

## **Prospects of Return and Risks Associated With the Implementation of a Stone Extraction Industry**

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**ABSTRACT:** *The study has the purpose of delimiting the impact of the technology through the estimation of return and the degree of risk associated with the implantation of a stone extraction industry. The article is focused on the extraction of stones for crushing in two alternatives, New Fixed Crusher and Used Mobile Crusher, keeping the concern with the sustainability of the business operation. Based on the analysis and structuring of data, we seek to identify which of the scenarios presents better prospects for return and lower risk, since both have different particularities and characteristics. The methodology used is composed of several investment analysis techniques, which provide the measurement in two categories of indicators that allow an advanced perception of return and risk, based on the discounted cash flow and the analysis of the context. To assess the business viability, the entire analysis was carried out with a view to calculating the indicators based on 10 years, using the TMA 6.25% pa, with the objective of identifying the best investment scenario.*

**KEY WORD:** *Return, Risk and Extraction Stone*

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### **I. INTRODUCTION AND LITERATURE REVIEW**

Mining activity is extremely important for Brazil, since the beginning of Brazilian colonization has accompanied and contributed to the economic and social development of Brazil (Barbosa & Gurmendi, 1995). Among the various types of mining, the extraction of rocks for crushing stands out for its variability of applications and like any other socioeconomic activity, crushing seeks to fulfill its important social function, which consists of meeting the needs of society in relation to consumption, of different types and sizes of stones.

In view of the current Brazilian economic scenario, there is a growing demand in civil construction and in urban and rural paving, resulting in an increase in the need for materials extracted from rock, mainly resulting from crushing and that can be a substitute for gravel used in gravel roads. Earth. Consequently, the search for exploration methods and processes that guarantee business and environmental sustainability, making the application of technological innovation, processes and business model fundamental, ensuring the quality of the final product offered.

The stone extraction activity contributes considerably to the economic strengthening of the region where it will be installed and consequently to its development. However, there is still a long way to go in the environmental management of this activity, especially in caring for the environment, seeking alternatives to

provide sustainable development. In this sense, it is important to know in advance the problems associated with the implementation and operation of the enterprise, through environmental impact assessment and planning instruments, measures can be taken to avoid or mitigate such impacts, reducing environmental damage and, consequently, possible financial expenditures involved in the remediation or correction of degraded areas.

Likewise, in the implementation of a new business, it is essential that an investment analysis of this new venture be carried out. Investment analysis consists of a series of methods used by a manager or investor to determine whether it is worth allocating resources to a given project. One of the common misconceptions is to think that investment analysis boils down to evaluating the profitability of a venture. This is because, in addition to the return, there are other fundamental variables to be considered, such as the cost of capital and the risk of the project.

This study is based on costs and expenses and return prospects, as well as the risks associated with the implementation of a stone extraction industry in the Midwest region of Santa Catarina, in two possible scenarios, one with a new fixed machine and another with a used mobile machine. Investments, production costs, profitability and risks linked to this extractive industry will be detailed in the course of this research.

## **II. The Evolution of the Use of Stones in Construction**

Since the beginning of man's history, we have noticed his relationship with stones through the making of domestic utensils, hunting weapons and sacred objects. Rocks such as sandstone and some granites were used to perpetuate the images of the pharaohs and gods in the form of large sculptures, temples, pyramids and tombs. The use of marble stood out in Greek culture, where artists carved human figures and built remarkable monuments in stone. However, the Romans were responsible for the most audacious constructions of antiquity using stone as a structural, aesthetic and social element, such as aqueducts, roads, forums and theaters. An equally important legacy left by the Romans was the pioneering technique of using rock in the form of slabs to clad large masonry structures.

After the decline of the Roman Empire, construction techniques were lost until the last century of the Middle Ages, when great works such as cathedrals, public buildings and palaces of medieval nobility were built in important cities in Europe, boosting again the use of stone as a noble material in architecture. In the Americas, civilizations such as the Incas and Aztecs also intensively used stone in their constructions.

In Brazil, the main constructions using stone began in the period colonial when irregular blocks laid with mortar were used. Until the end of the 19th century and the beginning of the 20th century, when the mechanization at extraction and at the beneficiation of rocks, your job in architecture it was more structural than ornamental. With the advent of construction metal and reinforced concrete, the use of stone as a structural material suffered great impact, starting to have other fields of application such as, for example, walls in support, foundation little deep, blocks for paving discontinuous, ballasts in railroads and mainly material aggregate, component of concrete in cement For use structural or at mixture asphalt used in paving.

Us last years old, were developed techniques improved in extraction and in beneficiation responsible through the intensification of job of rocks, making This one material more accessible for coating in floors and walls. THE commercialization in many types in rocks, mainly at “granitic”, The opening of companies and the demand of the international market in the last three decades positioned The industry of rocks ornamental and in coating with a important construction sector.

### **2.1 Characterization of the Mining and Stone Extraction Industry**

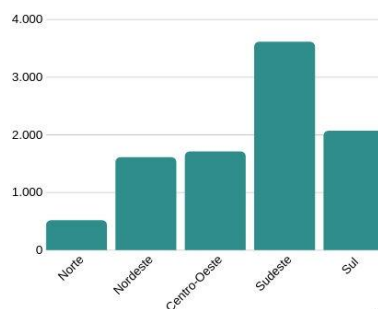
Mining represents one of the economic and industrial activities that significantly contribute to the socioeconomic development of the country . The exploitation of mineral resources in Brazil is linked with its own history, since its period of occupation in search of gold in the interior of the country.

Brazil is considered one of the countries with the greatest mineral potential in the world , producing approximately 70 mineral substances. According to the National Department of Mineral Production, it is a very diversified activity.

Also according to the department, around 3,354 mines are located in Brazil, 159 of which are large. According to data from the Brazilian Mining Institute ( Ibram ), there are more than 8,000 mining companies in the country distributed among the regions. See below where there is a greater concentration of these companies:

Figure 1: Distribution of mining companies in Brazilian regions.

Companhias mineradoras no Brasil



Fonte: DNPM 2012

Source: National Department of Mineral Production.

the mineral sector it represents 4.2% of the country's Gross Domestic Product and around 20% of the value of Brazilian exports, according to the Ministry of Mines and Energy. It is expected for Brazil, through the National Mining Plan 2030, released by the same Ministry, that approximately US\$ 270 billion will be invested in mineral research, mining and mineral processing by the year 2030.

In 2011, according to Ibram, Brazil reached its best index, producing around US\$ 50 billion. Currently, the country is the world's largest exporter of iron and niobium and the second largest of manganese and bauxite, according to DNPM data.

## 2.2 General Characteristics and Types of Rock or Stone

It is common for many people to be confused about the difference between rocks and minerals. Many believe they are the same thing, others even know that they are different, but cannot define what makes one object different from another. For this reason, it is necessary to know their respective concepts from the point of view of Earth Sciences.

Minerals are chemical compounds that are almost always inorganic and present in solid form. They are usually homogeneous and have subclassifications according to their different properties, such as texture, hardness, opacity, brightness, color, among others.

A rock or stone is an aggregate of minerals. Therefore, minerals are just compositions that structure rocks.

The surface and solid layer of the Earth (lithosphere) is composed of rocks, which, in turn, are formed by the natural union between different minerals. Thus, due to the dynamic nature of the surface, there are an infinity of types of rocks. However, the three main types of rocks are: sedimentary, igneous or magmatic and metamorphic. Sedimentary rocks are formed from the cementing or joining under high pressure of preexisting rock remains (sediment); igneous rocks arise from the solidification of magma both on the surface (extrusive) and inside the Earth (intrusive); and metamorphic rocks arise from the metamorphism of other previously existing rocks, in which these are modified without first turning into magma or sediments.

## 2.3 Mining Concept and Methods

The extraction of stones for crushing is characterized as a type of mining. In this way, it becomes important to understand the mining concept and the extraction methods. The mining corresponds to an economic and industrial activity that consists of research, exploration, mining (extraction) and processing of ores present in the subsurface. This activity is largely responsible for the current configuration of the society in which we live, since several products and resources used by us come from this activity, such as computers, cosmetics, roads, metal structures, among others. Basically, there are two mining methods:

a) Underground Mining Method: refers to the extraction of ores that are found in deeper deposits, that is, the deposits are far from the surface. In this method, the ore must be delimited via probes through topography services:

B) Open pit mining method: refers to the extraction of ores that are found in shallower deposits, that is, the deposits are located very close to the surface. Typically, this method mines the ore to exhaustion. The main open pit mining methods are:

- Bench mining: it is applied in horizontal layers close to the surface. The benches are developed from top to bottom, until reaching the final limits of the deepest mineralized bodies.

Figure 2: Mining Method by Bench



Source: <https://tecnicoeminerao.com.br/metodos-de-lavra-a-ceu-aberto>

- Mining in Strips or Slices : it is most applied in tabular deposits or with horizontal layers with little capping thickness. It provides a large production scale, providing even lower operating costs and greater productivity than bench mining.

Figure 3: Mining Method by Strips or Slices



Source: <https://tecnicoeminerao.com.br/metodos-de-lavra-a-ceu-aberto>

- Quarry mining: the method adopted for the production of rocks or minerals for direct use in civil construction, such as stones for covering and gravel in general. Quarries are generally shallower than other types of mineral extraction. This is the type of extraction that is the subject of this study .

Figure 4: Quarry Mining Method



Source: <https://tecnicoeminerao.com.br/metodos-de-lavra-a-ceu-aberto>



## **2.4 Sustainability in Stone Extraction**

The mineral sector is considered one of the main causes of environmental degradation, mainly due to changes in physical geography and in the quality and quantity of water resources. In this sense, the mining or extraction and processing of any type of rock causes the expressive generation of tailings, causing a profound environmental impact, mainly on the soil and water resources. (LANGSCH; CARISSO; PEITER, 2009).

However, environmental aspects do not necessarily refer to environmental degradations. According to the Brazilian Standard NBR ISO 14001:2004, an environmental aspect is the element of an organization's activities, products or services that can interact with the environment. Resolution 01/86 of the National Council for the Environment (CONAMA) considers an environmental impact to be any change in the physical, chemical and biological properties of the environment, caused by any form of matter or energy resulting from human activities that directly or indirectly affect the health, safety and well-being of the population; social and economic activities; the biota; the aesthetic and sanitary conditions of the environment and the quality of environmental resources.

However, new businesses also have positive impacts on the environment and society. According to Abi-Chahin et al (2008), projects can also produce impacts that are considered positive, such as increasing the supply of jobs and heating the local economy and cities close to the project. In such a way, then, environmental impact is any modification of the environment, adverse or beneficial, that results, in whole or in part, in modifications of the environmental aspects of the organization (NBR ISO 14001:2004).

The biggest environmental impacts arising from the disposal of ornamental rock tailings is the way they are allocated. In general, disposal is carried out in the mining or processing region itself, without any technical criteria. It is common, including the disposal of tailings close to water bodies, causing silting, increased turbidity and even water contamination, which will compromise the availability and quality of the resource, in addition to impacts on aquatic fauna. The disordered disposal of waste also occupies a large surface area, making it impossible to use the soil for agriculture, among other activities.

The concept of environmental impact is associated with the idea of change or environmental effect considered significant or important through an assessment specifically directed to the project of the enterprise in question, which can be positive or negative (OLIVEIRA; BRITO, 1998).

The techniques applied in the mining and processing of ornamental rocks cause the expressive generation of tailings, causing environmental impact mainly on the soil and water resources. The proper identification and management of environmental risks can avoid problems that affect the life of the surrounding communities and sometimes cause the continuity of operations of these facilities to be compromised (LANGSCH et al., 2009).

In this way, it becomes a prerequisite to know in advance the problems associated with the implementation and operation of the stone extraction industry, using impact assessment instruments and environmental planning, thus making it possible to adopt measures to avoid and mitigate negative impacts on the environment. These preliminary studies will provide a reduction in environmental damage, in addition to avoiding possible costs resulting from remediation processes or correction of areas that did not have adequate treatment.

## **2.5 Investment Analysis and Decision**

For a better understanding of what investment analysis consists of, it is important to understand what an investment is, something fundamental to achieving goals. Therefore, we can say that investment is any expenditure or application of resources in some asset that will produce a return in the future. An investment can be in the design of a new company or a specific project in an existing organization (Ross et al, 2015).

Investment analysis consists of a series of methods used by a manager or investor to determine whether it is worth allocating resources to a given project. In this sense, according to Lemes, Rigo & Cherobin, (2005), it is important to first understand the time value of money, that is, the money received today has more value than the same amount received in the future. One of the common misconceptions is to think that investment analysis boils down to evaluating the profitability of a venture. This is because, in addition to the return, there are other fundamental variables to be considered, such as the cost of capital and the risk of the project.

First, with regard to risk, investors need to be able to measure how much they are willing to gain or lose by investing in projects that have a lot of uncertainty about the outcome. Therefore, it is not appropriate to invest in a venture or project that has low profit potential and high risks.

The process of analyzing risk, return and cost of capital is not easy and is sometimes subjective. However, there are investment feasibility techniques that can help investors and managers in evaluating the most different opportunities in the market. Thus, in order to ensure greater consistency in the evaluation of the investment, the Multi-Index Methodology, developed by Souza & Clemente (2008, p.124), arises, where "the aim is to base the decision-making process regarding the acceptance or rejection of a certain investment project through the use of various indicators". The use of several indicators at the same time instead of the isolated and

independent use of one of these indicators is what makes it possible to compare the expected return with the risk assessment.

### **III. Research Methodology**

The extraction of rocks for crushing is an activity with a short operating cycle, which requires a moderate investment in inventory and which normally has a quick inventory turnover. Despite this characteristic of the operating cycle, investment decisions use the projected cash flow approach so that the prospects for return and the risks associated with this business can be properly evaluated. With the option of projected cash flow, the Multi-Index Methodology, proposed by Souza and Clemente (2008), was considered to assess return expectations and risks associated with the stone extraction industry.

Thus, with the Multi-Index Methodology, two sets of indicators will be generated from the discounted cash flow. The first set of indicators that aim to improve the perception of the project's financial returns consist of the NPV - Net Present Value, NPPV - Annual Equivalent Net Present Value, IBC - Benefit/Cost Ratio and ROIA - Additional Return on Investment. On the other hand, the second set of indicators aims to improve the perception of project risk and is composed of IRR - Internal Rate of Return, TMA/IRR - Minimum Attractive Rate / Internal Rate of Return, Payback /N - Recovery Period of Investment. The TMA – Minimum Attractive Rate used is 6.25%, not incorporating a spread on the discount rate, as the objective is to project the net return obtained by investing investment capital in low-risk securities that are compatible with the investor profile.

This research is quantitative, in terms of the way to analyze the problem, as it uses mathematical resources for analysis and solution, it is descriptive in terms of objectives, because it studies the activities necessary for the operationalization of stone extraction and crushing, it is bibliographical and surveys regarding the data collection procedures, since it is using material already published and being built based on data collected from the company created for this project.

As a strategy to carry out the study and obtain the primary information, a company was chosen that had already passed the investment decision, but that did not objectively and pragmatically evaluate the two possible scenarios for project implementation. The sample is given by a temporal cut, represented by the 2021-2030 cycle, using the data collected in the entrepreneurial company. The analysis variables for the two scenarios studied: acquisition of a New Fixed Machine and acquisition of a Used Mobile Machine were investments, production costs, production scale, productivity and market price.

### **IV. Findings and Interpretation**

The investment for the implantation project of a stone extraction industry comprises all the capital used to start and make viable the business in the crushing sector, using a complete crusher in two scenarios, new fixed model and used mobile model, in addition to all heavy machinery, civil and electrical structure and furniture and fixtures for the company's operation. Fixed assets destined for the company's operation in each scenario were identified, raising the quantities and respective market values, thus composing the first part of the investments, as can be seen below in tables 1 and 2.

Table 1 - Investments in Fixed Assets

Descrição	Quantidade	Valor (R\$)	
		Britador Fixo Novo	
		Unitário	Total
Terreno e Edificações	1	245.000,00	245.000,00
Licenças de Funcionamento	1	40.000,00	40.000,00
Britador Completo Fixo Novo	1	1.060.000,00	1.060.000,00
Retroescavadeira Usada	1	100.000,00	100.000,00
Caminhão Caçamba Usada	1	30.000,00	30.000,00
Balança Completa	1	120.000,00	120.000,00
Total			1.595.000,00

Source: Authors 2021

Table 2 - Investments in Fixed Assets

Descrição	Quantidade	Valor (R\$)	
		Britador Móvel Usado	
		Unitário	Total
Terreno e Edificações	1	245.000,00	245.000,00
Licenças de Funcionamento	1	40.000,00	40.000,00
Britador Completo Fixo Novo	1	680.000,00	680.000,00
Retroescavadeira Usada	1	100.000,00	100.000,00
Caminhão Caçamba Usada	1	30.000,00	30.000,00
Balança Completa	1	120.000,00	120.000,00
Total			1.215.000,00

Source: Authors 2021

In surveying the operating costs of the industry, employees were separated into direct labor, such as those working in the process of extraction and production of crushed stone, and indirect labor working in other activities, such as sales and administration, in addition to of the company's other indirect operating costs.

Then, the need for collaborators for the activity was identified, having as reference the two scenarios, stone extraction and crushing using a new fixed crusher and a used mobile crusher. For the elaboration of the composition of the costs, the value of the salaries practiced in the region and aligned with the market was considered, adding vacation and 13th salary and 8% of FGTS. There is no incidence of the INSS Employer as the Simples taxation regime was considered, resulting in the values as shown in table 3. It is important to note that the cost of direct labor is the same in both scenarios.

Table 3 - Labor Cost

Descrição	Britador Fixo Novo		Britador Móvel Usado	
	Quantidade	Valor (R\$)	Quantidade	Valor (R\$)
Operador de Máquinas	1	34.056,00	1	34.056,00
Operador de Operação	3	76.626,00	3	76.626,00
Total		110.682,00		110.682,00

Source: Authors 2021

The composition of indirect fixed costs includes the costs necessary for the operation and operation of the business, as shown in table 4, in addition to depreciation costs. There is a difference in values between the New Fixed Crusher and the Used Mobile Crusher scenarios influenced by the maintenance and fuel costs of the truck and backhoe, electricity and relatively higher detonation in the New Fixed Crusher scenario, due to the higher production volume and sale.

Table 4 - Indirect Fixed Operating Costs

Descrição	Valor (R\$)	
	Britador Fixo	Britador Móvel
	Novo	Usado
Detonações	84.000,00	70.000,00
Energia Elétrica	48.000,00	36.000,00
Combustível	48.000,00	36.000,00
Manutenção Máquinas e Equipamentos	36.000,00	36.000,00
Manutenção Caminhão e Retroescavadeira	30.000,00	24.000,00
Responsável Técnico	10.800,00	10.800,00
Contador	4.200,00	4.200,00
Sistema de Gestão	1.440,00	1.440,00
Seguro	9.600,00	9.600,00
Telefone e Internet	1.440,00	1.440,00
Material Expediente	1.800,00	1.800,00
Produtos de Limpeza	1.200,00	1.200,00
Total	276.480,00	232.480,00

Source: Authors 2021

For both investment scenarios, the depreciation calculation (table 5) was based on the useful life and value of the fixed asset.

Table 5 - Depreciation

Descrição	Valor (R\$)	
	Britador Fixo	Britador Móvel
	Novo	Usado
Terreno e Edificações	24.500,00	24.500,00
Licenças de Funcionamento	4.000,00	4.000,00
Britador Completo Fixo Novo	106.000,00	68.000,00
Retroescavadeira Usada	10.000,00	10.000,00
Caminhão Caçamba Usada	3.000,00	3.000,00
Balança Completa	12.000,00	12.000,00
Total	159.500,00	121.500,00

Source: Authors 2021

The production capacity was based on the rock processing speed in the New Fixed Crusher and in the Used Mobile Crusher, where the annual production in tons of crushed stone resulting from the crushing process was estimated. In addition, the sales value of the product was also raised, thus composing the estimated sales revenue for each of the scenarios.

Table 6 - Annual Capacity and Sale Price

Descrição	Britador Fixo	Britador Móvel
	Novo	Usado
Produção anual em ton	21.600	16.200
Preço de venda (R\$/ton)	37,00	37,00
Receita (R\$)	799.200,00	599.400,00

Source: Authors 2021

Considering the amounts collected previously, the Income Statement was prepared for the taxation of Simples in the two investment alternatives, New Fixed Crusher (Table 7) and Used Mobile Crusher (Table 9). Subsequently, the cash flow statements of New Fixed Crusher (table 8) and Used Mobile Crusher (table 10) were generated. In order to adjust the estimated revenue, the simple rate was considered according to Annex II of Complementary Law 155/2016.

Table 7 - Income Statement - New Fixed Crusher

Descrição	Valor (R\$)									
	ano 1	ano 2	ano 3	ano 4	ano 5	ano 6	ano 7	ano 8	ano 9	ano 10
Previsão de Vendas (ton)	21.600	21.600	21.600	21.600	21.600	21.600	21.600	21.600	21.600	21.600
Preço de Venda (R\$/ton)	37,00	37,00	37,00	37,00	37,00	37,00	37,00	37,00	37,00	37,00
Faturamento Bruto	799.200,00	799.200,00	799.200,00	799.200,00	799.200,00	799.200,00	799.200,00	799.200,00	799.200,00	799.200,00
=Receita Bruta	799.200,00	799.200,00	799.200,00	799.200,00	799.200,00	799.200,00	799.200,00	799.200,00	799.200,00	799.200,00
(-) Simples Nacional - Anexo II	(67.010,40)	(67.010,40)	(67.010,40)	(67.010,40)	(67.010,40)	(67.010,40)	(67.010,40)	(67.010,40)	(67.010,40)	(67.010,40)
=Receita Líquida	732.189,60	732.189,60	732.189,60	732.189,60	732.189,60	732.189,60	732.189,60	732.189,60	732.189,60	732.189,60
(-) Despesa Variável de Venda	-	-	-	-	-	-	-	-	-	-
(-) Custo Variável de Produção	-	-	-	-	-	-	-	-	-	-
=Margem de Contribuição	732.189,60	732.189,60	732.189,60	732.189,60	732.189,60	732.189,60	732.189,60	732.189,60	732.189,60	732.189,60
(-) Mão de obra direta	(110.682,00)	(110.682,00)	(110.682,00)	(110.682,00)	(110.682,00)	(110.682,00)	(110.682,00)	(110.682,00)	(110.682,00)	(110.682,00)
(-) Custos indiretos	(276.480,00)	(276.480,00)	(276.480,00)	(276.480,00)	(276.480,00)	(276.480,00)	(276.480,00)	(276.480,00)	(276.480,00)	(276.480,00)
(-) Depreciação	(159.500,00)	(159.500,00)	(159.500,00)	(159.500,00)	(159.500,00)	(159.500,00)	(159.500,00)	(159.500,00)	(159.500,00)	(159.500,00)
Lucro Operacional Líquido	185.527,60	185.527,60	185.527,60	185.527,60	185.527,60	185.527,60	185.527,60	185.527,60	185.527,60	185.527,60

Source: Authors 2021



Table 8 - Cash Flow Statement - New Fixed Crusher

Ano	Investimento	Receitas	Desembolsos	Fluxo de Caixa	Saldo
0	(1.595.000,00)			(1.595.000,00)	(1.595.000,00)
1		799.200,00	(454.172,40)	345.027,60	(1.249.972,40)
2		799.200,00	(454.172,40)	345.027,60	(904.944,80)
3		799.200,00	(454.172,40)	345.027,60	(559.917,20)
4		799.200,00	(454.172,40)	345.027,60	(214.889,60)
5		799.200,00	(454.172,40)	345.027,60	130.138,00
6		799.200,00	(454.172,40)	345.027,60	475.165,60
7		799.200,00	(454.172,40)	345.027,60	820.193,20
8		799.200,00	(454.172,40)	345.027,60	1.165.220,80
9		799.200,00	(454.172,40)	345.027,60	1.510.248,40
10		799.200,00	(454.172,40)	345.027,60	1.855.276,00

Source: Authors 2021

Table 9 - Income Statement - Used Mobile Crusher

DRE - Simplificada	Valor (R\$)									
	ano 1	ano 2	ano 3	ano 4	ano 5	ano 6	ano 7	ano 8	ano 9	ano 10
Previsão de Vendas (ton)	16.200	16.200	16.200	16.200	16.200	16.200	16.200	16.200	16.200	16.200
Preço de Venda (R\$/ton)	37,00	37,00	37,00	37,00	37,00	37,00	37,00	37,00	37,00	37,00
Faturamento Bruto	599.400,00	599.400,00	599.400,00	599.400,00	599.400,00	599.400,00	599.400,00	599.400,00	599.400,00	599.400,00
=Receita Bruta	599.400,00	599.400,00	599.400,00	599.400,00	599.400,00	599.400,00	599.400,00	599.400,00	599.400,00	599.400,00
(-) Simples Nacional - Anexo II	(46.080,00)	(46.080,00)	(46.080,00)	(46.080,00)	(46.080,00)	(46.080,00)	(46.080,00)	(46.080,00)	(46.080,00)	(46.080,00)
=Receita Líquida	553.320,00	553.320,00	553.320,00	553.320,00	553.320,00	553.320,00	553.320,00	553.320,00	553.320,00	553.320,00
(-) Despesa Variável de Venda	-	-	-	-	-	-	-	-	-	-
(-) Custo Variável de Produção	-	-	-	-	-	-	-	-	-	-
=Margem de Contribuição	553.320,00	553.320,00	553.320,00	553.320,00	553.320,00	553.320,00	553.320,00	553.320,00	553.320,00	553.320,00
(-) Mão de obra direta	(110.682,00)	(110.682,00)	(110.682,00)	(110.682,00)	(110.682,00)	(110.682,00)	(110.682,00)	(110.682,00)	(110.682,00)	(110.682,00)
(-) Custos indiretos	(232.480,00)	(232.480,00)	(232.480,00)	(232.480,00)	(232.480,00)	(232.480,00)	(232.480,00)	(232.480,00)	(232.480,00)	(232.480,00)
(-) Depreciação	(121.500,00)	(121.500,00)	(121.500,00)	(121.500,00)	(121.500,00)	(121.500,00)	(121.500,00)	(121.500,00)	(121.500,00)	(121.500,00)
Lucro Operacional Líquido	88.658,00	88.658,00	88.658,00	88.658,00	88.658,00	88.658,00	88.658,00	88.658,00	88.658,00	88.658,00

Source: Authors 2021

Table 10 - Cash Flow Statement - Used Mobile Crusher

Investimento	Receitas	Desembolsos	Fluxo de Caixa	Saldo
(1.215.000,00)			(1.215.000,00)	(1.215.000,00)
	599.400,00	(389.242,00)	210.158,00	(1.004.842,00)
	599.400,00	(389.242,00)	210.158,00	(794.684,00)
	599.400,00	(389.242,00)	210.158,00	(584.526,00)
	599.400,00	(389.242,00)	210.158,00	(374.368,00)
	599.400,00	(389.242,00)	210.158,00	(164.210,00)
	599.400,00	(389.242,00)	210.158,00	45.948,00
	599.400,00	(389.242,00)	210.158,00	256.106,00
	599.400,00	(389.242,00)	210.158,00	466.264,00
	599.400,00	(389.242,00)	210.158,00	676.422,00
	599.400,00	(389.242,00)	210.158,00	886.580,00

Source: Authors 2021

Based on the values found previously and on the Multi-Index Methodology, the calculations of the risk and return indicators were prepared, within a period of ten years, presented in table 11.

Table 11 - Multi-Index Methodology: Return and Risk Indicators

		Indicadores	
		Britador Fixo Novo	Britador Móvel Usado
RETORNO	Valor Presente	2.509.624	1.528.624
	Valor Presente Líquido	914.624	313.624
	Valor Presente Líquido Anualizado	125.744	43.118
	Índice Benefício / Custo	1,57	1,26
	ROIA anual	4,64%	2,32%
	Taxa Interna de Retorno	17,21%	11,44%
RISCO	Índice TMA/TIR	0,36	0,55
	Pay back descontado anual	5,63	7,40
	Índice Pay-back/N	0,56	0,74
	Grau de Comprometimento da Receita	0,75	0,84
	Risco de Gestão	0,70	0,70
	Risco de Negócio	0,50	0,50

Source: Authors 2021

When analyzing the return indicators, the present value found in the New Fixed Britador calculation exceeds by two and a half times the value found in the Used Mobile Crusher calculation, thus impacting the Net Present Value. Both investments are viable, as the NPV obtained is greater than zero and means that by investing in the Used Mobile Crusher, a surplus cash result of R\$ 313,624.00 is achieved and in the New Fixed Crusher, a cash surplus of R\$ 914,624 is achieved. .00, higher than the desirable minimum (6.25% pa ).

When analyzing the NPV , both investment scenarios tend to be viable and deserve to continue to be evaluated, as  $NPV > 0$ . While NPV shows the net result of a cash flow at present value, allowing to estimate the gain of an investment, the VPLa indicates an estimate of expected gain on an investment over a period of one year . In the Used Mobile Crusher scenario, the NPV is R\$ 43,118.00 and indicates that the investment project is viable, since it would be equivalent to having a profit of this amount per year throughout the entire project. This same indicator for the New Fixed Crusher scenario, results in an average profit of R\$ 125,744.00 per year.

The Benefit Cost Index (IBC) is the measure of how much the return will be for each monetary unit invested. This analysis is performed from the investment recovery itself , where IBC is equal to 1. Thus, to proceed with the investment project, it is necessary that the  $IBC > 1$ , and to decline the investment project, the  $IBC < 1$ . In the case of investment in the New Fixed Crusher, the additional gain per unit of capital invested is 1.57, that is, opting for the investment of R\$ 1,595,000.00 in the implementation of this business scenario instead of applying it to a rate of 6.25% pa , represents that the capital invested would receive an additional remuneration of 57.0%. In the event of investment in the Used Mobile Crusher, the indicator is 1.26, which represents that the capital of R\$ 1,215,000.00 would receive an additional remuneration of 26.0% on the return if the option had been to apply the amount investment at a rate of 6.25% pa

The additional return on investment (ROIA) , corresponds to a percentage measure of the wealth generated in an investment, being considered the best estimate of the profitability for an investment project. In this indicator, the investment project in the New Fixed Crusher reached an ROIA of 4.63%, well above the 2.32% obtained in the Used Mobile Crusher scenario.

The internal rate of return (IRR) is used as a risk measure and is considered one of the most used ways to evaluate investment projects, representing the rate of return of a cash flow considering its Net Present Value (NPV) equal to zero. A project is considered to be financially viable when the IRR is greater than the TMA. In this case, the investment proposal in the New Fixed Crusher reached an IRR of 17.21% and, for the Used Mobile Crusher, an IRR of 11.44% indicating the two project scenarios are considered viable for a TMA of 6.25% aa This project viability is reinforced by the TMA/IRR index, which contains a scale from 0 to 1, where 0 represents the lowest risk. A TMA/IRR ratio of 0.36 represents a lower risk for the New Fixed Crusher investment project and 0.55 represents a higher risk for the Used Mobile Crusher investment alternative.

The payback period is considered a risk measure and corresponds to the period in which investment values and cash values neutralize each other. The New Fixed Crusher shows recovery of invested capital around 5 years and 8 months, approximately 01 and 09 months ahead of the capital recovery period of the Used Mobile Crusher, which is 7 years and 5 months.

In the analysis of the Degree of Commitment to Revenue, the indicator can vary from 0 to 1, with the operational risk of the project increasing as the indicator approaches 1. The scenario with the New Fixed Crusher reached a GCR of 0.75, that is , project will show profits at 75% of its maximum capacity. For the

scenario with the Used Mobile Crusher, the investment project will only show profits at 84% of its production capacity.

With regard to the management risk that is related to the operation process, which ranges from the production to the commercialization of the product, it is considered 0.70, since the investor needs to know the particularities of management of the activity, the installation crusher technique and training of employees to handle the machines and equipment that will be in operation. Regarding the business risk, it can be evaluated at 0.50 due to the existence of competition in the extraction of stones for crushing, but that is not something very strong, as there is only 01 competitor close to the surroundings where the business will be installed. Another important factor is that there is a growing demand in civil construction and in various applications for materials resulting from crushing, such as paving, embankment bases, a substitute for gravel for dirt roads.

## **V. Considerations**

This case study was guided by the objective of delimiting the impact that the technological evolution causes in the comparison of the installation of a stone extraction industry with a New Fixed Crusher and another Used Mobile Crusher, used in the production of crushed stone, when submitted to the evaluation of investment project, in terms of speed, production capacity and business sustainability.

Analyzing the information and indicators obtained, it can be said that the two investment projects are viable, and when the risk and return indicators are compared, the results of the Used Mobile Crusher acquisition scenario present considerably unfavorable indicators. It is important to highlight that the best indicators in the New Fixed Crusher scenario are significantly due to higher speed and production capacity, which offset the investment and higher indirect costs. On the other hand, for the investor who has less capital, the Used Mobile Crusher is recommended, as it presents very interesting return and risk indicators.

The extraction of stones for crushing is a complex process that requires a relatively high investment and care with the sustainability of the business. However, the revenue obtained is high, and considering that it is a new business, the recovery of the capital invested in the implementation in the business is, on average, between 5 and 7 years, when the project is analyzed in a period of 10 years. The acquisition of a New Fixed Crusher presupposes a greater return on more current technology and greater production capacity, since this occurs due to the fixed costs being very similar when comparing the crusher in the two scenarios.

Furthermore, it is important to point out that in this case the investors, even without having carried out an investment analysis, opted for the investment project in the Britador Fixo Novo, which was a wise decision since all the return and risk indicators of this scenario were better than the previous one. investment project scenario in a Used Mobile Crusher.

## **BIBLIOGRAPHY**

- [1]. BENDLIN, Luciano et al. Production costs, return expectations and risks associated with planting eucalyptus in the Planalto Norte region – Catarinense/ Brazil . Costs and @agronegócio on line . v . 12, no. 2, 2016.
- [2]. JUNIOR, Antonio BL; RIGO, Cláudio M.; CHEROBIM, Ana Paula MS Administration financial : Brazilian principles, foundations and practices. 2nd ed. Rio de Janeiro: Elsevier, 2005.
- [3]. KASSAI, José Roberto et al. Return on Investment: Mathematical and accounting approach to business profit. 3. ed. Sao Paulo: Atlas, 2003.
- [4]. LOPES, Mark. Open Pit Mining Methods , 2015. Available at: < <https://tecnicoemineracao.com.br> >
- [5]. SILVA, EL and MENEZES, EM Research Methodology and Dissertation Preparation . 2005. Available at: <<http://www5.eesc.usp.br>> Accessed: 01 nov. 2021
- [6]. SOUZA, A.; CLEMENTE, A. Financial Decisions and Investment Analysis . Sao Paulo: Atlas, 2008.
- [7]. OLIVEIRA, AMS, BRITO, SNA; Engineering Geology . São Paulo: Brazilian Association of Engineering Geology, 1998.
- [8]. ROSS, Stephen A. et al. Financial Administration . 10. ed. Bookman, 2015.
- [9]. <http://www5.eesc.usp.br/portaldeconhecimentos/index.php/por/Conteudo/Metodologia-da-pesquisa-e-elaboracao-de-dissertacao>