen in this situation, since the company has an increasing ratio every year (Figure 10).

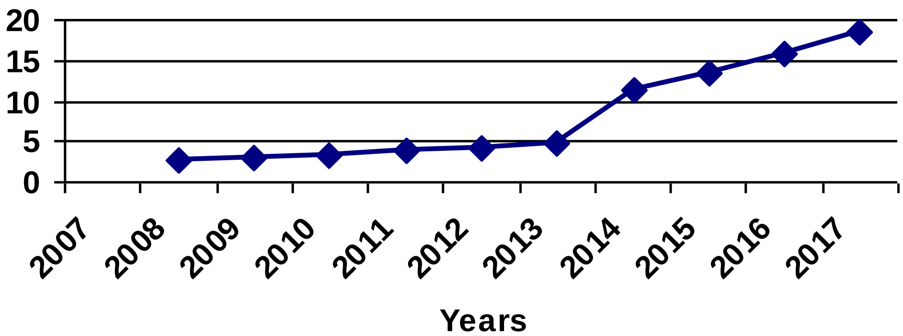

Figure 10: Net current ratio

Liquid current ratio (quick current ratio): The acid-test or quick ratio measures the ability of a company to use its “near cash” or quick assets to immediately extinguish its current liabilities. Quick assets include those current assets that presumably can be quickly converted into cash at close to their book values. Such items are cash, stock investments, and accounts receivable. This ratio implies a liquidation approach and does not recognise the revolving nature of current assets and liabilities. The behaviour of this ratio is very similar to the previous (Figure 11) (Appendix 7).

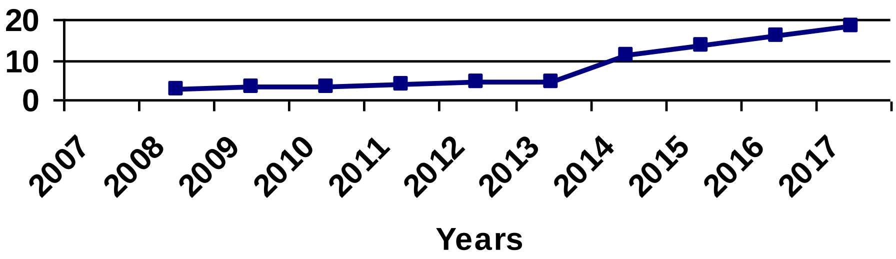

Figure 11: Liquid current ratio

Debt Service Coverage is a measure of a company’s or an individual’s ability to cover, or pay off debt. It refers to the amount of cash or cash flow required to pay off a debt, and how much the total debt actually is. The higher this ratio is, the easier it is to borrow money for the investment. In the project, some problems are faced in the first four years, but after that period, the ratio is over 1.5, which is a good one, in general terms (Figure 12).

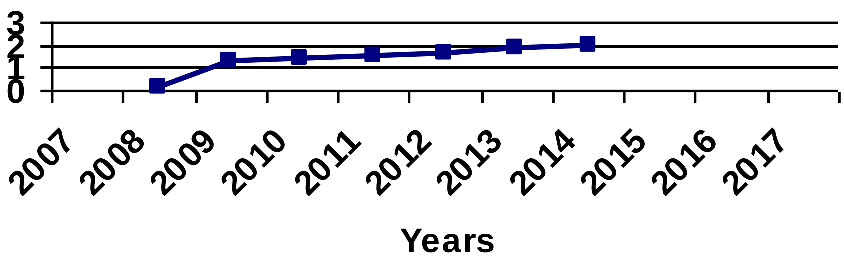

Figure 12: Debt service coverage

4.4 Sensitivity analysis

A sensitivity analysis is a good method to understand uncertainty in any type of financial model. Its objective is to identify critical inputs of the financial model and how they impact the results. This is particularly important in investments where a change of say 10% in an input can make the project unprofitable. It is, therefore, essential to understand the dynamics of the underlying variables. This analysis was performed using two methods, impact analysis and scenario analysis.

4.4.1 Impact analysis

The main goal of the study is to evaluate the changes in the internal rate of return of the equity, when variations of the inputs are introduced. The process was carried out by changing one element at the time, sales price, sales quantity or ship cost. Then the output shows that sales price is the most critical component in this case, a decrease of only 10% would lead to an internal rate of return equal to zero. This also happens when the sales quantity is diminished by 10%, the internal rate of return would drop by 17%, from 21% to 4%. On the other hand, a variation of the ship cost does not affect this economic indicator too much. The results are displayed in Table 5 and Figure 13.

Table 5: Impact analysis on internal rate of return of equity showing IRR of equity against deviation for sales price, quantity and ship cost.

Variation	Sales price variation	IRR=21%	Sales quantity variation	IRR=21%	Ship cost variation	IRR=21%
-50%	50%	0%	50%	0%	50%	37%
-40%	60%	0%	60%	0%	60%	33%
-30%	70%	0%	70%	0%	70%	30%
-20%	80%	0%	80%	0%	80%	26%
-10%	90%	0%	90%	4%	90%	24%
0%	100%	21%	100%	21%	100%	21%
10%	110%	52%	110%	38%	110%	18%
20%	120%	86%	120%	55%	120%	16%
30%	130%	122%	130%	74%	130%	14%
40%	140%	160%	140%	92%	140%	12%
50%	150%	198%	150%	112%	150%	11%

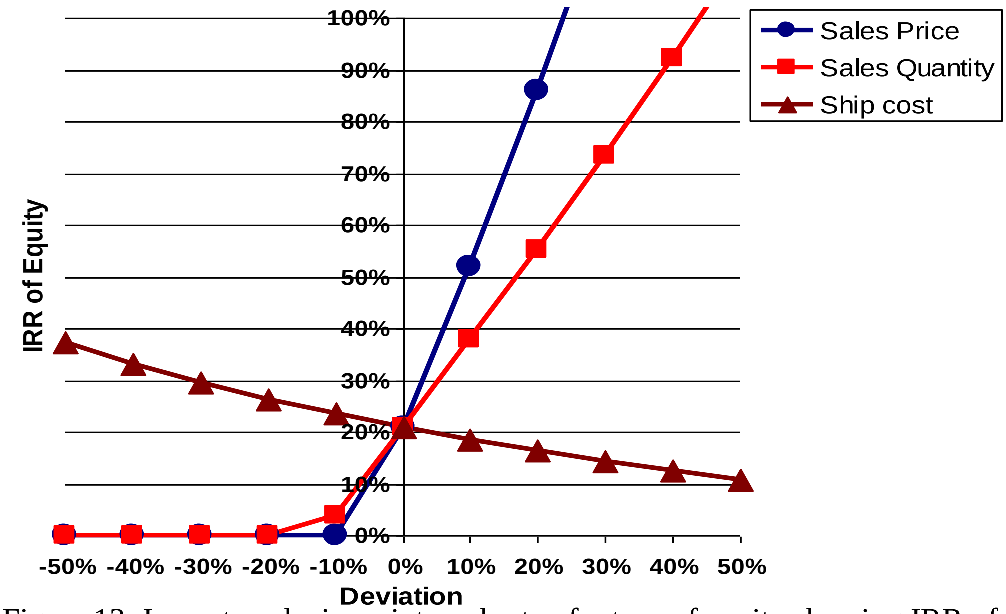

Figure 13: Impact analysis on internal rate of return of equity showing IRR of equity against deviation for sales price, quantity and ship cost.

4.4.2 Scenario analysis

A scenario analysis is a special case of sensitivity analysis where a pre-determined set of possible outcomes is identified. It is highly effective as a communication tool to describe the uncertainty of a project. It bounds the outcomes of a project and communicates the risks associated with the project. It differs from the previous method because in this case, the three elements are changed at the same time. First two scenarios were defined, pessimistic and optimistic, using Microsoft Excel scenario manager. In the pessimistic scenario it was assumed that the ship cost, the sales quantity and the sales price were 10% worse than the current values and in the optimistic, the assumptions were the other way around. Results are shown in Table 6.

Table 6: Scenario analysis summary

Scenario summary		Current values:	Pessimistic	Optimistic
Changing cells:				
	Ship_cost	100%	110%	90%
	Sales_quantity	100%	90%	110%
	Sales_price	100%	90%	110%
Result cells:				
	NPV_total_capital	25	-297	370
	NPV_equity	39	-282	383
	IRR_total_capital	17%	0%	42%
	IRR_equity	21%	0%	79%

4.5 Risk assessment using Monte Carlo simulation

A Monte Carlo simulation examines the effect of fluctuations in sales prices on the internal rate of return of equity. The simulation was performed using 100 random numbers generated automatically by Microsoft Excel. The numbers were produced following a normal distribution, with a mean equal to one and a standard deviation equal to 0.05. The choice of this value for standard deviation can be criticised. However, a detailed analysis would have required much more data collection than was possible in this project.

Then the respective internal rate of return of equity to those values, was calculated. The sales price was chosen because it was found to be the most critical element in the impact analysis. The frequency and the cumulative results are shown in Table 7 and in graphical form in Figure 14.

Table 7: Frequency and cumulative results for internal rate of return of equity

IRR	Frequency	Cumulative %
0%	7	7%
5%	6	13%
10%	8	21%
15%	13	34%
20%	17	51%
25%	13	64%
30%	14	78%
35%	5	83%
40%	8	91%
45%	4	95%
50%	1	96%
55%	2	98%
60%	0	98%
65%	2	100%

The results showed that in 7% of the cases, the internal rate of return of equity was 0 or negative. It can also be taken a little further, 34% of the values yielded an internal rate of return of equity lower than 15%.

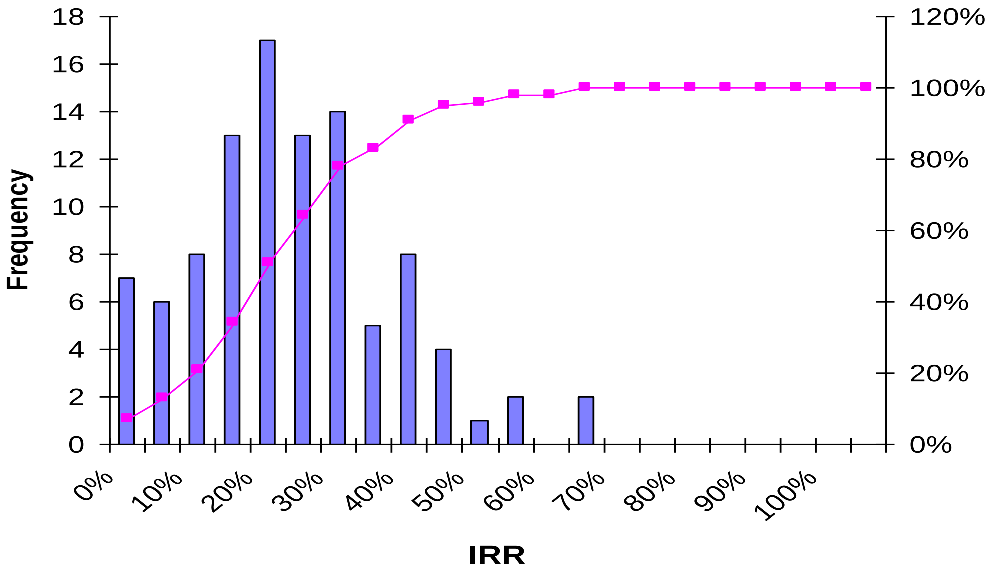

Figure 14: Frequency and cumulative results for internal rate of return (IRR) of equity

4.6 Analytic hierarchy process

This method was used to evaluate other topics than economics. Specifically, the issues involving environmental, social and effectiveness elements. For the environmental elements, the sea bottom disturbance and the probability of an oil spill were analysed. Living conditions on board, number of jobs and salaries were taken into consideration to estimate the social aspects. Finally, the effectiveness was evaluated by looking at the proportion of by catch and shrimp of the total catch of the vessel.

The study was carried out in four main steps, after defining the criteria that were applied. Firstly, a pairwise comparison of criteria was performed in order to assign the weights and to establish the relationship among all of them. The results can be seen in Table 8. The effectiveness is three times more important than the environmental topic and it is seven times more important than social issues. On the other hand, social elements are six times less important than environmental subjects.

Table 8: Pairwise comparison of criteria => weights (Step 1)

	Comparison		
	Environmental	Social	Effectiveness
Environmental	1	6	1/3
Social	1/6	1	1/7
Effectiveness	3	7	1
Sum:	4.17	14.00	1.48

The next step was to check the consistency of the weights (Table 9). For further information, please, refer to (Winston 1994).

Table 9: Checking consistency (Step 2)

	Normalised:					
	Environmental	Social	Effectiveness	**Weights**	A*w'	A*w'/w'
Environmental	0.24	0.43	0.23	**0.30**	0.93	3.10
Social	0.04	0.07	0.10	**0.07**	0.21	3.02
Effectiveness	0.72	0.50	0.68	**0.63**	2.01	3.18
	1.00	1.00	1.00	1.00	M=	3.10
					CI =	0.051
					CI/RI=	0.087
					Consistency	

Once it has been stated the weights are consistent then the third step is to compare the two vessels, the old and the new, according to the different criteria, that is environmental, social and effectiveness elements. The weights are given in the range of 1 to 10, meaning the times that a characteristic is stronger compared to the other boat (Tables 10 to 12).

Table 10: Pairwise comparison of alternatives => weights (environmental) (Step 3)

Environmental	Comparison	
	Old	New
Old	1	1/3
New	3	1
Sum:	4.00	1.33

Environmental	Normalised	
	Old	New
Old	0.25	0.25
New	0.75	0.75
Sum:	1.00	1.00

Table 11: Pairwise comparison of alternatives => weights (social) (Step 3)

Social	Comparison	
	Old	New
Old	1	1/9
New	9	1
Sum:	10.00	1.11

Social	Normalised	
	Old	New
Old	0.10	0.10
New	0.90	0.90
Sum:	1.00	1.00

Table 12: Pairwise comparison of alternatives => weights (effectiveness) (Step 3)

Effectiveness	Comparison	
	Old	New
Old	1	1/5
New	5	1
Sum:	6.00	1.20

Effectiveness	Normalised	
	Old	New
Old	0.17	0.17
New	0.83	0.83
Sum:	1.00	1.00

In sum, the new trawler is three times better than the old one in the environmental issue, nine times better in the social aspects and five times better regarding the effectiveness.

The fourth step is to calculate weighted final scores, combining the criteria with the alternatives, as summarised in Table 13. Therefore, the final scores are determined by multiplying the weights of the criteria, environmental, social and effectiveness with the marks obtained by the old and new vessels according to those topics. Table 14 and Figures 15 and 16 show these data in graphical form.

Table 13: Criteria weights and alternatives comparison (Step 4)

	Environmental	Social	Effectiveness
	0.30	0.07	0.63
Old	0.25	0.10	0.17
New	0.75	0.90	0.83

Table 14: Calculation of final scores (Step 4)

	Alternatives' weights			Alternatives and criteria weighted			**Final scores**
	Environmental	Social	Effectiveness	Environmental	Social	Effectiveness	
Old	0.25	0.10	0.17	0.075	0.007	0.105	**0.19**
New	0.75	0.90	0.83	0.224	0.062	0.527	**0.81**

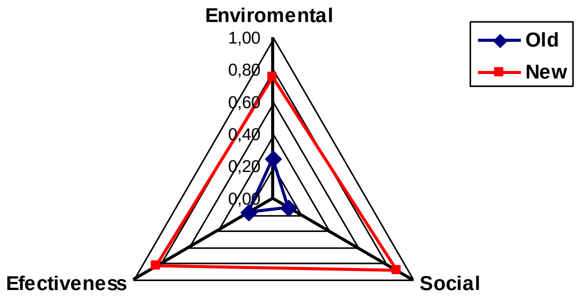

Figure 15: Alternatives' weights

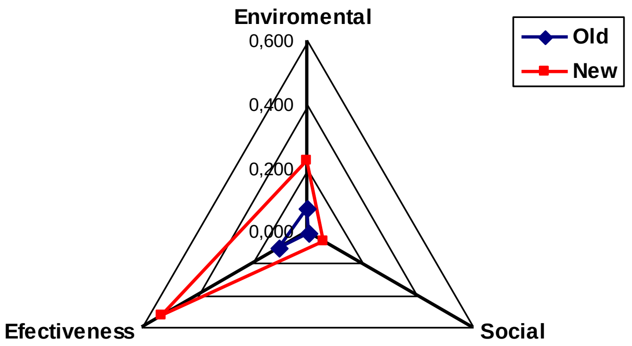

Figure 16: Alternatives and criteria weighted

Analysing the final scores, a conclusion can be made. The new trawler is superior in all aspects to the old one.

5 CONCLUSIONS AND RECOMMENDATIONS

In order to achieve the most important objective of the research, it is vital to state if the project should be carried out or not. Therefore, the purpose of this chapter is to answer that question, summarising the methods and techniques applied and the results obtained. The breakeven analysis was applied to find out the necessary quantity of shrimp to be caught each year in order to have an annual profit greater than zero. The result is that a minimum of 48 tons is needed to keep the business running properly. In other words, with current prices, the catch has to be over that value to assure at least 480 000 euros, in order to get some profit. Taking into account that expected annual catch is 54 tons, the margin is not so big. Therefore, a small decrease in the fisheries or in the sales price, would lead the company to run losses.

The general cash flow of the project is rather stable, throughout the planning horizon. However, in the first year of operation, the organisation would experience some cash flow problems. The net cash flow after that period increases every year. It is even higher in the last years forecasted, when debt is already paid off. Therefore, the company would be financially healthy in the short term and has no problem with liquidity. In the profitability analysis, the internal rate of return = 21%, meaning the investment is feasible. The net present value = 39 000 euros is acceptable, however, the discounted payback period is very long. The ratios studied, net current, liquid current and debt service coverage have a positive and increasing behaviour as well.

In the impact analysis, the sales price came out to be the most critical element, since a decrease of only 10% would make the internal rate of return 0. This variable was taken to perform the scenario analysis, as well as the ship costs and the sales quantity. The pessimistic scenario yielded very bad results, with a negative net present value and internal rate of return = 0% while the optimistic scenario had opposite results. Consequently, the project is highly risky, because those elements were only modified by 10% and the results experienced a great variation from the original values. Then a Monte Carlo simulation was performed for the most sensitive aspect, that is sales price. The outcome confirms the great risk of the investment, since 34 cases out of 100, produced an insufficient internal rate of return. At last, an analytic hierarchy process was carried out to asses some other aspects. Those are effectiveness, social and environmental topics. The comparison between the two vessels on these matters shows that the new one is much better than the old one.

Summing up, it is strongly advisable to put into effect the purchasing project, to boost the shrimp fisheries and therefore the Cuban economy. Nevertheless, the high risk associated with the investment has to be assessed very closely in order to minimise it.

Finally, it is essential to remark that the research made can be a very useful tool to evaluate the feasibility of investments and the risks associated to it. In Cuba, it would mean a necessary change in the mind and way of work of decision makers. Having the expected result of a project by a scientific and overall study would result in minimising losses in both financial and production terms. The analysis proposed here can be applied not only to fishing vessels but also to almost every investment in the world, just by adapting the model to the circumstances of the particular task. So, it is strongly recommended to implement it as a valuable evaluation instrument and guideline for investment projects.

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APPENDIX 1: TEMPLATE FOR THE PROFITABILITY ANALYSIS

Characteristics:	Estimated values:
Investment Assumptions:	
Ship	___________ EUR
Equipment	___________ EUR
Other (Design, Training, Special clothes …)	___________ EUR
Marketing Assumptions:	
Sales Volume	___________ kg/year
Sales Price	___________ EUR/kg
Production Assumptions:	
Catch	___________kg/year
Operating Costs Assumptions:	
Cost of Fuel	___________ EUR/year
Salary Cost	___________ EUR/ton
Maintenance Cost	___________ EUR/year
Sales Cost	___________ EUR/year
Insurance etc	___________ EUR/year
Food Cost	___________ EUR/year
Supplies	___________ EUR/ton
Financial Assumptions:	
Loan Financing	___________ %
Interest on loan	___________ %
Discounting rate	___________ %
Planning Horizon	___________ years
Depreciation (ship, equipment …)	___________ years

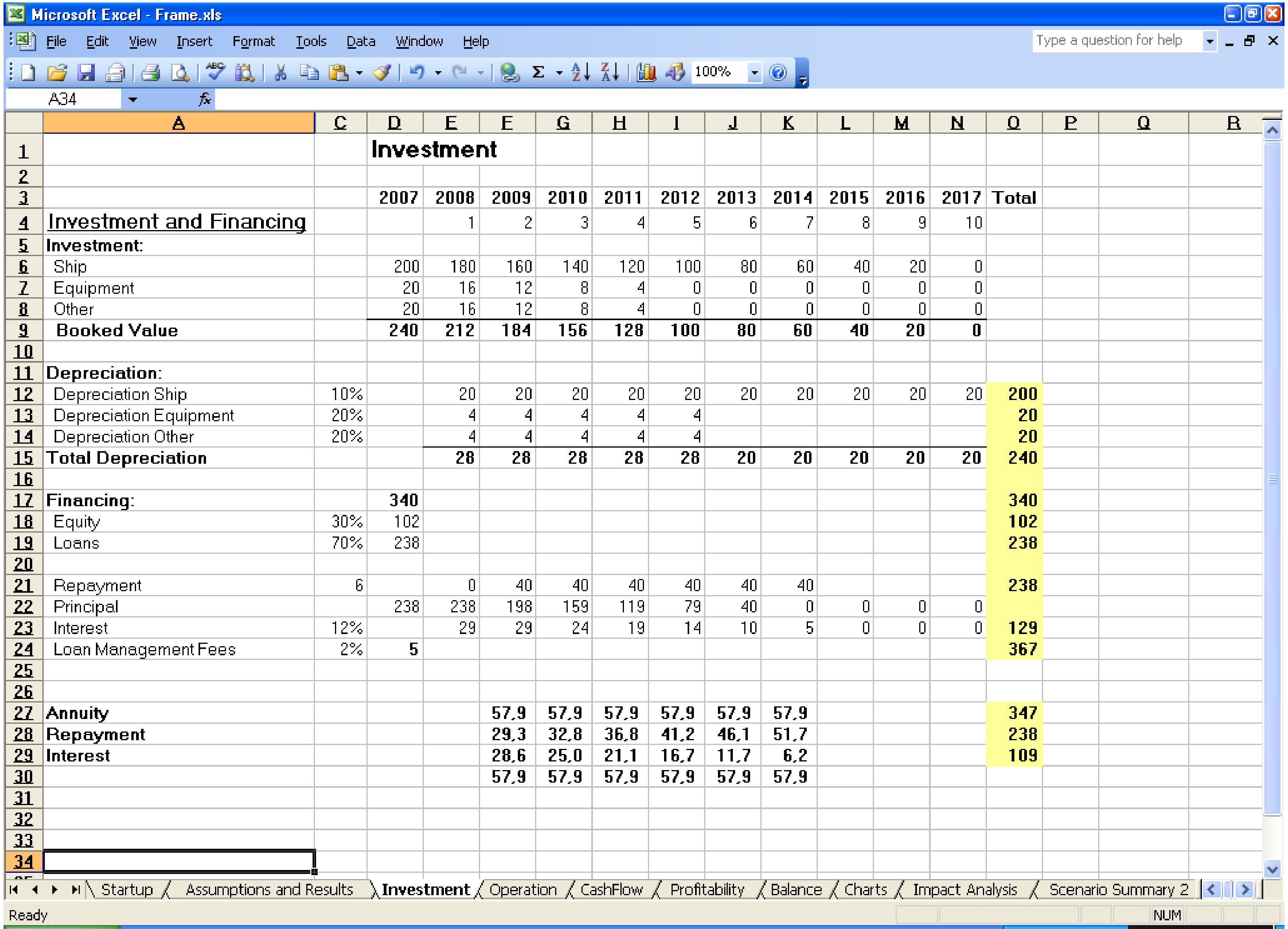
APPENDIX 2: ASSUMPTIONS AND RESULTS SHEET

Microsoft Excel - Frame.xls

	A	C	D	E	F	G	H	I	J	K	L	M	N	O
1				**Assumptions and Results**										
2														
3			2007		Discounting Rate		15%							
4	Investment:		KEUR		Planning Horizon		10	years						
5	Ship	100%	200											
6	Equipment	100%	20				Total Capital	Equity						
7	Other		20		NPV of Cash Flow		25	39		25	39			
8	Total		240		Internal Rate of Return		17%	21%		17%	21%			
9	Financing:													
10	Working Capital		100		Capital/Equity (Internal Value of Shares)				6					
11	Total Financing		340		after 10 years									
12	Equity	100%	30%											
13	Loan Repayments	100%	6	years	Minimum Cash Account		69							
14	Loan Interest	100%	12%											
15	Operations:			2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
16	Sales Quantity	100%		54	54	54	54	54	54	54	54	54	54	ton/year
17	Sales Price	100%		10	10	10	10	10	10	10	10	10	10	KEUR/ton
18	Variable Cost	100%	4,3	KEUR/ton										
19	Fixed Cost	100%	212	KEUR/year										
20	Inventory Build-up			10										
21	Debtors	20%												
22	Creditors	10%												
23	Income Tax	15%												
25	Depreciation Ship	10%												
26	Depreciation Equipment	20%												
27	Depreciation Other Investement	20%												
28	Loan Management Fee	2%												
29														
30														
31														
32														
33														
34														
35														

Startup / Assumptions and Results / Investment / Operation / CashFlow / Profitability / Balance / Charts / Impact Analysis / Scenario Summary 2

APPENDIX 3: INVESTMENT SHEET



		Investment											
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Investment and Financing			1	2	3	4	5	6	7	8	9	10	
Investment:													
Ship		200	180	160	140	120	100	80	60	40	20	0	
Equipment		20	16	12	8	4	0	0	0	0	0	0	
Other		20	16	12	8	4	0	0	0	0	0	0	
Booked Value		**240**	**212**	**184**	**156**	**128**	**100**	**80**	**60**	**40**	**20**	**0**	
Depreciation:													
Depreciation Ship	10%		20	20	20	20	20	20	20	20	20	20	**200**
Depreciation Equipment	20%		4	4	4	4	4						**20**
Depreciation Other	20%		4	4	4	4	4						**20**
Total Depreciation			**28**	**28**	**28**	**28**	**28**	**20**	**20**	**20**	**20**	**20**	**240**
Financing:		**340**											**340**
Equity	30%	102											**102**
Loans	70%	238											**238**
Repayment	6		0	40	40	40	40	40	40				**238**
Principal		238	238	198	159	119	79	40	0	0	0	0	
Interest	12%		29	29	24	19	14	10	5	0	0	0	**129**
Loan Management Fees	2%	**5**											**367**
Annuity				**57,9**	**57,9**	**57,9**	**57,9**	**57,9**	**57,9**				**347**
Repayment				**29,3**	**32,8**	**36,8**	**41,2**	**46,1**	**51,7**				**238**
Interest				**28,6**	**25,0**	**21,1**	**16,7**	**11,7**	**6,2**				**109**
				57,9	**57,9**	**57,9**	**57,9**	**57,9**	**57,9**				

APPENDIX 4: OPERATION SHEET

Microsoft Excel - Frame.xls

Operation

	A	C	D	E	F	G	H	I	J	K	L	M	N	O
3			2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
4	Operations Statement													
5	Sales Volume Ktons/year			54	54	54	54	54	54	54	54	54	54	540
6	Price KEUR/ton			10	10	10	10	10	10	10	10	10	10	
7	**Revenue**			540	540	540	540	540	540	540	540	540	540	5400
8														
9	Variable Cost	4,3		242	232	232	232	232	232	232	232	232	232	2332
10	**Net Profit Contribution**			298	308	308	308	308	308	308	308	308	308	3068
11	Fixed Cost	212		212	212	212	212	212	212	212	212	212	212	2116
13	**Operating Surplus (EBITDA)**			86	96	96	96	96	96	96	96	96	96	952
14														
15	Inventory Movement			10										10
16	Depreciation			28	28	28	28	28	20	20	20	20	20	240
17	**Operating Gain/Loss**			68	68	68	68	68	76	76	76	76	76	722
18														
19	Interest + Loan Man. Fee		5	29	29	24	19	14	10	5	0	0	0	133
20	**Profit before Tax**		-5	40	40	44	49	54	67	71	76	76	76	589
21														
22	Loss Transfer	0	-5	0	0	0	0	0	0	0	0	0	0	
24	Taxable Profit		0	35	40	44	49	54	67	71	76	76	76	589
25	Income Tax	15%	0	5	6	7	7	8	10	11	11	11	11	88
27	**Profit after Tax**		-5	34	34	38	42	46	57	61	65	65	65	500
29	**Net Profit/Loss**		-5	34	34	38	42	46	57	61	65	65	65	500

Startup / Assumptions and Results / Investment / Operation / CashFlow / Profitability / Balance / Charts / Impact Analysis / Scenario Summary 2

APPENDIX 5: CASH FLOW SHEET

Cash Flow

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Cash Flow												
Operating Surplus (EBITDA)	0	86	96	96	96	96	96	96	96	96	96	952
Debtor Changes		-108	0	0	0	0	0	0	0	0	0	-108
Creditor Changes		24	-1	0	0	0	0	0	0	0	0	23
Cash Flow before Tax	0	2	95	96	96	96	96	96	96	96	96	867
Paid Taxes		0	5	6	7	7	8	10	11	11	11	77
Cash Flow after Tax	0	2	90	90	90	89	88	86	85	85	85	790
Interest + Loan Man. Fee	5	29	29	24	19	14	10	5	0	0	0	133
Repayment	0	0	40	40	40	40	40	40	0	0	0	238
Net Cash Flow	-5	-26	22	27	31	35	39	42	85	85	85	419
Financing - Expenditure (Working Capital)	100											100
Cash Movement	95	-26	22	27	31	35	39	42	85	85	85	519
(changes in Cash Account)												

APPENDIX 6: PROFITABILITY SHEET

6 APPENDIX 7: BALANCE SHEET

Balance

	A	C	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
4	Balance Sheet												
5													
6	**Assets**												
7	Cash Account	0	95	69	91	118	148	183	222	264	350	434	519
8	Debtors (Accounts Receivable)	20%	0	108	108	108	108	108	108	108	108	108	108
9	Stock (Inventory)	0	0	10	10	10	10	10	10	10	10	10	10
10	**Current Assets**		**95**	**187**	**209**	**236**	**266**	**301**	**340**	**382**	**468**	**552**	**637**
11	Fixed Assets (Booked Value)		240	212	184	156	128	100	80	60	40	20	0
12	**Total Assets**		**335**	**399**	**393**	**392**	**394**	**401**	**420**	**442**	**508**	**572**	**637**
13													
14	**Debts**												
16	Taxes Payable		0	5	6	7	7	8	10	11	11	11	11
17	Creditors (Accounts Payable)	10%	0	24	23	23	23	23	23	23	23	23	23
18	Next Year Repayment		0	40	40	40	40	40	40	0	0	0	0
19	**Current Liabilities (Short Term Debt)**		**0**	**69**	**69**	**70**	**70**	**71**	**73**	**34**	**35**	**35**	**35**
20	Long Term Debt (- next year repayment)		238	198	159	119	79	40	0	0	0	0	0
21	**Total Debt**		**238**	**267**	**227**	**189**	**150**	**111**	**73**	**34**	**35**	**35**	**35**
22													
23	Equity (Shareholders Capital)	0	102	102	102	102	102	102	102	102	102	102	102
24	Profit & Loss Balance	0	-5	30	63	101	143	189	245	306	371	436	500
25	**Total Capital**		**97**	**132**	**165**	**203**	**245**	**291**	**347**	**408**	**473**	**538**	**602**
26													
27	**Debts and Capital**		**335**	**399**	**393**	**392**	**394**	**401**	**420**	**442**	**508**	**572**	**637**
28													
29	Check		0	0	0	0	0	0	0	0	0	0	0