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Pre-Feasibility Project for the Creation of a High-Traffic Pavers Factory for the Decentralized Autonomous Government of Sigchos Canton

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ABSTRACT

The objective of this study is to determine the technical, legal, and economic feasibility of establishing a heavy-duty paver block factory for the Municipal Decentralized Autonomous Government of Sigchos Canton. The methodology used included a non-experimental research approach, with an explanatory, descriptive, and correlational design. Surveys were conducted with the legal representatives of the parish councils to gather primary information, while secondary information was obtained through bibliographic and documentary review.

The results from the market study reveal significant demand and acceptance from the parish representatives toward the production of vehicular pavers, supporting the need to improve local road infrastructure and economic development. A market opportunity was identified both in government projects and private initiatives, with an estimated daily demand of 2,800 paver units.

As for the technical study, efficient production processes were designed, with rigorous quality control measures and an annual production capacity of 2,880,000 pavers. The administrative-legal analysis reflects a comprehensive and proactive approach to meeting legal and regulatory requirements, including the decision to establish a Corporation (S.A.) and obtaining the necessary permits for the factory's operation.

Finally, the financial study results indicate that the project is economically viable, with a positive Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PBP), average profitability (AP), and Benefit-Cost Ratio (BCR), supporting the project's feasibility.

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1. Introduction

The planning and execution of road infrastructure projects are crucial for the sustainable development of local communities. In this context, the Municipal Decentralized Autonomous Government of Sigchos Canton, located in the province of Cotopaxi, faces the need to improve its road network to meet the growing mobility demands of its population [1-3].

In line with this need, the establishment of a Heavy-Duty Paver Block Factory presents a strategic opportunity for Sigchos Canton. research highlighted that, "the production of pavers not only improves road infrastructure but can also have a significant impact on local economic development"[4] .

In response to this situation, this thesis aims to examine the feasibility of developing a Heavy-Duty Paver Block Factory for the Municipal Decentralized Autonomous Government of Sigchos Canton. The study seeks to apply a methodology that determines the technical and financial feasibility of this project. It is expected that the implementation of best practices from this guide will have a positive impact on the project's success. The feasibility study will address various studies and factors involved in assessing the viability of a project of this nature [5].

1.1. Research Methodology

The main objective of this research chapter is to evaluate the feasibility of establishing a heavy-duty paver block factory for the Municipal Decentralized Autonomous Government of Sigchos Canton, analyzing the impact of macroeconomic variables on the production sector. Specifically, it seeks to identify opportunities and threats for the project, determine its economic viability through key indicators, and calculate the necessary investment. The research, classified as non-experimental, descriptive, explanatory, and correlational, uses a quantitative approach.

A survey was conducted with the legal representatives of the Parochial GADs to collect primary data, complemented by a bibliographic review. The population corresponds to Sigchos Canton and its 4 parishes, while the sample will be selected by convenience, defined according to Leiner [6] as a method adopted by researchers in which market study data is collected from a conveniently available group of respondents. It is the most commonly used sampling technique because it is fast, simple, and economical. In many cases, members are selected based on their accessibility to form part of the sample, and the researcher chooses members simply based on proximity;-

Table 1
Product Characteristics

PEDESTRIAN PAVER	VEHICULAR PAVER
Dimensions: 20 centimeters in length, 10 centimeters in width, and 8 centimeters in height.	Dimensions: 23 centimeters in length, 17 centimeters in width, and 8.5 centimeters in height.
Strength: Supports a load of 350 kilograms-force.	Strength: Capable of supporting a load of 400 kilograms-force.
Ingredients for manufacturing 120 units:	Materials required to manufacture 50 units:
Fine macadam: 91 kilograms	
Stone: 91 kilograms	Sand: 91 kilograms
Cement: 50 kilograms	Gravel: 91 kilograms
Water: 21 liters	Cement: 50 kilograms
	Water: 21 liters
	

using this technique, habits, opinions, and viewpoints can be observed in the easiest possible way. Therefore, in this project, the sample will correspond to the presidents.

The data analysis was based on descriptive statistics to assess the supply and demand of the project. Through an analytical-synthetic analysis, the entire production process was studied, from supply to distribution, in order to identify improvements and optimize production.

1.2. Data Analysis

The initial analysis was based on the product characteristics (Table 1), where, thanks to primary sources at the GAD, it was possible to establish the requirements and specifications for the product in accordance with demand.

The cobblestone can be considered an effective road and social solution due to its durability, resistance, and ability to enhance urban aesthetics. Additionally, its use can promote social interaction by creating more pleasant and safer spaces for pedestrians. In rural areas, cobblestones can also be beneficial by improving accessibility and road infrastructure, thus contributing to local development.

The Decentralized Autonomous Municipal Government of Sigchos, as part of its responsibilities, is in charge of the proper maintenance of the urban road circuit of the canton. Most of these roads currently consist of unpaved or gravel surfaces (figure 1), which need to be improved through the implementation of vehicular cobblestones with a resistance of 350 kg/cm². To achieve this goal, the execution of additional subprojects will be required.

The demand for cobblestones is based both on the paving requirements presented by the Decentralized Autonomous Government (GAD) and on additional needs that may arise from private projects. To determine the demand for cobblestones from the GAD, the following projects for the next 5 years were considered, as shown in Table 2.

On the other hand, the demand from private companies was considered. The three representatives interested in acquiring vehicular cobblestones are distributed as shown in Table 3.

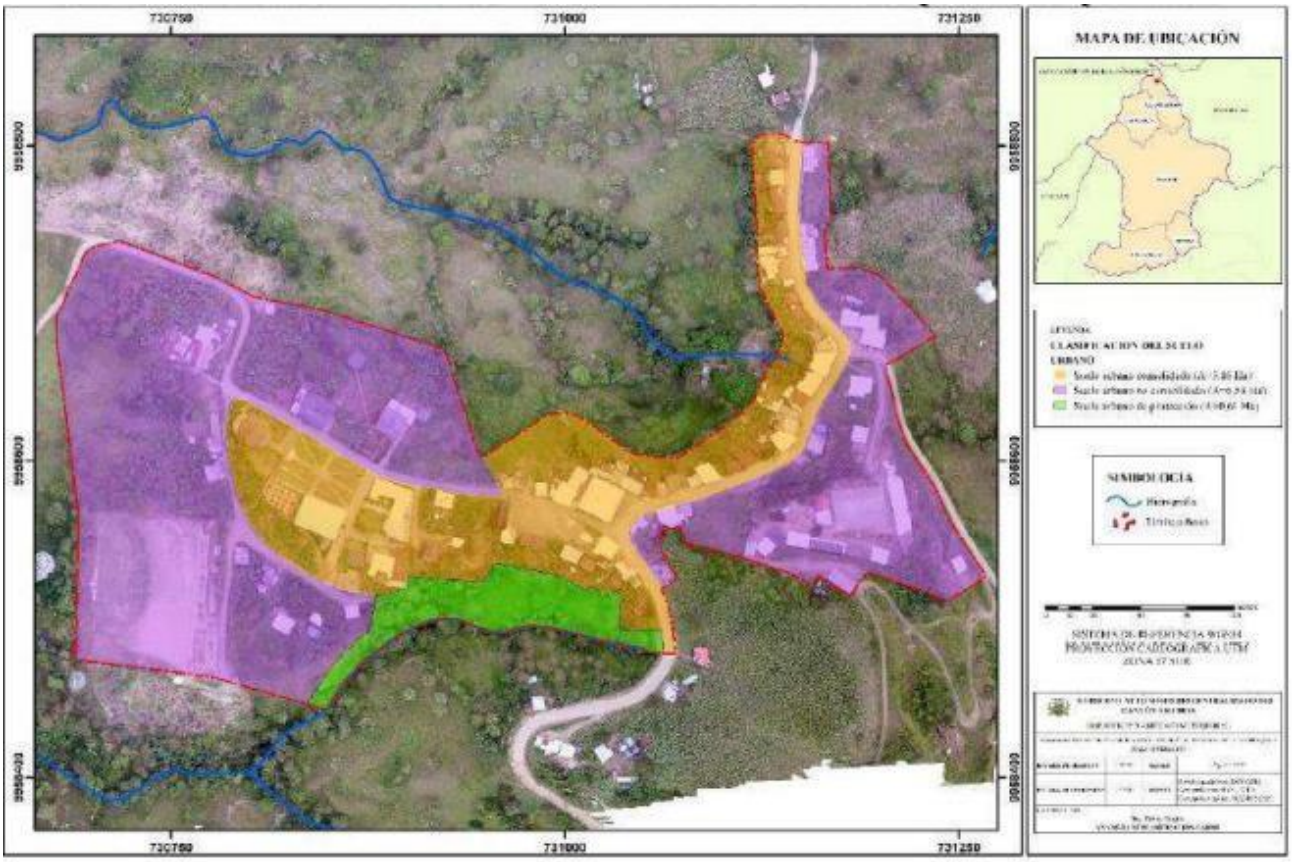

Fig. 1 Current Demand

Table 2

Requirements for Vehicular Cobblestones from GAD Projects in Sigchos

NO.	Location	Length (M)	Width (M)	Area (M²)	Cobblestones (Units)
1	Chugchilán	152.4	9.5	1447.8	30404
2	Guayaquil	265	8.6	2279	47859
3	Topaliví	352	8.06	2837.12	59580
4	Culacusig	72	6	432	9072
5	Dr. Rodrigo Borja	172	7	1204	25284
6	Vía al Calvario	305	6	1830	38430
TOTAL		1318.4		10029.92	210629

Table 3

Requirements for Vehicular Cobblestones from the Representatives of Sigchos

Number of Representatives	Quantity of Cobblestones per Month	Total Cobblestones per Month	Total Cobblestones per Day
15	3500,00	52500 ,00	2625,00

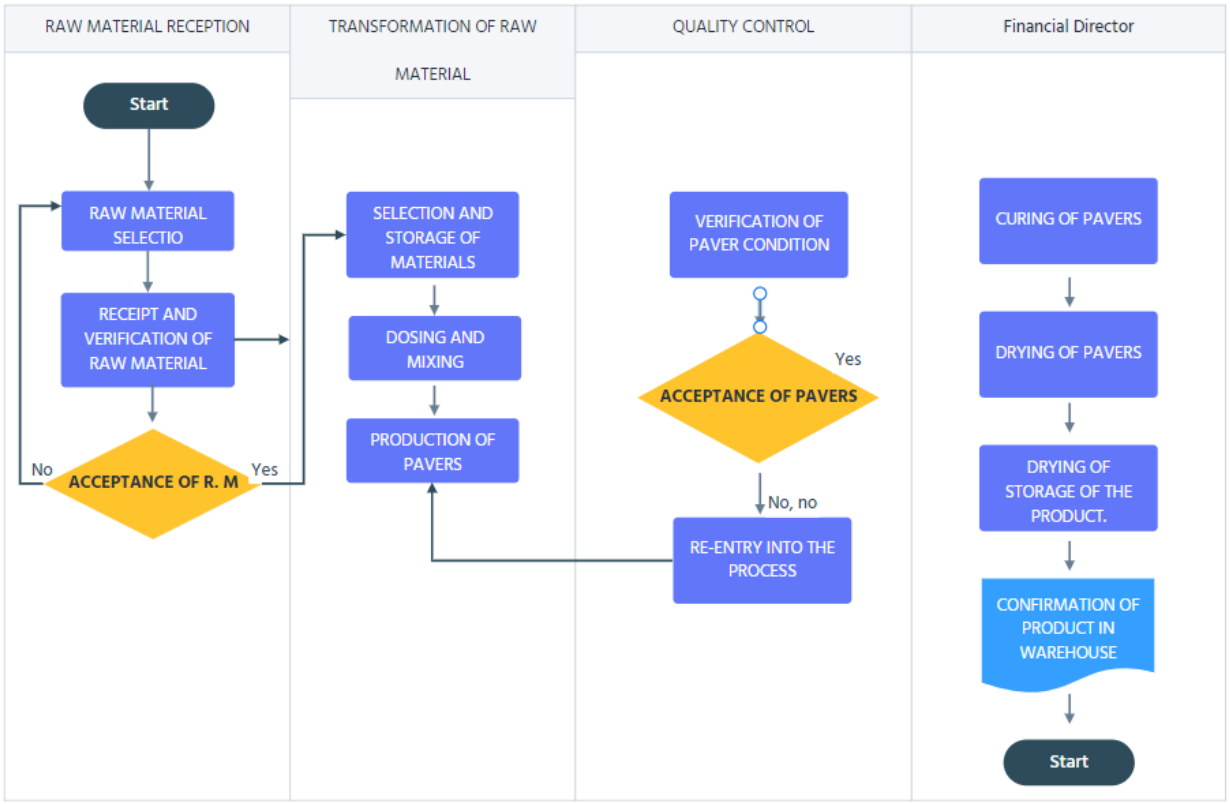

Fig.2 Proceso de producción

This demand corresponds to 2,625 vehicular cobblestones per day to meet the needs of private companies, as no interest was observed in purchasing pedestrian cobblestones. The current project exclusively addresses the production of vehicular cobblestones. Additionally, considering the projects of the GAD, the total number of cobblestones required daily is 2,800 units.

1.3. Performance Indicators

The fundamental purpose of incorporating the project's feasibility evaluation is to optimize the production process, making the most of the available resources and achieving a high-quality final product at a reduced cost.

To standardize the product requirements, we will rely solely on the INEN 3040 standard for Concrete Cobblestones [7], which establishes the necessary requirements and testing methods. This standard will be the main guide in our research project, ensuring that our product meets the quality and strength standards required in the industry (Fig. 2).

The production process of the paving stone, taking into account the raw material specifications and design established in the product architecture, is described as follows:

1. Preparation of raw materials: The process begins with the selection and purchase of high-quality materials that meet the specifications of the INEN 3040 standard. A crushing and mixing process of the materials, such as cement, aggregates, and water, is carried out to obtain a homogeneous mixture.

2. Dosage of aggregates: This is a critical step in the paving stone production process, as it ensures that the mixture has the appropriate properties to meet quality standards.

3. Preparation of the mixture: This determines the physical and chemical properties of the final product.

4. Manufacturing of paving stones: This involves the production of concrete blocks designed for paving surfaces. It includes the preparation of the concrete mixture, the molding of the blocks, and their curing to ensure strength and durability.

5. Setting of the paving stone: During setting, the concrete undergoes a chemical reaction known as hydration, where cement combines with water to form a gel that binds the aggregates. This process is fundamental for the strength and durability of the paving stones.

6. Curing of the paving stone: This is the process of maintaining adequate moisture and temperature in the freshly made paving stones to allow the concrete to achieve its optimal strength and durability. This process typically lasts several days and can be carried out using methods such as air curing, steam curing, or mist water curing.

7. Storage of paving stones: It is important that storage is carried out in a flat, firm area, away from moisture and protected from the elements to prevent damage. Paving stones should be stacked in a way that prevents warping or cracking, and it is recommended to use spacers between layers to avoid them sticking together.

Table 4
Annual Production of Paving Stones

Raw Material	Total Daily Paving Stones	Total Annual Paving Stones
Cement		
Stone Dust	4,000 daily (2 lines would be 8,000 daily)	2.880.000,00
Gravel type 3/8		
Water		

2. Development of the Financial Analysis

An instrument that measures the time required for the net cash flows of an investment to recover its initial cost or investment is the Payback Period.

$$PAYBACK = \frac{(TOTAL\ INVESTMENT - NET\ CASH\ FLOW\ YEAR\ 1)}{NET\ CASH\ FLOW\ YEAR\ 2} \quad (1)$$

$$PAYBACK = \frac{(\$85344{,}73 - \$238625{,}52)}{\$234710{,}95}$$

$$PAYBACK = 0.065 \times 360$$

$$PAYBACK = 6\ MONTHS\ 5\ DAYS$$

The payback period for the investment will occur in 6 months and 4 days, which is feasible since it falls within the project's useful life.

The Net Present Value (NPV) is a procedure that calculates the present value of specific future cash flows generated by an investment. It is defined as the difference between the revenues and expenses at updated values, or the difference between net income and the initial investment. In other words, the net present value is simply the updated sum of all benefits, costs, and investments of the project. Practically, it is the updated sum of the net cash flows for each period [8].

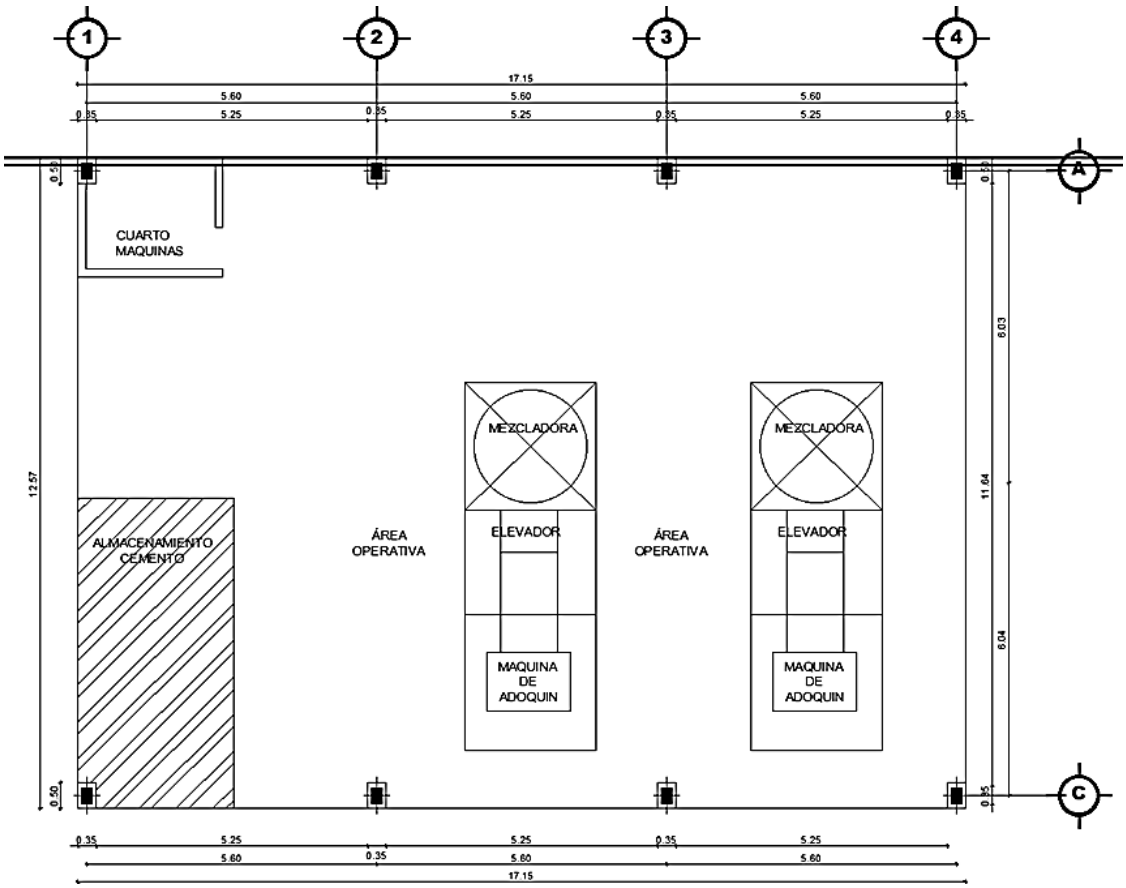

Fig. 3 Plant View of the Project (Production Area)

Table 5

Payback Period of the studied project

Period (year)	Investment ($)	Net Cash Flow ($)	Cumulative Net Cash Flow ($)
0	85,344.73 $		
1		238,625.52 $	238,625.52 $
2		234,710.95 $	473,336.47 $
3		233,811.20 $	707,147.67 $
4		232,564.04 $	939,711.71 $
5		230,160.75 $	1,169,872.46 $
6		223,725.73 $	1,393,598,19 $
7		219,542.89 $	1,613,141.08 $
8		212,576.01 $	1,825,717.09 $
9		208,807.18 $	2,034,524.27 $
10		202,241.00 $	2,236,765.27 $
Total	85,344.73 $		

For the calculation, an update factor of 3.20% is used, which corresponds only to the estimated inflation for the year 2025 as provided by the Central Bank, since the Municipal GAD of the Sigchos Canton is not an investor; therefore, the passive rate offered by the financial system for savings is not taken into account.

The NPV (Net Present Value) can be calculated as follow:

$$NPV = \sum (Updated\ Net\ Cash\ Flow - Updated\ Investment) \quad (2)$$

$$NPV = 1{,}812{,}081.54\ \$$$

The net present value of the project is $1,812,081.54, which is a figure greater than zero, indicating that the investment will yield returns above the required rate of return (Table 6).

The benefit-cost ratio is an indicator that separates the updated revenues and expenditures of the project and the relationship between them (Table 7). It determines how many times the revenues exceed the expenditures.

The Benefit-Cost Ratio can be calculated as follow:

$$BC = \frac{\sum(Net\ Cash\ Flow)}{Current\ Investment} \quad (3)$$

$$BC = 22.23$$

The profitability of a project is a financial indicator that measures the project's ability to generate economic benefits in relation to the initial investment made

Table 6
NPV (Net Present Value) of the studied project

Period	Current Values		Discount Factor	Updating Factor	
	Investment	Net Cash Flow		Investment	Net Cash Flow
0	85,344.73 $		1	85,344.73 $	
1		238,625.52 $	0.969		231.228.13
2		234,710.95 $	0.939		220.393.58
3		233,811.20 $	0.91		212.768.19
4		232,564.04 $	0.882		205.121.48
5		230,160.75 $	0.854		196.557.28
6		223,725.73 $	0.828		185.244.90
7		219,542.89 $	0.802		176.073.40
8		212,576.01 $	0.777		165.171.56
9		208,807.18 $	0.753		157.231.81
10		202,241.00 $	0.73		147.635.93
Total		2,236,765.27 $		85,344.73 $	1,897,426.27 $

Table 7
Benefit-Cost Ratio

Period	Investment	Net Cash Flow Updated Cash
0	85,344.73 $	
1		231.228.13
2		220.393.58
3		212.768.19
4		205.121.48
5		196.557.28
6		185.244.90
7		176.073.40
8		165.171.56
9		157.231.81
10		147.635.93
Total	85,344.73 $	1,897,426.27 $

Table 8
Project Profitability

Profitability	
Project Cost	561,712.88 $
Sale Cost	792,000.000 $
Profit USD$	230,287.12 $
Profitability	41.00 %

The table demonstrates that with an initial investment (project cost) of $561,712.88, the brick factory generated sales amounting to $792,000.00, resulting in a profit of $230,287.12. This translates to a profitability of 41% (Table 8).

3. Results and Discussion

The market study reveals a strong demand and acceptance among representatives of the parishes in the Sigchos canton for the production of vehicular pavers, supporting the need to enhance local road infrastructure and promote economic development. Additionally, a market opportunity is identified in both government projects and private initiatives, with an estimated daily demand of 2,800 units of vehicular pavers. The absence of local manufacturers presents a significant opportunity for establishing a paver factory in the region, which can leverage direct marketing channels to effectively reach consumers.

In summary, the study suggests a favorable outlook for the production and marketing of vehicular pavers in Sigchos canton, backed by robust demand and the lack of local competition. The technical study focused on the product architecture and production process of both vehicular and pedestrian pavers, adhering to standards such as INEN 3040. Efficient processes were designed, covering everything from material selection to the storage of finished products, with an annual production capacity of 2,880,000 pavers. Rigorous quality control measures and balances of raw materials and personnel were established, while fixed asset and manufacturing costs were meticulously analyzed. A retail price was determined with a 30% profit margin, following validation of its acceptance through a survey, and specific areas were allocated within the manufacturing plant to ensure operational efficiency.

The administrative-legal analysis conducted for the establishment and operation of the high-traffic paver factory in Sigchos canton reflects a comprehensive and proactive approach to meeting legal and regulatory requirements. The decision to form a Corporation (S.A.) is based on the separation of responsibilities between shareholders and the company, providing stability and flexibility in business management. Furthermore, the need to complete legal processes such as obtaining the Unique Taxpayer Registry (RUC), Land Use Permit, Municipal License, and Environmental Permit demonstrates a

commitment to legality and environmental respect. Additionally, the analysis of labor obligations established in the Labor Code ensures the protection of workers' rights.

The financial study results indicate that the project is economically viable, as evidenced by positive outcomes in the Net Present Value (NPV), Payback Period (PP), and Benefit-Cost Ratio (BCR). Moreover, the short payback period of six months and the high profitability of 41% further corroborate its financial viability.

4. Conclusion

The conducted study demonstrates the high viability of establishing a high-traffic paver factory in Sigchos canton. The unmet demand from local parishes, combined with the absence of direct competitors, creates a potentially lucrative market. From a technical perspective, an efficient and high-quality production process has been designed, complying with current regulations. Additionally, the administrative-legal analysis ensures adherence to all legal and labor requirements. Finally, the financial assessment reveals the project's robustness, with positive economic indicators supporting its short-term profitability. In conclusion, the establishment of this factory not only addresses a local infrastructure need but also represents an opportunity for economic development in Sigchos canton.

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