The Role of Engineering Economics in the Evaluation of Investment Projects by the Bank of Amazon-Brazil

Maria Bernadete Junkes*, Anabela Pereira Tereso**, Paulo Sérgio Lima Pereira Afonso**

* Accounting Department, Federal University of Rondônia, Campus of Cacoal, Brazil
** Industrial and Technology Management Centre (CGIT), School of Engineering, University of Minho, Campus of Azurém, 4800-058 Guimarães, Portugal

Email: bernadetejunkes@gmail.com, anabelat@dps.uminho.pt, psafonso@dps.uminho.pt.

Abstract

One of the engineering economics objectives is to do economic analysis of investment decisions. It has quite extensive applications since the investment may come from private companies or government entities. The analysis or evaluation of projects involves a set of techniques that establish feasibility parameters. These parameters are expressed by PBP (Payback Period - number of years to recover the investment), IRR (internal rate of return) or NPV (Net Present Value). Thus, it has an important role on investment analysis or to buy a capital good, checking all technically feasible investment alternatives.

This research is based on a case study, namely a project of extension of a micro enterprise, whose data was collected on Bank of Amazon. The Bank of Amazon is an agent for the application of policies and programs of the Federal Government in the Amazon region, as well as its feasibility and the potential to carry out the project. Based on these facts, it was studied the role of engineering economics in the evaluation of investment projects by the Bank of Amazon, located in the northern region of Brazil. It was concluded that the Bank relies on the economic feasibility and engineering economics to analyses the submitted projects, having as a reference a IRR parameter between 4% and 12% and a PBP of 4 to 12 years in the investment projects less or equal to R$ 400,000.00. Some opportunities and suggestions to extend and improve investment analysis procedures and tools are discussed at the end of this paper.

Keywords: Bank of Amazon; engineering economics; investment projects; analysis tools; decision making.

1 Introduction

Engineering Economics is considered as a set of techniques that allow the monetary quantification and economic evaluation of investment alternatives, enabling the manager to have the necessary information knowledge to support decision-making. The engineering economics techniques used for analyzing projects are intended to clarify and quantify the advantages and disadvantages of each alternative of investment. The whole investment project consists of the identification and analysis of the consequences that result in decision-making to apply capital resources (Gonçalves, 2009).

These consequences vary from one project to another, but generally include the financial and economic ones. In this context, the analysis or evaluation of projects involves a set of techniques that establish feasibility parameters. These parameters are expressed in terms of PBP (Payback Period - number of years to recover the investment), IRR (internal rate of return) or NPV (Net Present Value). NPV is the sum of discounted cash flows (i.e. future values are expressed in terms of their equivalent present values) subtracted from the initial investment.

Engineering economics has an important role on investment analysis, especially in the case of expressing advantages and disadvantages in monetary terms, when you want to invest a capital or buy a capital good, checking all technically feasible alternatives of investment.

In terms of investment policy, it is important to note that in the northern region of Brazil, Bank of Amazon is responsible for policies, plans and programs which should reflect the Federal Government policy in the Amazon region, acting as a strategic element to support projects. Amazon's economy, in its dynamics of

growth and modernization, has been going through a renovation process, evaluation, analysis and definition of the feasibility of new enterprises and businesses. In this regard, the Bank of Amazon has been focused on a new development model based on sustainable business, directing their actions to support ventures, entering in local productive arrangements, structuring and sustaining projects, so as to enhance the local potential (BRASIL, 2011).

But, for this to become a reality, it is necessary a correct allocation of private and public resources to support the best investment projects. Based on these facts, this research aims to examine the role of engineering economics in evaluating investment projects by the Bank of Amazon, located in the northern region of Brazil.

The paper begins with an introduction, followed by the basic conceptualization of engineering economics, their fundamentals and methods of analysis. In the sequel it is described the methodology used in the research. It is presented the case study of a company and the characterization of the Bank of Amazon and his performance as a promotion agent, as well as a presentation of the tools that the financial institution uses to review or assess the feasibility of investment projects directed to fundraising. The discussion of the results, the presentation of suggestions and opportunities for further research and the conclusions are presented at the end of the paper.

2 Engineering Economics

In the early 20th century, E.L. Grant and W.G. Ireson *apud* Gonçalves (2009) have made a systematization of productive investment analysis and the term engineering economics arose from this study. The term was born in fact, because engineers were the first ones who tried to deal, in a systematically way, with the problems of investment alternatives inherent in large engineering projects. However, its implementation always depends on the analysis of macro and microeconomic aspects, because factors such as inflation and taxes significantly influence the results (Gonçalves, 2009).

Engineering economics throughout the twentieth century was being developed by incorporating concepts from other disciplines. According to the Institute of Industrial Engineers (IIE), engineering economics is defined as the application of economic analysis and synthesis or mathematics or engineering decisions to a body of knowledge and techniques involved in the assessment of the value of goods and services in relation to the cost and methods to estimate the data. In this sense, it is understood as a set of techniques that allow the monetary quantification and economic evaluation of investment alternatives, providing the necessary information and knowledge for decision-making (IIE, 1998).

The decision-making process in alternative investments is comprised of steps, being considered a useful procedure for the analysis of alternatives and the selection of options. It begins with the identification and presentation of a problem to be solved or a function to be executed, followed by the presentation of a set of technically and economically feasible alternatives, including the decision to do nothing. The next step is to set each alternative, highlighting the main features, limitations and the expected results for each alternative created in the previous step (Liesi, 2008).

The main engineering economics objective is the economic analysis of investment decisions and has quite extensive applications because the investments can either be from companies, individuals or government agencies. It is also known that economic factors are considered strategic in most engineering activities. Because of that, the widespread acceptance, among engineers, of the responsibility for assessing whether the engineering proposals are solid, from a technical as an economic point of view and for examining the proposals in terms of cost and value, contributed to the increased confidence in the profession of engineering (Thuesen; Fabrycky, 1984).

2.1 Fundamentals of Engineering Economics

The foundations of engineering economics are the set of principles or concepts that form a solid basis for the development, study and application of the tools used for analysis and/or evaluation of projects (Brealey; Myers, 1998):

- Recognize and define alternatives: decisions are between alternatives;
- Need to consider the consequences: decisions must be based on the expected consequences of various alternatives. All of these consequences can occur in the future;
- Before establishing procedures for project formulation and evaluation, it is essential to decide what is the point of view to be adopted;
- Irrelevance of aspects common to all alternatives: only the differences between alternatives are relevant in its comparison;
- Separation of decisions: as far as possible, separable decisions should be made separately;
- Need of decision criteria: it is desirable to have a criterion for decision-making, or, possibly, multiple criteria;
- Choose main criterion: the choice between alternative investments in tangible goods must take into consideration the best use of limited resources;
- Need for a systemic viewpoint: often, there are side effects that tend to be overlooked when individual decisions are taken. To consider these side effects properly, it may be necessary to examine the interrelationships between of the different decisions, before it can be taken any individual decision.

Another related point, is that the whole foundation of engineering economics relies on financial mathematics; to support cost, investment, and sensitivity analysis, the time value of money must be taken into consideration.

2.2 Equivalent Time Value of the Money

The concept of equivalence is closely linked to the ability to generate money or the cost of the money (i.e. the interest rate). One cannot compare absolute values of money on different dates or times. This comparison will depend on the interest rate that is assigned to the money. It can be assumed that the money can be invested in any productive activity that will provide a certain amount of interest that will be an investment performance. The minimum rate of return on investment is evaluated in relation to the situation of the financial market and considering the risk of the investment. The minimum "attractive rate of return" of an investment is, therefore, totally subjective and may vary from one company to another, from business to business, etc. (Degarmo et al., 1993).

In this sense, engineering economics is necessary to recognize the time value of money: a monetary unit on a date is not directly comparable with the same monetary unit in another date. Hence the relevance of the chronology of the monetary cash flows in engineering economics. The interest rate can be defined as the money paid for the use of borrowed money. On the other hand, interest is the consideration that one can obtain by the productive investment of capital (Wernk, 2004).

2.3 Methods of Analysis

The primary tools or methods of analysis used by engineering economics to make decisions between investment alternatives are (Black et al., 2011):

- Payback time (PAY BACK): consists of determining how much time (the time unit is generally considered a year) is required for an investor agent to recover the invested capital. A rough estimative for the payback may be obtained by dividing the sum of investments, costs and expenses incurred by the sum of income/profit earned.

- Net Present Value (NPV): is defined as the algebraic sum of the discounted cash flow values associated with the project. In other words, it is the difference of the present value of income less the present value of costs. It should be highlighted that the project will be viable if the NPV is positive. This indicator of feasibility of the project is estimated using the following formula:

$$NPV = F_0 + F_1/(1+r) + F_2/(1+r)^2 + F_3/(1+r)^3 + \ldots\ldots\ldots + F_n/(1+r)^n$$

Where: F_0 = initial investment; F_1, F_2, F_3, ...F_n = cash flow during the periods of the project life; r = discount rate: cost of capital/ opportunity cost of the investment.

- Internal Rate of Return (IRR): is calculated from the cash flows of the project, with no need to arbitrate a discount rate. It is a demonstration of the profitability of the project, and the higher the IRR is, the more advantage the project is in financial terms. A project, to be acceptable, must have an IRR exceeding the opportunity cost, at least the basic rate of interest established by the monetary authorities (Central Bank of Brazil). The IRR can be evaluated with the aid of financial calculators, computers and/or through a process of trial and error, when the net present values of outflows (cost of investment) and cash inflows (net profits) is equal to zero. It is estimated from the following formula:

$$IRR = F_0 + F_1/1 + r^* + F_2/(1+r^*)^2 + \ldots\ldots + F_n/(1+r^*)^n = 0$$

Where: r* matches the desired internal rate of return, and F_0, F_1, F_2, ...F_n are the cash flows of the project.

- The Benefit/Cost Ratio (BC ratio): it is extensively used and its interpretation as it is relatively easy compared to the other indicators. It is calculated dividing the discounted benefits by the discounted costs of the project. The project would be rejected by this criterion if the BC ratio is below the unit (i.e. B/C <1).

- Breakeven point: is the minimum level of production associated with the level of sales which cover the costs i.e. without losses. It is the point that defines the exact amount of sales (or production quantity) in which a productive unit neither gains nor loses money: above this point, the productive unit begins presenting profits; below, suffers losses. Thus, the lower is the breakeven point, the greater is the stability of the project against the fluctuations in income and costs. The breakeven point is estimated from the following formula:

Breakeven point (value) = Fixed Costs **/** Contribution Margin in percentage

Where: Contrib. Marg. % = (Revenues – Variable Costs) / Revenues

- Sensitivity and Risk Analysis: approach in which a model/projection is examined again by changing the value of one of its variables to see what would happen with the end result. It allows knowing how the variations of the main productive factors can influence in the expected results of the project. It allows to know the importance of each input and each variable on the performance of the productive unit. The sensitivity analysis allows to define the project's profitability in function of each one of its variables, and to observe the change that will occur on profitability for each change in the variables. In other words, one can determine the sensitivity of the project (the profitability) to each variable (Blank; Turquin, 2007).

- Financial analysis: it is an important tool to support the decision-making process. It is through it that it is possible to find out the impact of certain facts over the company's financial situation, in relation to the financial aspects of what makes the manager aware of all variables regarding payment capacity, liquidity and solvency of the company (Watts; Chapman, 2012).

- Cost-benefit analysis (CBA): in a cost-benefit analysis, the present value of all costs and benefits for all stakeholders should be combined to produce an NPV. Externalities which result from the project should be considered. These consist of social costs or benefits that manifest themselves beyond the realm of the project and influence the welfare of third parties without any monetary compensation. Where the project needs or deserves an evaluation by a public entity, the externalities generated should be taken into consideration. The evaluation of the project from the private perspective does not consider the effects on third parties arising from associated externalities. Nevertheless, the externalities generated by a project are in many cases difficult to quantify.

Thus, besides the perspective of the firm, external factors should also be considered. A project must have as a goal to provide goods and services that may enhance the well-being of the society. Supporting the decision-making with a cost-benefit analysis can fulfill these requirements, by assigning social value to all the effects of a particular project (Valentin, 2012).

3 Research Methodology

This research was based on qualitative and quantitative variables, discrete and continuous, in a retrospectively way, in the form of bibliographical research, namely on the database of the Bank of Amazon.

A descriptive and exploratory case study was undertaken, allowing researchers to understand the strategies adopted by the Bank of Amazon in relation to the use and the role of engineering economics in investment projects evaluation that are targeted by the entrepreneurs to capture the available financial resources of the Federal Government.

The case study analyzed was a project submitted for the expansion of a bakery, located in the State of Rondônia, which falls into financing program FINAME MODERMAQ, which finances machines and equipment for micro-businesses with Annual Gross Operating Revenues of up to R$ 1,200,000.00 and Small Businesses with Annual Gross Operating Revenues of up to R$ 10,500,000.00, framed in the National Classification of Economic Activities-CNAE disclosed by the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* – IBGE) as extraction industry (Section B), manufacturing industry (Section C), heavy construction (Section F) or human health care activities (Section Q 86), except health management support activities (Section Q 86.6). The funding ceiling is up to 90% of the value of the goods. The forward transaction is up to 120 months, included the grace period of up to 24 with fixed interest rate up to 12% p.a.; or a variable interest rate-up to long-term interest rate (TJLP) up to 4% p.a. The guarantee required is banking bail, pledge, chattel mortgage, guarantee, endorsement, warranty insurance, and other types of guarantees, at the discretion of the Bank, under prior consultation and the direct debit payment at Bank of Amazon.

4 Case Study

4.1 The Bank of Amazon

The Bank of Amazon was created in 1942 under the name of *Banco de Crédito da Borracha* (BCB). Its role was to promote the development of incentives for exploration of natural rubber, in support to the allied forces during World War II. In 1950, the BCB was transformed into *Banco de Crédito da Amazônia* (BCA) and it went on to participate in wider regional development processes by funding all economic segments of the region. From 1966, as Financial Agent of the Federal Government's credit policy for the Amazon region, it has assumed the name of Bank of Amazon (*Banco da Amazônia*).

The main mission of the Bank of Amazon is to "create solutions to enable Amazon to reach sustainable development" unpublished indexes from conscious entrepreneurship" having as focus the promotion of

the region's economic and social development on a sustainable basis through the exploitation of regional potentials, with strategic actions aimed at reducing intra and interregional inequalities and improving the quality of life of the local population (BA, 2011).

Through its Social and Environmental Policy, the Bank of Amazon seeks to incorporate the economic, environmental and social sustainability components in the entire spectrum of its activities, in order to promote solidification of innovative local productive arrangements, inserted into projects aligned with sustainable development assumptions and articulated to the flows of domestic and international markets. The categorized ventures under this view receive preferential treatment, considering its contribution to the regional development and the demonstration of the supporter effect over other projects (BA, 2011).

4.2 Investment Projects Supported by the Bank of Amazon

The Bank of Amazon is the agent of the policies, plans and programs of the Brazilian Federal Government for the Amazon region, acting strategically to support projects, in this context, with the following ten priorities (BA, 2011):

- Supporting the National Policy of Agrarian Reform financing productive activities in the region;
- Contributing to National Policy of Technical Assistance and Rural Extension (PNATER) with its own budget resources to official bodies of service providers of technical assistance and rural extension in the States of the North Region. This represents a pioneering partnership with the Ministry of Agrarian Development;
- Promoting the growth acceleration program (*Programa de Aceleração do Crescimento* - PAC) of the Federal Government by financing projects for strategic sectors of the regional economy, such as transportation, sanitation and energy generation;
- Supporting the development of tourism on a sustainable basis through the publication of Encouraging Tourism Plans in the Amazon;
- Contributing to the encouragement of the Amazonian culture, through the program "*Amazônia mais Cultura*", which represents an important anchor for the recovery of the Amazonian culture;
- Giving incentives to micro and small enterprises through the participation in the Permanent Forum of Micro and Small Enterprises, under the coordination of the Ministry of Development, Industry and Foreign Trade (*Ministério do Desenvolvimento, Indústria e do Comércio* – MDIC), and the partnership with National SEBRAE – (*Serviço Brasileiro de Apoio as Micro e Pequenas Empresas*);
- Contributing to the National Policy of the Local Productive Arrangements by participating as a membership of the Permanent Working Group for Local Productive Arrangements (*Grupo de Trabalho Permanente para Arranjos Produtivos Locais* - GTP/APL), coordinated by MDIC and composed by 33 institutions;
- Encouraging the development of scientific and technological research in the Amazon;
- Stimulating the development of integrated activities to regional agribusiness production chain of biodiesel production and fisheries and aquaculture;
- Supporting the Productive Oriented Microcredit Program (*Programa de Microcrédito Produtivo Orientado*) of the Federal Government, through the deployment of the Program "Amazônia Florescer".

4.3 A Summary of a Project Submitted to the Bank of Amazon

The project selected for analysis in this research project is of a micro company dedicated to the production and sale of bread and other products derived from wheat flour to the region of influence of the project. This project is located in a small town in the State of Rondônia, with a high economic growth rate due to an industry of production of mattresses and its proximity of rural properties, of which there is

an exodus of the rural population to the city. The project's goal is the acquisition of new equipment that will modernize and increase production, giving better performance to the production activity, undertaken growing demand.

In the description of the project submitted in 2010 to the Bank of Amazon, it is seen that the company was formed in 2007, composed by two partners, having one of them 95% of the share, with a capital of R$ 40,000.00 (forty thousand reais - brazilian money). The value of the investment is of R$ 191,954.00 (one hundred and ninety-one thousand, nine hundred and fifty-four reais) having as goal the magnification of the production capabilities. This project is under the support of FNO (Fundo Constitucional de Financiamento do Norte/PROGRAMA AMAZÔNIA SUSTENTÁVEL) program, with a total time of payment of 144 months, 48 months amortization and a grace period of 96 months. The warranty is a ground of the company in the amount of R$ 100,000.00 (one hundred thousand reais). Projected production/annual sales are R$ 339,840.00 (three hundred and thirty-nine thousand, eight hundred and forty reais). In term of costs they were estimated fixed costs of R$ 46,902.15 (forty-six thousand, nine hundred and two reais and fifteen cents) and variable costs of R$ 241,069.12 (two hundred and forty-one thousand, sixty-nine reais and twelve cents).

4.4 Investment Project Design and Submission –the Perspective of the Firm

The investment project presented above, according to the proponent, fills a gap existing in the region, since, despite the great concentration of townhouses, commercial shops, leisure and service, yet there is no a bakery offer that fulfills satisfactorily consumers' needs. The accelerated growth of demand provides a guarantee for consumption of new products for those who come to this enterprise, enabling fulfill the commitments and responsibilities given to the prestigious financial institution, with the aim of getting the resources required to the deployment of the enterprise.

The company and its partners first have registered in an agency of the Bank of Amazon. After that, they drew up the project in its technical, economic and financial aspects through an enabled professional who is registered in the Bank for this type of activities. The presentation of the project in the agency of the Bank of Amazon where the company is registered was made in 2 copies in paper and an electronic one. Along with the projector it has been presented clarifications and further information requested by the Bank, and it has been scheduled the visit of the bank representative to the location of the project.

Once the project was approved, the company has been reported to provide the necessary documentation to the hiring/releasing of the claim, showing it to the bank agency, signing the guarantees, the credit ballot and providing its registration on a competent public notary, returning it to the Bank. Completed these steps, the company has waited only to receive the credit for the first plot according with the schedule previously defined through financial credit in current account, whose availability was directly to the suppliers and service providers, through physical and documentary evidence of its execution (BA, 2011).

4.5 The Process of Investment Project Evaluation – the Perspective of the Bank of Amazon

To facilitate analysis and checking of the projects sent to the Bank of Amazon, some criteria must be observed as:

- The use of the appropriate nomenclature; the proposal must contain all information and be accompanied by the necessary documents required for consideration.
- Wherever necessary, they may be added others that are strictly and specifically related to the company or the producer;
- The verification of the guarantees in terms of construction plans and other buildings, unhindered and free of any charge or charges.
- The value of the pre-existing guarantees shall correspond to the following:

  - Minimum of 100% of the value of the financing investment and 130% for costing (FNO), except for mini and small producers that can be admitted the progressive guarantee, according to the regulatory of the Bank;
  - At least 130% to BNDES – Banco Nacional de Desenvolvimento Economico Social;
  - Minimum of 167% for Mandatory Features and Amazon Savings.
- The grace periods and amortization of financing shall be stipulated on the basis of the ability to pay scaled by the analysis within the limits allowable by the sources of usable resources;
- Tenderers are warned that they will be responsible for the accuracy of the information provided (BA, 2011).

4.6 Tools and Concepts used in Project Evaluation

For the economic and financial analysis of the projects, the Bank of Amazon has created a series of worksheets in Excel, with instructions to facilitate the preparation of the business plan or technical project. Among the scripts are tools of engineering economics, namely the net Present Value Method, the Internal Rate of Return and the Recovery Time of the Capital (i.e. the Payback Time), plus a sensitivity analysis to identify the variables that interfere with the project's feasibility (BA, 2011).

5 Discussion

The Bank of Amazon like other development institutions uses several tools for the evaluation of investment projects directed to them, seeking to select the projects that best fit the region needs, its opportunities and particularities.

This case shows how important is the role of engineering economics for the design and the evaluation of such projects. It was realized that engineering economics concepts and toolset helps in the application of mathematical techniques in financial decision-making problems, showing quantitatively the situations presented in projects and providing opportunities for the evaluator to check the veracity and appropriateness of the technical and economic assumptions and expected results and their impact in terms of the assumed return on investment.

Engineering economics analysis is also useful for sensitivity and risk analysis of investment projects what is about the possibility of modifying variables through simulations which permit to perform the risk assessment of the project.

It is important to notice that in the northern region of Brazil, the Bank of Amazon has the responsibility to invest capital for development purposes, in agrarian reform projects, technical assistance and rural extension projects using the growth acceleration program -, as well as supporting projects for the development of tourism, giving incentives for projects on Amazon culture as well as to help micro companies and small business, scientific and technological research in the Amazon. Thus, the cost-benefit analysis and the estimation of external positive and negative impacts (externalities) of private and public projects shall be considered.

In the project presented above, the verification of what tools the Bank of Amazon uses to perform its feasibility analysis, it was found the existence of an extension of the business plan which refers to an investment in land in the amount of R$ 50,000.00 (fifty thousand reais), improvements in the amount of R$ 75,000.00 (seventy five thousand reais), machinery and equipment in the amount of R$ 66,954.00 (sixty-six thousand, nine hundred and fifty-four dollars). The used spreadsheets refers to a company's annual net income of R$ 34,949.95 (thirty-four thousand, nine hundred and forty-nine reais and ninety-five cents), which is equivalent to 10% of gross revenues.

In terms of the common project assessment indicators proposed by engineering economics, the information obtained in this research project showed that the evaluators, after eliciting all data described in spreadsheets, have check the Internal Rate of Return (IRR) and the Payback Time, but did not used the Net Present Value (NPV), because in most projects with values below or equal to R$ 400,000.00 (four hundred thousand reais) they do not use this indicator.

In this observed project the designed gross operating revenues is R$ 339,840.00 (three hundred and thirty-nine thousand eight hundred and forty reais) at an operational cost of 85% on this gross revenue, which would determine the net income of 10%. In this way, the return rate on initial investment was 18% whereas the values with average occurrence probability of products to be marketed, and return on investment time, if the projected profit remained on the value described and also gross revenues remained on the same level, would be of 5.6 years.

The sensitivity analysis should be done to verify which variables have greatest impact on costs, deadlines or other project results in practice, i.e., those which the project is sensitive to. In the project under consideration, changes have been made to the projections of the revenues. A decrease of 20% on the revenue was considered, because of economic policy influence, such as increased inflation and taxes, what would increase the inputs and finance charges. Even so, the return of this investment was considered by the Bank's technicians as compensator. The project was approved because of the 48 months grace period. It would provide the company the enlargement conditions, and an increase in sales, achieving a sufficient income to meet the payment schedule, without affecting the other financial commitments. Another incentive that the company has considered was the interest rate charged for this type of financing that is 8.75% *per* year, which is below the financial market when compared to the same financial transaction in other banks.

Other information passed was that the development portfolio of Bank of Amazon, in the granting of long-term funding, which requires the demonstration of either the technical feasibility, economic and financial, as well as social and economic benefits arising out of the investment funded, i.e. a cost-benefit analysis considering the externalities of the project. The level of detail of these statements depends on the size of the undertaking project and of the volume of resources that will be up to the Bank's participation in the investments to be made.

Finally, it was found that in the case of the Bank of Amazon, besides the tools provided by economic engineering to viability evaluation of investment projects, it was realized that the institution adds further criteria for approval of such projects, verifying information in worksheets available for professionals responsible for the elaboration and implementation of projects such as the truth in relation to the company's characterization, discrimination on the funding as requested value, payment deadlines, justification of the request, the plan of implementation of the inversions, ability to own resources contribution, technical, economic and financial aspects, and finally items relating to charges, taxes, production cost structure and other additional attachments such as documentation of the company and directors, balance sheet, negative debits and other certificates. It also emphasizes questions about guarantee values to be financed, grace periods and amortization of investment on the basis of ability to pay.

6 Conclusions

Economic conditions are considered strategic in most engineering activities, hence the widespread acceptance, of engineering economics for verifying whether the engineering proposals are solid, either from a technical and an economic point of view through their evaluation in terms of revenues and costs.

This is the case of investment projects submitted for funding to the Bank of Amazon. The case presented here showed that engineering economics concepts and tools are important for both investors and bank analysts. Nevertheless, other aspects are also important for the global assessment made by the bank and the promoters should be aware of them. Furthermore, engineering economics must be viewed as

complementary and interlinked with these additional evaluation parameters. In fact, the relative role of engineering economics, cost-benefit analysis, balance sheet analysis, financial requirements and constraints and other project conditions will vary in function of the nature of the different projects. How and why the relative role of engineering economics is different deserves further research.

Thus, to extend and improve investment analysis procedures and tools engineering economics tools should be combined with other tools and approaches as the case presented showed. This is a challenging and promising area of research with potential contributions to both practitioners and academics. Further studies must be conducted to encourage somehow researchers, managers and other professionals to adapt new tools of financial calculations, to facilitate the analysis of the viability of investment projects in Amazon region, taking the opportunity of resources provided by the Federal Government, through the Bank of Amazon.

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