

Sustainable Management Model applied to the Metallic Mining Industry of Mexico: Case Study in San Luis Potosí. (Dissertation Abstract)

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1. Relevance of the metallic mining industrial sector

The Mining-metallurgical Industry has a strong economic contribution in Mexico and, geologically, the geography stands out for its mineral wealth, considering that the 70% of the national territory contains mineral deposits, so there is a high potential for mining developments; this among the 12 main producers worldwide of 20 minerals and places it as the first destination for investment in mining exploration in Latin America and the 4th in the world (SE, 2019; SNL Metals & Mining, 2019; SGM, 2019).

Metallic Mining Industry, represents the 50.38% of the total of mining production in the country; collaborating with the 10.25% of this total Silver production, and is representative since it manages to occupy the 1st place in worldwide since 2014. The state of San Luis Potosi contributes 3.3 % per year (SE, 2019; SGM, 2019).

San Luis Potosi represents 3.12% of the mexican territory and in turn it has 91% of mineralized soil (SGM, 2018); the mineralization and geographic location promotes it as an economically active state; it occupies the seventh place in silver production in the country.

About caring for the environment, centralized around the mining industry in Mexico, there are facts that place the country as one of the most backward in this context. The environment in the world begins to be evaluated to counteract the damage, around 1950; Recently the UN (2016), through the *Agenda 2030*, presents the Sustainable Development Objectives (SDG) suggested to be implemented in the member countries to guarantee the well-being of future generations.

Mexican mining environmental Laws began until 1985 due to global pressures, for which a severe devastation of the environment is estimated. Considering these facts, the importance and relevance of carrying out a research within the Mexican mining metal sector is visualized, which provides information about the implementation of these SDGs. This study is supported by a case study developed in an underground silver mine in the state of San Luis Potosí.

2. Originality

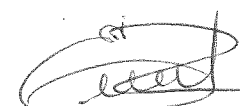
According to the author, the originality of the thesis consists of:

- The research presents a way of evaluating the environmental practices that guarantee the mineral resource for future generations in developing countries like Mexico through Sustainability foundations (UNEP, 2016).
- It represents a proposal to evaluate the environmental practices in Mexico oriented to the mining sector of metallic resources.
- This thesis presents a model to measure the environmental practices of the Metallic Mining Industry focusing on Sustainable fundamentals.
- The research proposes a set of recommendations to promote the implementation of the Sustainable Model in the Metallic Mining Industry.
- The thesis presents an implementation proposal within the Metallic Mining Industry (silver), with the possibility of extending it to the metallic Industry and another entities in the country.

3. Research Objectives and hypothesis

General Objective

Propose Sustainable Model that allows the Metallic Mining Industry of Mexico from its Management, to carry out environmental practices that align with universal principles of Sustainability (UNEP, 2010) in addition to compliance with legislation (SEMARNAT, 2002).


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Specific Objectives

- Carry out literary analyzes to relate the Sustainable foundation and the Legislative foundation of Mexican Mining Industry.
- Analyze the environmental practices carried out in the Metallic Mining Industry in Mexico, considering an underground silver mine.
- Develop a Model to evaluate environmental practices in reference to compliance with Sustainable Principles.
- Propose best practices to guarantee the metallic mineral resource in San Luis Potosi and define recommendations for the Metallic Mining Industry in Mexico.

Hypothesis

- Research studies related to environmental mining practices have focused mainly on the ecological damage, therefore, their results are not aligned with Sustainable Principles in the Metallic Mining Industry of Mexico.
- The determination of the environmental practices aligned with Sustainable Principles in Mexico will be possible through an investigation of the Metallic Mining Industry.
- Defining best environmental practices, implies the implementation of a Sustainable Model and its validation in the field in the Metallic Mining Industry, particularly the metallic mineral resource in San Luis Potosi (Silver). It is allow to extend a set of recommendation for Mexican Metallic Mining Industry.

4. Research Methodology

The research was conducted between the years 2017-2019. It contemplates a *research line* of Sustainability inside a *scientific discipline* of Management in the Environmental area. The literary information and hypothesis description, allows to be validated by a Case Study method. It presents through a Qualitative focus and a Constructivist Interpretative paradigm, a Descriptive Analysis of the obtained results; the data collection was carried out with the use of measuring instruments constructed for this investigation: guide of observations, list of verification and informal interviews.

The Simple Holistic Case Study method is appropriate to analyze different subjects in the same place or analysis unit, also with the evidence that the case study obtains, is possible to verify, generate or describe new theories, that in this particular case it refer to the hypothesis verification (Yin, 1994: 2002). The selected analysis unit is a metallic mineral underground mine that produces Silver. The unit is located in the state of San Luis Potosi, close to the border with Zacatecas. It is belonging to the Trend of mineralization Ag-Au-Pb-Zn. The sample selection was for convenience (Hernandez, 2014).

The development is performed systematically, considering the literary basis as a starting point allowing to formalize a model to evaluate from the environmental practices of a unit, sustainable and legislative aspects. The model is constructed and validated theoretically and practically through the Case Study, It contains the foundations of four Sustainable Principles taken from the Agenda 2030 (UN, 2016) and 15 Legislative Parameters taken from the Environmental Impact Manifest (SEMARNAT, 2002), that is official document to follow and evaluate the environmental aspects in Mexico.

5. Main Results

The conducted research, the application of the model, and the field work in the unit of analysis in San Luis Potosi allowed to verify the goals and the hypothesis. The field work was made systematically following the case study method. The silver mine in SLP, offers observations that allows interpreting and describing the practices that are carried out according to each Sustainable Principle and in reference to the Legislative Parameters. Some of the results are:

- The research presents a proposal to evaluate the environmental practices in Mexico oriented to the mining sector of metallic resources through a validated Sustainable Management Model.
- The implementation of the Model, provided observations on the way in which Sustainable Principles are considered in the Environmental Management strategy.

- About Sustainable Principles and Legislative Parameters, important observations are:
 - The legislative parameters in full, were noted in one Sustainable Principle: *life of Terrestrial Ecosystems*, that in first instance proves the hypothesis about the Mexican legislation in mining matter, it validates only ecological impacts, not minding the resource guarantee in the close future, that in relation with the *Responsible Production and Consumption* principle meaning that the social and environmental dimension, are far from being considered for Mexico's normativity.
 - In reference with the principle of *Sustainable Cities and Communities*, the silver mine presents their practices around the definition of Social Responsibility programs, which take place without funding, just to operate with the minimum of social problems.
 - In its implementation, the model proposed confirms the hypothesis of the research: the current studies in the mining sector, are focused on the ecological damage, due to that, the metallic units in Mexico, follow the normative just for their operating permission (*Hypothesis 1*).
 - It is possible that through an investigation in the metallic mining industry, the environmental practices line up to the Sustainable Principles (*Hypothesis 2*).
 - To define best practices, it is necessary to implement a Sustainable Management validated Model in the field in the Metallic Mining Industry, particularly in the San Luis Potosi metal units (*Hypothesis 3*).

6. Recommendations and replicability

The research, through the implementation of the Sustainable Management Model, described how the actual environment practices in the selected unit, line up with the global suggestions, as the UN proposed through the Agenda 2030; It describes in addition, problems of functionality in the mining industry, which were taken into account to define a series of actions aimed at promoting better environmental practices in this sector. The recommendations were organized according to the Sustainable Principles to give viability to each of the proposed actions, the most appropriate institutions were identified to support their implementation, also complying with the obligations of law.

The Model designed for the Metallic Mining Industry and that was implemented in San Luis Potosi, can be replicated in other metallic units in Mexico, considering it is extended activity in the country and, that the Legislative Parameters are the same for the entire sector. It represents a complement to the strategy from the Organizational Management based on compliance with environmental regulations at the international and national level, managing to show if the current environmental practices provide achievements in favor of the environment or, reconsider and rewrite them so that they are effective.

7. Conclusions

The conclusions described, frame a summary of everything observed in the unit of analysis through methodological rigor, which, using a Case Study, analyze environmental practices through the observation and qualitative descriptions in the data collection instruments. The hypotheses and the course of the specific objectives of the research were verified on the basis of the measure of Sustainable Principles and Legislative Parameters; in the practical and theoretical validation the proposal of the Sustainable Management Model, achieving the general objective.

A literary debate is also generated in which, for the purposes of this investigation, a triangulated description is presented, which is also considered, a conceptual contribution. For the Metallic Mining Industry in Mexico, a valid and original proposal is presented. It is considered a Sustainable Management Model that measure global requirements without missing its legislative obligations. It is flexible, updated and presents documentary innovation, then it is possible, in its operational part, being inserted in the environmental management of companies.

Note to the reader: Regarding the references used in this summary, please note that they are included in the corresponding section of the Thesis.